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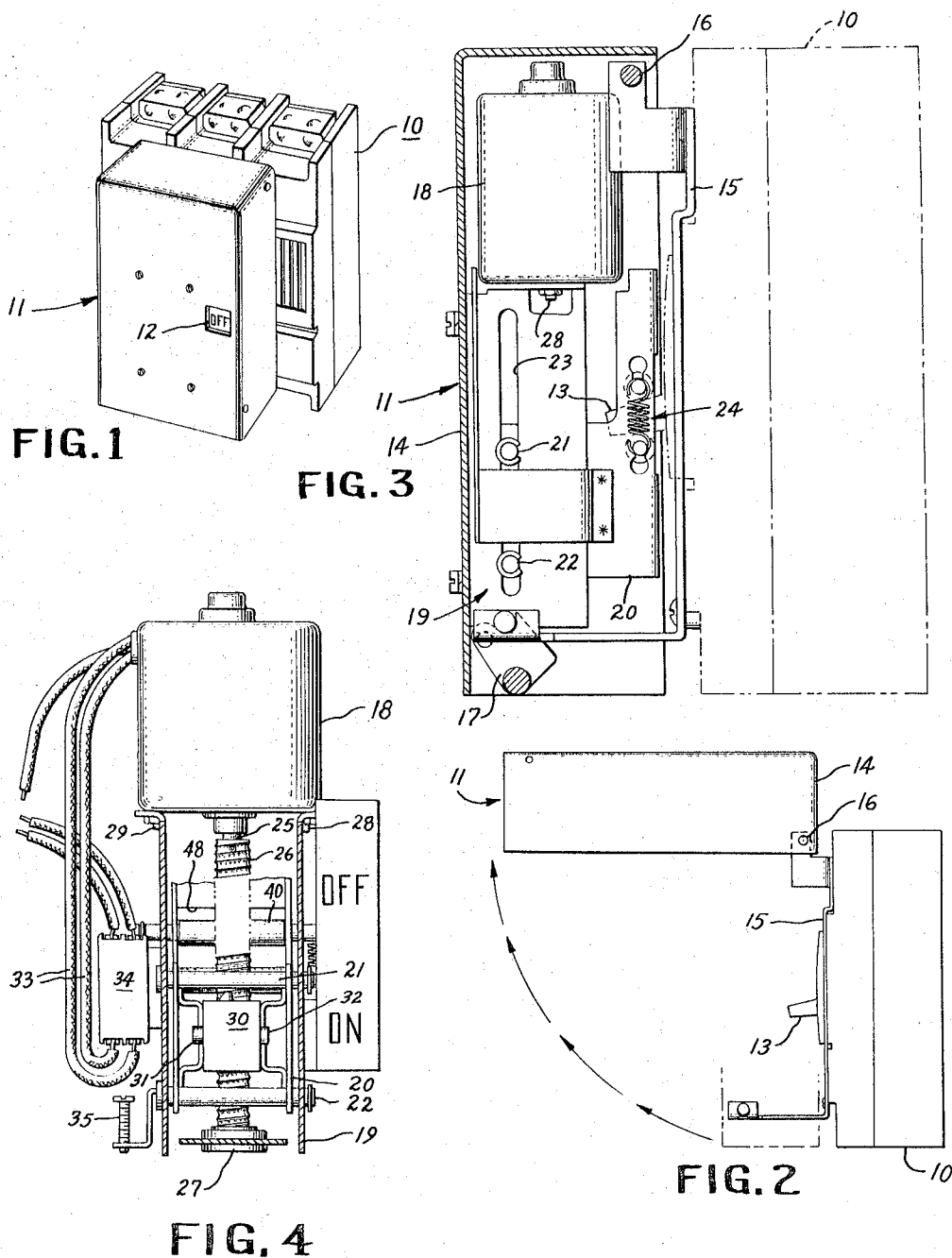
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MOTOR-DRIVEN SWITCH OPERATING MECHANISM WITH INDICATING MEANS

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5 Sheets-Sheet 3

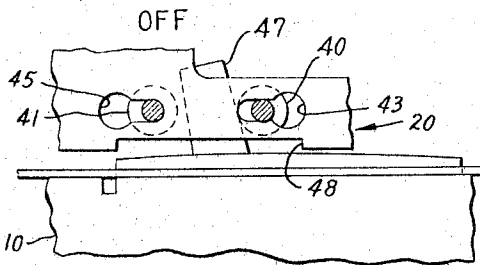


FIG. 6a

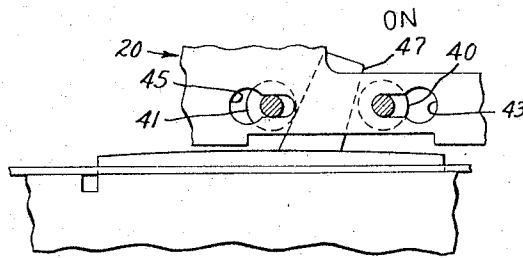


FIG. 6b

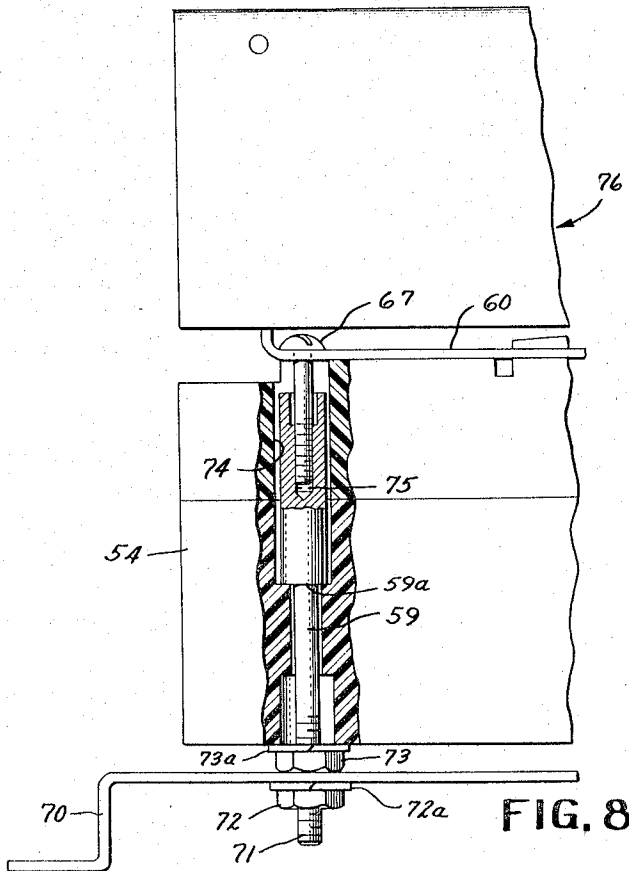


FIG. 8

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MOTOR-DRIVEN SWITCH OPERATING MECHANISM WITH INDICATING MEANS

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5 Claims. (Cl. 335—69)

This invention relates to electric circuit breakers, and particularly to electric circuit breakers of the type having a reciprocally operable handle for permitting manual operation and also an electric motor operating mechanism for adapting such circuit breaker to remotely controlled operation.

Electric circuit breakers of the molded insulating casing type, including a reciprocally operable handle for manual actuation, are frequently used in combination with a motor driven mechanism affording remote control of the position of the operating handle and manual operation when the motor driven mechanism is disengaged, as well as automatic actuation of the circuit breaker in response to overload conditions.

It is an object of the present invention to provide a motor operating mechanism to actuate a circuit breaker including a handle engaging assembly for dissipating the rotational momentum of the motor at the limit of the handle travel in either of two directions.

It is another object of the invention to provide a motor operating mechanism retractably mounted for remote, or manual actuation of a reciprocally operable circuit breaker handle which prevents closure upon the circuit breaker when its handle is in an improper position for engagement.

It is another object of the present invention to provide a motor operating mechanism retractably mounted for engagement with a reciprocally operable circuit breaker handle which resiliently cams the handle to full "reset" position upon closure.

A further object of the present invention is to provide a circuit breaker motor operating mechanism of the screw-driven type which includes means for transmitting the rotational actuation of the screw and permitting limited radial movement with respect to the axis of rotation of the screw.

Yet another object of the present invention is to provide a motor operating mechanism for a circuit breaker having a visual indicator for indicating "off" and "on" conditions of the circuit breaker.

In accordance with the invention in one form an electric motor is mounted on a frame member which in turn is adapted to be mounted adjacent the reciprocally operable handle of an electric switching device. A threaded shaft is connected at one end to the output shaft of an electric motor and at its other end it is rotatably supported in a bearing means mounted on the frame. A carriage is provided with guides which engage slots along the frame and the carriage is actuated in guided movement along the frame by means responsive to the rotation of the threaded shaft such as for instance, a travelling nut. Movement of the travelling nut along the rotating threaded shaft is transmitted to the carriage through means which affords limited radial displacement with respect to the axis of rotation of the threaded shaft and may take the form of trunnion pins. Finally the entire mechanism is operably connected with the reciprocally operable handle of the electric switching device by means of a handle engaging assembly which is resiliently mounted on the carriage so as to be resiliently displaceable in either of two directions and thereby dissipate the rotational momentum of the motor at the limit of the handle travel in either of those two directions.

In accordance with another aspect of the invention, the entire assembly is enclosed in a suitable housing having an aperture in it and the carriage supports a visual indicator which is alignable with the aperture in the cover housing so as to visually indicate the "off" and the "on" condition of the electric switching device.

In accordance with a further aspect of the invention, the electric motor operating mechanism is adapted for use with an electric switching device having a reciprocally operable handle projecting from its front cover, which device is supported by mounting means extending through from its rear to its cover such as internally threaded studs and the entire assembly of the present invention is mounted onto the studs so that the electric motor operating mechanism is supported by the electric switching device mounting means rather than by the frame or any part of the assembly of such electric switching device. In accordance with a further aspect of the present invention, a switch means is mounted on the frame of the assembly and an actuating member is mounted on the carriage, the switch means being disposed and positioned to be operatively engaged by the actuating member upon predetermined displacement of the carriage in each of two directions of movement and the actuating member is independently adjustable to selectively establish its points of engagement with the frame mounted switch in each of its two directions of movement.

These and other aspects and objects of the invention will be more fully understood from the following detailed description and its scope will be pointed out in the appended claims.

In the drawings:

FIGURE 1 is a perspective view of an embodiment of the motor operating mechanism of the present invention mounted on a three pole circuit breaker;

FIGURE 2 is a side elevational view illustrating the manner in which the motor operating mechanism of the present invention may be retractably removed from engagement with the reciprocally operable external handle of a circuit breaker;

FIGURE 3 is a partially sectional side view of a motor operating mechanism of the present invention mounted on a circuit breaker;

FIGURE 4 is a front view of the internal assembly of the motor operating mechanism of the present invention;

FIGURE 5 is an exploded perspective view of the principal elements of the internal assembly of one form of the present invention;

FIGURES 6a and 6b are illustrations of the manner of operation of the resiliently mounted handle engaging assembly of the motor operating mechanism of the present invention;

FIGURE 7 is an exploded perspective view showing the manner of mounting a typical circuit breaker installation so as to support the motor operating mechanism of the present invention on the same mounting means, and

FIGURE 8 is a view on enlarged scale of a portion of the embodiment of FIGURE 1, parts of the enclosure being broken away to shown the details of the mounting means.

Referring now to FIGURE 1 there is shown a three pole circuit breaker 10 in perspective view and an electric motor operating mechanism 11 mounted so as to engage the reciprocally operable external handle of the circuit breaker (not shown). It will be noted that the outer housing of the motor operating mechanism 11 has an aperture therein 12 which is adapted to be alignable with an indicator of the mechanism to visually indicate the "off" and "on" conditions of the circuit breaker in the manner illustrated.

Referring now to FIGURE 2, there is shown the circuit

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breaker 10 in side elevational view including its reciprocally operable external handle 13. An electric motor operating mechanism is shown in partially cross-sectional view as mounted for engagement with the reciprocally operable external handle 13 of the circuit breaker 10 and the electric motor operating mechanism is seen to comprise an assembly contained within a generally rectangular housing enclosure 14 including a base plate 15 having an aperture therein to accommodate the externally extending reciprocally operable handle member 13 of the circuit breaker 10. The entire assembly including its housing enclosure 14 is pivotally supported on the base plate 15 by suitable pivot means 16. The general internal structure of the electric motor operating mechanism of the present invention may be better seen from the enlarged partially cross-sectional side view of FIGURE 3 where there is shown a circuit breaker 10 having an electric motor operating mechanism shown generally at 11 mounted to be engaged with its external reciprocally operable handle 13. As was previously explained in connection with FIGURE 2, the electric motor operating mechanism 11 comprises an assembly which is contained within a generally rectangular housing enclosure 14 and includes a base plate 15 which is mounted directly adjacent the circuit breaker 10. The entire assembly contained within the enclosure 14 is pivotally supported by suitable pivot means so as to be retractable for disengagement from the external reciprocally operable handle 13 of the circuit breaker and afford manual operation of the circuit breaker when desired. A suitable latch means shown generally at 17 retains the electric motor operating mechanism in its position of engagement with the reciprocally operable handle 13 of the circuit breaker 10 when the mechanism is not in its retracted position as shown in FIGURE 2. The remainder of the assembly 11 comprises a reversible electric motor 18 supported within the assembly and affixed to a frame shown generally at 19. A carriage 20 is supported by pins 21 and 22 for guided movement along elongated slots 23 in the frame 19. A handle engaging assembly shown generally at 24 is resiliently mounted in the carriage 20 to engage the external reciprocally operable handle 13 of the circuit breaker 10, and its manner of operation will be more fully explained hereinafter.

Referring now to FIGURE 4, there is shown a front view of the assembly of the electric motor operating mechanism of the present invention without the housing enclosure 14 which is shown in FIGURE 3. The assembly is seen to comprise a reversible electric motor 18 having an output shaft 25 which is connected to a threaded shaft 26. The threaded shaft 26 is rotatably supported at its other end by suitable bearing means 27 carried by the frame member 19 and the frame in turn is affixed to the reversible electric motor 18 by suitable means such as the studs shown at 28 and 29. The frame 19 is slotted along its sides as is illustrated in FIGURE 3 and the pins 21 and 22 support a carriage 20 for guided movement along the frame. Means responsive to the rotation of the threaded shaft 26 for movement along the frame 19, which may take the form of a travelling nut 30, is supported for translating the rotation of the threaded shaft 26 to guided movement of the carriage 20 along the frame 19. The travelling nut 30, it will be noted, is operably engaged with the carriage 20 by means of two trunnion pins 31 and 32 which permit limited axial displacement of the travelling nut 30 and thereby avoid any binding effect or undue wear such as may be caused by slight misalignment of the travelling nut 30 with the rotatable threaded shaft 26. The carriage 20 also supports a visual indicator which is adapted to be aligned with the aperture in the housing enclosure 14 so as to indicate the "off" or the "on" condition of the circuit breaker. The assembly also includes a handle engaging means 24 resiliently mounted on the frame 20. The reversible electric motor 18 is connected through electrical conductors 33 to a switch means 34

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mounted on the frame 19 adjacent to the carriage 20 and disposed for engagement and actuation by an adjustable means such as the threaded screw shown at 35.

The relationships and operation of the moving parts of the electric motor operating mechanism of the present invention can perhaps be best understood from the exploded perspective view of FIGURE 5. In FIGURE 5 there is shown a frame member 19 which is affixed to a reversible motor 18 (partly shown) by suitable means such as the stud 28 and its associated nut and washer 36. The electric motor 18 has an output shaft (not shown) which is connected to a threaded shaft 26. The threaded shaft 26 is in turn supported at its other end by suitable bearing means 27 mounted in the end portion of the frame 19. The threaded shaft 26 is operably engaged with a suitable means for translating the rotational movement of the threaded shaft 26 to lineal movement along the major axis of the frame 19 which may take the form of a travelling nut 30. The travelling nut 30 is provided with trunnion pins such as that shown at 32, which are received loosely in suitable recesses 39 in brackets 37 and 38 affixed to a carriage member 20. In this manner the threaded shaft 26 is afforded some misalignment with respect to the travelling nut 30 inasmuch as the travelling nut 30 by means of its trunnion pins 31 and 32 is primarily restrained from rotational movement and loosely fits into the recesses 39 of the brackets 37 and 38 affixed to the frame 19 so that limited axial movement of the travelling nut 30 is permitted to avoid binding of the travelling nut 30 with the rotatable threaded shaft 26. The carriage 20 also supports a handle engaging assembly 24 which is resiliently mounted thereon. The handle engaging assembly 24 comprises two rollers 40 and 41 which are received into opposed and aligned slots 42 and 43 as a first pair, and 44 and 45 as a second pair, respectively, on either side of the frame 20. The rollers 40 and 41 are retained in their resiliently mounted position by appropriate spring means on each side of the frame 20 such as the spring shown at 46. Thus, both of the rollers 40 and 41 are permitted some resilient movement away from each other and this arrangement permits the handle engaging assembly 24 to dissipate the rotational momentum of the electric motor 18 at the limit of the handle travel in either of its two reciprocally operable directions in a manner of operation which will be more fully explained hereinafter. A handle such as that shown at 47 is the external reciprocally operable member of a circuit breaker and is received through an aperture 48 in the carriage 20 as well as being received through an aperture in a base plate (not shown) for engagement with the handle engaging assembly 24. Additionally, as shown in FIGURE 5, the assembly of the electric motor operating mechanism of the present invention includes a switch means 34 having a reciprocally operable member 49 and being fixedly supported with respect to the frame 19. An actuating assembly shown generally at 50 is affixed to and supported by the carriage 20 by suitable means such as the screws shown at 51 and is disposed and positioned so as to be engageable with the reciprocally operable member 49. Thus, when the carriage 20 approaches the full extent of its movement in one direction, the actuating mechanism 50 engages the reciprocally operable member 49, operating the switch 34 to shut off the motor 18. As can be seen from the perspective view of FIGURE 5, this operation takes place in the same manner whether the carriage is moving in its first or second direction of movement. As may be seen, there are provided two adjustable means in the form of threaded screws 52 and 53 so that the point of actuation of the switch 34 can be adjustably predetermined in either the first or the second direction of movement of the carriage 20 with respect to the frame 19.

FIGURES 6a and 6b are partial views which illustrate the manner of operation of the resiliently mounted handle engaging assembly employed in the present invention. Like members bear the same numerical designations in

FIGURES 6a and 6b as in FIGURE 5. FIGURE 6b illustrates a circuit breaker (partly shown) having an external reciprocally operable handle 47 positioned in the "off" condition. On either side of the handle are seen two rollers 40 and 41 received in slots 43 and 45, respectively, of a carriage 20 (partly shown). As will be recalled from the explanation of the operation of the mechanism of FIGURE 5, the two rollers 40 and 41 of the handle engaging assembly 24 of the present invention are resiliently mounted in the carriage 20 and biased toward each other by two springs, one of which connects both rollers 40 and 41 on each side as illustrated at 46. Thus when the carriage 20 moves in a direction to the left as shown in FIGURE 6a, switching the circuit breaker to its "off" condition, the residual momentum of the electric drive motor will be dissipated by the springs such as that at 46 which hold the two rollers 40 and 41 in a spaced, spring-biased position. At the end of the travel of the carriage 20, the overrun of the electric drive motor will be absorbed by the resilient yielding of the two springs, one on each side of the handle engaging assembly 24 as shown at 46 which permit the roller 40 to be partially displaced in its slot to the right as illustrated in FIGURE 6a. When the electric motor operating mechanism of the present invention is operated in the other direction, i.e., to remotely actuate the circuit breaker from its "off" to its "on" position, the converse operation takes place and the resiliently supported handle engaging assembly 24 of the present invention operates in the same general manner as described in conjunction with FIGURE 6a. As can be seen from FIGURE 6b, the electric drive motor has moved the carriage 20 to the right and the reciprocally operable handle 47 has now been positioned to the right in its "on" position. However, the rotational momentum of the electric drive motor continues to rotate the threaded shaft, driving the carriage 20 a short distance further. In order not to damage the handle 47 or the internal mechanism with which it is operably engaged, the roller 41 is permitted some displacement to the left along its slot 45, the springs on either side, such as the spring 46, which resiliently retain rollers 40 and 41 in opposed relationship, spring-biased toward each other. Thus, as may be seen in FIGURE 6b, the roller 41 is resiliently displaced along its slot 45 in order to dissipate the rotational momentum of the electric drive motor of the electric motor operating mechanism of the present invention.

The illustration of FIGURE 7 shows the manner in which the present invention may be employed with a circuit breaker which is mounted by means of studs having internal threads so as to permit the mounting of the electric motor operating mechanism directly on the studs rather than on the frame or other member of the circuit breaker itself. As may be seen from the perspective view of FIGURE 7, a three pole circuit breaker 54 is shown as having four holes therethrough at 55, 56, 57 and 58; a stud such as that shown at 59, externally threaded on one end and internally threaded on the other end, passes through each one of the holes 55, 56, 57 and 58 and is secured by a nut and washer 68 and 69 to a suitable support (not shown) to mount the circuit breaker 54. The base plate 60 of a motor operating mechanism of the present invention is shown in perspective view aligned with the circuit breaker 54 and it will be noted that it includes an aperture 61 positioned and disposed to permit access to the external reciprocally operable handle 62 of the circuit breaker 54 therethrough. The base plate 60 includes four aligned holes therethrough 63, 64, 65 and 66 which are adapted to accept studs of the type shown at 59 so that suitable screw means as illustrated at 67 may be engaged with the internal threads of the studs 59 to secure the base plate 60 and thereby support the assembly of the electric motor operating mechanism of the present invention for pivotal engagement or disengagement as desired as was more particularly described in connection

with FIGURE 2. Thus, the illustrated manner of mounting the electric motor operating mechanism of the present invention insures that the stress of its weight will not be exerted against the outer casing or any portion of the mechanism of the circuit breaker with which it is associated because within the concept of the present invention the electric motor operating mechanism and the circuit breaker with which it is associated are independently supported on the same mounting members.

The enlarged illustration of FIGURE 8 wherein like members bear the same numerical designation as in FIGURE 7 shows this arrangement more clearly. A basic structural support such as that shown at 70 has a hole therein to receive a stud shown generally at 59 which is externally threaded at one end as shown at 71 and has two nuts 72 and 73 threaded thereon against washers 72a and 73a on either side of the structural support 70 so that the stud 59 is firmly fixed against sidewise displacement. The stud 59 passes through an appropriate hole 74 in the circuit breaker 54 extending to its other side, the shoulder 59a of the stud 59 being seated against a complementary shaped portion of the hole 74. It will be noted that the stud 59 is internally threaded as shown at 75 to receive a bolt or other suitable means 67 which secures the base plate 60 of an electric motor operating mechanism 76. Four or more such internally and externally threaded studs comparable to the stud 59 are preferably employed and disposed generally as shown in FIGURE 7. Thus the electric motor operating mechanism of the present invention is mounted on the structural support 70 rather than upon the frame or other member of the circuit breaker with which it is associated and accordingly does not impose any stress upon the circuit breaker. Moreover, the arrangement shown in FIGURES 7 and 8 permits the removal of the circuit breaker 54 and its associated motor operating mechanism 76 as a unit by the removal of four nuts from behind the structural support 70 such as the nut 72 shown in FIGURE 8. Alternatively, the motor operating mechanism 76 may be removed separately by removing four bolts such as that shown at 67, leaving the circuit breaker 54 mounted and affixed upon the structural support 70.

Thus the present invention affords the advantages of an electric motor operating mechanism for the remote control and operation of an electric switching device having an external reciprocally operable handle which is mountable upon means obviating any stress or strain upon the frame or other member of the electric switching device with which it is used. Moreover, the concept of the present invention provides a visual indication of the "on" or "off" condition of the electric switching device with which it is used. Additionally, the arrangement of the motion transmitting means which is responsive to the rotation of the electric motor of the mechanism is so arranged as to afford limited axial movement or displacement of the motion transmitting means with respect to the threaded shaft driven by the electric motor, avoiding unnecessary wear and the possibility of the motion transmitting means binding with respect to the threaded shaft because of minor misalignment during its travel therealong.

The resiliently supporting handle engagement assembly of the present invention affords a simple and effective means of dissipating the terminal rotational momentum of the motor during its operation, thereby protecting the external reciprocally operable handle and the mechanism to which it is connected. The handle engaging assembly of the present invention also is so arranged as to prevent closure of the electric motor operating mechanism upon the electric switching device unless the external handle of the device is in the proper position, i.e., consistent with the "on" or "off" position as indicated by the indicator of the electric motor operating mechanism. Another feature of the resiliently supported handle engaging assembly is that upon closure of the electric motor operating mechanism about its pivotal point, the resilience of the handle

engaging assembly cams the external handle to a full "reset" position.

While we have disclosed only certain embodiments of the invention, it will be readily appreciated that many modifications thereof may be made. We therefore intend by the appended claims to cover all such modifications as fall within the true spirit and scope of the invention.

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

1. An electric motor operating mechanism for use with an electric switching device having an external reciprocally operable handle, comprising a frame adapted to be mounted adjacent said handle, an electric motor supported on said frame and having one end connected to said output shaft for rotation thereby and its other end rotatably supported by bearing means mounted on said frame, a travelling nut carried by said threaded shaft and having opposed trunnion pins extending therefrom, a carriage operatively engaged with said frame for guided movement therealong and having recesses therein loosely receiving said trunnion pins respectively, whereby axial displacement of said nut is permitted, and binding of said nut on said shaft is avoided, and a handle engaging assembly resiliently supported on said carriage.

2. An electric motor operating mechanism for use with an electric switching device having a reciprocally operable handle, comprising a frame mounted adjacent said handle, an electric motor supported on said frame and having an output shaft, a threaded shaft having one end connected to said output shaft for rotation thereby and its other end rotatably supported by bearing means mounted on said frame, a carriage having guides engaged with said frame and means operatively responsive to the rotation of said shaft for guided movement therealong, a handle engaging assembly resiliently mounted on said carriage, a cover member removably supported by said frame and enclosing said frame and members assembled therewith, said cover member having an indicator aperture therein, and an indicator affixed to said carriage to indicate the position of said handle in register with said indicator aperture.

3. An electric motor operating mechanism for use with an electric switching device having a reciprocally operable handle capable of first and second positions commensurate

with "off" and "on" conditions respectively, a frame mounted adjacent said handle, a reversible electric motor supported on said frame and having an output shaft, a threaded shaft having one end connected to said output shaft for rotation thereby and its other end rotatably supported by bearing means mounted on said frame, a carriage having guides engaged with said frame and means operatively responsive to the rotation of said shaft for guided movement therealong in first and second directions in accordance with the direction of rotation of said motor-driven threaded shaft, a handle engaging assembly resiliently mounted on said carriage, a cover member removably supported by said frame and enclosing said frame and members assembled therewith, said frame having an indicator aperture therein, and an indicator affixed to said carriage in register with said indicator aperture, whereby said indicator indicates the extreme position of said carriage in its first direction corresponding with said "off" condition of said electric switching device and said indicator indicates the extreme position of said carriage in its second direction corresponding to the "on" condition of said electric switching device.

4. A mechanism as claimed in claim 2 and including electrical switch means mounted on said frame and an actuating member mounted on said carriage, said switch means being disposed to be operatively engaged by said actuating member upon predetermined displacement of said carriage in each of its first and second directions of movement.

5. The mechanism as claimed in claim 4 wherein said actuating member includes means for independently adjusting its points of engagement with said frame-mounted switch means upon displacement of said carriage in each of its first and second direction of movement.

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