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Worrix

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[54] **SWITCH OPERATING DEVICE**

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[52] **U.S. Cl.** **74/89.15**

[51] **Int. Cl.** **F16h 27/02**

[58] **Field of Search** ..... 74/89.15, 424.8 R

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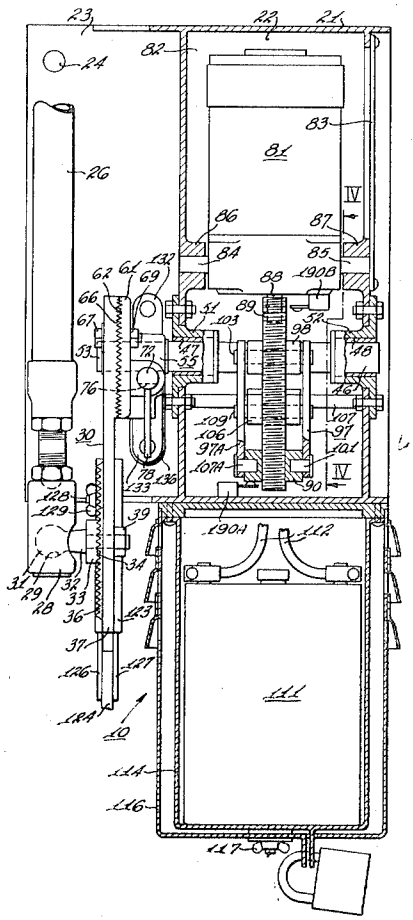
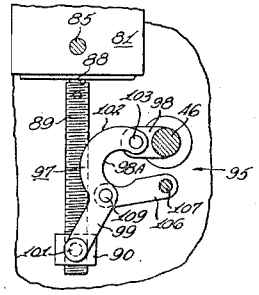
[57] **ABSTRACT**

A remotely located self-contained switch operating device is provided which includes an independent power source connected to energize a drive motor that is arranged to actuate a screw and nut drive mechanism for effecting the operation of a remotely located switch in an opening or closing movement.

6 Claims, 4 Drawing Figures





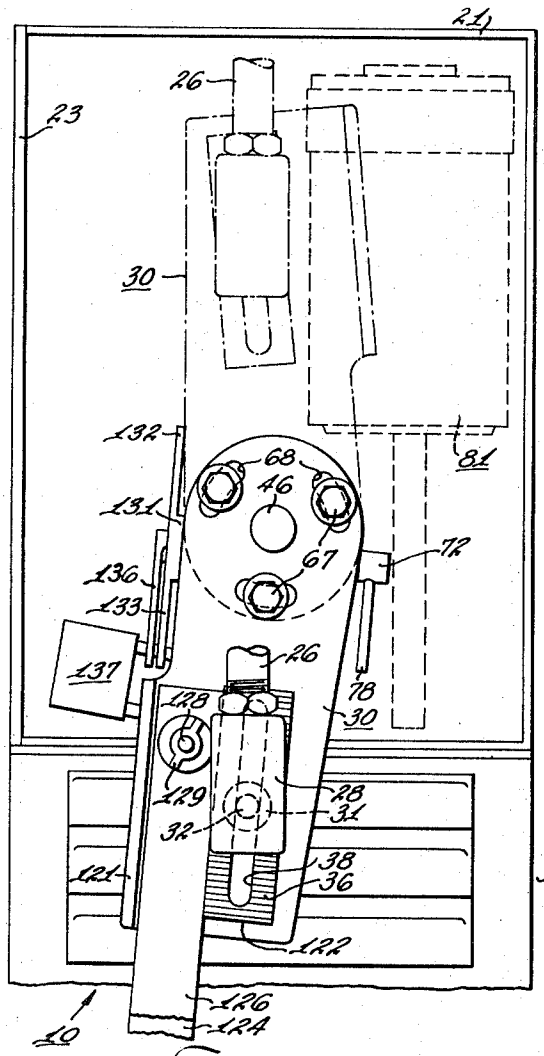


Fig. 2

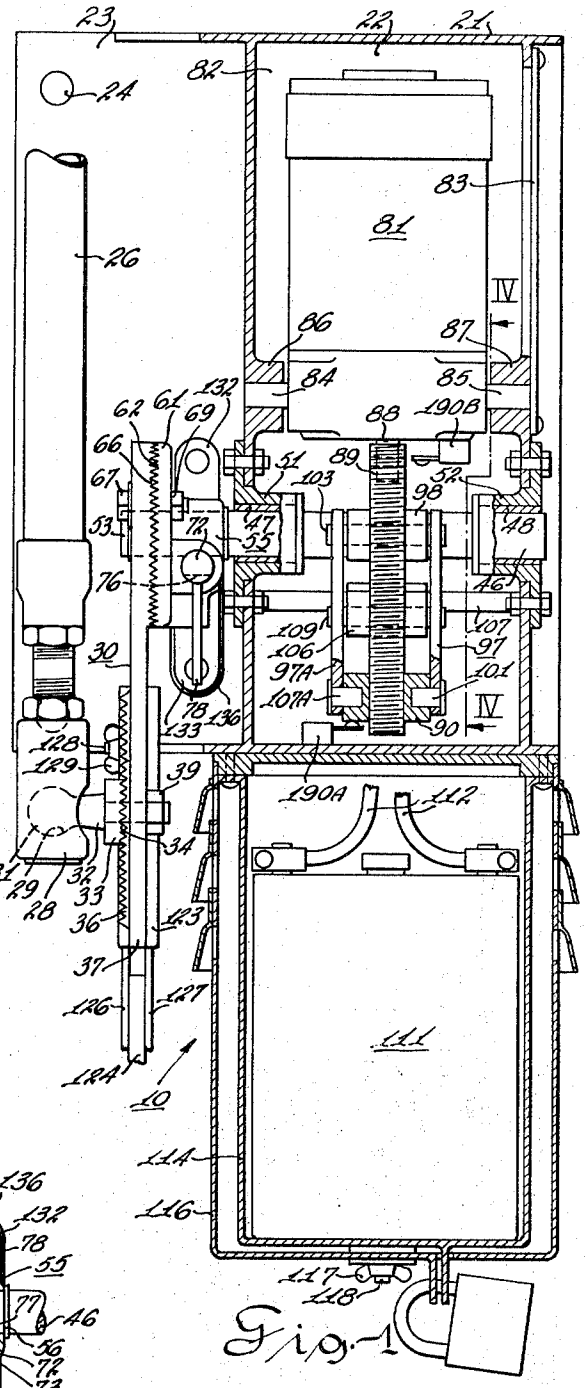


Fig. 1

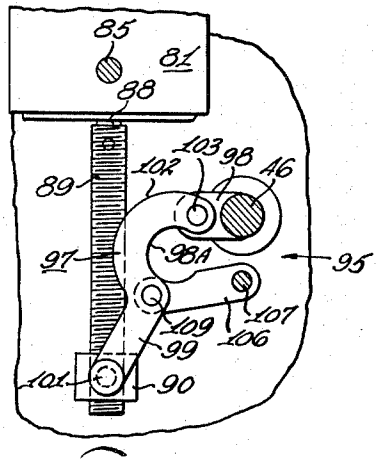


Fig. 4

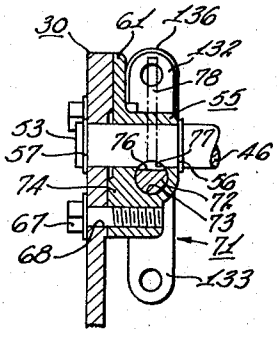


Fig. 3

SWITCH OPERATING DEVICE

BACKGROUND OF THE INVENTION

In accordance with the present invention, a self-contained switch operating device capable of being located at a position remote from the switch to be actuated is provided. The device includes a motor with an associated power supply that is operable to actuate a screw and nut drive arrangement for effecting rotation of an actuating arm which, in turn, is connected to operate a switch in an opening or closing movement. The screw and nut drive mechanism is constructed and arranged to prevent back driving of the motor so that inadvertent operation of the switch cannot occur. A linkage arrangement is connected to be operated by the screw and nut mechanism for effect rotation of the actuating arm. The linkage is arranged to provide a position wherein the actuating arm when rotated in a direction for effecting a closing movement of the switch is retained in the closed position.

Manual means are provided for rotating the actuating arm and include means for disconnecting the linkage drive from the actuating arm.

Accordingly, it is the general object of this invention to provide an improved self-contained switch operator.

Another object of this invention is to provide an improved switch operator having a power driven rotary transmission which prevents motion feedback.

Still another object of this invention is to provide an improved switch operator which provides for manual operation of the switch mechanism without requiring the overriding of the power drive.

Yet another object of the present invention is to provide an improved switch operator having mechanical disconnect means to provide for manual operation of the switch devices.

Another object of the present invention is to provide a power operated switch operation which does not require a clutch mechanism.

Yet another object of the present invention is to provide an improved motor driven switch operator that includes lost motion means to allow the motor to drive past a predetermined switch closed position.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view partly in elevation and partly in vertical section through the motor switch operator of the present invention showing the motor power source and drive connections;

FIG. 2 is a view in left side elevation of the device depicted in FIG. 1 with parts omitted;

FIG. 3 is an enlarged detailed view of the rotatable arm mechanism partly in vertical section and partly in elevation showing the decoupling arrangement for freeing the arm for manual operation; and

FIG. 4 is enlarged fragmentary view partly in elevation and partly in vertical section showing the drive linkage arrangement between the motor and the switch actuating arm taken generally along lines IV—IV in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings and particularly to FIG. 1 thereof, the motor switch operator is generally

identified by the reference numeral **10**. The switch operator **10** is adapted to be mounted remotely associated and that is normally located high above the ground in operative relationship with transmission lines which are carried on supporting structures, such as poles. The practical aspects of the arrangement requires that means be provided for actuating these switches devices, and the actuating device should be readily accessible to maintenance operators. Thus, the operating device of necessity must be located remotely from the device with which it is operably associated, such location normally being the supporting structure or pole on which the switch device is supported.

The switch operator **10** comprises a housing **21** having a rear side closure plate **22** which is constructed with a leftwardly extending bracket portion **23** that serves as a mounting bracket. The bracket **23** is provided with a plurality of screw or bolt openings **24**, one of which is shown, through which fasteners are inserted to engage in the support means such as a pole (not shown) to secure the switch operator in a desired position.

An operable actuating connection between a remotely located switch device (not shown) and the switch operator **10** is effected through a vertically disposed rod **26**. The upper end (not shown) of rod **26** is connected, in a well known manner, to the switch devices (not shown) to effect an opening or closing movement thereof. Axial upward movement of the rod **26** from the position it occupies as depicted in FIG. **1** will operate to effect a closing of the remotely located switch device (not shown). Conversely axial downward movement of the rod **26** to the position shown in FIG. **1** will serve to actuate the switch device (not shown) to an open position. The lower end of the rod **26** is provided with an adjustable swivel coupling **28** which is provided with a ball socket **29** that is adapted to secure the ball end **31** of a pin **32**. The rod **26** through the coupling **28** is operatively connected to an actuating arm **30** which is operable to the axial vertical movement of the rod **26**. An adjustable connection is established between the end of the actuating arm **30** and the pin **32** by means of a nut **33** that is mounted on the pin **32**. Serrations **34** formed on the inner face of the nut **33** are adapted to engage with complementary serrations **36** formed on the depending end **37** of the arm **30**. The end of the pin **32** extends through an elongated slot **38**, FIG. **2**, formed in the lower or free end of the arm **30**. A nut **39** threadedly engaged on the protruding end of the pin **32** serves to clamp the serrated nut **33** in interengaged relationship with the serrations **36** formed on the arm **30**. Thus, with a proper operating relationship established between the end of the rod **26** and the actuating arm **30**, the nut **39** is tightened to effect an interlocking engagement between the locking serrated nut **33** and the arm **30**. It will be understood that the axial relationship between the rod **26** and arm **30** is established by adjusting the serrated nut **33** axially on the pin **32**.

Pivotal movement of the actuating arm **30** for moving the rod **26** is accomplished by rotation of a horizontally disposed main drive output shaft **46**. The drive shaft **46** is rotatably supported in the side walls of the housing **21** being journaled in sleeve bearings **47** and **48** that are carried in bearing retainers **51** and **52**, respectively. As shown in FIG. **1** the left end **53** of the shaft **46** extends outwardly of the housing **21** and receives a drive

bracket 55. To maintain the drive bracket 55 in operative position on the extending end 53 of the shaft 46, a pair of snap rings 56 and 57 are provided. The snap rings 56 and 57 are disposed on either side of the drive bracket and engage in suitable circumferential grooves formed in the surface of the shaft 46.

A positive drive connection is provided between the drive bracket 55 and the actuating arm 30 and to this end the bracket 55 is provided with circular hub 61 that is integrally formed with the bracket. The outwardly facing axial end face of the hub 61 is provided with circumferentially arranged radial extended teeth or serrations 62. In like manner, the upper end of the arm 30 is provided with a circular inner face 66 in which circumferentially disposed radially extending teeth or serrations are formed. The interengagement of the circular serrations 66 on the arm 30 with the serration on the drive bracket hub 61 provides a positive drive connection therebetween. The arm 30 is clamped in engagement with the drive bracket 55 by means of a plurality of bolts 67 which extend through arcuate slots 68 formed in the upper portion of the arm 30 and through associated openings provided in the hub 61 of the drive bracket 55. Nuts 69 thread on the extending ends of the bolts 67 and effect an interlocking engagement between the serrations 62 and 66 of the drive bracket 55 and arm 30, respectively. By providing the arcuate slots 68 in the upper end of the arm 30 through which the bolts 67 pass, limited angular adjustment of the arm 30 and bracket 55 relative to each other may be effected to establish an operative relationship therebetween.

To effect a driving engagement between the drive bracket 55 and the drive shaft 46 a decoupler or disconnect mechanism 71 is provided. As shown in FIGS. 1, 2 and 3, the decoupler mechanism 71 includes a pin 72 that is rotatably disposed in a transversely extending opening 73 provided in a boss 74 of the drive bracket 55. The transverse opening 73 has communication with the axial opening in the bracket 55 in which the shaft 46 extends. Thus, an interference between the shaft 46 and pin 72 will occur. However, one side of the pin 72 is formed with a relief as at 76, FIG. 3, which is positioned adjacent to the shaft 46. In like manner, the surface of the shaft 46 adjacent the pin 72 is formed with relief 77. Thus, with the pin 72 angularly positioned relative to the shaft 46 wherein the relieved portion 76 thereof is positioned downwardly away from the relieved portion 77 on the shaft 46, as depicted in FIG. 1, the surface of the pin 72 is in interengagement with the relieved portion 77 of the shaft 46. In this manner, the shaft 46 is locked to the bracket 55. Thus, rotational movement of the shaft 46 will be imparted to the bracket 55, through the pin 72, for effecting rotational or pivotal movement of the arm 30 about the axis of the shaft 46. To release the shaft 46 from its driving connection with the bracket 55, the pin 72 need only be rotated, by means of a lever 78, 180° to the position it occupies in FIG. 3. In this position the relief or flat 76 of the pin 72 is located adjacent to the relieved or grooved portion 77 pf the shaft 46. Under this condition the bracket 55 and thus the arm 30 is disconnected from the shaft 46 and rotational movement of the shaft 46 will not be imparted to the arm 30.

Rotation of the shaft 46 for effecting movement of the arm 30 is accomplished by means of motor 81. As shown in FIGS. 1 and 2, the motor 81 is disposed in an enclosed motor compartment 82 provided in the housing 21, access to which is obtained through a removable screw fastened side cover 83. The motor 81 is supported in operative position within the housing 21 by a pair of oppositely extending stub shafts 84 and 85 which are journalled in bearing bosses 86 and 87, respectively. The motor drive shaft 88 is operably engaged in a suitable axial opening provided in a drive screw 89.

Rotational movement of the screw 89 is imparted to the shaft 46 by means of a nut 90 which is operatively connected through a linkage mechanism 95 to the shaft 46. As shown in FIGS. 1 and 4, the nut 90 is threadedly engaged on the motor screw 89 for axial movement relative to the screw in either direction upon selective rotational operation of the motor 81.

For effecting rotation of the drive shaft 46 through a predetermined angle a motion linkage mechanism 95 is provided. With the linkage mechanism 95 the full output torque of the drive motor 81 may be utilized without the danger of damage occurring to the linkage mechanism, drive shaft 46 or to the drive connection to the linkage mechanism.

As shown in FIGS. 1 and 4, the linkage mechanism 95 includes a pair of actuating links 97 and 97A each of which have one end pivotally connected to opposite sides of the nut 90 which is welded or otherwise secured to the shaft 46. The links 97 and 97A are identical and the description of link 97 will apply to the link 97A. As shown in FIG. 4, the link 97 is formed witn an arm 99 one end of which is pivotally secured to one side of the nut 90 by means of a pin 101. At the opposite end of the arm portion 99 of link 97, there is an arcuate portion 98A, the free end 102 of which is pivotally connected to the extending end of a pin 103. The pin 103 is disposed in a transverse opening formed in the free end of the crank 98. In like manner, the link 97A is also operatively connected to the nut 90 and crank 98. A control or guide link 106 is provided to stabilize the movement of the linkage in effecting rotation of the shaft 46. As shown, one end of the guide link 106 is pivotally mounted on a pin 107 that is supported in the side walls of the housing 21. As shown in FIG. 4, the guide link 106 extends from the pin 107 and is disposed between the links 97 and 97A to which it is pivotally secured. The pivotal connection between the end of the guide link 106 and the actuating links 97 and 97A is effected by means of pin 109 that is journalled in the end of the guide link 106 and extends outwardly from both sides thereof. Thus, as the nut 90 moves on the screw 89 towards the motor 81, as viewed in FIG. 4, the ends of the actuating links 97 and 97A that are pivotally connected to the nut 90 move with the nut. Since the axes of the pins 103, 109 and 101 are parallel and in a common plane which passes through the axes of the pins, the upward movement of the nut 90, as viewed in FIG. 4, towards the motor 81 will force the actuating links 97 and 97A upwardly. As the actuating links move upwardly the axis of the pin 103 will move in an arcuate path of travel about an axis which coincides with the axis of shaft 46. Similarly the axis of the pin 109 moves in an arcuate path of travel about an axis which coincides with the axis of the pin 107. As previously mentioned, the axes of the pins 103, 109 and 101–101A are in a common plane which passes through the axes of the pins and such relationship must be maintained. However, since the nut 90 moves axially relative to the screw 89 the location of the axes of the

pins 101–101A will continually change with the movement of nut 90. Thus, a means is provided to maintain the relationship between axes of the pins 103, 109 and 101–101A. To this end as the motor 81 operates to rotate the screw 89 to move the nut 90 axially towards the motor, the motor 81 will pivot in a clockwise direction, as viewed in FIG. 4, about the axes of its associated pivot pins 84 and 85, continually adjusting so as to maintain the axes of the pins 101–101A in the common plane in which the axes of the pins 109 and 103 are disposed. As the actuating links 97 and 97A are moved, by operation of the nut 90, the end of the crank 98 moving with the ends of the actuating links 97 and 97A will effect rotation of the shaft 46 in a clockwise direction as viewed in FIG. 4, and from the right side as viewed in FIG. 1. Clockwise rotation of the shaft 46 operates to pivot the arm 30 in a counterclockwise direction, as viewed in FIG. 2, from the position it occupies as shown in solid lines, thereby swinging the end of the rod 26 via the coupling 28 outwardly and upwardly to the positions indicated by the phantom lines to effect the closing of the associated switch mechanism (not shown).

Power for energizing the motor 81 is obtained from a storage battery 111 which is operatively connected to the motor 81 by suitable cables 112. The battery 111 is supported on a depending bracket 114 which is screw fastened to the under side of the housing 21. To protect the battery 111 from the elements and from damage a case 116 which encompasses the bracket 114 and battery 111 is provided. A wing nut 117 that is engaged on a screw 118 that extends downwardly from the bracket 114 operates to retain the case 116 in place.

Means are provided for manually operating the rod 26 in switch closing or opening movements. To this end, the outer surface of the arm 30 is provided with an elongated horizontally extending abutment 121 which is disposed in parallel spaced relationship to the elevated block portion 122 in which the serrations 36 are formed in the arm 30. The opposite or inner face of the arm 30 is provided with a pair of parallel spaced abutments 123, one of which is shown in FIG. 1. A spade handle 124 having spaced frame members 126 and 127 is provided for operating the arm 30. As shown, the spaced frame members 126 and 127 are disposed to engage on each side of the arm 30. The frame member 126 is disposed between the abutment 121, and the serrated block portion 122; the frame member 127 is disposed on the inner face of the arm 30 being contained thereon between the pair of spaced abutments 123. A bolt 128 passes through the frame members 126 and 127 and the arm 30 and receives a winged nut 129 for removably securing the handle 124 to the arm 30.

When it is desired to operate the rod 26 manually the drive connection between the shaft 46 and the bracket 55 is interrupted. This is easily and quickly accomplished by means of the coupling pin mechanism 71 previously described, with the drive connection between the shaft 46 and bracket 55 disengaged the spade handle 124 is attached to the arm 30. As the operator moves the spade handle 124 the bracket 55 under the rotational influence imparted by the arm 30 will rotate on the shaft 46. The coupler pin 72 will move with the bracket 55 maintaining its disengagement relationship with respect to the shaft 46.

To prevent accidental power operation occurring during manual actuation of the rod 26, a locking means for the coupler mechanism 71 has been provided. As shown in FIGS. 1 and 2, the bracket 55 at the rear side thereof or left side thereof, as viewed in FIG. 2, is provided with a hub 131 having an opening through which the pin 72 extends. Formed integrally with the hub 131 and extending in opposite directions transversely of the axis of the hub are a pair of lugs 132 and 133. The end of the pin 72 extends beyond the hub 131 and is provided with a single transversely extending lug 136. With the pin 72 rotated to its bracket-shaft coupling position the lug 136 of the pin 72 is disposed in adjacent parallel relationship to the lug 133 of the hub 131. In this position a hasp of a padlock 137 may be inserted through suitable aligned openings provided in the ends of the lugs 136 and 133 to lock the pin 72 in the coupling position. On the other hand when the pin 72 has been rotated to its decouple position as depicted in FIG. 3, the lug 136 associated with the pin 72 will have been rotated into parallel spaced relationship to the lug 132. In this position the opening in the lug 136 will be aligned with a suitable opening provided in the end of the lug 132 so that the hasp of the padlock 137 can be inserted through the aligned openings to effectively lock the pin 72 in its decoupled position. With the arrangement the pin 72 may be positively locked in the desired selected position and inadvertent displacement of the pin 72 cannot occur.

It is apparent that with the pin 72 rotated to the decoupled position, depicted in FIG. 3, the motor 81 may operate to move the nut 90 and thereby effect rotation of the shaft 46. However, if the drive connection between the bracket 55 and shaft 46 has been interrupted, the shaft 46 will merely rotate relative to the bracket and no movement will be imparted to the bracket 55.

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

1. A switch operator for operating a switch device in an opening and closing movement;

a housing adapted to be mounted on a supporting structure;

a shaft rotatably supported in said housing and having one end extending outwardly of said housing;

an arm member having one end connected to the extending end of said rotatable shaft in a manner that the opposite end of said arm member moves in an arcuate path of travel upon rotation of said shaft, the end of said arm member which moves in an arcuate path of travel being operatively connected to the switch device for effecting its operation;

a reversible electric motor supported by said housing;

a screw and nut drive mechanism operably connected to be actuated by said motor for relative bodily translational movement;

a linkage mechanism including a crank secured to said rotatable shaft and extending outwardly therefrom;

a drive link having one end pivotally secured to the extending end of said crank, the opposite end of said drive link being operatively connected to said screw and nut mechanism in a manner to be actuated by the relative bodily translational movement of said screw and nut mechanism; and,

a battery carried by said housing and operatively connected to energize said motor.

2. A switch operator according to claim **1** wherein said motor is pivotally supported in said housing for pivotal movement about an axis which is disposed in a plane parallel to a plane in which the axis of said shaft is located, said motor being operably connected to rotate said screw;

said nut being threadedly engaged on said screw for movement therealong upon rotation of said screw;

said drive link having an end thereof pivotally connected to said nut;

a guide link pivotally connected to said drive link at a point midway between the pivotal connections of said drive link with said crank and said nut, the opposite end of said guide link being pivotally connected to a stationary member carried by said housing and located below said shaft; and,

whereby movement of said nut serves to actuate said drive link which acts against the extending end of said crank to thereby rotate said shaft and said motor moves about its pivot axis to maintain a straight force line drive between said nut and said crank.

3. A switch operator according to claim **1** including a disengageable coupling member operable to establish a drive connection between said shaft and said arm.

4. A switch operator according to claim **3** wherein said disengageable coupling including a housing having an opening which rotatably receives the extending end of said shaft;

a locking member carried in said coupling housing for movement between a locking position in which it operates to lock said coupling housing to said shaft for rotation therewith, said locking member being also movable to an unlock position wherein it operates to release the coupling housing from rotating with said shaft so that the rotation of said shaft will not be imparted to said arm.

5. A switch operator according to claim **4** wherein said coupling housing is provided with a surface transverse to the opening which receives the extending end of said shaft, said surface having serrations therein arranged in an annular row around the shaft opening;

said arm at the end thereof that is adjacent to said coupling housing being provided with a surface having an annular row of serrations complementary to the annular row of serrations on said coupling housing; and,

means to secure said arm to said coupling housing wherein said serrations on said coupling housing surface and in said arm surface interengage to establish an angular adjustable positive drive connection therebetween.

6. A switch operator according to claim **5** wherein said arm remote from said coupling housing is provided with a pad surface having serrations therein arranged transversely to the axis of said arm, said serrated pad surface being disposed on the opposite side of the arm from the side thereof on which said coupling housing surface is provided;

a pivotal coupling member having a serrated collar portion adjustable secured to said serrated pad portion of said arm; and,

means connected to said pivotal coupling and to the switch device.

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