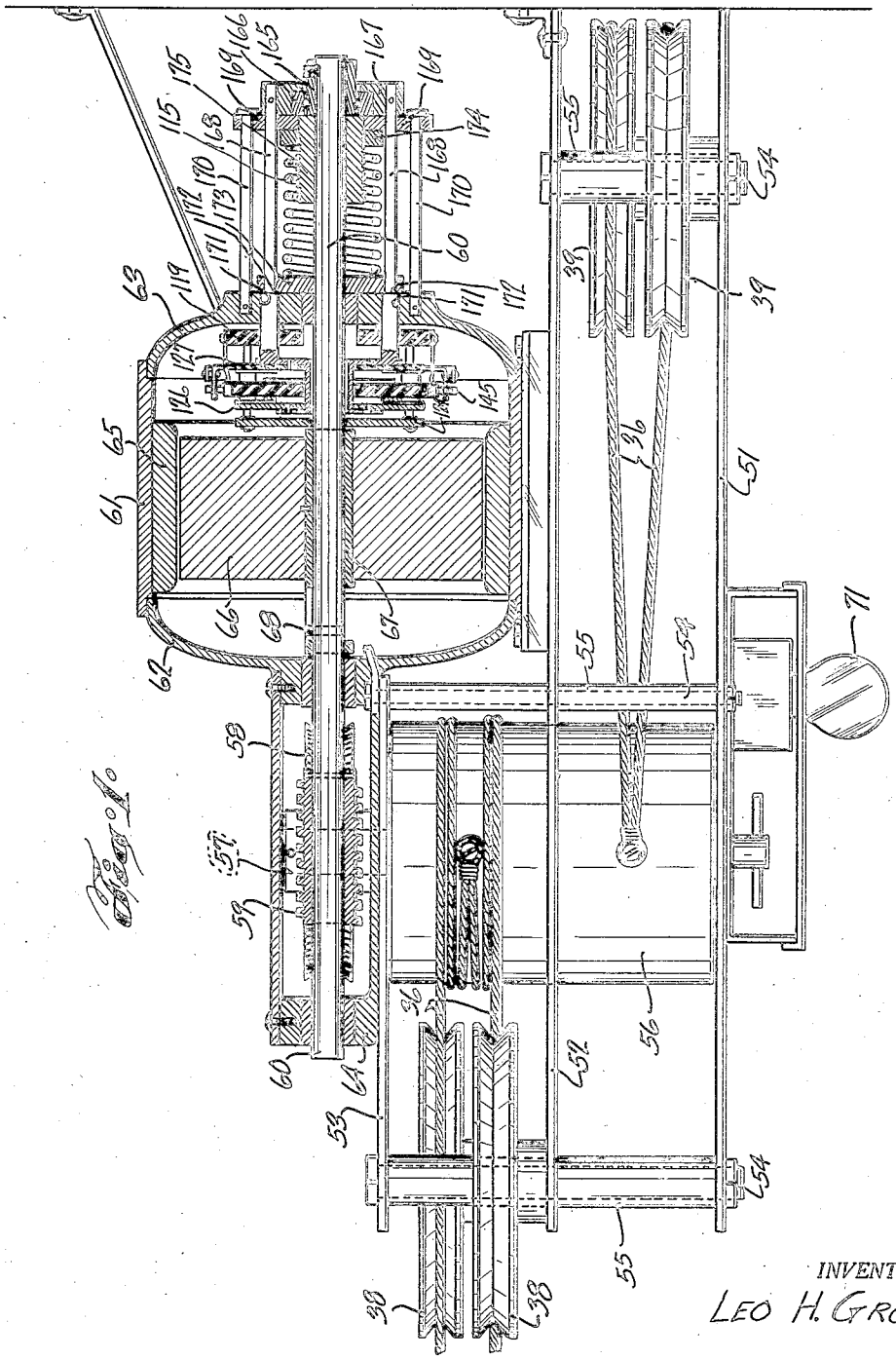
April 21, 1936. L. H. GROSS 2,037,780

DOOR ACTUATING APPARATUS

Filed July 12, 1933 2 Sheets-Sheet 1



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DOOR ACTUATING APPARATUS

Filed July 12, 1933 2 Sheets-Sheet 2

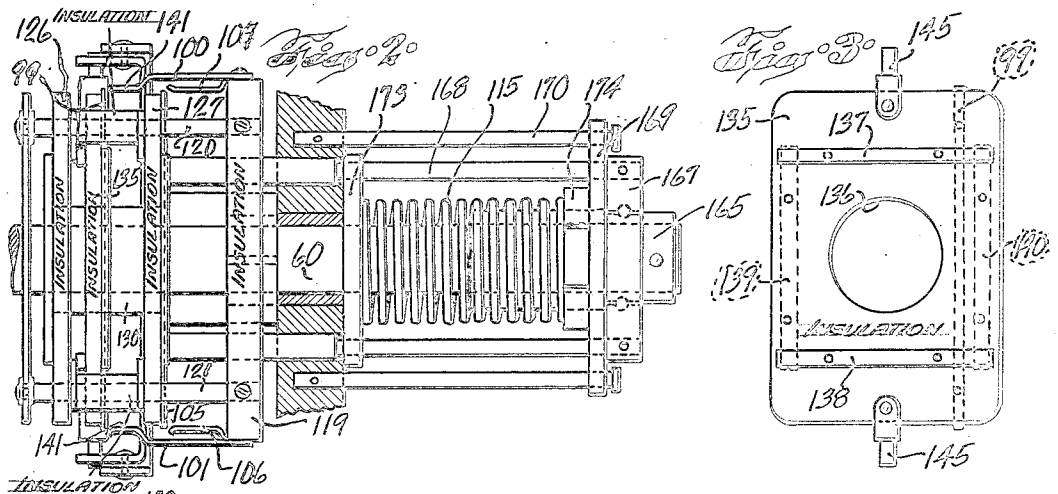


Fig. 2.

Fig. 3.

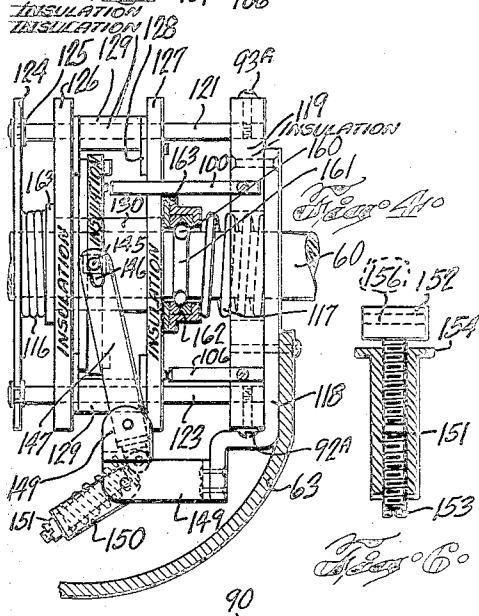


Fig. 4.

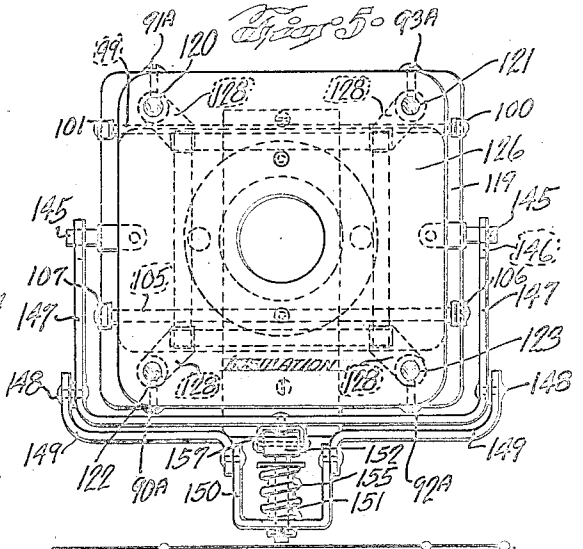


Fig. 5.

Fig. 6.

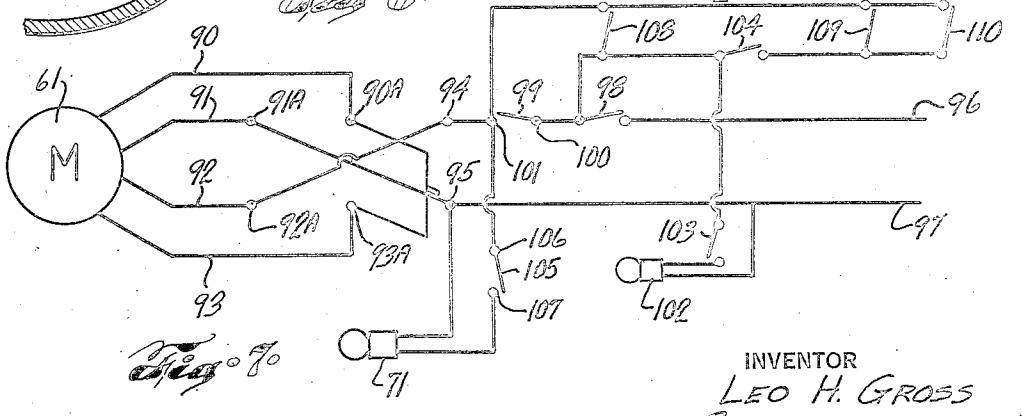


Fig. 7.

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2,037,780

DOOR ACTUATING APPARATUS

Leo H. Gross, Bartelso, Ill.

Application July 12, 1933, Serial No. 680,021

14 Claims. (Cl. 200—16)

This invention relates to improvements in electric switching apparatus, and particularly to a power switch and switch-operating assembly for use in connection with power operators for the doors of garages and like structure in which it may be desired to effect door movement by remote control means. This invention constitutes a continuation, in part, of my copending application, Serial No. 600,148, filed March 21, 1932.

An object of the present invention is attained in an improved and simplified motor-switching device combining the functions of a limit-switch and a reversing switch for an electric door operator, with the function of an overload-release switch, operable in any position of the doors to open the motor circuit in response to abnormal load conditions arising from any cause.

Yet another object of the invention is attained in an improved motor switch, serving the purposes of the object first above mentioned, which switch is of such type that it may be built into the motor frame.

Among the additional objects of the invention may be mentioned an improved inbuilt motor switch, susceptible of use with an electric motor directly connected to its driven apparatus as through the use of a worm and worm gearing, the switch being of such a nature as to operate responsively to axial movement of a motor shaft coordinately with overload conditions in a transmission including worm gearing.

The foregoing and other objects will more fully appear from the following description, considered in connection with the appended drawings of a presently preferred executional embodiment of the invention. In the drawings:

Fig. 1 is a vertical sectional elevation of a power door operator embodying improvements according to the present invention; Fig. 2 is a fragmentary horizontal sectional elevation of a switch structure such as appears in Fig. 1, and illustrating on an enlarged scale, certain elements of the switch; Fig. 3 is an elevation of a movable switch plate, serving to carry some of the movable switch contacts of the structure of Fig. 2; Fig. 4 is an alternate form of switch of a type which may be disposed entirely within a motor frame of usual design; Fig. 5 is an elevation illustrating a toggle mounting of the movable switch plate of Fig. 4, Fig. 5 being viewed at a right angle to the plane of Fig. 4; Fig. 6 is a sectional elevation of an adjustment employed in connection with the toggle linkage of Figs. 4 and 5, and Fig. 7 is a circuit diagram illustrating a simplified wiring arrangement of a power operator such as shown by Fig. 1, and the several switches utilized in the assembly and including a limit and overload switch of the type illustrated by Fig. 4, for example.

Considering now, as exemplifying an application of the switching means hereinafter claimed, a power operator unit as arranged for winding paired door actuating cables, there is shown by Fig. 1 a frame structure consisting of superposed decks or plates, such as **51** at the bottom, **52** as an intermediate member, and **53** at the top. These decks or plates are suitably assembled in spaced relation as by bolts **54** and spacer tubes **55**. These bolts or the tubes are preferably utilized to receive in journalling relation, pulleys **38** and **39**.

A winding member or reel **56**, which is in the nature of a hollow drum, is engaged in wrapped or wound relation by the cables **36**, the bight portions of which are secured to the drum or reel **56** as by clamps or screws. The drum is actuated from a vertical shaft **57** projecting upwardly from the reel, and secured to a worm gear **58** (Fig. 1), engaged by a worm **59** secured to a shaft **60** of a motor, the frame of which is located generally at **61**, and provided with end bells or bearing arms **62** and **63**. The end bell **62** is provided with an extension or housing portion **64**, serving as a journal for the shaft **60**, and also serving as a housing for the reception of grease or other lubricant packed about the worm **59** and worm gear **58**. The motor **61** is of reversible type and includes a stator **65** and a rotor **66**.

Carried preferably by the motor frame, say the end bell **63**, is a motor switch assembly hereinafter described in detail, it being presently sufficient to indicate that this switch is in the motor circuit, and is operated by axial movement of the shaft **60** in response to overload conditions imparted to the worm **59** and worm gear **58**, which condition, due to the abnormal thrust of the worm, serves to effect a movement of the shaft **60** in one direction or the other, along its axis. In order to permit of a substantial axial movement of the shaft **60** in response to overload conditions without necessarily moving the rotor **66** out of its intended plane of rotation, the rotor **66** is by preference mounted on and carried by a hollow shaft or sleeve **67**, which in turn is carried by the shaft **60**. The tube or sleeve **67** is rotatable on the shaft **60** except as it drives this shaft through the agency of a pin **68** disposed transversely of the shaft, and projecting into a recess formed by cutting away one end of the sleeve or tube **67**. The axial length of

the slot is such that as the shaft **60** is axially moved in either direction, the pin **68** may traverse the slot endwise without axially displacing the rotor **66**. The pin and slot connection also provides a lost-motion driving connection between the rotor **66** and the shaft **60**, since, when the motor circuit is closed, the rotor **66** may revolve through substantially a complete revolution before picking up the load of the shaft **60** and related parts, and thus will fully overcome the friction at rest of the motor before being subjected to the load of the doors and transmission. Since successive periods of motor operation will normally take place in opposite directions of rotation, it will appear that the pin **68** will abut first one, and then the other face of the abutment formed by the cut away portion of the sleeve.

It will have been observed that my preference, according to Fig. 1, is to support the motor **61** on the deck **52**, to which it is anchored as by means of the usual hold down bolts, the spacing between decks **52** and **53** being such that the latter deck underlies the housing **64** as the immediate support for this overhung portion of the structure.

To illustrate a useful adaptation of the subject matter herein claimed, there is illustrated a typical circuit arrangement in Fig. 7, in which it is preferred that the motor heretofore designated at **61**, be of some standard reversible type. Assuming by way of example, the motor to be of alternating current type, a fractional horsepower, repulsion-induction motor is preferred. It is understood that in this type of motor, the direction of initial current input will determine the direction of running rotation. The motor is shown as provided with four leads **90**, **91**, **92**, and **93**, connected respectively to contacts **90A**, **91A**, **92A**, and **93A**, the latter forming, with contacts **94** and **95**, what may here be referred to as a double pole, double throw reversing switch, the preferred physical embodiment of which is hereinafter described. It will appear that, by connecting the terminal **90A** to **94**, and the terminal **93A** to **95**, the initial direction of current input is opposite that prevailing when the terminals **90A** and **93A** are connected respectively to the terminals **91A** and **92A**.

The feeder circuit for the system is indicated by the conductors **96** and **97**. The latter leg of the feeder circuit proceeds directly to the terminal **95**, as shown. The lead **96** is, however, provided with a switch **98** which may be located at any convenient point, and which, when opened and locked against closing, may be utilized to prevent unauthorized actuation of the doors by the power operator. The leg **96** of the feeder circuit is further provided with a switch identified with a movable switch member **99**, serving to bridge contacts **100** and **101**, this switch, as hereinafter appears, being utilized as a limit switch for de-energizing the motor at or near each limit of its operation.

For completeness, the circuit of Fig. 7 is shown as including several light fixtures, such as one shown at **102**, controlled by switch **103**; a driveway control station switch **104**, a garage light **71**; a house switch **108** and driveway switches **109** and **110**.

Considering the structure of the reversing and limit switch assembly identified with Figs. 1 to 6, the switch assemblies of Figs. 1 and 2 are identical as to structure, and may be identical with the structure of Fig. 4 except for a slightly differing arrangement of compression springs employed to enhance the snap action of the switch. In the assemblies of Figs. 1 and 2, a single spring **115** serves this purpose, and in Fig. 4 a pair of springs **116** and **117** operate respectively to oppose axial movement of shaft **60** and to urge the movable switch members to their opposite motor-reversing positions. The arrangement of Figs. 1 and 2 is preferred in heavy duty units, while that of Fig. 4 is preferred, by reason of compactness, in the case of lighter domestic installations. Considering first the structure of Fig. 4, there is mounted within the end bell **63** of the motor, a bracket **118** serving to carry an insulating plate **119**, projecting inwardly of which, in parallel relation, are four conductor studs **120**, **121**, **122**, and **123** (see Fig. 5). These conductor and guide elements project inwardly of the motor and are provided at their inner ends with a spacer plate **124** connected to the conductor rods through insulating bushings **125**, the plate **124** serving, as appears from Fig. 1, to limit the movement of the rotor **66** of the motor **61**, in one direction along the shaft **60**. Slidably mounted on the four studs **120—123**, is a slidable frame or carriage consisting of a pair of plates **126** and **127**, each provided with metal contacting bushings **128** which serve slidably to embrace the conductor studs **120—123**. Each of these bushings includes a strap portion extending inwardly, for contact purposes, from the conductor stud or guide with which it is associated. The two plates **126** and **127** are preferably formed of insulating material such as a rigid fiber, and are maintained in spaced parallel relation by tubular insulating spacers **129**, being also centrally bridged by a tubular member **130** surrounding that portion of the shaft **60**.

Mounted for slidable movement between the plates **126** and **127**, is an insulating plate **135**, centrally apertured as at **136** to receive through the aperture, the tubular element **130**. The insulating plate **135** carries on one face (Fig. 3) a pair of spaced parallel conductor strips **137** and **138**, disposed vertically in the assembly, while on the opposite face of the plate are mounted a pair of similar horizontal conductor strips **139** and **140**. The strips **137—140** constitute the movable elements of the reversing switch identified diagrammatically in Fig. 7. Disposed on one face of the insulating plate **135** is an additional conducting strip shown at **99**, and extending across and marginally beyond each side of the plate. The strip **99** (Fig. 3) constitutes the movable element connecting the contacts **100** and **101** according to the diagram of Fig. 7. The strip **99** serves normally when the motor is in operation, to bridge inwardly extending contact portions **141** of a pair of spring contact fingers, which for convenience of reference to the diagram of Fig. 7 may be designated as **100** and **101**.

In case it is desired to control the energization of the light fixture **71** within the garage or like structure, according to the position of the doors and hence of the parts of the power operator, there is conveniently provided, say on the outer face of the plate **127**, a conducting strip designated to correspond with Fig. 7 and strip **105**. The strip **105** is adapted, when the switch elements are in their right hand position (Figs. 2 and 4) bridgingly to engage a pair of spring fingers or contacts **106** and **107**. It will thus appear that, with the movable switch parts in one extreme of the range of movement, the switch **105—107** is closed and, whenever the switches **98** and **108** are closed,

the fixture 71 will be energized to provide interior illumination for the building.

It will have appeared from Figs. 1, 2, 3, 4, and 5, that it is desirable for the plate 135 to be moved with a snap action across the space between the plates 126 and 127 of the slidable frame. This result is accomplished through the provision of pivot studs or trunnions 145 secured to opposite margins of the contact plate. These studs engage slotted openings 146 near the free ends of a U shaped member 147, pivoted at 148 to a stationary U frame 149, conveniently supported, as by riveting, to the bracket 118. A depending toggle frame of U shape indicated at 150 also pivotally engages the frame 149, and is centrally apertured to receive one end of a thimble 151. The thimble is internally threaded to receive an adjustable T shaped element 152 (Fig. 6) a jamb screw 153 being utilized to retain the threaded element 152 in adjusted relation within the thimble 151. The inner end of the thimble 151 is provided with a collar 154 serving as an abutment for a toggle spring 155, the outer end of which abuts against the lower portion of the U frame 150. The T shaped element 152 has its head portion transversely apertured as at 156 to receive a pivot pin secured through the arms of a U shaped yoke 157, this yoke being secured centrally to the lower portion of the toggle bracket 147, the relation of these parts best appearing in Figs. 4 and 5. It will appear that the parts 147 and 150, being connected through the spring 155, will tend, under the loading of the spring, to assume an angular relation as in Fig. 4; further that, as the slidable frame 126—127 is moved to its opposite limit, the tendency will be first to center the toggle, thence with a snap action due to the loading of spring 155, cause the parts 147 and 150 to assume an opposite angular relation.

It will have appeared heretofore that actuation of the reversing and limit switch assembly is effected through the axial movement of shaft 60. This axial shaft movement is imparted to the slidable frame 126—127, and hence to the plate 135, through the agency of a ball thrust bearing of special design embodying ball elements 160 operable in a shaft groove 161, and within a race 162 carried by a two part collar 163 which conveniently constitutes a part of the element 130. The collar 163 also serves as an abutment for one end of the spring 117, the opposite end of which is anchored by engagement with the bracket 118. The spring 116 is likewise engaged by a similar bearing assembly 163 at one end, and at its opposite end by the plate 124.

In the structure of Fig. 2, the slidable frame, the toggle arrangement, the frame-guiding conductor studs are all, or may be, identical with these elements of Fig. 4. In Fig. 2, however, the spring 115, serving the purpose of springs 116 and 117 of Fig. 4, is mounted outwardly of the motor bearing arm on the shaft 60. As best appears in Fig. 1 the shaft 60 is provided with an antifriction thrust bearing assembly consisting of an inner race 165 and an outer race 166, the former being secured to the shaft as by a set screw and the latter being carried internally of a collar 167. The collar 167 is connected through paired distance rods 168 pinned to the collar 167 and engaging, at their inner ends, the plate 127 of the slidable frame. This assembly is supported, and the rods maintained in spaced relation, through a plate 169 which is apertured to receive slidably the distance pieces 168, and is in turn slidably mounted on fixed rods 170 carried by and secured to the end bell 63. It will appear from Fig. 1 that the rods 168 are slidably operable through apertures 171 therefor, in the end bell, and that the rods 168 are shouldered as at 172 so as to abut a plate 173 which is slidable on the rods 168 and forms an abutment for the inner end of spring 115. The opposite end of spring 115 is engaged by a threaded nut or collar 174 engaging an externally threaded bushing, for purposes of adjusting the loading of spring 115, the bushing being indicated at 175.

The operation of the springs 116 and 117, is selective, according to the arrangement of Fig. 4, the former serving to resist the movement of the slidable frame, and hence of the shaft 60, to the left, and the latter opposing the movement of the frame and shaft to the right. According to the spring arrangement of Figs. 1 and 2, axial movement of shaft 60 to the right, serves, through the thrust bearing, to move the collar 167 to the right. This movement is transferred through rods 168, particularly the shoulders 172 thereof, to the plate 173 bearing against the left hand end of spring 115, the nut 174 and plate 169 being held against movement to the right by the heads of pins 170. Thus it is seen that the spring 115 will be compressed and its loading serve to resist movement of the slidable frame, in this direction. When, however, the frame and shaft can overcome the spring loading, the movement of the frame will be such as to move the contact carrier plate 135 a sufficient distance to throw the toggle, when the strip 99 will clear parts 141 to open the motor circuit. The strips 137—140 are now positioned so that reenergization of the motor will cause it to start in the opposite direction.

When the tendency of the worm and worm gear, due to resistance to rotation of the worm gear, is to move shaft 60 to the left, it will appear that the collar 167 will act upon rods 168 and tend directly to move the slidable switch frame to the left. The left hand end of the spring remains stationary because of the abutment of plate 173 against the end bell 163. The plate 169 is however free to slide on the rods 170 to permit a compression of the spring to the left, as it appears in Fig. 1. It thus appears that the spring 115 will serve to resist axial movement of shaft 60 in either direction, and to augment the action of the toggle arrangement identified with the frame 150 and yoke 147.

The switch action of the parts of Fig. 4 is essentially the same as that of the structure of Figs. 1 and 2. Upon movement of the slidable frame to the right, the spring 117 is compressed between the structure 163, and the plate 118. Upon movement of the switch frame to the left, the spring 116 is compressed between the bearing 163, the adjacent plate 126, and the plate 124.

It thus appears that, irrespective of the spring arrangement employed when the plate 135 is in one position between the plates 126 and 127, the vertical conductor strips 137 and 138 will directly connect, through one of such strips, the conductor guide studs 120 and 122, and through the other of such strips, the studs 121 and 123. When the plate 135 is in its opposite extreme position and engaging the other of the plates 126—127, one of the horizontal strips 139 will serve to connect the studs 120 and 121, while the other, 140, will serve to connect the studs 122 and 123, thus providing selectively either the normal or crossed relation of conductors to care for the reversal of current input according to the dia-

gram of Fig. 7. In order to correlate the switch structure with the diagram of Fig. 7, screw terminals are shown in Figs. 2, 4, and 5, as bearing the numerals corresponding to those of Fig. 7.

From the foregoing it will appear that the plate 135 and contacts carried thereby together with the conductor studs 120—123 constitute the motor-reversing switch while the elements 99, 100, and 101 of this structure constitute the limit switch for the motor. It will further appear that the slidable switch frame 126—127 is moved from one extreme to the other of its range, through the axial movement in opposite directions of the shaft 60 under the influence of the worm and worm gear, due either to attainment of end positions of the driven apparatus, or to overload condition. The augmented thrust of shaft 60 thus serves to shut off the motor through the action of the strip 99 and contact fingers 100 and 101, at the same time disposing the reverse switch elements in such position that when the motor is reenergized, the power operator is started in the opposite direction.

It will be observed from Fig. 2 that, when the switch parts are in their left hand position, with the motor at rest, the strip 99 fails to bridge the contacts 100 and 101. When, however, the motor is started, as for example by closing one of the driveway switches or the switch 108, the switch 98 being closed, starting current is shunted around the switch 99, 100, 101, so as to initiate operation of the unit. As soon as this is done, the working torque of the motor and the worm is sufficient to move, axially, the motor shaft, the slidable switch frame, and hence the plate, to a position in which strip 99 bridges the contacts 100—101. The inturned ends 141 of the contacts 100—101 are likewise cleared by the strip 99, as the plate 135 and frame 126—127 are moved to their right hand position. Upon restarting the motor, which will then operate in the opposite direction, the working torque of the motor and worm is sufficient to restore the strip 99 to a bridging relation with the parts 141 of the contacts 100—101.

From the circuit of Fig. 7, switch 104 being closed, it will appear that closing either of switches 109 and 110 will normally close the shunt leg of the lead 94—96 and will thus serve initially to energize the power operator motor and to maintain the current input until the circuit is closed through the switch 99, 100, 101.

It will further appear that the several items of structure heretofore described constitute marked improvements in the production and operation of devices of the present order; that the motor control and switching arrangement is substantially simplified over those heretofore offered to the trade, and rendered more reliable in operation, in fulfillment of the several objects above set forth.

While I have described the invention by making specific reference to certain definite, preferred embodiments thereof, it is to be understood that the details of the disclosure are to be understood as exemplifying the invention, rather than a limiting sense, since a number of changes may be made in the parts, their combinations and assembly, without departing from the full scope of the invention defined by the appended claims.

I claim:

1. A switch mechanism including, in combination with an axially movable shaft, a contact support adapted to be shifted responsively to axial movement of shaft, a contact carrier operable along the shaft, contacts on the support, and contacts on the carrier adapted selectively to engage those on the support, a spring and lever mechanism for actuation of said carrier, and a connection from the support to said shaft, for moving the support responsively to axial movement of the shaft.

2. A combined reversing and limit switch assembly for an electric door operator motor, including an axially movable shaft, a plurality of movable contacts for the reversing switch, reversing switch contacts adapted to be engaged by said movable contacts, a plurality of movable contacts for the limit switch, other contacts adapted to be engaged by the last said contacts, a member constituting a carrier common to the movable contacts of both switches, and means for causing a movement of said carrier responsively to axial movement of said shaft.

3. A switch mechanism including, in combination with a rotatable and axially movable shaft, a plurality of stationary contacts spaced in the direction of the shaft axis, a contact carrier, contacts on the carrier adapted selectively to engage the stationary contacts, means connecting the carrier for movement responsively to axial movement of the shaft, means for imparting an axial movement to the shaft responsively to a predetermined shaft torque, and spring means tending selectively to urge the carrier toward and away from the stationary contacts.

4. In a switch mechanism, in combination with an axially movable switch actuating shaft, a pair of spaced plates, contacts carried on opposed adjacent faces of said plates, a carrier operable between the plates, contacts on the carrier, means for moving the said plates responsively to axial movement of the shaft, elements for slidably supporting said plates, and means tending to bias the carrier toward the plates, one at a time, responsively to axial movement of the shaft.

5. A switch mechanism including, in combination with an axially movable shaft, a plurality of conductors disposed parallel to said shaft, a frame slidably carried by said conductors contacts carried by said frame and connected to said conductors, a contact carrier movable along said shaft, and movable with respect to said frame, contacts on the carrier adapted to engage those on the frame, means connecting the frame and shaft for movement of the frame responsively to axial movement of the shaft, and spring means tending selectively to urge the said carrier into and out of engagement with the frame.

6. A switch mechanism including, in combination with an axially movable shaft, a plurality of conductors disposed parallel to said shaft, a frame slidably carried by said conductors, contacts carried by said frame and connected to said conductors, a contact carrying plate movable along said shaft, toward and away from said frame, contacts on the plate adapted to engage those on the frame, means connecting the frame and shaft to cause a movement of the frame responsively to axial movement of the shaft, a spring tending selectively to urge the carrier into and out of engagement with the frame, responsively to movement of the frame, and spring means tending to oppose axial movement of the shaft.

7. A combined reversing and limit switch for an electric motor, including an axially movable shaft, a frame including a pair of spaced insulating plates assembled in spaced relation, a con-

nection from the shaft to the frame whereby the frame is adapted to be shifted responsively to the axial movement of the shaft, a contact carrier operable between the plates of the frame, contacts on the inner surfaces of the plates and the companion contacts on the opposite surfaces of the carrier, a spring and a lever cooperating to provide a snap movement of the carrier from each plate to the other thereof as the shaft is axially moved, spring means opposing the axial movement of the shaft, a plurality of stationary contacts disposed along the path of the movement of the frame and carrier, and a conducting member on the carrier adapted to bridge said stationary contacts.

8. A switch mechanism including, in combination with an axially movable shaft, a plurality of stationary contacts, supporting means therefor, a movable frame having contacts slidably engageable with said stationary contacts, a support on which said frame is slidably mounted, a contact carrier movable along the shaft, and with and within said movable frame, means connecting the movable frame for movement responsively to axial movement of the shaft, and spring means for actuation of the carrier in the frame, and toward and away from the stationary contacts.

9. A combined current reversing and circuit opening and closing switch and cooperating means therefor, for use in a supply circuit of electrically driven apparatus and including in combination with an axially movable and rotatable shaft, a spring structure compressible in either direction, and connected to said movable shaft, a movable switch member and contacts thereon for opening the associated circuit when the spring structure is held compressed in either direction, means operable by axial pressure on the said shaft in each direction, for opening the switch, said means being further adapted for automatically closing the associated circuit when said pressure is released.

10. A combined reversing and circuit controlling switch for a supply circuit such as that of an electric motor, the switch including a rotatable shaft element, an axially movable connection thereto, a plurality of stationary contacts, a support therefor, a contact frame and contacts thereon, slidably carried by the said stationary contacts, a contact carrier and contacts thereon, movable with and within said contact frame and along the shaft, a spring and lever mechanism having through the carrier an operative connection to the frame serving to actuate said contact carrier in said contact frame, and a double acting spring device connecting said contact frame with said movable connection to the shaft.

11. A switch and switch-operating mechanism for controlling an electric supply circuit and including an axially movable and rotatable shaft, a movable contact member, contacts in the supply circuit and coacting therewith, means for shifting the movable contact member responsively to axial movement of the shaft, means for imparting a snap movement to the movable contact member as it approaches its limits of movement, and means responsive to shaft torque, for actuating the movable contact member.

12. In a switch and switch-operating assembly, in combination with an axially movable and rotatable shaft, a movable contact member, contacts thereon, other contacts selectively engageable thereby, means for shifting the movable contact member responsively to axial movement of the shaft, a spring, a toggle connection between the spring and the movable contact member for effecting a snap action of the member into circuit changing position, and means responsive to changes in shaft torque for axially displacing the shaft and actuating the movable contact member.

13. In a switch and switch-operating assembly, in combination with an axially movable and rotatable shaft, a movable contact member, contacts thereon, other contacts coacting therewith and mounted separately therefrom, means for shifting the movable contact member between circuit changing positions responsively to axial movement of the shaft, a spring yieldably opposing axial movement of the shaft, means for adjusting the loading of the spring, yieldable means for imparting a snap movement to the movable contact member as it approaches a circuit changing position, and means responsive to shaft torque for axially moving the shaft, and thereby the movable contact member.

14. In a switch and switch-operating assembly of a type for actuation by, and in combination with an axially movable and reversibly rotatable shaft section, a movable switch member and contacts coacting therewith, means for shifting the switch member responsively to axial movement of the shaft, a spring device opposing axial shaft movement in each direction, means for adjusting the loading of the spring device, a spring and toggle linkage actuated by the movable switch member and arranged to impart a snap action thereto, and means responsive to a predetermined operating load on the shaft, in each direction of operation, for effecting an axial movement of the shaft whereby effectively to actuate the movable switch member.

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