April 5, 1966 T. PARRIS, JR 3,244,015

SWITCH OPERATING MECHANISM

Filed July 10, 1964

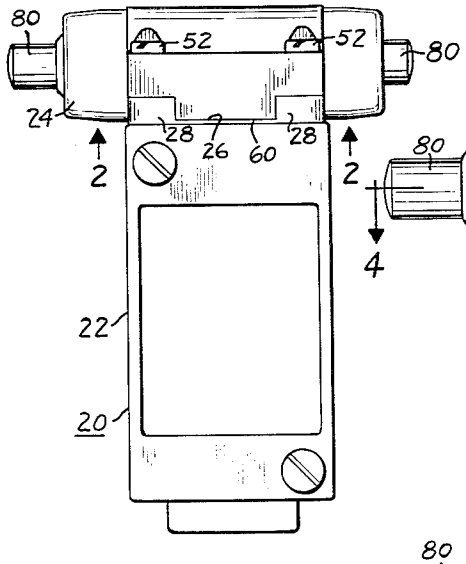


FIG. 1

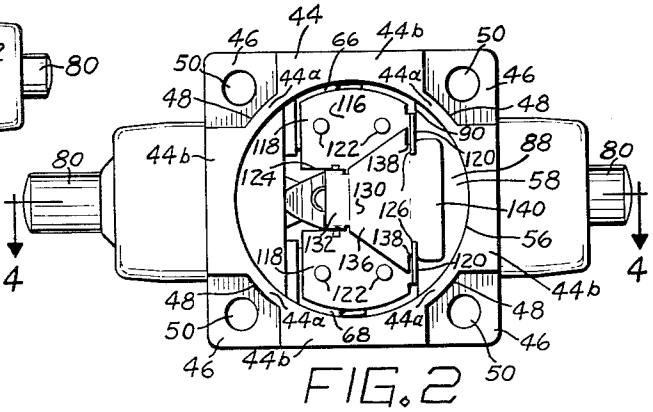


FIG. 2

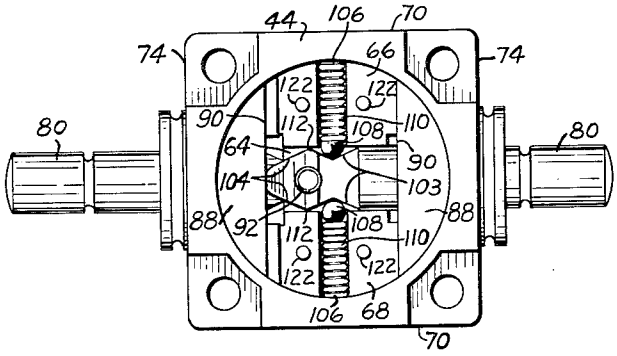


FIG. 3

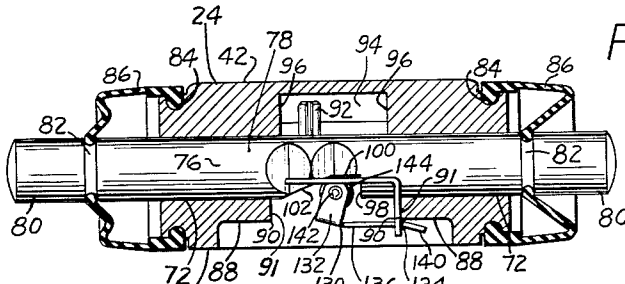


FIG. 4

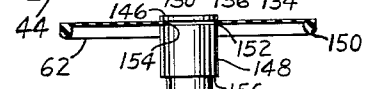


FIG. 5

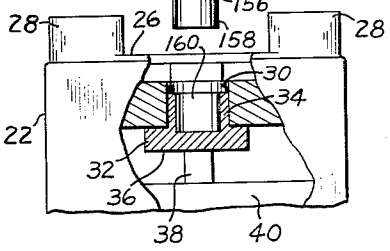


FIG. 6

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SWITCH OPERATING MECHANISM

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5 Claims. (Cl. 74—107)

The present invention relates to switch operating mechanisms and is more particularly concerned with a self-contained operating mechanism which may be mounted in any one of a plurality of positions on a housing for an electric limit switch for the purpose of transmitting motion from an external force to the switches within the interior of the limit switch housing.

The present invention is concerned with an improved operator for a limit switch which is characterized by its rugged construction, reliability of operation and simplicity of construction. The operator according to the present invention is adapted to be mounted in any one of a plurality of positions on an end of an enclosure for a limit switch and includes a reciprocating plunger which operates along an axis perpendicular to sides of the enclosure of the limit switch and is maintained in either of two positions when the plunger is operated by alternately applied forces from opposite sides of the limit switch.

It is an object of the present invention to provide an improved self-contained operator for a limit switch which operator may be mounted in any one of a plurality of positions on an end of an enclosure which contains the switching units of the limit switch and to provide cooperating bosses and recesses on the end of the enclosure and the housing for the operator so a rugged non-rotatable connection is provided between the operator and enclosure when the operator is mounted on the enclosure in any one of a plurality of positions. In carrying out the foregoing, it is an object to provide the operator with a reciprocating plunger which is maintained in either of two positions and operates along an axis parallel to the end of the enclosure and has operating ends extending beyond the opposite side walls of the enclosure.

A further object of the present inventon is to provide an improved operator for a limit switch which is self-contained in a housing and to provide the housing and switch enclosure, whereon the operator is mounted, with cooperating bosses and recesses which are arranged so the housing may be immovably mounted in a plurality of positions on the switch enclosure and to provide the operator with a shaft-like plunger which is movable between two resiliently held positions along an axis parallel to the end of the enclosure on which the housing is mounted and to provide a portion of the plunger, which is carried within a cavity within the housing, with a flattened portion and an inclined portion so a roller on an end of a pivoted lever will engage the flattened portion when the plunger is at one of the positions and will roll upon the inclined portion to a position where the roller engages the outer surface of the shaft forming the plunger when the plunger is at the other of the two positions.

In carrying out the foregoing object it is another object of the present invention to provide the operator with a means which will also limit the movement of the plunger after the plunger has moved beyond either of the two positions wherein it is resiliently held and to guide the plunger in the housing so the flattened portion and inclined portion constantly face in a predetermined direction.

In carrying out the foregoing object it is another object of the present invention to provide a disc-like seal between the end of the enclosure and the housing for the operator to not only prevent entry of foreign matter into the cavity within the housing and enclosure but also to provide an operating member which is carried by the seal which has one portion in engagement with the pivoted lever and another portion extending through an opening in the enclosure for operating switching units in the enclosure in response to the movement of the plunger.

Further objects and features of the invention will be readily apparent to those skilled in the art from the specification and appended drawings illustrating certain preferred embodiments in which:

FIG. 1 is an elevational side view of an operator according to the present invention as mounted on an enclosure which contains the switching units of a limit switch.

FIG. 2 is a plan of the operator according to the present invention taken in the direction of arrows 2—2 in FIG. 1.

FIG. 3 is a view similar to FIG. 2 with certain components of the operator removed to more clearly illustrate the remaining components of the operator.

FIGS. 4, 5 and 6 respectively show a cross-sectional view taken along line 4—4 in FIG. 2, a cross-sectional view of a disc-like seal and operating member and a portion of the housing for the switches in FIG. 1 which includes a broken-away portion to illustrate the manner in which the operating member is employed to impart movement to the switching units within the switch enclosure.

In the drawings, the numeral 20 designates a limit switch which includes an enclosure 22 and an operator 24. The present invention is principally concerned with the details of the operator 24 which may be used with a variety of switching mechanisms within enclosures similar to enclosure 22 providing the switching mechanisms will accept the operator 24 and have mechanisms which will respond to actuation of the operator 24, and therefore the switching mechanisms within enclosure 22 are not shown in detail. The operator 24, however, is particularly suited for use with the mechanism in an enclosure 22 which is fully disclosed in an application for United States Patent Ser. No. 372,854, filed June 5, 1964, which has been assigned by the inventors Rudolf H. Kiessling and Carl A. Schaefer to the assignee of the present invention.

In the preferred form of the present invention the enclosure 22 has an upper or top wall 26 which is square in shape and has a raised boss 28 formed at each of the corners of the top wall 26. The top wall 26 has a centrally located opening or bore 30 which extends into an internal cavity within the enclosure 22. The bore 30 is arranged to act as a guide for a movable slider 32 which has a portion 34 within the bore 30 and a portion 36 engaging an actuator 38 of a switch unit 40. The switch unit 40 in the preferred form comprises a switch which has contacts, not shown, which will move with a snap action to circuit making and breaking positions in response to movement of the actuator 38 and will constantly resiliently bias the actuator 38 and the slider 32 toward the top wall 26.

The operator 24 for the limit switch 20 has a housing 42, preferably formed of a die cast material to have a square shaped bottom surface 44 which is complementary in size and shape to the top wall 26 of the enclosure 22. The complementary shape of the surface 44 and the top wall 26 is achieved by forming a recess 46 at each of the corners of the bottom surface 44 which recesses are complementary in shape to the bosses 28 on the enclosure 22. As clearly seen in FIG. 2, each of the recesses 46 is provided with an arcuate wall 48 and an opening 50. The bosses 28 are provided with complementary arcuate walls, not shown, and threaded openings, not shown, which are aligned with the openings 50 when the housing 42 is positioned on the top wall 26. The openings 50 and threaded openings in the bosses 28 permit screws 52 to

be used to fasten the housing 42 to the enclosure 22. The arcuate walls 48 preferably are formed as segments of a circle which has its center located at the center of the square shaped surface 44 which circle has a diameter which will permit portions 44*a* of the bottom wall to be exposed between the arcuate walls 48 and an opening 56 which is formed in the bottom surface 44 to expose an internal cavity 58 within the housing 42. The recesses 46 are spaced at the corners of bottom surface to also expose portions 44*b* of the surface 44 between the adjacent recesses 46. The top wall 26 of enclosure 22, while having surface portions similar in shape to the portions 44*a* and 44*b* of the bottom surface 44 additionally has raised ribs 60, see FIG. 1, extending between the bosses 28 so portions of the surface portions 44*a* and 44*b* are slightly spaced from corresponding surface portions on the enclosure 22 to provide clearance so a seal 62 may be positioned and compressed between the housing 42 and the enclosure 22 when the housing is positioned on the top wall 26.

The cavity 58 is provided with a top wall which is divided by a hemispherical groove 64 to provide a pair of ledges 66 and 68 on opposite sides of the groove 64, as shown in FIG. 3. The groove 64 extends parallel to the surface 44 and also is parallel to and equidistantly spaced between opposite side walls 70 of the housing 42 and is formed as a continuation of a pair of axially aligned bores 72 which extend in opposite directions through the end walls 74 of the housing 42 from the groove 64 and the cavity 58 to the exterior of the housing 42. The bores 72 act as guides for a reciprocal shaft or plunger 76 which has an intermediate portion 78 disposed within the cavity 58 and an operating portion 80 extending at each end through the bores 72 to the exterior of the housing 42. If desired, the operating portions 80 may be provided with annular groove 82 and a portion of the exterior of the housing 42 surrounding the bores 72 may be provided with a circular hub which provides an annular groove 84 to provide a fastening arrangement for the beads on the ends of a resilient sleeve 86 which prevents passage of foreign material from the exterior of the housing 42 to the cavity 58.

Positioned intermediate the surface 44 and the top wall of the cavity as defined by ledges 66 and 68 are a pair of flat surfaces 88 which extend in a plane parallel to the surface 44 and have edges 90 formed by walls 91 which are substantially parallel to end walls 74 of the housing 42. The bores 72 also extend through the walls 91 which extend from the top wall to provide the edges 90. The shaft 76 is guided for reciprocating movement in the bores 72 and the groove 64 by a pin 92 which extends from the shaft 76 into a rectangular slot 94 which is formed in a portion of the top surface of the groove 64 along an axis parallel to the axis of the shaft 76. The slot 94 has end walls 96 which limit the left to right horizontal movement of the shaft 76 in FIG. 4.

As is most clearly shown in FIGS. 3 and 4, the intermediate portion 78 of the shaft 76 is provided with a notch which is formed by a vertical edge 98 and a flat surface portion 100. The flat surface portion extends to the left of the vertical edge 98 in FIG. 4 to an inclined wall or surface 102 which has its left end terminating in the smooth outer cylindrical surface of the shaft 76. Located on opposite sides of the shaft are a pair of notches 103 and a pair of notches 104. The notches 103 and 104 are formed as V-shaped grooves having their apexes extending normal to the surfaces 100 and 102 with the apexes of the notches 103 being disposed substantially at the midpoint of the flat surface 100 and the apexes of the notches 104 being disposed adjacent the junction of the surface 102 and the cylindrical exterior of shaft 76.

As shown in FIG. 3, a pair of hemispherically-shaped grooves 106 are formed in the ledges 66 and 68. The grooves 106 extend normal to the axis of the shaft 76 in substantial alignment with the axial centerline of the shaft 76. Positioned in each of the grooves 106 is a ball 108 and a spring 110. The balls 108 and the springs 110 are arranged in the grooves 106 so the balls 108 are urged by the springs 110 into resilient engagement with the shaft 76 and thus will resiliently maintain the shaft 76 in either of two positions relative to the housing 42.

In FIG. 3 the balls 108 are shown as positioned in the apexes of the notches 103 to maintain the shaft 76 in one of its two positions. When an external force on the shaft 76 causes the shaft 76 to move to the right, the balls 108 will be forced out of the notches 103 against the bias of the springs 110. Movement of the shaft 76 sufficiently to the right to a position where an apex 112, which exists between the notches 103 and 104, passes to the right of the balls 108, will permit the balls 108 to engage the inclined surface of the notches 104 to the left of the apexes 112. The force exerted on the balls 108 by the springs 110 will then cause continued movement of the shaft 76 to the right without any additional external force and will finally position the shaft 76 in a position wherein the balls 108 are positioned in the apexes of the notches 104 wherein the shaft 76 is positioned in its second position. In this connection it should be noted that the end walls 96 of notch 94 are located to be spaced from pin 92 when the shaft 76 is in either of the two resiliently held positions. However, should the shaft 76 be forced either to the left or right beyond the resiliently held positions, the pin 92 will engage the proper end wall 96 to positively limit further movement of the shaft 76 beyond the point of engagement of the pin 92 with the end wall 96.

Positioned within the cavity 58 is a member 116 which has a base portion 118 and a portion 120 extending at right angles to the base portion. The base portion 118 is preferably secured to the ledges 66 and 68 by rivet-like portions 122 which are integrally formed on the ledges 66 and 68 and are arranged to extend through suitable openings in the base portion 118 so the tops thereof may be peened over to secure the base portion 118 on the ledges 66 and 68. The base portion 118 when secured to the ledges 66 and 68 confines the balls 108 and the springs 110 in the grooves 106. The base portion 118 is provided with an elongated notch 124 which extends from the left free end of the base portion to the angle portion 120 to fully expose the flat surface 100 and the inclined surface 102 of the shaft 76 to the bottom surface 44 side of the cavity 58, as in FIG. 2. The right angle portion 120 is juxtaposed to the wall 91 and has a free end extending beyond the edges 90 of the surface 88 on the right side of the housing 42 in FIG. 2. The free end portion of the angle portion 120 has an opening extending toward the base portion 118 which opening is arranged to provide a pair of ears 126 which are directed from opposite sides of the shaft 76 toward the shaft 76. The ears 126 have a top surface spaced beneath the surface 88.

An operating lever 130 is formed as shown in FIGS. 2 and 4 to have a roller portion 132 on one end and a pivot portion 134 on the other end of a body portion 136. The pivot portion 134 is formed by a pair of oppositely extending notches 138 in the edges of the body portion 136 which has a portion extending beyond a centerline through the notches 138 to provide an inclined portion 140. The roller portion 132 is formed as a pair of upwardly extending ears 142 which are spaced apart and arranged to support and provide a journal for a rotatable roller 144.

When the operating lever 130 is positioned in the cavity 58 the notches 138 straddle portions of the right angle portion 120 of member 116 and portions of the bottom surface of the body portion 136 are positioned on the top surface of ears 126 while the top surface of the inclined portion 140 is positioned below the surface 88 to provide an arrangement whereby the body portion 136 including the roller portion 132 may move along a vertical path which is limited when the inclined portion 140 engages the surface 88 with a face-to-face engagement. The roller 144, when the operating lever 130 is positioned in cavity 58, engages the flat surface 100 when the balls

108 are positioned in the notches 103 and when the shaft 76 is moved to the right, from the position shown in FIG. 4, the roller 144 moves over the inclined surface 102 when the balls 108 are positioned in the notches 104. It will be seen that when the roller 144 moves from its position in FIG. 4 wherein it is in engagement with the flat surface 100 along the inclined portion 102, the roller portion 132 will move vertically downwardly. Similarly, when the roller 144 moves from its position wherein it engages the inclined surface 102 to the position shown in FIG. 4 wherein it engages the flat surface 100, the roller portion 132 will move vertically upwardly. The roller portion 132, as shown in FIG. 4, is slightly inclined and located centrally of opening 66 and engages a flat end 146 of a cylindrical operating member 148 when the housing 24 and the seal 62 are assembled on the enclosure, 22.

The seal 62 has a bead 150 formed on its periphery and a central opening 152. The bead 150 is compressed between the surface 44 on the housing 42 and complementary surfaces on the enclosure 22 when the housing 42 and enclosure 22 are secured by screws 52. The member 148 has an annular groove 154 located near the end 146 which receives the material of the seal 62 surrounding the opening 152 so the seal effectively carries the member 148. The member 148 is provided with a shoulder 156 which engages the free end of the portion 34 on the slider 30 while a cylindrical portion 158 extending from the shoulder 156 is received in a bore 160 in the portion 34 of slider 32 when the operator 24 and seal 62 are assembled on the enclosure 22.

When the external operator 24 is assembled on the enclosure, 22, the cylindrical portion 158 of the member 148 is received in a bore 160 in the slider 32 and the shoulder 156 engages the free end of the portion 34 of the slider 32, while the flat face 146 of the member 148 engages the roller portion 132. The shaft 76 is maintained in the position shown in FIG. 4 by the resilient means which includes the balls 108, the springs 110 and the notches 103. When the shaft 76 is thus positioned. the roller 142 will be pressed into engagement with the flat surface 100 by the force supplied by the actuator 38 of the snap switch 40. It was previously explained that the snap switch 40 is arranged to constantly bias the actuator 38 upwardly, as in FIG. 6. The force of actuator 38 is applied through the slider 32 and the operating member 148 to the roller portion 132 to thereby press the roller 144 into engagement with the flat surface 100.

When the shaft 76 is moved to the right from the position shown in FIG. 4 to a second position wherein it is resiliently held by the balls 108 and the springs 110 which force the balls 108 into the apexes of the notches 104, the roller portion 132 will move downwardly as the roller 142 passes over the inclined portion 102. The downward movement of the roller portion 132 is transmitted through the flat end 146 of operating member 148 to the slider 32 which causes the actuator 38 to be depressed into snap switch 40 to actuate the switch 40.

It is believed that in view of the foregoing description the operation of the parts of the device when the shaft 76 is moved from the position wherein the actuator 38 is depressed to the position shown in FIG. 4 is apparent.

While certain preferred embodiments of the invention have been specifically disclosed, it is understood that the invention is not limited thereto, as many variations will be readily apparent to those skilled in the art and the invention is to be given the broadest possible interpretation within the terms of the following claims.

What is claimed is:

1. An operator for an electric limit switch having the switch within an enclosure, said operator comprising: a housing mountable in any one of a plurality of angular positions on an end of the enclosure which housing and enclosure have cooperating recesses and bosses for preventing rotation of the housing on the enclosure when the housing is positioned on the enclosure, said housing when mounted having a cavity facing in the end and a pair of axially aligned bores extending in opposite directions from the cavity to the exterior of the housing, said bores being aligned along an axis parallel to said end when the housing is mounted on the end, a shaft mounted for reciprocal movement in said bores, said shaft having an intermediate portion disposed within the cavity and a pair of operating portions extending in opposite directions from the intermediate portion through said bores to ends which are disposed external to the housing, a notch formed in said intermediate portion, said notch having a substantially flat bottom wall portion extending toward one of the ends of one of the operating portions and an inclined wall extending from the flat bottom wall portion toward the end of the other operating portion to the external surface of the shaft, means for guiding the shaft in said bores so the inclined portion and bottom will face the end of the enclosure and for limiting axial movement of the shaft in said bores, means for resiliently maintaining the shaft in either of two positions in said bores, and an operating lever carried by the housing in the cavity, said operating lever having a roller engaging the flat bottom wall when the shaft is in one of its two positions and arranged to move on the inclined surface toward the external surface of the shaft when the shaft is moved from the said one position to the other of the two positions.

2. An operator for an electric limit switch having the switch within an enclosure, said operator comprising: a housing mountable in any one of a plurality of angular positions on an end of the enclosure which housing and enclosure have cooperating recesses and bosses for preventing rotation of the housing on the end when the housing is positioned on the enclosure, said housing when mounted having a cavity facing the end and a pair of axially aligned bores extending in opposite directions from the cavity to the exterior of the housing, said bores being aligned along an axis parallel to said end when the housing is mounted on the end, a shaft mounted for reciprocal movement in said bores, said shaft having an intermediate portion disposed within the cavity and a pair of operating portions extending in opposite directions from the intermediate portion through said bores to ends which are disposed external to the housing, a notch formed in said intermediate portion, said notch having a substantially flat bottom wall portion extending toward one of the ends of one of the operating portions and an inclined wall extending from the flat bottom wall portion toward the end of the other operating portion to the external surface of the shaft, means for guiding the shaft in said bores so the inclined portion and bottom wall face the end of the enclosure and for limiting axial movement of the shaft in said bores, means for resiliently maintaining the shaft in either of two positions in said bores, an operating lever carried by the housing in the cavity, said operating lever having a roller engaging the flat bottom wall when the shaft is in one of its two positions and arranged to move on the inclined surface toward the external surface of the shaft when the shaft is moved from the said one position to the other of the two positions, a seal positioned between the housing and the end of the enclosure, and an operating member carried by the seal having a portion extending through an opening in the end of the enclosure and a portion engageable by the operating lever.

3. An operator for an electric limit switch having the switch within an enclosure, said operator comprising: a housing mountable in any one of a plurality of angular positions on an end of the enclosure which housing and enclosure have cooperating recesses and bosses for preventing rotation of the housing on the end when the housing is positioned on the enclosure, said housing when mounted having a cavity facing the end and a pair of axially aligned bores extending in opposite directions from

the cavity to the exterior of the housing, said bores being aligned along an axis parallel to said end when the housing is mounted on the end, a shaft mounted for reciprocal movement in said bores, said shaft having an intermediate portion disposed within the cavity and a pair of operating portions extending in opposite directions from the intermediate portion through said bores to end which are disposed external to the housing, a notch formed in said intermediate portion, said notch having a substantially flat bottom wall portion extending toward one of the ends of one of the operating portions and an inclined wall extending from the flat bottom wall portion toward the end of the other operating portion to the external surface of the shaft, means for guiding the shaft in said bores so the inclined portion and bottom wall face the end of the enclosure and for limiting axial movement of the shaft in said bores, means including a pair of spring biased balls and a pair of notches in the shaft for resiliently maintaining the shaft in either of two positions in said bores, and an operating lever carried by the housing in the cavity, said operating lever having a roller engaging the flat bottom wall when the shaft is in one of its two positions and arranged to move on the inclined surface toward the external surface of the shaft when the shaft is moved from the said one position to the other of the two positions.

4. An operator for an electric limit switch having the switch within an enclosure, said operator comprising: a housing mountable in any one of a plurality of angular positions on an end of the enclosure which housing and enclosure have cooperating recesses and bosses for preventing rotation of the housing on the end when the housing is positioned on the enclosure, said housing when mounted having a cavity facing the end and a pair of axially aligned bores extending in opposite directions from the cavity to the exterior of the housing, said bores being aligned along an axis parallel to said end when the housing is mounted on the end, a shaft mounted for reciprocal movement in said bores, said shaft having an intermediate portion disposed within the cavity and a pair of operating portions extending in opposite directions from the intermediate portion through said bores to ends which are disposed external to the housing, a notch formed in said intermediate portion, said notch having a substantially flat bottom wall portion extending toward one of the ends of one of the operating portions and an inclined wall extending from the flat bottom wall portion toward the end of the other operating portion to the external surface of the shaft, means for guiding the shaft in said bores so the inclined portion and bottom wall face the end of the enclosure and for limiting axial movement of the shaft in said bores, means including a pair of spring biased balls and a pair of notches in the shaft for resiliently maintaining the shaft in either of two positions in said bores, an operating lever carried by the housing in the cavity, said operating lever having a roller engaging the flat bottom wall when the shaft is in one of its two positions and arranged to move on the inclined surface toward the external surface of the shaft when the shaft is moved from the said one position to the other of the two positions, a seal positioned between the housing and the end of the enclosure, and an operating member carried by the seal, said operating member having a portion extending through an opening in the end of the enclosure and a portion engageable by the operating lever.

5. An operator for an electric limit switch having the switch within an enclosure, said operator comprising: a housing mountable in any one of a plurality of angular positions on an end of the enclosure which housing and enclosure have cooperating recesses and bosses for preventing rotation of the housing on the enclosure when the housing is positioned on the enclosure, said housing when mounted having a cavity facing the end and a pair of axially aligned bores extending in opposite directions from the cavity to the exterior of the housing, said bores being aligned along an axis parallel to said end when the housing is mounted on the end, a shaft mounted for reciprocal movement in said bores, said shaft having an intermediate portion disposed within the cavity and a pair of operating portions extending in opposite directions from the intermediate portion through said bores to ends which are disposed external to the housing, a notch formed in said intermediate portion, said notch having a substantially flat bottom wall portion extending toward one of the ends of one of the operating portions and an inclined wall extending from the flat bottom wall portion toward the end of the other operating portion to the external surface of the shaft, means for guiding the shaft in said bores so the inclined portion and bottom wall face the end of the enclosure and for limiting axial movement of the shaft in said bores, means for resiliently maintaining the shaft in either of two positions in said bores a pivoted operating lever carried by the housing in the cavity, said operating lever having a roller on one end engaging the flat bottom wall when the shaft is in one of its two positions and arranged to move on the inclined surface toward the external surface of the shaft when the shaft is moved from the said one position to the other of the two positions, a disc-like seal positioned between the housing and the end of the enclosure, and an operating member carried by the seal and having a portion extending through an opening in the end of the enclosure and a portion continuously in engagement with the said one end of the operating lever.

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BROUGHTON G. DURHAM, *Primary Examiner.*