Nov. 6, 1951 C. M. CHRISTENSEN 2,573,833

ELECTRIC SWITCH ACTUATOR

Filed April 8, 1946 2 SHEETS—SHEET 1

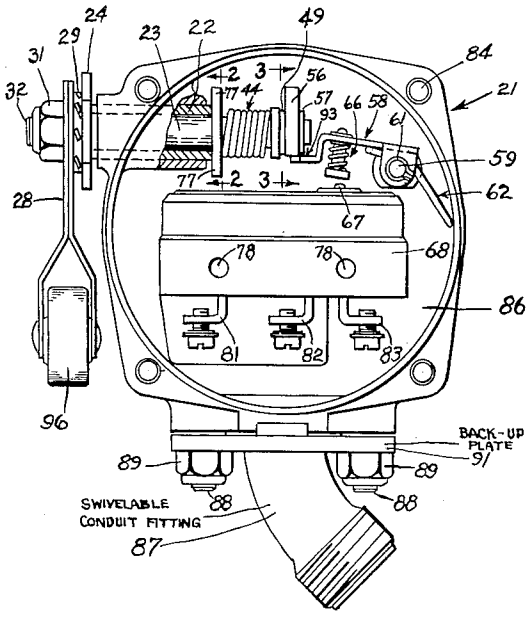


Fig. 1

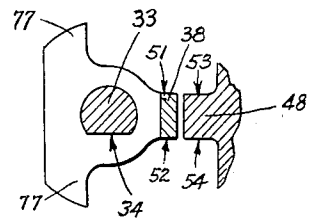


Fig. 2

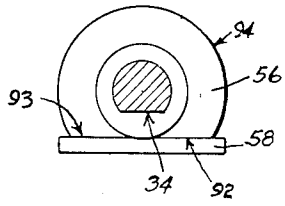


Fig. 3

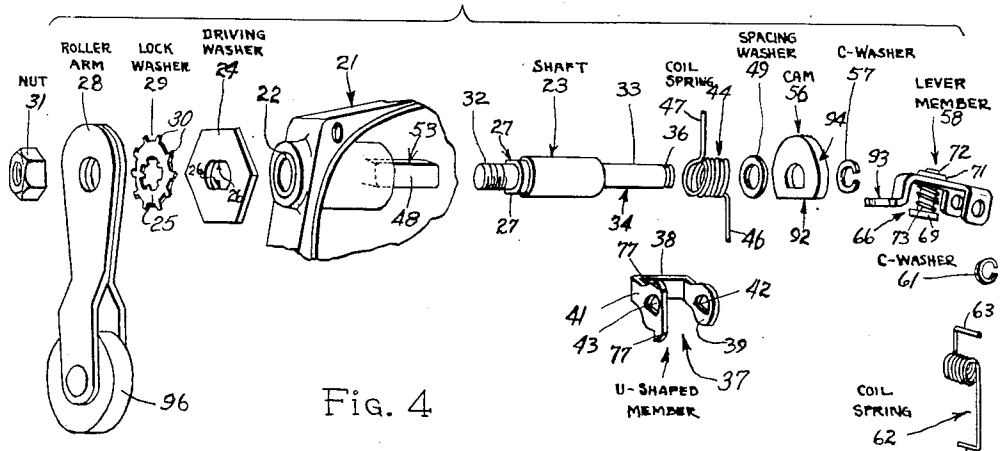


Fig. 4

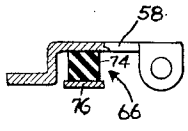


Fig. 11

Inventor

Carlo M. Christensen

By McCanna and Morsbach

Attys

Nov. 6, 1951 C. M. CHRISTENSEN 2,573,833

ELECTRIC SWITCH ACTUATOR

Filed April 8, 1946 2 SHEETS—SHEET 2

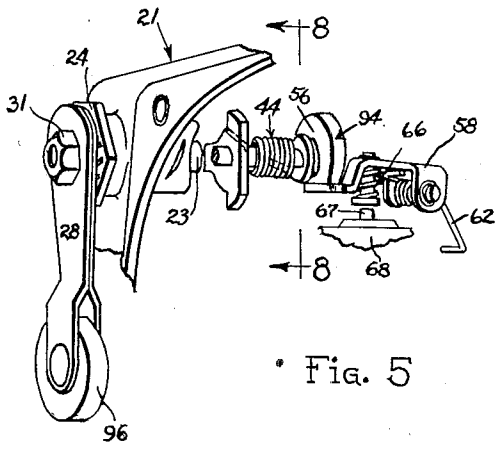


Fig. 5

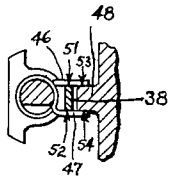


Fig. 8

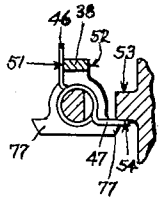


Fig. 9

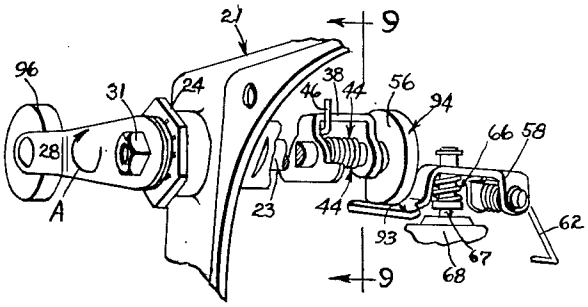


Fig. 6

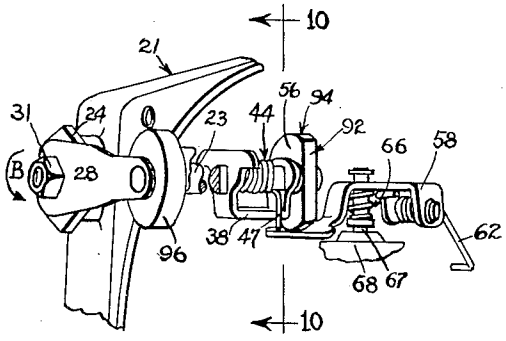


Fig. 7

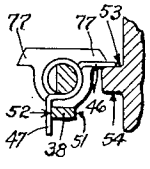


Fig. 10

Inventor

Carlo M. Christensen

By McCanna and Morsbach

Att'ys

Patented Nov. 6, 1951

2,573,833

UNITED STATES PATENT OFFICE

2,573,833

ELECTRIC SWITCH ACTUATOR

Carlo M. Christensen, Freeport, Ill., assignor, by mesne assignments, to Minneapolis-Honeywell Regulator Company, Minneapolis, Minn., a corporation of Delaware

Application April 8, 1946, Serial No. 660,314

7 Claims. (Cl. 74—96)

1

This invention relates to switch mechanisms and has special reference to an improved switch actuating mechanism.

Objects of this invention include the provision of a rugged, compact, low cost electric switch actuator that is simple and economical in construction, easily assembled, and reliable and precise in operation.

A preferred embodiment adapted to be employed to operate a compact precision type electric switch includes an external arm adapted to rotate a cam, the cam being engageable with a lever to press the latter into engagement with the switch operating plunger. Specific objects with respect to this preferred embodiment lie in (*a*) the provision of a resilient member between the switch plunger and the lever whereby movement of the lever includes a certain amount of overtravel beyond the switch "operate" position, (*b*) so dimensioning and positioning the cam with respect to the lever that the rotation of the external arm includes a certain amount of overtravel, with respect to the lever, beyond the "operate" position. Another specific object lies in the provision of a novel arrangement of parts associated with a coiled spring for urging the parts to a normal or "non-operate" position.

Other objects and advantages will become apparent from the following description in connection with the drawings, in which—

Figure 1 is a switch actuator illustrating a preferred embodiment of my invention and shown assembled with a switch;

Fig. 2 is a partial sectional view of Figure 1 taken on the line 2—2;

Fig. 3 is a partial sectional view of Figure 1 taken on the line 3—3;

Fig. 4 is an exploded perspective view of the parts of the actuator shown in Figure 1;

Fig. 5 is a partial perspective view of the actuator showing the positions of the parts at the normal or "non-operate" position;

Fig. 6 is a view similar to Fig. 5 showing the actuator arm rotated to one "operate" position;

Fig. 7 is a view similar to Fig. 6 in which the actuator lever is moved to its "operate" position by rotating the actuating arm to a position opposite its Fig. 6 position;

Fig. 8 is a sectional view of Fig. 5 taken on the line 8—8;

Fig. 9 is a sectional view of Fig. 6 taken on the line 9—9;

Fig. 10 is a sectional view of Fig. 7 taken on the line 10—10, and

2

Fig. 11 is a modification of one of the parts shown in Figures 1 and 4.

Like parts are designated by like reference characters throughout the figures.

Considering now the figures in more detail, the actuator comprises a housing generally designated 21 having a bushing 22 for rotatably journaling the shaft. When assembled within the bushing, the shaft will have at its exterior portion the driving washer 24, preferably having its outer periphery flattened at preselected positions so as to be readily received between the jaws of a wrench. The washer edges 26 also engage the surfaces 27 on the shaft so that any rotational movement applied to the driving washer will rotate the shaft. The roller arm 28 and the lock washer 29 are forced upon the driving washer 24 by means of the nut 31 which is threadedly engaged with the extreme outer end portion 32 of the shaft. Preferably the lock washer 29 is of the type comprising a ring portion 25 having a plurality of outwardly and inwardly projecting annularly spaced radially extending projections or fingers 30 inclined at an angle with respect to the plane of the ring portion 25. Thus, when the nut 31, preferably of the self-locking type, is screwed into position against the outer side of the arm 28, the fingers 30 on the lock washer 29 bite into the other side of the arm and the driving washer or abutment 24. This construction assures that the arm 28 is rigidly attached to the shaft. This construction is also advantageous in that the arm 28 may be adjusted to any desired angular position relative to the shaft. By this construction the roller arm 28 can be adjusted for any angular position with respect to the housing at any given position of the shaft 23.

The inner end portion 33 of the shaft is formed with the longitudinally extending flattened surface 34 (see Figs. 2 and 3) and the circumferential groove 36. A U-shaped member or bracket generally designated 37 and having the base portion 38 and the side portions 39 and 41 is apertured as at 42 and 43 so as to be assembled slidably over the shaft end portion 33 whereby the base portion 38 will, in effect, constitute a parallel bar which is rotatable with the shaft about the latter's axis. The coiled torsion spring 44 will be telescopically assembled upon the shaft end portion 33 between the sides 39 and 41 of the U-shaped member. The substantially radially extending end portions 46 and 47 of the coiled spring will be assembled to normally abut the opposite surfaces or sides of both the bar 38 and

the housing boss 48, as shown in Fig. 8. In practice, these end portions will rarely abut both bar surfaces 51 and 52 and both boss surfaces 53 and 54 in the normal or Fig. 8 position, since a high degree of precision is not required in this part of the construction and hence the bar and the boss will usually vary slightly in width. A spacing washer 49 and a D-shaped cam 56 will be maintained upon the shaft end portion 33 by a C-washer 57 which is seated in the groove 36.

A lever member generally designated 58 is pivotally mounted on the pin 59 which may be formed integrally with or otherwise fastened to the housing 21. The C-washer 61, seating in a suitable groove (not shown) on the pin serves to hold the lever member in place. The formed coil spring 62 is likewise assembled on the pin 59 so that its end portions 63 and 64 respectively engage the lever member 58 and the interior of the housing to maintain the lever pressed resiliently upward into engagement with the cam 56 at all times. In some constructions it may be feasible to dispense with this spring 62; however, it will usually be preferred, to maintain the lever completely out of contact with the switch in the "non-operate" position (as shown in Figures 1 and 5). The lever member 58 has associated with it a resilient member generally designated 66 which provides the actual engagement with the switch operating plunger 67. This provides for a certain amount of overtravel movement of the lever member 58 past the "operate" position of the switch plunger 67. One form of this resilient member may be as shown in Fig. 4 consisting of a headed rivet 69 and a washer 71 peened together as at 72, the rivet 69 being loosely engaged within an aperture (not shown) in the lever member and with its head pressed resiliently away from the lever by means of the interposed spring member 73. Another form which this resilient member may take is shown in Fig. 11 where a rubber block 74 and a metal or fiber cap 76 are bonded together and to the lever as shown.

Rotating of the roller arm 28 past the "operate" position (i. e., the position at which the switch is operated) in either direction is suitably limited by the engagement of the ears or extensions 77 on the U-shaped member 37 with one or the other of the surfaces 53 or 54 of the boss 48. These limiting positions are shown in Figures 9 and 10.

The present invention is applicable for use with a large number of electric switches. It is, therefore, only for purposes of illustration that I have shown the particular switch 68, mounted on the housing pins 78. It is a conventional compact precision type single pole, double throw switch in which the terminals 81 and 83 are normally connected when the plunger is not depressed, and in which the terminals 82 and 83 are connected when the operating plunger 67 is depressed.

In service, a gasketed cover plate (not shown) attached by bolts (also not shown) threadedly engaged in the tapped holes 84 will serve to seal off the front housing opening 86. A swivelable conduit fitting 87, held in place by bolts 88, nuts 89 and the back-up plate 91, may be turned at any suitable angle to accommodate the connecting conduit.

Operation

Considering now the operation of the actuator illustrated in the drawings, assume that the parts are in the normal positions shown in Figures 1, 2, 3, 5, and 8. As shown, particularly in Fig. 3, the flat cam surface 92 is engaged in flatwise abutment with the end portion 93 of the lever member 58 and that the lever member 58 is out of contact with the operating plunger 67 (Fig. 1). Furthermore, the roller arm 28 is in an up and down position, parallel to the housing although, as stated above, the normal position of the roller arm with respect to the housing can be at any desired angle to accommodate the requirements of the particular service condition.

When the roller arm 28 is rotated clockwise, that is, in the direction of the arrow designated A in Fig. 6, the lever member 58 will be moved downwardly, stressing its resilient portion 66 in added compression until sufficient force is applied to the switch plunger 67 to depress it to the "operate" position. The lever member can be moved downwardly considerably beyond this "operate" position due to the added compressibility of the resilient portion 66 and this additional movement constitutes lever overtravel. As the roller arm 28 is rotated to rotate the cam 56 in this manner, the lever member will be moved downwardly until a certain point is reached where the circular surface 94 of the cam is in contact with the lever surface 93. Further rotation of the arm past this point constitutes actuator arm overtravel. Thus, it will be seen that by providing an actuator construction with overtravel built into the connection between the cam and lever and additional overtravel built into the connection between the lever and plunger 67, a highly sensitive precision type switch having in itself a very short operating plunger movement may be employed to indicate the condition of a part moving through relatively great distances to operate the arm 28. For example, it may be used to energize an indicating light in an aircraft landing gear mechanism where the actuating arm may be rotated through almost 90° between "lowered" and "retracted" positions, yet the switch plunger 67 will have a movement differential of only a few thousandths of an inch.

When the actuator arm is rotated clockwise, in the direction of the arrow A, the end portion 46 of the coil spring will act upon the bar 38 to urge it to the normal or Figure 8 position. Similarly when the roller arm 28 is rotated in the opposite direction, in the direction of arrow B, the end portion 47 of the coil spring 44 will act against the bar 38 to urge it to return to the Fig. 8 position.

One modification of the present invention has been illustrated in which the cam 56 is of symmetrical shape and, as a result, the roller arm 28 may be moved in either direction to operate the switch 68. Obviously, the actuator need not necessarily be operable in both directions in this manner for many cam configurations may be employed within the scope of the present invention whereby the arm 28 may operate the switch in only one direction or at different degrees of rotation in different directions. Also, while the arm 28 has been illustrated as employing a roller 96, this actually forms no essential part of the present invention as many other types of actuating arms may be employed.

It will be apparent that minor changes in the invention as disclosed will readily suggest themselves to others skilled in the art without departing from the spirit and scope of the invention. What is claimed as new is:

1. In combination, a compact actuator construction of the class described, a housing, a

shaft rotatably journaled in said housing, a U-shaped member having its sides engaging said shaft to be rotatable therewith, a member attached to said shaft being engageable with said housing to limit rotation of said shaft in one direction, a coil spring mounted upon said shaft between the sides of said U-shaped member and engageable with said housing to urge said shaft to a preselected normal position, a cam associated with said shaft, a lever member pivotally mounted within said housing and positioned for engagement by said cam, said lever member having attached thereto a resilient compressible member.

2. In combination, a compact actuator construction of the class described, a housing, a shaft rotatably journaled in said housing, a U-shaped member having its sides engaging said shaft to be rotatable therewith, a member attached to said shaft being engageable with said housing to limit rotation of said shaft, a spring mounted upon said shaft between the sides of said U-shaped member and engageable with said housing to urge said shaft to a preselected normal position, a cam associated with said shaft, a lever member pivotally mounted within said housing and positioned for engagement by said cam, resilient means associated with said lever for maintaining it resiliently pressed against said cam, said cam and said lever being so dimensioned and so positioned with respect to one another that initial rotation of said shaft from said normal position effects movement of said pivoted lever and that further rotation of said shaft beyond said initial rotation does not move said lever whereby the rotation of said shaft is characterized by overtravel movement with respect to said lever.

3. In combination, a compact actuator construction of the class described, a housing, a rotatable shaft journally engaged with said housing, said housing having a boss formed therein, said shaft having a bar mounted in spaced parallel relation therewith, a coil spring telescopically engaging said shaft, said spring having end portions engageable with opposite sides of said bar and said boss to urge the parts to a normal position where said shaft, said bar, and said boss are in substantial alignment, cam means associated with said shaft and rotatable therewith, lever means operatively associated with said cam means, said cam means being so dimensioned and so positioned with respect to said lever means that movement of said shaft to a certain position is operative to move said lever in one direction and further movement of said shaft beyond said certain position is inoperative to move said lever farther in said direction.

4. In combination, a compact actuator construction of the class described, a housing, a shaft rotatably journaled in said housing, a U-shaped member having its sides engaging said shaft to be rotatable therewith, said U-shaped member being engageable with said housing to limit rotation of said shaft, a spring mounted upon said shaft between the sides of said U-shaped member and engageable with said housing to urge said shaft to a preselected normal position, a cam associated with said shaft, a lever member pivotally mounted within said housing and positioned for engagement by said cam, said shaft having at its outer end portion a washer interlocked therewith to prevent independent rotational movement of said shaft and washer, an actuating arm engaged by said shaft and normally rotatable with respect thereto, threaded means for moving said arm toward said washer, locking means interposed between said arm and said washer and adapted to restrain both from independent rotational movement with respect to one another when said arm is urged forcibly toward said washer by said locking means.

5. In an actuator the combination of, a housing comprising a body having a recess opening on a side surface and a cover shaped to be secured to said body to overlie said recess and form a closed chamber in said housing, said chamber being shaped to receive a mechanism having a longitudinal axis and operated by a plunger, a rotatable shaft supported on said housing in spaced relation with said mechanism and having its rotational axis in substantially parallel relation with the longitudinal axis of said mechanism, said shaft having a portion disposed in said chamber and a portion disposed on the exterior of said housing, a bracket in said chamber rigidly mounted on said portion of the shaft in said chamber and having a portion in substantially spaced parallel relation with the shaft, said portion of the bracket being rotatable with said shaft, a coil spring mounted on said portion of the shaft disposed in said chamber and having its ends engageable with opposite sides of said portion in spaced relation with said shaft and with said housing to urge said shaft to a preselected position, a cam mounted on the portion of the shaft disposed in the chamber and rotatable therewith, a pivotally mounted lever shaped to engage said cam and having its longitudinal axis substantially disposed in a plane of the axis of rotation of said shaft, said lever being shaped to engage the plunger, means for urging said lever into engagement with said cam, and means engageable with the portion of the shaft on the exterior of the housing for rotating the shaft whereby said cam effects movement of the lever to actuate the mechanism.

6. In an actuator, the combination of, a housing having a chamber formed therein for the reception of a mechanism having a first axis and operated by a plunger, a shaft rotatably journaled on said housing and projecting into said chamber, said shaft having its axis of rotation in substantially spaced parallel relation with said first axis of the mechanism, a U-shaped member in said chamber comprising side portions rigidly mounted on said shaft and rotatable therewith and a bridging portion connected to said side portions and spaced from said shaft, said housing having a boss disposed in said chamber and projecting toward said shaft, one of said side portions being formed with a projection engageable with said boss to limit rotation of said shaft, a coil spring in said chamber mounted on said shaft between said side portions and having its ends engageable with said bridging portion and said boss to urge said shaft to a preselected position, a cam in said chamber rigidly mounted on said shaft, an elongated pivotally mounted lever disposed in said chamber and having an end positioned for engagement by said cam and its opposite end spaced axially from said cam, said lever being engageable with said plunger, and means for urging said first end of the lever into engagement with the cam whereby rotation of the latter causes said lever to move the plunger to actuate the mechanism.

7. In an actuator for a device operated by a plunger, the combination of a support, a shaft rotatably mounted on said support and having a flattened surface formed thereon, a mechanism actuated by rotation of said shaft for operating

the plunger, a washer having an opening shaped to receive said flattened surface whereby said washer is rigidly mounted on said shaft, said washer having its periphery flattened at preselected positions to be readily received between the jaws of a wrench, an actuating arm mounted on said shaft, a lockwasher disposed between said washer and said arm comprising a ring portion having a plurality of radial projections inclined at an angle with respect to the plane of the ring portion, and a self-locking nut mounted on said shaft to abut against the arm whereby said projections bite into the arm and the washer to effect a rigid connection between the arm and the shaft.

CARLO M. CHRISTENSEN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
438,167	Marcher	Oct. 14, 1890
1,262,969	Morey	Apr. 16, 1918
1,427,807	Halbleib	Sept. 5, 1922
1,846,271	Olson	Feb. 23, 1932
1,855,612	Salinas	Apr. 26, 1932
2,270,867	Cotesworth et al.	Jan. 27, 1942
2,270,951	Jeffrey	Jan. 27, 1942
2,289,108	Eaton	July 7, 1942
2,328,266	Durbin	Aug. 31, 1943
2,336,425	Shenton	Dec. 7, 1943
2,349,487	Davis	May 23, 1944