1. 3,525,960, ELECTROMECHANICALLY AND MANUALLY OPERABLE SWITCH MECHANISM. Samuel B. Robbins, Rochester, Mich., assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware  

Filed Jan. 28, 1969, Ser. No. 794,502  
Int. Cl. H01H 3/00  
U.S. Cl. 335—185  
2 Claims  

ABSTRACT OF THE DISCLOSURE

The switch mechanism includes a manually manipulatable actuator pivotally connected within a switch housing for movement in opposite directions between first and second positions. The actuator carries mobile contact means which are movable into engagement with respective ones of stationary contacts carried by the switch housing to effect first and second switching functions when the actuator is moved to its first and second positions, respectively. The switch mechanism also includes an electromechanical means operatively connected with the actuator for moving the same between its positions, the connection therebetween being such that the actuator can be manually manipulated without disturbing the normal operational position of the electromechanical means.

The preferred embodiment, are carried out by providing a manually manipulatable actuator which is pivotally connected within a switch housing for movement in opposite directions about a fixed axis between first and second positions and which carries mobile contact means which are selectively engageable with stationary contacts carried by the housing when moved to its first and second positions. The actuator is provided with an inverted V-shaped slot having a rounded, constant radius apex at the upper side of the slot and a pointed apex at the lower side of the slot, the slot slidable receiving one end of a link member connected with a core of a single solenoid means. The end of the link member is biased toward a position in which it is vertically aligned with the pivot axis of the actuator by a spring and guide arrangement. This construction and arrangement enables the actuator to be manually manipulated without affecting the normal position of the electromechanical means and enables the electromechanical means when actuated to move the actuator between its positions.

The present invention further resides in various novel constructions and arrangement of parts, and further objects, novel characteristics and advantages of the present invention will be apparent to those skilled in the art to which it relates and from the following detailed description of the preferred illustrated embodiment thereof made with reference to the accompanying drawings forming a part of this specification and in which similar reference numerals or characters are employed to designate corresponding parts throughout the several views, and in which:

FIG. 1 is a longitudinal cross-sectional view, with portions shown in elevation, of the preferred embodiment of the switch mechanism of the present invention;  
FIG. 2 is a fragmentary view similar to that shown in FIG. 1, but showing certain parts thereof in different positions;  
FIG. 3 is a sectional view, with portions shown in elevation, taken approximately along line 3—3 of FIG. 1;  
FIG. 4 is a perspective view of part of the switch mechanism shown in FIG. 1;  
FIGS. 5 and 6 are views similar to that shown in FIG. 1, but showing different parts thereof in different positions;  
FIG. 7 is a view similar to that shown in FIG. 5, but with additional parts shown in elevation; and  
FIG. 8 is a schematic wiring diagram for controlling operation of a solenoid means of the switch mechanism shown in FIG. 1.

The present invention provides a novel switch mechanism and in particular a novel switch mechanism which can be either manually operated or operated from a remote location to selectively control energization and de-energization of a plurality of electric circuits. Although the switch mechanism of the present invention could be used in various applications where both manual and remote control of a plurality of switching functions are required or desired, it is particularly useful in vehicular applications, such as for use as a locking control switch in an electrically operated door locking and unlocking system for an automobile. For the purposes of description, it will be herein merely described as being used for controlling energization and de-energization of a pair of electric circuits.
As representing a preferred embodiment of the present invention, the drawings show a switch mechanism A. The switch mechanism A comprises, in general, a switch housing 10, a plurality of stationary contacts or terminals 11, 12, 13 and 14 carried by the housing 10, a manually manipulable actuating means 15 carried by the housing 10 and which is manually movable in opposite directions between its first and second positions, and an electromechanical means 20 operatively connected with the manually manipulable actuating means 15 and which is also operable to move the actuating means 15 between its first and second positions. The actuating means 15 broadly comprises an actuator 21 and a mobile contact means 22 carried by the actuator 21 and selectively engageable with respective ones of the stationary contacts when the actuator 21 is moved between its first and second positions, and a snap act, over center spring 24 for moving the mobile contacts means 22 into engagement with the stationary contacts with a snap action when the actuator 21 is moved over dead center midway between its path of travel between its positions and for biasing holding the mobile contact means 22 in engagement with the stationary contacts.

The housing 10 is adapted to be mounted on a suitable support structure of the vehicle and in a manner such that the actuator 21 is readily accessible to the operator of the vehicle for manual manipulation. For the purposes of description, the housing 10 will be described as being supported by the vehicle in a vertical position.

The housing 10 is made from a suitable plastic or electrically insulated material and is of a generally rectangular shape. The housing 10 has vertically disposed side walls 26 and an upper horizontally disposed end wall 27 provided with a slot 27a through which the actuator 21 extends. The stationary terminals 11, 12, 13 and 14 are secured to side walls 26 of the housing 10 and project inwardly of the housing 10.

The stationary terminals 11 and 12 and 13 and 14 are vertically aligned, but spaced from each other, and have convex contact surfaces. The terminals 13 and 14 are integral with each other and connected by a suitable wire or conductor (not shown) to ground. The terminals 11 and 12 are in suitable circuits (not shown) with a battery and devices to be controlled.

The mobile contact means 22 comprises a leaf spring member having convex contact surfaces integral with its upper and lower sides at its opposite ends. The mobile contact means 22 is secured to the underside of the actuator 21 as by rivets 29.

The actuator 21 has an upper finger portion 21a which is adapted to be manually grasped by the operator and an inner generally triangularly shaped base portion 21b. The base portion 21b of the actuator 21 is pivotally connected by a pivot pin means 30 to oppose side walls 26 of the housing 10 for movement in opposite directions about the axis 30a of the pin 30.

The actuator 21 is movable between its first position, as shown in FIG. 1, in which it holds the mobile contact means 22 in engagement with the stationary contacts 11 and 14 to provide a conductive path between these latter contacts to enable a first circuit to be completed and a second position, as shown in FIG. 2, wherein the actuator 21 holds the mobile contact means 22 in engagement with the stationary contacts 12 and 13 to provide a conductive path therebetween to enable a second circuit to be completed.

The actuator 21 when moved from one position toward its other position is moved to the other position during the latter portion of its travel by a snap action and then biasingly held in the position in which it has been moved. To this end, the over center, snap acting spring 24 is provided. The spring 24 comprises a resilient, one-piece, generally U-shaped member having one end connected by a pin 35 to the actuator 21 and its other end connected by a pin 36 to the housing 10. As shown in FIG. 1, the disposition of the U-shaped spring 24 is such that as the actuator 21 is moved from its first position toward its second position, as shown in FIG. 2, it will move the legs of the U-shaped spring towards each other to compress the spring 24 until the actuator is in a top dead center position, i.e., vertically disposed. As the actuator 21 is moved past its top dead center position the spring 24 is no longer being compressed and its self-biasing force will cause the legs thereof to move away from each other and move the mobile contact means 22 into engagement with the terminals 11 and 14 with a snap action.

The actuator 21 can also be moved between its first and second positions from a remote location by energizing the electromechanical means 20. The electromechanical means 20 comprises a solenoid means 50 carried by the housing 10. The solenoid means 50 comprises an upper pole piece 51 in abutting engagement with inwardly extending projections 52 on the housing 10, a side pole piece 54 connected with the upper pole piece and a bottom pole piece or base 55 suitably secured as by screws 56 to the housing 10. The solenoid means 50 further includes an annular coil 60 having a central opening through 61 therein which slidably receives a core 62 or armature made of iron or other suitable material. The core 62 extends through a central opening 64 in the upper pole piece 51 and is linearly movable along an axis which is normal to and intersects pivot axis 30a of the pivot pin 30 for the actuator 21.

The upper end of the solenoid core 62 is pivotally connected to a horizontally extending pin-like portion 65a of a link or member 65. The link 65 also includes a stepped intermediate portion 65b and a horizontally extending pin-like portion 65c adjacent its other end. The other horizontally extending end portion 65c of the link 65 is slidably received within a cam slot 70 formed within the base portion 21b of the actuator 21 and located above the axis 30a of the pivot pin 30.

The cam slot 70 is generally in the shape of an inverted V and includes linearly extending side portions 71 and 72. It also has a rounded, constant radius recessed apex 73 at its upper side edge and a pointed apex 74 at its lower side edge. The apex 74 is located relative to the apex 73 such that a plane containing the apex 74 and the axis 30a of the pivot pin means 30 bisects the rounded apex 73 at the upper side edge of the slot 70.

The link 65 and core 62 are biased toward an upper or first position, shown in FIGS. 1 and 2, in which the upper end portion 65c of the link 65 is located above the pivot pin 30 and received in the recessed apex 73. To this end, a spring and guide arrangement, designated generally by reference numeral 80 is provided. The spring and guide arrangement includes a tension spring 81 having one end suitably connected to the upper end 27 of the housing 10 and its other end suitably connected to the step 84 of the intermediate portion 65b of the link 65. The spring 81 is guided by a guide in the form of an ear 85 secured to the intermediate portion 65b of the link 65 and which has an opening 86 therethrough through which the spring 81 extends. As best shown in FIG. 7, the spring force is such that it tends to maintain the spring 81 straight, which in turn causes the spring to bear against the side wall defining the opening 86 in the ear 85 and bias the link 65 to the position shown in FIGS. 1 and 2 in which the upper end portion thereof is vertically aligned with the pivot pin 30.

The solenoid means 50 is operable to move the actuating means 15 from its first position, as shown in FIG. 1, to its second position, as shown in FIGS. 2 or 5, in response to energization of the solenoid coil 60. When the solenoid coil 60 is energized, it causes the core 62 to be drawn in a downward direction from its position shown in FIG. 1. Movement of the core 62 in this direction causes the link 65 to be moved downwardly, which in turn causes the upper end portion 65c thereof to move from
Although the illustrated preferred embodiment thereof has been described in great detail, it should be apparent that certain modifications, changes, and adaptations may be made therein without departing from the spirit and scope of the appended claims. What is claimed is:

1. A switch mechanism for selectively effecting first and second switching functions comprising: a housing; a manually manipulatable actuator pivotally supported by said housing for movement in opposite directions about a fixed axis between first and second positions; a plurality of stationary contacts carried by said housing; mobile contact means carried by said actuator and engageable with selective ones of said stationary contacts to effect first and second switching functions when said actuator is moved to its first and second positions, respectively; means for releasably retaining said actuator in the position in which it is moved; said actuator having a cam slot therein including first and second recess portions, and electromechanical means for moving said actuator between its first and second positions; said electromechanical means including a member for biasing said actuator within said slot, spring means for biasing said member into said first and second recess portions when said actuator is in its first and second positions, respectively, said member being effective to cam said actuator from the position in which it is disposed to its other position in response to energization of said electromechanical means.

2. A switch mechanism for selectively effecting first and second switching functions comprising: a switch housing; a manually manipulatable actuator pivotally supported by said housing for movement in opposite directions about a fixed axis between first and second positions; a plurality of stationary contacts carried by said housing; mobile contact means carried by said actuator and engageable with selective ones of said stationary contacts to effect first and second switching functions when said actuator is moved to its first and second positions, respectively; snap acting, over-center spring means operatively connected with said housing and said actuator, said spring means effecting a snap action movement of said actuator toward the position in which it is being moved as it is moved past dead center midway between its first and second positions and biasingly holding said actuator in the position in which it is disposed, said actuator having a generally inverted V-shaped slot thereof, said slot having a rounded recess at its apex, said recess including first and second portions disposed on opposite sides of a plane passing through the apex of the V-shaped slot and which bisects the included angle of the V-shaped slot; an electromechanical means for moving said actuator between its first and second positions; said electromechanical means comprising a selectively energizable solenoid having a linearly movable core, a link member having one end pivotally connected to one end of said core and the other end slidably disposed within said slot in said actuator; second spring means operatively connected with said housing and said link member for biasing said link member toward the apex of said generally V-shaped slot and into said first or second recess portions when said actuator is disposed in said first and second position, respectively, said solenoid when energized causing said core to move away from said actuator member to cause said other end of said link to move within said slot and cam said actuator member from the position in which it was located to its other position, said second spring means being effective to return the other end of said link to its vertically aligned position with respect to the pivot axis of the actuator and into the other recess portion disposed thereat when said solenoid is de-energized, said link member including an ear portion having an opening there-through through which said second spring means extends

right portion of the recessed apex 73 and engage the lower wall surface defining the lower side of the slot portion 72. As the upper end portion 65c of the link 65 engages with the pivot pin 30 and the actuator 21 to be cammed in a clockwise direction, as viewed in FIG. 1, about its pivot axis 30a. The link 65 during its downward movement is also free to pivot relative to the core 62 due to the pivotional connection therebetween. As the actuator 21 moves past top dead center, the spring 24 will function to move the actuator 21 during the remaining portion of its movement to its second position, as shown in FIGS. 2 or 5, and in the same manner as hereinbefore described. When the actuating means 15 is in its second position, as shown in FIG. 5, and the solenoid coil 60 is de-energized the spring 81, whose mid-position has been deflected laterally out of alignment with a line drawn between its ends (see FIG. 7) will cause the ears 85 and hence the link 65 to be moved in the direction of the arrow 90 until the upper portion 65a is again in vertical alignment with the pivot axis 30a and disposed within the left portion of the recessed apex 73, as shown in FIG. 6.

Movement of the actuator means 15 from its second position to its first position is effected by again momentarily energizing the solenoid coil 60. The same mode of operation takes place except that the upper end portion 65a of the link 65 will now cooperate with the lower wall defining the pivot portion 71 to effect a camming action of the actuator in a counterclockwise direction. As schematically shown in FIG. 8, the solenoid coil 60 is respectively connected via suitable wires 92 and 93 to ground and one terminal of push button switch 94. The other terminal of the switch 94 is connected via a wire to another terminal of a battery 96, the other terminal of the battery 96 being connected to ground via wire 97. As is apparent from the above, the push button switch 94, when depressed, completes a circuit from the battery 96 through wire 95, switch 94, wire 93, solenoid coil 60, wire 92 to ground.

An important advantage of the novel switch mechanism A is that the actuating means 15 can be manually manipulated between its first and second positions without effecting the normal or ready position of the electromechanical means 20. The provision of the slot and pin connection between the actuator 21 and the link 65 enables the actuating means 15 to be pivotally moved between its first and second positions without affecting the vertical position of the link member with respect to the pivot axis 30a of the pivot pin 30. Although a slight downward camming movement of the link member 65 occurs during movement of the actuator 21 since it is necessary to displace the link 65 from the right or left portion of the recessed apex 73 in which it is disposed to the other portion of the apex 73, the spring 81 will immediately return the link 65 back to its previous position even though it will be disposed in the other portion of the recessed apex 73.

Another advantage of the switch mechanism A is that the link 65 is always biased toward the position in which it is vertically disposed above the pivot pin 30 by the spring and guide arrangement 80. This insures that the electromechanical means 20 is always properly positioned to effect movement of the actuator 21 from the position it is now in to the desired position in response to energization of the coil 60. This provides for a very positive and reliable switching operation. A further advantage is that only a single solenoid means is necessary to effect movement of the actuator in opposite directions between its positions. Additionally, by providing the righted in line 73 and the pivoted apex 74 of the cam slot 70 in conjunction with the spring and guide arrangement 80 insures that the electromechanical means 20 will always be returned or remain in its ready position, as shown in FIGS. 1 and 2, even though the switch mechanism A is subjected to vibration or shock loads.
whereby when said link member is biased toward a position in which it is disposed within one of said recess portions of said inverted V-shaped slot.

### References Cited

**UNITED STATES PATENTS**

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Date</th>
<th>Inventor(s)</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,966,285</td>
<td>7/1934</td>
<td>Deans</td>
<td>335—190</td>
</tr>
<tr>
<td>2,434,070</td>
<td>1/1948</td>
<td>Gross</td>
<td>335—190</td>
</tr>
<tr>
<td>2,922,861</td>
<td>1/1960</td>
<td>White</td>
<td>335—186</td>
</tr>
<tr>
<td>3,153,124</td>
<td>10/1964</td>
<td>Bury</td>
<td>335—186</td>
</tr>
</tbody>
</table>

BERNARD A. GILHEANY, Primary Examiner

H. BROOME, Assistant Examiner

U.S. Cl. X.R.