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D-80538 München (DE)(54) **Combined push-to-activate and rotary switch.**

(57) A switch housing for plural switches is formed of thermoplastic molded in a first stage with grooves or recesses. In a second stage molding process, the grooves are filled with platable thermoplastic which is subsequently plated with copper, nickel, or silver to provide conductive strips and exposed contact areas. A common switch actuator is slidably and rotatably mounted on the housing. Upon pushing the actuator is latched to actuate a switch; and, upon subsequent pushing the actuator is unlatched and the switch de-actuated. Upon rotation of the actuators, independently of the push-to-actuate movement, a second rotary switch is actuated. Both switches employ the two-stage molding and plating for forming integrally with the housing and the stationary contacts.

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BACKGROUND OF THE INVENTION

The present invention relates to low voltage switches and particularly to switches employed for automotive switching applications where it is desired to provide a push-to-actuate function for user control of certain convenience items or accessories. In certain automotive switching applications it has been deemed desirable to provide a rotary type switch action for ergonomic reasons, and to prevent confusion of the user as to which switch controls what function as among a group of switches.

In certain automotive switch applications, it has been desired to combine a push-to-actuate switch and a rotary switch function for controlling separate switching functions with a common actuator. Known switch designs for combining a push-to-actuate and rotary actuation have resulted in switches which are complicated in construction and costly to manufacture. The marketplace for automotive switches for mass-produced vehicles is quite competitive, so low manufacturing cost is required in order to maintain a competitive position in such a market.

Accordingly, it has been desired to provide a switch having a combined push-to-actuate and rotary movement for user control of separate switching functions, and to provide such a switch which is reliable when operated over a relatively high number of repeated actuations and is low in manufacturing cost.

SUMMARY OF THE INVENTION

The switch assembly of the present invention has a pushable actuator which is slidably mounted on the housing through a rotatable disc such that rotation of the actuator member causes the disc to rotate; and, pushing of the actuator without rotation effects sliding movement of a non-rotatable member. The non-rotatable member effects actuation of a latching member which effects push-to-actuate/push-to-deactuate functioning of a movable switching contact member. The movable switching contact member is in the form of a shorting bar which makes sliding contact with a pair of stationary contact members or strips. The stationary contact strips are formed of conductively plated thermoplastic material. The thermoplastic material is molded in two stages: a first stage of unplatable material forming the switch housing and having a recess provided therein, and a second stage which fills the recess with platable thermoplastic material which is subsequently plated on the exposed surface with conductive material to form the stationary contact strips. The two-stage molding of the housing with the contact surfaces subsequently formed by plating provides a low-cost technique for manu-

facturing the switching device.

The rotary switch member has at least one wiper type shorting bar contact thereon which wipes against a stationary set of contacts or strips formed by molding a first stage unplatable thermoplastic with a recess therein and a second stage platable thermoplastic which is subsequently plated after molding to provide the stationary contact surfaces. If desired, additional push-to-actuate only switching functions may be provided with additional latchable switches which are mounted on a common housing with the combined push-to-actuate and rotary switches.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of the switch assembly of the present invention, with portions of the cover broken away;

FIG. 2 is a section view, taken along section-indicating lines 2-2 of **FIG. 1**;

FIG. 3 is an enlarged view of a portion of **FIG. 2**;

FIG. 4 is a section view, taken along section-indicating lines 4-4 of **FIG. 3**; and

FIG. 5 is a section view, taken along section-indicating lines 5-5 of **FIG. 2**.

DETAILED DESCRIPTION

Referring to **FIGS. 1** and **2**, the switch assembly of the present invention is indicated generally at 10 as having a housing formed of a lower shell 12 and an upper shell or cover 14 received thereover and secured by any suitable fastening expedient as, for example, snap-locking tabs or plastic weldment. The lower housing shell 12 is formed with partitions or walls 16, 18 which form an electrical receptacle area 20 which is open to the exterior and is adapted for insertion of a plug or wiring harness connector therein. A plurality of electrical connector terminals 22, 24, 26, 28, 30, 31 extend through the partition or wall 18 into the receptacle area 20 and also through the interior side of wall 18 and are individually electrically connected, respectively, to stationary terminal strips denoted by reference numerals 32, 34, 36, 38, 40, 41, which are formed integrally with the housing shell 12, as will hereinafter be described in greater detail.

Referring to **FIG. 5**, each of the terminals 22 - 31 passes through partition 18 and one of the strips 32 - 41, and is soldered thereto for making internal connection within housing 12 to the components of the switching assembly 10.

Another partition or wall 42 is provided separately located in the housing shell 12, and has an aperture 44 provided therethrough. Aperture 44 has rotatably received therein a reduced diameter portion or shoulder 46 formed on a hub or boss 48,

which is provided preferably integrally formed on a rotatable arm 50. Hub 48 has formed centrally therethrough a bore 52 preferably having a polygonal shape in transverse section through which is received in guided free-sliding engagement therewith a plunger or rod 54 with conforming transverse section.

Rod 54 has one end thereof extending downwardly through hub 48, and received over and rotatably guided on one end of an actuator member 56. The actuator member 56 has its upper end freely rotatable in rod 54, but axially secured therein by any suitable expedient as, for example, integral snap-locking annular rib 57.

Referring to FIGS. 2, 3, and 4, the lower end of actuator 56 has a generally rectangular transverse section, and is slidably received in a groove 58 formed between two raised wall portions or lugs 60,62, which are integrally molded with the lower housing shell 12. Actuator 56 is retained in the groove 58 by a preferably metal cover plate 64,68 secured over the lugs 60,62 by tabs 66 crimped downwardly into grooves provided in the lugs 60,62. An aperture is provided in the metal cover 64 and is denoted by reference numeral 74, and has one end of a generally U-shaped wire latch member 70 received therein, with the opposite end of the U-shaped latch member 70 received in a cardioid shaped cam slot or groove 72 formed in the actuator 56. Actuator member 56 has a flange 73 provided adjacent the upper end thereof against which is received one end of a return spring 76, which biases the actuator 56 and plunger 54 in an upward or return direction.

Referring to FIG. 2, the upper end of plunger 54 has a user knob or button 78 provided thereon, which is slidably and rotatably received in aperture 80 formed in the upper housing shell 14.

In operation, the user may push the button from the position shown in dashed outline downwardly to the position shown in solid outline in FIG. 2; and, the latch member 70 is operative to maintain the actuator in the downward position. It will be understood that the upper end of the wire latch member 70 received through aperture 74 traverses in a slot 80 provided in the actuator 56 during the movement of the actuator 56.

Referring to FIGS. 2 and 4, the stationary contacts for the switch, indicated generally at 75, comprise a pair of conductive strips 82,84 are formed in the bottom of groove 58; and, a shorting bar or conductive strip 86 is mounted on the bottom of actuator 56 and slidably moved therewith for contacting the conductive strips 82,84. It will be understood that strips 82,84 are of differing lengths such that the shorting bar 86 makes contact with both strips when the actuator 56 is in the upward position shown in dashed outline of button 78 and the

shorting bar 86 makes contact with only one of the strips 82,84 when the actuator 56 is in the downward position represented by the solid outline of button 78 in FIG. 2.

In the presently preferred practice, the housing 14 is molded in two stages, a first stage of thermoplastic material having recesses 88,90 therein with the first stage molded material comprising the outline of the part for the lower housing shell 12. The first stage molded part is removed from the mold and inserted in a second stage mold wherein second stage platable thermoplastic material is injected to fill the grooves 88,90 with platable thermoplastic material. The two-stage molded part is then removed from the second stage mold and the platable thermoplastic material is plated with conductive material to form the strips 82,84.

Portions of the strips 82,84 are shown in FIG. 2, and are truncated, but it will be understood that the strips ultimately connect to one of the connector terminals, such as terminals 22 through 31.

The first stage of the molded thermoplastic material is preferably a blend of acrylonitrile butadiene styrene and polysulfone. One such material is available from Amoco Performance Products, Inc., 380 Grove Street, Ridgefield, Connecticut 06877, with manufacturer's designation 5-1000; other materials, however, may be employed. The second stage material comprising the platable resin, may be obtained from Mitsui Pathtek Corporation, 250 Metro Park, Rochester, New York 14626. In the presently contemplated practice, the conductive strips 82,84 may be formed of copper, nickel, or silver plated material. The second stage thermoplastic is preferably formed of polyether sulfone resin, and may be glass-reinforced, and contains a catalytic additive to facilitate plating.

Referring to FIGS. 1 and 2, the rotary switch indicated generally at 49 is shown with the rotatable arm 50 having a pair of conductive wipers 92,94 provided thereon which are preferably formed from a strip of copper alloy and may be attached by providing apertures in the strip and heat staking over pegs 96,98 provided on the undersurface of the wiper arm. The wipers 92,94 are thus electrically connected together to form a shorting bar. Upon rotation of the arm 50 in a clockwise direction from the position shown in FIG. 1, the wiper 92 sequentially makes contact between a common terminal strip 100 and a plurality of spaced discrete contact strips disposed in spaced-parallel arrangement therewith, and which are denoted by reference numerals 102,104,106, each of which is formed integrally with a conductive strip denoted, respectively, by 100',102',104',106'. It will be understood that the contacts 100,102,104,106 and their respective strips denoted by primed numerals are formed

integrally with the wall partition 42 in the same process and from the same materials as the strips 82,84 provided in the bottom of groove 58 for sliding actuator 56 of switch 49. It will be understood that the strips 100' through 106' are shown truncated in FIG. 1, but are ultimately each connected to a connector terminal, such as terminals 22 through 31,30.

In operation when button 78 and contact arm 50 are rotated in a clockwise direction to any of the contact positions corresponding to contacts 102, 104, or 106 a discrete switching function is effected for switch 75. In the illustrated embodiment, the push-to-latch, push-to-unlatch function of the button 78 which results in the making and breaking of a circuit between contact strips 82,84 of switch 49 is employed to engage or disengage a separate vehicle accessory such as a sentinel control for head-lamps.

Although individual contacts 102,104,106 are shown as wiped by wiper 92, it will be understood that alternatively a single resistive strip may replace contacts 102,104,106 as shown in dashed outline in FIG. 1 and denoted by reference numeral 108. The resistive strip 108 would thus render switch 49 operative. The strip 108 may be formed by etching resistive material on the conductive strip plated on the second stage molded thermoplastic.

With reference to FIG. 2, a pair of additional push-to-actuate switch buttons 108,110 are slidably mounted in the cover 14 for actuating individually push-to-actuate switches indicated generally at 112,114. It will be understood that the switches 112,114 are identical in construction and operation to the switch 75 described with respect to contact strips 82,84. The contact strips for switches 112,114 are similarly integrally molded in a two-stage molding process with the lower housing shell 12 in the identical manner as are contact strips 82,84. Switches 112,114 have their contact strips each similarly connected to one of the connector terminals such as terminals 20 - 31, but the conductive strips are omitted in the drawings for the sake of brevity. Switches 112,114 may be employed for any desired accessory control functions as, for example, front and rear window defogger circuits. It will be understood that although a single row of connector terminals 22,24,26,28,30,31 is illustrated in FIG. 2, a second may be disposed in spaced-parallel arrangement to the illustrated row.

The present invention thus employs a two-stage thermoplastic molding process to form discrete contact strips integrally with a switch housing in which the first step of molding provides the basic part outline with recesses formed therein; and, the second stage of molding fills the recesses with platable thermoplastic, which is subsequently plated to provide conductive strips and exposed

contact surfaces for switching. This construction provides a relatively low manufacturing cost. The switch actuator comprises a push-to-actuate, push-to-release slidable and rotatable member which passes through a rotary member having a pair of wipers thereon. The wipers contact stationary contact strips to provide rotary switching of individual circuits upon rotation of the actuator member; and, upon push-to-actuate movement, a second switch is actuated without actuation of the rotary switching mechanism.

Although the invention has hereinabove been described with respect to the illustrated embodiments, it will be understood that the invention is capable of modification and variation, and is limited only by the scope of the following claims.

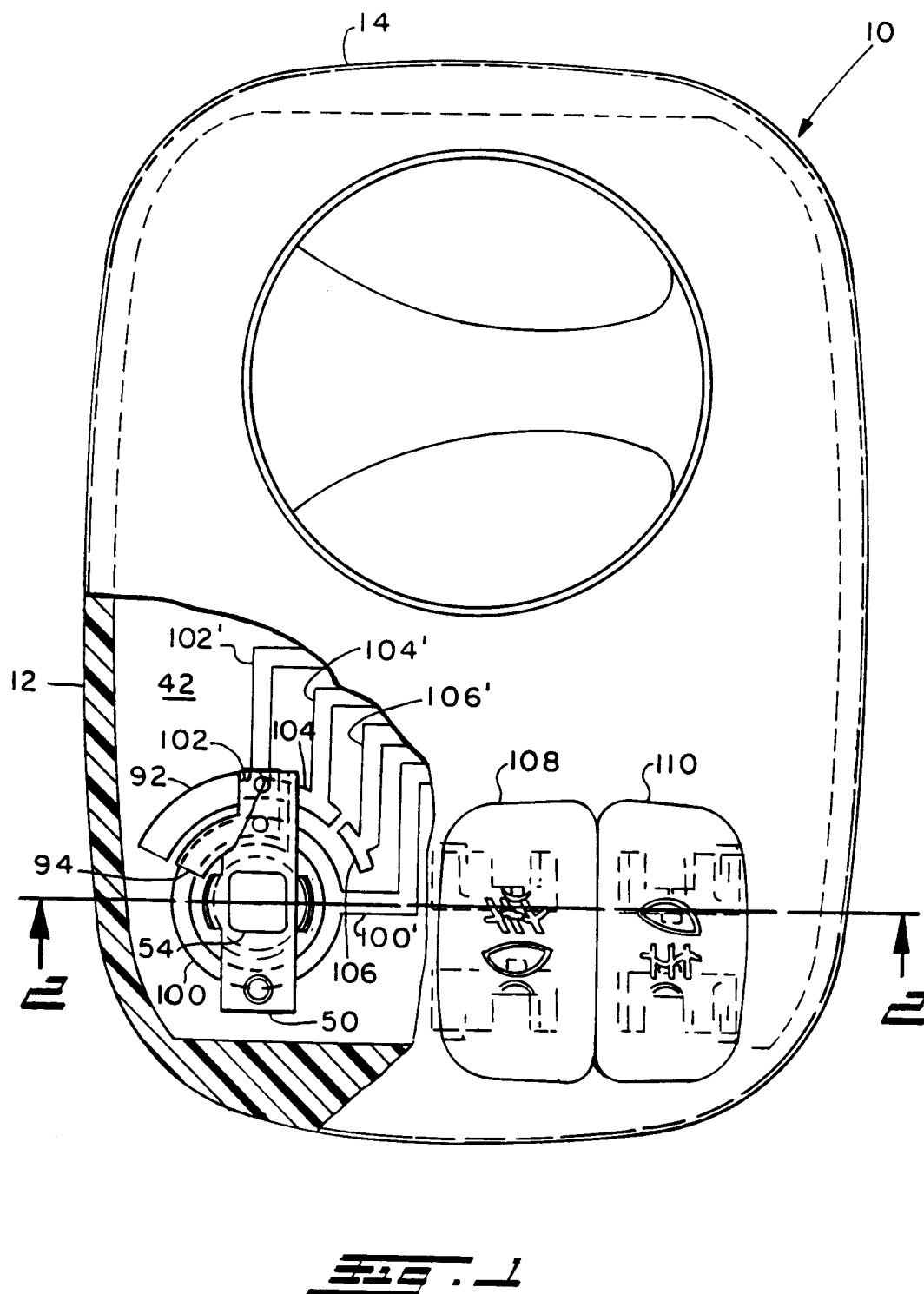
Claims

1. A switching assembly comprising:
 - (a) housing means;
 - (b) a user-movable actuator member mounted for sliding movement on said housing; and,
 - (c) latchable means connected to said actuator means and operable, upon movement to effect opening and closing a set of electrical contacts, said latchable means including conductive means formed of thermoplastic material having (i) a first stage molded portion having recessed areas therein, (ii) a second stage portion formed of platable thermoplastic molded in said recessed areas, with exposed surfaces and with conductive material plated on said exposed surfaces; said second stage portion defining a stationary switching contact; and,
 - (d) a movable contact operable to be slidably opened and closed against said stationary contact, in response to movement of said actuator means.
2. The assembly defined in claim 1, wherein said latchable means includes a cardioid shaped cam member.
3. The assembly defined in claim 1, wherein said actuator member is also rotatable and includes second rotatable electrical contact means, rotatable for effecting a second switching function, and said conductive means includes a second stationary contact switched by said second rotatable contact means.
4. The assembly defined in claim 1, wherein said actuator member is also rotatable and includes a second movable contact rotatable therewith and a resistive strip on said housing means

wiped by said second movable contact.

5. The assembly defined in claim 1, wherein said actuator member is also rotatable and includes a second movable contact rotatable therewith; and, said housing means includes a resistive strip formed by etching resistive material on a conductive strip and said strip is wiped by said second movable contact. 5
6. The switching assembly defined in claim 1, wherein said latchable means includes means operable to latch upon a first movement of said actuator in one direction and return thereof and operable to release upon a second movement of said actuator in said on direction and return thereof. 10 15
7. The switching assembly defined in claim 1, wherein said latchable means includes means biasing said actuator means in a certain direction. 20
8. The switching assembly defined in claim 1, wherein said actuator means is user-rotatable about an axis along the direction of said sliding movement; and, operative for a second rotary switching means responsive to said rotation of said switching means and including a member having said actuator means slidably received therethrough. 25 30
9. A switching assembly comprising:
 - (a) housing means;
 - (b) a user-pushable actuator member mounted for sliding movement on said housing means, said actuator member also rotatable about an axis oriented along the direction of said sliding movement; 35
 - (c) a first switch operable for actuation and deactuation in response to said sliding movement of said actuator member; 40
 - (d) latchable means operable to effect a push-to-actuate and push-to-deactuate sliding movement of said actuator member; and, 45
 - (e) a second switch having a switching member operable upon rotation of said actuator member to effect wiping movement of a movable contact with respect to a stationary contact, said switching member having a void therein with said actuator member slidably received therethrough. 50
10. The assembly defined in claim 10, wherein said latchable means includes a cardioid cam member. 55

11. The assembly defined in claim 10, wherein said housing means includes an integrally formed member defining said stationary contacts for said first and second switch comprising (i) a first stage molded thermoplastic material plated with conductive material, and (ii) a second stage unplated molded thermoplastic material supporting said first stage material, and defining said housing means.



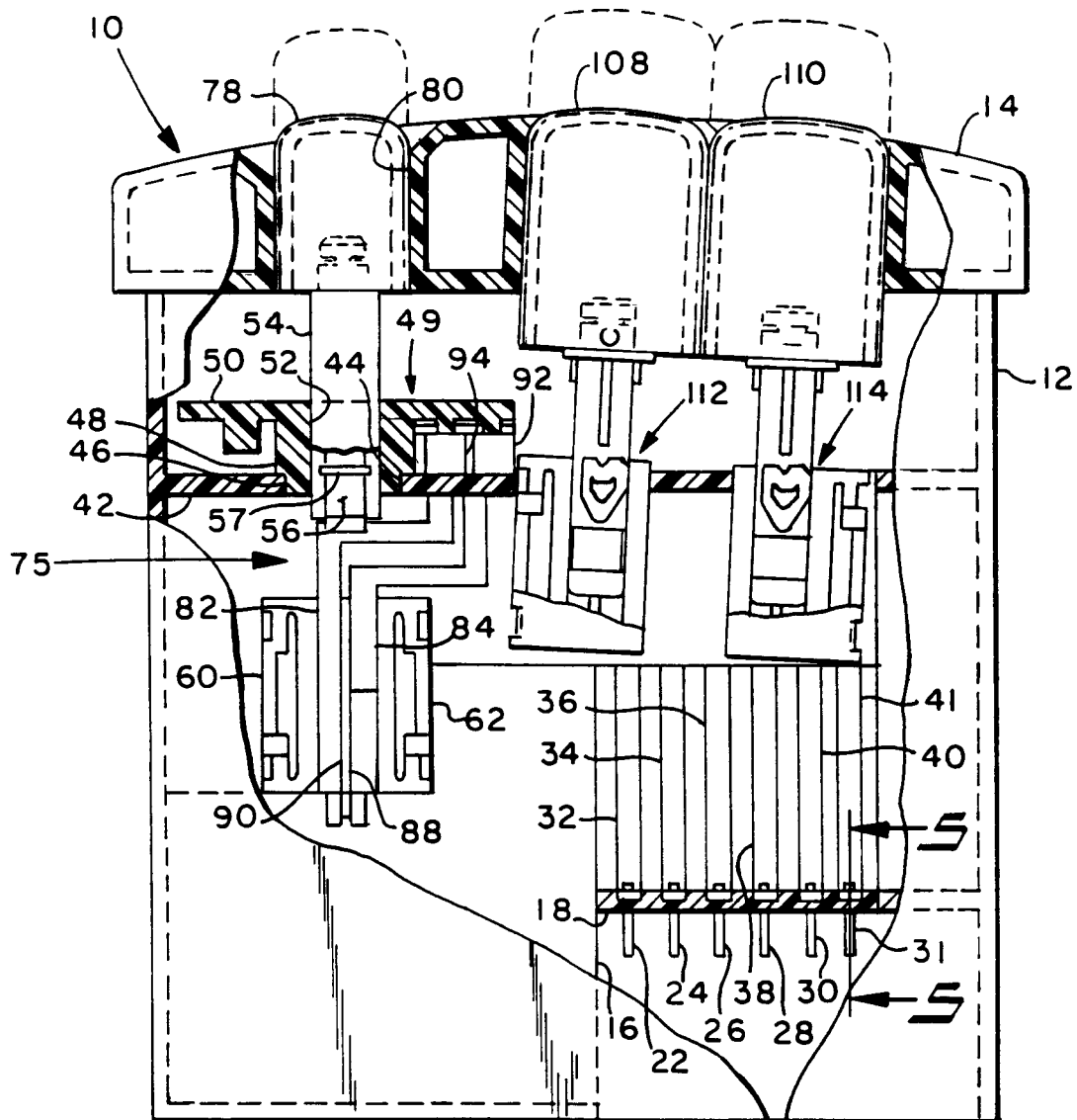


Fig. 2

