

Switch Assembly and Switch Arrangement

BACKGROUND OF THE INVENTION

(Field of the Invention)

The present invention relates to a switch assembly and also to a switch arrangement including the switch assembly and a frame structure for fitting the switch assembly to a support surface such as, for example, a switch box received in a housing wall.

(Description of the Prior Art)

Electric switches for selectively opening and closing an electric circuit are a popular item that can be seen everywhere. Houses we live in, factories, hospitals and other facilities have varying types of electric switches. As one of those switches, the switch has long been well known in which the operating button is pivoted to selectively turn a switch contact mechanism off or on such as disclosed in, for example, the Japanese Laid-open Patent Publication No. 63-301438.

According to the publication, the switch is generally in the form of a rectangular block in its outer appearance and is adapted to be installed in a mounting recess defined in a support surface such as, for example, a housing interior wall, by means of a mounting frame made of metal or synthetic resin. The switch is, after having been installed in the mounting recess, covered by an ornamental make-up plate with only the operating button exposed to the outside for the access thereto by a user.

In any event, mounting of the switch on the mounting frame is generally required preceding the mounting of the switch in the mounting recess in the support surface. For this purpose, the switch has at least one engagement nail protruding outwardly from each of opposite ends thereof and, on the other hand, the mounting frame having a generally rectangular mounting opening defined therein has a mating engagement groove or perforation defined in each of opposite inner side edges confronting the mounting opening. To mount the switch

on the mounting frame before the assembly is installed in the mounting recess in the support surface, for example, the housing interior wall, the switch is first mounted on the mounting frame by inserting it from rear into the mounting opening in the mounting frame until the engagement
5 nails are snugly engaged in the associated engagement grooves or perforations in the mounting frame.

The assembly of the mounting frame carrying the switch is subsequently installed in the mounting recess with the mounting frame bolted to the housing interior wall or a switch box installed within the
10 mounting recess, to thereby complete the mounting of the switch in the mounting recess with the operating button exposed to the outside. The ornamental make-up plate having defined therein a window of a size at least corresponding to an operating surface area of the operating button is subsequently fitted to the mounting frame with only an operating
15 surface region of the operating button exposed to the outside through the window.

In this prior art switch arrangement, it has been found that since the operating button is generally of a size smaller than the surface area of the window in the ornamental make-up plate, difficulty is often
20 encountered in turning the switch off or on.

Although the switch having the operating button of a size larger than the window in the ornamental make-up plate is currently available, complicated mounting procedures are required since the operating button of the larger size requires it to be fitted after the
25 mounting frame carrying the switch without the operating button has been mounted in the mounting recess and the ornamental make-up plate has subsequently been fitted to the mounting frame. In addition, since the operating button is fitted to the switch externally of the ornamental make-up plate, the operating button itself protrudes a
30 substantial distance outwardly from the plane of an outer surface of the

ornamental make-up plate, posing a problem associated with the aesthetic finish.

SUMMARY OF THE INVENTION

Accordingly, the present invention has been aimed at
5 substantially eliminating the above discussed problems and
inconveniences found with the prior art switches and switch
arrangements and is intended to provide an improved switch assembly
having the operating button which in an installed condition will not
protrude a substantial distance outwardly from the plane of the outer
10 surface of the mounting plate.

Another important object of the present invention is to
provide the improved switch assembly of the type referred to above,
which is effective to provide an aesthetically appealing appearance when
installed in the support surface.

15 In order to accomplish these and other objects of the present
invention, one aspect of the present invention is a switch assembly
which comprises a generally rectangular box-like switch housing having
a generally rectangular opening defined therein and also having its
interior divided into at least first and second terminal compartments
20 and at least one switch compartment intermediate between the first and
second terminal compartments. An actuator element having an upper
portion is pivotally accommodated within the switch compartment with
the upper portion exposed to the outside through the rectangular
opening, and is supported in the switch housing for angular movement
25 between two operative positions. The first and second terminal
compartments accommodate therein at least one first stationary
terminal member and at least one second stationary terminal member
having a fixed contact piece secured thereto. A first connector means
connected with the first stationary terminal member and a second
30 connector means connected with the second stationary terminal member

are also accommodated within the first and second terminal compartments for an external electric connection with external electric wires.

A movable contact member having a movable contact piece
5 secured thereto and electrically connected with the first stationary
terminal member is accommodated within the switch compartment for
pivotal movement between an engaged position, in which the movable
contact piece is engaged with the fixed contact piece to close a circuit
between the first and second stationary terminal members, and a
10 disengaged position in which the movable contact piece is disengaged
from the fixed contact piece to open the circuit. A generally elongated
spring element having upper and lower end portions retained
respectively by the actuator element and the movable contact member is
utilized to drive the movable contact member in response to the pivotal
15 motion of the actuator element between the operative positions.

The switch assembly also comprises a generally rectangular
operating button angularly movably mounted on the switch housing for
driving the actuator element between the operative positions, said
operating button having a width substantially equal to or equal to the
20 width of the switch housing, and at least one engagement nail formed at
each of opposite ends of the switch housing, said engagement nails on
the opposite ends of the switch housing being engageable with
corresponding engagements formed in a frame structure being utilized
to fit the switch assembly to a support surface through the frame
25 structure.

According to this structure, the switch assembly in the form
as provided with the operating button can be mounted in the frame
structure can be installed in the mounting recess and, therefore,
installation of the switch assembly to the support surface can easily be
30 accomplished. In addition, since the operating button does not protrude

so much outwardly from the plane of the outer surface of the ornamental make-up plate which will be fitted to the mounting frame as a final step of switch installation, the switch assembly of the present invention provide an aesthetically appealing appearance.

5 Preferably, the number of each of the first and second stationary terminal members is two, in which case the movable contact member comprises two movable contact bridges electrically connected with the two first stationary terminal members, respectively, and adapted to connect the two first stationary terminal members with the
10 two second stationary terminal members, respectively, when moved to the engaged position. Alternatively, the movable contact member may have an additional movable contact piece secured thereto and that one of the movable contact pieces is engageable with the fixed contact piece of one of the two second stationary terminal members when the movable
15 contact member is moved to the engaged position and the other of the movable contact pieces is engageable with the fixed contact piece of the other of the two second stationary terminal members when the movable contact member is moved to the disengaged position. If desired, the two first stationary terminal members and the two second stationary
20 terminal members may be employed in combination with two elongated spring elements, in which case the movable contact member comprises two movable contact bridges electrically connected with the two first stationary terminal members, respectively.

 Also preferably, a light emitting position indicator
25 electrically connected between the first and second stationary terminal members may be employed in combination with a prism carried by the operating button with a portion thereof positioned in a window in the operating button. This position indicator may comprise a printed circuit board having a light emitting element mounted thereon and
30 contact elements one for each of the first and second stationary terminal

members, said contact element being electrically connected with a corresponding terminal piece formed on an undersurface of the printed circuit board. The printed circuit board may be carried by the switch housing with the contact elements resiliently held in contact with
5 respective portions of the first and second stationary terminal members.

Alternatively, the position indicator may comprise a mounting plate having a light emitting element mounted thereon and also a terminal piece protruding outwardly from the mounting plate and electrically connected with the light emitting element, and a resistor
10 having one end connected electrically with the light emitting element and the opposite end electrically coupled with the spring element.

The switch assembly may have the switch housing having four corner areas removed by cutting in a direction heightwise thereof.

In such case, the two switch assemblies of an identical construction can
15 be accommodated snugly within a known switch box of a generally cylindrical configuration with no space or clearance required between those switch assemblies.

Specifically, the switch housing preferably comprises a switch lid of a generally rectangular cap-like configuration and a switch casing of a generally rectangular cup-like configuration. In such case,
20 the switch lid has a plurality of anchor legs each having an anchor hole defined therein, and the switch casing has a corresponding number of anchor protuberances formed therein so as to protrude laterally outwardly therefrom. The protuberances can be engaged in the
25 corresponding anchor holes in the anchor legs when the switch lid is mounted on the switch casing to thereby unite the switch lid and the switch casing together. If desired, each of said protuberances may have an inclined face for allowing the corresponding anchor leg to slide thereover as the switch lid is mounted on the switch casing.

30 Alternatively, the switch lid may have a pair of bearing lugs

formed integrally therewith so as to protrude upwardly therefrom in face-to-face relation and positioned on respective sides of the rectangular opening, each of said bearing lugs having a bearing groove defined therein. In this case, the actuator element has pivot shafts formed
5 integrally therewith so as to protrude laterally outwardly therefrom in respective directions opposite to each other, said pivot shafts being received in said bearing grooves in the bearing lugs to allow the actuator element to undergo a seesaw motion about a common axis aligned with said pivot shafts. In this switch assembly, mating dowels may be
10 formed integrally with the respective bearing lugs at a location within the associated bearing grooves and below the pivot shafts.

The switch assembly of the type in which the operating button pivots at one end thereof requires an actuator rod to be formed integrally therewith so that a lower end of the actuator rod is engaged
15 with the actuator element to drive the latter as the operating button is pivoted at one end thereof relative to the switch lid. In this case, a pair of bearing recesses are defined in the switch lid at a location adjacent one of opposite ends thereof and that the operating and that the operating button includes bearing pins formed integrally therewith so as
20 to protrude inwardly in respective directions confronting with each other in alignment with each other, said operating button being mounted on the switch lid with the bearing pins pivotally received in the bearing recess. Also, the operating button may have at least one engagement projection formed integrally therewith so as to protrude towards the
25 switch lid and the switch lid has a hook formed integrally therewith so as to protrude towards the operating button, said engagement projection being engaged with the hook to restrict the angle of pivot of the operating button.

According to another aspect of the present invention, the
30 latter also provides a switch arrangement comprising at least one switch

assembly of the structure discussed above, a generally rectangular mounting frame having a generally rectangular mounting opening defined therein for supporting the switch assembly, and a generally rectangular ornamental make-up frame having a substantially rectangular window defined therein. The mounting frame includes a rigid beam formed integrally therewith so as to extend along one of opposite side edges of the mounting frame adjacent the rectangular opening and a flexible beam formed integrally therewith so as to extend along the other of the opposite side edge of the mounting frame adjacent the rectangular opening, each of said rigid and flexible beams having at least one engagement groove defined therein for receiving the engagement nail. In this arrangement, the switch assembly is mounted in the rectangular opening with the operating button exposed to the outside through the rectangular window and with the engagement nails received within the engagement grooves in the rigid and flexible beams.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become readily understood from the following description of preferred embodiments thereof made with reference to the accompanying drawings, in which like parts are designated by like reference numeral and in which:

Fig. 1 is an exploded view of a switch assembly according to a first preferred embodiment of the present invention;

Figs. 2A and 2B are top plan and side views of the switch assembly shown in Fig. 1;

Fig. 3 is a longitudinal sectional view, on an enlarged scale, of the switch assembly shown in Fig. 1;

Fig. 4 is a perspective view showing a mounting frame for supporting the switch assembly and an ornamental make-up plate used to cover up the switch assembly supported by the mounting frame;

Fig. 5 is a view similar to Fig. 4, showing the mounting

frame and the make-up plate which are turned upside down;

Figs. 6A to 6C is schematic side views showing the sequence of mounting of the switch assembly onto the mounting frame;

Fig. 7A is a top plan view of the switch assembly mounted
5 on the mounting frame;

Fig. 7B is a longitudinal sectional view of the mounting frame showing the manner in which the switch assembly is mounted as viewed in a direction endwise thereof;

Fig. 7C is a longitudinal sectional view of the mounting
10 frame showing the manner in which the switch assembly is mounted as viewed in a direction sidewise thereof;

Figs. 8A to 8C are views similar to Figs. 7A to 7C, respectively, showing a modified form of the mounting frame;

Fig. 9 is a schematic diagram showing how the two switch
15 assemblies are arranged when they are mounted on a generally cylindrical switch box;

Figs. 10A to 10C are views similar to Figs. 7A to 7C, respectively, showing how the three switch assemblies are arranged in the mounting frame;

20 Figs. 11A to 11C are views similar to Figs. 7A to 7C, respectively, showing how the two switch assemblies are arranged in the mounting frame;

Figs. 12A to 12C are views similar to Figs. 7A to 7C, respectively, showing an operating button of a size that may be used
25 where the single switch assembly is mounted on the mounting frame of a type capable of accommodating up to three switch assemblies;

Fig. 13A to 13C are views similar to Figs. 7A to 7C, respectively, showing the operating button of a size that may be used where the three switch assemblies are mounted on the mounting frame;

30 Figs. 14 to 21 are views similar to Fig. 1, showing the switch

assembly according to second to ninth preferred embodiments of the present invention, respectively;

Figs. 22A to 22C are top plan, side and end views of the switch assembly of Fig. 21, respectively;

5 Fig. 23 is a top plan view of a switch lid used in the switch assembly of Fig. 21;

Fig. 24 is a top plan view of a switch casing used in the switch assembly of Fig. 21;

10 Fig. 25 is a perspective view, on an enlarged scale, showing the manner in which the switch lid carrying the operating button is mounted onto the switch casing to complete the switch assembly of Fig. 21;

Fig. 26 is a perspective view showing the operating button used in the switch assembly shown in Fig. 21, said operating button
15 being shown in an inverted fashion;

Fig. 27 is a perspective view, on an enlarged scale, showing the manner in which the operating button is mounted onto the switch lid which has been mounted on the switch casing to complete the switch assembly of Fig. 21;

20 Fig. 28 is a schematic side sectional view of the switch assembly of Fig. 21; and

Figs. 29 and 30 are side sectional views, on an enlarged scale, of the switch assembly of Fig. 21 in different operative positions, respectively.

25 DETAILED DESCRIPTION OF THE EMBODIMENTS

A switch arrangement according to a first preferred embodiment of the present invention will be described with reference to Figs. 1 to 13.

The switch arrangement includes a switch assembly which
30 is generally identified by A₁ and which comprises a toggle switch module

1 including a generally rectangular box-like switch casing 1a made of a
thermosetting resin such as, for example, urea resin, and opening
upwardly as viewed particularly in Figs. 1 and 3 and a generally
rectangular switch lid 1b made of a thermoplastic resin such as, for
5 example, polybutylene terephthalate and adapted to be mounted onto
the casing 1a to substantially close the upper opening of the casing 1a.
The lid 1b has two short sides and two long sides transverse to the short
sides and has two parallel anchor legs 10 formed integrally therewith so
as to extend downwardly from each long side of the lid 1b. The anchor
10 legs 10 have an anchor hole 10a defined therein so that when the lid 1b
is mounted onto the switch casing 1a with the paired anchor legs 10
sliding along associated outer side faces of the switch casing 1a, corres-
ponding anchor protuberances 2 formed two on each outer side faces of
the switch casing 1a so as to protrude outwardly therefrom are engaged
15 in the respective anchor holes 10a to thereby unite the switch casing 1a
and the switch lid 1b together.

By the reason which will subsequently be described, each of
the anchor protuberances 2, paired on each outer side face of the switch
casing 1a, has an upper edge which is inclined downwardly as viewed in
20 Figs. 1 and 2B, the downwardly inclined upper edge of each anchor
protuberance 2 defining a guide face 2a.

The switch casing 1a and the switch lid 1b are united
together to complete the toggle switch module 1 in a manner which will
now be described. Assuming that the switch lid 1b is mounted over the
25 switch casing 1a with the anchor legs 10 aligned with the associated
anchor protuberances 2, and as an external pushing force is applied to
the anchor lid 1b to urge the latter towards the switch casing 1a, the
anchor legs 10 expand outwardly against their own resiliency while
sliding along the guide faces 2a of the anchor protuberances 2.
30 Continued application of the external pushing force to the switch casing

1b results in slide of the anchor legs 10 over the associated anchor protuberances 2 and the anchor protuberances 2 consequently trapped into the respective anchor holes 10a as the anchor legs 10 restore to the original shape by the action of their own resiliency. In this way, the
5 switch casing 1a and the switch lid 1b are united together to complete the toggle switch module 1.

Although not essential, but if so desired to facilitate guiding of the switch lid 1b onto the switch casing 1a, the opposite outer side faces of the switch casing 1a may have a guide rib 7 formed integrally
10 therewith at a location between the paired anchor protuberances 2 on each outer side face, which guide rib 7 is snugly positioned between the paired anchor legs 10 when the switch casing 1a and the switch lid 1b are united together.

As best shown in Figs. 1 to 3, the switch lid 1b has an
15 actuator block 30 mounted thereon for pivotal movement, or a seesaw motion in the illustrated embodiment, about a transverse pivot axis defined so as to extend transverse to the longitudinal sense of the switch assembly A₁ as will now be described. The actuator block 30 is made of a thermosetting resin such as, for example, urea resin and is of a
20 generally rectangular box-like configuration opening downwardly. This actuator block 30 includes a rectangular top wall, end walls extending downwardly from the top wall and side walls also extending downwardly from the top wall so as to lie transverse to the end walls. Each of the side walls of the actuator block 30 have a generally elongated pivot strip
25 31 positioned intermediate of the length of the rectangular actuator block 30 and formed integrally therewith so as to protrude laterally outwardly a slight distance therefrom and, also, so as to extend in a direction widthwise of the respective side wall. One end of the pivot strip 31 on each side wall, which is opposite to the bottom opening of the
30 actuator block 30, is so tapered as to provide an apex which functions in

a manner as will become clear from the subsequent description.

As best shown in Fig. 3, the actuator block 30 also has a tubular bearing 32 formed integrally with the top wall thereof so as to extend downwardly, into which an elongated coil spring 25 is partly
5 inserted. As will become clear from the subsequent description, the elongated coil spring 25 forms a part of a toggle switch mechanism encased within the switch casing 1a and is used to drive a generally U-shaped movable contact bridge 24, which also forms another part of the toggle switch mechanism, in response to a seesaw motion of the actuator
10 block 30. For this purpose, when the switch lid 1b is united together with the switch casing 1a in the manner hereinbefore described, the coil spring 25 received in the tubular bearing 32 integral with the actuator block 30 extends downwardly into the interior of the switch casing 1a and is received in the movable contact bridge 24.

15 Referring to the switch lid 1b, this switch lid 1b has a rectangular opening 11 defined therein, leaving two parallel end bars and two parallel side bars having the respective paired anchor legs 10 formed integrally therewith. The two parallel side bars are formed integrally with respective bearing lugs 12 on one side opposite to and
20 substantially intermediate between the paired anchor legs 10 so as to protrude upwardly. Respective inner surfaces of the side bars of the switch lid 1b are formed with bearing grooves 12a for receiving the associated pivot strip 31 integral with the actuator block 30. Thus, it will readily be seen that the actuator blocks 30 is received within the
25 rectangular opening 11 in the switch lid 1b with the pivot strips 31 inserted from below into the associated bearing grooves 12a in the bearing lugs 12.

In order for the actuator block 30 to undergo the seesaw motion about the transverse pivot axis, each of the bearing grooves 12a
30 has a width greater than the width of the respective pivot strip 31. On

the other hand, each bearing groove 12a in the respective bearing lug 12 integral with the switch lid 1b is of a shape generally similar to the shape of an inverted figure of "U", the bottom of which is inwardly beveled to loosely receive the apex of the corresponding pivot strip 31.

5 Accordingly, the transverse pivot axis about which the actuator block 30 undergoes the seesaw motion is defined by the imaginary transverse line connecting together respective points of contact between the apexes of the bearing strips 31 and the bevelled bottoms of the bearing grooves 12a.

10 Although not essential according to a broad aspect of the present invention, means is provided to avoid any possible separation from the switch lid 1b which would otherwise take place when the switch lid 1b is removed from the switch casing 1a. For this purpose, each of the pivot strips 31 integral with the actuator block 30 has a shoulder 31a
15 formed integrally therewith and positioned a distance downwardly from the apex thereof. The shoulders 31a on the respective pivot trips 31 are, once the actuator block 30 has been received in the rectangular opening 11 of the switch lid 1b with the pivot strips 31 loosely received within the bearing grooves 12a, engaged with mating dowels 12b each formed
20 integrally with the respective bearing lug 12 and positioned within the associated bearing groove 12a.

The toggle switch mechanism encased within the switch casing 1a will now be described with particular reference to Figs. 1 and 3.

In view of electrical component parts forming the toggle switch
25 mechanism are accommodated within the switch casing 1a, the latter is preferably made of urea resin since the urea resin has an excellent resistance to tracking. The interior of the switch casing 1a is divided by partition walls into two terminal chambers 3, adjacent the opposite ends of the switch casing 1a, and a switch chamber 4 positioned intermediate
30 between the terminal chambers 3 and accommodating the movable

contact bridge 24 therein. Opposite end portions of the bottom wall of the switch casing 1a that are aligned with the terminal chambers 3 are formed with respective pairs of insertion holes 5 and also with respective access slots 6. Each access slots 6 is utilized to receive a screw driver or the like took to displace a release button 27 within the respective terminal chamber 3 when an electric wire inserted into such terminal chamber 3 through one of the insertion holes of the associated pair is desired to be removed as will be described later.

Referring particularly to Fig. 3, each of the terminal chambers 3 accommodates therein a so-called quick-connect electrical terminal assembly including a first or second stationary terminal member 20 or 21, first or second pair of lock springs 26 and the release button 27. The quick-connect electrical terminal assembly referred to above is well known in the art and is of a design wherein electric connection of an electrical wire with a terminal element can be accomplished merely by inserting the wire end into the insertion hole and disconnection thereof from the terminal element can be accomplished merely by driving a release button while pulling the electrical wire outwardly.

In this quick-connect electric terminal assembly within each of the terminal chambers 3, the first stationary terminal member 20 is of a shape generally similar to the shape of an inverted figure of "U" and is prepared from a generally rectangular sheet metal. This first stationary terminal member 20 is of one-piece structure including a pair of terminal legs 20a that occupy one of opposite arms of the shape of "U" and spaced a distance corresponding to the span between the insertion holes 5 of the associated pair; an upright terminal wall 20b that occupy the other of the arms of the shape of "U" and extend substantially parallel to the terminal legs 20a, and an elongated intermediate terminal tongue 20c protruding outwardly from a free edge of the

terminal wall 20b and positioned intermediate of the width of the terminal wall 20b so as to extend into the switch chamber 4 along the bottom wall of the switch casing 1a as clearly shown in Fig. 3.

Each of the lock springs 26 of the first pair that is used in association with the first stationary terminal member 20 is in the form of a generally oblong, elastic metal plate and is shaped to have a flattened, generally C-shaped body 26c and contact legs 26a and 26b defined by opposite ends of the elastic metal plate and extending generally parallel to each other in a fashion substantially upwardly inclined relative to the C-shaped body 26c. This lock spring 26 is accommodated within a cavity defined in the first stationary terminal member 20 with the parallel contact legs 26a and 26b positioned in contact with, or spaced a slight distance separated from, a corresponding one of the terminal legs 20a so that when an electric wire (not shown) is inserted into the respective terminal chamber 3 through the associated insertion hole 5, the parallel contact legs 26a and 26b are forced to bend towards the C-shaped body 26c against their own resiliency to permit the inserted wire end to be elastically clamped between the parallel contact legs 26a and 26b and the corresponding terminal leg 20a.

The other of the lock springs 26 of the first pair is also accommodated within the cavity defined in the first stationary terminal member 20, but is interposed between the upright terminal wall 20b and the other of the terminal legs 20a, and functions in a manner substantially similar to that described above.

On the other hand, the second stationary terminal member 21 is of a shape generally similar to the shape of an inverted figure of "U" and is similarly prepared from a generally rectangular sheet metal. This second stationary terminal member 21 is of one-piece structure including a pair of terminal legs 21a that occupy one of opposite arms of the shape of "U" and spaced a distance corresponding to the span

between the insertion holes 5 of the associated pair; an upright terminal wall 21b that occupy the other of the arms of the shape of "U" and extend substantially parallel to the terminal legs 21a; and an elongated intermediate terminal tongue 21c lanced or slotted so as to raise
5 outwardly from the upright terminal wall 21b and extend generally parallel to the upright terminal wall 21b while occupying a position within the switch chamber 4 as clearly shown in Fig. 3.

In a manner similar to that described in connection with the first stationary terminal member 20, the second stationary terminal
10 member 21 also accommodate therein the lock springs 26 of the second pair. It is to be noted that the lock springs 26 of the first and second pairs are all identical in construction and shape.

In this quick-connect electric terminal assembly, the wire end once inserted into the terminal chamber 3 through the respective
15 insertion hole 5 to establish an electric circuit between the electrical wire and the first or second stationary terminal member 20 or 21 will not be removed out of the switch chamber with no difficulty. This is partly because as clearly shown in Fig. 3, the parallel contact legs 26a and 26b of each lock spring 26 extend slantwise from the corresponding C-shaped
20 body 26c in a direction conforming to the direction of insertion of the wire end and partly because once the wire end has been inserted with the wire end urged by the resiliency of the parallel contact legs 26a and 26b against the terminal leg 20a or 21a, the tip of at least one of the contact legs, for example, the tip of the contact leg 26a "bites" the wire
25 end to resist against a pulling force which would be applied to the electrical wire during removal of the wire end out of the terminal chamber 3.

The release button 27 accommodated within each of the terminal chambers 3 is so positioned in alignment with the associated
30 access slot 6 that when the electric wire once inserted into the terminal

chamber 3 to establish an electric circuit between the electrical wire and the first or second stationary terminal member 20 or 21 is desired to be removed out of the switch chamber and, for this purpose, the screw driver or the like tool is inserted into the access slot 6, the release button
5 27 can be shifted upwardly as viewed in Fig. 3 with its lateral wings 27a slidably pushing the contact legs 26a of the lock springs 26 of the first or second pair to urge such contact legs 26a to set backwardly against their own resiliency and then to separate away from the associated terminal legs 20a or 21a. Accordingly, once the contact legs 26a are so urged
10 against their own resiliency, the inserted wire end can readily be pulled out of the switch chamber to disconnect the electrical wire from the switch assembly.

The movable contact bridge 24 is made up of a pair of arms connected at one end with each other by means of a base to represent a
15 generally U-shaped configuration. To ensure a mobility of the movable contact bridge 24 while maintaining a persistent electrical contact between the movable contact bridge 24 and the intermediate terminal tongue 20c, a free end of the intermediate terminal tongue 20c is bent to define a raised contact area 20d of a shape generally similar to the shape
20 of an inverted figure of "V". This movable contact bridge 24 is accommodated within the switch chamber 4 with the base thereof resting on and held in contact with the raised contact area 20d of the intermediate terminal tongue 20c integral with the first stationary terminal member 20. Thus, it will readily be seen that the movable contact bridge 24
25 resting on the raised contact area 20d has a propensity to tilt in either direction about the raised contact area 20d.

Since the toggle switch module 1 in the illustrated embodiment is in essence of a single-pole single-throw switch design, the first and second stationary terminal members 20 and 21 are electrically
30 connected together by means of the movable contact bridge 24 depending

on the position of the latter. Specifically, in an assembled condition of the toggle switch module 1, the end of the coil spring 25 opposite to the actuator block 30 is received within a U-shaped cavity in the movable contact bridge 24 that is delimited by the arms and base of the movable contact bridge 24 with the coil spring 25 held in a compressed state. Fig. 3 illustrates the condition in which the switch lid 1b is pivoted to an ON position about the transverse pivot axis, in which condition the movable contact bridge 24 is leftwards as viewed therein with the left arm of the movable contact bridge 24 held in tight contact with the intermediate terminal tongue 21c integral with the second stationary terminal member 21, thereby completing a circuit between the first and second stationary terminal members 20 and 21 by way of the movable contact bridge 24.

However, when the switch lid 1b is pivoted to an OFF position about the transverse pivot axis in a direction counter to the angular movement towards the ON position, the movable contact bridge 24 is toggled so as to tilt rightwards about the raised contact area 20d with the opposite arm thereof brought into a position adjacent to the upright terminal wall 20b integral with the first stationary terminal member. In this condition, the arm of the movable contact bridge 24 which has been engaged with the intermediate terminal tongue 21c is separated from the intermediate terminal tongue 21c and, therefore, the circuit between the first and second stationary terminal members 20 and 21 is opened. It is to be noted that respective portions of the intermediate terminal tongue 21c and the adjacent arm of the movable contact bridge 24, which are brought into engagement with each other when the toggle switch module 1 is switched on, are provided with a contact piece 28 and 29 to ensure a persistent electrical contact therebetween.

Also, to restrict the angular movement of the movable

contact bridge 24 about the raised contact area 20d, the opposite arms of the movable contact bridge 24 are formed with respective pairs of lateral wings 24a protruding laterally outwardly therefrom as shown in Fig. 1 and engageable, one pair at a time depending on the position of the movable contact bridge 24, with mutually confronting ribs 4a that are formed integrally with opposite side walls of the switch casing 1a so as to protrude into the switch chamber 4 and spaced from each other a distance sufficient to loosely accommodate the movable contact bridge 24 therebetween.

10 The switch assembly also comprises a generally rectangular operating button 40 detachably mounted externally on the actuator block 30. In accordance with the present invention, this operating button 40 is of a size having a width equal to or substantially equal to that of at least the switch lid 1b or that of the toggle switch module 1.

15 The operating button 40 is formed of a thermoplastic resin such as, for example, ABS resin into a generally cap-like configuration opening downwardly towards the actuator block 30 as clearly shown in Fig. 3. The operating button 40 includes a substantially rectangular touch panel 40c and a similarly rectangular-sectioned peripheral wall lying

20 perpendicular to the touch panel 40c and made up of opposite end wall segments 40d and 40e and opposite side wall segments 40f and 40g.

 An inner surface of the touch panel 40c confronting the actuator block 30 has anchor hooks 41a and 41b formed integrally therewith so as to extend transverse thereto and spaced from each other

25 a distance corresponding to the length of the top wall of the actuator block 30 so that when the operating button 40 is capped onto the actuator block 30 with the inner surface thereof held in contact with the top surface of the actuator block 30, the anchor hooks 41a and 41b are engaged with mating engagements 33a and 33b, formed integrally with

30 the respective end walls of the top wall of the actuator block 30 so as to

protrude outwardly therefrom, generally in a handshake fashion.

The opposite side wall segments 40f and 40g of the operating button 40 is of a shape having a lower side edge so beveled at an intermediate portion outwardly as to protrude towards the switch casing 1a, the thickness of that intermediate portion of each side wall segment 40f and 40g being greater than that at each end of such side wall segment 40f and 40g. Although not shown, an inner surface area of that intermediate portion of each side wall segment 40f and 40g is inwardly depressed or grooved in a shape sufficient to accommodate the respective bearing lug 12 integral with the switch lid 1b when the operating button 40 is capped onto the actuator block 30. As best shown in Fig. 2A, one end of the touch panel 40c has a generally oval-shaped indicium, for example, protuberance 43 that provides an visual indication of one of the operating states (either ON or OFF) of the toggle switch module 1 and, hence, the switch assembly A₁.

In the structure described above, assuming that the operating button 40 together with the actuator block 30 assumes one of the tilt positions, for example, the ON position as shown in Fig. 3, application of a finger pressure to one of the opposite ends of the operating button 40 remote from the indicium 43 on the touch panel 40c results in the operating button 40 brought to the OFF position, accompanied by the movable contact bridge 24 having been toggled to tilt rightwards as viewed in Fig. 3. With the movable contact bridge 24 tilted rightwards, the contact piece 29 rigid with the movable contact bridge 24 is disengaged from the intermediate terminal tongue 21c integral with the second stationary terminal member 21 to thereby open a circuit between the first and second stationary terminal members 20 and 21.

Even though the present invention makes use of the operating button 40, the overall height of the switch assembly A₁ as

measured from the bottom of the switch casing 1a to an outer surface of the touch panel 40c of the operating button 40 can remain substantially the same as that of the prior art similar switch assembly wherein no operating button is employed and the actuator block, similar to the actuator block 30, serves as an operating button. In other words, while the position of the transverse pivot axis about which the actuator block 30 undergoes the seesaw motion remains substantially the same as that in the prior art similar switch assembly, and in order to render the overall height of the switch assembly A_1 of the present invention to be substantially the same as that of the prior art similar switch assembly, the operating button 40 is so designed and so configured as to be capped deep onto the actuator block 30 with the bearing lugs 12 accommodated deep inside the operating button 40. Accordingly, this design is particularly advantageous in that even when the switch assembly A_1 of the present invention is installed on, for example, a housing interior wall, a portion of the switch assembly A_1 that protrudes outwardly from the housing interior wall, that is, the operating button 40 will not deteriorate the pleasing appearance of the switch assembly A_1 since it does not unnecessarily protrude outwardly from the plane of the housing interior wall.

For the reason as will become clear later, each of the opposite end bars of the switch lid 1b has a bank 14 formed integrally therewith so as to extend widthwise of the switch lid 1b and as to protrude a slight distance upwardly therefrom. This bank 14 on each end bar of the switch lid 1b is formed integrally with a pair of nails 13 protruding outwardly therefrom, an upper surface 13a of each nail 13 being upwardly inclined to continue to the top of the respective bank 14.

A mounting frame B and an ornamental make-up plate C with which the switch assembly A_1 of the present invention is utilized at the site of installation will now be described with particular reference to

Figs. 4 to 7. The mounting frame B referred to above is utilized to support the switch assembly A₁ on and within a known switch box that is generally embedded in a mounting recess defined in, for example, the housing interior wall. The ornamental make-up plate C referred to
5 above is utilized to cover up the mounting frame B and any other portion of the switch assembly A₁ than the touch panel 40c of the operating button 40 to thereby provide an aesthetically appealing appearance.

The mounting frame B is preferably made of a thermoplastic resin such as, for example, ABS resin, or a thermosetting resin of a kind
10 having an elasticity comprises, as best shown in Figs. 4 and 5, a generally rectangular flattened mounting framework 51 having a rectangular mount opening 52 defined therein, thereby leaving a pair of side plates 53a and 53b opposite to each other and a pair of end plates 60a and 60b opposite to each other and lying perpendicular to the side
15 plates. This rectangular mounting framework 51 has a rigid beam 54 and a flexible beam 55 formed along and positioned inwardly of the respective side plates 53a and 53b in opposition to each other with the rectangular mount opening 52 intervening therebetween. The flexible beam 55 is spaced a slight distance inwardly from the side plate 53b, but
20 is integrated together therewith by means of opposite end connections 56 each extending between one of opposite ends of the flexible beam 55 and the adjacent end plate 60a and 60b. As will become clear from the subsequent description, the rigid and flexible beams 54 and 55 are deformable relative to the adjacent side plates 53a and 53b although the
25 mounting framework 51 is of one-piece construction including those rigid and flexible beams 54 and 55.

A narrow longitudinal gap between the flexible beam 55 and the adjacent side plate 53b is divided into a plurality of, for example, three, slots 58a, 58b and 58c by means of two connecting ribs 57 that
30 connect the flexible beam 55 and the adjacent side plate 53b while

traversing the longitudinal gap. It is to be noted that outer two slots 58a and 58c positioned on respective sides of the intermediate slot 58b is generally L-shape to extend not only along the side plate 53b, but also along the corresponding end of the flexible beam 55 and, also, the
5 corresponding end connection 56. In addition, to facilitate elastic deformation of the flexible beam 55, elongated slots 59 are formed in the side plate 53b in register with the respective connecting ribs 57, but parallel to any one of the slots 58a to 58c.

Each of the rigid and flexible beams 54 and 55 is formed
10 with a row of six engagement grooves 54a or 55a defined in an inner surface thereof confronting the rectangular mount opening 52 at an equally spaced relation to each other in a direction longitudinally thereof, the neighboring engagement grooves 54a or 55b being spaced a distance equal to the distance between the nails 13 integral with the switch lid 1b
15 so that when the switch assembly A₁ is mounted in the rectangular mount opening 52 in the mounting framework 51 of the mounting frame B with the operating button 40 exposed to the outside, the opposite pairs of the nails 13 can be snugly received in the respective pairs of the engagement grooves 54a and 55a.

20 Considering that the space between the inner surfaces of the respective rigid and flexible beams 54 and 55 is of a distance substantially equal to or slightly greater than the length of the switch lid 1b and, hence, the length of the toggle switch module 1, and in order for the opposite pairs of the nails 13 to be smoothly received within the
25 associated pairs of the engagement grooves 54a and 55a during the mounting of the toggle switch module 1 onto the mounting framework 51, the rigid and flexible beams 54 and 55 have respective guide faces 54b and 55b that are inclined so as to diverge outwardly from the associated engagement grooves 54a and 55a.

30 The mounting of the toggle switch module 1 onto the

mounting framework 51 is carried out in a manner as sequentially shown in Figs. 6A, 6B and 6C, reference to which will now be made. Assuming that as shown in Fig. 6A one of the pairs of the nails 13 integral with the switch lid 1b that are associated with the rigid beam 54 have been received within the corresponding pair of the engagement grooves 54a in the rigid beam 54, the other of the pairs of the nails 13 are slidingly guided along the corresponding guide face 55b while deforming the flexible beam 55 in a direction away from the rigid beam 54 against their own resiliency to expand the width of the rectangular mount opening 52 as shown in Fig. 6B, and are finally snapped into the associated engagement grooves 54a and 55b as shown in Fig. 6C.

Since the operating button 40 has a width equal to or substantially equal to that of at least the switch lid 1bm, the toggle switch module 1 in a completely assembled condition with the operating button 1 mounted on the actuator block 30 can be mounted into the rectangular mount opening 52 of the mounting framework 51 from rear, that is, with the operating button 1 oriented towards the rectangular mount opening 52. This is in contrast to the prior art switch assembly which because the operating button that is so sized large as to provide an increased operativity cannot pass through the rectangular opening in the mounting framework, requires the operating button to be removed, when the toggle switch module is mounted in the mount opening, and to be subsequently capped onto the actuator block after the toggle switch module has been mounted on the mounting framework.

Each of the rigid and flexible beams 54 and 55 is formed integrally with an elongated abutment flange 54d or 55d extending over the entire length of the associated beam 54 or 55 and protruding a slight distance into the rectangular mount opening 52, said distance being generally equal to the thickness of the bank 14 integral with the switch lid 1b. The abutment flanges 54d and 55d integral with the rigid and

flexible beams 54 and 55, respectively, serve to prevent the toggle switch module 1 from "overrunning" past the mount opening 52 when an excessive pushing force is applied to the toggle switch module 1 in a direction conforming to the direction of mounting of the toggle switch module 1 onto the mounting framework 51. Even when an excessive pushing force is applied to the toggle switch module 1 in a direction counter to the direction of mounting of the toggle switch module 1, the toggle switch module 1 will not fall out of and separate from the mounting framework 51 because the pairs of the nails 13 are firmly engaged in the respective pairs of the engagement grooves 54a and 55a.

The connections 56 connecting the flexible beam 55 with the side plate 53b of the mounting framework 51 are in practice formed by bending the opposite ends of the flexible beam 55 adjacent the slots 58a and 58c, respectively, and are therefore thin-walled. Consequently, when a considerable pushing force is applied from front to the toggle switch module 1 of the switch assembly A_1 in a direction counter to the direction of mounting of the toggle switch module 1 onto the mounting framework 51, the flexible beam 55 elastically flexes in a direction inwardly of the mount opening 52 to prevent the adjacent pair of the nails 13 integral with the switch lid 1b from being disengaged from the associated pair of the engagement grooves 55a, thereby avoiding any possible separation of the switch assembly A_1 from the mounting frame B.

On the other hand, the rigid beam 54 has a tool access slot 54c defined therein at a location between the engagement grooves 54a of each pair for insertion therethrough of a screw driver or the like tool when the switch assembly A_1 is desired to be removed from the mounting frame B. Specifically, when the screw driver or the like tool is inserted into the tool access slot 54c and is subsequently tilted to forcibly displace the switch casing 1 towards the flexible beam 55, a

substantially slight force brought about by the principle of leverage will suffice to displace the switch casing 1 accompanied by a corresponding deformation of the flexible beam 55 to such an extent that the nails 13 integral with the switch lid 1b, which are then engaged in the respective engagement grooves 54a in the rigid beam 54, can be disengaged therefrom to allow the switch assembly A_1 to be removed from the mounting frame B. It is to be noted that, in order for the screw driver or the like tool to displace the switch assembly A_1 towards the flexible beam 55 and, hence, to deform the flexible beam 55 in immediate response to insertion of the screw driver or the like tool through the tool access slot 54c, at least one end face of the switch lid 1b is formed with a guide projection 16 positioned below and immediately between the adjacent nails 13 of the pair as shown in Fig. 1, said guide projection 16 having an inclined guide face 16a along which the tip of the screw driver or the like tool can be guided as it is inserted into the tool access slot 54c.

In the foregoing description, each of the rigid and flexible beams 54 and 55 of the mounting frame B has been described and shown as having a row of six engagement grooves 54a or 55a defined at an equally spaced relation to each other in a direction longitudinally thereof, although a single pair of the engagement grooves 54a or 55a is sufficient where the mounting frame B is designed exclusively to accommodate only one switch assembly A_1 . The use of the six engagement grooves 54a or 55a in each of the rigid and flexible beams 54 and 55 is for the purpose of allowing the mounting frame B in the illustrated embodiment to accommodate up to three switch assemblies A_1 of an identical construction. Specifically, where the mounting frame B is used in association with only one switch assembly A_1 , the switch assembly A_1 can be mounted at any one of five positions each defined by the neighboring members of the engagement grooves 54a or 55a.

Referring particularly to Fig. 4, the mounting framework 51 has a recess 61 formed on an outer surface of each of the end plates 60a and 60b thereof and also has a transverse slot 62 and a pair of set holes 63 both extending across the corresponding end plate 60a or 60b and positioned within the respective recess 61. The transverse slots 62 in the respective end plates 60a and 60b are used for passage of set screws therethrough to secure the mounting frame B to a switch box (not shown) embedded in, for example, a housing interior wall whereas the set holes 63 of the respective pairs in the end plates 60a and 60b are used for passage of set screws therethrough to secure the mounting frame B directly to the housing interior surface. This mounting framework 51 furthermore has a pair of engagement perforations 64 which are clamped by clamp pieces (not shown) when the mounting frame B is to be secured directly to an interior panel forming the housing interior wall. The transverse slots 62, the paired set holes 63 and the engagement perforations 64 are utilized one at a time depending the manner in and by which the mounting frame is installed with respect to the housing interior wall.

In order for the ornamental make-up plate C to be fitted to the mounting frame B at the time of finalizing the installation of the switch assembly or assemblies A₁ to the housing interior wall, a catch hole 65 is formed at each of the four corner areas of the mounting framework 51. As will become clear from the subsequent description, as best shown in Fig. 5 the ornamental make-up plate C has four engagement nails 83 formed on an inner surface thereof so as to protrude outwardly and towards the mounting frame B and, accordingly, when the ornamental make-up plate 6 is fitted to the mounting frame B, the engagement nails 83 are detachably engaged in and trapped by the catch holes 65.

Referring particularly to Figs. 4 and 5, the ornamental

make-up plate C is made of a thermoplastic resin such as, for example, ABS resin as is the case with the mounting frame B and comprises a generally rectangular make-up framework 80 of one-piece construction including a rectangular make-up panel 81 having a pair of opposite sides and a pair of opposite ends, a pair of opposite side walls 82a and 82b protruding from the respective sides of the make-up panel 81 generally at right angles thereto and a pair of opposite end walls 82c and 82d protruding from the respective ends of the make-up panel 81 generally at right angles thereto and lying perpendicular to the side walls 82a and 82b. The engagement nails 83 referred to hereinbefore are formed on an inner surface of the make-up panel 81 of the make-up plate C at respective positions corresponding to four corner areas thereof. It is to be noted that the side walls 82a and 82b and the end walls 82c and 82d are spaced from each other a distance greater than the width and length of the mounting framework 51, respectively, so that when the ornamental make-up plate C is fitted to the mounting frame B the mounting frame B can be completely covered by the ornamental make-up plate C with the peripheral walls 82a to 82d held in contact with the surface of the housing interior wall. Accordingly, no portion of the mounting frame B is exposed to the outside through the ornamental make-up plate C nor is visible from the outside and, therefore, an aesthetically appealing switch arrangement can be obtained.

The make-up panel 81 has a generally center area perforated to define a rectangular opening 81a of a size slightly greater than the size of the operating button 40 of the switch assembly A₁ such that when the ornamental make-up plate C is fitted to the mounting frame B with the operating button 40 aligned with the rectangular opening 81a, the operating button 40 can be exposed to the outside for the access of an operator's finger thereto.

Respective inner free edges of the peripheral walls 82a to

82d of the make-up framework 80 are so bevelled as to define inclined faces generally identified by 82e and are formed with opposed sets of regulating ribs 84 which are, when the ornamental make-up plate C is fitted to the mounting frame B, brought into contact with the surface of the housing interior wall from a direction parallel to the wall surface to thereby prevent the mounting framework 51 from being displaced in position. In other words, when the ornamental make-up plate C is fitted to the mounting frame B, the regulating ribs are engaged with side and end edges of the mounting framework 51 to avoid any possible rattling of the ornamental make-up plate C relative to the mounting framework 51.

One of the opposite side walls of the rectangular make-up framework 80, for example, the side wall 82b thereof, has two cutouts 86 formed therein so as to extend inwardly from the free edge thereof. Those cutouts 86 are utilized for the insertion therethrough of a screw driver or the like tool when the rectangular make-up framework 80 is desired to be removed from the mounting framework 51 of the mounting frame B. Specifically, by inserting the screw driver or the like tool into the cutouts 86 one at a time and then applying a force to the rectangular make-up framework 80 through the screw driver or the like so as to move the make-up framework 80 to separate away from the housing interior wall, the engagement nails 83 integral with the make-up framework 80 can be forcibly disengaged from the associated catch holes 65 in the rectangular mounting framework 51 to thereby detach the make-up framework 80 from the mounting framework 51.

On the other hand, as best shown in Fig. 4, respective portions of the side plate 53b of the mounting framework 51, which will be aligned with the cutouts 86 in the make-up frame 80 are formed with recesses 66 that extend inwardly of the side plate 53b so that the tip of the screw driver or the like tool used to remove the rectangular make-up

framework 80 from the mounting framework 51 can be inserted deep through the cutouts 86 to facilitate application of the force to the ornamental make-up plate C through the screw driver or the like tool in removing the ornamental make-up plate C. The side plate 53b is also
5 formed with a thin-walled rib 67 aligned with each recess 66 and protruding outwardly from the side plate 53b a distance substantially equal to or slightly smaller than the thickness of the adjacent side wall 82b of the rectangular make-up framework 80. The thin-walled ribs 67 serve to provide a fulcrum base about which the screw driver or the like
10 tool can be pivoted to apply the force to the rectangular make-up framework 80 in removing the latter from the mounting framework 51 without impairing the housing interior wall surface.

The make-up panel 81 has an inner surface confronting the mounting framework 51, which surface is formed with three plate-like
15 barriers 88a, 88b and 88c that are engageable in the respective slots 58a, 58b and 58c in the side plate 53b of the mounting framework 51. Each of those barriers 88a to 88c is of a size slightly smaller than the corresponding slot 58a to 58c so that when the ornamental make-up plate C is fitted to the mounting frame B carrying the switch assembly
20 A₁ with the operating button 40 exposed to the outside through a rectangular opening 81a, the barriers 88a to 88c are snugly engaged in the associated slots 58a to 58c to refrain the flexible beam 55 from being unduly deformed. Consequently, even though impacts are applied externally to the switch assembly A₁, the flexible beam 55 will not be
25 easily deformed to ensure that the nails 13 rigid with the switch assembly A₁ are firmly retained as engaged in the engagement grooves 55a and 54a in the flexible and rigid beams 55 and 54.

As hereinbefore described, the mounting frame B and, hence, the mounting framework 51 has been described and shown as having
30 two pairs of six equally spaced engagement slots 54a and 55a formed in

the respective rigid and flexible beams 54 and 55. In the illustrated embodiment, as best shown in Figs. 7A to 7C, the intermediate pairs of the engagement slots 54a and 55a are utilized to support the single switch assembly A_1 and the ornamental make-up plate C having the correspondingly single rectangular opening 81a is fitted to the mounting frame B with the operating button 40 of such single switch assembly A_1 exposed to the outside through the rectangular opening 81a. The use of the six equally spaced engagement slots 54a and 55a of each pair permits the mounting frame B to accommodate up to three switch assemblies A_1 of an identical construction.

However, to allow the three switch assemblies A_1 to be snugly positioned within the rectangular opening 52 in the mounting frame B with their engagement nails 13 engaged in the corresponding engagement slots 54a and 55a, partition ribs 70 are formed integrally with the rigid and flexible beams 54 and 55. It is to be noted that each neighboring partition ribs 70 in each of the rigid and flexible beams 54 and 55 are so spaced a distance substantially equal to the width of each switch assembly A_1 as clearly shown in Fig. 7B that no switch assembly can be mounted at a position other than the specific positions delimited by the pairs of the partition ribs 70.

Four corner faces of the toggle switch module 1, particularly of the switch lid 1b are formed with escape recesses 15 to which when the switch assembly A_1 is mounted at one of the specific positions, the partition ribs 0 are engaged. The switch assembly A_1 carried by the mounting frame B can thus be prevented from rattling and, consequently, the possibility of the engagement nails 13 being damaged which would otherwise take place when an unnecessary force is applied to the toggle switch module 1 of the switch assembly A_1 can advantageously be avoided.

Figs. 8A to 8C illustrate a modification of the foregoing

embodiment of the present invention in which the switch assembly A₁ is mounted on a mounting frame D which corresponds in function to the mounting frame B made of the synthetic resin, but which is made of a metallic material. As shown therein, the metallic mounting frame D is
5 of a generally rectangular shape having a rectangular opening 90 defined therein to thereby leave a pair of side plates 96a and 96b opposite to each other and a pair of end plates 91a and 91b opposite to each other and lying perpendicular to the side plates 96a and 96b. The opposite end plates 91a and 91b are formed with respective transverse
10 slots 92 for passage of set screws therethrough to secure the mounting frame D to a switch box (not shown) embedded in, for example, a housing interior wall and also with respective pairs of set holes 93 for passage of set screws therethrough to secure the mounting frame D directly to the housing interior surface. The opposite end plates 91a and 91b are
15 furthermore formed with respective pairs of engagement perforations 94 which are clamped by clamp pieces (not shown) when the mounting frame D is to be secured directly to an interior panel forming the housing interior wall, and respective screw holes 95 to which associated set screws (not shown) are threaded to secure the metallic ornamental
20 make-up plate or the like.

As best shown in Fig. 8A, the opposite side plates 96a and 96b on respective sides of the rectangular opening 90 are formed integrally with respective engagement nails 97 and 98 for engagement in associated mounting slits 17 formed in the opposite end walls of the
25 switch lid 1b at a location intermediate between and below the nails 13.

One of the side plates of the metallic mounting frame D, for example, the side plate 96b is so designed as to support the corresponding engagement nail 98 from opposite directions by means of support pieces 99 of a reduced width. When the switch assembly A₁ is to be mounted
30 in the metallic mounting frame D, the engagement nail 97 in the side

plate 96a is first engaged in the associated mounting slit 17 in the switch assembly A_1 and the support pieces 99 in the other side plate 96b are forcibly bent so as to protrude towards the rectangular opening 90 by the use of a tool such as, for example, a screw driver, to allow the engagement nail 98 to be engaged in the other mounting slit 17 in the switch assembly A_1 to thereby complete the mounting of the switch assembly A_1 in the metallic mounting frame D.

The switch box (not shown) embedded in, for example, a housing interior wall for accommodating the mounting frame carrying at least one switch assembly A_1 as discussed hereinbefore is currently available in two types. One type is of a generally rectangular box-like configuration with a generally rectangular opening and the other type is of a generally cylindrical box-like configuration having a round opening.

In the case of the generally cylindrical switch box, it may occur that two or more switch assemblies A_1 can be accommodated therein depending on the size of the toggle switch module 1 of each switch assembly A_1 . In view of this, each corner of the toggle switch module 1 (the switch casing 1a and the switch lid 1b) of the switch assembly A_1 is removed by cutting, as indicated by 1c, in a direction heightwise of the switch assembly A_1 so that as shown in Fig. 9, two switch assemblies A_1 can be snugly accommodated in side-by-side relation within the round opening of the generally cylindrical switch box without the corners of the toggle switch modules 1 interfering the cylindrical wall of the switch box.

As hereinbefore discussed, the mounting frame used in the illustrated embodiment is of a design capable of accommodating up to three switch assemblies A_1 with the operating button 40 of each switch assembly A_1 having a width that is substantially one third of the length of the rectangular opening 52 in the mounting frame B. In contrast thereto, where two switch assemblies A_1 of an identical construction are desired to be mounted in the mounting frame B, the left and right

opposite pairs of the engagement grooves 54a and 55a as viewed in Fig. 11A may be used to support the respective switch assemblies A_1 in combination of the operating buttons 40' each having a size sufficient to occupy about one half of the length of the rectangular opening 52 as best
5 shown in Figs. 11A and 11B. By so designing, a portion of the rectangular opening 52 in which the intermediate opposite pair of the engagement grooves 54a and 55a are situated can be closed in part by the operating button 40' on one of the switch assemblies A_1 and in part by the operating button 40' on the other of the switch assemblies A_1 . In
10 such case, the ornamental make-up plate C may have a single rectangular opening 81a of a size sufficient to encompass the two operating buttons 40' of those two switch assemblies A_1 .

Where the ornamental make-up plate C having the rectangular opening 81a of a size corresponding to the rectangular
15 opening 52 in the mounting frame B is desired to be used in association with the toggle switch module 1, the operating button to be used on the toggle switch module 1 to complete the switch assembly A_1 has to be of a size sufficient to be encompassed by the rectangular opening 81a in the ornamental make-up plate C as indicated by 40" in Figs. 12A to 12C.

20 In either case, the toggle switch module or modules 1 can be mounted in the mounting frame B from rear in the form as having each or the operating button 40' or 40" mounted on the respective toggle switch module. Thus, according to the present invention, where the operating buttons of varying sizes corresponding respectively to the use
25 of one, two and three switch assemblies A_1 are made available, the single ornamental make-up plate C can advantageously be employed for any one of the single switch unit, the double switch unit and the triple switch unit, making it possible to minimize the manufacturing cost.

The description concerning the capability of the single
30 ornamental make-up plate in conjunction with the use of the operating

buttons of varying sizes can equally apply even where the metallic mounting frame D is employed in place of the resinous mounting plate B.

The switch arrangement according to a second preferred embodiment of the present invention is shown in Fig. 14. This second embodiment of the present invention differs from the foregoing embodiment in respect of the details of the switch assembly. Specifically, while the switch assembly A_1 in the foregoing embodiment is of a single-pole single-throw switch design, the switch assembly A_2 employed in the second embodiment of the present invention is of a double-pole single-throw switch design and, accordingly, only the difference between the first and second embodiments will now be discussed.

The switch assembly A_2 makes use of a pair of first stationary terminal members 20_1 and 20_2 , a pair of second stationary terminal members 21_1 and 21_2 , two movable contact bridges 24_1 and 24_2 , and two coil springs 25_1 and 25_2 . The switch casing 1a has its interior divided by a longitudinal partition wall 8 into two longitudinal compartments each made up of two terminal chambers 3_1 and 3_3 or 3_2 and 3_4 and a switch chamber 4_1 or 4_2 positioned between the terminal chambers 3_1 and 3_3 or 3_2 and 3_4 . The first stationary terminal members 20_1 and 20_2 are fixedly accommodated within the neighboring switch chambers 3_1 and 3_2 together with respective lock springs 26, the second stationary terminal members 21_1 and 21_2 are similarly fixedly accommodated within the neighboring switch chambers 3_3 and 3_4 together with respective lock springs 26, and the movable contact bridges 24_1 and 24_2 are movably accommodated within the neighboring intermediate chambers 4_1 and 4_2 defined on respective sides of the longitudinal partition wall 8. A release button 27 operatively associated with the respective lock spring 26 is accommodated between

the neighboring switch chambers 3_1 and 3_2 or 3_3 and 3_4 in a manner similar to that described in connection with the foregoing embodiment of the present invention.

Each of the first stationary terminal members 20_1 and 20_2 has an intermediate terminal tongue $20c$ having a raised contact area $20d$ that provides the fulcrum about which the corresponding movable contact bridge 24_1 or 24_2 undergoes a pivotal movement. Similarly, each of the second stationary terminal members 21_1 and 21_2 has an intermediate terminal tongue $21c$ protruding into the corresponding intermediate switch chamber 4_1 or 4_2 and also has a fixed contact piece 28_1 or 28_2 fixed to the tip of the associated intermediate terminal tongue $21c$.

As is the case with the movable contact bridge 24 used in the foregoing embodiment of the present invention, each of the movable contact bridges 24_1 and 24_2 is made of a metallic material and made up of a pair of arms connected at one end with each other by means of a base to represent a generally U-shaped configuration opening upwardly.

Each movable contact bridge 24_1 or 24_2 is accommodated within the switch chamber 4_1 or 4_2 with the base thereof resting on and held in contact with the raised contact area $20d$ of the intermediate terminal tongue $20c$ integral with the associated first stationary terminal member 20_1 or 20_2 . Thus, it will readily be seen that each of the movable contact bridges 24_1 and 24_2 resting on the associated raised contact area $20d$ has a propensity to tilt in either direction about the raised contact area $20d$.

To restrict the angular movement of each movable contact bridge 24_1 or 24_2 about the associated raised contact area $20d$, the opposite arms of the respective movable contact bridge 24_1 or 24_2 are formed with respective pairs of lateral wings $24a$ protruding laterally outwardly therefrom and engageable, one pair at a time depending on the position of the movable contact bridge 24 , with mutually confronting

ribs that are formed integrally with opposite side walls of the switch casing 1a so as to protrude into the switch chamber 4 and spaced from each other a distance sufficient to loosely accommodate the respective movable contact bridge 24₁ or 24₂ therebetween. It is to be noted that a
5 portion of one of the arms of each movable contact bridge 24₁ or 24₂ which confronts the associated fixed contact piece 28₁ or 28₂ is provided with a movable contact piece 299₁ or 29₂ to ensure a persistent electrical contact therebetween.

Also substantially as is the case with the actuator block 30
10 in the foregoing embodiment, the actuator block 30 shown in Fig. 14 has two tubular bearings formed integrally with the top wall thereof so as to extend downwardly in alignment with the respective switch chambers 4₁ and 4₂ for receiving therein respective upper portions of the coil springs 25₁ and 25₂. Respective lower end portions of the coil springs 25₁ and
15 25₂ are received in the associated movable contact bridges 24₁ and 24₂.

The operating button 40 shown in Fig. 14 is substantially identical with that shown particularly in Fig. 1.

According to the second embodiment of the present invention, the switch assembly A₂ is so designed and so configured that
20 when the operating button 40 is pushed in either direction, the movable contact bridges 24₁ and 24₂ are simultaneously toggled with the movable contact pieces 29₁ and 29₂ consequently engaged with or disengaged from the fixed contact pieces 28₁ and 28₂ depending on the direction in which the movable contact bridges 24₁ and 24₂ are tilted, to thereby close
25 or open respective electric circuits between the first stationary terminal members 20₁ and 20₂ and the second stationary terminal members 21₁ and 21₂. Thus, the switch assembly A₂ in the second embodiment of the present is a double-pole single-throw type.

The switch assembly A₃ according to a third preferred
30 embodiment of the present invention will now be described with

particular reference to Fig. 15. The switch assembly A_3 shown therein is of a so-called three-way type wherein the single first terminal member 20 can be selectively engaged with or disengaged from one of the two second terminal members $21_1'$ and $21_2'$ by means of the single movable
5 contact bridge 24.

Referring to Fig. 15, as is the case with the first stationary terminal member used in the first embodiment of the present invention, the first stationary terminal member 20 has the intermediate terminal tongue 20c having the raised contact area 20d and is accommodated
10 within the terminal chamber 3 in the switch casing 1a with the intermediate terminal tongue 20c positioned at the bottom of the switch chamber 4 in which the movable contact bridge 24 is accommodated so as to rest on the raised contact area 20d.

On the other hand, one of the second stationary terminal
15 members, for example, the second stationary terminal member $21_2'$ includes the intermediate terminal tongue 21c protruding into the switch chamber 4 and then bent to extend in a direction substantially perpendicular to the longitudinal sense of the switch casing 1a, and the fixed contact piece 28_2 fixed to the intermediate terminal tongue 21c.
20 This second stationary terminal member $21_2'$ is accommodated within the terminal chamber $3_2'$ defined on one side of the switch chamber 4 remote from the terminal chamber 3. The other of the second stationary terminal members, that is, the second stationary terminal member $21_1'$ includes a tongue 21e protruding into the terminal chamber
25 3 past the switch chamber 4 with a free end thereof bent to extend in a direction substantially perpendicular to the longitudinal sense of the switch casing 1a, and a fixed contact piece 28_1 fixed to the free end of the tongue 21e so as to face towards the switch chamber 4. This second stationary terminal member $21_1'$ is accommodated within the terminal
30 chamber $3_1'$ defined on one side of the switch chamber 4 remote from the

terminal chamber 3, but laterally neighboring the terminal chamber 3₁'.

In this arrangement, the fixed contact pieces 28₁ and 28₂ rigid with the respective second stationary terminal members 21₁' and 21₂' are spaced a distance from each other within the switch chamber 4 while
5 confronting with each other.

The movable contact bridge 24 of the generally U-shaped configuration accommodated movably within the switch chamber 4 includes the movable contact pieces 29₁ and 29₂ fixedly secured to respective portions of one of the arms thereof which confronts the second
10 stationary terminal members 21₁' and 21₂'. Accordingly, one of the movable contact piece 29₁ rigid with the movable contact bridge 24 is held in face-to-face relation with the fixed contact piece 28₂ rigid with the second stationary terminal member 21₂' while the movable contact piece 29₂ thereof is held in face-to-face relation with the fixed contact
15 piece 28₁ rigid with the second stationary terminal member 21₁'.

According to the third embodiment of the present invention, the switch assembly A₃ is so designed and so configured that when the operating button 40 is pushed in either direction, the movable contact bridge 24 is toggled with the movable contact pieces 29₁ and 29₂
20 consequently engaged with or disengaged from the fixed contact pieces 28₁ and 28₂ depending on the direction in which the movable contact bridge 24 is tilted, to thereby close or open respective electric circuits between the first stationary terminal members 20 and the second stationary terminal member 20₁ and between the first stationary
25 terminal member 20 and the second stationary terminal member 20₂.

A fourth preferred embodiment of the present invention will now be described with particular reference to Fig. 16. The switch assembly A₄ shown in Fig. 16 is of a so-called four-way type in which an electrical connection between one of the first stationary terminal
30 members 20₁ and 20₂ and one of the second stationary terminal

members 21_1 " and 21_2 " and an electrical connection between the other of the first stationary terminal members 20_1 and 20_2 and the other of the second stationary terminal members 21_1 " and 21_2 " are alternately established by means of the respective movable contact bridges 24_1 and
5 24_2 .

Referring to Fig. 16, the pair of the first stationary terminal members 20_1 and 20_2 and the pair of the second stationary terminal members 21_1 " and 21_2 " are accommodated within the respective terminal chambers 3_1 to 3_4 together with associated lock springs 26 in a manner
10 similar to that described in connection with the second embodiment of the present invention. Similarly, the movable contact bridges 24_1 and 24_2 are movably accommodated within the respective switch chambers 4_1 and 4_2 , and the release buttons 27 are accommodated respectively within and between the terminal chambers 3_1 and 3_2 and within and
15 between the terminal chambers 3_3 and 3_4 .

Each of the first stationary terminal members 20_1 and 20_2 has the intermediate terminal tongue 20c having the raised contact area 20d that are positioned at the bottoms of the respective switch chambers 4_1 and 4_2 and on which the associated movable contact bridges 24_1 and
20 24_2 rest. On the other hand, the second stationary terminal member 21_1 " is accommodated within the terminal chamber 3_3 and has a tongue $21c$ " protruding into the switch chamber 4_2 with a free end thereof bend to extend in a direction substantially perpendicular to the longitudinal sense of the switch casing 1a, and a fixed contact piece 28_1 fixed to the
25 free end of the tongue $21c$ ". The other second stationary terminal member 21_2 is accommodated within the terminal chamber 3_4 and has a tongue $21e$ " protruding into the terminal chamber 3_1 past the switch chamber 4_2 with a free end thereof bend to extend in a direction towards the switch chamber 4_1 , and a fixed contact piece 28_2 fixed to the free end
30 of the tongue $21e$ ".

As is the case with the movable contact bridge 24 used in the foregoing embodiment of the present invention, each of the movable contact bridges 24₁ and 24₂ is made up of a pair of arms connected at one end with each other by means of a base to represent a generally U-shaped configuration opening upwardly. Each movable contact bridge 24₁ or 24₂ is accommodated within the switch chamber 4₁ or 4₂ with the base thereof resting on and held in contact with the raised contact area 20d of the intermediate terminal tongue 20c integral with the associated first stationary terminal member 20₁ or 20₂. The arms of each of the movable contact bridges 24₁ and 24₂ are provided with respective fixed contact pieces 29₁₁ and 29₁₂ or 29₂₁ and 29₂₂ so that the movable contact piece 29₁₁ rigid with the movable contact bridge 24₁ confronts the fixed contact piece 28₂ rigid with the second stationary terminal member 21₂ whereas the movable contact piece 29₂₂ rigid with the movable contact bridge 24₂ confronts the fixed contact piece 28₁ rigid with the second stationary terminal member 21₁.

According to the fourth embodiment of the present invention, the switch assembly A4₁ is so designed and so configured that when the operating button 40 is pushed in either direction to cause the actuator block 30 to assume one of the ON and OFF positions, the movable contact bridges 24₁ and 24₂ are simultaneously toggled with the movable contact pieces 29₁₁ and 29₂₂ consequently engaged with or disengaged from the fixed contact pieces 28₁ and 28₂ depending on the direction in which the movable contact bridge 24 is tilted, to thereby alternately establish a circuit between the first and second stationary terminal members 20₁ and 21₂ and a circuit between the first and second stationary terminal members 20₂ and 21₁.

The switch assembly A₅ according to a fifth preferred embodiment of the present invention is shown in Fig. 17. The switch assembly A₅ shown in Fig. 17 is substantially identical in structure to

the switch assembly A_1 shown in and described with reference to Figs. 1 to 13, but differs therefrom in that a light emitting position indicator is additionally employed to provide a visual indication descriptive of the position of the operating button 40 that can be visible even under a poor lighting condition such as, for example, in a dark room. This type of switch assembly is generally called a firefly switch. In view of the switch assembly A_5 identical in structure to the switch assembly A_1 , only the difference, that is, the light emitting position indicator will be described with reference to Fig. 17.

10 The light emitting position indicator comprises a generally rectangular printed circuit board 101 having a generally rectangular center opening 101a, and a neon lamp 100 and a resistor 102 are mounted on the circuit board 101. Although not shown, an undersurface of the printed circuit board 101 opposite to the mounting surface on which the lamp 100 and the resistor 102 are mounted has a plurality of contacts which are electrically connected with the lamp 100 and the resistor 102.

Each of the first and second stationary terminal members 20 and 21 is provided with an angled contact element 103 welded at one end to a top area of the first or second stationary terminal member 20 or 21 by the use of any known laser welding technique, said angled contact element 103 having a resiliency. The printed circuit board 101 is mounted on the first and second stationary terminal members 20 and 21 with the contacts of the printed circuit board 101 held in contact with the angled contact elements 103. To ensure firm contact between the contacts of the printed circuit board 101 and the angled contact elements 103 in the assembled condition of the switch assembly A_5 , the switch lid 1b is formed with a plurality of retainer ribs (not shown) protruding inwardly from an inner surface thereof so that in the assembled condition the retainer ribs are brought into contact with a peripheral

area of the printed circuit board 101 to urge the latter towards the switch casing 1a. Consequently, the contacts of the printed circuit board 101 are elastically engaged with the angled contact elements 103 to establish electric circuits between the first and second stationary
5 terminal members 20 and 21 and the printed circuit board 101. It is to be noted that the presence of the center opening 101a effectively permits the tubular bearing 32 integral with the switch lid 1b to pass therethrough and, hence, the printed circuit board 101 does not disturb the angular movement of the tubular bearing 32.

10 In order for rays of light emitted by the neon lamp 100 to be emitted outwardly from the operating button 40, the operating button 40 has a window 44 defined therein at a location substantially aligned with the position of the neon lamp 100 on the printed circuit board 101. A prism 110 having a protrusion 111 formed integrally therewith is
15 bonded from below to the operating button 40 with the protrusion 111 snugly received within the window 44. The prism 110 is preferably made of a transparent synthetic resin such as, for example, a polycarbonate resin and is operable to guide the light from the neon lamp 100 towards the outside of the switch assembly A₅ through the
20 window 44.

The prism 110 is of one-piece construction including a generally rectangular body 112 having one of its opposite ends cut slantwise, the protrusion 111 formed on an upper surface of the body 112, and a fixing tab 113 protruding outwardly from the upper surface of the
25 body 112 and formed with pin holes 113a at opposite sides thereof. An upper surface of the protrusion 111 is formed with a recess 111a of a contour substantially similar to the outer contour of the protrusion 111.

In order for the light from the lamp 100 to be transmitted to the prism 110, a portion of the actuator block 30 which is positioned
30 below and aligned with the prism 110 secured to the operating button 40

is formed with a perforation 35 for receiving therein the body 112 of the prism 110. Accordingly, when the operating button 40 is mounted on the actuator block 30, the body 112 of the prism 110 is snugly received within the perforation 35 in face-to-face relation with the neon lamp 100 positioned immediately therebelow. Accordingly, the light emitted from the lamp 100 can be transmitted to the protrusion 111 via the body 112 of the prism 110 and then emerge outwardly from the window 44 in the operating button 40.

Fig. 18 illustrates a sixth preferred embodiment of the present invention in which the switch assembly A_6 is substantially identical with the switch assembly A_5 shown in Fig. 17, but differs therefrom as to the details of the printed circuit board and its associated component parts. More specifically, while in the previous embodiment of the present invention, the printed circuit board 101 is employed, in the embodiment shown in Fig. 18 a generally rectangular mounting plate 104 made of a synthetic resin and having terminals (not shown) insert-molded therein is employed with the neon lamp 100 and the resistor 102 mounted thereon in electrical connection with the insert-molded terminals.

As clearly shown in Fig. 18, the mounting plate 104 is formed with a round hole 104a defined at a substantially central portion thereof, into which the tubular bearing 32 integral with the actuator block 30 is press-fitted so that the mounting plate 104 can be fixedly mounted on the tubular bearing 32 and, hence, carried by the actuator block 30. At this time, the neon lamp 100 and the resistor 102 are accommodated within a cavity left around the tubular bearing 32 in the actuator block 30. The assembly of the actuator block 30 with the mounting plate 104 is positioned between the actuator block 30 and the toggle switch module in a manner substantially similar to the printed circuit board 101 discussed in connection with the previous embodiment

of the present invention.

As shown therein, one end of the mounting plate 104 adjacent the second stationary terminal member 21 is formed integrally with a terminal plate insert-molded in the mounting plate 104, said
5 terminal plate having a terminal piece 105 protruding outwardly therefrom. This terminal piece 105 is adapted to be selectively engaged with or disengaged from an upper portion of the second stationary terminal member 21. A contact piece (not shown) is formed on an undersurface of the terminal piece 105. A terminal 102a of the resistor
10 102 is inserted into the tubular bearing 32 through an axial groove (not shown) formed on a peripheral surface of the tubular projection 32 so that the terminal 102a of the resistor 102 is held in electrical connection with the coil spring 25 within the tubular bearing 32.

In the construction described above, when the operating
15 button 40 is pushed in either direction to cause the actuator block 30 to assume one of the ON and OFF positions, for example, the OFF position in which the movable contact piece 29 rigid with the movable contact bridge 24 is separated from the fixed contact piece 28 rigid with the second stationary terminal member 21, the contact piece rigid with the
20 terminal piece 105 protruding from the end of the mounting plate 104 is brought into contact with the upper portion of the second stationary terminal member 21 to supply an electric power to the neon lamp 100 and the resistor 102 through the movable contact bridge 24 and then through the coil spring 25, resulting in lighting of the neon lamp 100.

25 On the other hand, when the operating button 40 is pushed to cause the actuator block 30 to assume the ON position, the terminal piece 105 on the mounting plate 104 is separated from the upper portion of the second stationary terminal member 21 and, consequently, the neon lamp 100 remains deenergized.

30 Fig. 19 illustrates a seventh preferred embodiment of the

present invention. The switch assembly A_7 shown therein is substantially identical with the switch assembly A_3 according to the third embodiment of the present invention, but differs therefrom in that the light emitting position indicator of the structure identical with that shown in Fig. 17 is employed. This difference will now be discussed.

The printed circuit board 101 shown in Fig. 19 is identical with that shown in Fig. 17. Specifically, the printed circuit board 101 has the center opening 101a and includes the neon lamp 100, the resistor 102 and the contacts (not shown) which formed on the undersurface of the printed circuit board 101 and which are electrically connected with the lamp 100 and the resistor 102.

Each of the second stationary terminal members 21_1 and 21_2 is provided with an angled contact element 103' welded at one end to a top area of the respective second stationary terminal member 21_1 or 21_2 by the use of any known laser welding technique, said angled contact element 103' having a resiliency. The printed circuit board 101 is mounted on the second stationary terminal members 21_1 and 21_2 with the contacts of the printed circuit board 101 held in contact with the angled contact elements 103'. To ensure firm contact between the contacts of the printed circuit board 101 and the angled contact elements 103' in the assembled condition of the switch assembly A_7 , the switch lid 1b is formed with a plurality of retainer ribs (not shown) protruding inwardly from an inner surface thereof so that in the assembled condition the retainer ribs are brought into contact with a peripheral area of the printed circuit board 101 to urge the latter towards the switch casing 1a. Consequently, the contacts of the printed circuit board 101 are elastically engaged with the angled contact elements 103' to establish electric circuits between the second stationary terminal members 21_1 and 21_2 and the printed circuit board 101. It is to be noted that the presence of the center opening 101a effectively permits the

tubular bearing 32 integral with the switch lid 1b to pass therethrough and, hence, the printed circuit board 101 does not disturb the angular movement of the tubular bearing 32.

5 The prism 110' secured to the operating button 40 is substantially similar in structure to the prism 110 used in the fifth embodiment of the present invention, except for a difference in which the prism 110' does not have any protrusion such as the protrusion 111 in the prism 110. It is to be noted that if two switch assemblies A_7 are electrically connected with a load and an alternating current power
10 source, respectively, a three-way switch circuit can be obtained.

The switch assembly A_8 according to an eighth preferred embodiment of the present invention shown in Fig. 20 is featured in that in the three-way switch provided with a position indicator (the neon lamp 100) of the structure shown in Fig. 19 a display lamp block
15 including a mounting plate 104', made of a synthetic resin, and a terminal plate (not shown) insert-molded in the mounting plate 104' and having the neon lamp 100 and the resistor 102 electrically connected at one end to the terminal plate is accommodated within the actuator block 30. Since the switch assembly A_8 is substantially similar in structure to
20 any one of the switch assemblies A_6 and A_7 , only the difference will now be described.

The mounting plate 104' is formed with a round hole 104a' defined at a substantially central portion thereof, into which the tubular bearing 32 integral with the actuator block 30 is press-fitted so that the
25 mounting plate 104' can be fixedly mounted on the tubular bearing 32 and, hence, carried by the actuator block 30. At this time, the neon lamp 100 and the resistor 102 are accommodated within a cavity left around the tubular bearing 32 in the actuator block 30.

As shown therein, the mounting plate 104' has its
30 undersurface provided with contacts (not shown) that are electrically

connected with the terminal plate, and those contacts are elastically urged to contact angled contact elements 103' that are fixed at one end to the respective upper portions of the second stationary terminal members 21₁ and 21₂. Accordingly, the neon lamp 100 and the resistor 102 are electrically connected with the second stationary terminal members 21₁ and 21₂, respectively, in a manner similar to that in the seventh embodiment of the present invention. Thus, as is the case with the seventh embodiment of the present invention the use of the two switch assemblies A₈ results in a three-way switch circuit.

10 In any one of the foregoing embodiments, the operating button 40 has been described as mounted on the actuator block 30 so as to undergo the seesaw motion together with the actuator block 30. However, the present invention equally applies to the switch assembly of a type in which the operating button pivots at one end thereof, a ninth preferred embodiment of which will now be described with particular reference to Figs. 21 to 30.

Referring to Figs. 21 to 30, the switch assembly generally identified by A comprises a switch module including a generally rectangular box-like switch casing 1x made of a thermosetting resin such as, for example, urea resin, and opening upwardly and a generally rectangular switch lid 10x made of a thermoplastic resin such as, for example, polybutylene terephthalate and adapted to be mounted onto the casing 1x to substantially close the upper opening of the casing 1x. The lid 10x has two short sides and two long sides transverse to the short sides and has two parallel anchor legs 11x formed integrally therewith so as to extend downwardly from each long side of the lid 10x.

25 The anchor legs 11x have an anchor hole 11ax defined therein so that when the lid 10x is mounted onto the switch casing 1x with the paired anchor legs 11x sliding along associated outer side faces of the switch casing 1x, corresponding anchor protuberances 2x formed

30

two on each outer side faces of the switch casing 1x so as to protrude outwardly therefrom are engaged in the respective anchor holes 11ax to thereby unite the switch casing 1x and the switch lid 10x together. Each of the anchor protuberances 2x, paired on each outer side face of the switch casing 1x, has an upper edge which is inclined downwardly as viewed in Fig. 20, the downwardly inclined upper edge of each anchor protuberance 2x defining a guide face 2ax effective to facilitate a smooth slide of the associated anchor leg 11x therealong.

The switch casing 1x and the switch lid 10x are united together to complete the toggle switch module 1 in a manner which will now be described. Assuming that the switch lid 10x is mounted over the switch casing 1x with the anchor legs 11x aligned with the associated anchor protuberances 2x, and as an external pushing force is applied to the anchor lid 10x to urge the latter towards the switch casing 1x, the anchor legs 11x expand outwardly against their own resiliency while sliding along the guide faces 2ax of the anchor protuberances 2x.

Continued application of the external pushing force to the switch casing 1x results in slide of the anchor legs 11x over the associated anchor protuberances 2x and the anchor protuberances 2x consequently trapped into the respective anchor holes 11ax as the anchor legs 11x restore to the original shape by the action of their own resiliency. In this way, the switch casing 1x and the switch lid 10x are united together to complete the switch module.

The structure in which the anchor legs 11x integral with the switch lid 10x are engaged with the corresponding anchor protuberances 2x integral with the switch casing 1x to unite the lid 10x and the casing 1x together is particularly advantageous in that the use of metallic frames hitherto employed to accomplish the assembly can be eliminated to minimize the number of component parts and the number of assembling steps both necessitated to complete the switch assembly.

The switch casing 1x is preferably made of urea resin since the urea resin has an excellent resistance to tracking. The interior of the switch casing 1x is divided by partition walls into two terminal chambers 3, adjacent the opposite ends of the switch casing 1x, for
5 accommodating therein respective terminal blocks and a switch chamber 4 positioned intermediate between the terminal chambers 3 and accommodating a movable contact element 42x therein. As best shown in Fig. 23, opposite end portions of the bottom wall of the switch casing 1x that are aligned with the terminal chambers 3 are formed with
10 respective pairs of insertion holes 5x for insertion therethrough of an external electric wire.

Each of the terminal blocks accommodated respectively within the terminal chambers 3 includes a generally U-shaped terminal plate 43x or 44x, made of an electroconductive metallic material and
15 formed by bending a generally oblong sheet metal to represent a generally U-shaped configuration, and a washer-mounted screw 45x having a washer 45ax threadingly mounted thereon.

The terminal plate 43x has opposite arms joined together by means of a base, one of the arms of which plate 43x is integrally formed
20 with a support tongue 43ax that is laid on the bottom of the switch chamber 4 with the movable contact element 42x resting on such support tongue 43ax. The other terminal plate 44x similarly has opposite arms joined together by means of a base, one of the arm of which plate 44x is formed integrally with a tongue 44ax that protrudes
25 into the switch chamber 4 with its free end bent upwardly, a fixed contact element 46x being fixed to that free end of the tongue 44ax. Both of the terminal plates 43x and 44x are formed with a respective holes 43bx or 44bx for threadingly receiving the associated screw 45x.

As best shown in Fig. 25, with the washer-mounted screws
30 45x received in the respective holes 43bx and 44bx in the associated

terminal plates 43x and 44x, the terminal blocks are accommodated and retained in position within the respective terminal chambers 3, with their opposite side edges received in grooves 6x formed in the opposite side walls of the switch casing 1x. In this condition, respective heads of
5 the screws 45x are received within respective U-shaped cutouts 8x defined in the opposite end walls of the switch casing 1x. With the terminal plate 44x accommodated within the associated terminal chamber 3, a fixing tongue 44cx formed integrally with the tongue 44ax and extending downwardly from a generally intermediate portion of
10 such tongue 44ax is inserted into an anchor hole 7ax formed on an upper surface of a bench 7x protruding upwardly from a portion of the casing bottom substantially intermediate between the terminal chamber 3 and the switch chamber 4, to thereby fix the terminal plate 44x in position.

Electric connection of an external electric wire with any one
15 of the terminal plates 43x and 44x can be accomplished by inserting a bared end of the external electric wire through one of the paired insertion holes 5x associated with the respective terminal plate 43x or 44x until the bared end of the electric wire reaches a position between the washer 45ax and the associated terminal plate 43x or 44x and then
20 by fastening the associated screw 45x to urge the washer 45ax against the associated terminal plate 43x or 44x to thereby clamp the bared end of the electric wire firmly.

The movable contact element 42x is in the form of a generally rectangular plate made of a metallic material having an
25 electroconductivity and formed integrally with lateral wings 42ax protruding laterally outwardly from opposite sides thereof and positioned adjacent a bottom edge thereof. This movable contact element 42x is accommodated within the switch chamber 4 with the lateral wings 42ax loosely received in respective V-shaped grooves 9x
30 that are defined in the respective side walls of the switch casing 1x,

while the bottom edges of the movable contact element 42x is pivotally held in contact with the support tongue 43x of the terminal plate 43x. This movable contact element 42x has a movable contact piece 47x fixed to an upper portion thereof, which piece 47x is selectively engageable
5 with and disengageable from the fixed contact piece 46x to close and open a circuit between the stationary terminal plates 43x and 44x, respectively, depending on the direction in which the movable contact element 42x is tilted.

A switching mechanism comprised of a coil spring 41x, an
10 actuator 40x and an operating button 30x is utilized to drive the movable contact element 42x. The movable contact element 42x has a projecting seat 42bx formed integrally therewith and positioned next to the movable contact piece 47x, and the coil spring 41x has a lower end seated on the movable contact element 42 with the projecting seat 42bx
15 received inside the coil spring 41x, and an upper end inserted into a tubular bearing 40ax formed integrally with the actuator 40x so as to protrude downwardly therefrom, so that depending on the angular position of the actuator 40x the movable contact element 42x can be driven in a plane perpendicular to the plane of the movable contact
20 element 42x as will be described in more detail later.

The switch lid 10x has a cavity 12x delimited by an upper surface thereof and a peripheral wall 15x integral with the switch lid 10x and also has a generally rectangular opening 13x defined in the bottom of the cavity 12x, that is, the upper surface of the switch lid 10x
25 encompassed by the peripheral wall 15x. The opposite side walls of the switch lid 10x are formed with bearings 14x positioned on respective sides of the rectangular opening 13x in alignment with each other. The tubular bearing 40ax integral with the actuator 40x has an outer peripheral surface formed with bearing pins 40bx protruding laterally
30 outwardly therefrom in respective directions opposite to each other, each

of said bearing pins 40bx being of a shape similar to the shape of an inverted triangle. This actuator 40x is inserted from below into the cavity 12x through the rectangular opening 13x with the bearing pins 40bx pivotally received in the respective bearings 14x.

5 A generally rectangular head 40cx of the actuator 40x that protrudes upwardly from the rectangular opening 13x in the switch lid 10x has its opposite end portions formed with respective abutments 40dx protruding upwardly therefrom, as best shown in Fig. 27, for engagement with an actuator rod 32x integral with the operating button
10 30x as will be described later.

 As best shown in Fig. 26, the operating button 30x is mounted externally on the actuator 40x. In the illustrated embodiment, this operating button 30x is of a size having a width equal to or substantially equal to that of at least the switch lid 10x or that of the
15 switch module. The operating button 30x is formed of a thermoplastic resin such as, for example, ABS resin into a generally cap-like configuration opening downwardly towards the actuator 40x. The operating button 30x includes a substantially rectangular touch panel 30bx and a similarly rectangular-sectioned peripheral wall lying
20 perpendicular to the touch panel 30bx and made up of opposite end wall segments 30cx and 30dx and opposite side wall segments 30ex and 30fx as clearly shown in Fig. 26.

 An inner surface of the touch panel 30bx confronting the actuator 40x is formed integrally with the actuator rod 32x protruding
25 downwardly towards the actuator 40x and also with a pair of engagement projections 31x protruding downwardly towards the switch lid 10x from one of opposite ends of the touch panel 30bx. Respective portions of the side wall segments 30ex and 30fx of the operating button 30x adjacent the other end of the touch panel 30bx are formed with
30 generally rectangular-sectioned tubular walls 33x having substantially

cylindrical pivot pins 34x formed therein in alignment with each other.

The pivot pins 34x integral with the operating button 30x are pivotally received within respecting bearing recesses 16x what are formed in respective opposite side wall segments of the peripheral wall 15x
5 surrounding the cavity 12x. Accordingly, the operating button 30x can be pivotable between depressed and released positions relative to the switch lid 10x about a common pivot axis defined by the mutually aligned pivot pins 34x pivotally received in the bearing recesses 16x.

Generally semi-circular-sectioned support ribs 18x are
10 formed in the upper surface of the switch lid 10x at respective location aligned with the associated bearing recesses 16x. The operating button 30x mounted on the switch lid 10x rests on those support ribs 18 and pivotable between the depressed and released positions with the support ribs 18x providing the fulcrum about which the operating button 10x
15 pivots. It is to be noted that the tubular walls 33x being of a hollow structure has is effective to permit the tubular walls 33x themselves to deform easily so that the operating button 30x can easily be mounted on the switch lid 10x with the pivot pins 34x rotatably received in the respective bearing recesses 16x. It is also to be noted that a portion of
20 each of the side wall segments 30ex and 30fx of the operating button 30x adjacent the respective tubular wall 33x has a width greater than that of the remaining portion of the associated side wall segment 30ex or 30fx and, therefore, when the operating button 30x is mounted on the switch lid 10x, the bearing recesses and their adjacent parts can effectively be
25 concealed as shown in Fig. 22B to provide an aesthetically appealing appearance.

Referring to Fig. 28, so long as the operating button 30x has not yet been pushed, that is, moved to the depressed position, a lowermost end of the actuator rod 32x integral with the operating button
30 30x is held in contact with one of the abutments 40dx integral with the

actuator 40x and the engagement projections 31x integral with the operating button 30x are engaged with respective hooks 17x formed in the switch lid 10x so as to protrude upwardly from upper edges of one end wall segment of the peripheral wall 15x remote from the bearing
5 recesses 16x. An upper surface of the touch panel 30bx of the operating button 30x is formed with a round recess 35 that provides an visual indication of the position of a portion of the operating button 30x that is to be pushed.

In the construction described above, when the operating
10 button 30x is depressed with an external finger pressure applied to the round recess 35, the actuator 40x is tilted counterclockwise as viewed in Fig. 29 by the action of the actuator rod 32x integral with the operating button 30x, accompanied by a clockwise pivot of the movable contact element 42x with the movable contact piece 47x engaged with the fixed
15 contact piece 46x to close the circuit between the first and second stationary terminal plates 43x and 44x. Release of the applied finger pressure from the operating button 30x results in return of the movable contact element 42x to the initial position with the movable contact piece 47x consequently disengaged from the fixed contact piece 46x to thereby
20 open the circuit between the first and second stationary terminal plates 43x and 44x. In this way, the movable contact piece 47x can be selectively engaged with and disengaged from the fixed contact piece 46x by causing the movable contact element 42x to tilt in either direction by the effect of a pressing force exerted by the coil spring 41x. Accordingly, in
25 operating the operating button 30x, the user can have the sensation of the operating button 30x being clicked in a well-organized fashion.

Since that portion of the actuator rod 32x which slidingly engage one of the abutments 40dx of the actuator 40x is inclined at 32ax downwardly towards the movable contact element 42x, the actuator 40x
30 can be smoothly pivoted with such one of the abutments 40dx sliding

along the inclined face 32ax of the actuator rod 32x as the operating button 30x is depressed. Also, by allowing the engagement projections 31x integral with the operating button 30x to be engaged with the associated hooks 17x integral with the peripheral wall 15x of the switch lid 10x, the operating button 30x will neither be separated from the switch lid 10x nor be floated.

According to the ninth embodiment of the present invention, the switch assembly A is a push-button switch of a type in which the operating button 30x can be pivoted at one end thereof. Accordingly, as compared with the prior art push-button switch assembly in which the operating button moves up and down in its entirety, there is no possibility that the operating button may be trapped halfway during its stroke of movement which would otherwise result in an erroneous operation of the switch assembly.

In addition, even the operating button 30x used in the ninth embodiment of the present invention has a width substantially equal to or equal to the width of the switch body, that is, the switch lid 10x, and accordingly, the switch assembly A has a relatively large area of the operating surface that permits the switch assembly to be easily and quickly manipulated. Also, the use of the operating button 30x of the specific size is effective to completely cover the rectangular opening 13x in the switch lid 10x and, therefore, no arcing which would be generated upon engagement or disengagement between the movable and fixed contact pieces 47x and 46x will be visible from the outside. Moreover, even though the operating button 30x is separated from the switch casing 10x, no charging portion will be exposed to the outside. See Fig. 27.

The switch assembly A can be mounted on the mounting frame B and is then covered by the ornamental make-up plate C in a manner substantially similar to that described with particular reference

to Figs. 5 to 8C.

Although the present invention has been described in connection with the preferred embodiments thereof with reference to the accompanying drawings, it is to be noted that various changes and
5 modifications are apparent to those skilled in the art. Such changes and modifications are to be understood as included within the scope of the present invention as defined by the appended claims, unless they depart therefrom.

WHAT IS CLAIMED IS:

1. A switch assembly characterized by comprises:

a generally rectangular box-like switch housing having a generally rectangular opening defined therein and also having its interior divided into at least first and second terminal compartments and at least one switch compartment intermediate between the first and second terminal compartments;

an actuator element having an upper portion and pivotally accommodated within the switch compartment with the upper portion exposed to the outside through the rectangular opening, said actuator element being supported in the switch housing for angular movement between two operative positions;

at least one first stationary terminal member accommodated fixedly within the first terminal compartment:

at least one second stationary terminal member accommodated fixedly within the second terminal compartment and having a fixed contact piece secured thereto;

a first connector means accommodated within the first terminal compartment and connected with the first stationary terminal member, said first connector means being utilized for an external electric connection with an external electric wire;

a second connector means accommodated within the second terminal compartment and connected with the second stationary terminal member, said second connector means being utilized for an external electric connection with another external electric wire;

a movable contact member having a movable contact piece secured thereto and electrically connected with the first stationary terminal member, said movable contact member being accommodated within the switch compartment for pivotal movement between an engaged position, in which the movable contact piece is engaged with the fixed contact





piece to close a circuit between the first and second stationary terminal members, and a disengaged position in which the movable contact piece is disengaged from the fixed contact piece to open the circuit;

a generally elongated spring element having upper and lower end portions retained respectively by the actuator element and the movable contact member for driving the movable contact member in response to the pivotal motion of the actuator element between the operative positions;

a generally rectangular operating button angularly movably mounted on the switch housing for driving the actuator element between the operative positions, said operating button having a width substantially equal to or equal to the width of the switch housing; and

at least one engagement nail formed at each of opposite ends of the switch housing, said engagement nails on the opposite ends of the switch housing being engageable with corresponding engagements formed in a frame structure being utilized to fit the switch assembly to a support surface through the frame structure.

2. The switch assembly as claimed in Claim 1, characterized in that the number of each of the first and second stationary terminal members is two and the movable contact member comprises two movable contact bridges electrically connected with the two first stationary terminal members, respectively, and adapted to connect the two first stationary terminal members with the two second stationary terminal members, respectively, when moved to the engaged position.

3. The switch assembly as claimed in Claim 1, characterized in that the number of the second stationary terminal member is two and the movable contact member has an additional movable contact piece secured thereto and that one of the movable contact pieces is engageable with the fixed contact piece of one of the two second stationary terminal members when the movable contact member is moved to the engaged



position and the other of the movable contact pieces is engageable with the fixed contact piece of the other of the two second stationary terminal members when the movable contact member is moved to the disengaged position.

4. The switch assembly as claimed in Claim 1, characterized in that the number of each of the first and second stationary terminal members is two and the number of the elongated spring element is also two, and that the movable contact member comprises two movable contact bridges electrically connected with the two first stationary terminal members, respectively.

5. The switch assembly as claimed in Claim 1, characterized in that said operating button has a window defined therein, and that there is further provided a light emitting position indicator electrically connected between the first and second stationary terminal members, and a prism carried by the operating button with a portion thereof positioned in said window, said prism having one end aligned with the position indicator through the window.

6. The switch assembly as claimed in Claim 1, characterized in that said position indicator comprises a printed circuit board having a light emitting element mounted thereon and contact elements one for each of the first and second stationary terminal members, said contact element being electrically connected with a corresponding terminal piece formed on an undersurface of the printed circuit board, said printed circuit board being carried by the switch housing with the contact elements resiliently held in contact with respective portions of the first and second stationary terminal members.

7. The switch assembly as claimed in Claim 6, characterized in that said position indicator comprises a mounting plate having a light emitting element mounted thereon and also a terminal piece protruding outwardly from the mounting plate and electrically connected with the



light emitting element, and a resistor having one end connected electrically with the light emitting element and the opposite end electrically coupled with the spring element.

8. The switch assembly as claimed in Claim 3, characterized in that said operating button has a window defined therein, and that there is further provided a light emitting position indicator electrically connected between the first and second stationary terminal members, and a prism carried by the operating button with a portion thereof positioned in said window, said prism having one end aligned with the position indicator through the window.

9. The switch assembly as claimed in Claim 8, characterized in that said position indicator comprises a printed circuit board having a light emitting element mounted thereon and contact elements one for each of the first and second stationary terminal members, said contact element being electrically connected with a corresponding terminal piece formed on an undersurface of the printed circuit board, said printed circuit board being carried by the switch housing with the contact elements resiliently held in contact with respective portions of the first and second stationary terminal members.

10. The switch assembly as claimed in Claim 8, characterized in that said position indicator comprises a mounting plate having a light emitting element mounted thereon and also a terminal piece protruding outwardly from the mounting plate and electrically connected with the light emitting element, and a resistor having one end connected electrically with the light emitting element and the opposite end electrically coupled with the spring element.

11. The switch assembly as claimed in Claim 1, characterized in that the switch housing has four corner areas removed by cutting in a direction heightwise thereof.

12. The switch assembly as claimed in Claim 1, characterized in



that the switch housing comprises a switch lid of a generally rectangular cap-like configuration and a switch casing of a generally rectangular cup-like configuration, said switch lid having a plurality of anchor legs each having an anchor hole defined therein, said switch casing having a corresponding number of anchor protuberances formed therein so as to protrude laterally outwardly therefrom, said protuberances being engaged in the corresponding anchor holes in the anchor legs when the switch lid is mounted on the switch casing to thereby unite the switch lid and the switch casing together.

13. The switch assembly as claimed in Claim 6, characterized in that each of said protuberances has an inclined face for allowing the corresponding anchor leg to slide thereover as the switch lid is mounted on the switch casing.

14. The switch assembly as claimed in Claim 6, characterized in that said switch lid has a pair of bearing lugs formed integrally therewith so as to protrude upwardly therefrom in face-to-face relation and positioned on respective sides of the rectangular opening, each of said bearing lugs having a bearing groove defined therein, and that said actuator element has pivot shafts formed integrally therewith so as to protrude laterally outwardly therefrom in respective directions opposite to each other, said pivot shafts being received in said bearing grooves in the bearing lugs to allow the actuator element to undergo a seesaw motion about a common axis aligned with said pivot shafts.

15. The switch assembly as claimed in Claim 14, characterized in that mating dowels are formed integrally with the respective bearing lugs at a location within the associated bearing grooves and below the pivot shafts.

16. The switch assembly as claimed in Claim 12, characterized in that said switch lid has an actuator rod formed integrally therewith, said actuator rod having a lower end engaged with the actuator element



to drive the latter as the operating button is pivoted at one end thereof relative to the switch lid.

17. The switch assembly as claimed in Claim 16, characterized in that a pair of bearing recesses are defined in the switch lid at a location adjacent one of opposite ends thereof and that the operating and that the operating button includes bearing pins formed integrally therewith so as to protrude inwardly in respective directions confronting with each other in alignment with each other, said operating button being mounted on the switch lid with the bearing pins pivotally received in the bearing recess.

18. The switch assembly as claimed in Claim 12, characterized in that said operating button has at least one engagement projection formed integrally therewith so as to protrude towards the switch lid and the switch lid has a hook formed integrally therewith so as to protrude towards the operating button, said engagement projection being engaged with the hook to restrict the angle of pivot of the operating button.

19. A switch arrangement characterized by comprising at least one switch assembly as described in any one of Claims 1 to 18, a generally rectangular mounting frame having a generally rectangular mounting opening defined therein for supporting the switch assembly, and a generally rectangular ornamental make-up frame having a substantially rectangular window defined therein; that mounting frame includes a rigid beam formed integrally therewith so as to extend along one of opposite side edges of the mounting frame adjacent the rectangular opening and a flexible beam formed integrally therewith so as to extend along the other of the opposite side edge of the mounting frame adjacent the rectangular opening, each of said rigid and flexible beams having at least one engagement groove defined therein for receiving the engagement nail; and that said switch assembly is mounted in the rectangular opening with the operating button exposed



to the outside through the rectangular window and with the engagement nails received within the engagement grooves in the rigid and flexible beams.

