

Sept. 16, 1969

C. E. MARTIN

3,467,802

CONDUCTOR APPARATUS FOR SWITCH STRUCTURE

Filed June 21, 1968

3 Sheets-Sheet 1

FIG. 1

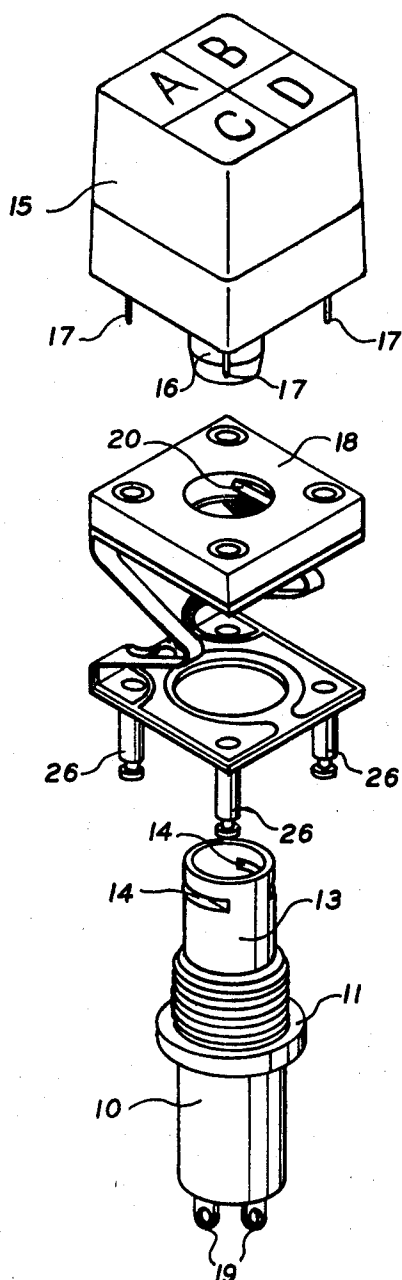


FIG. 2

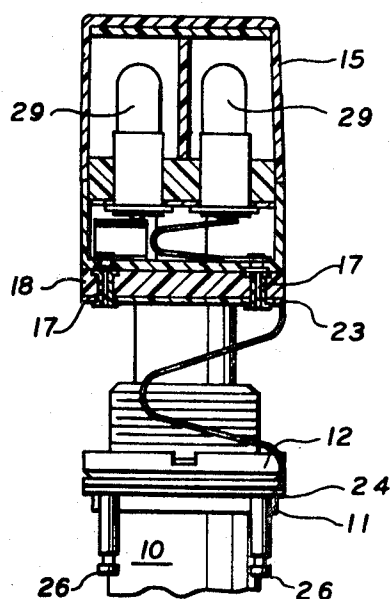
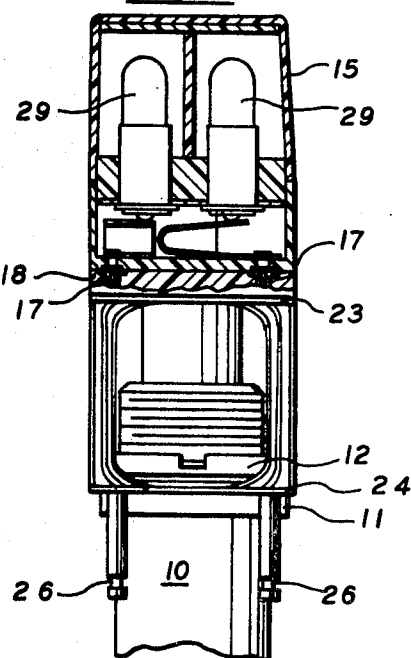


FIG. 3



INVENTOR.
CARL E. MARTIN

BY *Wells & St. John*
ATTYS.

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FIG. 5

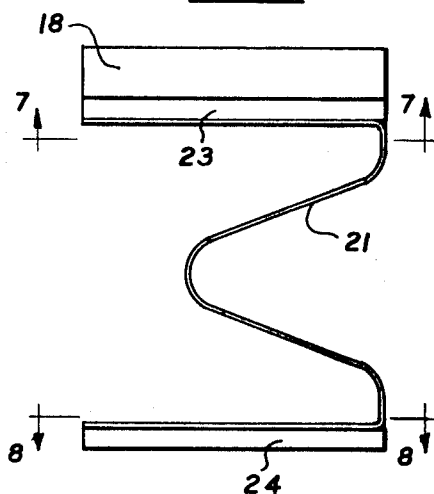


FIG. 6

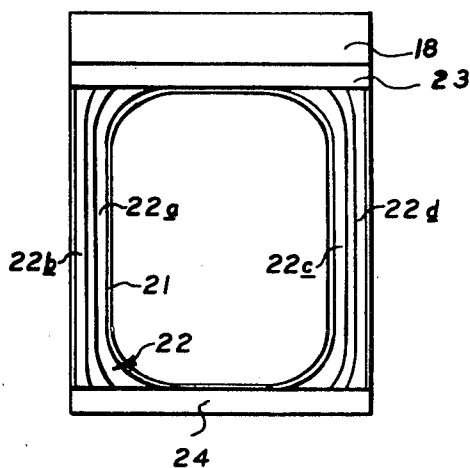


FIG. 7

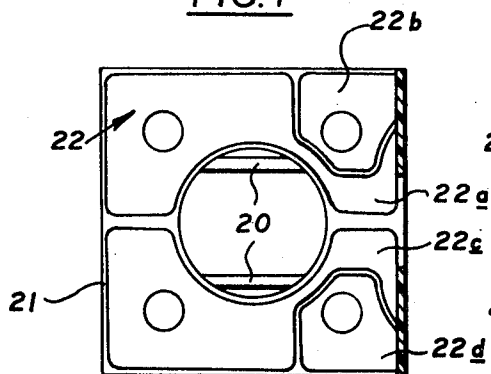


FIG. 8

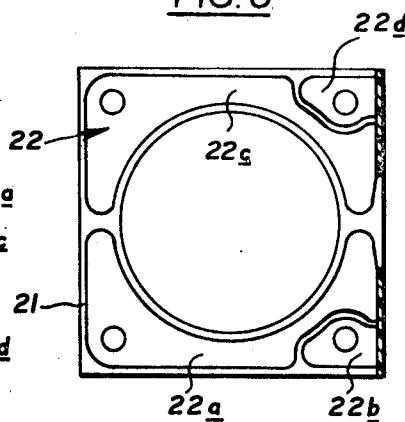
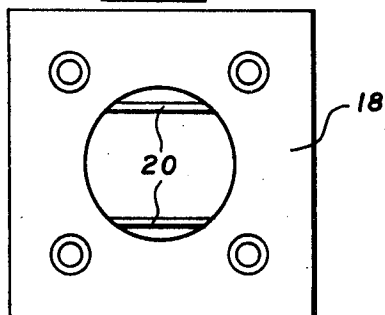


FIG. 4



INVENTOR
CARL E. MARTIN

BY *Wells & St. John*
ATTYS.

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C. E. MARTIN

3,467,802

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FIG. 10

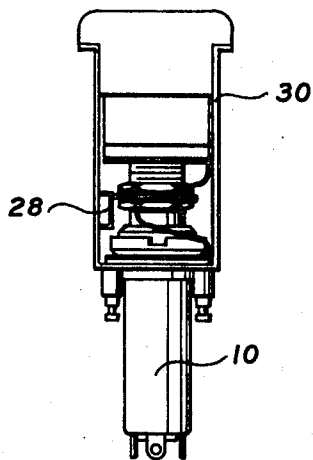


FIG. 9

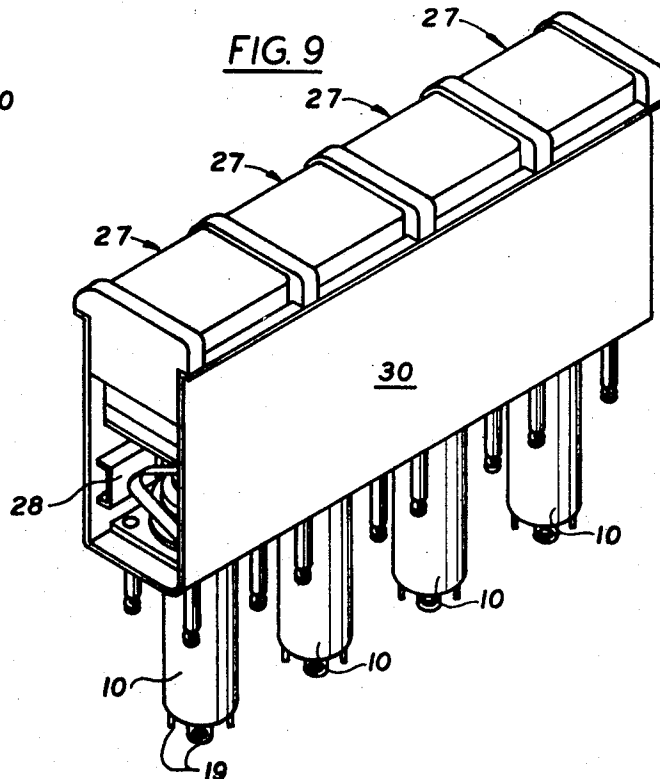
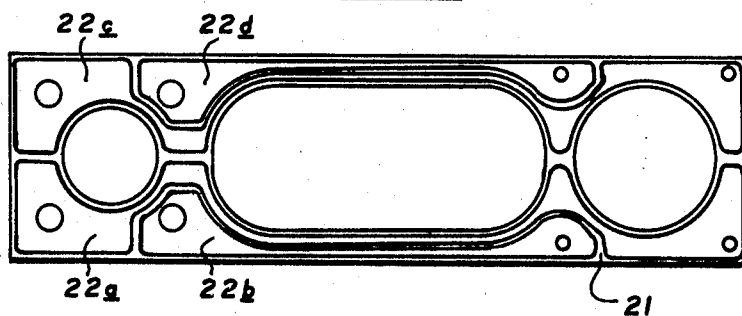


FIG. 11



INVENTOR.
CARL E. MARTIN

BY *Wells & St John*
ATTYS.

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CONDUCTOR APPARATUS FOR SWITCH STRUCTURE

Carl E. Martin, Post Falls, Idaho, assignor to Clare-Pendar Co., Post Falls, Idaho, a corporation of Idaho
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U.S. Cl. 200-167

9 Claims

ABSTRACT OF THE DISCLOSURE

A conductor apparatus for a push button switch including a lighted lens assembly that reciprocates relative to a switch housing. The electrical connections between the stationary mount for the switch and the moving lighted display element or lens are provided through a flexible conductor in the form of a resin strip having layers of suitable conductive material embedded therein. Individual lengths of electrically conductive material are electrically in contact with the lamp terminals on the lighted lens assembly and with the stationary lamp terminals on the switch assembly.

BACKGROUND OF THE INVENTION

This disclosure is concerned generally with the problem of providing an electrical circuit to a moving push button having one or more lamps mounted therein used for indicator purposes. In prior art devices, the electrical connections to the push button lamp circuits for a moving lens have been provided by telescoping contact posts or other devices involving contact elements which wipe one another to maintain the electrical circuit regardless of the lens position relative to the switch assembly. Another alternative has been the use of individual light coil springs as flexible connectors. Both alternatives involve structures which add to the bulk and complexity of the switch assembly. Additionally, their placement is peculiarly restricted both by the design of the switch structure and by the necessary relative placement of the lamps within the display element. Each presents the risk of electrical or mechanical failure due to the singular or combined effects of environmental stresses such as moisture, salt spray, sand and dust, vibration or mechanical shock.

According to the present disclosure, the electrical lamp circuit connections are provided in a flexible member that is fully insulated except at the areas of terminal contact. The thin resin strip adds only a negligible resistance to the normal force relationship that exists in the switch assembly and is capable of repeated flexing during the full expected life of such a switch structure. It also permits all of the electrical connections to the lighted lens or display element to be made along the sides of the switch structure, leaving the remaining sides clear for other mechanisms such as interlock devices running alongside a plurality of such switches.

SUMMARY OF THE INVENTION

The basic invention relates to a conductor apparatus for the essential components of a push button operated switch assembly which includes a switching module, a plunger that moves axially relative to the housing and a lighted push button lens or display element on the plunger, including at least one indicator lamp. The conductor improvement includes a first lamp terminal on the plunger connected to the lamp, a second lamp terminal fixed relative to the switching module and a planiform or flattened strip of electrically insulated flexible resin having a continuous length of electrically conductive material en-

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veloped within it. One end of the strip is secured to the first lamp terminal with the conductive material in electrical contact with the terminal. The remaining end of the strip is secured to the second lamp terminal with the material in electrical contact with the terminal. This basic relationship can be accomplished with any number of lamps and terminals by using a plurality of lengths of conductive material within the strip. In the preferred form of the device, the length of the strip that extends between the respective terminal connections is greater than the maximum separation between the first and second terminals during reciprocation of the plunger relative to the switch housing. The central portions of the strip are preferably in the form of U-shaped projections extending inward in elevation from the edges of the switch structure.

It is a first object of this invention to provide a mechanical alternative to the usual wiping or telescoping spring contacts used for movable conductors between a lighted lens assembly or display element and a stationary terminal structure on a lighted push button switch structure.

Another object of this invention is to provide an improved conductor apparatus for a lighted push button lens assembly wherein the conductor apparatus is fully insulated from the surrounding structure.

Another object of the invention is to provide a mechanically simple conductor apparatus for lighted push button switches which is capable of withstanding repeated flexing and bending and which is not susceptible to damage due to vibration or external shock loading.

Another object of the invention lies in providing a mechanically simple conductor apparatus for lighted push button switch assemblies, improving projected operation of the assembly and reducing assembly and production expense.

Another object of the invention lies in providing a mechanically simple conductor apparatus which can be easily varied to accommodate different combinations of switch and lens structure.

These and further objects will be evident from the following disclosure, taken together with the accompanying drawings which illustrate a preferred form of the invention. The specific form of the device shown in the drawings is only presented by way of example, the invention set out herein being applicable to many variations in such a structure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view of the switch assembly and lighted push button lens assembly together with the improved conductor apparatus;

FIG. 2 is a front elevation view of the assembled switch and lens combination shown in FIG. 1, with the lens shown in section;

FIG. 3 is a side elevation of the structure shown in FIG. 2;

FIG. 4 is a top view of the improved conductor apparatus;

FIG. 5 is an elevation view of the conductor apparatus;

FIG. 6 is a side elevation view of the conductor apparatus as seen in FIG. 5;

FIG. 7 is a sectional view of the conductor apparatus as seen along line 7-7 in FIG. 5;

FIG. 8 is a sectional view of the conductor apparatus as seen along line 8-8 in FIG. 5;

FIG. 9 is a perspective view of a group of switch assemblies mounted in a channel and provided with an interlocking mechanism;

FIG. 10 is an end view of the grouped structure shown in FIG. 9; and

FIG. 11 is a flat view of the conductor strip.

PREFERRED EMBODIMENT OF THE INVENTION

The essential elements of the present disclosure can be seen in FIGS. 1, 2 and 3. The improvement in a conductor apparatus relates to the electrical circuit for a lighted push buttons lens 15 which serves as a selectively lighted display element and is used as a manual actuator for a push button controlled switch. The details of the switch are not particularly pertinent to this disclosure, since the switch may be of any conventional type operated by a reciprocation of a push button.

In the present instance, the switching devices are mounted within a switching module shown at 10. The switching module 10 is disclosed as an elongated structure having a plurality of terminals 19 at one end and having a reciprocable tubular plunger 13 projecting beyond its remaining end. The plunger 13 moves axially relative to the switching module 10 to manipulate the switch elements contained within the switching module 10. The devices within switching module 10 can be adapted to carry out various functions in relation to circuits connected to the terminals 19, the switch being actuated or deactuated by depression of plunger 13. For purposes of this disclosure, the switching module 10 will be discussed as being in a stationary condition, and movement of plunger 13 will be referred to as being axial, that is, parallel to the longitudinal central axis of the plunger 13. The plunger 13 is axially movable between an extended position as illustrated in the drawings and a depressed position offset toward the switching module 10.

The detailed interior structure of the lighted push button lens 15 is also not particularly material to an understanding of the present improvement. The lens 15 is generally constructed of electrically insulating material and normally includes a translucent or transparent outer surface on which can be imprinted suitable indicia relating to the intended use of the switch assembly. By choice of colored filters and printing techniques, a suitably chosen lighted display can be achieved when the lamp or lamps 29 within the lens 15 are activated. The lens 15 in some instances is provided with a single lamp. Many varied lamp combinations are available. It also can be provided with a plurality of lamps wired in series or a plurality of lamps within lens 15 might be wired independently but operated simultaneously by external circuitry. A plurality of lamps might be entirely individual in operation so as to provide, as an example, four different colored or written indications on the face of the lens 15, depending upon which of the four individual lamps is activated at a particular time. For purpose of example, the present device is illustrated with four lamp terminals projecting outward from the base of the lens 15, the lamp terminals being designated by the numeral 17. Terminals 17 can be connected to four separate miniature lamps 29 within the lens 15, or to a greater or lesser number of lamps depending upon the particular lens structure.

The plunger 13 is slidably mounted within the switching module 10 for reciprocation between its extended and depressed positions relative to housing 10. It normally is biased to its extended position as illustrated, preferably by means of springs or other mechanisms contained within switching module 10. The switching module 10 is provided with an exterior mounting shoulder 11. The switch is preferably mounted in a panel or subpanel by engagement through a suitably apertured mounting plate or surface and is locked in place by a releasable mounting nut 12 threadably engaged about switching module 10.

The outer end of plunger 13 is shown provided with two slots 14 cut therein, by which an adapter block 18 is secured to the outer end of plunger 13. The adapter block 18, formed of electrically insulating resin, includes opposed straight springs 20 which project across a central aperture complementary to the outside cross section of the plunger 13. The springs 20 releasably engage the slots 14 and project inwardly across the interior of the plunger

13. They serve both to mount the adapter block 18 in place on plunger 13 and also to releasably engage a projecting pin 16 that extends from the center of the base of lens 15.

The pin 16 mechanically interlocks lens 15 and plunger 13, and can further serve as a common ground for the lamp circuits within lens 15 if this is desired. In this instance, one or more of the terminals 19 at the opposite end of switching module 10 is utilized as a terminal connection for the central common ground. The illustrated four lamp terminals 17 can then serve as the remaining terminals for four individual lamp circuits within lens 15.

The improvement in a conductor to the movable lamp terminals 17 is best understood with reference to FIGS. 4 through 8. The conductor comprises a planiform or flattened resin strip 21 of flexible material such as flexible polyester resins or flexible epoxy resins. Strip 21 is first produced in a flattened condition as shown in FIG. 11 and is formed by heat on a suitable jig, the heating being accomplished by immersion in a heated bath or by any other suitable process. After being formed, the strip generally maintains the configuration shown in FIGS. 4, 5 and 6. Other configurations permitting free flexing of strip 21 can be used with equal efficiency.

The resin strip 21 has embedded within it a conductor film or layer of copper or other suitable thin electrically conductive material. The conductive material 22 is etched to provide spacing between adjacent lengths of the conductive material, each length of conductive material serving as a separate conductor to the individual terminals 17. As illustrated, there are four lengths of conductive material 22 within the resin strip 21, the individual lengths of conductive material being respectively designated by the numerals 22a, 22b, 22c and 22d.

One end of the resin strip 21 is bonded to a rigid upper mounting block 23. The remaining end is bonded to a similar lower mounting block 24. The blocks 23, 24 are preferably formed of rigid resin such as an epoxy resin. They can be suitably reinforced by materials such as glass fibers. The upper block 23 is apertured to complement the exterior cross section of plunger 13, and the lower block 24 is apertured to complement the exterior of switching module 10. The upper block is preferably bonded to the adapter block 18. It is therefore mounted in a fixed relation to plunger 13 along with the adapter block 18. The lower block 24 is mounted in a fixed position relative to switching module 10, by either being secured by the mounting nuts 12 or by any other suitable securing structure. The intermediate sections of the resin strip 21 and conductive material 22 provide a resilient and flexible conductor necessary to maintain constant electrical contact between the relatively moving ends of the strip 21.

At the upper end of the conductor assembly, each length of conductive film 22 is in electrical contact with one of the lamp terminals 17 by means of a suitable receptacle or plug mechanically connected to the conductive material at confined exposed areas thereof. The remaining end of each length of conductive material 22 is electrically connected to lamp terminal posts 26 which in turn are suitably insulated and which serve as soldering terminals for connection to exterior control circuits for the lamps within the lens 15.

One advantage of the flexible conductor structure is that all of the connections to the moving lens 15 can be provided at one side of the switch structure. The two legs of strip 21 can closely straddle plunger 13, and even physical contact with the plunger 13 is not detrimental since the conductive material 22 is protected by a continuous coating of the insulating resin.

By maintaining all of the conductive structure at one side of the switch apparatus, a more compact mounting arrangement is possible when mounting a series of switches 27 in combination with an interlock structure 28 within a channel 30 as shown in FIGS. 9 and 10. The conducting strips 21 do not interfere with the mechanical

operation of the interlock structure 28, and permit the width of channel 30 to be reduced from that necessary in prior switch devices where individual conductive posts were provided at the four corners of the structure. The details of the interlock mechanism 28 are not necessary to an understanding of the application of the present improved conductor assembly, the interlock arrangement shown in the drawings being based upon the essential description of the interlock apparatus shown in U.S. Patent No. 3,126,457 to Jones.

The use of a flexible conductor has considerable advantage over the use of wiping or telescoping contacts or exposed light springs. The conductor assembly is capable of withstanding environmental stresses due to temperature, moisture, salt or dust conditions. It does not add appreciably to the operating force required to depress the switch actuator or plunger, being made of a resin having practically no reactive characteristic or force similar to a spring. By using a relatively thin conductive layer 22, one can design the lengths of conductive material within strips 21 to accommodate great design flexibility in the placement of the respective lamp terminals or other structures used to conduct current to the external contacts and lamps. This structure further provides independent lamp circuitry for a plurality of lamps in a movable lens with less material bulk and physical size than has been accomplished previously.

Obviously, many different changes can be made in this structure without deviating from the basic concept of the thin, flexible insulating strip and the conductive film embedded therein.

Having thus described my invention, I claim:

1. In combination with a push-button-operated switch assembly comprising:

a switching module;

a movable plunger extending outward from one end of said switching module, said plunger being mounted by said switching module for axial movement relative thereto;

and a lighted pushbutton mounted on the outer end of said plunger for movement therewith, including an indicator lamp;

the improvement comprising:

first lamp terminal means at the outer end of the plunger operatively connected to the electrical circuit of said lamp;

second lamp terminal means on said switching module adjacent said one end thereof;

a thin planiform strip of electrically insulating flexible resin;

a continuous layer of electrically conductive material enveloped within said strip;

one end of said strip secured relative to said first lamp terminal means with the layer of electrically conductive material in electrical contact therewith;

the remaining end of said strip secured relative to said second lamp terminal means with the layer of electrically conductive material in electrical contact therewith.

2. The apparatus as set out in claim 1 wherein the length of said strip between the respective ends of said strip is greater than the maximum distance of travel of said plunger.

3. The apparatus as set out in claim 1 wherein said first lamp terminal means is mounted on a first rigid board of electrically insulating material surrounding said plunger and positioned in a plane perpendicular to the plunger axis;

said second lamp terminal means being mounted on a second rigid board of electrically insulating material

surrounding said switching module and positioned parallel to said first rigid board;

the respective outer ends of said strip being bonded to opposing surfaces of said first and second rigid board.

4. The apparatus as set out in claim 3 wherein said strip extends across the space separating said first and second rigid boards from locations on each of said boards aligned with one another in a plane that is parallel to the plunger axis.

5. The apparatus as set out in claim 4 wherein said strip extends across the space separating said first and second rigid boards from the periphery of each board, the intermediate portion thereof extending inwardly therefrom and lying within the confines of the respective boards.

6. In combination with a pushbutton-operated switch assembly comprising:

a switching module;

a movable plunger extending outward from one end of said switching module, said plunger including a plurality of indicator lamps mounted thereon;

a plurality of first lamp terminals mounted about said plunger at the outer end thereof for reciprocating movement along with said plunger, and first lamp terminals being operatively connected in the respective electrical circuits of the lamps;

a plurality of second lamp terminals equal in number to said first lamp terminals, said second lamp terminals being fixed relative to said switching module adjacent said one end thereof;

a thin planiform strip of electrically insulating flexible resin;

a plurality of continuous lengths of electrically conductive material equal in number to said first lamp terminals, said lengths of conductive material being enveloped within said strip, each length of conductive material extending between the respective ends of said strip;

one end of said strip secured relative to said first lamp terminals, the respective ends of said lengths of conductive material at said one end of said strip electrically connected with the individual first lamp terminals;

the remaining end of said strip secured relative to said second lamp terminals, the respective ends of said lengths of conductive material at said remaining end of said strip electrically connected with the individual second lamp terminals.

7. The apparatus as set out in claim 6 wherein the length of said strip between the respective ends thereof is greater than the maximum distance of travel of said plunger.

8. The apparatus as set out in claim 7 wherein the portions of said strip between the ends thereof are in the form of two relatively narrow sections in comparison to the total width of said strip, said sections being positioned at opposite sides of said plunger.

9. The apparatus as set out in claim 8 wherein the portions of said strip between the ends thereof is formed in a U-shaped configuration extending inwardly across the switch assembly and within the space confines thereof.

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H. O. JONES, Primary Examiner