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Pittman et al.

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[45] **June 25, 1974**

[54] **ELECTRONIC MOMENTARY SWITCH**

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[73] Assignee: **Lectradate, Inc.,** Atlanta, Ga.

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[52] **U.S. Cl.**.... **200/159 B,** 200/166 C, 200/166 BH, 200/167 A

[51] **Int. Cl.**..... **H01h 13/52,** H01h 1/02, H01h 1/06

[58] **Field of Search**..... 200/166 C, 159 B, 166 BH, 200/5 A, 16 A; 340/365 R

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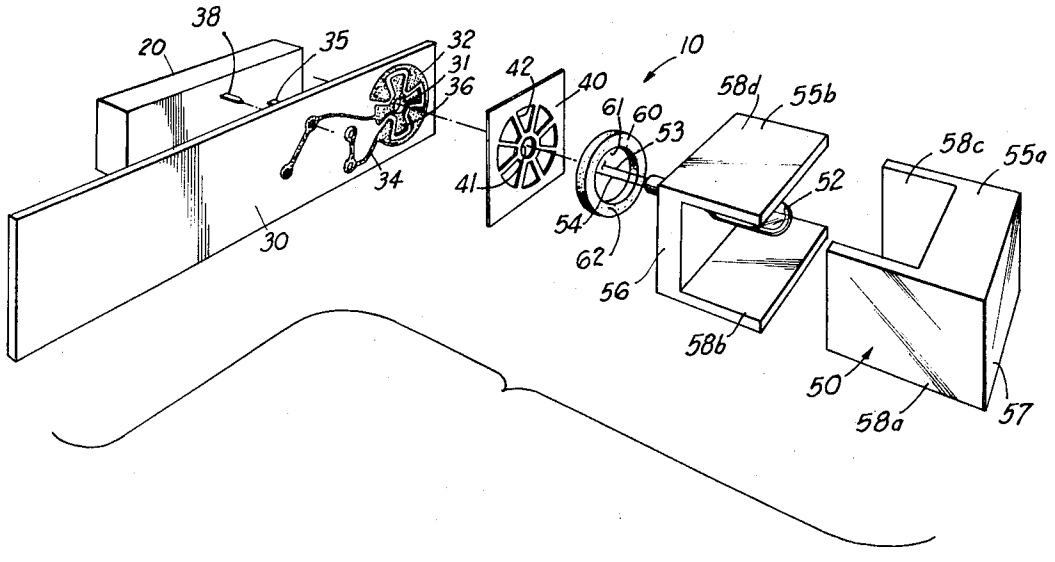
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Attorney, Agent, or Firm—Newton, Hopkins & Ormsby

[57] **ABSTRACT**

An electronic momentary switch operable for initiating current flow in solid state circuit means in response to movement of depressible switch button means. The electronic momentary switch means includes circuit means electrically connected to the solid state circuit means. The electrical circuit means includes a number of space conductive contacts detailed in location to normally prevent current flow, therethrough. Insulation means having a number of cut out openings corresponding to the number and location of the conductive contacts. A deformable conductive resilient elastromeric means is supported on the depressible switch button means and positioned above the openings in the insulation means whereby depressing movement of the switch button means will deform the conductive resilient means, such that the conductive resilient means is deformed through the openings in the insulation member and into contact with the conductive contacts, whereby electrical current can flow through the spaced contacts for biasing the solid state circuit from an off non-current conducting condition to an on, or momentarily closed, current conducting position. The switch button means is constructed of a clear transparent housing and includes light mounted therein, with the light being illuminated in response to movement of the solid state circuit means to an on current conducting position.

In the second embodiment the switch is shown with a plurality of circumferentially spaced terminals which are closed or shunted momentarily, operating with an alphanumeric indicator, such as light emitting diodes or Nixie tubes. By selection of the arrangement of the apertures in an insulation sheet, selective lighting of the indicator is provided.

5 Claims, 11 Drawing Figures



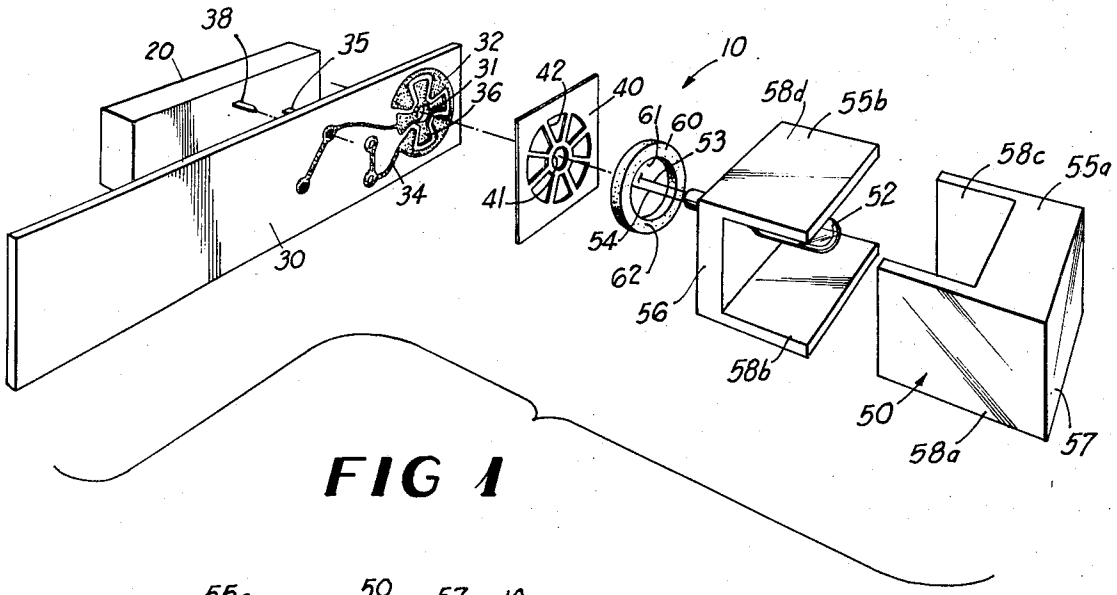


FIG 1

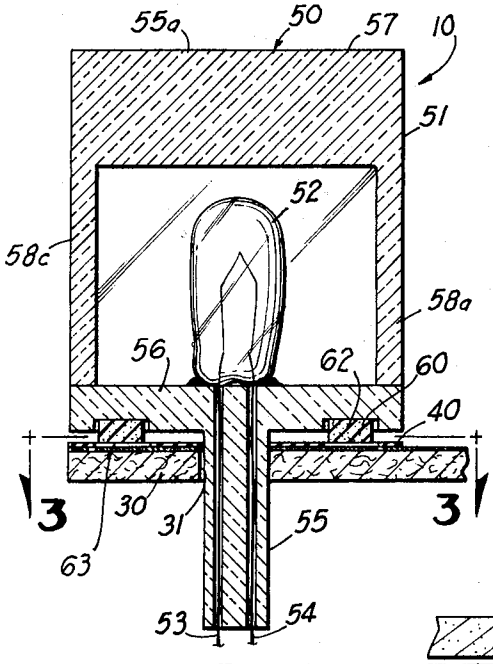


FIG 2

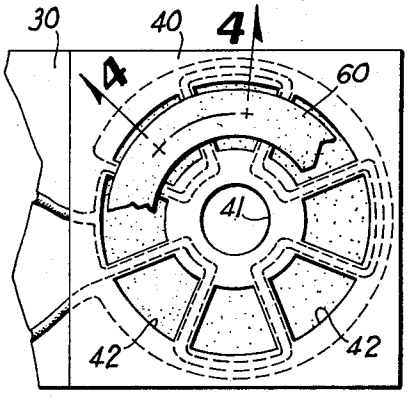


FIG 3

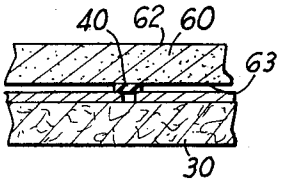


FIG 4

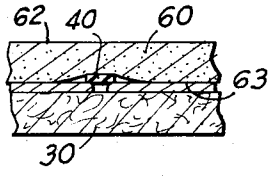


FIG 5

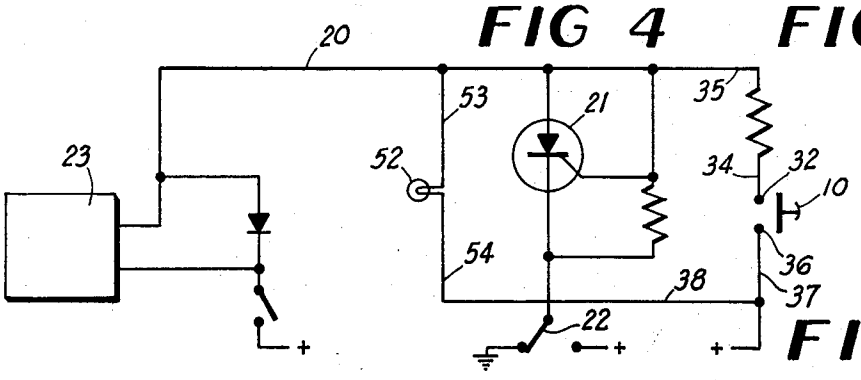


FIG 6

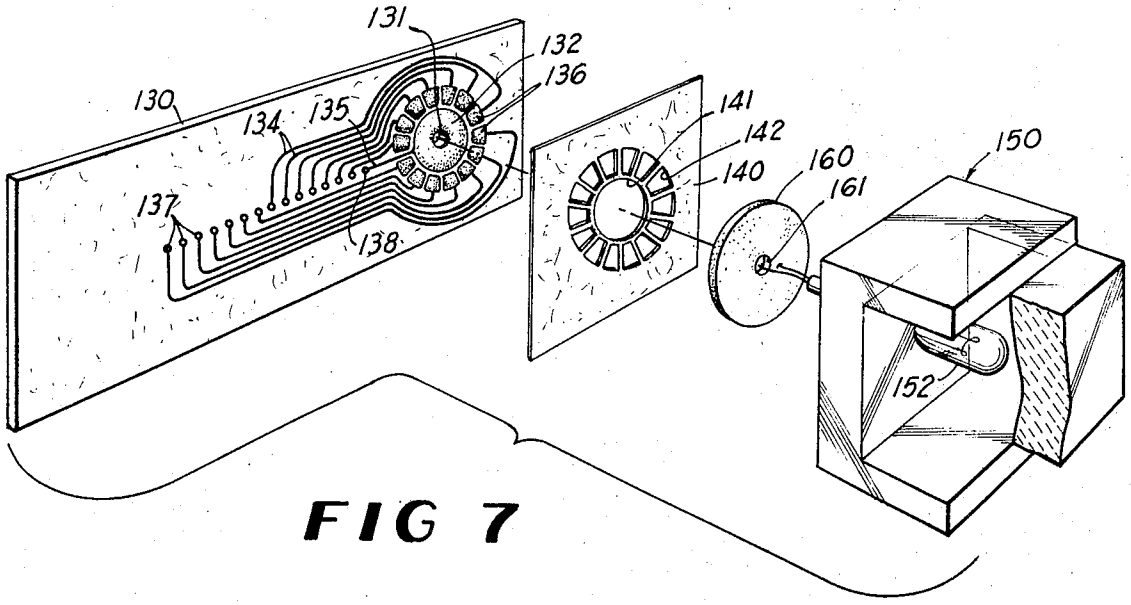


FIG 7

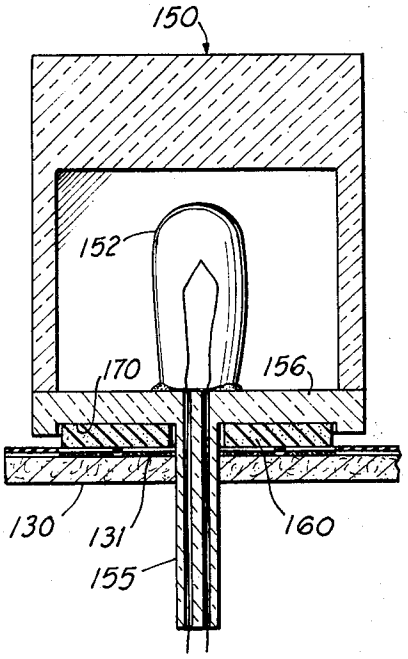


FIG 8

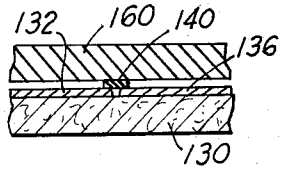


FIG 9

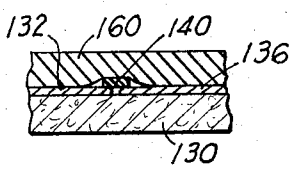


FIG 10

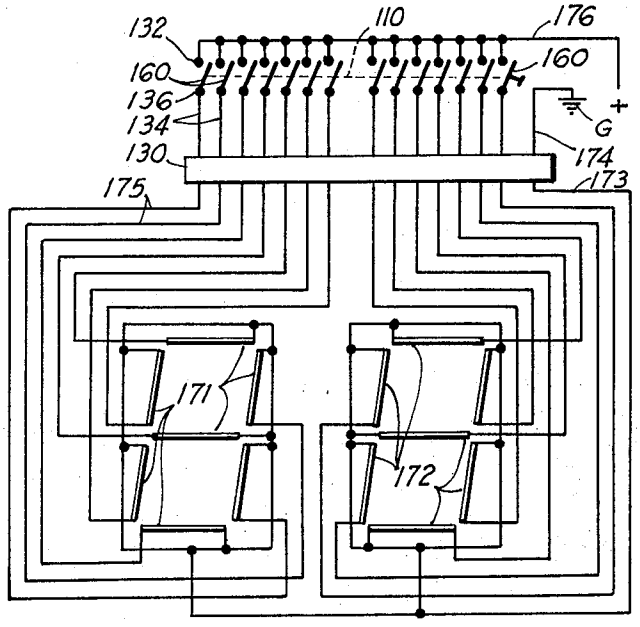


FIG 11

ELECTRONIC MOMENTARY SWITCH

BACKGROUND OF THE INVENTION

This invention relates to an electrically operable depressible switch means having means for initiating current flow in response to depressing of the switch button means.

A number of prior art electronic momentary switch means have been provided for initiating current flow in a solid state circuit. However, the prior art electronic momentary switches are constructed to include a number of mechanical linkages and movable parts, with an operable switch button means associated therewith and normally spring biased to a nonoperable position. A current is initiated in the prior art momentary switch means by depressing the switch button to overcome the resistance of the spring biasing means and for thereafter moving linkage members containing electrical current conducting contacts into engagement with each other for initiating current flow therethrough.

One problem with the prior art mechanical switch devices includes an electrical bounce created in the circuit due to the translating movement of the mechanical linkage and switch carrying contact members.

These prior art momentary switches including linkage means and mechanical contact support members are complex in construction and assembly, uneconomical to manufacture and unreliable in operation.

Another problem with the prior art devices is that the switches do not lend themselves well to alteration for momentarily connecting a plurality of terminals together.

SUMMARY OF THE INVENTION

The above disadvantages of the prior art momentary switch devices have been overcome by the present invention which basically includes a resilient conducting member operatively associated with a number of spaced electrical conducting contacts, wherein the resilient conducting member is normally held in spaced relationship relative to the terminals or space contact and is caused to deform such that the member will contact the space contact the space contact is initiate current flow therethrough, whereby the current flow conducted through the spaced contacts can effect operation of solid state circuit means to bias the solid state circuit from an off non-current conducting position to an on current conducting position.

The electronic momentary switch embodying the principles of the present invention is constructed of a base supporting non-conducting member having an opening formed therein with a number of conductive contacts concentrically arranged around the opening and detailed in spacing to prevent current flow therethrough. An insulation member is supported on the base support member above the electrical circuit, with the insulation member being provided with an opening therein coaxially arranged relative to the openings in the base support member and with the insulation members being provided with a number of cut outs or apertures concentrically arranged relative to the openings and detailed in location and aligned with the conductive contacts on the base support member.

A depressible switch means having an elongated axially extending projection, complementary to the openings in the insulation member and the base supporting member, is supported for axial movement relative thereto. An annular ring of resilient conducting material is supported around the depressible switch button's axially extending projection, with the material being positioned above the cut outs or apertures in the insulation member. The momentary switch is operable under depression of the switch button means to effect deforming of the material whereby the material is moved through the apertures in the insulation member, to make contact with the conductive contacts or terminals and thereby initiate current flow in the electrical circuit.

A feature of the present invention includes the construction of the switch button means of transparent material and wherein the switch button means includes light mounted therein and an electrical circuit means extending through the axially extending projection and connected to the electrical circuit means whereby initiation of current flow in the solid state circuit will energize the light in the switch button means.

The electronic momentary switch of the present invention has the advantage of lowering the resistance of a depressible switch button means until a threshold current is reached, which current latches up a solid state circuit device such as SCR's, transistors, etc., whereby current flow initiated in the solid state devices will continue to flow when the pressure is released on the depressible switch means.

In one embodiment the number of apertures and terminals are selectively provided so that the switch lends itself well to alphanumeric coding the actuation Nixie tubes or light emitting diodes.

It is therefore a primary object of the present invention to provide a low resistance depressible switch means which is operable for initiating current flow in a solid state circuit and which is operable for eliminating current bounce.

An additional object of the present invention is to provide an electronic momentary switch which is simple in construction and operation, economical to manufacture and reliable in performance.

Another object of the present invention is to provide a switch selectively programmable for use in alphanumeric type actuation, without material change to the basic switch.

Another object of the present invention is to provide a normally open switch capable of simultaneously shunting a plurality of juxtaposed electrical terminals.

Still other objects and advantages of the details of construction will become apparent upon reading the following description of the illustrative embodiment embodying the principles of the present invention with reference to the attached drawings herein like reference numerals have been used to refer to like parts throughout the several figures, and wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view of an electronic momentary switch embodying the principles of the present invention;

FIG. 2 is an enlarged vertical sectional view of the switch shown in FIG. 1 in an assembled relationship;

FIG. 3 is an enlarged sectional view taken along line 3—3 of FIG. 2 showing the resilient conducting member; and,

FIG. 4 is a vertical sectional view taken along line 4—4 of FIG. 3;

FIG. 5 is a vertical sectional view similar to FIG. 4 showing the deformation of the resilient conducting member;

FIG. 6 is an electrical schematic of solid state circuit means operatively connected to the electronic momentary switch means; and

FIG. 7 is an exploded perspective view similar to FIG. 1 and showing the use of the switch in conjunction with with a printed circuit board for shunting a plurality of terminals;

FIG. 8 is a view similar to FIG. 2 but showing the switch depicted in FIG. 7;

FIG. 9 is a vertical technical view taken along line 9—9 in FIG. 8;

FIG. 10 is a vertical sectional view similar to FIG. 9 and showing the switch is a depressed closed condition; and

FIG. 11 is an electrical schematic of a circuit depicting the operation of the switch of FIG. 7 in an alphanumeric electrical circuit.

DESCRIPTION OF THE ILLUSTRATIVE EMBODIMENT

Referring now to the drawings, the electronic momentary switch embodying the principles of the present invention is shown and generally represented by the reference numeral **10.** Switch **10** will be described with reference to solid state circuit means **20,** a base support member **30,** an insulation member **40,** a depressible switch button means **50** and an annular resilient conducting member **60.** Preferably the annular conducting member **60** is made from "chomeric rubber;" however, any other electrically conducting deformable elastomer could be submitted for the "chomeric rubber."

As shown in FIG. **1,** the base support member **30** is constructed of non-conductive material, rectangular in configuration and includes an opening **31** formed therein. A number of conductive contacts **32, 36** are attached to the surface of member **30** and are concentrically spaced around opening **31.** Contacts **32** are connected by lead line **34** to an input lead **35** which is electrically connected to solid state circuit **20.** Contacts **36** are detailed in location relative to contacts **32** whereby current flow cannot normally be transmitted therethrough. Contacts **36** are connected by a lead line **37** to an input line **38** electrically connected to the solid state circuit **20.**

Switch **10** includes an insulation member **40** constructed of non-conductive material in substantially rectangular configuration. The insulation member **40** includes an opening **41** formed therethrough. Opening **41** is identical in dimension to the base support opening **31.** Insulation member **40** includes a number of cut out openings **42** concentrically arranged around opening **41.** In an assembled relationship, the insulation member is secured on the surface of the base support member **30** on the same side as the contacts **32, 36.** In the assembled relationships the openings **41** and contacts **42** are aligned with opening **31** and conductive contacts **32, 36,** respectively.

As shown in FIGS. **1** and **2,** the electrical momentary switch **10** includes a switch button means **50.** The switch button means **50** includes a rectangular housing formed from a pair of U-shaped, transparent, plastic housing elements **55***a* and **55***b* fitted together to define a flat rectangular bottom or base **56,** a flat rectangular top **57** and flat rectangular sides **58***a*, **58***b*, **58***c* and **58***d*. When fitted together, the elements **55***a*, **55***b* define an interior light cavity.

A light means or lamp **52** is disposed in the cavity of housing **50,** being mounted centrally on the inner surface of base **56.** Light means **52** is provided with a pair of wires or lead lines **53** and **54** which pass outwardly through base **56** and thence through a guide plunger or projection **55,** which protrudes outwardly from the central portion of base **56.**

Lead lines **53, 54** are electrically connected to the solid state circuit means **20.** When the solid state circuit means **20** is in an on current conducting position, current will flow through the lead lines **43, 54,** thereby illuminating light means **52** which will affect a corresponding illumination of the switch button means **50.**

As shown in FIGS. **1** and **2,** the axially extending cylindrical projection or plunger **55** is complementary with and slidably supported within openings **31, 41** formed in the base support member **30** and insulation member **40,** respectively.

As shown in FIGS. **2** and **3,** the annular conducting elastomeric member **60** is mounted on the bottom or outer surface of base **56** around the axially extending projection **55.** The annular member **60** is provided with a central opening **61,** in FIG. **1,** which receives projection **55** and includes flat parallel upper and lower surfaces **62** and **63** and a radial dimension which assures that member **60** overlies the cutout openings **42** formed in the insulation member **40.** As pointed out above, the annular member **60** is constructed of conductive elastic material which can be deformed within its eleastic limits from an original planar, unstressed state to a deformed stressed state, with pressure. The insulation member **40** will, however, normally support ring member **60** in spaced relationship relative to the conductive contacts **32, 36** (FIG. **4**). When pressure is applied inwardly to the switch housing **51,** the member **60** is clamped between support member **30** and base **56** whereby portions of the member **60** are urged within its elastic limits through the cutaway openings or apertures **42** into simultaneous contact with conductive contacts **32, 36** (FIG. **5**). When the member **60** is moved into contact with conductive contacts **32, 36,** the switch is closed and a circuit is made between contacts **32,** and **36.** Thus, current can flow between input lines **35, 38** into the solid state circuit **20.** Current flowing through the input lines **35, 38** will bias the solid state circuit from an off, non-conducting position to an on, current conducting position. When the solid state circuit is biased to an on, current conducting position, current will flow through lead lines **53, 54** to the light means **52,** thereby illuminating housing **51.**

After the pressure has been released from the switch button means **50,** the solid state circuit **20** will remain in an on, current conducting position until the solid state circuity is returned to an off, non-conducting position by receiving a remote electrical pulse for resetting the solid state circuitry to an off, non-conducting position.

As shown in the electrical schematic of FIG. **4,** the solid state circuit **20** includes a transistor **21.** The transistor **21** is normally biased to an off non-current conducting position. When the electronic momentary switch **10** is depressed to initiate current flow between

contacts 32, 26, the current flowing therethrough will bias the transistor 21 to an on current conducting position. After switch 10 moves to an open non-current conducting position, the transistor 21 will remain in a biased current conducting position until an electrical pulse is transmitted through the transistor 21 from a control switch 22.

When the solid state circuit 20 biased to an on current conducting position, the current flow will be transmitted to the light means 52 and will be operable for transmitting current flow therethrough to additional electronic actuating means, such as electronic counter means 23 associated with voting machines.

Referring to the second embodiment, as depicted in FIGS. 7 through 11, the momentary switch of this embodiment includes a printed circuit board which is a thin flat substrate or support member 130 formed of a non-conducting material and provided with a hole 131. The member 130 forms the base lamina or wafer which receives conducting material, forming a circuit, printed or deposited onto the member or substrate 130. In this particular instance, the electrically conducting material includes a centran annular base contact or inner terminal 132 disposed concentrically with the hole 131. Surrounding and spaced radially from the terminal 132 are a plurality of circumferentially spaced terminal segments or outer contacts 136. Each of the terminals 136 is isolated electrically from each other terminal 136 and is also isolated electrically from the central base terminal 132; however, they are in close proximity with each other and the terminals 136 form a segmented outer ring or annulas or rose surrounding the central terminal 132. The terminals 132, 136 form a wafer or lamina in which upper surface of terminals 132, 136 are in a common plane with each other and are slightly above the place of the front surface of substrate 130.

Each of the terminals 136 is provided with a lead line or printed electrical conductor, denoted by numeral 134. Each of the lead lines or conductors 134 terminates at an aperture or hole 137, surrounded by conducting material so that an appropriate electrical element can be connected thereto or subsequent dip soldering. The base terminal 132 is, likewise, provided with a lead line or electrical conductor 135 and a hole 138 in a manner described for the preceding terminals.

Overlying the spaced roses formed by the terminals 132 and 136 is a thin flat wafer or dielectric member insulation 140 larger in diameter than the rose of terminals 136 and having a central circular hole or aperture 141 which is slightly larger in diameter than the diameter of the base terminal 132. The insulation member 140 forms a lamina which is mounted on and adhered substrate 130 with the hole 141 in registry with and concentric with the central terminal 132. In the present embodiment, the insulation member 140 is provided with aperture segments or openings 132 which, in the present embodiment, correspond to and are in registry respectively with the terminals 136. The apertures 142 are circumferentially spaced from each other and form an outer ring or rose surrounding the central aperture 141.

According to the present invention, any one or a plurality of the apertures 142 may be closed, thereby isolating the corresponding terminal 136. By selectively closing off the apertures 142 prior to assembly (or, simply failing to cut an aperture 142) the switch may be programmed for a prescribed alphanumerical signal. The same effect can be accomplished by leaving an open circuit to one or several of the conductors 134. The functioning of the circuit of the second embodiment, however, will be explained in more detail later.

Outwardly of the insulation member 140 is the annular resilient elastomeric conducting member of pole 160. This member 160 is formed of "chromeric rubber" or some other electrically conducting elastomer and has an outside diameter equal to or slightly smaller than the diameter of the outer rose formed by the apertures 142. The central hole 161 of the member 160 is of a diameter slightly larger than the diameter of hole 131. The elastomeric conducting member 160 has a flat bottom surface 148 which is contiguous with the outer surface of insulation member 140 so as to be spaced from and parallel to the plane of terminals 132, 136 by the thickness of insulation member 140.

The remainder of the switch, as illustrated in FIGS. 7 and 8, are substantially identical to the switch illustrated in FIGS. 1 and 2, the switch of FIGS. 7 and 8 including a transparent housing or actuating button means 150 having a cavity which receives the lamp or light 152. The elastomeric conducting member 160 is adhered to the bottom surface of the base 156 of housing 150. If desired, this conducting member 160 can be received in an annular recess 170 in the bottom surface of base 136, as illustrated in FIG. 8. Thus is provided an annular or perimetrical flange 171 for limiting inward movement of button means 150.

When installed, the conducting member 160 surrounds the depending axially disposed plunger or protrusion 155, which projects from the central portion of base 156. As in the preceding embodiment, the plunger 155 projects through the annular ground terminal 132 and through the hole 131 in substrate 130. The insulator member 140 is of a thickness sufficient to support the contact member or pole 160 with its flat or planer bottom surface 148 in spaced relationship to the planar upper surface of all of the terminals 132 and 136. Thus, with no pressure on means 150, no electrical contact is made between or among any of these terminals 132, 136. When, however, the actuator means 150 is pressed toward the substrate 130, the portions of the elastomeric conducting member 160 over openings or apertures 141, 142 will be deformed inwardly within its elastic limits, as illustrated in FIG. 10, whereby physical contact is made simultaneously between increments of the conducting member 160 and the terminals 132 and 136. When pressure is released from the actuator means 150, the elastomeric conducting member 160 will act as a spring and return the deformed increments to its original shape, thereby returning to its open position, spaced from terminals 132 and 136, as illustrated in FIG. 9.

A switch, such as hereinabove described for the second embodiment, is particularly useful in the actuation of an alphanumeric indicator, such as a Nixie tube or light emitting diodes disposed for emitting light corresponding to the alphabet and corresponding to the numerals. A decade type indicator is depicted in FIG. 11 by the light emitting elements 171 and 172. These light emitting elements 171 and 172 are appropriately connected via wire 173 and conductor 174 to ground G. The hot side of elements 171 and 172 are connected

respectively by individual wires **175** to the substrate **130**, passing respectively through holes **137**. The conductors **134** then, respectively, connect the wires **175** to a terminal **136**. In this typical circuit, a potential is supplied by wire **176** and conductor **135** to the other side of the switch **110**, thus when conducting member **160** is closed against the terminals **132** and **136**, all of the light emitting elements **171** and **172** will be lighted. This forms the numeral "**88**." By a combination or permeation of arrangements of the holes or apertures **142**, the switch **110** may be caused to light, selectively, the elements **171**, **172** and or the elements **172** for the formation of any one or pair of letters or elements.

While we have provided seven contact members or terminals **136** for the "tens" elements **171** and seven contact members or terminals **136** for the units element **172**, any number of terminals **136**, may be provided in an outer terminal rose, if desired. Also, any number of separate terminals may be provided in other concentric roses (not shown) so that the conducting member **160** will shunt all exposed terminals, simultaneously. Furthermore, it is contemplated that more than one conducting member **160** could be provided for selective shunting of prescribed terminals, as desired, in a single switch.

We claim:

1. A switch operable for momentarily closing an electrical circuit comprising:

a. a plurality of spaced electrically conducting terminals;

b. an elastomeric electrically conducting pole disposed adjacent to said terminals and in sufficiently spaced relationship to one of said terminals that a portion of the pole may be deformed from an electrically open position to an electrically closed position with respect to said terminal, within the elastic limits of said elastomeric conducting pole;

c. arresting means for normally holding said elastomeric conducting pole in its adjacent, spaced relationship to said one of said terminals, said arresting means providing a path between said elastomeric conducting pole and said one of said terminals through which a portion of said elastomeric conducting pole may be extruded, said arresting means includes a flat thin insulating wafer sandwiched between said terminals on one side and said elastomeric conducting means on the other, said wafer having apertures in registry with said terminals; and

d. actuator means for applying pressure to elastomeric conducting pole sufficient to extrude, within its elastic limits, said portion of said elastomeric conducting pole through said path and into electrical contact with said one of said terminals.

2. A switch operable for momentarily closing an electrical circuit comprising:

a. a plurality of spaced electrically conducting terminals;

b. an elastomeric electrically conducting pole disposed adjacent to said terminals and in sufficiently spaced relationship to one of said terminals that a portion of the pole may be deformed from an electrically open position to an electrically closed position with respect to said terminal, within the elastic limits of said elastomeric conducting pole;

c. arresting means for normally holding said elastomeric conducting pole in its adjacent, spaced relationship to said one of said terminals, said arresting means providing a path between said elastomeric conducting pole and said one of said terminals through which a portion of said elastomeric conducting pole may be extruded; and

d. actuator means for applying pressure to elastomeric conducting pole sufficient to extrude, within its elastic limits, said portion of said elastomeric conducting pole through said path and into electrical contact with said one of said terminals; and

e. a flat substrate and wherein said terminals are mounted on said substrate and wherein said arresting means includes a thin flat insulating wafer disposed over said substrate, said wafer being provided with openings in registry with said terminals.

3. The switch defined in claim **2** including electrical leads on said substrate and respectively connected to said terminals, said terminals and said leads being printed circuits.

4. The switch defined in claim **2** wherein said elastomeric conducting pole is disposed over said openings and said actuator means is disposed over said elastomeric conducting pole and is moveable toward said pole for deforming increments of said pole through said openings and into contact with said terminals.

5. A switch operable for momentarily closing an electrical circuit comprising:

a. a plurality of spaced electrically conducting terminals;

b. an elastomeric electrically conducting pole disposed adjacent to said terminals and in sufficiently spaced relationship to one of said terminals that a portion of the pole may be deformed from an electrically open position to an electrically closed position with respect to said terminal, within the elastic limits of said elastomeric conducting pole;

c. arresting means for normally holding said elastomeric conducting pole in its adjacent, spaced relationship to said one of said terminals, said arresting means providing a path between said elastomeric conducting pole and said one of said terminals through which a portion of said elastomeric conducting pole may be extruded; and

d. actuator means for applying pressure to elastomeric conducting pole sufficient to extrude, within its elastic limits, said portion of said elastomeric conducting pole through said path and into electrical contact with said one of said terminals;

e. said terminals include a central terminal and outer terminals concentrically arranged around said central terminal in spaced relationship; said terminals having upper surfaces in a common plane, said arresting means is a flat insulating wafer having openings respectively aligned with said terminals, said elastomeric conducting switch overlies said openings of said wafer.

* * * * *