United States Patent

Huggard

[15] **3,697,706**

[45] **Oct. 10, 1972**

[54] **PUSH TYPE ELECTRIC SWITCH WITH CONTACT POST, MOVABLE COIL SPRING CONTACT AND INTERPOSED NON CONDUCTIVE PLUNGER**

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[73] Assignee: **D. H. Baldwin Company,** Cincinnati, Ohio

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[52] **U.S. Cl.** .....**200/5 R,** 200/61.19, 200/153 M, 200/166 BA

[51] **Int. Cl.**.....**H01h 9/26,** H01h 27/04

[58] **Field of Search**.....200/5 R, 5 A, 61.19, 153 M, 200/166 BA

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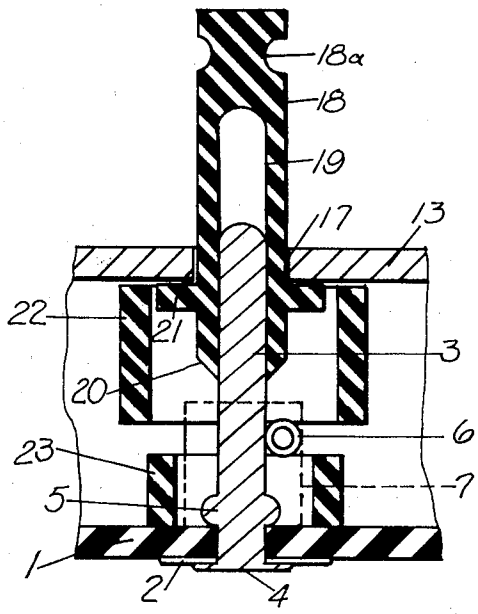
Primary Examiner—J. R. Scott

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[57] **ABSTRACT**

A push-pull type electric switch for single or matrix switching applications comprising a fixed contact in the form of an elongated pin, and at least one movable contact biased to a closed position against the fixed contact. An insulative plunger is slidably mounted on the fixed contact and is axially movable thereon between a depressed position wherein it shifts the movable contact away from the fixed contact to an open position, and a retracted position wherein it permits the movable contact to assume its biased closed position against the fixed contact.

13 Claims, 12 Drawing Figures



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SHEET 1 OF 2

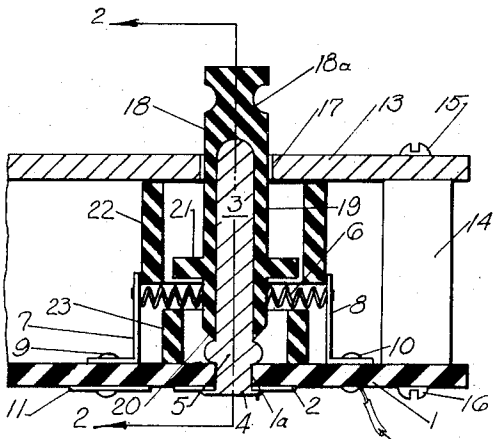


Fig 1

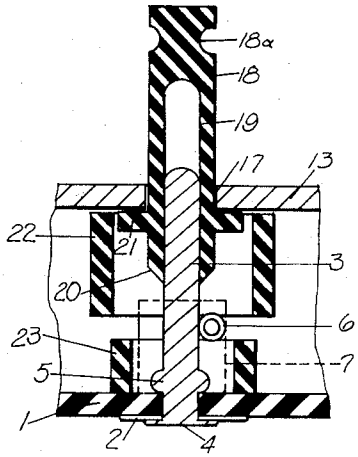


Fig 2

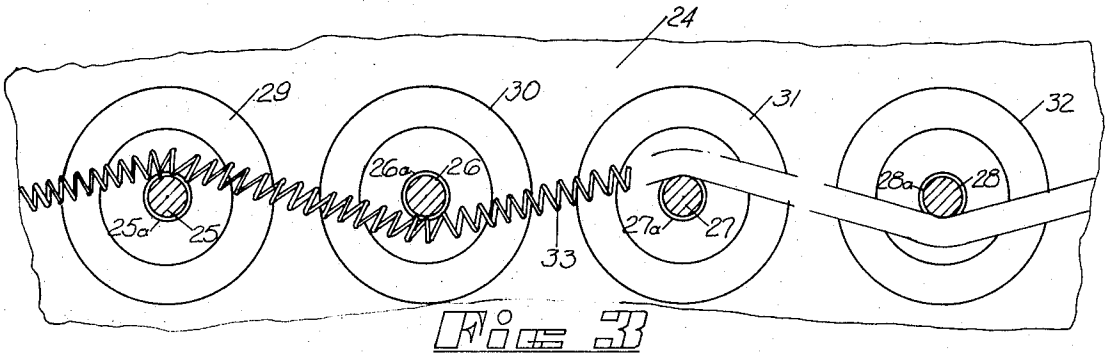


Fig 3

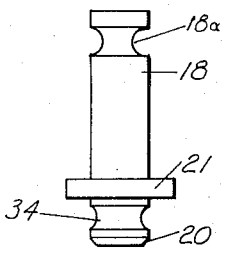


Fig 4

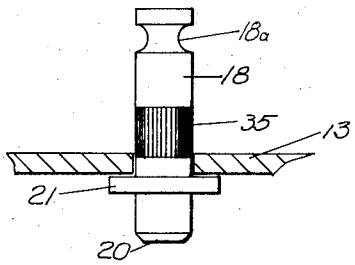


Fig 5

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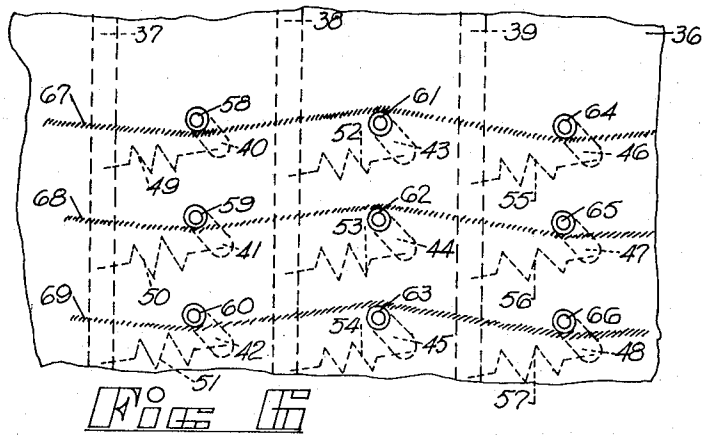


FIG 6

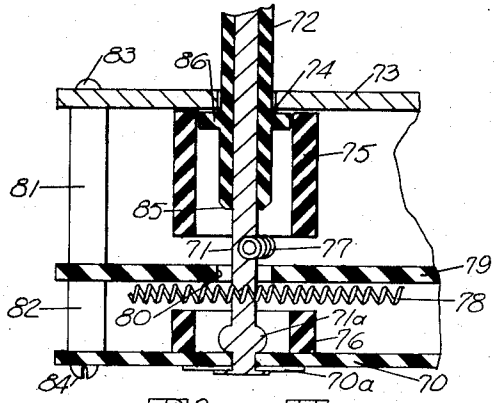


FIG 7

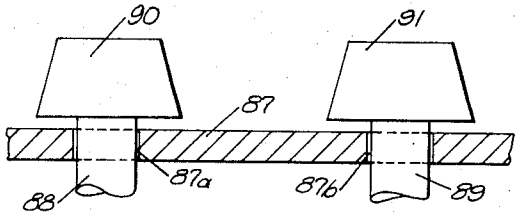


FIG 8

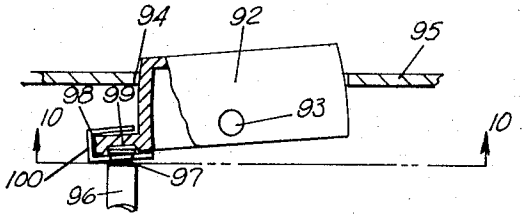


FIG 9

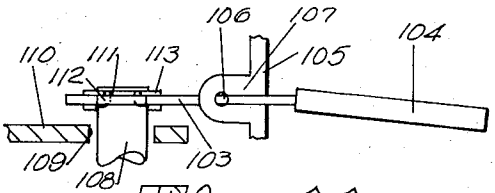


FIG 11

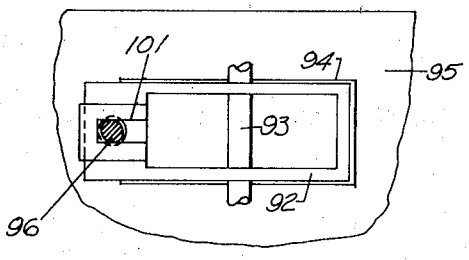


FIG 10

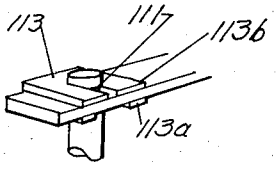


FIG 12

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PUSH TYPE ELECTRIC SWITCH WITH CONTACT POST, MOVABLE COIL SPRING CONTACT AND INTERPOSED NON CONDUCTIVE PLUNGER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a push-pull type electric switch, and more particularly to an electric switch suitable for single or matrix switching applications.

2. Description of the Prior Art

Prior art workers have devised many forms of electric switches comprising a fixed contact, a movable contact biased against the fixed contact and an insulative actuator to shift the movable contact away from the fixed contact. U.S. Letters Patent No. 3,400,236 is exemplary of such switches. Generally, however, prior art switches of the type described have required a number of parts and have been expensive to manufacture. Frequently, the prior art switches have been bulky and have utilized pivotal or shifting-type actuators. Therefore, they have not been characterized by high packing densities. In many instances, the prior art switches have required critical assembly operations, and once assemblied, the switch parts have not been readily accessible.

The present invention is directed to a simple electric switch wherein standard or low cost molded components may be used. The switch of the present invention requires no critical assembly operations and, once assembled, all parts are captive. The switch may be provided with any desired form of face plate, and by simple removal of the face plate, all parts of the switch are accessible. The switch is characterized by a positive switching action, and the contacts are self-cleaning. When used with a printed circuit board, the board need have an etched pattern on one side only. Each switch of the present invention is capable of having more than one movable contact. The switch of the present invention is particularly adapted to matrix uses, since it is characterized by a high packing density.

SUMMARY OF THE INVENTION

In its simplest form, the switch of the present invention comprises an elongated pin-like fixed contact a movable contact biased against the pin and plunger means slidably mounted on the pin and axially movable between a position wherein it lies between the pin and the movable contact and a position wherein it is withdrawn from between the pin and the movable contact. In one embodiment, the pin is affixed to a printed circuit board and makes electrical connection with the pattern on the board, as required. The movable contact comprises a helical spring, tensioned between two mounts affixed to the board. The spring mounts are so positioned on the board as to cause the spring to normally contact the pin. A plunger, made of insulative material, is slidably mounted on the pin. The plunger has a tapered end so that as it is moved to its depressed position it shifts the spring or movable contact away from the pin.

A face plate is provided in parallel spaced relationship to the printed circuit board. The free end of the plunger extends through a perforation in the face plate. Axial movement of the plunger along the pin in a direction toward the face plate may be limited by an annular flange on the plunger contacting the inner surface of the face plate. A cylindrical spacer is located about the pin and plunger in the space between the face plate and the spring or movable contact. This spacer limits movement of the spring in a direction toward the face plate. A cylindrical washer is provided about the pin and in the space between the spring or movable contact and the printed circuit board to limit movement of the spring in a direction toward the printed circuit board.

The plunger may be provided with an annular groove adjacent its tapered end for a more positive engagement of the plunger and the movable contact or spring when the plunger is in its "off" position. The plunger may also have a colored band so located on its body as to show above the face plate when the plunger is in its "on" position.

A single switch of the present invention may be provided with more than one spring contact, each spring contact being separated from the other by a panel of insulative material. A number of switches of the present invention may be located adjacent each other and may share the same common spring contact. In addition, a plurality of switches of the present invention may be applied to a matrix system, as for example the matrix system used in association with the setter boards of electric organs.

Finally, any suitable means may be provided to actuate the plungers. They may, for example, simply be actuated by hand. The free ends of the plungers may be provided with knobs to assist hand actuation. Finally, the plungers may be actuated by other means such as the rocker tabs or tone color tabs of an electric organ.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary elevational view, partly in cross section, illustrating the switch of the present invention in its open position.

FIG. 2 is a cross sectional view, taken along the section line 2—2 of FIG. 1, but illustrates the switch in its closed position.

FIG. 3 is a fragmentary plan view, partly in cross section, illustrating a plurality of switches of the present invention utilizing a common movable contact.

FIG. 4 is an elevational view of a plunger of the present invention provided with an annular groove.

FIG. 5 is a fragmentary, elevational view, partly in cross section, and illustrating a face plate and a plunger of the present invention, the plunger being provided with a color band.

FIG. 6 is a fragmentary plan view, partly in cross section, illustrating a plurality of switches of the present invention as used in a matrix system.

FIG. 7 is a fragmentary elevational view, partly in cross section, illustrating a switch of the present invention having two movable contacts.

FIG. 8 is a fragmentary elevational view, partly in cross section, illustrating a face plate and a pair of plungers provided with knobs.

FIG. 9 is a fragmentary elevational view, partly in cross section, illustrating a plunger of the present invention actuated by a rocker tab.

FIG. 10 is a cross sectional view taken along the section line 10—10 of FIG. 9.

FIG. 11 is a fragmentary elevational, partly in cross section, illustrating a plunger of the present invention actuated by a tone color tab.

FIG. 12 is a fragmentary perspective view of the plunger and tone color tab of FIG. 11.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The switch of the present invention is illustrated in its simplest form in FIG. 1 and 2. In these Figures, an etched board or printed circuit board is shown at 1. A portion of a circuit is illustrated (of exaggerated thickness) on the rearward side of the board, as at 2.

A fixed contact, in the form of an elongated pin, is illustrated at 3. The pin 3 may be affixed to the printed circuit board 1 in any suitable manner. For purposes of an exemplary illustration, the rearward end of the pin is shown as passing through a perforation 1*a* in the printed circuit board. That portion of the rearward end of the pin which extends beyond the rearward surface of the printed circuit board is upset to form a head 4, in the manner of a rivet or the like. The head 4 makes electrical contact with the printed circuit portion 2. The pin 3 is provided with an annular flange 5 which serves a number of purposes. First of all, the annular flange 5 determines the extent to which the rearward end of the pin extends through the perforation 1a. Secondly, the annular flange cooperates with the head 4 to firmly affix the pin 3 to the printed circuit board 1. An additional purpose of the flange 5 will be described hereinafter.

A movable contact is illustrated at 6 in the form of a coil spring. The ends of the coil spring are affixed to mounts 7 and 8. Again, the mounts 7 and 8 may be affixed to the printed circuit board by any suitable means. For purposes of an exemplary showing, they are illustrated as affixed by rivets 9 and 10, respectively. The mounts 7 and 8 may either connect with the printed circuit on the board 1, or they may serve as terminals for external wiring. For purposes of an exemplary illustration, the rivet 9 is illustrated as making contact with a portion 11 of the printed circuit. The rivet 10, is illustrated as having a wire 12 connected thereto by soldering or the like.

As will be evident from FIGS. 1 and 2, the mounts 7 and 8 are so positioned with respect to the pin 3 that the pin will lie in the normal axial path of the spring contact 6 between the mounts 7 and 8, with the result that the spring contact 6 will be biased into contact with the pin 3.

A face plate 13 is affixed to the printed circuit board 1 by means of a plurality of supports, one of which is shown at 14. These supports maintain the face plate in parallel spaced relationship to the printed circuit board. The assembly of the face plate, the printed circuit board and the supports may be made in any suitable manner, as by screws 15 and 16.

The face plate 13 has a perforation therein, indicated at 17. It will be noted from FIGS. 1 and 2 that the pin 3 extends part way through the perforation 17. A plunger, made of insulative material, is shown at 18. The plunger has a central bore 19 adapted to receive the pin 3 with a sliding fit. Thus the plunger 18 is supported by the pin 3 and extends through the perforation 17 in the face plate 13.

The rearward end of the plunger is provided with a tapered surface or nose portion 20. The body of the plunger is provided with an annular flange 21. The annular flange 21 is of greater diameter than the perforation 17 in the face plate, so that the uppermost or retracted position of the plunger is determined by the abutment of the rearward surface of the face plate 13 and the annular flange 21. The lowermost position of the plunger may be determined either by the bottoming of the pin 3 in the perforation 19 or by the abutment of the tapered nose 20 and the annular pin flange 5. The plunger 18 may also be provided with an annular groove 18a at its forward end. The annular groove may serve as means to assist manual actuation of the plunger, or it may serve as means for attachment of some other form of actuation means, as will be described hereinafter.

A cylindrical spacer is shown at 22. The spacer 22 has an internal diameter slightly greater than the diameter of the plunger flange 21. It will be noted from FIGS. 1 and 2 that the spacer 22 is captively held by the plunger between the rearward surface of the face plate 13 and the spring contact 6.

A cylindrical washer is shown at 23. The washer 23 has an internal diameter greater than the diameter of the plunger body and is captively held by the pin 3 between the spring contact 6 and the forward surface of the printed circuit board 1. Finally, it will be noted that the plunger 18 is captively held on the pin 3 by virtue of the cooperation of the rearward surface of the face plate 13 and the annular plunger flange 21.

The operation of the electric switch of FIGS. 1 and 2 may be described as follows. FIG. 2 illustrates the switch in its closed condition. In this instance, the plunger is in is retracted position and the movable or spring contact 6 is free to make electrical contact with the fixed contact or pin 3.

To open the switch, it is only necessary to move the plunger 18 to its depressed position, as illustrated in FIG. 1. As the plunger moves downwardly along the pin 3, the nose 20 will engage the spring contact 6. Upon engagement of the spring contact by the plunger nose 20, the spring contact will first be pushed down along the pin 3 thus wiping the contact surfaces clean. The spring contact will then abut the cylindrical washer 23, which will deter further downward movement of the spring 6. This action of the washer 23, together with increased tension of the spring contact will cause the spring contact to be drawn upwardly along the tapered nose 20 of the plunger, thus shifting the spring contact away from the pin 3.

To return the switch to its closed position, the plunger 18 is moved to its retracted position illustrated in FIG. 2. As the plunger moves upwardly, the spring 6 will contact the spacer 22, which will serve to limit upward movement of the spring. When the plunger attains its fully retracted position, the spring 6 will be free to make electrical contact with the pin 3.

It will be understood by one skilled in the art that the annular pin flange 5 will serve to space the cylindrical washer 23 from the main body of the pin, so that the washer 23 cannot interfere with the downward movement of the plunger nose 20. The plunger 18, the cylindrical spacer 22 and the cylindrical washer 23 are all made of insulative material. They can, for example, comprise simple molded parts of plastic or other insulative material.

FIG. 3 is a fragmentary view illustrating a plurality of switches similar to that shown in FIG. 1 and 2. A

printed circuit board is illustrated at 24 and may be similar to the printed circuit board 1 of FIGS. 1 and 2. The board is provided with a plurality of pins 25 through 28, each identical to the pin 3 of FIGS. 1 and 2, and each having a pin flange 25*a* through 28*a*, respectively, identical to the pin flange 5 of FIGS. 1 and 2. The pins 25 through 28 are surrounded with cylindrical washers 29 through 32, respectively, identical to the cylindrical washer 23 of FIGS. 1 and 2.

Each of the pins 25–28 will be provided with a plunger and a cylindrical spacer, identical to the plunger 18 and cylindrical spacer 22 of FIGS. 1 and 2. A face plate similar to face plate 13 of FIGS. 1 and 2 will also be provided, having a plurality of perforations through which the plungers will extend. For purposes of clarity, the plungers, cylindrical spacers and the face plate have not been illustrated in FIG. 3, but their respective purposes and modes of operations will be identical to that described with respect to FIGS. 1 and 2.

The purpose of FIG. 3 is to illustrate that a plurality of switch assemblies may use a common movable contact. For purposes of an exemplary showing, the movable contact in FIG. 3 is illustrated as a coil spring 33 substantially identical to the spring contact 6 of FIGS. 1 and 2. It will be understood by one skilled in the art that the ultimate ends of the spring contact 33 will be provided with mounts which may be similar to those shown at 7 and 8 in FIGS. 1 and 2.

The spring contact 33 is threaded about the pins 25 through 28 in a zig-zag manner, so that the spring contact 33 is biased into contact with each of the pins. Thus, in essence, pins 25 and 27 serve as effective mounts for that of the spring contact 33 which makes electrical contact with the pin 26. Pins 26 and 28 serve as effect mounts for that portion of the spring 33 which makes electrical contact with pin 27, and so on. The operation of the individual switch assemblies of FIG. 3 is identical to that described with respect to FIGS. 1 and 2, the only difference being that each fixed contact or pin 25 through 28 will make electrical contact with the same movable contact 33 when its respective plunger is in its retracted position.

It will be understood by one skilled in the art that the movable contact 33 will have adequate contact pressure against pins 25 through 28, regardless of errors in alignment of the pins. Furthermore, where the spacing between the pins is small, it is not necessary to provide a cylindrical spacer and a cylindrical washer for each pin.

FIG. 4 illustrates a plunger substantially identical to that shown in FIGS. 1 and 2, and like parts have been given like index numerals. The pin of FIG. 4 differs from that of FIGS. 1 and 2 only in that it is provided with an annular notch 34 adjacent its nose portion 20. The annular notch 34 is so sized that when the plunger of FIG. 4 is in its fully depressed position (as shown in FIG. 1) the spring contact will engage the annular notch 34 and more positively hold the plunger in its depressed or switch-off position. The nature of the interengagement of the spring contact and the annular notch 34 is such, however, as to not interfere with movement of the plunger to its retracted or switch-on position, when a pulling force is applied to the plunger.

FIG. 5 illustrates a face plate and plunger substantially identical to that shown in FIGS. 1 and 2, and like parts have been given like index numerals. Instant visual identification of the state of the switch can be facilitated by providing a color band about the body of the plunger and so positioned that the color shows above the face plate 13 only when the plunger is in its retracted or switch-on position. Such a color band is shown at 35 in FIG. 5. The band is of such width that when the plunger is in its depressed or switch-off position (i.e., the position shown in FIG. 1) the band 25 will be wholly below the face plate 13 and will not be visable to the observer.

FIG. 6 illustrates a plurality of switches of the present invention in a matrix arrangement. The Figure illustrates the forward or upper surface of a printed circuit board 36 substantially equivalent to the printed circuit board 1 of FIGS. 1 and 2. For purposes of an exemplary showing, the lower or rearward side of the printed circuit board 36 is illustrated as having 3 printed circuit pattern elements 37 through 39 thereon, together with 9 additional printed circuit elements 40 through 48. The printed circuit elements 40 through 42 are connected to the printed circuit element 37 via resistors, diodes or the like, indicated at 49 through 51. Similarly the printed circuit elements 43 through 45 are connected to the printed circuit element 38 via resistors 52 through 54 and the printed circuit elements 46 through 48 are connected to the printed circuit elements 39 via resistors 55 through 57. For purposes of clarity, only the pins of the individual switch elements are illustrated, it being understood that each of the switch elements may be identical to that shown in FIGS. 1 and 2. Thus, pins 58 through 60 make electrical contact with printed circuit elements 40 through 42, respectively. Similarly, pins 61 through 63 make electrical contact with printed circuit elements 43 through 45, respectively, and pins 64 through 66 make electrical contact with printed circuit elements 46 through 48, respectively. Finally, the matrix is provided with 3 movable contact elements 67, 68 and 69. The movable contact element 67 is adapted to make contact with pins 58, 61 and 64, in the same zig-zag manner illustrated in FIG. 3. Similarly, movable switch contact 68 is intended to make electrical contact with pins 59, 62 and 65, while movable contact 69 is intended to make electrical contact with pins 60, 63 and 66.

If each of the printed circuit elements 37 through 39 are connected to their own particular circuitry, and if each of the movable contact elements 67 through 69 are connected to their own particulary circuitry, it will be evident from FIG. 6 that the circuit of movable contact 67 may be connected to any one of, or all of, the circuits of printed circuit elements 37 through 39 through the agency of the switch assemblies respresented by pins 58, 61 and 64. The same is true with respect to the circuit connected to movable switch contact 68, through the agency of switch assemblies respresented by pins 59 62 and 65. Finally, the circuit connected to the movable contact 69 may be connected to any or all of the circuits of printed circuit elements 37 through 39 through the agency of switch assemblies represented by pins 60, 63 and 66.

FIG. 6 illustrates how well the switch assemblies of the present invention lend themselves to a matrix

system and how a great many such switch assemblies may be located in a relatively small space on the printed circuit board **36**. Again, as in the case of the structure illustrated in FIG. **3**, each of the movable contact elements will have adaquate contact pressures against their respective pins, regardless of errors in alignment of the pins. Again, where the center-to-center spacing between the pins is small, it is not necessary to provide a cylindrical spacer and a cylindrical washer (of the types shown at **22** and **23** in FIGS. **1** and **2**) for each pin.

It is possible to provide a switch of the type shown in FIGS. **1** and **2** with a plurality of movable switch contacts. This is illustrated in FIG. **7** wherein, for purposes of an exemplary illustration, a switch is shown having two movable contacts. In this instance, a printed circuit board is shown at **70** equivalent to the printed circuit board in FIGS. **1** and **2**. A portion of a printed circuit is indicated at **70***a*, similar to that portion shown at **2** in FIGS. **1** and **2**. A pin **71** is affixed to the board **70** and has an annular flange **71***a*. Again, the pin **71** is equivalent to the pin **3** of FIGS. **1** and **2**. A plunger is illustrated at **72**. A face plate is shown at **73** having a perforation for the pin **71** and the plunger **72** at **74**. Finally, a cylindrical spacer **75** and a cylindrical washer **76** are also shown. It will be understood by one skilled in the art that the plunger **72**, face plate **73**, cylindrical spacer **75** and cylindrical washer **76** are equivalent to the plunger **18**, face plate **13**, cylindrical spacer **22** and cylindrical washer **23** of FIGS. **1** and **2**.

In the embodiment of FIG. **7** a pair of movable contacts, in the form of coil springs, are shown at **77** and **78**. While the embodiment is not so limited, for purposes of an exemplary showing the contacts **77** and **78** are illustrated as being oriented generally at right angles to each other. The contacts **77** and **78** will be provided with any suitable form of mounts (not shown). The mounts may, for example, be substantially identical to those shown at **7** and **8** in FIGS. **1** and **2**. It will be understood that the mounts will be so located with respect to the pins that both the upper contact **77** and lower contact **78** will be biased into contact with the pin **71** in the same manner described with respect to contact **6** of FIGS. **1** and **2**. Similarly, the mounts for the contacts **77** and **78** may be electrically connected to portions of the printed circuit, or they may comprise terminals for external wiring.

The upper movable contact **77** and the lower movable contact **78** are separated from each other by an insulative plate **79** having a perforation **80** therethrough of sufficient diameter to permit passage of the pin **71** and the plunger **72**. The face plate **73**, the printed circuit board **68** and the separating plate **79** are maintained in parallel spaced relationship by a plurality of supports, two of which are illustrated at **81** and **82**. Again the assembly may be held together by any suitable means such as screws or bolts **83** and **84**.

It will be noted that the plunger **72** has a tapered nose **85** and an annular flange **86** similar to the tapered noise **20** and annular flange **21** of the plunger **18** in FIGS. **1** and **2**. The distance between the tapered nose **85** and the annular flange **86** must be sufficient to permit the tapered nose to extend downwardly beyond the lower movable contact **78**.

The operation of the embodiment of FIG. **7** is substantially identical to that of the embodiment of FIGS. **1** and **2** and may be described as follows. The plunger **72** is illustrated in its retracted to switch-on position. This uppermost position is limited by contact of the plunger flange **86** and the rearward surface of the face plate **73**. The plunger will retain this position by virtue of the fact that the nose portion **85** will rest lightly on the upper switch contact **77**. When the plunger is in the position illustrated, movable contacts **77** and **78** will make electrical contact with the fixed pin **71** and the switch will be "on." When the plunger is depressed, the tapered nose **85** of the plunger will engage the upper movable contact **77** shoving it downwardly along the pin **71** thereby cleaning the contact areas between these two elements. Downward movement of the upper contact **77** will be deterred by contact with the separating plate **79**. This action, combined with increased tension on the upper contact **77**, will cause the upper contact to ride upwardly on the tapered nose of the plunger and be shifted away from the pin **71**. The plunger will continue until it next engages the lower movable contact **78**. Again it will cause a wiping action between this contact and the pin **71**, whereupon further depression of the movable contact will be prevented by the cylindrical washer **76**. This action, coupled with increased tension on the lower contact member **78**, will cause it to ride upwardly over the tapered nose **85** of the plunger and shift to a position out of contact with the pin **71**. Thus, when the plunger **72** is in its depressed or switch-off position, both contacts **77** and **78** will be held in spaced relationship to the pin **70** by the plunger.

FIG. **8** illustrates a face plate **87** equivalent to the face plate **13** of FIGS. **1** and **2** or the face plate **73** of FIG. **7**. In this instance, the face plate is provided with a pair of perforations **87***a* and **87***b*. A plunger **88** extends through the perforation **87***a* and a plunger **89** extends through the perforation **87***b*. The plungers **88** and **89** may be the equivalent of any of the plunger illustrated in FIGS. **1**, **2**, **4**, **5**, or **7**.

FIG. **8** is intended to illustrate that when the plunger or plungers are intended to be manipulated by hand, they may be provided with knobs to facilitate engagement by the operators finger. To this end, the plunger **88** is provided with a knob **90** and the plunger **89** is provided with a knob **91**. The particular configuration of the knobs **90** and **91** and their manner of attachment to their respective plunger do not constitute a limitation on the present invention.

The switch assemblies of the present invention are not limited to actuation by hand. The plungers may be moved between their depressed and retracted positions by any suitable means since the switch assemblies are particularly well adapted for use in electric organs and the like. For purposes of an exemplary showing FIGS. **9** and **10** illustrate a switch means of the present invention actuated by a typical rocker tab of an electric organ. A rocker tab (of conventional configuration) is illustrated at **92** and is rockably mounted on a pivot pin **93**, supported by conventional support means (not shown). The upper portion of the rock tab extends through a perforation **94** in a panel **95**, again as is conventional. A switch plunger of the present invention is shown at **96**. The plunger may be considered the equivalent of any of the plungers illustrated in FIGS. **1**,

2, 4, 5 and 7. Again, the plunger is illustrated as having an annular groove 97 adjacent its upper end.

One end of the rocker tab 92 is provided with an outwardly extending lug 98. The underside of the lug 98 is provided with a depression 99 of sufficient size as to receive the uppermost end of plunger 96. A resilient spring clip 100, of U-shaped cross section, is provided on the lug 98 and is intended to frictionally engage the lug. The lower surface of the spring clip 100 has a slot 101 (see FIG. 10). The slot is so sized as to permit engagement by the clip of the plunger 96 at the annular groove 97. Thus, the spring clip 100 operatively connects the plunger 96 to the rocker tab lug 98.

As will be evident from FIG. 9, the rocker tab has been rocked in a counter-clockwise direction about the pivot pin 93 and the plunger 96 is in its depressed position. Pressure applied to the forward end of the rocker tab 92 will cause it to rock in a clockwise direction, thereby moving the plunger 96 to its retracted position. The limits of movement of the plunger between its retracted and depressed positions will be controlled in the manner described with respect to FIG. 1 and 2. This, in turn, will determine the limits of the rocking movement of the rocker tab 92 in the clockwise and counter-clockwise directions about the pivot pin 93.

FIGS. 11 and 12 illustrate a switch of the present invention actuable by means of a conventional tone color tab of an electric organ. Turning first to FIG. 11, the tone color tab comprises a shank 103 having an enlarged portion 104 engageable by the operators fingers. The shank 103 extends through an opening in a panel 105 and is pivotally mounted as at 106 to a conventional lug or mount 107.

The upper end of a switch plunger of the present invention is illustrated at 108, extending through a perforation 109 in a face plate 110. The face plate 110 may be considered to be the equivalent of face plates 13 or 73 in FIGS. 1, 2, 5 and 7, respectively. In similar fashion, the plunger 108 may be considered to be the equivalent of any of the plungers illustrated in FIGS. 1, 2, 4, 5 and 7. It will be noted that the upper end of the plunger 108 is again provided with an annular groove 111. It will further be noted that the upper end of the plunger 108 passes through a perforation 112 in the rearward end of the tone color tab shank 103. As is clearly shown both in FIGS. 11 and 12, the rearward end of the shank 103 is provided with a resilient spring clip 113 of U-shaped cross section and adapted to frictionally engage the shank 103. The bottom portion of the U-shaped clip has a slot 113a there of a width equivalent to the diameter of the body of the plunger 108. The upper portion of the U-shaped clip has a slot 113b of a width equivalent to the diameter of the plunger 108 at the annular groove 111. Thus, when the upper end of the plunger 108 is inserted through the perforation 112 in the shank 103 and the clip 113 is put in place as illustrated, the plunger 108 will be operatively affixed to the rearward end of the shank 103 of the tone colored tab.

It will be evident from FIG. 11 that the plunger 108 is illustrated in its fully depressed position. If the tone color tab is caused to rock or pivot in a clockwise direction about the pivot point 106, the plunger 108 will be moved to its retracted position. Rocking of the tone color tab about the pivot point 106 in a counter-clockwise direction will return the plunger 108 to the position illustrated. The limited movement of the plunger between its depressed and retracted positions will limit the amount of rocking of the tone color tab. Sufficient clearance must be provided with respect to the perforation 112 and the clip slots 113a and 113b to accommodate the changes in angular orientation of the shank 103 with respect to the plunger 108, brought about by the rocking of the tone color tab about the pivot point 106.

Modifications may be made in the invention without departing from the spirit of it. For example, while all of the movable contacts illustrated herein are shown in the form of coil springs, they may be made of any suitable resilient, conductive material.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A push-pull type electric switch assembly for single and matrix applications comprising an elongated, fixed, pin-like contact mounted on a base and a movable contact, means to mount said movable contact perpendicular to said pin, means to bias said movable contact to a closed position against said pin, an insulative plunger having a nose portion at one end, said plunger being slidably mounted on said pin, said plunger being reciprocable between a depressed position wherein said nose portion lies between said pin and said movable contact and a retracted position wherein said nose portion is removed from between said pin and said movable contact, and means to limit movement of said movable contact by said plunger along said pin parallel to the axis of said pin.

2. The structure claimed in claim 1 wherein said plunger has an axial bore, said pin being receivable within said bore with a sliding fit.

3. The structure claimed in claim 1 including a plurality of said switch assemblies, said switch assemblies being arranged in a row with their pins in spaced relationship to each other on said base, the movable contacts of each said assemblies comprising a common, elongated, resilient contact threaded along said pins in a zig-zag fashion, whereby said common movable contact is biased against said pins.

4. The structure claimed in claim 1 including a second movable contact, said movable contacts being mounted one above the other, means to bias said second movable contact to a closed position against said pin, means to limit movement of said second movable contact by said plunger along said pin parallel to the axis of said pin, the nose of said plunger lying between said pin and both of said movable contacts when said plunger is in its depressed position, the nose of said plunger lying between said pin and both of said movable contacts when said plunger is in its retracted position, and means to prevent contact between said movable contacts.

5. The structure claimed in claim 2 wherein said base comprises a planar member having first and second parallel surfaces, said pin being mounted on said first surface normal thereto, a pair of spaced mounts said movable contact comprising an elongated, resilient contact having its ends affixed to said mounts and being in parallel spaced relationship with said first surface, said mounts being affixed to said first surface on either

side of said pin, said mounts being so located with respect to said pin as to cause said biasing of said movable contact.

6. The structure claimed in claim 2 wherein said plunger has a circular cross-section perpendicular to its axis, and said nose portion has a tapered surface whereby to assist the shifting of said movable contact away from said pin by said plunger as said plunger is moved from said retracted position to said depressed position.

7. The structure claimed in claim 3 including additional rows of said pins, each of said rows of said pins having its respective common movable contact for said pins thereof, said base comprising a printed circuit board, all of said pins being mounted on said board, one pin from each of said rows making electrical contact with a common portion of said printed circuit on said board.

8. The structure claimed in claim 5 wherein said movable contact comprises a coil spring.

9. The structure claimed in claim 5 wherein said base member comprises a printed circuit board, said board having a printed circuit on said second surface, said pin extending through said base and making electrical contact with a portion of said printed circuit.

10. The structure claimed in claim 5 including a face plate, means for affixing said face plate to said base in parallel spaced relationship to said first surface, said movable contact being located between said first surface and said face plate, said face plate having a perforation therein, the end of said plunger opposite said end having said nose portion extending through said perforation in said face plate with a clearance fit, a flange on said plunger adapted to abut said face plate and determine said retracted position of said plunger.

11. The structure claimed in claim 6 wherein said plunger has an annular groove into which said movable contact seats when said plunger is in its depressed position.

12. The structure claimed in claim 10 wherein said means to limit movement of said movable contact along said pin parallel to said pin axis comprises a cylindrical washer surrounding said pin and positioned between said first surface of said base and said movable contact, said washer having an internal diameter sufficient to permit passage of said plunger nose portion therein, said washer having an axial length slightly less than the distance between said first surface of said base and said movable contact, and a cylindrical spacer about said pin and said plunger and positioned between said face plate and said movable contact, said cylindrical spacer having an internal diameter sufficient to permit passage of said plunger and plunger flange therethrough, said cylindrical spacer having an axial length slightly less than the distance between said face plate and said movable contact.

13. The structure claimed in claim 10 including a color band about said plunger and so positioned thereon as to be visible above said face plate when said plunger is in its retracted position.

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