

AN ELECTRIC SWITCH

The present invention relates to a simplified electric switch construction.

In many kinds of conventional discrete-component switches such as sliding switches and toggle switches, opposed and spaced contact elements are directly connected together by a push member or indirectly connected together via a moving contact element to provide electrical coupling therebetween. Generally, in a dual-in line package, abbreviated DIP, making use of such a switch, electrically connected are opposed ones of juxtaposed rows of terminals rather than adjacent terminals. This conventional package is difficult to miniaturise. Further, miniaturisation of a dual-in line package in which adjacent terminals are electrically connected together is also

limited, if it has the same construction as the conventional discrete-component switches. In addition, the contact condition of contact elements may introduce problems.

Another dual-in line package has also been heretofore known in which switch driving portions are selectively actuated for providing a desired electrical connection between desired terminals via an electronic circuit incorporated in the package. This DIP switch has terminals which are similar to those of ordinary DIP switches and are connected to some portions of an electronic circuit fabricated on a printed board or the like, the switch being enclosed in a casing. This switch tends to become bulky, because it uses a DIP switch and a separate printed board, which has an electronic circuit fabricated thereon and is usually encased in a molded resin material. Accordingly, a construction where a DIP switch is made integral with a printed board is contemplated. However, the construction of the conventional discrete-component switch for use in a DIP switch does not allow a considerable miniaturization. Further, since the switch handles minute electric current, the stability of the contact state at its contact portions is not ensured. For example, even if contact portions printed on a printed board are pressed by means of the contact element of a switch having a conventional construction, a good contact will not be made. Therefore, it is required that the

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contact portions of the printed board and of the contact element be plated with gold and that the contact area of the contact portions be made large.

The above-described drawbacks in the prior art
5 devices have been successfully eliminated by the present invention.

It is an object of the present invention to provide an electric switch construction which is simple in structure and capable of effecting its switching
10 operation stably.

It is another object of the invention to provide an electric switch construction of this kind which can be quite miniaturised, and which can incorporate an electronic circuit.

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The invention is defined in the claims appended hereto.
Various embodiments will now be described with
reference to the accompanying drawings.

Figure 1 is a cross-sectional view of a switch
5 according to the present invention;

Figure 2 is a plan view of the switch shown in Figure 1;

Figure 3 is a cross-sectional view of the switch
shown in Figure 1 when the push member of the switch has
been moved to the right;

10 Figure 4 is a partially cutaway plan view of another
switch according to the invention;

Figure 5A is a cross-sectional view of the switch
shown in Figure 4;

Figure 5B is a perspective view of the movable
15 contact element used in the switch shown in Figures
4 and 5A;

Figure 6 is a view for illustrating the operation
of the movable contact element of the switch shown
in Figures 1 - 3;



Fig. 7 is a cross-sectional view of a further switch according to the invention;

Fig. 8 is a plan view partially in section of the switch shown in Fig. 7;

Fig. 9 is a cross-sectional view of the switch of Fig. 7 when the push member of the switch has been moved to the right;

Fig. 10 is a perspective view of a still further switch according to the invention;

Fig. 11 is a diagram of the electronic circuit incorporated into a DIP switch according to the invention;

Figs. 12, 13 and 14 are circuit diagrams of other electronic circuits in the form of chip selectors;

Fig. 15 is a circuit diagram of another electronic circuit in the form of a potentiometer; and

Figs. 16 (a) and 16 (b) are perspective views of the movable contact element shown in Fig. 6 for illustrating the manufacturing process of same.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring first to Figs. 1 and 2, there is shown a switch embodying the concept of the present invention. This switch is comprised of an insulating base 3, two parallel rows of terminals 1a, 1b and 2a, 2b disposed on opposite sides of the base 3, a switch cover 4 fitly placed on the base 3, a



movable contact element 6, and a push member 7. The contact element 6 and the push member 7 are disposed in the space 5 which is formed between the base 3 and the cover 4. The contact element 6 has a belly portion 15 which is downwardly and gently curved and has a projection 12 in its center. The element 6 is mounted to the base 3 such that the element 6 can rock about the projection 12. The contact element 6 further has shoulder portions 14 bent in a direction opposite to the direction in which the belly portion 15 is curved, on opposite sides of the belly portion 15. Formed on opposite sides of the element 6 are two pairs of contact ends 8a, 8b and 9a, 9b each of which is blanked by a press into a knife-edged form having a vertex P and forming an acute angle 17e (Fig. 16 (a)). Each end in the form of a polygonal pyramid, in this illustrative example a triangular pyramid, is bent in X direction (Fig. 16 (b)). More specifically, the base 3 is provided with a pair of recesses 11 at which protruding portions 10 on opposite sides are pivoted. These protruding portions 10 are disposed so as to rock about the downwardly directed projection 12 in the center of the element 6. The push member 7 has an arm 13a which brings the protrusion 13 into abutting engagement with the inner side of the projection 12. The arm 13a is interposed among the inner surface of the cover 4 and the shoulder portions 14, and is anchored at its neutral position. When the push member is moved to the right, as shown in Fig. 3, the

protrusion 13 pushes the belly portion 15, so that the contact ends 9a and 9b at the front end of the element 6 are made contact with internal lead wires (bridge portions) 17a and 17b connected to the terminals 2a and 2b, respectively, whereby the terminals 2a and 2b are excited. During this movement, the contact element 6 is resiliently deformed, and the internal lead wires 17a and 17b are pulled from the positions indicated by the solid lines in Fig. 6 and to the positions indicated by the broken lines while the vertices P at the triangular pyramidal contact ends 9a and 9b remain contacted. Therefore, even if flux is attached to the internal lead wires or oxide coating is formed on the wires, it is scraped off and hence it is ensured that a good contact is made.

Similarly, when the push member 7 is moved to the left, the contact ends 8a and 8b are brought into contact with the internal lead wires 16a and 16b, resulting in the terminals 1a and 1b to be excited.

In the above example, two terminals on either one side of the base 3 are excited by the contact element 6, but the number of terminals excited is not limited to two. A greater or less number of terminals may be excited. Further, in the above embodiment, the contact element 6 is slid by the push member 7. It is also possible to use a toggle or rotary means to drive the contact element 6. Since it is

simple in structure, it can readily be applied to a DIP switch, thus contributing to the miniaturisation of the DIP switch.

Referring next to Figure 4, there is shown another switch 5 which comprises an insulating base 18, one terminal 19a disposed on one side of the base, another terminal 19b disposed on the other side, and a common terminal 20. One of the terminals 19a and 19b is electrically connected to the common terminal so as to be excited. This switch 10 has a contact element 21 similar to the contact element 6 shown in Figure 1, but the contact element 21 has only one contact end 22a or 22b on each side and a contact end 23 in the centre, the end 23, being electrically connected to the common terminal 20 (Figure 5B). In this 15 case, the tip of the contact end 23 preferably is divided into two knife-edged portions 23a and 23b to ensure that the contact element 21 stably makes contact with an internal lead wire 24 (Figures 4 and 5a) connected to the common terminal 20, whether the contact element 21 is located 20 at its neutral position or a contact position. In this switch, when a push member 7a is moved to the left, the terminals 20 and 19a are connected together and excited, while when it is moved to the right, the terminals 20 and 19b are connected and excited.

25 As can be seen from the foregoing embodiment, the present invention provides a switch

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which, is simple in structure and capable of effecting a switching operation stably, and which can be applied to a quite small DIP (dual-in line package) switch which handles small electric current.

5 Referring now to Figures 7 and 8, there is shown a DIP switch making use of the aforementioned novel switch construction and incorporating an electronic circuit. This DIP switch has an insulating base 31, terminals 32,33 disposed on the left side of the base, and terminals 34, 10 35 disposed on the right side of the base. The terminals 33 and 34 have ordinary external lead wires attached thereto, whereas the terminals 32 and 35 have no external lead wires attached thereto. These terminals are disposed in a predetermined manner. Some of the internal lead 15 wires connected to the terminals 32-35 extend upwardly, while the others extend downwardly. An electronic circuit is formed on the underside of a printed board 36, which is held among the upper internal lead wires 32a, 33a, 34a, 35a and the lower internal lead wires, 32b, 33b, 34b, 20 35b. The lower lead wires 32b - 35b are connected to the associated portions of the electronic circuit (described later), and all of them are enclosed in the moulded insulating base to constitute a unit, whereby contributing a substantial miniaturisation of the switch. The

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upper internal lead wires 32a-35a are disposed on the upper surface of the printed board, and are opposed to contact ends 38, 39, 40 and 41 bending downwardly. These contact ends 38-41 are shaped into a knife-edged form by cutting both ends of a contact element 37.

The contact element 37 consists of an electrically conductive plate, the opposite end portions of which are gently bent downwardly, so that the element 37 is shaped like inverted "U". The contact element 37 has opposed protruding portions 42 in its center. The base 31 is provided with recesses 43, at which the protruding portions 42 are pivoted. Formed below a switch cover 45 is a space 46 in which the contact element 37 is disposed so as to rock about a projection 44 in the center of the element 37. The projection 44 is gently bent downwardly like letter "U". The protruding portions 47 abuts on the inner side of the projection 44 from above, and the push member 48 abuts on the shoulder portions 49 below the cover 45. Thus, the contact element 37 is anchored at its neutral position. When the push member 48 is moved to the right, the protrusion 47 pushes the belly portion 50, as shown in Fig. 9, bringing the contact ends 40 and 41 at its tip into contact with the upper internal lead wires (bridge portions) 34a and 35a. As a result, the terminals 34 and 35 are electrically connected together and excited. On the other



hand, the terminals 32 and 33 are not connected together. In this case, as the push member 48 is shifted, the contact element 37 is resiliently deformed. As such, the upper internal lead wires 34a and 35a are pulled while the vertices P of the knife-edged contact ends 40 and 41 remain contacted. Therefore, even if flux is attached to these internal leads or oxide coating is formed on them, such unwanted material is scraped off, thereby exposing the active surfaces. Consequently, contact is made well. Likewise, when the push member 48 is moved to the left, the contact ends 38 and 39 come into contact with the upper internal lead wires 32a and 33a, so that the terminals 32 and 33 are electrically connected together and excited. At the same time, the terminals 34 and 35 are not excited.

In the example described above, two juxtaposed rows of terminals on opposite sides are shown in such a way, for the sake of simplicity, that one of them is a pair of ordinary terminals and that the other is a pair of terminals to which no external lead wires are connected. The device shown in Fig. 10 is similarly fabricated. In particular, this device includes a pair of ordinary terminals 51 disposed appropriately and another pair of terminals 52 to which upper internal lead wires 53 are connected. The two terminals on either one side are connected together by the aforementioned contact element and excited.



Although the contact element 37 is slided by the push member 48, a toggle or rotary means may also be used to drive the contact element 37.

The base 31 and the cover 45 can be molded out of thermosetting resin, but the therosetting temperature is high, e.g. 280°C. Further, the time required for such process is long. Therefore, it is cumbersome to control the manufacturing process. However, when the base and the cover is made from thermoplastic resin, the temperature required for molding is relatively low, e.g., in the range of 170 to 260°C, and the time required is shorter. This facilitates the control of the manufacturing process and reduces the cost to manufacture the switch. In case where such thermoplastic resin is employed, externally applied heat tends to soften the enclosure 31 and the cover 45, but the printed board 36 which is made of ceramic, glass, epoxy resin, or the like reinforces their strength and retains their mechanical and physical properties. Also, in the embodiment shown in Figs. 1-5B, when the base 3 and the cover 4 are made from thermoplastic resin, if externally applied heat softens the resinous components, loss in their mechanical and physical properties and in strength can be made up by locating a reinforcing base plate (excluding an electric circuit) as described above in the position shown in Figs. 7-9.

In this way, a DIP switch equipped with a certain

number of slide switches can be fabricated. In an actual DIP switch, an electronic circuit is formed on the printed board 36 so as to cooperate with a potentiometer or chip selector through the use of switches. Such a chip selector is shown in Fig. 11, and it has switches a-d and output terminals A'-D'. When any one of the switches a-d is closed, the voltage applied to the corresponding one of the terminals A'-D' changes from V_{CC} to ground potential GND. It is possible for this chip selector to deliver an output signal in binary form. Specifically, mathematical weights of 2^0 to 2^3 are given to the signals appearing at the switches a-d, respectively. Then, some of the terminals are closed simultaneously, resulting in data in parallel binary form at the output terminals A'-D'.

Although the devices used for the chip selector are all resistors in the above embodiment, these resistors can be replaced by capacitors, diodes or logical elements. Referring to Fig. 12, there is shown a chip selector constituting a four-input OR circuit. In this configuration, switches a-d are connected to diodes D_1 - D_4 , respectively, and one of the switches is closed.

Referring next to Fig. 13, there is shown another chip selector which has an X terminal connected to a power supply V_{CC} , for example, input terminals A-D grounded, switches a-d, and logical elements I_1 - I_4 . When one of the switches

a-d is closed, an inverted output signal appears at the corresponding one of the output terminals A'-D' via the corresponding one of the logical elements.

Referring next to Figure 14, there is shown a further
5 chip selector which has input terminals A-D and output terminals A'-D' which are connected to the input terminals through capacitors C_1-C_4 by closing switches a-d.

A potentiometer is shown in Figure 15, in which switches a-d are connected to resistors R_1-R_4 , respectively,
10 in parallel relation. A given resistance value is obtained across terminals X and Y by closing one of the switches a-d.



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CLAIMS

1. An electric switch comprising an insulating base carrying electrical terminals having portions which define stationary contacts, a rockable moving contact element comprising a curved strip or plate of electrically conductive material which is formed to provide a convexly curved middle portion in contact with the base, a concave outer portion on each side of the middle portion, and pointed contact ends, and an actuating member held in a neutral position between the outer portions and the inner surface of a cover fitted over the base, the actuating member having a projection which bears upon the inside of the convexly curved middle portion of the contact element and being movable away from the neutral position to one side or the other, whereby the movable contact element is caused to rock by the projection to bring one or more pointed contact ends of the contact element into contact with one or more of the stationary contacts.

2. A switch according to Claim 1 ~~or Claim 2~~ wherein the stationary contacts are arranged opposite one another with the movable contact element disposed therebetween and arranged to make contact with one or more stationary contacts on either side thereof.



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3. A switch according to any one of Claims 1 to ~~2~~ wherein two pointed contact ends are provided at each end of the contact element to establish a connection between two stationary contacts disposed side by side on the base, in response to movement of the actuating member.

4. A switch according to any one of Claims 1 to ~~2~~ having a common stationary contact in the base and wherein the moving contact element has, at the centre of the convexly curved middle portion, knife-edged contact means in contact with the common stationary contact and upon which the moving contact element rocks in response to movement of the actuating member.

5. A switch according to any one of Claims 1 to ~~3~~ wherein the stationary contacts are connected to a printed circuit board forming part of the switch.

6. A switch according to any preceding claim, wherein the rockable movable contact element comprises an electrically conductive plate having a curved central belly portion centrally provided with a projection, the contact element being mounted so as to be able to rock about the projection.



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7. An electric switch according to any preceding claim, including a printed board having an electronic circuit formed on one side of the board, the stationary contacts extending respectively upwardly and downwardly and holding the board therebetween, the stationary contacts extending upwardly being opposed to each other on the printed board and the stationary contacts extending downwardly being connected to the associated portions of the electronic circuit.
