

SWITCH

The present invention relates to a switch, and more particularly to a switch having a conductive contact which is movable relative to contact terminals between an open and a closed position.

5 There are various forms of mechanisms for switching current. One known mechanism is of a toggle construction having a conductive contact which is resiliently held against the end of one terminal and movable into contact with the end of the other terminal by a toggle rotatable about an
10 intermediate ball member for making electrical connection between the terminals. The terminals can be electrically disconnected from each other when the contact is disengaged from the end of the other terminal upon release of pressure on the contact. The pressure with which the contact is held
15 against the end of the other terminals is relatively weak with the use of such a toggle.

Another conventional structure is known as a sliding mechanism including a conductive contact which is normally urged downwardly as by a spring and held against
20 one terminal end, the conductive contact being slidable laterally into contact with the other terminal end for electrical connection between the terminal ends. The electrical connection can be broken by sliding the contact out of contact with the other terminal end. The sliding
25 mechanism can press the contact against the other terminal

end with a relatively high pressure. However, there are structural limitations which prevent the application of a pressure large enough to sufficiently remove deposits from the contact or the terminal ends while the contact
5 slides frictionally.

In order to prevent deposition of various forms of foreign matter such as dust and flux which could lose electrical conduction, it is necessary to enclose the switch in a shielded structure.

10 Due to external environmental conditions, the metal surfaces of the terminal ends and contact tend with time, to form non-conductive films thereon, non-conductive films such as natural oxides formed by oxygen in the ambient air. Such non-conductive films can be broken
15 by currents of medium magnitudes flowing through switches, and removed by frictional contact with the contact. However, the deposits cause malfunctions such as non-conduction particularly in switches such as DIP switches which handle small currents on the order of microamperes. To avoid the formation of oxidised layers, vital portions
20 of the terminal ends and contact have heretofore been plated with chemically stable precious metals such as rhodium and gold.

An object of the invention is to provide an improved switch.

25 According to the present invention we propose a switch comprising a body of insulating material, contact terminals.

supported on the body and a conductive contact in the form of a curved plate which is movable relative to the contact terminals between and open and a closed position of the switch wherein the curved plate respectively makes or breaks
5 contact between the contact terminals, the plate being preloaded in the body such that in the closed position a peripheral edge of the plate is urged into contact with the contact terminals and slidable in contact therewith during movement to and from the open position.

10 In one embodiment, the ends of a plurality of terminals project into a cavity in the body, the movable conductive contact being pre-loaded in the cavity, with the peripheral edge thereof resiliently held against and slidable relative to the ends of the terminal. The contact is held
15 against the terminal ends under pressure due to the shape of the contact without the need for separate biasing means such as a spring. Being thus pressed into biting engagement with the terminal ends, the contact is able to withstand repeated switching operations and renews contact
20 surfaces when switching is repeated, so enabling reliable switching of currents over an extended period of time. Contacting surfaces of the terminal ends and contact do not need to be plated with precious metal. The switch requires no shielding structure, and can bodily be washed in water.
25 Since the switch is simple in construction, it is cheaper to make than conventional switches.

The switch may have a low current rating of the order

of microamperes as in the case of a DIP switch.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

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

Figure 2 is a perspective view of a movable conductive contact and a slide plate on which the contact is mounted for the switch shown in Figure 1;

10 Figure 3 is a longitudinal cross-sectional view of the switch illustrated in Figure 1;

Figure 4(a) and 4(b) are transverse and longitudinal cross-sectional views, respectively, showing the position of the respective parts with the switch turned off;

15 Figure 5(a) and 5(b) are transverse and longitudinal cross-sectional views, respectively, of a switch according to a second embodiment of the invention;

Figure 6(a) and 6(b) are transverse and longitudinal cross-sectional views, respectively, of a switch

20 according to a third embodiment of the invention; and

Figure 7(a) and 7(b) are transverse and longitudinal cross-sectional views, respectively, of a switch according to a fourth embodiment of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

As shown in Fig. 1, a switch according to the first embodiment of the invention comprises; and insulating base 3 supporting a pair of terminals 1a, 1b having ends 2a, 2b projecting into a cavity defined in the insulating base 3 and a cover 4 fitted over the insulating base 3, and a movable conductive contact 5 fitted in the cavity.

It will be seen from Fig. 2 that the contact 5 is in the form of a part-spherical plate having formed in its peripheral edge a recess 6 for breaking off a current flowing between the terminals 1a, 1b. The peripheral edge of the contact 5 also has angularly spaced recesses 7, 8 serving to attach the contact 5 to a slide plate 10, and a slit 9 for adjusting the resilient force of the contact 5. The current-breaking recess 6 doubles as a recess for attaching the contact 5.

The contact 5 is formed by pressing a plate of a metal such as an alloy of copper and rhodium into a part-spherical plate. The peripheral edge of the part-spherical plate is held in contact with sides 2a', 2b' of the terminal ends 2a, 2b. The peripheral edge of the contact 5 bites into the sides 2a', 2b' for good electrical contact therewith. The peripheral edge may be cut into a knife

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edge for more reliable electrical contact.

When the terminal ends 2a and 2b are in electrical contact with one another as shown in Figures 1 and 3 the current-breaking recess 6 is positioned such that it opens toward a resin wall 3a of the insulating base 3, a lever 11 of the switch being displaced to the right as shown.

When the lever 11 is moved to the left as shown in Fig. 4 (a), the recess 6 is located at the side 2a' of the terminal end 2a. With the side 2a' positioned in the recess 6, the terminals 2a, 2b are electrically disconnected from one another.

The slide plate 10 illustrated in Fig. 2 serves to facilitate rotation of the contact 5. The slide plate 10 is made of synthetic resin and is in the form of a disc having a lower sectoral portion cut away. The lever 11 is mounted on the slide plate 10 and extends radially therefrom. The slide plate 10 has projections 12, 13 and 14 and the contact 5 is mounted on the slide plate 10 with the projections 12, 13 and 14 fitted respectively in the recesses, 6, 7 and 8 of the contacts. The peripheral edge of the contact 5 is held against a surface A of the slide plate 10. A lower portion 15 of the peripheral edge of contact 5 projects downwardly of the slide plate 10 into abutment against the sides 2a', 2b' of the terminal ends. The projection 12 which

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fits in the current-breaking recess 6 has a rear surface B lying flush with the surface A of the slide plate 10. When the slide plate 10 is angularly moved, the rear surface B is brought into abutment against the side 2a' of the terminal end 2a as shown in Fig. 4(b).

As illustrated in Fig. 3, the contact 5 as mounted on the slide plate 10 is fitted in a gap or clearance defined between resin walls 16, 16' of the insulating base 3. Before the contact 5 is thus inserted in the gap, the distance L_1 between a crest C of the part-spherical surface of the contact 5 and a rear sliding surface D of the slide plate 10 is larger than the distance l_1 between the resin walls 16, 16'. Thus, the contact 5 and the slide plate 10 combined therewith is force-fitted into the gap. The contact 5 as pressed in the gap is rendered rotatable about the crest C with the lower peripheral edge portion 15 resiliently held against the sides 2a', 2b' of the terminal ends 2a, 2b. Upon angular movement of the slide plate 10, the contact 5 is turned about the crest C while being guided by edges 17, 17' (Fig. 1) and and edge 18 of the cover 4, during which time the peripheral edge of the contact 5 is pressed against the sides 2a', 2b' as it rotates in a place defined by the sides 2a', 2b'.

With the contact 5 as mounted on the slide plate 10 being thus press-fitted between the resin walls 16, 16', the

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peripheral edge portion 15 can be pressed against the sides 2a', 2b' of the terminal ends under increased pressure in biting engagement therewith for good electrical contact therebetween. The slit 9 in the contact 5 allows the peripheral edge portion 15 to be stably and uniformly held against the sides 2a', 2b' of the terminal ends under adjusted resilient forces even if the sides 2a', 2b', are staggered in position.

Operation of the switch shown in the first embodiment is as follows: when the lever 11 of the slide plate 10 is moved to the right as shown in Fig. 1, the contact 5 mounted on the slide plate 10 is moved angularly clockwise to bring the lower peripheral edge portion 15 into contact with the sides 2a', 2b' of the terminal ends 2a, 2b whereupon the terminals 1a, 1b are electrically connected. Conversely, when the lever 11 is pushed to the left as illustrated in Fig. 4(a) the contact 5 is turned counterclockwise to cause the rear surface B of the projection 12 fitted in the recess 6 to be held against the side 2a', whereupon the terminals 1a, 1b are electrically disconnected from one another. Thus, electrical connection or disconnection between the terminals 1a, 1b is effected in the manner described above by angular movement of the contact 5. Since the peripheral edge portion 15 of the contact 5 is

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held in biting engagement with the sides 2a', 2b' under high pressure, good electrical connection is assured between the contact 5 and the sides 2a', 2b' even if the sides 2a', 2b' have thereon layers of flux, oxides or other impurities which could otherwise obstruct such electrical connection .

Figs. 5(a) and 5(b) show a switch according to a second embodiment. The switch has an insulating base 22 supporting thereon terminals 20a, 20b having ends 21a, 21b, respectively, which project into a cavity 24 defined jointly by the insulating base 22 and a cover 23 fitted over the insulating base 22. Disposed in the cavity 24 is a movable conductive contact 25 in the form of an arcuate construction pressed from a rectangular conductive metal plate. The contact 25 is fitted in a recess 27 in a slide member 26 and oriented such that it looks arcuate when viewed in the direction of sliding of the slide member 26 are indicated by the arrowheads 28. The contact 25 has ends 29 held in abutment against upper surfaces 21a', 21b' of the ends 21a, 21b of the terminals 20a, 20b.

With the contact 25 mounted in the slide member 26, the ends 29 project beyond a lower end 30 of the slide member 26, and the distance L_2 between the ends 29 and an upper end 31 of the slide member 26 is larger than the vertical dimension h_2

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of the cavity 24. The slide member 26 has a side 32 which is of a vertical length slightly smaller than the dimension λ_2 . When the contact 25 as disposed in the slide member 26 is force-fitted in the cavity 24, the ends 29 of the contact 25 are resiliently pressed against the upper surfaces 21a', 21b' of the terminal ends. When a knob 33 on the slide member 26 is slid in the direction of one of the arrowheads 28 at a time, the slide member 26 is guided by an inner surface 23' of the cover 23 so as to slide over the upper surfaces 21a', 21b' of the terminal ends.

Since the contact 25 is in the form of a resilient arcuate metal plate, the ends 29 thereof are held in biting engagement with the upper surfaces 21a', 21b' for good electrical connection. The ends 29 may be cut into the shape of a knife edge for better electrical connection.

Operation of the switch shown in FIGS. 5(a) and 5(b) will be described. In FIG. 5(a), the contact 25 is displaced out of contact with the upper surface 21a' of the end of the terminal 20a, the hence the terminals 20a, 20b are electrically disconnected from each other. When the knob 33 is slid to the left to move the contact 25 towards the left the ends 29 of the contact 25 are brought over the upper surface 21a' of the terminal end 21a, whereupon the terminals 20a, 20b are electrically interconnected. With the arrangement shown in FIGS. 5(a) and 5(b), the ends 29 of the contact 25 are pressed strongly against the upper surfaces 21a', 21b' under high pressure in biting engagement therewith.

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According to a third embodiment shown in FIGS. 6(a) and 6(b), a movable conductive contact 40 is formed from a rectangular conductive metal plate into an arcuate structure with an end portion 40a extending rectilinearly. The movable conductive contact 40 is fitted in a recess 42 in a slide member 41. The contact 40 is positioned such that it looks arcuately when viewed in the direction of the arrowheads 43 along which the slide member 41 is slidable or the terminal ends 21a, 21b are spaced from each other, the contact 40 being disposed on an insulating base 44. The contact 40 has an end 45 held in frictional contact with arms 48a', 48b' of L-shaped contact members 48a, 48b mounted on ends 47a, 47b, respectively, of terminals 46a, 46b supported on the insulating base 44. The arms 48a', 48b' extend into a cavity 50 in the insulating base 44.

With the contact 40 mounted in the slide member 41, the distance L_3 between an arcuate crest 40b of the contact 40 held against a resin wall 49 of the recess 42 in the slide member 41 and a distal edge of the end 45 of the contact 40 is larger than the distance L_3 between the resin wall 49 and the arms 48a', 48b' of the contact members 48a, 48b. Therefore, the contact 40 as mounted in the slide member 41 and inserted forcibly between the arms 48a', 48b' projecting into the cavity 50 and the resin wall 49, has its end 45 resiliently held against the arms 48a', 48b'. When a knob 51 on the slide member 41 is slid in the direction of one of the arrowheads 43, the slide member 41 is guided by an inner surface 52' of a cover 52 so as to slide over the arms 48a', 48b'.

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Although the contact 40 is shown as being held against the arms 48a', 48b' of the L-shaped contact members 48a, 48b mounted on the terminal ends 47a', 47b', the contact 40 may be held in frictional engagement directly with the terminal ends 47a', 47b' which may be L-shaped in cross section.

In FIG. 6(a), the end 45 of the contact 40 is shown as contacting the arms 48a', 48b' of the contact members 48a, 48b, and the terminals 46a, 46b are electrically connected to each other. When the knob 51 is displaced to slide the contact 40 to the left, the end 45 of the contact 40 is disengaged from one of the arms 48b', whereupon the terminals 46a, 46b are electrically disconnected from each other.

FIGS. 7(a) and 7(b) illustrate a switch according to a fourth embodiment of the present invention. The switch of FIGS. 7(a) and 7(b) is basically of the same construction as that of the switch shown in FIGS. 6(a) and 6(b). The switch has an insulating base 62 supporting terminals 60a, 60b having ends 61a, 61b, a cover 63 fitted over the insulating base 62, and a contact 65 disposed in a cavity 64 defined jointly by the insulating base 62 and the cover 63. The contact 65 is formed from a rectangular conductive metal plate into an arcuate construction with a rectilinear end portion 65a, an arrangement similar to that shown in FIGS. 6(a) and 6(b). The contact 65 is mounted on the insulating base 62 such that it looks arcuate when viewed in the direction along which a slide member 66 with the contact 65 mounted therein is slidable. The contact 65 has an end 67 held in frictional engagement with projecting arms 68a', 68b' of L-shaped contact members 68a, 68b fixedly mounted on the ends 61a, 61b of the terminals 60a, 60b.

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When the contact 65 is mounted in the slide member 66, the distance L_4 between an arcuate crest 69 of the contact 65 which is held against a resin wall 69 of the insulating base 62 and a distal edge of the end 67 of the contact 65 is larger than the distance L_4 between the resin wall 69 and the arms 68a', 68b'. Therefore, the contact 65 as it is mounted in the slide member 66 and force-fitted between the resin wall 69 of the cavity 64 and the arms 68a', 68b', has its end 65 pressed resiliently against the arms 68a', 68b'. Angular movement of a knob 71 of a toggle lever 70 engaging the slide member 66 in the directions of the arrowheads 72 causes the contact 65 to slide on the arms 68a', 68b' in the directions of the arrowheads 73.

The end 67 of the contact 65 may be cut into the form of a knife edge for better electrical connection with the arms 68a', 68b'. As with the switch shown in FIGS. 6(a) and 6(b), the terminal ends 61a, 61b may be cross-sectionally L-shaped and the contact 65 may be elongated in the longitudinal direction for direct frictional contact with the terminal ends 61a, 61b. Although in the illustrated embodiment the contact 65 is mounted in the slide member 66 and press-fitted between the resin wall 69 of the cavity 64 and the arms 68a', 68b' for easily sliding movement, the slide member 66 may be dispensed with and the contact 65 may directly be inserted between the wall 69 and the arms 68a', 68b'.

In the position of FIG. 7(a), the end 67 of the contact 65 is pressed in frictional contact with the arms 68a', 68b' of the contact members 68a, 68b, and the terminals 60a, 60b are electrically connected to each other. When the knob 71 of the lever 70 is angularly moved counterclockwise, the end 67 of the

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contact 65 mounted in the slide member 66 is slidably turned counterclockwise in a plane defined jointly by the arms 68a', 68b' until the end 67 is disengaged from one of the arms 68a', whereupon the terminals 60a, 60n are electrically disconnected from each other.



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CLAIMS

1. A switch comprising a body of insulating material, contact terminals supported on the body and a conductive contact in the form of a curved plate which is movable relative to the contact terminals between an open and a closed position
5 of the switch wherein the curved plate respectively makes or breaks contact between the contact terminals, the plate being preloaded in the body such that in the closed position a peripheral edge of the plate is urged into contact with the contact terminals and slidable in contact therewith during
10 movement to and from the open position.
2. A switch according to claim 1 wherein the ends of a plurality of terminals project into a cavity in the body, the movable conductive contact being pre-loaded in the cavity, with the peripheral edge thereof resiliently held against
15 and slidable relative to the ends of the terminals.
3. A switch according to claim 2 comprising a slide member slidably mounted in the insulating body, and on which the movable conductive contact is mounted, the movable conductive contact and the slide member being pressed together in the
20 cavity.
4. A switch according to claim 2 wherein the movable conductive contact is a part spherical plate which contacts



side surfaces of the terminal ends and having a current breaking recess in the said peripheral edge thereof, said movable conductive contacts being angularly displaceable to move the peripheral edge in a plane defined jointly by the
5 said side surfaces, for displacing the current-breaking recess into or out of engagement with one of the side surfaces for breaking or making electrical connection between the terminals.

5. A switch according to claim 4, wherein the movable
10 contact is mounted on a slide plate in the form of a resin disc having a sectoral notch exposing the peripheral edge of the movable contact for engagement with the ends of the terminals, the movable conductive contact and the slide plate being pressed together in the cavity.

15 6. A switch according to any one of the preceding claims, wherein the peripheral edge of the movable contact has a slit for adjusting the resilient force with which the peripheral edge is pressed against the ends of the terminals.

7. A switch according to claim 2 wherein the movable
20 conductive contact comprises an arcuate rectangular plate pressed in the cavity and having a peripheral edge which extends in a direction along which the terminal ends are aligned, the peripheral edge of the movable contact being resiliently held against and slidable relative to the ends



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of the terminals.

8. A switch according to claim 7 wherein the peripheral edge of the movable conductive contact contacts upper surfaces of the terminal ends.

5 9. A switch according to claim 7 wherein the peripheral edge of the movable contact contacts side surfaces of the terminal ends.

10. A switch according to claim 7 wherein the said end of each terminal comprises an L-shaped contact member having
10 an arm extending into the cavity.

11. A switch according to any one of claims 8 to 10 wherein the movable contact is mounted on a member, which is slidable in the said direction, the movable contact and the slide member being pressed together in the cavity.

15 12. A switch according to claim 9 or 10 wherein the movable contact is mounted upon a slide member which is rotatable in a plane in which the said sides or the said arms are disposed, the movable contact and the slide member being pressed together in the cavity.

20 13. A switch according to any one of the preceding claims, wherein the peripheral edge of the movable conductive contact is in the form of a knife edge.

14. A switch substantially as hereinbefore described with reference to and as illustrated in Figures 1 to 4, 5, 6 and 7.
