

[54] **KEY SWITCH**

[75] Inventor: William A. Berry, Covina, Calif.

[73] Assignee: Addmaster Corporation, San Gabriel, Calif.

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[58] Field of Search 200/166 BA, 166 PC, 200/153 LA, 159 R, 16 A

[56] **References Cited**

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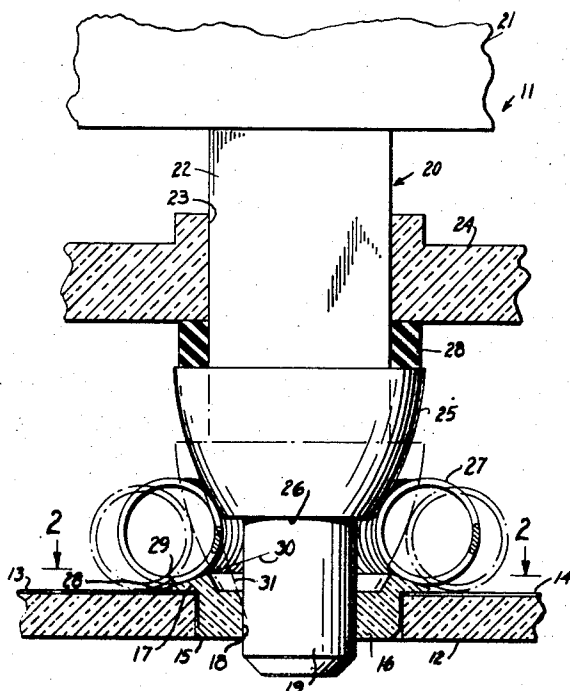
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Primary Examiner—Robert K. Schaefer
Assistant Examiner—Robert A. Vanderhye
Attorney—Fred N. Schwend

[57] **ABSTRACT**

A key switch incorporated with a printed circuit board having conductors thereon and a bearing member loosely fitted in a hole formed between adjacent terminal ends of the conductors. A depressible key is slideable in the bearing member and has a generally conical surface engaging an expandable toroidal contact spring member which rests on an outwardly tapering surface of the bearing member. As the key is depressed the conical surface thereof expands the spring member downwardly over the surface of the bearing member and into bridging contact with the conductors.

5 Claims, 2 Drawing Figures



KEY SWITCH

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to electric switches, and has particular reference to key operated switches for use with printed circuit boards or the like.

2. Description of the Prior Art

Switches have been developed heretofore for use in connection with printed circuit boards to control electronic circuits. Generally, control of such an electronic circuit requires a signal of adequate voltage, although the current requirements are generally small. Accordingly, it is necessary that the switch contacts be clean and free from metal oxides which might otherwise increase the resistance of the contacts to a point where the signal will be unreliable. Also, it is essential in many cases that the switch contacts do not produce "noise" or contact "bounce" or "chatter" which may give rise to spurious and unwanted signals.

Although it is well known that certain of the noble metals, such as gold or platinum, are relatively free from oxidation and therefore make excellent switch contacts, such metals are very expensive and therefore cannot be used in relatively inexpensive switches unless they are applied to a base metal as an extremely thin plating or coating. However, it is found that any wiping action between the contacts of prior art switches tends to wear off such thin coating, thereby exposing the base metal of the contacts to oxidation.

Many prior art switches are constructed to insure sufficient wiping action to remove any oxides that may develop between the contact points. The U.S. Pat. to Fordeck, No. 3206561, issued on Sept. 14, 1965, is an example of such a switch. The latter discloses a toroidal, helically wound spring which, when the key is depressed, slides over the conductors of a printed circuit board to make contact. Although such a switch is generally satisfactory, it has been discovered that the sliding movement of the many coils of the spring over the printed circuit connectors tends to abrade any metallic coating and also tends to give rise to a certain amount of "noise" which in many cases is undesirable. Also, the construction of said switch requires that the end of the conductors in the vicinity of the switch terminate outside the normal location of the spring. Such construction requires precise location of such terminal ends and the guide means for the key since any lateral movement of the key in any direction might cause undesired contact to be made. On the other hand, if the spacing is too great an undue length of key stroke is required to close the switch. Further, during depression of the key, the contact spring must engage and ride over the adjacent terminal ends of the conductors and this tends to give rise to contact bounce when the key is depressed quickly.

SUMMARY OF THE INVENTION

The present invention represents an improvement over the switch disclosed in the above noted Fordeck Patent and comprises a printed circuit board having an opening therein and two or more conductors thereon terminating at such opening. An annular non-conducting bearing member fits in the opening and sideably guides the lower end of a key member having a tapered actuating portion. The bearing member also normally

supports the toroidal contact spring and guides it into contact with the upper surfaces of the conductors just as the key member reaches the bottom of its stroke.

Since little or no wiping action occurs between the contact elements, i.e., the contact spring and the conductors, a very thin coating of non-oxidizing metal, such as gold, may be applied. Although this coating may be extremely thin, i.e., on the order of 0.00050 inches in thickness, it will insure adequate electrical contact with little or no tendency for the coating to wear.

Also, since the contact spring does not have to ride over the terminal ends of the conductors, contact "bounce" is reduced or eliminated regardless of the speed at which the switch is operated.

A further feature of the invention resides in the fact that the opening in the printed circuit board, through which the key member extends, need not be precisely located relative to the terminal ends of the conductors.

A further feature is that the terminal ends of the conductors need not be spaced from the edge of the opening in the printed circuit board but instead, need only be initially located adjacent the opening. For example, the conductors may initially be terminated anywhere within the area of the desired opening and then such opening may be later drilled or punched.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional elevation view through a keyswitch embodying a preferred form of the present invention.

FIG. 2 is a sectional plan view taken substantially on the line 2-2 of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing, a single key operated switch, generally indicated at 11 is illustrated, the latter being incorporated with a printed circuit board 12 of plastic or similar non-conductive material having a pair of conductors 13 and 14 bonded on the upper surface thereof. However, it is to note that a large number of such switches can be grouped together on the board 12 to form a keyboard switching assembly.

A hole 15 is formed in the board 12 to receive an annular bearing member 16 having a radially extending flange 17 at the upper end thereof. The bearing member 16 is formed of plastic or other non-conductive material and has a bearing opening 18 therein to slideably receive the lower bearing portion 19 of a plastic key member 20, the latter having a key top indicated at 21.

The key member 20 has an upper bearing portion 22 of rectangular cross section which is slideably received in a mating bearing 23 formed in an upper key plate 24 suitably supported in fixed relation to the printed circuit board 12.

The bearing member 16 may be smaller in diameter than the hole 15 to permit the bearing member to "float" to enable it to align itself with the bearing 23 even though the hole 15 may be somewhat out of alignment with the bearing 23.

A convex-conical surface 25 is formed on the key member 20 intermediate the bearing portions 19 and 22 and forms a shoulder 26 on the bottom thereof

which is adapted to limit against the upper surface of the bearing member 16 to arrest depression of the key member 20.

A helically wound toroidal contact spring 27 is tensioned over the conical surface 25 and normally rests on the upper surface of the flange 17 of the bearing member 16. Because of its constriction against the conical surface 25, the spring 27 normally maintains the key member 20 in its illustrated raised position wherein a bumper ring 28 of elastomeric material fitted over the bearing portion 22 engages the bottom of the key plate 24. The spring 27 is also effective to raise the key member from depressed position in which case the bumper ring absorbs the shock of arresting the key member in its upper position.

Preferably, a flash coating of gold, platinum or other metal having little or no tendency to oxidize and having a thickness of approximately 0.00050 inches is applied to both the spring 27 and the conductors 13 and 14.

It will be noted that the flange 17 of the bearing member 16 has a conical upper surface 29 which terminates in an outer, substantially sharp edge 28. The plane of such upper surface extends coincident with a line 30 which is at right angles to a line 31 extending coincident with the general plane of the conical surface 25.

Accordingly, upon depression of the key member 20, the plastic surface 25 exerts a force against various coils of the spring 27 which is substantially parallel to the plane of the conical surface of flange 17, thus expanding the spring and causing it to move down the conical surface 29 and into contact with the conductors 13 and 14. Due to the sliding action of the spring 27 in moving down the smooth plastic upper surface of flange 17 onto the conductors 13 and 14 and the minimum wiping action of the spring 27 and the conductors 13 and 14, there will be little tendency for the coating of noble metal to wear and there will be no tendency for the contact spring 27 to bounce or chatter.

It will be noted that in forming the switch, the hole 15 need not be precisely centered over the adjacent ends of the conductors 13 and 14 but may be offset considerably in any direction without affecting the operation of the switch.

In order to provide a maximum area of contact between the contacts 27 and the conductors 13 and 14, the adjacent terminal ends of such conductors are preferably enlarged into semi-circular projections 32 and 33, respectively, so that the majority of the coils of the spring will establish contact when the key member 20 is fully depressed.

The convex-conical surface 25 enables the contact spring 27 to exert a maximum upward force against the key member 20 when in its illustrated raised position and a minimum upward force when the key member is fully depressed. Although this gives a generally desired key characteristic, the surface 25 could also be made conical or concave-conical with resultant different key characteristics.

I claim:

1. A key operated switch comprising a flat support of non-conductive material having a pair of conductors on and extending along the upper surface thereof and having flat upper coplanar contact surfaces spaced from each other, an opening in said support between said conductors, an annular member of non-conductive material extending around said opening and over adjacent portions of said contact surfaces of said conductors, a depressible key member extending through said opening and having a generally conical surface thereon, said key member being movable at right angles to said support, and an expandable toroidal spring contact member of conductive material tensioned over said conical surface and normally located in contact with the upper surface of said annular member, said key member being depressible in said opening whereby to cause said conical surface to expand said contact member radially beyond the upper surface of said annular member and into contact with contact surfaces of said conductors.
2. A key operated switch according to claim 1 wherein said upper surface of said annular member tapers outwardly towards said conductors to a substantially sharp edge.
3. A key operated switch according to claim 1 wherein a bearing member fits in said opening in said support and has a flange constituting said annular member extending radially over said conductors, said flange tapering outwardly to a substantially sharp edge.
4. A key operated switch according to claim 3 wherein said key member is arrested during depression thereof against the upper surface of said bearing member.
5. A key operated switch according to claim 2 wherein the plane of said upper surface of said bearing member extends substantially at right angles to the general plane of said conical surface.

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