United States Patent [19]

Berry

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[54] **KEYBOARD PRINTED CIRCUIT SWITCH ASSEMBLY WITH AXIALLY MOVABLE COIL SPRING CONTACT AND ASSOCIATED KEY TYPE ACTUATOR**

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[52] **U.S. Cl.** .....**200/16 A,** 200/5 R, 200/61.76, 200/159 R, 200/166 BA

[51] **Int. Cl.** **H01h 15/04,** H01h 1/34

[58] **Field of Search** .....200/5 R, 16 A, 16 B, 200/61.76, 159 R, 166 BA

[56] **References Cited**

UNITED STATES PATENTS

3,697,706	10/1972	Huggard	200/61.19
959,435	5/1910	Thomson	200/166 BA
1,333,115	3/1920	Jones	200/166 BA
1,873,141	8/1932	Norviel et al.	200/166 BA
3,206,561	9/1965	Fordeck	200/5 R

Primary Examiner—J. R. Scott
Attorney—Fred N. Schwend

[57] **ABSTRACT**

A key operated switch incorporated with a printed circuit board having conductors thereon and an upwardly extending conical post of non-conducting material between adjacent terminals of certain of the conductors. An expandable toroidal contact spring surrounds the post and is normally located above the conductors by virtue of its constriction against the conical surface. A depressible key member, which is normally held in raised position by the contact spring, is effective upon depression to move the spring into bridging contact with the conductors.

8 Claims, 3 Drawing Figures

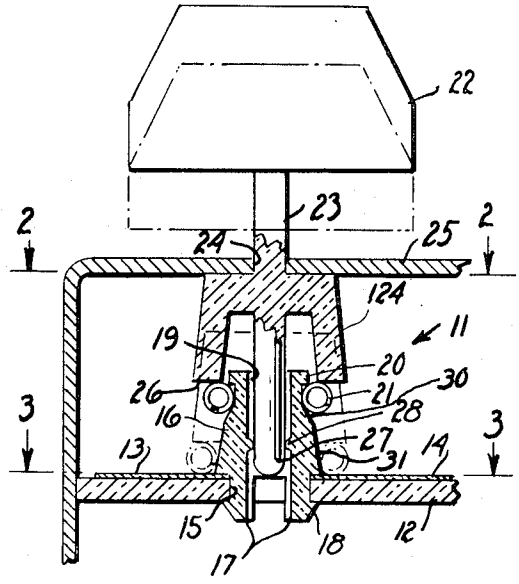
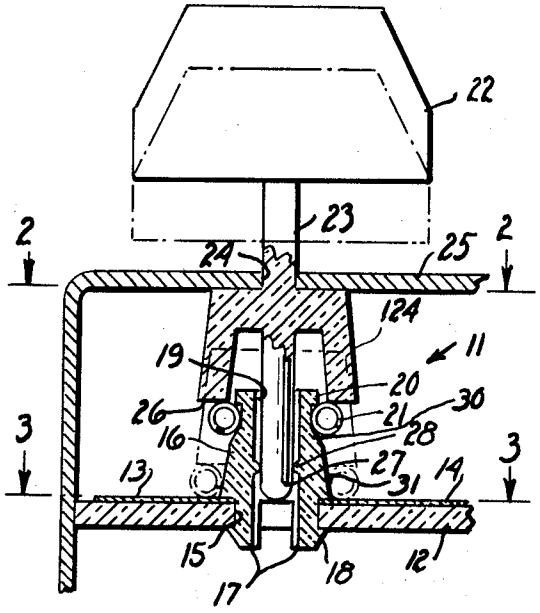


FIG. 1.



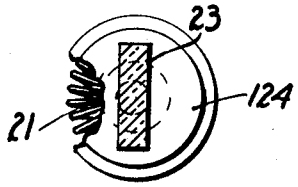


FIG. 2.

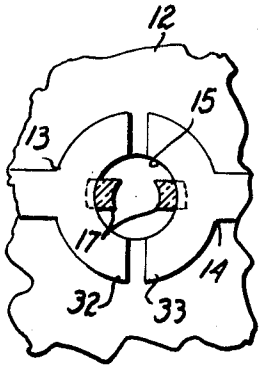


FIG. 3.

KEYBOARD PRINTED CIRCUIT SWITCH ASSEMBLY WITH AXIALLY MOVABLE COIL SPRING CONTACT AND ASSOCIATED KEY TYPE ACTUATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to electric switches, and has particular reference to depressible key operated switches for use with printed circuit boards wherein the circuits are formed by printing or etching conductors on an insulated base or board.

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, etc., 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.

Heretofore, switches of the above type have generally been constructed to provide a certain amount of wiping action between the switch contacts to remove any oxides or dirt that may accumulate. The U.S. Pat. to Fordeck No. 3,206,561, 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 conductors gives rise to a certain amount of "noise" which in many cases is undesirable.

Other switches, as disclosed for example, by the U.S. Pat. to Andren No. 3,523,163, issued on Aug. 4, 1970, produce a snap action of the switch contacts which tend to insure good electrical contact. However, such switches tend to cause the contacts to "bounce" which may give rise to unwanted multiple signals.

Although it is well known that certain of the noble metals, such as gold and 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 has been found that continued wiping action of the contacts of prior art switches tends to wear off such thin coating, thereby exposing the base metal to oxidation.

SUMMARY OF THE INVENTION

According to the present invention, a relatively simple and inexpensive switch employing a toroidal, helically wound spring contact is provided in which no wiping action occurs between the contact spring and the conductors, thereby allowing a very thin coating of non-oxidizing metal, such as gold, to be applied to the contact points. Although this coating may be extremely thin, i.e., on the order of 0.000050 inches in thickness, it will insure adequate electrical contact and since there is no wiping or abrading action between the contact points there will be no tendency for the coating to wear.

Further, since there is negligible or no wiping action between the contacting points, no "noise" is generated. Also, since no snap or violent contact action is involved, contact bounce or chattering is eliminated.

Further, since a toroidal, helically wound contact spring is employed to effect the electrical contact, the many coils of the spring provide multiple points of contact effective to insure adequate electrical connection regardless of any minor imperfections in any one coil.

An additional feature of the invention is that the switch is simple and inexpensive to manufacture and assemble and yet is compact so that multiple number of said switches can be grouped together to form a keyboard switching system.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view through a switch assembly embodying a preferred form of the present invention.

FIG. 2 is a sectional plan view taken along line 2—2 of FIG. 1.

FIG. 3 is a sectional plan view taken along 3—3 of FIG. 1.

DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

Referring to the drawing, a single key operated switch, generally indicated **11**, is illustrated. However, it is to be understood that a large number of such switches can be grouped together to form a keyboard switching assembly.

A printed circuit board **12** plastic or similar non-conductive material is provided having two or more conductors **13** and **14** formed on the upper surface thereof.

A hole **15** is drilled or otherwise formed through the board intermediate the terminal ends of the conductors to receive a hollow post **16** of plastic or other non-conductive material. The post has a pair of diametrically opposed yeilable prongs **17** formed integrally therewith and terminating in barbs **18.** When the prongs are fully inserted in the hole **15,** such barbs spring outwardly to securely lock the post in a centered position over the hole.

The post has a vertical hole **19** extending concentrically therethrough and an upwardly converging conical surface which terminates in a flange **20** at its upper end.

A toroidal helically wound metal contact spring **21** is streched over the post and because of its constriction against the conical surface it normally maintains itself in its upward full line illustrated position in FIG. **1,** where it may engage the flange **20.** Thus, the flange **20** prevents the spring **21** from becoming removed from the top of the post especially during assembly of the switch parts.

A depressible key is provided including a keytop **22** and a keystem **23** suitably attached thereto. The keystem is rectangular in cross section at its upper end and is slidably mounted in a mating slot **24** formed in a key guide plate **25** which extends in spaced parallel relation to the circuit board **12.**

The keystem has an annular skirt **124** integral therewith, whose bottom edge **26** rests on and is supported by the contact spring **21.** The lower end of the keystem **23** terminates in a cylindrical guide plunger **27** which is guided for vertical movement within an inwardly ex-

tending bearing flange **28** formed midway along the length of the hole **19** in the post **16.** Thus, the post **16** and key frame **25** will vertically guide the key during the depression thereof. Since the slot **24** and bearing flange **28** are relatively short in length they will tolerate an appreciable mis-alignment of each other without binding the keystem against sliding movement.

It will be noted that the upper end of the skirt limits against the key frame **25.**

Preferably, a flash coating of gold, platinum or similar noble metal having little or no tendency to oxidize and having a thickness of approximately 0.000050 inches is applied to both the spring **21** and the conductors **13** and **14.**

It will be noted that upon depression of the keytop **22,** the skirt **124** will cause the spring **21** to roll down the conical surface of the post until it contacts the conductors **13** and **14,** thereby establishing an electrical circuit across these conductors.

It will also be noted that the conical surface is divided into two sections, one shown at **30** having a relatively great angular diversion and the remaining section **31** having a lesser angular diversion. Thus, at the commencement of a key stroke, a greater resistance to depression will be met and thereafter the key stroke will be materially easier as the contact spring **21** moves over the section **31.** Such contour and the resulting key action may, however, be varied as desired.

It will be noted that by enlarging the adjacent terminal ends of the conductors **13** and **14** to substantially surround the hole **15,** as indicated at **32** and **33** in FIG. **3,** a majority of the coils of the contact spring **21** will be utilized to establish electrical contact.

Alternatively, the plunger **27** may be omitted whereby the keystem may be guided solely by the bearing **24** in the keyframe **25** or the bearing **28** may be greatly enlarged whereby the keystem may be guided solely by the bearing **28.**

An important feature of the invention is the ease of assembly of the key operated switch or group of such switches. In this case, the post **16** is merely snapped to the hole **15,** the spring **21** is placed over the post and the key guide plate **25** with the keytop **22** and keystem **23** assembled thereon, is merely located in position with the plunger **27** fitted into the hole **19** of the post.

I claim:

1. A key operated switch comprising

a printed circuit board of non-conductive material having a plurality of conductors on the upper surface thereof, and spaced from each other,

a post of non-conductive material supported by said board adjacent said conductors,

said post having an upwardly converging surface,

a toroidal spring contact member of conductive material tensioned over said upwardly converging surface,

said spring contact member being normally elevated on said post by virtue of its constriction against said upwardly converging surface,

and a depressible key member for moving said spring contact member downwardly over said post and into contact with said conductors.

2. A key operated switch according to claim **1** comprising

means on said post for vertically guiding said key.

3. A key operated switch according to claim **1** comprising

a key plate having a bearing therein for vertically guiding the upper end of said key member,

and said post having a second bearing therein for vertically guiding the lower end of said key member.

4. A key operated switch according to claim **1** comprising

means at the upper end of said post for limiting upward movement of said spring contact member.

5. A key operated switch according to claim **1** wherein said board has an opening therein extending between a pair of said conductors,

and said post has a plurality of downwardly extending yieldable prongs fitted in said opening whereby to locate said post between said conductors.

6. A key operated switch according to claim **1** wherein said converging surface comprises sections of different angular convergence.

7. A key operated switch comprising

a printed circuit board of non-conductive material having a pair of conductors on the upper surface thereof and spaced from each other,

said board having an opening therethrough intermediate said conductors,

a post of non-conductive material having a plurality of yieldable prongs engaging the sides of said opening whereby to locate said post intermediate said conductors,

said post having an upwardly converging surface,

a toroidal spring contact member of conductive material tensioned over said converging surface,

a depressible key member,

a key guide element having a bearing for guiding the upper end of said key member for vertical movement,

said post having a bearing therein for guiding the lower end of said key member for vertical movement,

and an annular element on said key member intermediate said bearings,

said annular member engaging said spring contact member and effective to move said spring contact member over said post and into contact with said conductors upon depression of said key member.

8. A key operated switch according to claim **7** wherein said spring contact member is normally effective to raise said key member to an undepressed condition.

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