United States Patent [19]

Abernethy

[11] **3,924,089**

[45] **Dec. 2, 1975**

[54] **KEYBOARD SWITCH**

[75] Inventor: **Lynn W. Abernethy**, Raleigh, N.C.

[73] Assignee: **Stackpole Components Company**, Raleigh, N.C.

[22] Filed: **Aug. 28, 1974**

[21] Appl. No.: **501,141**

[52] **U.S. Cl.**..... **200/159 R**; 200/264; 200/276

[51] **Int. Cl.**²..... **H01H 13/52**; H01H 1/02; H01H 1/24; H01H 1/32

[58] **Field of Search**..... 200/159 R, 276, 264, 165, 200/241, 242

[56] **References Cited**

UNITED STATES PATENTS

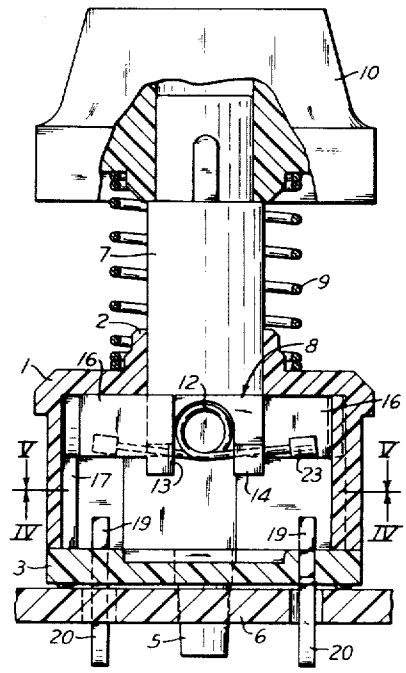
2,567,421	9/1951	Bratingson	200/276
3,096,422	7/1963	Alexandersson et al.	200/246
3,133,177	5/1964	Alexandersson	200/245
3,244,847	4/1966	Erpel	200/276 X
3,430,019	2/1969	Krautwald et al.	200/245
3,767,878	10/1973	Sykora	200/276 X

Primary Examiner—James R. Scott
Assistant Examiner—William J. Smith
Attorney, Agent, or Firm—Brown, Murray, Flick & Peckham

[57] **ABSTRACT**

A switch case has a top provided with an opening in which slides the stem of a plunger that has a foot inside the case normally held adjacent the top of the case by means of a spring. The foot carries a bridging contact member formed from a spring wire coil attached to it and having free end portions extending tangentially away from the opposite sides of the plunger foot. Electrically conductive elastic members are rigidly mounted on the ends of the coil wire to form movable contacts that engage stationary contacts in the case when the plunger is depressed.

5 Claims, 5 Drawing Figures



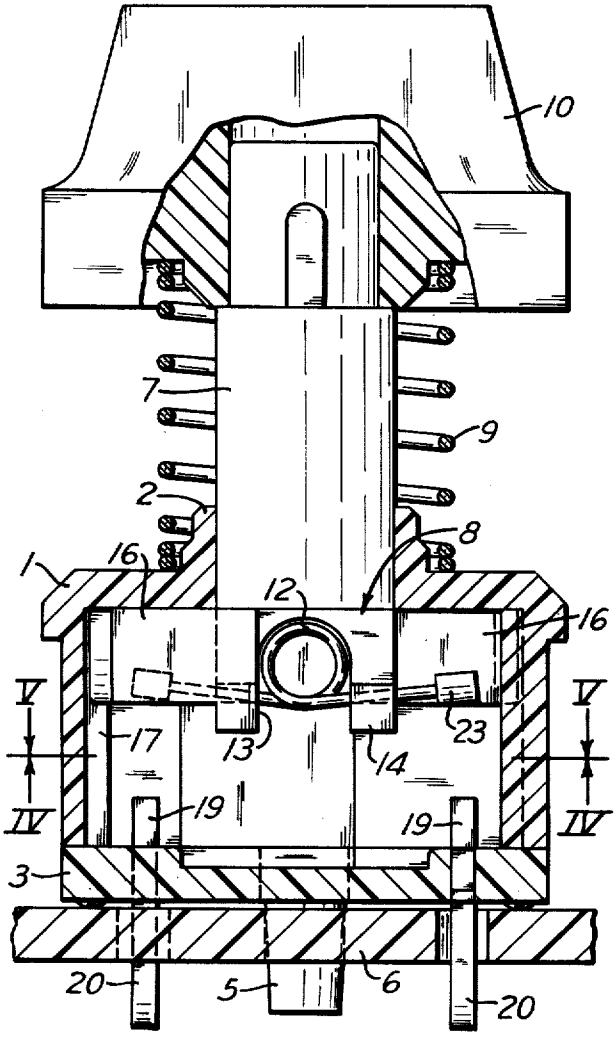


Fig. 1

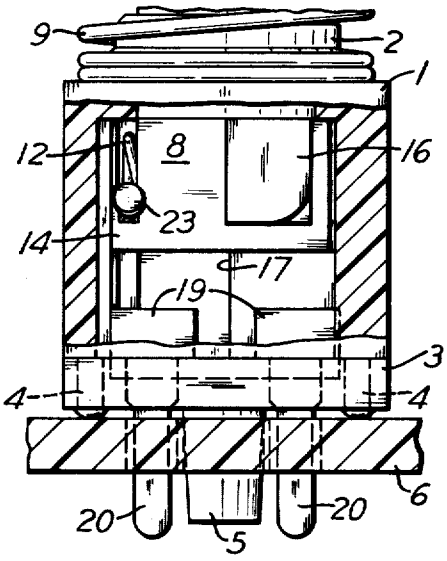


Fig. 2

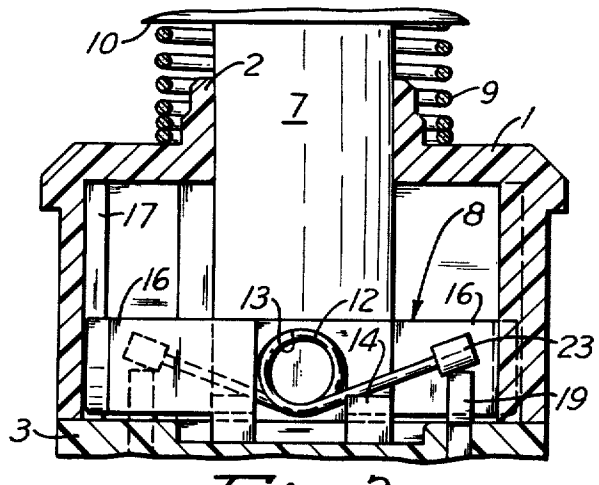


Fig. 3

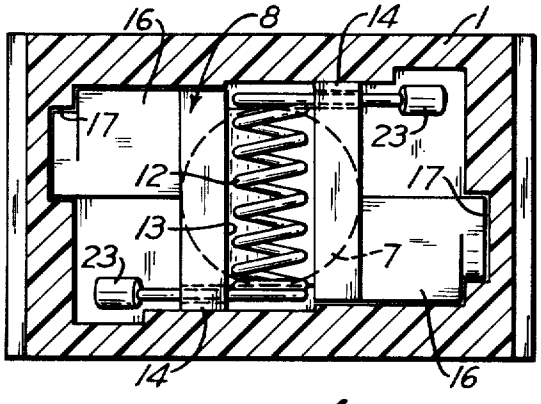


Fig. 4

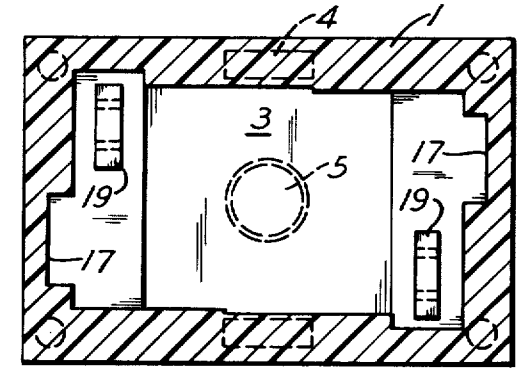


Fig. 5

KEYBOARD SWITCH

This invention relates to keyboard switches suitable for use in calculators, data processing and stock quotation equipment, cash registers, audio-visual education equipment, communication equipment, typewriters, and other devices. The invention relates more particularly to the switch shown in U.S. Pat. No. **3,767,878.**

It is among the objects of this invention to provide a keyboard switch of the type shown in the above-mentioned patent, which has a longer life than the patented switch and even less bounce.

The preferred embodiment of the invention is illustrated in the accompanying drawings, in which

FIG. **1** is a vertical section of the open switch;

FIG. **2** is a fragmentary view at **90°** to FIG. **1,** with part of the switch case broken away;

FIG. **3** is a fragmentary vertical section similar to FIG. **1,** but with the switch closed; and

FIGS. **4** and **5** are horizontal sections taken on the line IV—IV and V—V, respectively, of FIG. **1.**

Referring to FIGS. **1, 2,** and **5** of the drawings, a rectangular case **1,** generally molded from a plastic, has in its top wall a central vertical opening, from which a cylindrical flange **2** extends upwardly a short distance. The bottom wall **3** of the case may be attached to the rest of the case by downwardly extending lugs **4** that project through slots in the bottom wall. The lower ends of these lugs can be deformed by heat to lock the bottom wall in place. The bottom of the case is provided with a central vertical post **5** designed to have a press fit in a printed circuit board or other panel **6** on which the switch can be mounted. The post holds the switch in place.

The stem of a plunger **7** is slidably mounted in the top wall opening and flange **2** of the case and extends above the flange. The lower end of the stem inside the case is provided with a foot **8** that normally is held against the top wall of the case by means of a coil spring **9** encircling the plunger and compressed between the case and a cap **10** frictionally mounted on the upper end of the plunger and always spaced from the case.

The foot of the plunger carries a bridging contact inside the case. The bridging contact includes a spring wire coil **12** that extends across the plunger foot as shown in FIG. **4.** The coil is disposed in a downwardly opening transverse slot **13** in the foot. The opposite end portions of the coil wire are more or less straight and extend tangentially away from opposite sides of the bottom of the coil and also away from opposite sides of the plunger foot as shown in FIG. **1.** These end portions constantly press downwardly because they are pressed upwardly relative to the axis of the coil by slotted stops **14** formed by extending beneath the end portions two diagonally opposite lower corners of the side walls of slot **13.** With this construction the wire presses down against the stops and extends away from them towards the opposite ends of the case.

To help guide the foot of the plunger in the case so as to prevent it from turning, the foot preferably is provided with guide lugs **16** extending away from the opposite side walls of slot **13** in substantially parallel spaced relation with the straight end portions of the coil wire, as shown in FIG. **4.** These guide lugs project beyond the ends of the coil wire and into sliding engagement with the end walls of the case. Preferably, the end walls are provided with guide slots **17** extending vertically across them for receiving the ends of the lugs.

Also, it is preferred that the lugs be located at diagonally opposite corners of the foot of the plunger.

The inside of the case is provided with a pair of fixed or stationary electric contacts **19** spaced beneath the ends of the coil wire and in their paths of movement. Most conveniently, the stationary contacts project upwardly from the bottom wall of the case. Also, it is preferred to make these stationary cantacts integral with the terminals **20** that project from the bottom of the case. Thus, each stationary contact can be the exposed wide head of a narrow terminal that extends down through an opening in the bottom wall of the case. The contact and terminal can be held firmly in place by providing the portion of the terminal inside the wall opening with teeth that tightly engage the sides of the opening. When the cap **10** is pressed to depress the plunger, the bridging contact member is moved downwardly in the case to move the opposite ends of the coil wire towards the stationary contacts below them.

It is a feature of this invention that the free ends of the bridging contact member are provided with electrically conductive elastic members **23** that form movable contacts for engaging the stationary contacts. Each movable contact is formed from an elastic matrix, in which electrically conductive particles are embedded. For example, a mixture of raw silicone rubber and carbon or metal powder can be extruded, preferably in the form of a cylindrical rod of any desired length, and then cured to form an elastic body filled with conductive particles. The rod is then cut into short lengths to form the contacts, which can be forced over the ends of the coil wire. The contacts will tightly grip the wire. If the rod is extruded with an axial passage through it of smaller diameter than the wire, it is easier to apply the contacts to the ends of the wire. Expansion of the passages through the contacts by the wire will cause the contacts to grip the wire.

Although one movable contact may engage the underlying stationary contact shortly before the other two contacts come into engagement, the plunger moves down far enough to ensure that both sets of contacts will engage firmly. Since the elastic contacts at both ends of the spring wire coil are pressed against the stationary contacts, the pressure of the two movable contacts against the stationary contacts is equalized because the coil is free to turn on its axis to the extent necessary for pressure equalization.

The switch disclosed herein has a much longer life than the one shown in U.S. Pat. No. **3,767,878** because, due to the resiliency or elasticity of the movable contacts, wear between the movable and stationary contacts is reduced greatly as compared with contacts having hard unyielding surfaces engaging each other. This new switch also has a lower error rate, errors being defined as failure of contact closure, or as contact bounce in excess of **5** milleseconds.

According to the provisions of the patent statutes, I have explained the principle of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. A keyboard switch comprising a case having a top with an opening therethrough, a plunger having a foot in the case and a stem extending upwardly through said

opening and above the case, a spring normally holding the plunger in its upper position with its foot adjacent the top of the case, a bridging contact member in the case carried by the plunger, said contact member being formed from a spring wire coil attached to said foot and having free end portions extending away from opposite sides of the foot, electrically conductive elastic members rigidly mounted on the ends of said free portions, a pair of stationary electric contacts mounted in the case beneath said movable contacts and normally spaced therefrom, said movable contacts being engageable with the stationary contacts when the plunger is depressed, and terminals connected with the stationary contacts and extending out of the case.

2. A keyboard switch according to claim **1**, in which each of said elastic members surrounds and frictionally grips the adjoining end of said coil wire.

3. A keyboard switch according to claim **1**, in which each of said elastic members is provided with a passage therein receiving the adjoining end of said coil wire, said members pressing tightly against the coil wire to hold them in place.

4. A keyboard switch according to claim **1**, in which each of said elastic members is a cylindrical extrusion provided with an axial passage therethrough receiving the adjoining end of said coil wire with said members tightly gripping the wire.

5. A keyboard switch according to claim **1**, in which said elastic members are composed of a matrix of silicone rubber in which electrically conductive particles are embedded.

* * * * *