June 23, 1970 J. L. YARBOROUGH 3,517,149

ACTUATOR FOR DIAPHRAGM TYPE SWITCH

Filed Oct. 15, 1968

FIG. 1

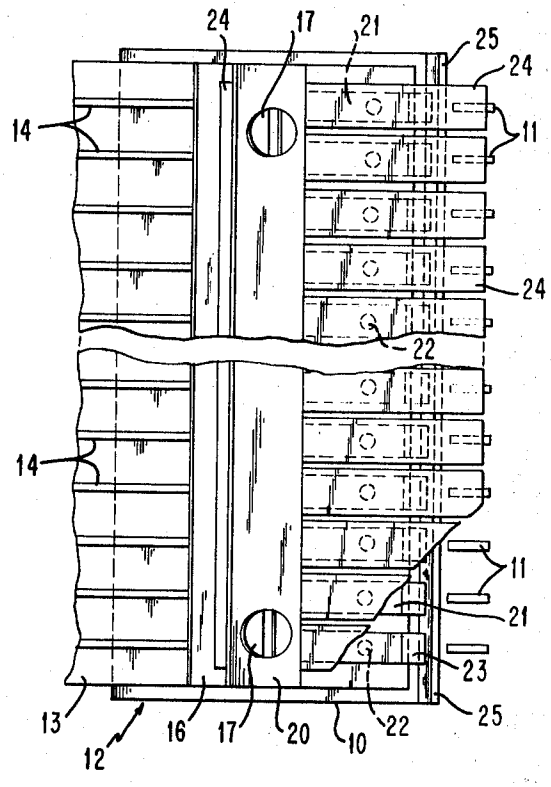


FIG. 2

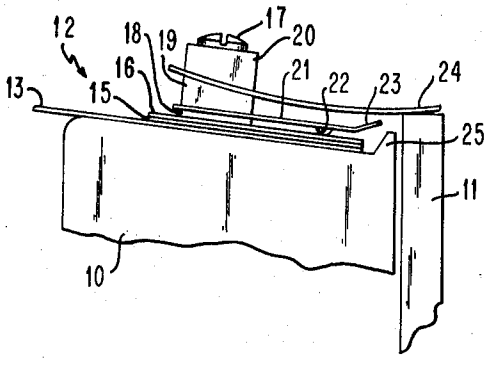
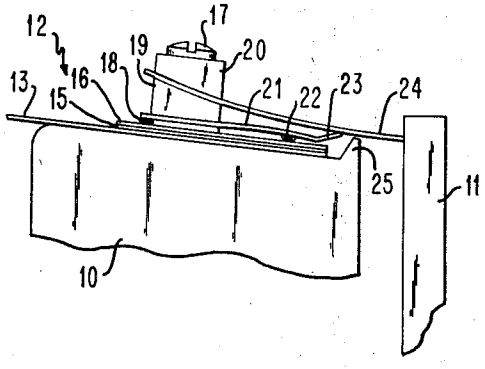


FIG. 3



INVENTOR.
JAMES L. YARBOROUGH

BY Delbert C. Thomas

ATTORNEY

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ACTUATOR FOR DIAPHRAGM TYPE SWITCH

James Lowell Yarborough, Raleigh, N.C., assignor to International Business Machines Corporation, Armonk, N.Y., a corporation of New York

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ABSTRACT OF THE DISCLOSURE

A diaphragm switch of the type having a flexible conductor pressable through a perforation in an insulator into contact with a fixed lower conductor will normally be actuated by a dimple formed on a driven member. To prevent damage to the flexible conductor, the dimple is moved to contact closing position relatively slowly to diminize dynamic forces and is in the form of a bead of rubberlike material shaped to avoid concentration of stress in the conductor. The switch actuating force applied through the dimple is controlled by mounting the dimple on a low rate spring as the driven member and by limiting the stroke of the driving member.

Background of the invention

Elastic diaphragm switches are now being developed for inexpensive, low current applications involving a plurality of circuits, se e the assignee's U.S. Pat. No. 3,308,253 issued Mar. 7, 1967 to M. Krakinowski. One example of such an application would be in a keyboard of the alpha-numeric type for a data transmission terminal wherein semi-conductor control circuits are selectively closed by operation of the keys. The diaphragm switch will comprise a substrate having printed circuit wiring forming one set of switch contacts, an insulating film of Mylar or the like with perforations at the contact points of the substrate and an overlayer of an elastic diaphragm having conductors bonded thereto. These conductors will normally be spaced from those on the substrate by the insulating film but can be depressed through the perforations to make the required contact. In the keyboard noted above, the switch actuator was originally a metallic dimple formed on a cantilever spring which was retained in deflected position by an interposer under its end. Operation of a key of the keyboard acted to withdraw the interposer past the end of the spring and allowed the spring to snap into an active position wherein its dimple pressing against an elastomeric top protective sheet, closed the switch contacts and with its free end latched the interposer against return. A mechanical machine cycle then moved the interposer below and under the end of the spring then returned the interposer and spring to the normal deflected position. It was found that the fast snap action of the spring needed for latching the interposer in the set position generated a dynamic force such that the diaphragm and its conductors were subject to rupture by the dimple as the switch was closed.

Description of the invention

This invention relates to an actuator for a switch and more particularly to an actuator which will transmit only a controlled force through a compressible element to an elastic diaphragm type of switch.

It is an object of this invention to provide an actuator for an elastic diaphragm type of switch, the actuator applying a small controlled contact closing pressure.

It is another object to provide a combined elastic diaphragm switch actuator which is fast enough to reliably

detent an interposer element but which applies a contact closing pressure at a relatively slow rate.

A further object is to provide a multiple circuit diaphragm type switch with independent circuit closing actuators each normally held in an inactive position by an interposer but releasable to drive a member having a controlled rate of force transmission to close its associated circuit and with each released element holding its interposer in an operated position.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention, as illustrated in the accompanying drawings.

Drawings

In the drawings:

FIG. 1 is a plan view of a multiple circuit switch as described herein;

FIG. 2 is a side view of the switch in a circuit open condition; and

FIG. 3 is a view similar to FIG. 2 but with the parts in an interposer latched condition.

Detailed description

The switch actuators are described as embodied in an alpha-numeric transmission terminal having a typewriter type keyboard. In such a terminal, there would be, see FIG. 1, a switch supporting frame **10** extending across the machine and supporting a plurality of interposers **11**. There will normally be one interposer **11** for each key of the keyboard. A multi-circuit switch **12** having at least one circuit for each interposer is mounted on the top surface of frame **10** with the circuits of switch **12** in alignment with the interposers **11**. Switch **12** will usually be constructed of a bottom substrate **13** having printed circuit type contacts and wiring **14** thereon. This is partially covered by a pair of sheets of a plastic insulating material such as Mylar[1], a lower sheet **15** having perforations at the contact points on substrate **13** and an upper sheet **16** having thin flexible circuits printed thereon to form the other switch contacts and connecting circuits. Parts **13**, **15** and **16** are held in place by a rigid retainer plate, not shown. A spring support is mounted by screws **17** to the top surface of switch **12** and comprises a lower bar **18**, an intermediate bar **19** having an inclined upper surface and an upper bar **20** having a matching inclined lower surface. A sheet of spring material is clamped between bars **18** and **19** and is slotted at its right extension to provide an actuator finger **21** for each set of contact points of switch **12**. Each finger **21** has a small button **22** formed of an elastomeric material and in position to close a set of contacts of switch **12**. Each finger **21** has its right end bent upward to form an operating ear **23** and the finger will, in its unstressed position, rest with button **22** very slightly, e.g. up to about six mils, above the surface of sheet **16** of switch **12**. A second sheet of spring material is clamped between the middle and upper bars **19** and **20** and is also slotted at its forward (right in FIG. 1) side to form spring fingers **24** each lying over a finger **21**. Due to the inclined faces of bars **19** and **20**, the fingers **24** are angled downwardly at the front but are normally held in an upper, stressed position above ears **23** by the upper ends of interposer **11**.

In operation, depression of a key of the terminal keyboard will rock the upper end of an interposer **11** to the right from the FIG. 2 position to the FIG. 3 position. This will free the right end of the associated finger **24** which will thereon snap behind the interposer **11** and

[1] A trademark of the Du Pont Corporation.

hold it in the actuated position of FIG. 3. The downward movement of finger **24** will be very fast and will be limited by its engagement with a stop bar **25** on the upper front edge of frame **10**. During a subsequent mechanical operation of the terminal initiated in response to the key operation, the interposer **11** will be depressed until it is below the right end of finger **24** and will then move under the finger. When the interposer **11** is restored to its initial position it will return its spring finger **24** to the ineffective position of FIG. 2.

The downward movement of a finger **24** when released by its interposer **11** will also close the associated circuit switch **12**. Near the start of its motion, finger **24** will contact the ear **23** of its aligned finger **21** and move it down until finger **24** impacts stop bar **25**. This will press button **22** against the upper film **16** of switch **12** to close its associated set of contacts. The compressibility of button **22** will allow the button to deform so as to spread the applied force over a substantial area of film **16** and thereby reduce stress concentration. The contacts of the switch **12** will initially meet at a central area with a comparatively high pressure which will be useful in breaking through any contaminant film, and due to the deforming of the button **22**, the meeting area will enlarge with a slight rolling action of the upper contact over the lower area. At the full depression of finger **21**, its button **22** will have deformed sufficiently to wedge the upper diaphragm **16** with its contact into the hole of the lower sheet **15**, thereby pressing the contacts into engagement over a sufficient area. To limit both the static and dynamic forces which can be applied through button **22** to film **16**, spring finger **21** is made of thin flexible spring material and is so designed that after a predetermined static force is transmitted, the finger **21** will tend to pivot about button **22** and will assume a double curvature in the part between button **22** and bars **18** and **19** and thus tend to compensate for any movement of ear **23** after the switch contacts are closed. The stop bar **25** intercepts upper finger **24** before it moves far enough to apply pressure to finger **21** at any point other than on ear **23**, limits the deflection of ear **23**, and limits the static force applied to the switch.

More importantly, the spring finger **21** has a slow rate of application of dynamic forces so that the energy of the sharp impact of spring finger **24** on ear **23** is applied through the spring **21** and button **22** to the switch diaphragm **16** over a comparatively long interval. This interval gives the diaphragm **16** and button **22** time to yield to the transmitted force and eliminates rupture of the diaphragm.

It may thus be seen that the switch actuator as described herein enables the elastic diaphragm switch to be simplified by elimination of a protective elastomeric film. The actuator also limits the force applied to the switch for contact closure without restriction on the spring force available for the other functions as detenting, etc.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. An actuator for an elastic diaphragm switch having a substrate with contacts thereon, a perforated insulating film covering the substrate and a deformable insulating film on the other side of said perforated film and having flexible conductors pressable through the perforations of said film into engagement with the contacts on said substrate, said actuator comprising a weak spring, a button of an elastomeric compound on said weak spring in alignment with a perforation of said insulating film and, in the unstressed condition of said week spring, closely adjacent to the outer surface of said deformable film, a strong spring which when free will snap into contact with said weak spring to move said button to close an associated pair of contacts of said switch, a moveable interposer normally holding said strong spring clear of said weak spring and a stop bar to arrest said strong spring after it has moved said weak spring and button sufficiently far to close said associated contacts.

2. A switch actuator as in claim **1** in which said weak spring has its free end bent away from said switch to form an ear for contact by said strong spring and in which said strong spring is mounted with its free end inclined toward said weak spring.

3. A switch actuator as in claim **2** in which said button is initially brought into contact with said deformable insulating film to first engage the contacts of said switch over a central area and with substantial pressure and thereafter deforms to engage further areas of said contacts with a slight rolling action and will finally wedge said deformable film into the underlying perforation.

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HERMAN O. JONES, Primary Examiner

U.S. Cl. X.R.

200—153