LAMINATE SWITCH ASSEMBLY HAVING IMPROVED DURABILITY

BACKGROUND OF THE INVENTION

This invention relates generally to laminate switch assemblies wherein tensioned diaphragms provide a tactile indication of switch activation and, more particularly, to an improved switch activating diaphragm structure which includes a surrounding reinforcing collar to relieve the stresses created in the area between such diaphragms and adjacent planar portions of a diaphragm plate.

A large variety of printed circuit contact switches are available for use as information input keyboards. Such keyboards are used for an ever expanding number of products ranging from calculators to microwave ovens. Of the available switch varieties, many do not provide tactile feedback and, hence, may be unacceptable for some users.

An inexpensive way to form keyboards having tactile feedback is to deposit electrical contact patterns onto a printed circuit board and to provide a tensioned diaphragm or dome over each of the contact patterns. Electrically conducting pads which match the contact patterns on the circuit board are provided so that when a dome is depressed by an operator's finger, an associated pad contacts one of the deposited contact patterns to complete an electrical circuit through the contact pattern. Upon removal of the operating force, the tensioned dome springs back to its initial unoperated position to open the circuit through the contact pattern. The electrically conducting pads can be provided on the interior surface of the dome or can be provided on a separate contact sheet formed from insulating material.

Such switch assemblies form reliable electrical connections and provide tactile feedback to an operator to reassure the operator that the switch contact has been closed. Although keyboards formed from such switches are highly reliable, there tend to be problems in that the domes or diaphragms are formed into sheets of plastic material and, hence, are subject to deterioration with use.

SUMMARY OF THE INVENTION

In accordance with the present invention, a laminate switch assembly is economically constructed to include a tensioned dome switch plate which has improved durability. Each tensioned dome on the switch plate is aligned with a switch contact area formed on a printed circuit board so that depression of the dome completes an electrical circuit through the contact area. Each dome, however, is surrounded by a reinforcing collar or band which relieves the stresses which normally are produced in the transition area between the tensioned domes and the remaining planar portion of the switch plate. This is the area of prior art switch plates which tend to fatigue and deteriorate with use.

The tensioned dome switch plate is formed from commercially available thermoplastic material such as that offered under the trademark Lexan registered to the General Electric Company. The tensioned domes and reinforcing collars or bands can be formed into the thermoplastic at the same time. The tensioned domes and the reinforcing collars are of approximately the same cross-sectional thickness with the domes extending above the reinforcing collars and the collars being arched upwardly to form an externally appearing ridge around each dome.

Key designations can be formed directly into the tensioned domes and the reinforcing collars or bands can be composed of contrasting colors to provide a pleasing appearance to keyboards using the switch plates in accordance with the present invention. During the switch operating deformations of the tensioned domes, the reinforcing collars experience certain limited flexure in performing their function of stress relief. However, compared to the movement of the switch domes, the reinforcing collars remain substantially stationary throughout switching operations.

Laminate switch assemblies incorporating the improved durability switch plate in accordance with the present invention can comprise separate electrical switching contact pads which are spaced from the printed circuit board, or electrically conductive coatings can be formed or deposited on the interior surfaces of the tensioned domes.

It is, therefore, an object of the present invention to provide a laminate switch assembly having improved durability while maintaining inexpensive manufacture techniques; and to provide a laminate switch assembly having an improved tactile dome switch plate wherein each tensioned dome is surrounded by a reinforcing collar or band whereby stresses are relieved in the transition area between the switch domes and the remaining planar portions of the switch plate.

Other objects and advantages of the present invention will be apparent from the following description, the accompanying drawings and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exploded view of one embodiment of a laminate switch assembly in accordance with the present invention.

FIG. **2** is a cross-section of one switching element of the embodiment of FIG. **1**.

DETAILED DESCRIPTION OF THE INVENTION

With reference to FIG. **1**, a five-layered laminate switch assembly or keyboard **100** constructed in accordance with the present invention is shown in exploded view. The first layer comprises a circuit board **101** upon which electrical conducting paths are deposited. A contact pattern **102** comprising an intermeshed pair of electrical contact areas is deposited for each switch or key of the keyboard. The contact patterns **102** as disclosed comprise generally circular areas.

Each contact pattern **102** comprises a pair of electrical contact areas. The first contact area of each pattern comprises a downwardly arched conductor **104** which has extending upwardly therefrom fingers **106**; and the second contact area of each pattern comprises an upwardly arched conductor **108** which has fingers **110** extending downwardly. The upwardly extending fingers **106** are intermeshed with the downwardly extending fingers **110** to facilitate electrical conduction between the conductors **104** and **108** by shorting the adjacent intermeshed fingers to one another.

A connection can be made to the conductor **104** through a terminal **112** and to the conductor **108** through the terminal **114**. It can be seen that this configuration of the electrical contact pattern **102** facilitates the operation of an associated switch since the intermeshed fingers **106, 110** can be conveniently shorted to