ACTUATOR FOR ELASTIC DIAPHRAGM SWITCH KEYBOARD

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Field of Search 197/98, 102, 103, 104, 35/5, 35/6; 340/337; 84/326, 423, 445, 446, 447, 478; 234/123, 124, 125; 235/145, 146; 178/101, 102, 103, 104, 105, 106, 107, 108, 109, 110; 200/5, 5 E, 5 A, 46, 83, 159 B

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6 Claims, 5 Drawing Figures

ABSTRACT

An actuator sheet carries clusters of switch actuating projections aligned with openings which receive deflectable contacts of an array of diaphragm switches. Intersecting ribs are carried on the same side of the actuator sheet as the switch actuating projections, to define isolation zones for the projections corresponding directly to the individual key areas of the keyboard. Integral, raised pressure pads for each key area are formed on the upper surface of the actuator sheet to enhance even pressure distribution over the pertinent switch contact area.
ACTUATOR FOR ELASTIC DIAPHRAGM SWITCH KEYBOARD

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to keyboards for providing input of data to electrical apparatus and more particularly to keyboards incorporating elastic diaphragm switches and the like.

2. Description of the Prior Art

A manual keyboard employing an integrated keying mechanism has previously been employed in an elastic diaphragm switch array incorporated within the keyboard. This type of structure has provided a simplified keyboard at reduced cost while providing a variably responsive mechanism in terms of manual force and pressure required for operation. Additionally, this structure provides pretravel, overtravel, variable touch and the effect of a keystone to simulate the feel of conventional keyboard operated apparatus, such as typewriters. These prior art devices will, for the sake of clarity, be discussed in greater detail in the specification which follows to more clearly point out the differences which characterize the present invention.

SUMMARY OF THE INVENTION

The present invention is directed to an improved elastic diaphragm switch assembly which includes a regular array of deflectable diaphragm switch contacts and an elastomeric sheet overlying the array of contacts and which sheet carries a plurality of projections depending therefrom in registration with the contacts for selectively actuating the same. In particular, the elastomeric actuator sheet carries a series of intersecting, straight-line ribs on the same side of the sheet as the rigid projections to define individual, rectangular isolation zones for the projections, which zones correspond in number and position to the underlying array of switch contacts. This assures prevention of crosstalk or interference problems between adjacent switches when a single key is depressed.

In addition, the present invention is directed to the same elastomeric sheet being provided with raised pressure pads corresponding to each key position of the keyboard on the surface facing the soft button carried internally within the opening of the rigid frame underlying the keyboard keys. The raised pressure pads provide even pressure distribution over the pertinent contact area when a key is depressed and allow relaxation of the tolerance requirements for the soft buttons since a variation in pressure pad tolerance will not be felt by any change in switch actuation pressure. Further, the provision of the intersecting straight ribs allows the entire actuator sheet to lie flat on the elastic diaphragm switch sheet, insuring uniform travel of the keys during depression of the same and enhancing uniform alignment of the actuator projection with the deflectable switch contact of the elastic diaphragm.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a vertical section of an integrated keyboard incorporating an array of elastic diaphragm switches of prior art design;

FIG. 2 is a top plan view, partially broken away, of a keyboard shown in FIG. 1;

FIG. 3 illustrates an alternative prior art design;

FIG. 4 is a bottom plan view of a portion of the improved actuator sheet of the present invention as applied to an integrated keyboard similar to that of FIGS. 1-3;

FIG. 5 is a vertical section of a modified manual keyboard similar to that of FIG. 1 but incorporating the improved actuator sheet of the present invention.

Referring to FIGS. 1 and 2, one form of a prior integrated keying mechanism constituting a manual keyboard which is presently in use is illustrated. It employs a polyurethane elastomer nomenclature sheet which defines the keyboard of the assembly and includes soft flexible keys which, upon depression, cause soft elastomer buttons to force protrusions of an actuator sheet to operate selected diaphragm switches in array. Contacts are carried by the elastic diaphragm, while contacts are carried on a rigid sheet supported by base. Separator sheet of insulative material, normally keeps contacts apart but apertures allow the contacts to close under pressure.

In greater detail, the flexible keys may carry visible indicia identifying the same to allow operator-selector depression as evidenced in FIG. 2. Lying below the keyboard sheet is a protective sheet, which also may be formed of an elastomer, which serves as a dust cover for sealing the actuating mechanism below from the environment and further facilitating manipulation of sheet. The protective sheet is supported by a rigid frame member and having circular or square holes aligned concentrically with keys. Keys may thus be depressed centrally due to the holes or openings. Within the same holes, and underlying the protective sheet, are the key buttons formed of a soft elastomer and molded integrally in a pad. The elastomers preferably are closed-pore cellular neoprene rubber with low compressive modulus.

Below the pad is an actuator sheet comprised, preferably, of a molded neoprene rubber or elastomer and having thereon a plurality of clusters of truncated cone-shaped protrusions or stops in axial alignment with holes and key. The four outer protrusions or stops are of similar length and are slightly shorter than and are circumferentially spaced about central protrusion. All protrusions lie generally within the area of the individual keys. The outer protrusions are rectangularly disposed and spaced from the central protrusion, however, they may be circularly disposed instead. Preferably, the central protrusion is about 6 to 10 mils longer than the outer protrusions which in turn are approximately one eighth inch in length. The central protrusion, when depressed, moves the contact into contact with a contact for a given element of switch array.

The combination of the very soft key pad and the actuator sheet, which is of medium hardness rubber, provides a relatively long keying stroke with pretravel and overtravel. A soft key pad and the flexible keys provide a combination of actuating elements with a low spring constant and a long stroke. These latter characteristics are controlled by the stiffness of key pad and keys. Of importance is the provision of the discrete projections in a uniform spaced pattern.
about the central projection 21 since these projections concentrate the actuating force on a given switch within the array 28. Because of the outside projections 22, the actuating force remains constant over the surface of each of the keys 11. Further, the concentric array of protrusions 22 tends to act as a fulcrum, causing areas outside of the "ring" of the cluster to rise rather than fall. Further, since protrusions 22 are preferably shorter than the central protrusion 21, they facilitate closure of the contacts by the central protrusion of the switch. Force applied to a given key 11 is distributed by protrusion 21 until protrusions 22 contact the elastic diaphragm 23. Then, however, the force is concentrated on the central protrusion 21. However, as the forces are increased, the forces are spread out to the stops or protrusions 22 so that the greater force is distributed over a relatively larger area of the elastic diaphragm 23 by all of the stops 22 surrounding the central protrusion 21.

Rather than employing a central protrusion 21 and a plurality of circumferentially spaced secondary protrusions 22 concentrically surrounding the central protrusion, a modified arrangement for use with a keyboard with square keys 11 is possible. As shown in FIG. 3, the peripheral protrusions 22 are eliminated and a unitary stop is formed by an endless rib 32 lying inside of the key area of a key 11 (shown in phantom). The central protrusion 21 lies well inside of the isolation area defined by the individual curved endless rib 32. The rib 32 thus serves as a stop in similar fashion to stops 22 which prevent interference with or from adjacent keys and which absorbs overtravel forces.

However, in such an arrangement, the individual ribs 32 must be formed under closer tolerances at exactly desired locations and the actuator sheet must be precisely positioned with respect to the other elements of the stacked keyboard. Further, since the force for actuation must be transmitted from the key 11, through the cover sheet 14, the soft button 16, ribs 32 must be manufactured with cone-shaped projection 21, ribs 32 must be manufactured with relatively close tolerances to insure proper and uniform force application to the central protrusion 21 effecting switch operation. Having thus discussed the prior art, the specific preferred embodiment of the improvements which comprise the invention will now be discussed with reference to the prior art.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning to FIGS. 4 and 5, the keyboard of the present invention involves, principally, a modified actuator sheet illustrated at 120 and being preferably rectangular. For the keyboard of FIG. 5, like numerals define like elements to the prior art arrangement of FIGS. 1 through 3. In like fashion the prior art arrangement, sheet 120 is preferably of molded neoprene rubber or similar elastomer, having a medium hardness of about 55 to 65 durometers and, in the illustrated arrangement, is approximately one sixteenth inch in thickness and provided with a plurality of clusters of truncated, cone-shaped protrusions 121 and 122 with the central protrusion 121 surrounded by four, preferably slightly shorter, protrusions 122 circumferentially spaced and concentric with the central protrusion 121.

Unlike the prior art arrangement, an elastomeric actuator sheet 120 has integrally molded thereon, on the top or upper surface 100, a plurality of individual raised pressure pads 102 corresponding in surface area and generally in configuration to the visual keying areas of keys 11 on the keyboard. While the raised pressure pads 102 are shown as being square, they may be irregular, rectangular or circular in form, depending of course upon the configuration and location of the individual keys 11 of the keyboard. The contact surface 104 of each of the raised pressure pads lies in contact with a soft button 16 of the integral pad 18 and in alignment with its respective key 11. Thus, under this arrangement, there is even pressure distribution over the pertinent contact area, in particular that area covering the series of projections 121-122. With the raised pressure pad 102 in contact with the major portion of the soft button 16, the soft button need not have the tolerance requirement of the prior art design. A variation in button tolerance will not be felt by any change in switch actuating pressure due to the presence of the raised pressure pad 102, which assures a more constant pressure pattern for making the switches.

On the underside of the actuator sheet 120 there is provided a plurality of intersecting, straight-line ribs 132 of rectangular cross section which are also integrally molded into the actuator sheet 120. The raised ribs 132 define rectangular isolation zones 106 within which, of course, are carried the protrusions 121-122. The raised ribs 132 lie outside the area of pressure pads 102 on the opposite side of the actuator sheet. The raised ribs 132, due to their intersections, define a regular matrix of rectangular isolation zones corresponding directly with the array of rectangular keys 11 of the keyboard 10. Further, since the straight line, evenly spaced raised ribs 132 contact major portions of the entire underlying elastic diaphragm sheet 123, the actuator lies flat and parallel with the elastic diaphragm sheet 123, thereby insuring uniform travel for each key being depressed and more uniform alignment of the actuator projection 121, achieving switching of contacts 124 and 127 for each switch location.

It is apparent from the above description that the actuator constitutes a more reliable, better balanced pressure actuator than the previously used actuator illustrated in FIGS. 1 through 3, inclusive.

What is claimed is:

1. In an elastic diaphragm switch assembly including; an array of deflectable diaphragm switch contacts and an elastomeric sheet overlying said array of contacts with a plurality of projections depending therefrom in registration with respective contacts, the improvement comprising: a series of intersecting ribs carried on the same side of said elastomeric sheet as said projections and defining a matrix of individual rectangular isolation zones for said projections, said zones corresponding in number and position to said array of contacts to eliminate crosstalk and interference problems between adjacent switches.

2. The elastic diaphragm switch assembly as claimed in claim 1 further comprising a keyboard, a rigid frame member lying below said keyboard and carrying key position separator openings, soft button means coupling said keyboard to said elastomeric sheet through said openings and raised pressure pads carried by said elastomeric sheet on the surface of said sheet
and facing respective soft button means for each key position to insure even pressure distribution over the switch contact area of each zone.

3. The elastic diaphragm switch assembly as claimed in claim 2 wherein said series of intersecting ribs and said raised pressure pad are integrally molded within said elastomeric actuator sheet.

4. The elastic diaphragm switch assembly as claimed in claim 1 wherein said intersecting straight-line ribs are of rectangular cross section and have a thickness at least as great as the length of said projections depending from the same side of said elastomeric actuator sheet.

5. A keyboard comprising: an elastomeric keyboard means bearing indicia and defining keys thereon, an elastomeric actuator sheet including an input surface and an output surface on opposite sides thereof, a rigid frame member having openings therein corresponding to the keys of said keyboard member supporting said keyboard means and positioned intermediate of said keyboard means and said actuator sheet, a plurality of soft elastomeric buttons carried within said frame opening and mechanically coupling said keyboard means to said actuator sheet, a plurality of diaphragm switches in an array corresponding to the keys of said keyboard means and having an actuation surface confronting the output surface of said elastomeric actuator sheet, a plurality of projections extending outwardly of the output surface of said elastomeric actuator sheet for contact with the actuation surface of respective diaphragm switches to close contacts of said switches relating to specific key areas of said keyboard means, one of said projections being responsive to deflection of said actuator sheet for effecting closure of said switch contact and a plurality of additional projections surrounding said one projection for stopping excessive deflection of said one projection, and a plurality of intersecting rectangular ribs projecting from the output surface of said elastomeric actuator sheet and defining individual rectangular isolation zones for the projections corresponding to each switch of said array, said series of intersecting ribs lying outside of the area defined by said switch contacts, said actuator sheet projections associated therewith, said soft elastomeric button, and said frame openings.

6. The keyboard as claimed in claim 5 wherein the input surface of said actuator sheet has integrally molded therein raised pressure pads corresponding in surface area and position to the openings within said frame member and the soft buttons carried thereby in contact with the input surface of said elastomeric actuator sheet.
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,693,775 Dated Sept. 26, 1972
Inventor(s) K. A. Brooks, L. L. Johnson, J. A. Mathewson

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Claim 3, Column 5, line 6, change "pad" to --pads--;
Claim 3, Column 5, line 7, delete "actuator";
Claim 4, Column 5, line 9, delete "straight-line";
Claim 4, Column 5, line 12, delete "actuator";
Claim 5, Column 5, line 19, after "keyboard" delete "member" and insert therefor --means for--;
Claim 5, Column 5, line 22, after "frame" insert --member--;
Claim 5, Column 6, line 7, delete "said switch contact" and insert therefor --a switch contact of a respective diaphragm switch--;
Claim 5, Column 6, line 14, delete "series" and insert therefor --plurality--;
Claim 5, Column 6, line 18, delete "button" and insert therefor --buttons--;
Claim 5, Column 6, line 19, after "frame" insert --member--.

Signed and sealed this 13th day of March 1973.

(SEAL)
Attest:
EDWARD M. FLETCHER, JR. ROBERT GOTTSCHALK
Attesting Officer Commissioner of Patents
UNIVERSAL STATES PATENT OFFICE
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