United States Patent

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[54] **ELASTOMERIC KEYBOARD WITH IMPROVED PRINTED CIRCUIT CONTACT MEANS**
5 Claims, 5 Drawing Figs.

[52] U.S. Cl. ..... 200/1 R, 200/5 E, 200/86 R
[51] Int. Cl. H01h 9/00, H01h 9/26, H01h 3/02
[50] Field of Search ..... 200/1 A, 1, 5, 16, 86; 179/90 K; 340/166, 324

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ABSTRACT: A signal-actuating device having its major component parts molded as a single piece. The actuating device includes a single body composed of an elastomeric material which is a glycol cured isocyanate terminated polyester formulated to be virtually a true gel, character symbols bonded on the body representing key positions and Mylar circuitry strips of etched copper wires bonded to raised projections located on the underside of the body. Contact made by depressing a key gives a binary-coded output, as well as providing a signal for activating distant devices.

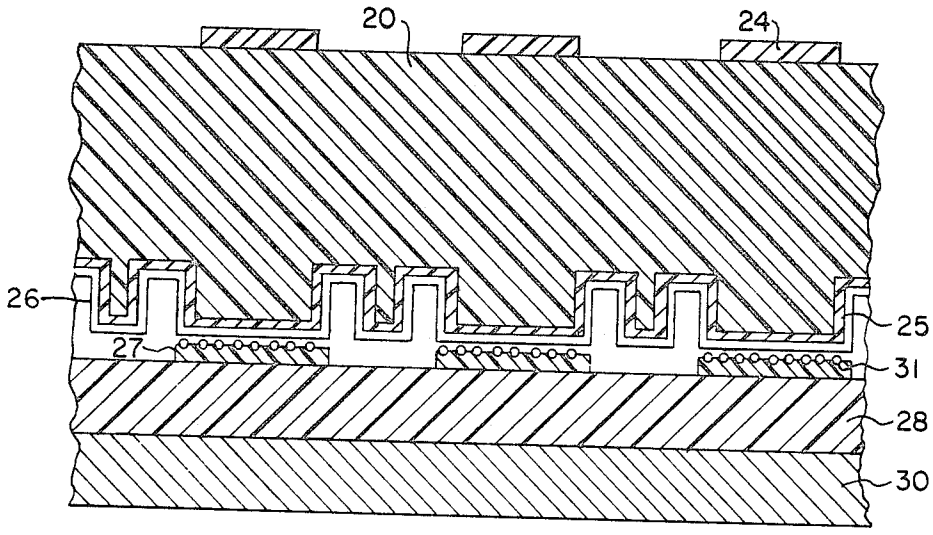

FIG. 1

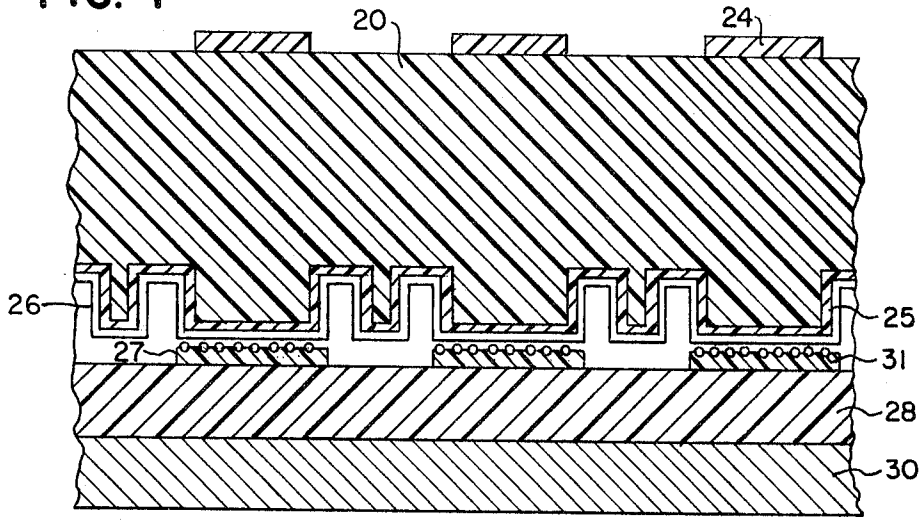

FIG. 2

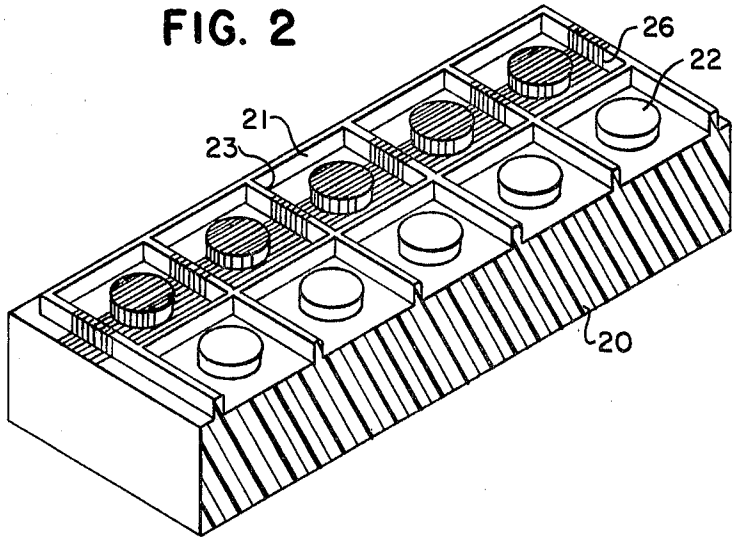

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FIG. 3

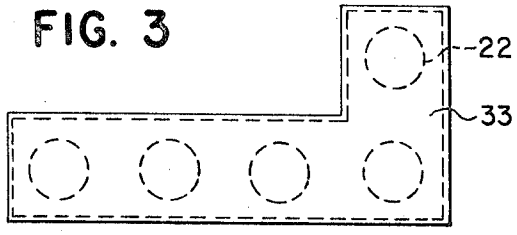
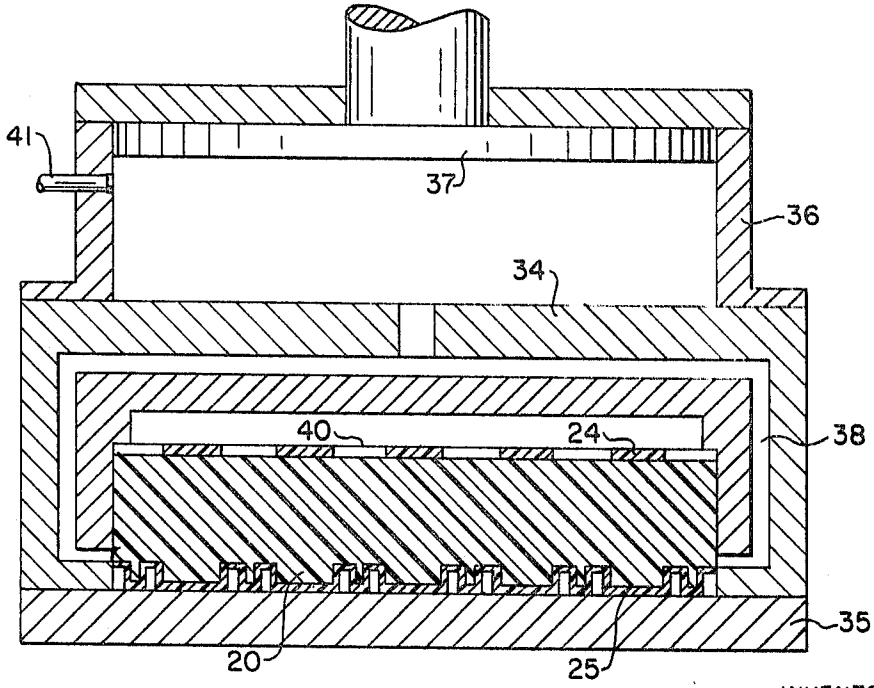


FIG. 4

FIG. 5



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ELASTOMERIC KEYBOARD WITH IMPROVED PRINTED CIRCUIT CONTACT MEANS

BACKGROUND OF THE INVENTION

Prior keyboards have been utilized in adding machines, cash registers, and accounting machines in which each of the keys has been individually constructed and mounted in a framework with attending detent members for controlling various mechanisms within the machine. Because of the mechanical nature of these keyboards and of the close tolerances that are required for proper operation, the keyboards are quite bulky in dimension and costly to manufacture. This type of keyboard is also prone to mechanical failure due to its complex construction. In order to overcome these disadvantages, it is the object of this invention to provide a keyboard device which is simple in construction and therefore low in cost.

SUMMARY OF THE INVENTION

A keyboard device includes a single elastomeric body with character symbols bonded on molded keys or key positions on the body and Mylar circuitry strips of etched copper wires bonded to a series of cylindrical projections located in rectangular grids formed in the underside of the body. A circuitry panel of Mylar strips with etched copper wires is positioned adjacent to the elastomeric body, with the copper wires orientated in a direction to form a cross bar switch mechanism with the circuitry strips of the elastomeric body, which, upon depression of the elastomeric body at the key position, will make contact between the circuitry strips to produce a binary-coded output as well as providing a signal for actuating distant devices.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial cross-sectional view of the keyboard.

FIG. 2 is a partial detailed view of the underside of the keyboard showing the grid patterns and the location of the circuitry strips.

FIG. 3 is a diagrammatic view of an L-shaped key and its relationship with the cylindrical projections.

FIG. 4 is a diagrammatic view of the cross bar circuitry for the key of FIG. 3 showing the contact points between the copper wires.

FIG. 5 is a detailed sectional side view of the molding die used to form the elastomeric keyboard member.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, there is shown a partial sectional view of the keyboard which includes the main body 20 composed of an elastomeric material. An example of the material that can be utilized is a liquid polyurethane system which consists of an isocyanate terminated polyester liquid polymer cured with a glycol curative, such as trimethanol propane. This stoichiometric level provides a degree of chain lengthening action with the cross-linking mechanism, so as to produce a polymer structure which can be regarded as a true gel. As such, this polymer has an extremely high coefficient of restitution. When the material is depressed or placed into any sort of flexure and then released, it assumes its original position in a very short period of time. Thus, the use of this material in the device to be disclosed is very important, since it permits the instantaneous springback which is so necessary in any type of keyboard or device into which a digital input is made.

As shown in FIG. 2, the bottom portion of the elastomeric body 20 is composed of a grid 21 design with a circular finger-like cylindrical member 22 located centrally in each of these grids. The walls 23 of each of the grids 21 provide a floating effect for each of the cylindrical members 22. Each of the members 22 is positioned opposite a character symbol 24 (FIG. 1), which is composed of a printed polyester film prefabricated on a fabric webbing, which in turn is molded on

the top portion of the elastomeric body 20. The floating action of each of the members 22 tends to separate one character symbol from another, so that, as a single depression is made, no matter how forceful, it would not in turn cause other members 22 in juxtaposition to be depressed.

Bonded to the underside of the body 20 and extending in a lengthwise direction along each row of the cylindrical members 22 is a strip 25 (FIG. 1), of Mylar, in which are embedded a plurality of copper wires 26 (FIGS. 2 and 4). As shown in FIG. 2, the strip 25 is somewhat narrower than the grids 21 and follows the contours (FIG. 1) of the grid structure and is bonded directly to each of the members 22.

The second part of the keyboard is a bottom circuit strip 27 (FIG. 1), which is similar in construction to the strip 25 and which strip 27 is adhesively attached to a plastic plate 28, which in turn is molded as part of the cabinetry of the machine or is bonded to the cabinetry 30 of the machine if so constructed. This strip 27, of Mylar, also contains wires of copper 31 (FIGS. 1 and 4), which run perpendicular to the wires of copper 26 (FIG. 4). Both sets of copper wires 26, 31 constitute a cross bar switching mechanism. As shown in FIG. 4, selected areas of the Mylar strips are cut away, exposing adjacent copper wires. These contacts points are designated as 32. With a source of voltage applied to the copper wires, depression of any character on the keyboard would result in the engagement of selective copper wires 26, 31 at contact points 32, resulting in a number of single voltages being generated. Since each character on the keyboard would have a different number of contacts 32, a binary-coded output could be generated. For example, if each of the Mylar strips 25, 27 contained eight copper wires, the total number of characters that could be accommodated would be as high as 500 or more. An electronic time delay is required from the moment of initial contact until registration of the impulses to insure that all contacts required by a given key are made. The elastomeric cylindrical members 22 will insure intimacy of contact between the adjacent copper wires, but, no matter how delicately or forcefully a key is depressed, in a situation where multiple contacts are made to produce a given code or signal, there will always be a succession of these contacts, separated, of course, from each other by only milliseconds. In an actual keying situation, this would produce a false input. A momentary time delay of, for example, 20 milliseconds before registration will prevent this fast keying. The signal of the first contact can be designed to activate the time delay mechanism.

In some keyboards, it may be desirable to have some keys larger than others because they are more frequently used, such as zero or tabulating bar. Such a key 33 (FIG. 3) may be represented as an L-shaped member traversing the entire bottom of the keyboard and cover a number of character positions. All that is required is that there be no walls separating the members 22 under the keys from each other. FIG. 4 shows a portion of the copper strip wiring for such a key arrangement.

Referring now to FIG. 5, there is shown a schematic representation of the molding die used to mold the elastomeric body 20. The character symbols 24, as previously disclosed, are prefabricated on a fabric webbing 40 and are made of a printed polyester film. This webbing is placed by means of locating pins (not shown) mounted on the upper die plate 34. On a lower die plate 35 are positioned the Mylar circuitry strips 25, loaded just prior to fitting the die plates together. The components of the polyurethane system are mixed and loaded into a pot 36 through the pipe 41. A ram 37 is operated to push downward into the pot 36, forcing the liquid material through the channel 38 into the main cavity, filling all impressions and, under pressure, contacting both the character symbols 24 and the circuitry strips 25, which have been precoated with a thin layer of urethane adhesive such as Dayton Chemicals, Thixom 1153 or Hughson Chemical, Chemlok 218. After the curing cycle, the finished part is ejected and can be held and manipulated as a single item. Post cure of 16 hours at 212° F. is required to achieve optimum properties.

If desired, the die can be designed to produce a panel with raised keys even to the point of simulating the style of the conventional keyboard, with each key rectangular and standing seemingly alone separated from the adjacent key by a thin moat produced by knifelike projections from the upper plate 34 of the molding die.

Instead of the copper wires described previously, pressure-sensitive transducers or diodes could be incorporated. Other forms of pressure switches, such as a reticulated form containing conductive slivers or filings, might be utilized to produce electrical contact.

The keyboard as it comes from the molding die and after post cure is ready for assembly into the machine. Wire attachments are made by soldering directly to the copper wires. In place, the keyboard is operated as any conventional mechanical keyboard, the operator depressing the key desired designated by the character symbol until contact is felt or registration is in some way signaled. With the type of elastomer used for the keyboard, keying is accomplished very rapidly. Restoration is accomplished almost instantaneously when the operator's finger is released, and one can move on to subsequent keys without hesitation.

What I claim is:

1. A keyboard device for generating binary information including:

a. a deformable body composed of an elastomeric material having a smooth upper surface and a plurality of rows of grid portions formed on its lower surface, each grid portion containing a portion of the body formed as a protrusion extending from the body;

b. a plurality of first parallel strips of insulating material bonded to the lower surface of the body, each strip extending along a row of grid portions and positioned on the lower surface of the protrusions located in each of the grid portions, said strips having selected openings therein;

c. a plurality of conductive contact elements embedded in each of said strips of insulating material, portions of which contact elements are located in said openings;

d. an indicia-bearing fabric sheet bonded to the top surface of the deformable body, the indicia being aligned with the protrusions on the lower surface of the deformable body;

e. a support member mounted adjacent the lower surface of said deformable body;

f. a plurality of second parallel strips of insulating material attached to said support member, each of said second strips containing openings therein and a plurality of conductive contact elements having portions located in said openings, said second strips being orientated at right angles with said first strips;

g. and means connected to each of the contact elements in said first and second strips for generating electrical signals whereby, upon depression of an indicia-bearing portion of the deformable body, contact is made between selected contact elements located in adjacent openings in said first and second insulation strips to produce a predetermined binary output signal.

2. The keyboard device of claim 1 in which said protrusions constitute a cylindrical body.

3. The keyboard device of claim 2 in which formed wall portions constitute said grid portions within which the cylindrical body is centered, whereby depression on the deformable body adjacent a cylindrical body will not affect adjacent cylindrical bodies.

4. A keyboard device including

a. deformable body composed of an elastomeric material with a smooth upper surface having a plurality of indicia thereon and a lower surface formed in a grid pattern with hills and valleys and a raised portion located within each grid, each of said raised portions being orientated opposite one of said indicia;

b. a first strip of insulating material bonded to the lower surface of each of said raised portions, said strip containing a plurality of selectively positioned apertures and a plurality of conductive contact elements embedded therein, said contact elements having portions located within said apertures;

c. and a second strip of insulating material having the same construction as said first strip, said second strip being positioned adjacent said raised portions and orientated at right angles to said first strip, whereby, upon depression of an indicia-orientated portion of said deformable body, selective portions of conductive contact elements in said first and second strips will be brought into contact with each other by the raised portion orientated with the depressed indicia.

5. The keyboard device of claim 4 in which said raised portion comprises a cylindrical body.