

[54] **MATRIX PUSH-BUTTON SWITCH**

[75] Inventors: **Takemi Shimojo; Makoto Yanaga,**
Tokyo, Japan

[73] Assignee: **Alps Electric Co., Ltd.,** Tokyo, Japan

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340/365 R

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340/365 R, 365 C

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Primary Examiner—Robert K. Schaefer

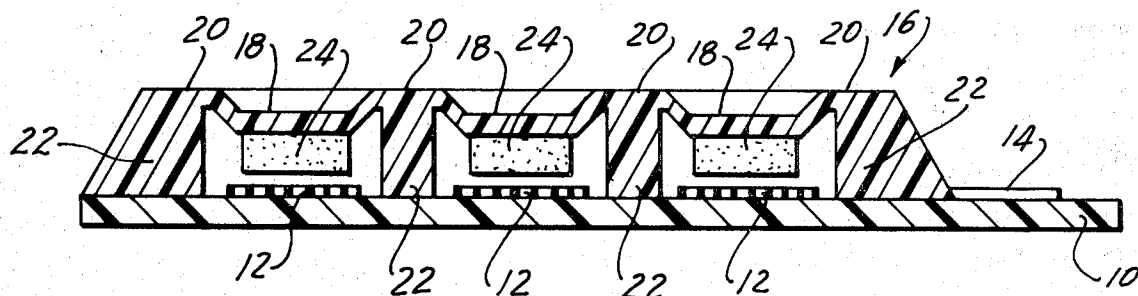
Assistant Examiner—William J. Smith

Attorney—Maxwell James et al.

[57] **ABSTRACT**

A switch has a substrate with a plurality of conductor pairs on it. A resilient cover is disposed over the substrate and has depressible areas aligned with the respective conductor pairs. Conducting contact pieces are mounted on the cover below each of the depressible areas, but normally spaced above the pairs. Upon pressing down a given depressible area, the corresponding contact piece moves to engage the conductor pair associated therewith, and thus closes the circuit between them.

4 Claims, 2 Drawing Figures



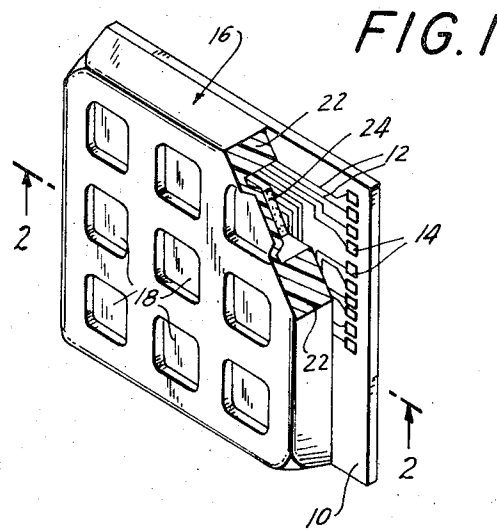
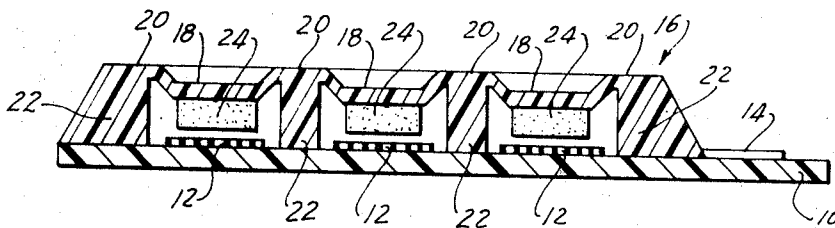


FIG. 2

INVENTORS
TAKEMI SHIMOJO
MAKOTO YANAGA
BY *James J. Strauslin*
ATTORNEY

MATRIX PUSH-BUTTON SWITCH

CROSS REFERENCE

This case is based upon Japanese application No. 98,909/70, filed on Oct. 5, 1970, the priority of which is hereby claimed.

BACKGROUND OF THE INVENTION

This invention relates to push-button switches, and more particularly to those that have a body with a plurality of depressible areas and isolating means between said areas.

Prior art switch systems for telephones or desk top computers, for example, comprise a plurality of individual switches arranged in a matrix of rows and columns, each with its own manual actuator, so that alphanumeric information can be fed into the system. Such arrangements require numerous parts and are therefore complicated, bulky, costly and expensive. When operated they are noisy, and when operated under less than ideal conditions errors frequently occur. If the operator does not press precisely in the proper place, or if he presses obliquely rather than straight down, the wrong switch may be actuated, or two switches may be actuated instead of one. Insufficient pressure may result in lack of actuation, and excessive pressure may damage the switch. To achieve reliability in switch systems of the type involved, it has been necessary to maximize size, weight and cost. This has militated strongly against the widespread use of such switch systems in mass-produced apparatus of low cost, and has virtually ruled them out where miniaturization is a factor. This is particularly true in connection with matrix systems adapted to be fingertip actuated, where the individual switch actuators must be close together for ease and rapidity of actuation.

It is the prime object of the present invention to devise a switch system suitable for small, inexpensive installations, and which is at the same time reliable in operation.

It is a further object to devise a matrix-type push-switch system which can be manipulated with a high degree of ease.

It is another object to devise such a switch system that operates with a minimum of noise.

It is a further object to have switches that are easy to operate with a minimum chance of making a mistake.

It is yet another object to provide push-type switches that are thin and compact.

To achieve these and other objects the invention comprises a board having a plurality of conductors defining conductor pairs. An at least partially resilient body is disposed above the board and has a plurality of depressible areas aligned with the conductor pairs respectively. Conducting contact pieces are mounted on said body beneath said areas with their lower ends spaced from said conductor pairs when said body is in a normal standby condition. Isolating means are provided between said areas so that when an operator depresses a given area he will move only the one contact piece corresponding to that area, thereby to complete a circuit through only one conductor pair, even though the operator may exert that depressive force faultily, e.g., in an oblique direction, or with a degree of force either greater or less than nominal.

Preferably, the isolation means completely surround each of the areas and are integrally formed with the

body. The body is preferably a cover with the depressible areas recessed from the remaining top surface of the cover. For best results the isolation means are themselves secured to the board, preferably at locations between the respective conductor pairs.

To the accomplishment of the above, and to such other objects as may hereinafter appear, the present invention relates to the construction of a switch having depressible areas as defined in the appended claims and as described in this specification, taken together with the accompanying drawings in which:

FIG. 1 is a perspective view, partly in cross-section, of a switch in accordance with the invention; and

FIG. 2 is a cross-sectional view of the switch of FIG. 1 taken along the lines 2—2 of FIG. 1.

The switch comprises a substrate 10, preferably, although not necessarily, a printed circuit board, which carries a plurality of conductors 12 arranged thereon to define a plurality of separated conductive pairs. As specifically disclosed, and as is preferred, the conductor pairs may be arranged in patterns spaced from one another over the upper surface of the substrate 10.

Each conductor is connected to a terminal 14 at the side of the board 10, so that connections can be made between external circuitry and the conductors of a given pair.

Disposed above the board is a cover 16 that can be molded or otherwise formed from any resilient insulating material, such as rubber or elastic synthetic resin. As best shown in FIG. 2 cover 16 has a plurality of depressible areas 18, preferably in the form of thin-walled recesses, which may be trapezoidal in outline.

Each area 18 is designed to represent a different system input, such as the numbers 1—10, and they are arranged in a row and column matrix and have numerical or other indicia on their outer surfaces. Each area 18 is at least partially encompassed by adjacent means for isolating motions of any one depressible area 18 from the remaining ones. The isolating means comprise thick-walled portions 20 which are highly resistant to deformation, more so than the relatively thin-walled depressive areas 18. Preferably, the depths of recesses 18 are equal to each other, and the heights of portions 20 are also equal to each other and greater than the depths of recesses 18, the lower surfaces of the portions 20 extending well below the lower surfaces of the depressible areas 18. Conductive contact pieces 24, formed of any suitable conductive material, are mounted on the lower surfaces of the depressible areas 18 in registration with the particular conductor pairs which are adapted to be bridged thereby. As may be seen in FIG. 2, when the cover 16 is in its normal standby condition the contact pieces 24 are retained in a position in which their lower surfaces are upwardly spaced from their respective conductor pairs, with the lower surfaces of the sections 22 of the portions 20 extending below the contact piece lower surfaces. The security of the standby spacing between contact piece 24 and its associated conductor pair is enhanced when the sections 22 normally engage the substrate upper surface. When, as is preferred, the sections 22 are secured to the substrate in any appropriate manner, as through the use of adhesive and preferably in the spaces between the patterns defined by the individual conductor pairs, positiveness and reliability of switch actuation is maximized.

In operation, a desired depressible area 18 is pushed down, the thin wall defining that area stretching, or the portions 20 deforming, or both, thereby to cause the corresponding contact piece 24 to engage the conductor pair thereunder and complete the circuit through the respective terminals 14. The thick-walled portions 20 prevent the motion of the depressed area 18 from affecting the other depressible areas 18, and hence the other contact pieces 24 do not engage their respective conductor pairs. Hence accurate system input is achieved. Since each conductor pair may be wound in a spiral having a large area, the areas 18 do not have to be depressed exactly perpendicular to board 10 to ensure good bridging contact. Also, if any area 18 is depressed in a direction departing from the vertical, then the sections 22 will deflect the exerted force, so that the proper area 18, with its associated contact piece 24, is depressed towards the respective conductor pair. Upon releasing the area 18, the cover 16 will spring back to its original shape, thereby lifting the depressed contact piece 24 and breaking the circuit.

It will be seen that the present invention is simple and inexpensive to fabricate, the cover by molding, the board by printed circuit techniques. Also, the switch is relatively thin and compact, and the recesses clearly mark the proper area to be depressed even under difficult conditions. Since both the cover and contact pieces are made of resilient material, the noise generated by operating the switch is minimal. Thus a small, light weight, inexpensive push-type switch matrix is produced, well adapted to miniaturization but with no sacrifice in reliability or ease of operation.

While but a single embodiment of the present invention has been here specifically disclosed, it will be apparent that many variations may be made therein, all

without departing from the spirit of the invention as defined in the following claims.

We claim:

1. A switch comprising an insulating substrate, a plurality of conductors on said substrate defining conductor pairs, means for making external connection with each of said conductors, an insulating body disposed above said substrate and forming the surface of said switch, said body having a plurality of recessed resilient depressible areas each of which is aligned with a different set of said conductor pairs, a plurality of individual conducting contact pieces each of which is mounted on the underside of a different one of said areas with the lower surface thereof spaced from said conductor pairs associated therewith when said area is in the nondepressed condition, a plurality of relatively rigid isolation means on said body integral with, disposed between and protruding above said depressible areas and separating same for isolating downward motions of each of said areas from the remaining areas, said means extending down towards said substrate beyond said lower surfaces of said contact pieces, whereby upon depressing any one of said depressible areas only the respective contact piece engages only the conductive pair associated therewith, thereby completing a circuit through said respective external connection means.

2. A switch as claimed in claim 1, wherein said isolating means engage said substrate.

3. A switch as claimed in claim 2, wherein said isolating means are fixed to said substrate.

4. A switch as claimed in claim 1, wherein said conductor pairs are disposed in spaced patterns on said substrate, said isolating means engaging said substrate between said patterns.

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