

[54] **ELONGATED SPRING COIL CONDUCTORS
APPLYING TENSION FORCE TO
PUSHBUTTON ACTUATORS IN KEYBOARD
MATRIX SWITCH ASSEMBLY**

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[58] Field of Search 200/5 R, 5 E, 5 EA,
200/61.78, 159 R, 159 B, 166 BA, 5 A

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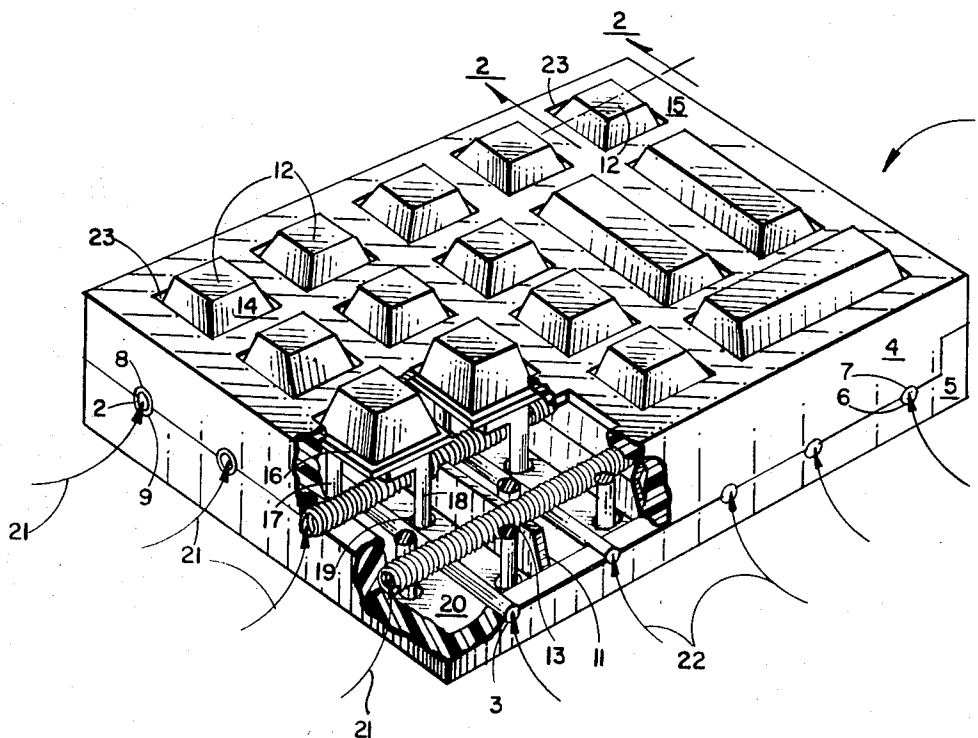
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[57]

ABSTRACT

A matrix of conductors is secured within a housing in a normally separated relationship. One set of the conductors is comprised of a flexible material and is positioned in the housing relative to keyboard pushbuttons for providing tensioning force under the pushbuttons. When a pushbutton is depressed, a flexible tensioning conductor is depressed into contact with another conductor of the matrix for providing an electrical output representing the depressed pushbutton.

4 Claims, 2 Drawing Figures



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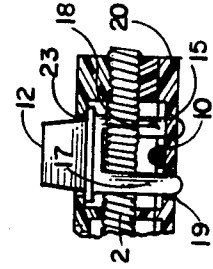
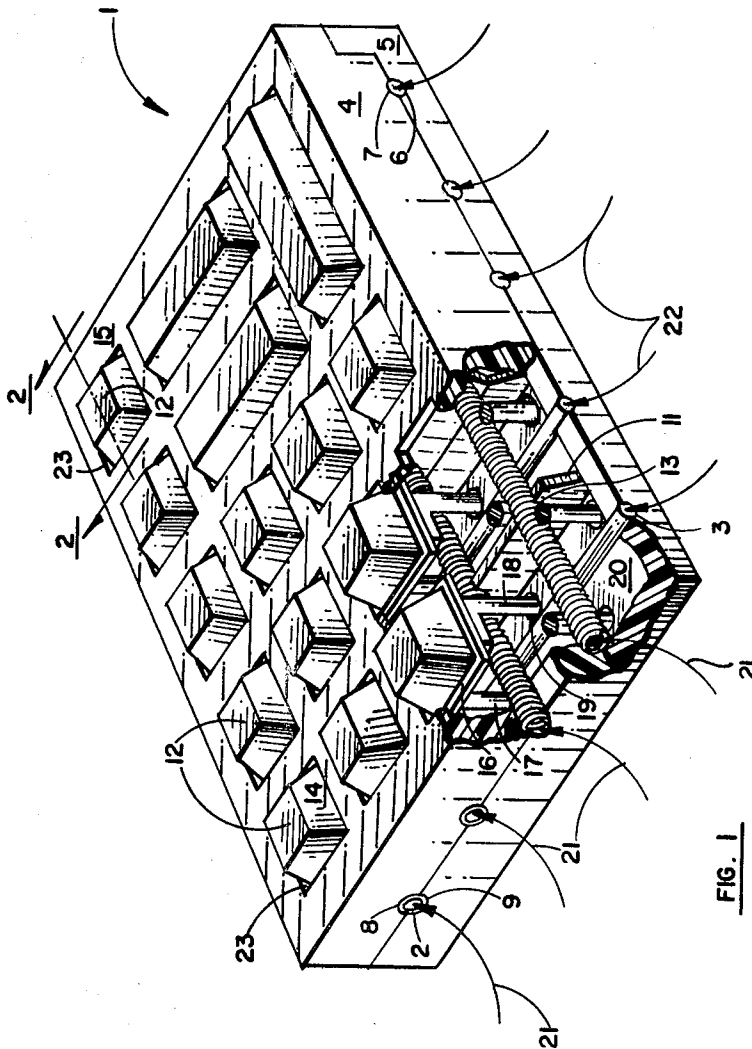


FIG. 2

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ELONGATED SPRING COIL CONDUCTORS APPLYING TENSION FORCE TO PUSHBUTTON ACTUATORS IN KEYBOARD MATRIX SWITCH ASSEMBLY

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a keyboard conductor matrix device and, more particularly, to such a device in which one set of the conductors comprising the matrix is utilized to spring tension pushbuttons of the keyboard as well as provide a signal representing a depressed pushbutton when two conductors of the matrix are formed into contact.

2. Description of Prior Art

U.S. Pat. No. 2,931,877, issued Apr. 5, 1960 to E. J. Henley for "Electrical Contact Device," describes the intersection of a flexible conductor and a deformable semiconductive member. The patent does not show a conductor matrix comprised of one set of flexible conductors disposed at right angles to a set of deformable semiconductive members secured within a housing in such a way that the flexible conductors provide tensioning for the pushbuttons of the keyboard. In addition, the patent does not teach structure necessary to properly house the pushbuttons, and the conductor matrix as described herein.

SUMMARY OF THE INVENTION

Briefly, the invention comprises a conductor matrix secured within a keyboard housing. The conductors are supported in a normally separated position. One set of the conductors is comprised of an elastic (flexible) conductive material, and the other set of conductors is comprised of a deformable conductive material in the preferred embodiment.

The flexible conductors are secured within the housing subjacent the bottom surface of the pushbuttons of the keyboard such that an upward spring tensioning force is exerted against the pushbuttons. As a result, the pushbuttons are held in a proper position in the housing. If moved position of a pushbutton is quickly restored by the spring tensioning force of the flexible member. In the preferred embodiment, the flexible member may be fabricated from a conducting metal in the form of a coiled spring for providing improved tensioning of the pushbuttons.

OBJECTS AND ADVANTAGES

The pushbutton includes prongs which project downward about the intersection of the conductors. Slots are provided in the housing for the prongs to reduce pushbutton wobble and to insure that the undersurface of the pushbutton correctly forces one conductor into contact with its subjacent conductor.

In the preferred embodiment, the subjacent conductor is fabricated from a deformable conductive material such as a conducting rubber so that improved electrical contact results when the two conductors are depressed into contact. In other embodiments, however, a non-deformable conductor may be used in lieu of the deformable conductor.

Therefore, it is an object of this invention to provide a keyboard conductor matrix device which is relatively compact and easy to fabricate.

It is still another object of this invention to provide a keyboard conductor matrix device in which the hous-

ing provides support for the conductors of the matrix.

A still further object of this invention is to provide a keyboard device in which one set of the conductors is fabricated of a flexible material and is positioned in a housing to provide a spring tensioning force to maintain the pushbuttons of the keyboard in a correct position.

A still further object of this invention is to provide an improved keyboard conductor matrix device in which one set of conductors of the matrix is comprised of a coiled spring for providing an upward force to hold the keyboard in the correct position in the keyboard housing and the other set of conductors is comprised of a deformable conductive material such that an improved electrical contact results when two conductors of the matrix are pressed into contact by a pushbutton.

A still further object of this invention is to provide an improved keyboard conductor matrix device in which pushbuttons are provided with downwardly projecting prongs to provide improved stability of the pushbuttons in the keyboard housing.

These and other objects of the invention will become more apparent when considered in connection with the description of the drawings, a brief description of which follows.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view, partially cut away, of a housing for the keyboard conductor matrix and keyboard pushbuttons.

FIG. 2 is a cross-sectional view of one corner of a keyboard housing showing enclosure of intersecting conductors by prongs of a pushbutton.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 is a perspective view of keyboard housing 1 in which a flexible set of conductors 2 and a deformable set of conductors 3 are secured in a matrix (X-Y) arrangement. The housing, which may be comprised of a plastic material, is divided into an upper section 4 and a lower section 5. Circular grooves, identified generally by numerals 6 and 7, are provided in the side of the upper and lower sections for engaging the ends of the set of deformable conductors identified by the numeral 3. A similar set of grooves is provided in the opposite side of the upper and lower members for securing the other end of the set of conductors identified by the numeral 3. In addition, grooves identified by the numerals 8 and 9 are provided in the orthogonal side of the upper and lower members for securing the ends of the set of flexible conductors identified generally by the numeral 2. Similarly, grooves are provided in the opposite side of the upper and lower members for securing the other ends of the set of conductors identified by the numeral 2.

Although more clearly shown in FIG. 2, the lower member 5 is provided with parallel grooves into which the set of conductors 3 are placed. The grooves are identified in FIG. 2 by the numeral 10.

The base member is also provided with regularly spaced ridges identified generally by the numeral 11 between each row of pushbuttons identified by numeral 12. The ridges 11 include grooves 13 for supporting the conductors 2 between the sides of the upper and lower members.

The pushbuttons 12 include an upper portion 14 which extends outward from the face 15 of the housing 1. In addition, each of the pushbuttons is provided with an extended ledge 16 which is relatively larger than the opening 23 in the upper surface 15 such that the push- 5 buttons are retained inside the housing. In addition, each pushbutton is provided with prongs 17 and 18 which project downward from the bottom surface of the pushbuttons into mating openings identified generally by numeral 19 in the bottom surface 20 of the lower member 5. The prongs and the mating openings are utilized to prevent the pushbuttons from wobbling during an operation in which a button is depressed. It is also pointed out that the prongs project downward across the intersection of the conductor sets 2 and 3. 15 As a result, a firm contact between the conductors is insured whenever a pushbutton is depressed. The openings 19 to the bottom surface 20 of lower member 5 can be seen more clearly in FIG. 2. The relationship of the prongs 17 and 18 relative to the intersecting con- 20 ductors can also be seen more clearly.

The set of conductors 2 and 3 intersect substantially at right angles in the usual application. Conductor set 2 in the preferred embodiment is comprised of a coiled spring, fabricated of electrically conducting material which is secured within the housing 1 along the sides as shown, in such a way that the upper surface of the coiled conductors provides an upward spring tension- 25 ing force to the bottom surface of each of the pushbut- tons. As a result, the pushbuttons are forced upward such that the ledges 16 of the pushbutton are secured against the undersurface of the top layer 15. When a pushbutton is depressed, the operator forces the coiled spring conductor 2 into contact with the subjacent con- 30 ductor of set 3. When the pushbutton is released, the spring tension provided by the coiled conductor forces the pushbutton back to its original position in the hous- ing.

While the pushbutton is depressed for making electrical contact between the intersecting conductors, an 40 electrical signal may be provided at the output of the pertinent one of the deformable conductors of set 3. In other words, a voltage may be continuously provided by means of an electrical contact at the ends of the con- ductors of set 2. When one of the conductors is pressed into electrical contact with a conductor of set 3, a cur- 45 rent path is provided so that a signal can be generated at the output of one of the conductors of set 3. Electrical contacts for the conductors are shown in schematic form and are identified generally by numerals 21 and 22.

The conductors of set 3 have been described as being deformable for improving the electrical contact be- 50 tween the sets of conductors when the pushbutton is depressed. In addition, the conductors of set 2 have been described as shown and a coiled set of conductors for providing spring tensioning to the pushbuttons of the keyboard as well as providing the required electrical circuit for generating an output signal representing the depressed key. It should be understood that other 55 types of conductors could be used to implement the conductors of sets 2 and 3. It is necessary that the con- ductors of set 2 be relatively flexible or elastic such that the required spring tensioning is provided. Both sets of 60 conductors must be electrically conductive.

It is also pointed out that the keyboard housing 1 is usually assembled with other elements as required to

complete a particular and complete embodiment. For example, drive circuits, sensing circuits, display ele- ments, etc. might be housed in a calculator case. The upper part of the housing (section 4) could be molded as part of the case. A substantial savings in cost would result.

In one embodiment, the housing 1, including push- buttons, may be comprised of a plastic material that can be formed in the configuration shown by molding, and/or extruding techniques known to persons skilled in the art. The various slots, grooves, openings, etc. can be similarly formed simultaneously or edging or grind- ing techniques can be utilized in the formation. Such techniques and variations are believed known to per- 15 sons skilled in the art. For that reason, the processes are not described in detail

I claim:

1. A keyboard device comprising
 - a matrix of conductors;
 - a housing in which all of said conductors are secured in a normally spaced relationship;
 - pushbuttons projecting from a surface of said housing for forcing said conductors of said matrix into tem- 20 porary electrical contact; 9
- said housing including a lower housing member sub- jacent the surface from which said pushbuttons project;
- a first set of said conductors comprising flexible con- ductors secured in said housing for applying a spring tensioning force to said pushbuttons whereby said pushbuttons are maintained in a de- 25 sired position in said housing;
- said first set of conductors comprising a plurality of coiled spring conductors secured at opposite sides of said housing such that one surface of said coiled spring conductors provides said spring tensioning force to the undersurface of said pushbuttons; and
- a second set of said conductors being disposed in grooves in the inner surface of said lower housing member,
- said second set of conductors comprising a plurality of conductors formed of deformable conducting material.
2. The keyboard device recited in claim 1 wherein 30 said housing further includes regularly spaced ridges for providing additional support to said first set of con- ductors.
3. The keyboard device recited in claim 1 wherein each of said pushbuttons include prongs which project downward across the intersections of said matrix of conductors, and wherein said housing includes a lower surface provided with openings into which said prongs project for improving the stability of said pushbuttons in said housing.
4. A keyboard device comprising
 - an array of electrical conductors including a first set of conductors arranged parallel to each other in a first plane and a second set of conductors arranged parallel to each other and transverse to said first set of conductors in a second plane;
 - said first set of conductors comprising flexible con- 35 ductors;
 - said second set of conductors being supported throughout substantially the entire length thereof to prevent movement thereof;
 - control means normally supported in a first position by said flexible conductors and responsive to exter-

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nal force to be selectively movable to a second position to force said one of said flexible conductors into temporary contact with a transversely disposed conductor whereupon said flexible conductor tends to return said control means to said first position after removal of said external force; and

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support means for supporting said flexible conductors on both sides of the point of contact with said transversely disposed conductor in order to permit only one point of contact between said transversely disposed conductors.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,743,798 Dated July 3, 1973

Inventor(s) Eugene E. Pentecost

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

Column 1, line 13, change "formed" to --forced--.

Column 4, line 24, delete "9",

line 29, change "houshing" to --housing--.

Signed and sealed this 20th day of November 1973.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents

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