United States Patent [19]

Anderson et al.

[11] **3,819,882**

[45] **June 25, 1974**

[54] **MATRIX KEYBOARD ASSEMBLY**

[75] Inventors: **Fred N. Anderson; Michael F. Bedocs; Eric L. Long,** all of Waukegan, Ill.

[73] Assignee: **Cherry Electrical Products Corporation,** Waukegan, Ill.

[22] Filed: **Mar. 8, 1973**

[21] Appl. No.: **339,351**

[52] **U.S. Cl.**..... **200/1 R,** 200/5 A, 200/159 A, 200/166 BH

[51] **Int. Cl.**..... **H01h 13/52,** H01h 9/00

[58] **Field of Search**..... 200/1 R, 1 A, 5 R, 5 A, 200/16 A, 159, 166 BH, 166 CT, 166 H, 166 J

[56] **References Cited**

UNITED STATES PATENTS

3,600,528	8/1971	Leposavic	200/159 B X
3,652,811	3/1972	Barney	200/166 CT X
3,731,014	5/1973	Brady	200/166 CT X

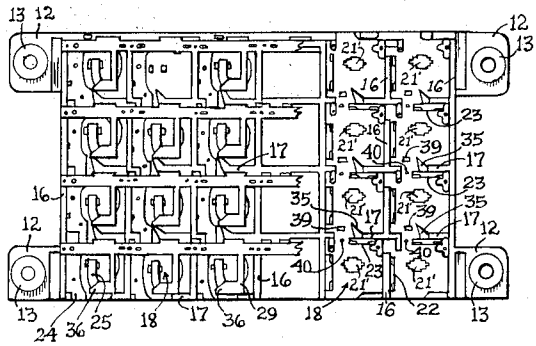
Primary Examiner—James R. Scott

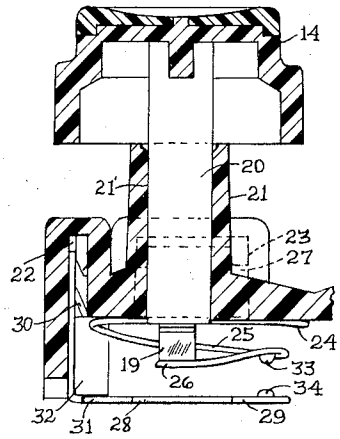
Attorney, Agent, or Firm—Edward C. Threedy

[57] **ABSTRACT**

A matrix keyboard for use with electronic equipment having a one-piece molded base providing on its upper surface a series of hollow upstanding projections through which slidably project the actuator stems of a plurality of actuating keys. The underside of the base provides a series of switching compartments including structure for receiving in a fixed relation one to another as well as to the free end of the actuator stem, an array of current-conducting strips. One strip provides the movable switch blade, while the other strip extending in spaced transverse relation to the first strip, provides the fixed terminal contact.

6 Claims, 7 Drawing Figures





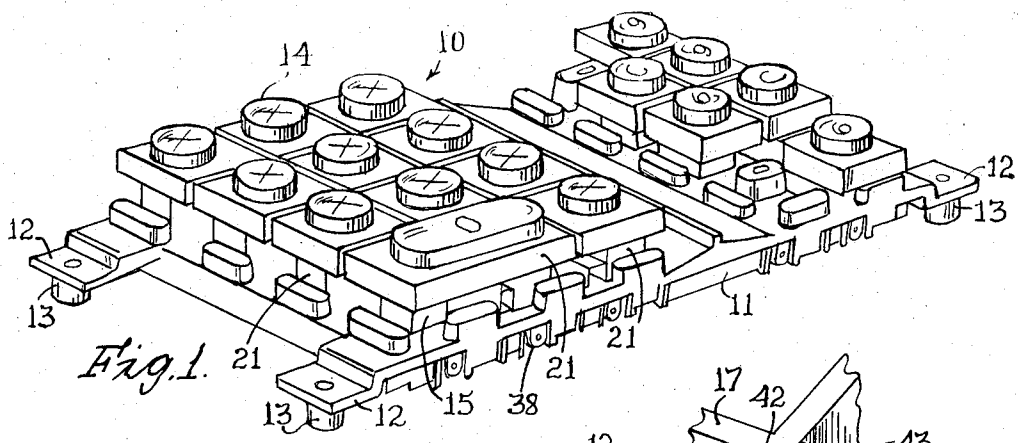


Fig. 1.

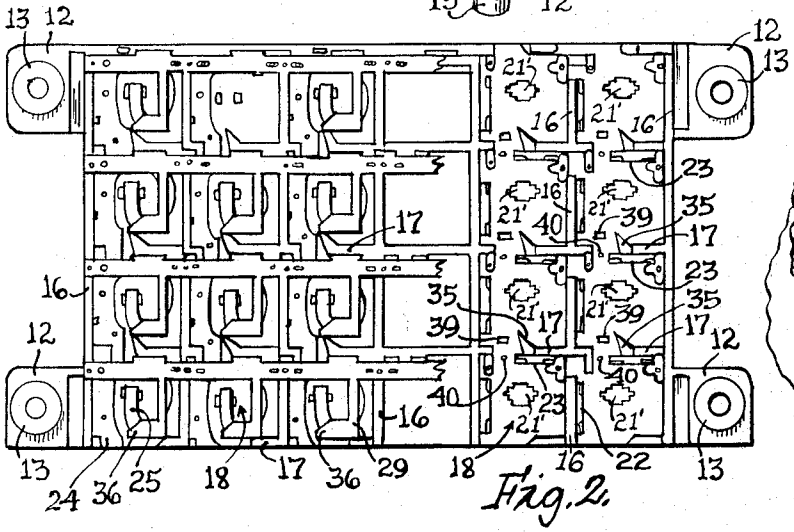


Fig. 2.

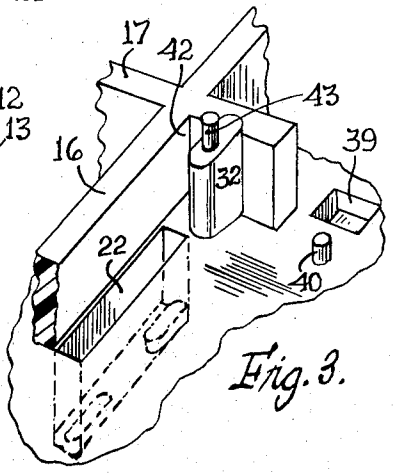


Fig. 3.

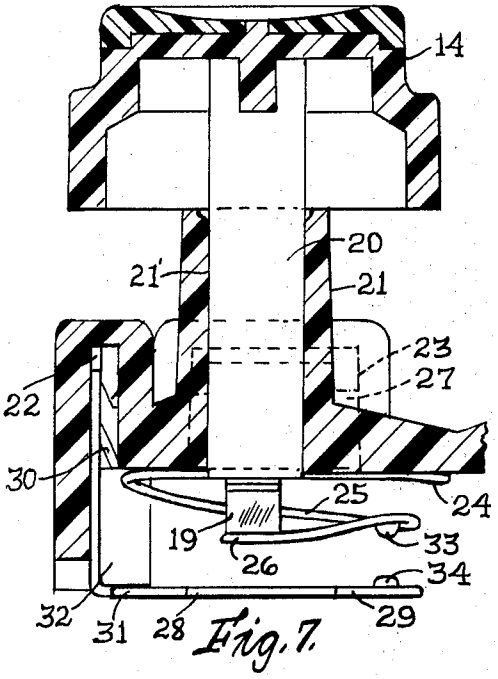


Fig. 7.

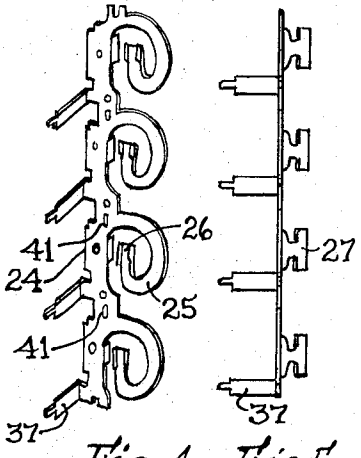


Fig. 4 Fig. 5.

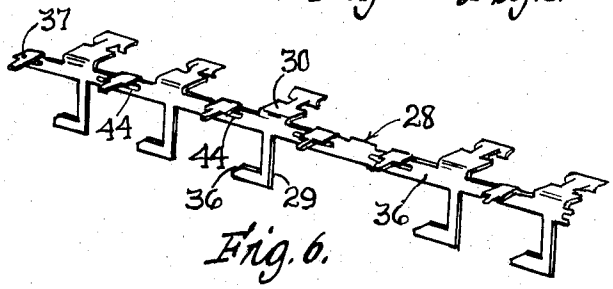


Fig. 6.

MATRIX KEYBOARD ASSEMBLY

SUMMARY OF THE INVENTION

A one-piece keyboard molded from a suitable dielectric material forming the assembly base for the matrix keyboard assembly. The upper surface of the base provides a series of upstanding hollow projections adapted to receive the actuator stem of an operating key button. The underside of the molded base provides prearranged wall structures as well as hollow wall abutments forming switch compartments for the matrix system of key switches. The hollow wall abutments are designed to receive snap-in clips provided by an array of current-conducting terminal strips, one terminal strip providing a series of movable switch blades, with one blade disposed within each switching compartment, while the other strip extends in a spaced transverse relation with respect to the first strip and provides a series of fixed contacts disposed in each compartment in operative relation to the movable switch blade.

The present invention provides an improved matrix keyboard construction including a novel arrangement of strip conductors forming a two-dimentional or X-Y matrix in which the entire area of the base is used to advantage, accommodating a high density of conductors and switch components and in which the making of pre-selected connections between each key switch is simplified.

GENERAL DESCRIPTION

The construction of parts and their arrangement and relation both structurally and functionally are best illustrated in the accompanying drawings showing the preferred form of invention, wherein:

FIG. **1** is a perspective view of a fully assembled matrix keyboard;

FIG. **2** is a plan view of the underside of the keyboard base partially showing the structural arrangements of the matrix conductors associated with the switch;

FIG. **3** is a fragmentary enlarged view of a portion of a switch compartment;

FIG. **4** is a perspective view of one of the conductors including the movable switch blade associated therewith;

FIG. **5** is an end view of the conductor illustrated in FIG. **4**;

FIG. **6** is a perspective view of the second conductor, showing the fixed contact terminal thereon;

FIG. **7** is a fragmentary detail sectional view of one of the key button switch assemblies.

As shown in FIG. **1**, the assembled matrix keyboard **10** consists of a one-piece molded base **11** having at corresponding corners thereof mounting flanges **12** and connector-receiving bearings **13**. A plurality of individual key buttons **14** are positioned above the upper surface of the base **11** and may be of a single switch construction or of a double switch construction, such as shown by the switch key button indicated at **15**.

Referring to FIG. **2** and particularly the right-hand portion thereof, it is seen that the underside of the base **11** provides a series of wall members **16** extending transversely of the longitudinal length of the base member **11**. These wall members **16** cooperate with a series of partial walls **17** extending perpendicularly to the walls **16** to define switch compartments **18**. As will hereinafter be made apparent, each compartment contains a fixed terminal contact provided by one conductor and a movable switch blade provided by another conductor, the free end of which is in axial alignment with the inner end **19** of a key stem **20**.

As shown in FIG. **6**, the base **11** provides a series of hollow projections **21** extending upwardly from the top surface of the base **11**, which provide open passages **21'** therethrough, there being a hollow projection for each of the switch compartments **18**. These passages **21'** formed in the projections **21** slidably receive the actuator stem **20** of a key button **14**.

Also molded into the base **11** and projected upwardly from the top surface thereof adjacent to each of the hollow projections **21**, is a pair of hollow sockets **22** and **23**, with the sockets **22** and **23** being disposed at right angles with respect to each other. Each pair of sockets **22** and **23** has open communication, through slots formed in the base **11**, with a compartment **18**.

In FIGS. **4** and **5** there is disclosed a continuous conductor strip **24** having integrally formed as a part thereof a curved arm **25** which has a free end **26** adapted to be in contact with the innermost end **19** of the actuator stem **20** as shown in FIG. **6**. This conductor **24** provides a spring tab **27** disposed perpendicularly to the longitudinal length of the conductor. The spring tab **27** is adapted to be frictionally projected into the hollow socket **23**, through the open slot formed in the underside of the base **11**, as shown in FIG. **7**. By reason of the length of the stem **20**, its free end **19** will bias the free end **26** of the curved arm **25** out of its normal plane into the configuration shown in FIG. **7**. This arrangement provides yieldable pressure against the key **14** and maintains it in normal inoperative position.

The second terminal **28** provides a plurality of L-shaped contact-bearing terminals **29**. This second conductor **28** also provides a spring tab **30** which is adapted to be received in the hollow socket **22**. However, the second conductor **28** has its body portion **31** seated upon a stud-bearing positioning post **32** so that it and its contact **29** are normally spaced from the movable contact finger **25** of the first conductor **24**. When the key button is depressed upon the projection **21**, the free actuator end **19** of the stem **20** thereof will spring-bias the arm **25** so that the contact **33** carried thereon will move into contact with the contact **34** carried by the fixed terminal **29**, thus establishing a current-conducting surface therebetween.

It should be noted that the partial wall member **17** provides an angled end portion **35** which extends inwardly of the compartment **18** and which is adapted to lie beneath the free end **36** of the terminal **29** to assist in maintaining it in a fixed position with respect to the arm **25** of the conductor **24**.

The conductors shown in FIGS. **4**, **5** and **6** include terminal connectors **37** which, when the keyboard **10** is utilized with a printed circuit, would project through suitable apertures in such printed circuit so as to establish a complete circuit therewith. In the event that the keyboard is not to be used with a printed circuit, certain ends of the conductors **24** and **28** may be provided with a flange member, such as that shown at **38** in FIG. **1**, to which a suitable current-conducting connector may be connected.

In some circumstances it may be desired to isolate a given switch, and in such event there is provided structure whereby this may be simply and effectively accom-

plished. To this end there is provided in each of the interior switch compartments **18** a well **39** formed in the underside of the base **11**, as shown in FIG. **3**. This well **39** lies beneath the conductor strip **24** immediately adjacent to a locating stud **40** projecting outwardly from the surface of the base **11** and which is journaled in an accommodating aperture **41** formed in the strip **24**. The conductor **28** extends across a pocket **42** formed between the partial wall **17** and the post **32**. The locating stud **43** carried by the post **32** is adapted to be projected into an aperture **44** formed in the body portion **31** of the conductor **28**.

Through the use of a suitable tool, such as a punch or chisel, the portion of the conductors **24** and **28** which extends across their associated wells **39** and pockets **42**, can be struck, severing the conductor strips. The struck strip will have a portion thereof folded into its respective well so as to be held thereby.

An isolated switch unit and the remaining conductor strips may by any suitable means be connected to separate current-conducting terminals. Thus, after fully assembling the keyboard, any switching arrangement may be achieved without destruction or interruption of the remaining circuitry components.

While we have illustrated and described the preferred form of construction for carrying our invention into effect, this is capable of variation and modification without departing from the spirit of the invention. We, therefore, do not wish to be limited to the precise details of construction set forth, but desire to avail ourselves of such variations and modifications as come within the scope of the appended claims.

Having thus described our invention, what we claim as new and desire to protect by letters Patent is:

1. A matrix switch keyboard having a plurality of manually depressible switch keys each with switch-actuating key stems, wherein the improvement comprises

a. a molded one-piece electrically non-conductive base member providing top and bottom surfaces,

b. rows of hollow projections extending vertically from the top surface of said base member and extending therethrough and dividing said top and bottom surfaces into separate switch areas, with each hollow projection adapted to slidably receive therein a stem of a switch key,

c. a first set of electrical conductor strips connected in parallel relation to the bottom surface of said base member with said strips providing a plurality of movable switch blades, with a blade positioned beneath each of said hollow projections,

d. a second set of electrical conductor strips connected in parallel relation to the bottom of said base member so as to extend transversely to and in spaced relation to said first set of electrical conductor strips, with said second set of strips providing a plurality of terminal contacts, with a terminal contact positioned in the path of movement of each of said movable switch blades,

e. holding means provided by each of said set of electrical conductor strips for securing the same on said bottom surface of said base member, and

f. means formed in said bottom surface of said base member cooperating with said holding means for securing said sets of electrical conductor strips onto the bottom surface of said base member.

2. A matrix switch keyboard as defined by claim **1** wherein said means formed in said base member cooperating with the holding means provided by said conductor strips for holding the same onto said base, comprise hollow sockets formed in the bottom surface of said base, with said sockets disposed at right angles to each other and spaced correspondingly from said hollow projections.

3. A matrix switch keyboard as defined by claim **1** wherein said holding means formed on said conductor strips comprise spring tabs carried by said conductor strips and extending at right angles to said switch blade and said terminal ends on their respective conductor strips and frictionally held within said cooperating means formed in said base.

4. A matrix switch keyboard as defined by claim **1** wherein said bottom surface of said base provides areas of suspension for said conductor strips through which individual switch units comprising a movable switch blade of one conductor strip and a terminal end of said other conductor strip may be severed from their respective conductor strips.

5. A matrix switch keyboard as defined by claim **4** wherein said areas of suspension consist of a well and a pocket over which said conductors extend when said holding means formed thereon secure said conductors onto said base relative to each other and to their associated key stem.

6. A matrix switch keyboard as defined by claim **1** wherein said switch blade comprises a curved arm having its free end beneath and in contact with the key stem and a portion thereof biased out of its normal plane and bendable into contact with said terminal end upon depression of said key.

* * * * *