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Hosokawa

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[54] **ELECTROMAGNETIC SWITCH ASSEMBLY**

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Nov. 17, 1970 Japan 45/113531

[52] **U.S. Cl.** **335/206**
[51] **Int. Cl.** **H01h 41/08**
[58] **Field of Search** 335/205, 206, 207

[56] **References Cited**

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[57] **ABSTRACT**

A magnetic switch assembly wherein a reed switch is mounted beneath an operative keyboard surface for operation by a permanent magnet manually brought into alignment with a predetermined location on said operative surface. The contact elements of said reed switch are displaced from a normal axis passing through said predetermined location in the path of the lines of magnetic force of said permanent magnet. A matrix of said predetermined locations may be provided on said operative keyboard surface, a reed switch being aligned with a diagonal passing through each intersection of said matrix.

7 Claims, 5 Drawing Figures

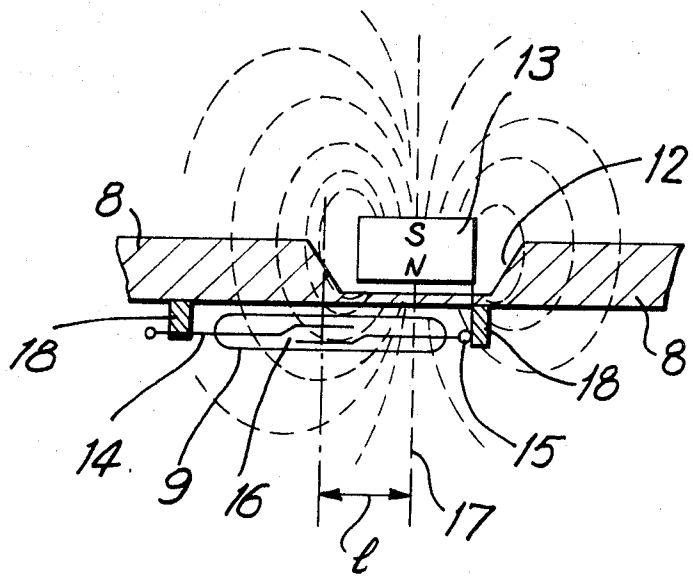


FIG. 1

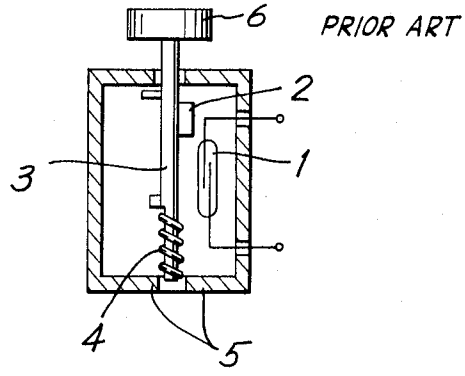


FIG. 2

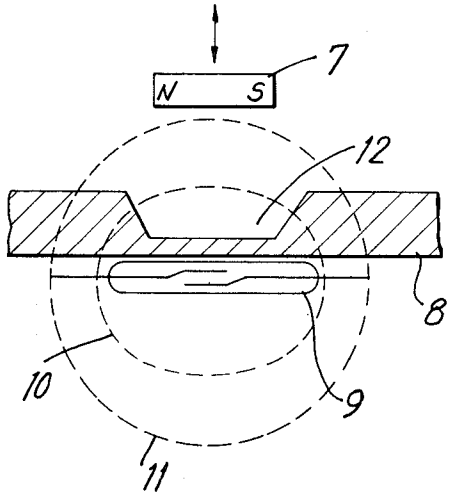


FIG. 3

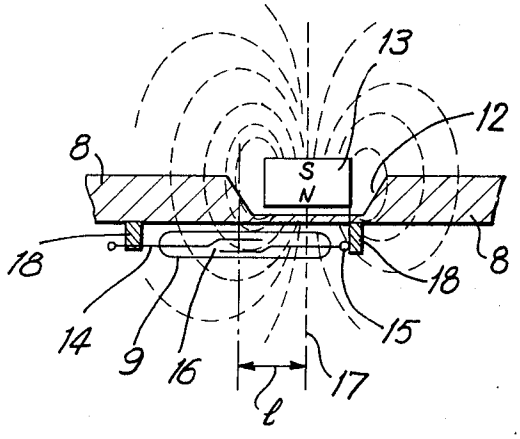


FIG. 4

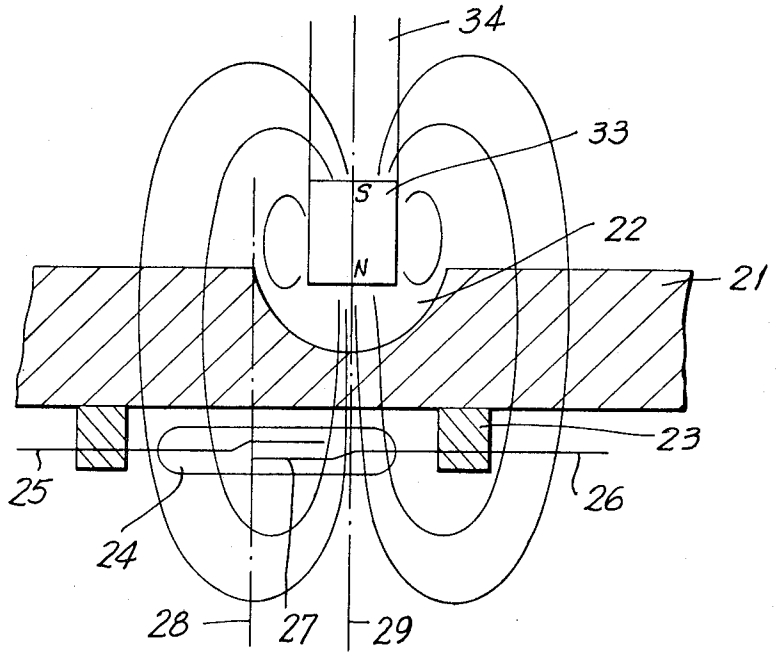
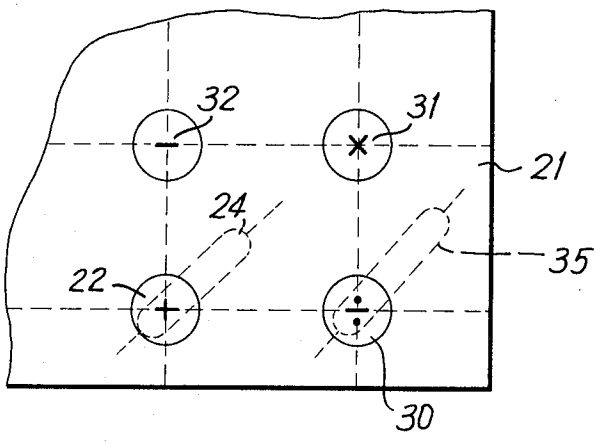


FIG. 5



ELECTROMAGNETIC SWITCH ASSEMBLY

BACKGROUND OF THE INVENTION

This invention relates to magnetic switch assemblies particularly adapted for use as an input device for electronic equipment such as electronic calculators. In the art, input devices for such electronic equipment is generally taken the form of a keyboard switch which occupies a large volume of space in the device. Where extreme miniaturization is required, such a large volume of space cannot be allocated to the input arrangement. It has been proposed to provide magnetically actuated reed switches beneath an operative keyboard surface, and to provide manually displaceable permanent magnets for actuation of said reed switches. However, this arrangement has, in the past, resulted in the erroneous actuation of reed switches adjacent to the intended reed switch. The arrangement according to the invention provides a compact magnetic switch assembly which avoids the deficiencies of the prior art arrangements.

SUMMARY OF THE INVENTION

Generally speaking, in accordance with the invention, a electromagnetic switch assembly is provided which includes an operative keyboard surface, at least one reed switch positioned beneath said operative surface and having contact elements; and a permanent magnet manually and selectively displaceable toward and away from a predetermined location on said operative keyboard surface. Said reed switch is positioned so that said contact elements are spaced from a normal axis passing through said predetermined location in the path of the lines of magnetic force of said permanent magnet when said permanent magnet is aligned with said predetermined location adjacent said operative keyboard surface.

The side of said operative keyboard surface opposed from said reed switch is formed with a recess at said predetermined location for positioning said permanent magnet. Said permanent magnet is aligned so that the poles thereof are substantially aligned with said normal axis.

Said operative keyboard surface may be provided with a matrix of said predetermined locations, a reed switch being positioned beneath said operative keyboard surface at each of said matrix locations, each of said reed switches being substantially aligned with a diagonal passing through each of said matrix locations.

Accordingly, it is an object of this invention to provide a compact and relatively inexpensive magnetic switch assembly particularly adapted for application to electronic calculators.

Still another object of the invention is to provide an magnetic switch assembly wherein actuation of the intended reed switch is assured, while accidental actuation of adjacent reed switches is avoided.

Still other objects and advantages of the invention will in part be obvious and will in part be apparent from the specification and drawings.

The invention accordingly comprises the features of construction, combinations of elements, and arrangement of parts which will be exemplified in the constructions hereinafter set forth, and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the invention, reference is had to the following description taken in connection with the accompanying drawings, in which:

FIG. 1 is a sectional view of a portion of a switchboard utilizing a conventional reed switch assembly;

FIG. 2 is a sectional view of still another conventional magnetic switch assembly;

FIG. 3 is a sectional view of an magnetic switch assembly according to the invention;

FIG. 4 is a sectional view of a second magnetic switch assembly according to the invention; and

FIG. 5 is a top plan view of a portion of the operative surface of the magnetic switch assembly of FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1, a prior art keyboard switch assembly utilizing a reed switch is depicted. Said keyboard switch is provided with a permanent magnet 2 which actuates a reed switch 1 during each switching action. Said permanent magnet is mounted on a key 3 for effecting switching action. A spring 4 extends around the base of key 3 for normally biasing said key in the "off" position. A guide portion 5 is provided on the base of the housing for guiding the key during its depression by the user who engages button 6. While the keyboard switch housing of FIG. 1 is substantially more compact than the conventional mechanical keyboard arrangements, a substantial volume is still required in the device in which it is incorporated. Where said device is a miniature electronic computer, the several centimeters in thickness required by the switchboard of FIG. 1 is large compared with the space required by the other components of the device, and is therefore deemed unsatisfactory.

In order to overcome the deficiencies of the arrangement of FIG. 1, the arrangement of FIG. 2 was proposed. In said arrangement, a base plate is provided defining the operative keyboard surface of the electronic device, said base plate being formed with a recess 12 therein. The switch defined by reed switch 9 is turned on and off by manually selectively displacing a permanent magnet 7 into and out of recess 12. Said permanent magnet is held by the hand of the user, the reed switch being mounted beneath base plate 8. When the permanent magnet enters the area defined by dashed line 10, the reed switch is operated on by said permanent magnet and turned"on". When the permanent magnet is moved away from recess 12 beyond dashed line 11, said reed switch is turned back to the "off" position.

In the embodiment of FIG. 2, the permanent magnet is aligned with its poles substantially parallel to the operative surface of base plate 8. While the thickness of the embodiment of FIG. 2 is reduced to several millimeters, for application to miniaturized electronic equipment, one disadvantage of the arrangement of FIG. 2 is that the lines of magnetic force generated by the magnet pass substantially vertically through the contact elements of the lead switch, resulting in the erratic operation of said reed switch, since the "on" and "off" action of said reed switch is controlled by the

direction of the lines of magnetic force applied thereto by the permanent magnet.

The foregoing deficiencies are overcome in the arrangement of FIG. 3, wherein the reed switch 9, fixed beneath base plate 8 by adhesive 18, is positioned so that the contact portion 16 thereof is spaced a distance "*l*" *from the* axis 17 defining the center line of recess 12. The permanent magnet 13 provided for operating reed switch 9 is formed with poles substantially aligned with said normal axis. When the elements are thus aligned, the lines of magnetic force shown by dashed lines in FIG. 3 pass through the contact elements 16 of reed switch 9 to cause the closing of the circuits between terminals 14 and 15 of said lead switch. The foregoing arrangement insures the proper operation of reed switch 9 every time permanent magnet 13 is positioned in recess 12.

Referring now to FIGS. 4 and 5, a second embodiment of the magnetic switch assembly according to the invention is depicted. In said embodiment, base plate 21 defining the operative keyboard surface is formed with a plurality of hemispherical recesses 22, 30, 31 and 32, aligned in an orthogonal matrix. Each of said recesses is associated with a different indicia, such as the minus, plus, multiplication and division signs depicted in FIG. 5. A reed switch 24 having a pair of terminals 25 and 26 is mounted beneath baseplate 21. The contact elements 27 are displaced from the normal axis 29 defining the centerline of the recesses as more particularly shown in FIG. 4. This spacing between axes 28 and 29 serves to position the contact elements 27 in the path of the lines of magnetic force of permanent magnet 33, as discussed in connection with FIG. 3.

As shown in FIG. 5, reed switch 24 is aligned on a diagonal intersecting the orthogonal matrix intersection defined by recesses 22, 32, 30, 31 and 32. A second reed switch 35 is shown similarly aligned with recess 30. Similarly, reed switches would be aligned on corresponding diagonal associated with each of the recesses defining the matrix.

Each of said reed switches is operated by manually manipulating operating bar 34 having permanent magnet 33 mounted on the end thereof to position said permanent magnet within one of said recesses, for example recess 22 as shown in FIG. 4. When said permanent magnet is brought into position within recess 22, the lines of magnetic force generated thereby act on the contact element 27 of lead switch 24 to dispose said reed switch in the "on" position. The positioning of the reed switches on the diagonal, insures that when the permanent magnet is aligned with one of the recesses, for example recess 22, the magnetic force generated by said permanent magnet has no effect on the reed switches of the adjacent recesses, namely recesses 30, 31 and 32. In this manner, misoperation of reed switches is avoided.

In the embodiment of FIG. 5, reed switches are depicted aligned on a diagonal extending to the right. When so positioned, a right handed operator would align the permanent magnet at a substantial right angle with the reed switch, an alignment which is particularly favorable. However, said lead switches may be disposed on the diagonal extending to the left, if desired.

It will thus be seen that the objects set forth above, and those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above constructions without departing from the spirit and scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

What is claimed is:

1. A magnetic switch assembly comprising a base plate having an operative keyboard surface on one side thereof; a plurality of reed switches positioned beneath said operative keyboard surface in a matrix, each of said reed switches having contact elements; and a single permanent magnet manually and selectively displaceable toward and away from each of a corresponding plurality of predetermined locations on said operative keyboard surface, said predetermined locations being positioned in a matrix so that the contact elements of each reed switch are laterally spaced along said operative keyboard surface from a normal axis passing through the associated predetermined location on said operative keyboard surface so that said contact elements lie in the path of the lines of magnetic force of said permanent magnet when said permanent magnet is aligned with said predetermined location adjacent said operative keyboard surface.

2. A magnetic switch assembly as recited in claim 1, wherein said base plate is formed with a recess at each said predetermined location for positioning said permanent magnet, the thickness of said base plate being selected so that said permanent magnet is close enough to a reed switch to operate said reed switch only when positioned in a recess.

3. A magnetic switch assembly as recited in claim 1, wherein said matrix of predetermined locations is defined at the intersection of orthogonal axes, each of said reed switches being aligned on a diagonal substantially bisecting the intersecting axes at each of said predetermined locations.

4. A magnetic switch assembly comprising a base plate having an operative keyboard surface on one side thereof defining a plurality of predetermined locations aligned in a matrix; at least one reed switch having contact elements positioned adjacent the opposed side of said base plate in the region of each of said predetermined locations; and a single permanent magnet means manually and selectively displaceable toward and away from each of said predetermined locations on said operative surface, each of said reed switches being substantially aligned with a diagonal relative to said matrix passing through each of said predetermined locations.

5. A magnetic switch assembly as recited in claim 4, wherein said matrix of predetermined locations is defined at the intersection of orthogonal axes, each of said reed switches being aligned on a diagonal substantially bisecting the intersecting axes at each of said predetermined locations.

6. A magnetic switch assembly as recited in claim 4, wherein said base plate is formed with recesses in said

operative keyboard surface at each of said predetermined locations for positioning said permanent magnet means.

7. A magnetic switch assembly as recited in claim 4, wherein said reed switch contact elements are spaced from a normal axis passing through each of said predetermined locations so that said contact elements lie in the path of the lines of magnetic force of said permanent magnet means when said permanent magnet means is aligned with said predetermined location on said operative keyboard surface, said permanent magnet means being formed with poles substantially aligned with said normal axis when said permanent magnet is positioned adjacent said operative surface.

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