

[54] **KEYBOARD SWITCH ASSEMBLY
WITH PUSHBUTTON MAGNETIC
LATCHING STRUCTURE FOR NON-
OPERATIVE POSITION**

[75] Inventor: Egon A. Pedersen, Diablo, Calif.

[73] Assignee: The Singer Company, New York,
N.Y.

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Related U.S. Application Data

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No. 3,693,123.

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200/172 R, 335/206, 335/205

[51] Int. Cl. H01h 3/20

[58] Field of Search 200/1 R, 5 R, 5 A,
200/17 R, 16 A, 159 R, 169 PB, 172;
335/205, 206-208; 197/102, 103

[56] **References Cited**

UNITED STATES PATENTS

3,657,492 9/1970 Arndt et al. 200/5 R

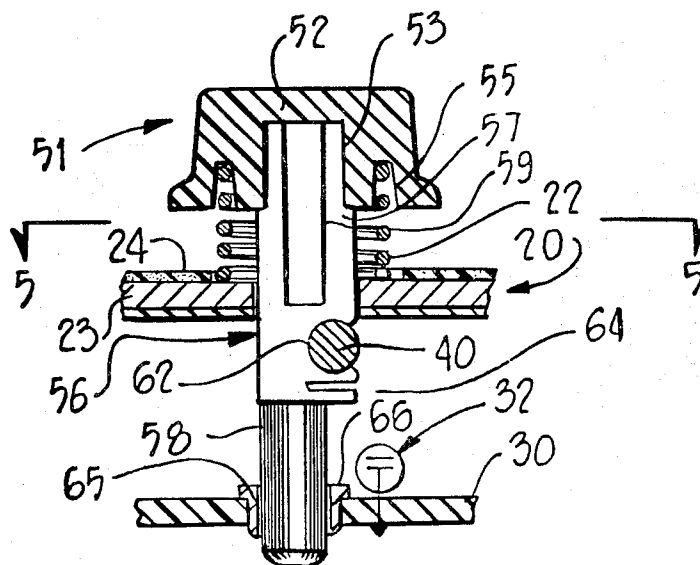
Primary Examiner—J. R. Scott

Attorney—Warren P. Kujawa and Patrick J. Schles-
inger

[57] **ABSTRACT**

A keyboard comprising a plurality of key assemblies mounted in a mounting member and a base member. Each key assembly is provided with a magnet which provides both a magnetic latching and an electrical switching action. The mounting member is constructed from a magnetic material having low magnetic remanence and is provided with an upper layer of resilient, foam material to provide key cushioning and a lower layer of resilient material to space the magnet from the mounting member. Each key assembly is also provided with a means for preventing formation of a vacuum between the bottom of an actuated key and the upper resilient layer of the mounting member.

10 Claims, 7 Drawing Figures



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3,736,397

2 Sheets-Sheet 1

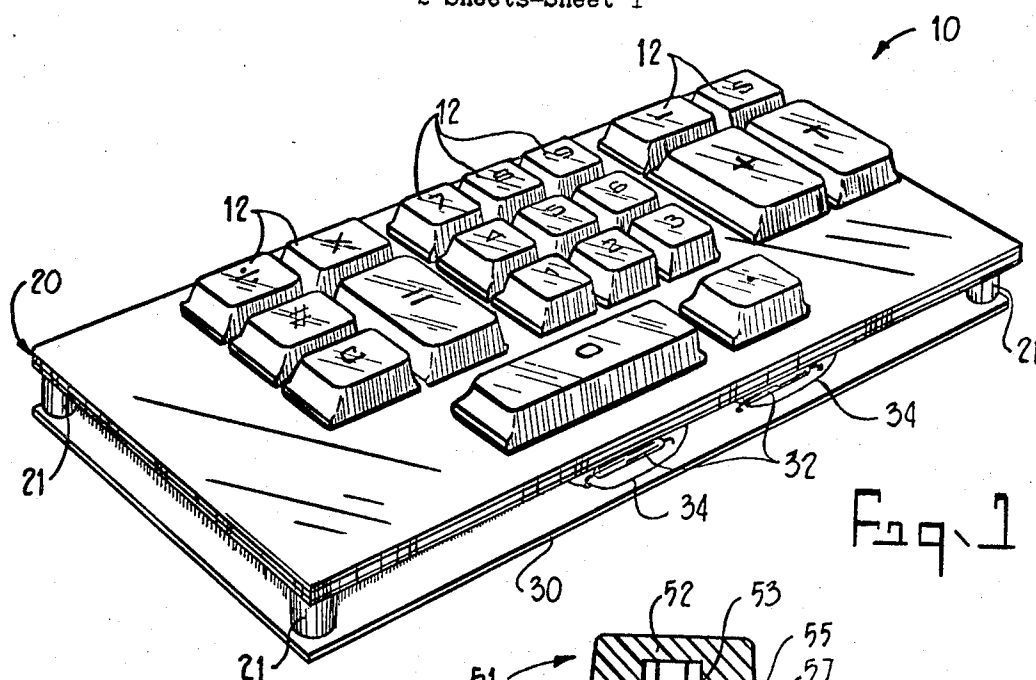


Fig. 1

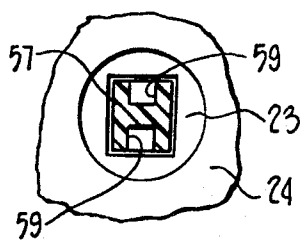


Fig. 5

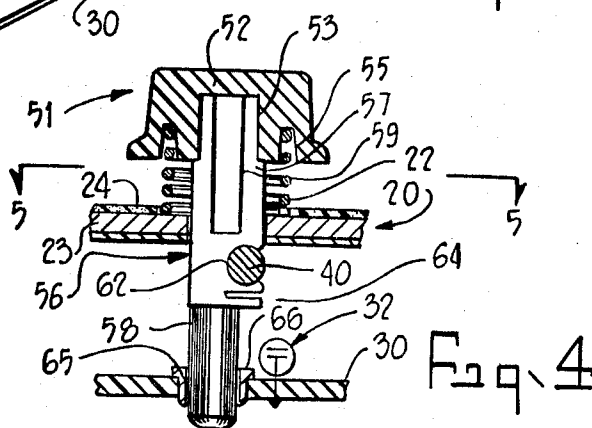


Fig. 4

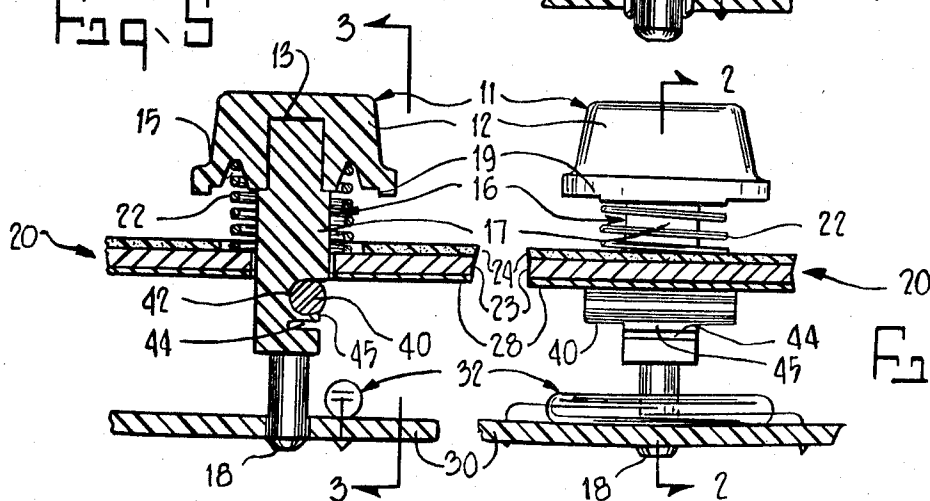
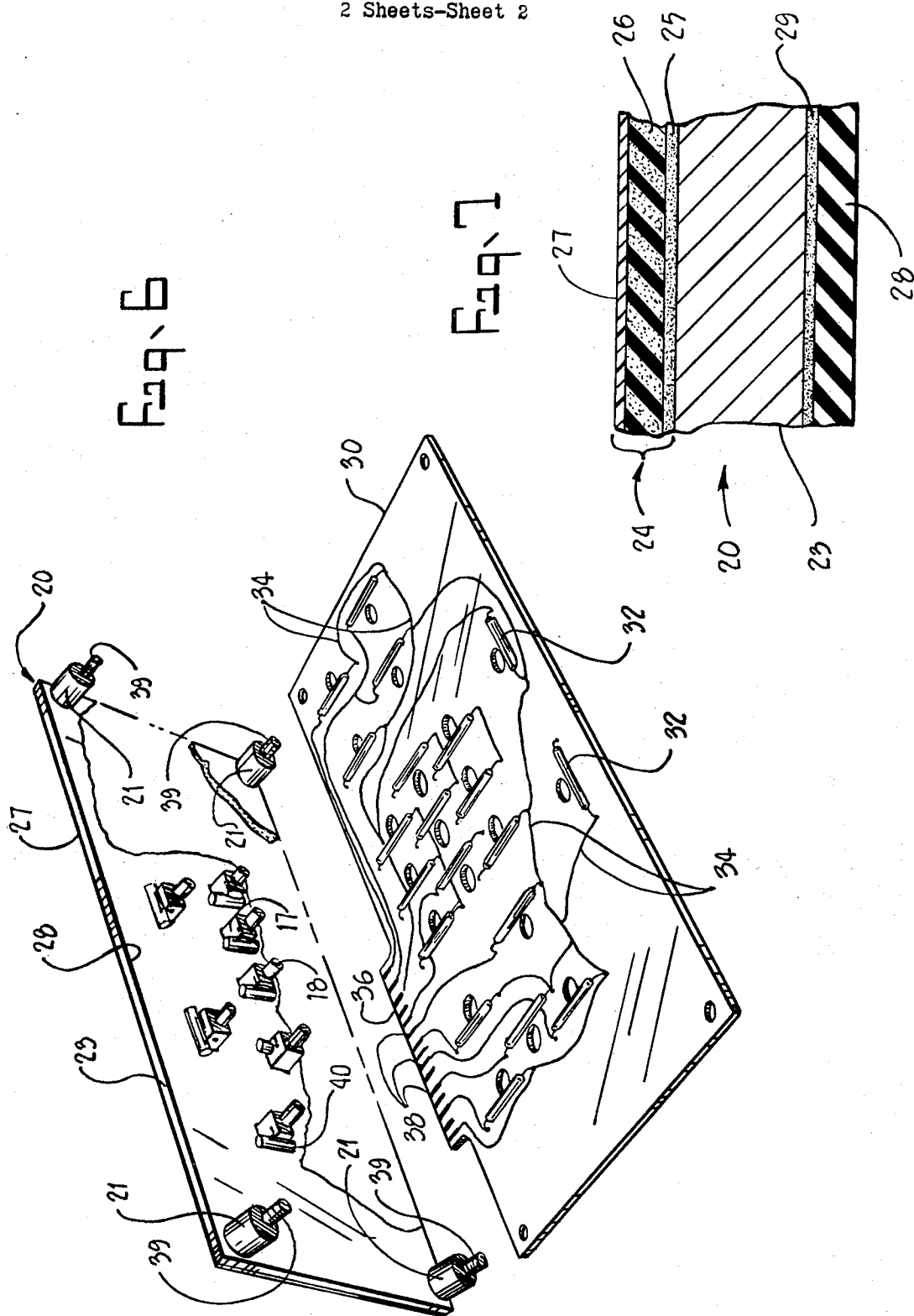


Fig. 2

Fig. 3



KEYBOARD SWITCH ASSEMBLY WITH PUSHBUTTON MAGNETIC LATCHING STRUCTURE FOR NON-OPERATIVE POSITION

STATEMENT OF RELATED CASES

This application is a divisional of commonly assigned U.S. Patent application, Ser. No. 86,678, filed Nov. 4, 1970, now U.S. Pat. No. 3,693,123.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to keyboards which are used in a wide variety of applications including, but not limited to, calculators, computers, electronic cash registers, and other devices requiring an interface between a machine and an operator. More specifically, this invention relates to keyboard devices having one or more key assemblies, each of which utilizes magnetic latching to maintain the key in a nonactuated position.

2. Description of the Prior Art

Keyboard devices are known which employ the principle of magnetic latching. In a typical keyboard device, such as that disclosed in U.S. Pat. No. 3,292,125, a plurality of key assemblies are reciprocally mounted in a frame member having a number of flat keeper members constructed of a magnetic material exhibiting low magnetic remanence. Each key assembly includes a key top and a key stem constructed of nonmagnetic material, to the latter of which is fastened a magnet. Each key assembly is reciprocally arranged with respect to a keeper member so that the magnet carried by the key stem contacts the flat surface of the keeper member when the key assembly is in a nonactuated position, thus latching the key assembly in that position. Further, when in this position the magnetic field associated with the magnet is shunted by the keeper member which substantially eliminates any stray magnetic fields within the keyboard housing.

In an assembled keyboard device, each key assembly is normally provided with a spring member which serves to bias the key assembly toward the nonactuated or rest position and to return the key assembly to that position from a depressed position. Typical known spring members include spring fingers, coil springs, and conically shaped rubber stem boots of the type disclosed in U.S. Pat. No. 3,478,857.

In known keyboard devices of the above type, magnetic reed switches of the type known in the art, such as that disclosed in U.S. Pat. No. 2,289,830, are advantageously employed as the electrical switching elements. A magnetic reed switch comprises a pair of reed contacts enclosed in an hermetically sealed envelope, usually glass. The contacts are so constructed and arranged within the envelope that the positioning of a magnet in proximity to the switch results in the actuation of that switch, usually by causing a pair of normally opened contacts to close, while removing the magnet from the vicinity of the switch causes the contacts to revert to their original state.

In a typical arrangement, several such reed switches are mounted in the keyboard device usually on a common circuit board located in the lower portion of the keyboard housing. Each reed switch is associated to a different one of the key stems and so positioned that the magnet carried by the associated key stem will be brought into proximity sufficiently close to actuate the switch whenever the associated key is depressed by an

operator. Because of the above-noted magnetic shunting effect produced by the keeper members whenever a key assembly is in the nonactuated position, many key assemblies having strong magnets can be mounted in close proximity to each other in a single keyboard without any stray magnetic field buildup and consequent false actuation of reed switches attendant therewith.

Known keyboard devices of the above type suffer from several disadvantages all related to common criteria for evaluating keyboard performance. One such criterion is operator touch or feel. A desirable keyboard should provide both a breakaway touch to the operator, by which the operator senses through his finger tips that a given key top has been depressed a sufficient distance to cause actuation of the associated switch; and a stop touch, by which the operator senses through his finger tips that a given key top has been depressed to the limit of its mechanical displacement.

Breakaway touch requires a mechanism which provides a resistance to the depression of the key which rapidly vanishes with continued key displacement. In prior art keyboards using magnetic latching, breakaway touch is provided by the force of magnetic attraction between the stem magnet and the flat keeper member. However, because strong magnets are usually required to ensure positive actuation of the associated reed switches, this force of attraction is initially very large and a correspondingly large initial actuation force is required of the operator to overcome this force of attraction when depressing a given key. In a typical operational environment, in which an operator must repetitively actuate the individual keys thousands of times, this large initial actuation force—when multiplied by a number of key actuations—quickly leads to operator fatigue, which is highly undesirable.

Stop touch requires a mechanism which limits the extent of key displacement and ordinarily is provided in known keyboards by equipping each key stem with a portion which will abut a stationary frame member when the maximum key displacement is reached. Because both abutting members are rigid, however, a highly undesirable jolting action is sensed by the operator each time a key top has been depressed to its maximum displacement. When multiplied by several thousand key actuations, this jolting action can be highly annoying to the operator and greatly lessens the desirability of such a keyboard.

Another common criterion used to evaluate keyboard performance is the noise factor. Keyboards which produce distracting sounds have been found to lead to increased operator errors, which is highly undesirable. It has been found that the above-described known stop touch mechanisms produce such noise. Moreover, it has been further noted that this problem is compounded in keyboards using magnetic latching by the noise produced during the return stroke whenever the key stem magnet strikes the flat surface of the keeper member. The combination of these two noise sources frequently results in a surprisingly high noise factor for keyboards using this magnetic latching principle.

SUMMARY OF THE INVENTION

The invention disclosed herein comprises a keyboard device having one or more key assemblies reciprocally received by a mounting member and a base member.

Each key assembly includes a key top and a key stem with a magnet mounted on the latter. The mounting member comprises a plate constructed of a material exhibiting low magnetic remanence, for example steel, an upper cushioning layer of resilient foam material, and a lower spacing layer of resilient material. The upper layer material is selected to provide an optimum cushioned stop touch and an attractive visual appearance. The lower layer material is selected to provide a minimum noise level for each return key stroke. The thickness of the lower layer is chosen to provide a predetermined maximum holding force between each key stem magnet and the plate, which results in an optimum breakaway touch. In addition, each key assembly is provided with a mechanism for preventing suction between the bottom of the key top and the upper layer of resilient foam material whenever a key has been depressed.

In addition to providing optimum breakaway touch, cushioned stop touch and a reduced noise level, the invention disclosed herein possesses other important advantages over the prior art. For example, because the keyboard device disclosed herein requires few working mechanical parts, the manufacturing cost and also the failure rate of keyboards constructed according to the invention are both substantially reduced.

For a fuller understanding of the nature and advantages of the invention, reference should be had to the following detailed description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a keyboard embodying the invention;

FIG. 2 is a sectional view of one embodiment of the invention;

FIG. 3 is a side view taken along lines 3—3 of FIG. 2;

FIG. 4 is a view partially in section of another embodiment of the invention;

FIG. 5 is a sectional view taken along lines 5—5 of FIG. 4;

FIG. 6 is an exposed view, partially in section of the keyboard of FIG. 1 illustrating certain features thereof; and

FIG. 7 is an enlarged sectional view showing details of the mounting plate according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to the drawings, FIG. 1 shows a keyboard device generally indicated at 10 which is suitable for use in an electronic calculator and which can embody any of the preferred embodiments of the invention disclosed hereinbelow. As shown in FIG. 1, keyboard 10 has a plurality of numeric keys and function keys 12 grouped in a fashion convenient for the human operator. Each key 12 is mounted on a mounting plate 20 for reciprocable motion in a manner described below. Located in the corners of mounting plate 20 are four spacers 21, the lower ends of which each have a threaded portion of reduced diameter adapted to be passed through associated openings in the corners of a base member 30, and to receive suitable fasteners (see FIG. 6). The lower surface of the body portion of each spacer 21 rests on the upper surface of base member 30.

Mounting plate 20 comprises a three-layered sheet having a number of openings therein for receiving a number of key assemblies, described below. As shown most clearly in FIG. 7, mounting plate 20 has a central core 23 which may be composed of any material known to those skilled in the art having low magnetic remanence. Low carbon steel and also soft iron have been found to be highly effective materials from which central core 23 may be constructed.

A cushioning layer 24 of suitable material is adhered to the upper side of central core 23. Since the primary purpose of this layer is to provide a cushioned stop as described below, there are many resilient materials which are suitable for constructing layer 24. Preferably, a three-layered material having an adhesive layer 25, a foam center layer 26, and a vinyl facing layer 27 can be used for this purpose. This type of material is preferred since adhesive layer 25 eliminates the need for cement, while layer 26 provides the desired cushioning effect and vinyl facing layer 27 minimizes wear of the foam as well as lends an attractive appearance to the finished keyboard. One such material found to be highly suitable comprises polyurethane foam having vinyl or polyester film on the facing side and adhesive on the underside. Other equally suitable materials will occur to those skilled in the art.

A spacing layer 28 is adhered to the underside of central core 23 by means of a suitable adhesive or cement layer 29. Spacing layer 28 performs two functions in the operation of keyboard 10: that of providing a maximum desired force for holding a key in a nonactuated rest position; and that of reducing noise produced by a key when returning to the rest position after release by an operator. Many materials are suitable for use in constructing spacing layer 28. In general, the material selected should be slightly resilient, should have a relatively high acoustic damping factor, and be relatively insensitive to permanent deformation with continued pressure over long periods of time. Many rubber materials have been found to be suitable for this purpose; excellent results have been obtained with polyurethane sheets having a hardness in the 70-90 durometer Shore A range. Other equally suitable materials will occur to those skilled in the art.

As partially visible in FIG. 1 but shown more clearly in FIG. 6, base member 30 has a number of magnetic reed switches 32, described above, mounted on the upper surface thereof, and a number of conductive paths 34 located on both the upper and lower surface of base member 30 and which electrically interconnect various ones of reed switches 32. Integrally formed at the back of base member 30 as viewed in FIG. 6 is a plug projection 36 having a number of conductive strips 38 to which various ones of conductive paths 34 are electrically connected. The dimensions of plug projection 36 and conductive strips 38 are such that a standard electrical jack may be fitted thereover to provide connections between keyboard 10 and the associated device, which in this instance is an electronic calculator. Base member 30 may be constructed from any suitable material, such as phenolic material commonly used for circuit boards. Reed switches 32 may be mounted on base member 30 in any suitable manner known to those skilled in the art, such as drilling two lead holes for each reed switch 32, inserting the end leads and soldering. Conductive paths 34 may comprise

individual electrically conductive wires, or etched solder paths, as desired.

FIGS. 2 and 3 illustrate a preferred embodiment of the invention. A key assembly 11 is shown in FIG. 2 which comprises a key top 12 and a key stem 16. Key top 12 has a central opening 13 adapted to receive the upper end of key stem 16. Key top 12 is provided with a conical groove 15 concentric with central opening 13, which is adapted to receive a return spring 22, described below. The bottom of key top 12 is provided with a pair of ridges 19 extending along the sides thereof, for a purpose also described below. Key stem 16 has a main body portion 17 and a lower body portion 18 of reduced diameter. Both key top 12 and key stem 16 may be constructed from any suitable nonmagnetic material known to those skilled in the art; e.g., ABS (acrylonitrile butadiene styrene) polymer compound has been found to be well suited for molding key tops 12. Both DELRIN and CELCON acetal compound have been found to be excellent for constructing key stems 16.

As shown in FIG. 2, key assembly 11 is mounted in keyboard 10 for reciprocable movement in a generally vertical direction, with main body portion 17 and lower body portion 18 of key stem 16 received by openings in mounting plate 20 and base member 30, respectively, both described above in detail. The cross-sectional configurations and dimensions of main body portion 17 and lower body portion 18 of key stem 16, and the mounting holes in mounting plate 20 and base member 30, are chosen to provide a close fit therebetween, but the tolerances are not extremely critical. Also, the cross-sectional shapes of all the above need not be identical. For example, main body portion 17 and the corresponding opening in mounting plate 20 may have a square cross-sectional configuration, while lower body portion 18 and the corresponding opening in base member 30 may have a round cross-sectional configuration, or vice versa.

A magnet 40 is mounted in a generally circular groove 42 on main body portion 17 of key stem 16 in a direction generally transverse to the longitudinal axis of key stem 16. Although a cylindrical magnet 40 is illustrated, this preferred shape is not critical and it has been found that a magnet 40 having a rectangular configuration is also suitable. To facilitate mounting of magnet 40, a slot 44 is formed in main body portion 17 of key stem 16 below circular groove 42 to provide a slightly resilient land 45.

To assemble keyboard 10, each key assembly 11 is first mounted on mounting plate 20. As a first step, key top 12 is press fitted onto key stem 16. If desired, a suitable cement substance may be included in central opening 13 of key top 12 to provide a permanent bond, although this step is optional. A suitable return spring 22 is next fitted into conical recess 15, and the assembly 11 is then inserted from the upper side of mounting plate 20 through the openings therein. When circular groove 42 clears the underside of mounting member 20, magnet 40 is snap fitted therein. If desired, a small quantity of a suitable cement material may be included to provide a permanent bond between the outer surface of magnet 40 and the surface of groove 42.

After each key assembly 11 has been assembled and mounted on mounting plate 20, the assembly of keyboard 10 may be completed by attaching base member 30 to the underside thereof, care being taken to insert

the lower end of each key stem 16 and each bolt 39 into their respective openings in base member 30 (see FIG. 6). During this step, the orientation of each key assembly 11 should be visually inspected to ensure that each magnet 40 is positioned substantially parallel to and on the same side of key stem 16 as the reed switch 32 associated thereto. After inspection, bolts 39 may be secured by any suitable means (not shown). This completes the assembly of keyboard 10 which is ready for installation in the utilization device.

In an assembled keyboard 10, each key assembly 11 is maintained in the nonactuated or rest position illustrated in FIGS. 2 and 3 primarily by the magnetic force of attraction between magnet 40 and central core 23, with the assistance of return spring 22. When a key is depressed, the magnetic force of attraction between magnet 40 and central core 23 decreases rapidly with increasing separation between these two elements as key assembly 11 moves in the downward direction, while the restoring force provided by return spring 22 increases as this spring becomes compressed. When the key is released, key assembly 11 is displaced in an upward direction under the influence of return spring 22 and, as the key approaches the rest position, the force of attraction between magnet 40 and central core 23. When key assembly 11 reaches the rest position illustrated, the magnetic force of attraction attains its maximum value, designated the maximum holding force.

As outlined above, in prior art devices it has been found expedient to ensure positive actuation of reed switch 32 for each depression of a key assembly by using very strong magnets. When such magnets are used, however, the maximum holding force is found to be correspondingly great. Consequently, the force required to be applied by the human operator in order to initially move a key assembly in a downward direction is undesirably high in prior art keyboards, resulting in an uncomfortable breakaway touch. This problem is avoided in keyboards constructed according to the invention disclosed herein by the provision of spacing layer 28 for mounting plate 20. As is most clearly shown in FIG. 3, when key assembly 11 is in a rest position, spacing layer 28 separates magnet 40 from central core 23 by an amount substantially equal to the thickness of layer 28. Since layer 28 is constructed from a nonmagnetic material, as discussed above, and since the force of attraction between magnet 40 and central core 23 is inversely proportional to the separation distance therebetween, the maximum holding force defined above is reduced from the value it would assume in the absence of layer 28 by an amount dependent upon the thickness of spacing layer 28. The actual optimum thickness of spacing layer 28 is a function of the breakaway touch desired, the strength of magnet 40, the magnetic permeability of central core 23, and other factors. In one application wherein polyurethane sheet material was used for spacer layer 28, a thickness of from 0.010 to 0.030 inch was found to provide excellent results, with the best results being provided with a thickness of 0.020 inch. For any given application, however, the optimum thickness of spacing layer 28 can be easily determined on an empirical basis.

Spacing layer 28 provides an additional function of reducing the noise level produced by an operated key. As can be seen from a consideration of the operation of a single key assembly 11 and as best shown in FIG. 3, when key assembly 11 returns to the rest position,

the upper surface of magnet 40 strikes the underside of mounting plate 20.

In the absence of spacing layer 28, a noise would be produced by the contact between the surfaces of magnet 40 and metallic central core 23, which has been found to be highly annoying and distracting to a human operator. In the invention disclosed herein, however, magnet 40 strikes the underside of spacing layer 28, which as noted above is constructed of a material having a relatively high acoustic damping factor. The nature of this material is such that any noise produced by this striking contact is so slight as to be well below the annoyance/distraction level. Thus, spacing layer 28 performs two functions in keyboards constructed according to the invention: that of providing optimum breakaway touch and that of ensuring an optimally low noise level.

In operation of keyboard 10, a cushioned stop touch is provided for each key assembly 11 in the following manner. When a key assembly 11 moves downward in response to the finger pressure of the human operator, the forces tending to oppose this downward movement are the magnetic force of attraction between magnet 40 and central core 23, which force decreases rapidly with distance as described above, and the restoring force of spring 22, which is chosen to be quite small as described below. During this portion of the key stroke, the resistance to further downward displacement felt by the operator is relatively small. Key assembly 11 continues to move downward with relatively small resistance to further displacement until magnet 40 reaches a position in sufficient proximity to associated reed switch 32 to actuate this switch. The relative dimensions of key assembly 11 are chosen such that after magnet 40 has reached the reed switch actuation position, the bottom contact surfaces of key top 12 (the bottom surfaces of raised portions 19 in the embodiment of FIGS. 2 and 3) begin to make contact with the upper surface of cushioning layer 24. Thereafter, further downward displacement in response to operator pressure is opposed by layer 24 in contact with the key top contact surfaces. Although the opposing force provided by layer 24 increases rapidly with further displacement, the compressibility of cushioning layer 24 ensures that this force is not sudden or abrupt. This, in turn, ensures that the operator will experience a cushioned stop, rather than an abrupt stop, each time a key is displaced the full extent of the key stroke.

As noted above, each time a key assembly 11 is displaced to the full extent of the key stroke, the key top contact surfaces first make contact with facing layer 27 of cushioning layer 24, and subsequently compress cushioning layer 24 a finite amount. When contact is first made, a partially closed void is created, the inner surfaces of which are the hollow under surfaces of the key top 12, the sides of the aperture in cushioning layer 24, the exposed top surface of central core 23, and the exposed outer surface of main body portion 17 of key stem 16. After initial contact, further downward displacement of key assembly 11 causes cushioning layer 24 to compress, which reduces the volume of the partially closed void. Because of this reduction in volume, a portion of the air in the void is expelled via the clearance space between the outer surface of main body portion 17 of key stem 16 and the aperture in central core 23 and spacing layer 28 of mounting plate 20. This produces a partial vacuum in the void whose strength

is dependent on the magnitude of the clearance space and the degree to which the key top 12-spacing layer 27 boundary comprises an hermetic seal. It has been found that many materials ideally suited for use as facing layer 27 (e.g., closed-cell vinyl products) also provide a highly effective seal when placed in contact with those materials which are ideally suited for use in constructing key top 12 (e.g., ABS polymer compound).

When the key is released by the operator, absent some means to immediately vent the void, key assembly 11 (under the influence of the relatively weak return force produced by return spring 22) would initially be prevented from returning to the rest position by the suction produced by the partial vacuum until this partial vacuum is relieved by air entering via the above-noted clearance space. Such a delay in upward displacement of key assembly 11 during the return portion of the key stroke would be highly undesirable in many keyboard applications wherein rapid reactivation of the same key is required.

To eliminate the above problem, each key top 12 is designed with a pair of ridges or raised portions 19 extending along parallel sides on the bottom surface thereof. The depth of the ridges is selected to ensure that the bottom surfaces of the two remaining parallel sides of key top 12 will not engage in sealing contact with the surface of facing layer 27, regardless of the extent of compression of cushioning layer 24. This prevents the formation of the above-noted partial vacuum and the undesirable effects attendant thereto.

Return spring 22 may be constructed of ordinary spring wire in the usual manner well known to those skilled in the art. In the preferred embodiment of the invention, optimum results have been achieved with springs producing a 2-4 ounce touch, with best results occurring with a 3-ounce touch. For any given application, however, the optimum touch can best be determined on an empirical basis.

A second embodiment of the invention is shown in FIGS. 4 and 5. FIG. 4 illustrates a key assembly 51 comprising a key top 52 and a key stem 56. Key top 52 also has a conical groove 55 concentric with central opening 53 which is adapted to receive a return spring 22 of the type described above.

Key stem 56 has a main body portion 57 and a lower body portion 58 of reduced diameter and offset from the longitudinal axis of key stem 56. Main body portion 57 is provided with a longitudinally extending groove 59 on two sides thereof, for a purpose described below, the general cross-section of main body portion 57 resembling the letter H as shown in FIG. 5. A magnet 40 is mounted below grooves 59 in a generally circular groove 62 on main body portion 57 of key stem 56 in a direction generally transverse to the longitudinal axis of key stem 56.

Key assembly 51 is mounted for reciprocal movement in a generally vertical direction with main body portion 57 and lower body portion 58 of key stem 56 received by openings in mounting plate 20 and base member 30 in a manner similar to that previously described in conjunction with the embodiment of FIGS. 2 and 3. In the FIG. 4 embodiment, however, each aperture in base member 30 is provided with an annular guide insert 65 having a keeper flange 66. Guide insert 65 is preferably constructed from DELRIN, TEFLON, or other suitable materials and serves to slidably receive and guide lower body portion 58 of key stem 56

during displacement of key assembly 51. The materials suitable for construction of key assembly 51 are substantially the same as those already set forth above in conjunction with the description of the FIG. 2 embodiment. Also, assembly and operation of the FIG. 4 embodiment proceeds as described above in connection with the description of the FIG. 2 embodiment.

In the FIG. 4 embodiment, longitudinal grooves 59 perform the function of ridges 19 of the FIG. 2 embodiment. The length of grooves 59 is so chosen in relation to the other dimensions of the keyboard that a lower portion of at least one groove 59 will be exposed to the space below mounting plate 20 before the flat bottom surface of key top 52 engages in physical contact with facing layer 27 of cushioning layer 24 whenever a key assembly 51 is displaced in the downward direction. In this manner, at least one groove 59 provides an unobstructed passage for the egress and intake of air to the void below the key top. This unobstructed passage prevents the formation of a partial vacuum tending to retard return of a key assembly to the rest position as described above in conjunction with the embodiment of FIGS. 2 and 3.

As mentioned above, key stem 56 of key assembly 51 is provided with an offset lower body portion 58 which is adapted to be slidably received by the opening in guide insert 65 in base member 30. As is evident from a consideration of FIGS. 4 and 5, the main body portion 57 of key stem 56, which has a generally symmetrical cross-section, is capable of being inserted into its associated aperture in mounting plate 20 in any one of four successive angular positions each differing from the preceding position by 90°. However, to ensure actuation of the associated reed switch 32 located on base member 30, each key assembly 51 must be mounted in that singular position in which magnet 40 is positioned parallel to, and on the same side of key stem 56 as reed switch 32. By providing key stem 56 with offset lower body portion 58 and by similarly positioning guide inserts 65 on base member 30, it is impossible to complete assembly of a keyboard unless each key assembly 51 is mounted in the correct angular position. By this simple expedient, improper assembly of keyboards constructed according to the invention is completely eliminated.

As will now be evident to those skilled in the art, the invention described above provides an improved keyboard utilizing magnetic latching and having a highly desirable operator touch. Further, keyboards constructed according to the invention are extremely inexpensive to manufacture and assemble and are not prone to mechanical failure due to the nature and small number of working elements. In addition, such keyboards are extremely well adapted for use as the operator input module in a wide variety of data processing machines. Moreover, other uses for keyboards constructed according to the invention will occur to those skilled in the art.

While the foregoing provides a full disclosure of the preferred embodiments of the invention, it is understood that various modifications, alternate constructions, and equivalents may be employed without de-

parting from the true spirit and scope of the invention. For example, other types of spring 22 than that actually illustrated may be employed to provide a restoring force to each key assembly. Also, key tops having other contours than those illustrated may be utilized in keyboards constructed according to the invention. Therefore, the above description and illustrations should not be construed as limiting the scope of the invention, which is solely defined by the appended claims.

What is claimed is:

1. A keyboard device comprising:

a flat mounting member having an opening therein and a resilient surface surrounding said opening;
a key assembly including a key stem reciprocally received by said opening in said mounting member and a key top mounted at one end of said key stem, the bottom portion of said key top being adapted to make contact with the resilient surface of said mounting member when said key assembly is in an actuated position to create a void under said key top;

means for biasing said key assembly toward a non-actuated position;

said key assembly further including means for preventing formation of a partial vacuum in said void when said contact has been established.

2. The apparatus of claim 1 wherein said last-named means comprises a raised portion extending along the bottom of said key top.

3. The apparatus of claim 2 wherein said last-named means comprises a pair of raised portions extending along the bottom of said key top.

4. The apparatus of claim 1 wherein said last-named means comprises a groove extending longitudinally of said key stem and having a length sufficient to extend below the bottom of said mounting member when said key assembly is in an actuated position.

5. The apparatus of claim 1 wherein said biasing means comprises a spring member mounted between said bottom of said key top and said mounting member.

6. The apparatus of claim 1 wherein said keyboard further includes a base member mounted adjacent said mounting member and having a guide opening adapted to slidably receive the other end of said key stem.

7. The apparatus of claim 6 wherein said base member includes a guide insert mounted therein and said guide opening is defined by the inner surface of said guide insert.

8. The apparatus of claim 6 wherein said key stem has a main body portion having a cross-sectional configuration substantially the same as said opening in said mounting member and a lower body portion having a cross-sectional configuration substantially the same as said guide opening in said base member.

9. The apparatus of claim 8 wherein said lower body portion is offset from said main body portion of said key stem.

10. The keyboard device according to claim 1 wherein said biasing means includes magnetic and spring means.

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