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MANUALLY ACTUATABLE SWITCH ASSEMBLY

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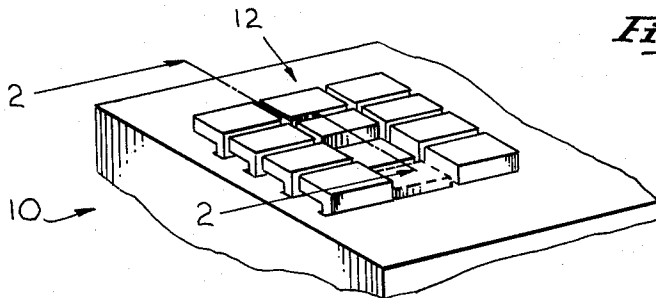


Fig. 1

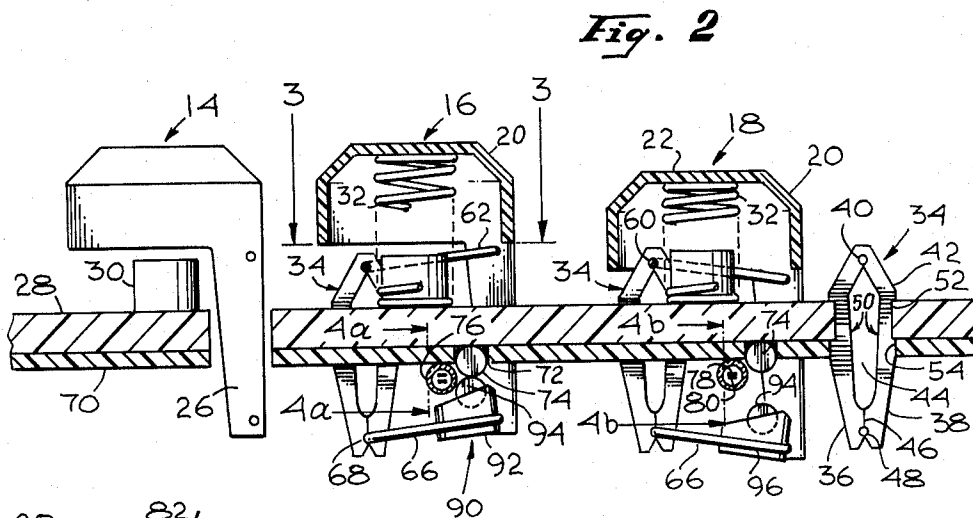


Fig. 2

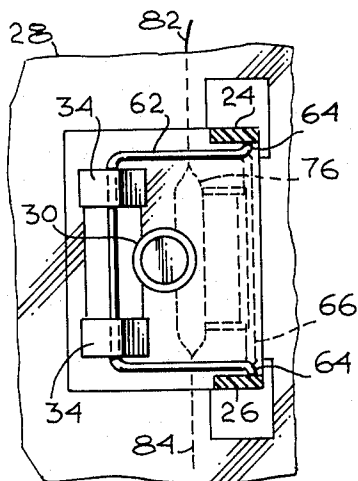


Fig. 3

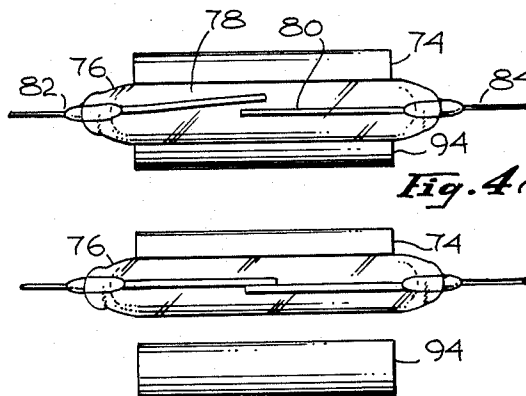


Fig. 4(a)

Fig. 4(b)

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MANUALLY ACTUATABLE SWITCH ASSEMBLY
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13 Claims. (Cl. 200—87)

This invention relates to improvements in electrical switching devices.

Although the prior art is replete with various types of electrical switches, often times none is very well suited for a particular application. For each different switch application, there are usually several objectives which must be considered with the final switch design usually representing an optimum compromise between these objectives. For example, consider the requirements of electrical switch assemblies employed in frequently used keyboards. Such keyboards can be used in electronic calculators, for example, and thus it should be appreciated that the switch assemblies must be constructed in a manner which assures a long and reliable life. In addition, an operator should be able to operate the switch assembly easily and comfortably. Another significant design requirement is that the switch assembly be constructed in a manner which permits several of them to be packed very closely and yet which also permits them to be mechanically and electrically isolated from one another. Of course, it is always a requirement to provide a suitable switch assembly as inexpensively as possible.

In order to assure that a switch assembly has a long and reliable life, it is desirable to utilize some form of switch contacts which are enclosed to thereby prevent the accumulation of dirt. The contacts can be selectively closed by appropriately manipulating a magnetic field in response to the actuation of a key forming part of the switch assembly. Utilization of a magnetic field to close the contacts however, raises a significant problem of how to restrict the effectiveness of each magnetic field, particularly where the switch assemblies are closely packed. Further, as noted, it is desirable that the assembly operate easily and comfortably which implies that the keys be restricted to linear movement. Also, in order to prevent false or spurious actuation of any of the keys, means should be provided in each switch assembly for establishing an initial mechanical force on each of the keys which tends to inhibit its actuation. This inhibiting force should however be considerably reduced once it is exceeded. Also, in order to provide a switch assembly which is relatively inexpensive, care must be taken to assure that the assembly can be fabricated easily.

In view of the above, it is an object of the present invention to provide an improved switch assembly particularly suited for use in keyboard applications.

It is a further object of the present invention to provide an improved switch assembly which is relatively inexpensive and which can operate very reliably even when packaged closely in a keyboard.

In accordance with a first aspect of the invention, when the switch assembly key is not actuated, the switch contacts are positioned in a zero magnitude magnetic field. The zero magnitude magnetic field can be defined between a pair of permanent magnets. When one of the magnets is moved relative to the other magnet and the switch contacts, the contacts will then reside in a non-zero magnitude magnetic field and as a result will be forced into contact with each other.

In accordance with a further aspect of the invention, the permanent magnets can be so arranged that when the switch assembly key is not actuated, the magnets are

in contact and thus present an initial resisting force in actuation of the key. Once the attracting force between the magnets is overcome, only a very small resisting force is exerted on the key.

In accordance with a still further aspect of the invention, the switch assembly key is supported relative to a mounting board in a manner which permits it to be moved substantially perpendicularly to the board thus facilitating manual actuation of the keys.

The novel features that are considered characteristic of this invention are set forth with particularity in the appended claims. The invention itself both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings, in which:

FIGURE 1 is a top perspective view of a keyboard constructed in accordance with the present invention;

FIGURE 2 is a vertical sectional view taken substantially along the plane 2—2 of FIGURE 1;

FIGURE 3 is a horizontal sectional view taken substantially along the plane 3—3 of FIGURE 2; and

FIGURES 4(a) and 4(b) are vertical sectional views respectively taken substantially along the plane 4a—4a and 4b—4b of FIGURE 2.

Attention is now called to FIGURE 1 of the drawings which illustrates an apparatus 10 including a keyboard 12 comprised of a plurality of switch assemblies. The apparatus 10 can comprise, for example, a calculator, a computer input-output device, or any one of several other pieces of equipment. In any event, the keyboard 12 is adapted to be manually operated by an operator so that in response to the depression of each of the different keys in the keyboard, a different pair of electrical switch contacts is closed.

Attention is now called to FIGURE 2 which illustrates three identically constructed switch assemblies 14, 16, and 18. An external side view of the switch assembly 14 in an unactuated position is illustrated. Sectional views of switch assemblies 16 and 18 are illustrated respectively in a non-actuated and an actuated position.

Each of the switch assemblies of FIGURE 2 includes a key portion 20 which can be readily seen on the keyboard 12 of FIGURE 1. Each of the key portions 20 comprises an inverted cup-shaped member having a flat bottom 22. A pair of spaced depending legs 24 and 26 extend from each of the key portions through a first pair of slots in a mounting board 28. The legs 24 and 26 are adapted to slide in the mounting board slots.

A boss 30 is secured to the upper surface of the mounting board 28 beneath each of the key portions 20. A circular spring 32 is adapted to be fitted between the key portion 20 and the upper surface of the mounting board 28 around the boss 30 to normally project the key portion 20 away from the mounting board 28.

An additional pair of slots is defined in the mounting board 28 forward of each first pair of slots. A post 34 is adapted to be received in each slot of the additional pair of slots. Each post 34 comprises a bifurcated member including first and second sections 36 and 38. The sections 36 and 38 are joined at the uppermost portion of the post 34 immediately above an upper bearing receptacle 40. The post 34 is slotted and flared outwardly at 42 immediately beneath the upper bearing receptacle 40. Beneath the slotted and flared portion 42, a major aperture 44 is defined between the sections 36 and 38. The sections 36 and 38 are constructed so that they define mating surfaces along a line 46 immediately beneath the aperture 44. Below the mating surfaces of the sections 36 and 38, a lower bearing receptacle 48 is defined. The sections 36 and 38 are slotted and flared outwardly beneath the lower bearing receptacle 48.

The outer edges of each of the sections 36 and 38 define a portion 50 of reduced thickness between shoulders 52 and 54. Each of the posts 34 is adapted to be received in a slot in the mounting board 28 in the manner indicated in FIGURE 2 with the portions of the mounting board 28 immediately adjacent the slot extending into the reduced portions 50 between the shoulders 52 and 54. The post 34 is preferably constructed of a slightly elastic material, e.g., some form of plastic, which permits the sections 36 and 38 to be pulled apart or slightly pushed together. By pressing the sections 36 and 38 together, the post 34 can be inserted into an appropriate slot in the mounting board 28.

Prior to inserting the post 34 into a slot in the mounting board 28, the bight portion 60 of an upper U-shaped rocker arm 62 is inserted into the upper bearing receptacles 40 of a pair of spaced posts 34. The bight portion 60 of the arm 62 can be inserted into the bearing receptacles 40 by pulling apart the sections 36 and 38 to thus enable the bight portion 60 to be forced through the lower bearing receptacle 48, the major aperture 44, the slotted and flared portion 42 and into the upper bearing receptacles 40. The posts 34 in which the rocker arm is mounted can then be forced into the appropriate slots in the mounting board 28 in the aforescribed manner.

The rocker arm 62 includes a pair of leg portions each terminating in an outwardly extending toe portion 64. The legs 24 and 26 depending from the switch assembly key portion 20 each define apertures adapted to receive the toe portions 64 of the U-shaped rocker arm 62.

In addition to the upper rocker arm 62, each switch assembly includes a lower rocker arm 66 which includes a bight portion 68 adapted to be received in the lower bearing receptacles 48 of a pair of spaced posts 34. The legs of the lower U-shaped rocker arm 66 terminate in toe portions identical to those illustrated for the upper rocker arm 60. The toe portions on the lower rocker arm 66 are also received between apertures defined in the legs 24 and 26.

With the structure thus far described, it should be apparent that an operator can manually depress the key portion 20 of a selected switch assembly and as a consequence, the legs 24 and 26 will be projected downwardly through the slots defined in the mounting board 28. The posts 34 of course will not move but the upper and lower rocker arms 62 and 66 will pivot in the bearing receptacles in the posts and the apertures defined in the legs 24 and 26. As soon as the operator releases the key portion 22, the spring 32 will return the switch assembly to its non-actuated position.

Secured beneath each switch assembly position on the mounting board 28 is a frame 70 defining a longitudinal opening 72 adapted to receive a small bar magnet 74. Mounted on the frame 70 adjacent the bar magnet 74 is a glass envelope 76 including a pair of parallel spaced contacts 78 and 80 formed of some magnetic material. Leads 82 and 84 are electrically connected to the contacts 78 and 80 and extend from the envelope 76.

A magnet carrier 90 defines an upper trough-shaped receptacle 92 receiving a second bar magnet 94. The carrier 90 additionally defines slots 96 which permit it to be slidably received on and between the opposed legs of the U-shaped rocker arm 66.

The magnets 74 and 94 are oppositely oriented and thus when the switch assembly is in its nonactuated position, as represented by switch assembly 16 of FIGURE 2, so that the magnets 74 and 94 are in contact, a substantially zero magnitude magnetic field is defined therebetween and in the region of the contacts 78 and 80. Inasmuch as the magnets 74 and 94 are oppositely oriented a magnetic attraction will be established therebetween. Thus, in attempting to actuate a switch assembly, the magnetic force between the magnets 74 and 94 will exert a force resisting the depression of the key

portion 20. The presence of this force tends to eliminate accidental or spurious switch actuations. Once the key portion 20 is actually depressed however, and the magnets 74 and 94 are pulled apart, the resisting force will be reduced considerably thereby enabling the key portion to be fully depressed with little difficulty.

In addition to the magnets 74 and 94 functioning to introduce an initial resisting force in the key portion 20, separation of the magnets causes a non-zero magnetic field to be developed in the vicinity of the contacts 78 and 80. Inasmuch as the magnetic flux lines will tend to follow the lowest reluctance path available, they will traverse the contacts 78 and 80 thereby urging the contacts into engagement. When the operator releases the key portion 20, the spring 32 will force the switch assembly to the non-actuated position thereby again establishing a zero magnitude magnetic field in the vicinity of the contacts 78 and 80 consequently causing their disengagement.

From the foregoing, it should be appreciated that an improved switch assembly has been provided herein which can be exceedingly reliable, relatively inexpensive, and which is easy and comfortable to operate. Reliability is assured inasmuch as the contacts are enclosed in an envelope and thus kept clean. In addition, inasmuch as the only points of friction in the switch assembly lie in the bearing receptacles in the posts 34 and the apertures in the legs 24 and 26 receiving the toe portions of the U-shaped rocker arms, there is little likelihood of excessive dirt accumulation which would introduce any significant frictional effects. The disclosed switch assembly can be provided at a relative low cost because of the ease with which it can be fabricated. More particularly, because of the simple manner in which the posts 34 can receive the rocker arms and be received in the board 28 and further in view of the simple manner in which the legs 24 and 26 are supported by the rocker arms, the switch assembly can be fabricated inexpensively.

Easy and comfortable operation of the switch assembly is assured inasmuch as the key portion 20 tends to move in a substantially linear, rather than circular, direction since the rocker arms coupling the posts 34 to the legs 24 and 26 form a parallelogram. If the length or throw of the rocker arm legs is considerably longer than the vertical distance which the legs 24 and 26 can move, the legs 24 and 26 will move substantially parallel to the posts 34, i.e. in a vertical direction. The distance which the legs 24 and 26 can move is of course restricted by the key portion and plate abutting. The second factor which facilitates comfortable operation of the switch assembly results from the utilization of the magnets 74 and 94 to create a magnetic attraction force tending to initially resist depression of the key portion. By selecting an appropriate spring 32 which establishes an upward force on the key which is considerably less than the attracting force between the magnets when the magnets are in contact and greater than the magnetic attraction when the magnets are spaced, a detent or break away feel is created which is exceedingly desirable in a keyboard device.

What is claimed is:

1. A switch assembly including:

a mounting plate defining a first pair of openings therein;

a switch actuator having a pair of spaced legs depending therefrom and extending through said openings for limited movement perpendicularly with respect to said plate;

a pair of posts secured to and extending above and below said mounting plate;

at least one link terminally pivoted between each of said posts and one of said legs, said links having a length greater than the limited distance said legs can move.

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2. The switch assembly of claim 1 including spring means urging said switch actuator away from said mounting plate.

3. The switch assembly of claim 2 wherein each of said posts comprises a bifurcated member defining first and second sections, said posts being formed of a material having elastic qualities thus permitting said sections to be pulled away from each other or pushed toward one another; and at least one bearing receptacle defined between opposing surfaces on said first and second sections of each of said posts for receiving one end of said links therein.

4. The switch assembly of claim 3 wherein each of said post sections has a reduced portion defined between spaced shoulders;

said mounting plate defining slots for receiving said posts with portions of said plate projecting into said reduced portions between said shoulders.

5. A switch assembly including:

a mounting plate defining a first pair of openings therein;

a switch actuator having a pair of spaced legs depending therefrom and extending through said openings for limited movement perpendicularly with respect to said plate;

a pair of posts secured to and extending above and below said mounting plate;

each of said posts coupled to a different one of said legs by a pair of upper and lower links, each of said links being terminally pivotally supported between a post and a leg; and

spring means urging said switch actuator away from said mounting plate.

6. A switch assembly including:

a mounting plate defining a first pair of openings therein;

a switch actuator having a pair of spaced legs depending therefrom and extending through said openings for limited movement perpendicularly with respect to said plate;

a pair of posts secured to and extending above and below said mounting plate;

each of said posts defining a bearing receptacle above and below said plate;

upper and lower U-shaped rocker arms each including a bight portion and a pair of leg portions;

said upper and lower rocker arm bight portions being respectively rotatably mounted in said post bearing receptacles above and below said plate;

said depending legs defining apertures therein;

said rocker arm leg portions being terminally rotatably received in said leg apertures, said apertures being positioned so that said upper and lower rocker arm leg portions are parallel;

said rocker arm leg portions having a length greater than the limited distance said legs can move whereby

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said legs will be restricted to movement substantially parallel to said posts.

7. The switch assembly of claim 6 including spring means urging said switch actuator away from said mounting plate.

8. The switch assembly of claim 6 wherein each of said posts comprises a bifurcated member defining first and second sections, said posts being formed of a material having elastic qualities thus permitting said sections to be pulled away from each other or pushed toward one another, said bearing receptacles being defined by opposing surfaces on said first and second sections.

9. The switch assembly of claim 8 wherein each of said post sections has a reduced portion defined between spaced shoulders;

said mounting plate defining slots for receiving said posts with portions of said plate projecting into said reduced portions between said shoulders.

10. The switch assembly of claim 6 including a pair of normally open contacts; and

means responsive to said switch actuator moving for selectively producing a magnetic field for closing said contacts.

11. The switch assembly of claim 10 wherein said means includes first and second magnets;

means securing said first magnet to said switch actuator for movement therewith;

means fixedly mounting said second magnet; and

means urging said switch actuator to a position whereby said first and second magnets cumulatively produce a zero magnitude magnetic field adjacent to said contacts.

12. The switch assembly of claim 11 wherein said first and second magnets are so oriented as to provide a magnetic attraction force therebetween tending to oppose movement of said switch actuator.

13. The switch assembly of claim 11 including a carrier defining a magnet receiving trough; and

means for removably supporting said carrier on said lower rocker arms.

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