

- [54] **PUSHBUTTON SWITCH AND ASSEMBLY**
- [72] Inventor: **Harold B. Chamberlain**, Denver, Colo.
- [73] Assignee: **Hathaway Instruments, Inc.**, Denver, Colo.
- [22] Filed: **Jan. 15, 1971**
- [21] Appl. No.: **106,786**

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*Primary Examiner*—Bernard A. Gilheany  
*Assistant Examiner*—R. N. Envall, Jr.  
*Attorney*—McGrew and Edwards

- [52] U.S. Cl.....335/205
- [51] Int. Cl.....H01h 13/00, H01h 13/14
- [58] Field of Search.....335/205, 206; 235/145; 197/98; 200/168 C

[57] **ABSTRACT**

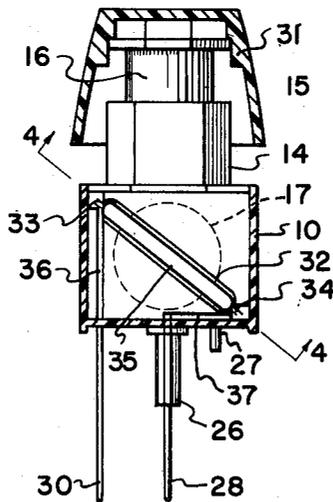
A push button switch having a spring biased slidably movable actuator is provided with a magnetically actuated reed switch of the sealed enclosure type. A permanent magnet is mounted in a cylindrical block rotatably mounted about its periphery in a cylindrical bearing in a fixed block adjacent the actuating slide. The magnet is rotated by a pin on the cylindrical block seated in a lateral slot in the slide. The switch is of a modular design and a plurality of the switches may be physically interlocked and mounted to constitute a keyboard assembly. The switch housings can accommodate integrated circuit components to incorporate features of a full circuit assembly.

[56] **References Cited**

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**7 Claims, 21 Drawing Figures**



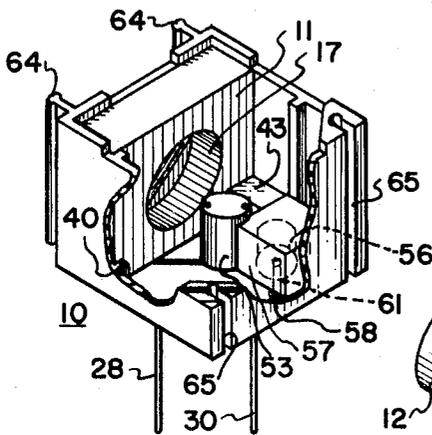
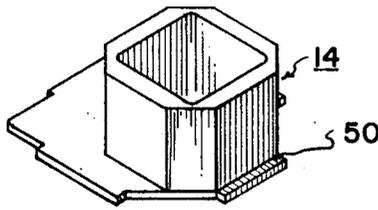


FIG. 1

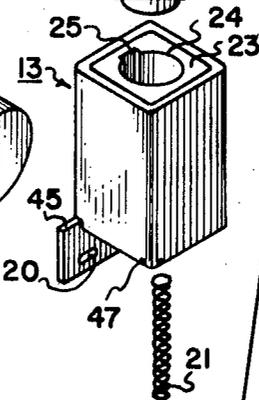
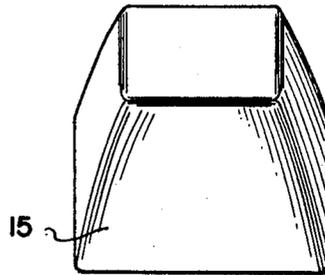


FIG. 2

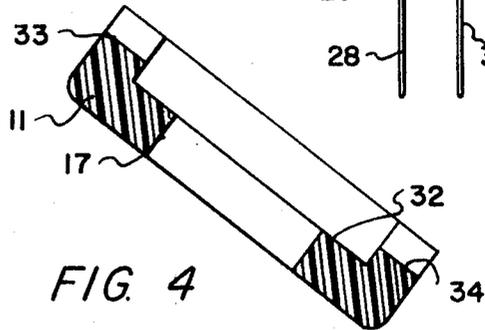
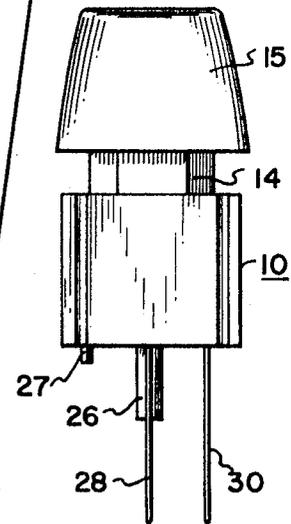


FIG. 4

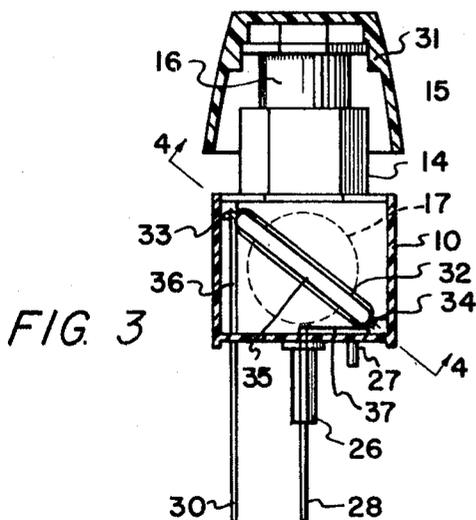


FIG. 3

INVENTOR  
HAROLD B. CHAMBERLAIN  
BY *McGraw-Hill*  
ATTORNEYS

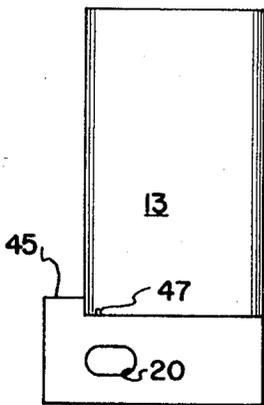
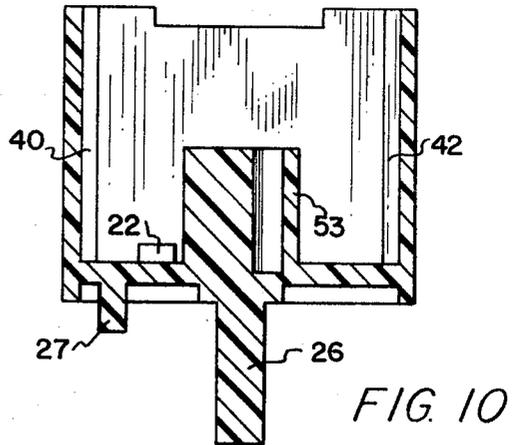
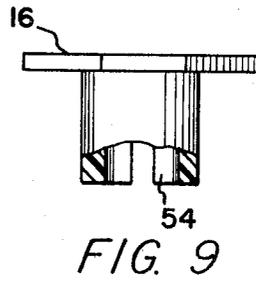
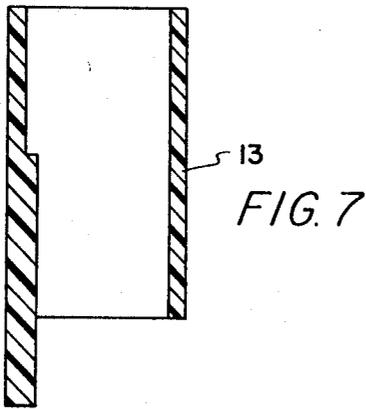
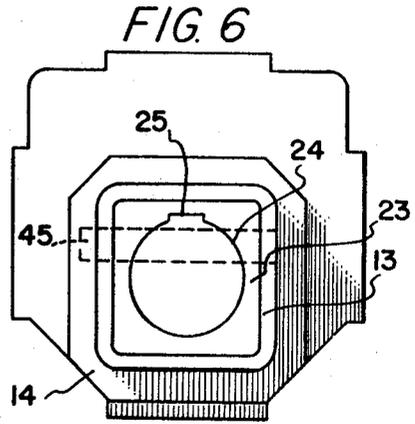
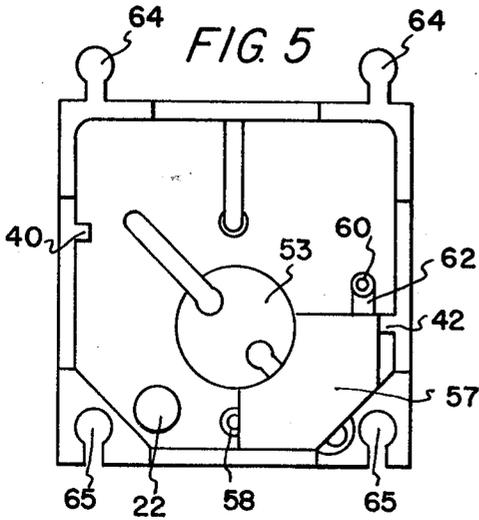


FIG. 8

INVENTOR  
HAROLD B. CHAMBERLAIN  
BY *[Signature]*  
ATTORNEYS

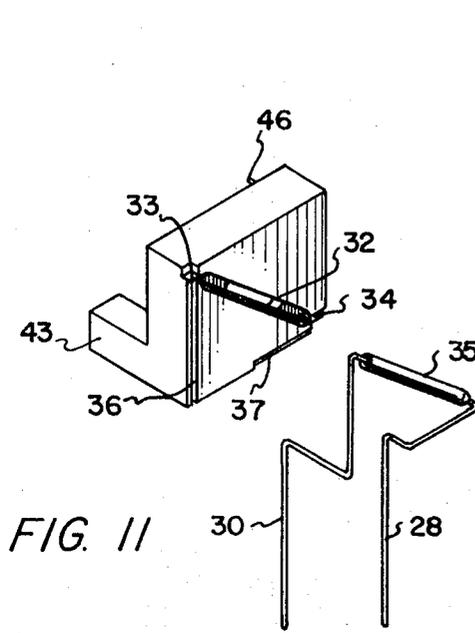


FIG. 11

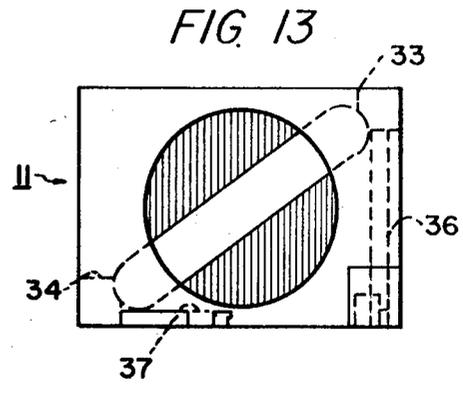


FIG. 13

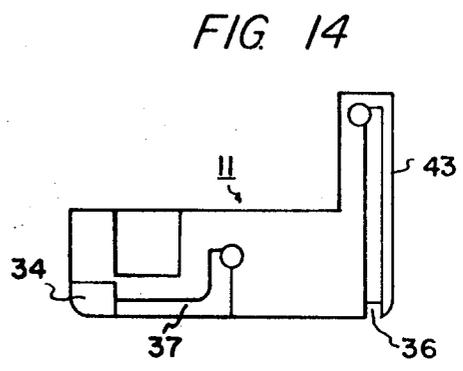


FIG. 14

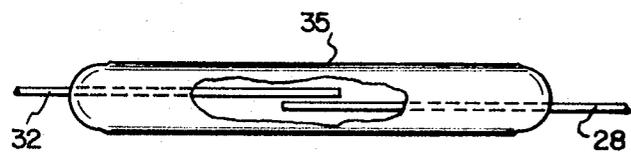


FIG. 12

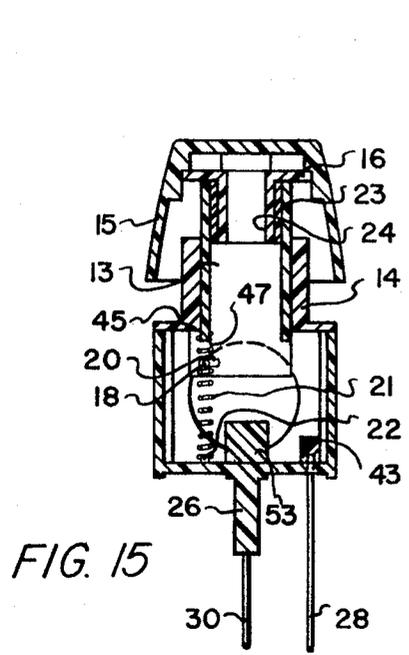


FIG. 15

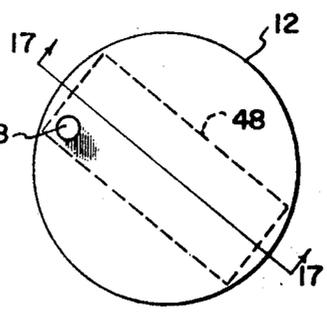


FIG. 16

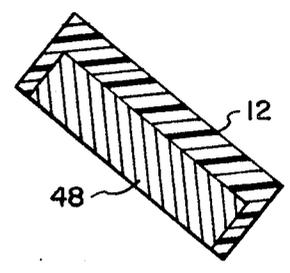


FIG. 17

INVENTOR  
HAROLD B. CHAMBERLAIN  
BY *McBrew & Edwards*  
ATTORNEYS

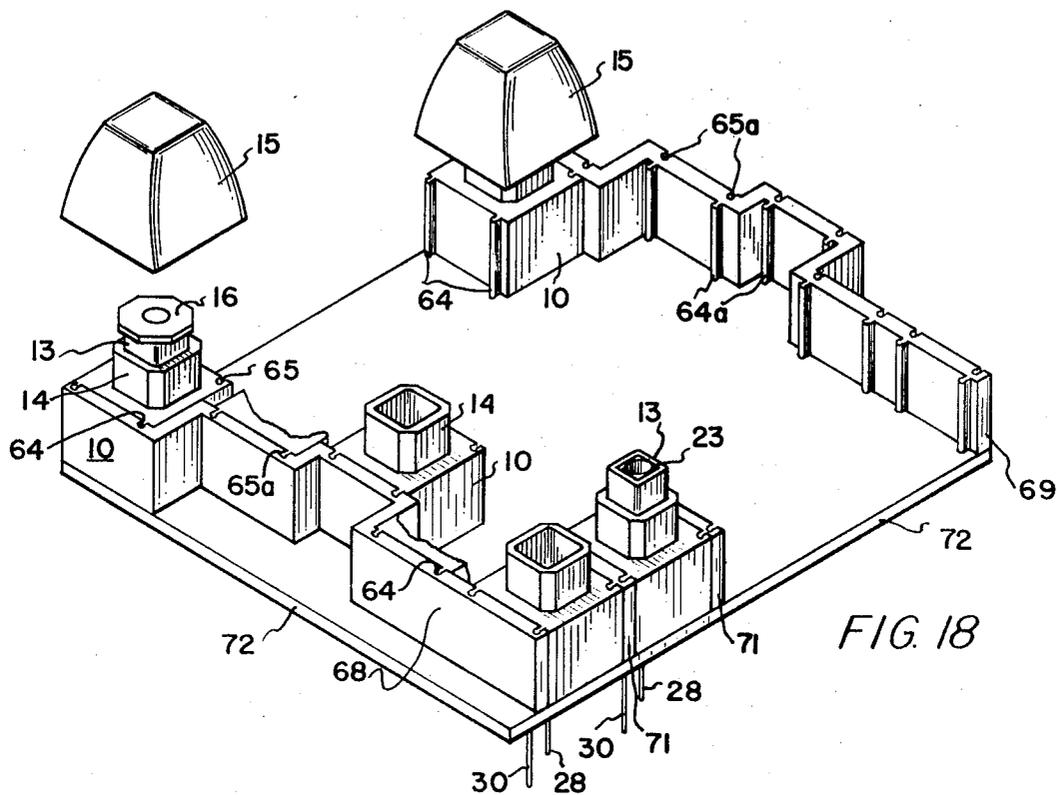


FIG. 18

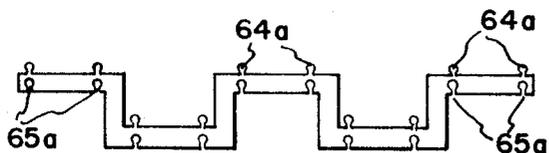


FIG. 19

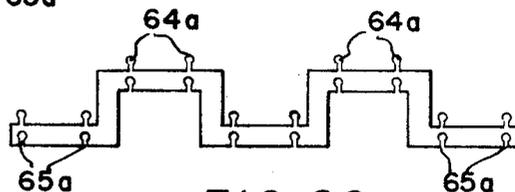


FIG. 20

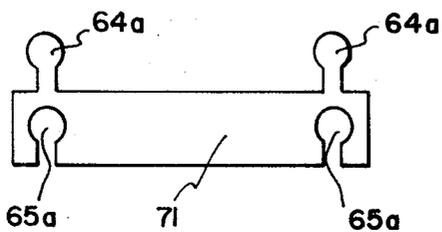


FIG. 21

INVENTOR  
HAROLD B. CHAMBERLAIN

BY *[Signature]*  
ATTORNEYS

**PUSHBUTTON SWITCH AND ASSEMBLY**

The present invention is an improvement on the push button switch disclosed and claimed in a copending application of Dean H. Fox, Ser. No. 91,060, filed Nov. 19, 1970, assigned to the same assignee as the present application.

Light touch push button switches are employed in apparatus such as computer keyboards and several types of these switches have been utilized for this purpose. The above identified Fox application is an example of a switch of this type which is provided with a magnet adjacent a reed switch and a push slide arranged to rotate the magnet through about ninety degrees to change the direction of the field to open the switch in one position and to close it in the other. It is desirable that these switches be as small as possible for flexibility in application and further that the switch activator be simple and reliable and effective for repeated operations over an extended period of time. It is further desirable that a multiplicity of these switches be adapted to assembly in close juxtaposition to provide keyboards for computers and the like. Accordingly, it is an object of this invention to provide an improved, simple, rugged, and reliable push button switch.

It is another object of this invention to provide an improved light touch push button switch of a small or compact construction.

It is another object of this invention to provide an improved push button switch capable of being interlocked in compact assembly in substantial numbers to provide keyboard assemblies and the like.

It is a further object of this invention to provide an improved push button switch of the light touch type, a plurality of which may be assembled to provide a substantially self-supporting keyboard or bank.

Briefly, in carrying out the objects of this invention in one embodiment thereof, a push button switch is provided which comprises a small generally rectangular housing having an open top, an actuating slide extending into the housing and retained by a top enclosure through which the slide assembly protrudes for attachment of the key or button. A sealed enclosure magnetic reed switch is mounted diagonally on one side of the housing in a block which is provided with a cylindrical recess adjacent the reed. A permanent magnet mounted in a drum is rotatable in the recess for actuation by the slide to which it is linked by a pin and slot connection. The housing is provided with complementary slot and bead interlocks on opposite sides whereby a row of the switches may be connected together in a bank; a plurality of such rows may be mounted on a relatively light weight backing board to provide a rigid keyboard assembly, the assembled housings of the switches constituting a structural part of the keyboard assembly.

The features of novelty which characterize this invention are pointed out with particularity in the claims annexed to and forming a part of this specification. The invention itself, however, both as to its organization and manner of operation, together with further objects and advantages thereof, will best be understood by reference to the following description taken in connection with the accompanying drawings in which:

FIG. 1 is an exploded isometric view of a push button switch embodying the invention;

FIG. 2 is a side elevation of the switch of FIG. 1 when assembled;

FIG. 3 is an elevation view, partly in section of the switch of FIG. 2;

FIG. 4 is an enlarged sectional view of the reed switch mounting block taken along the line 4—4 of FIG. 3;

FIG. 5 is a top view of the main housing of the switch;

FIG. 6 is a top plan view of the cover of the switch;

FIG. 7 is a sectional elevation view of the actuating slide of the switch;

FIG. 8 is a right side elevation of the slide shown in FIG. 7;

FIG. 9 is a side elevation view, partly in section, of the button attaching element or adapter;

FIG. 10 is a side elevation view, partly in section, of the housing of FIG. 5;

FIG. 11 is an exploded isometric view of the reed switch and block assembly;

FIG. 12 is a side elevation, partly broken away, of the reed switch element;

FIG. 13 is a front elevation view of the switch support block;

FIG. 14 is a bottom plan view of the block of FIG. 13;

FIG. 15 is a sectional elevation view taken along the center line of the switch assembly;

FIG. 16 is an enlarged front elevation of the magnet cylinder;

FIG. 17 is a sectional view taken along the lines 17—17 of FIG. 16;

FIG. 18 is an isometric view of a keyboard assembly of a multiplicity of switches;

FIGS. 19 and 20 are top plan views of two different modified forms of lateral support members for the keyboard assembly; and

FIG. 21 is a top plan view of a single housing spacer.

Referring now to the drawings, the general configuration and the component parts of the switch of the illustrated embodiment of the invention are shown in FIGS. 1, 2 and 3. The component parts as shown in FIG. 1 comprise a rectangular housing 10 having a removable block 11 therein, a cylindrical magnet member or carrier 12, a slide actuator 13, a cover 14 for the housing, a button or actuating element 15 and an adapter 16 for connecting the button to the slide 13. The magnet member 12 is journaled in a cylindrical bearing 17 in the block 11, and is rotated in the same manner as the magnet of the aforesaid Fox application upon linear movement of the slide by a pin 18 on the member which is engaged in a lateral slot 20 in the slide. The slide 13 is biased upwardly by a spring 21 which is seated on a pin 22 on the bottom of the housing and bears against the slide. The slide is provided with a frictionally held adapter insert 23 having a cylindrical recess 24 with a longitudinal positioning slot 25. The adapter 16 is provided with a cylindrical downward extension which fits in the recess 24 in a position determined by the slot 25 and is held by friction.

The assembled switch appears as shown in FIG. 2 in which a locating pin or extension 26 is shown for locating in a board or panel (not shown) and an orienting or positioning pin 27. The two switch leads, indicated at 28 and 30 extend downwardly from the housing. As shown in FIG. 3 the button 15 has lugs or shoulders 31 for engaging the octagonal top of the adapter 16. This view also shows a diagonal slot 32 in the block 11 which is provided to receive the glass enclosed sealed magnetic reed switch. Extensions of the slot 32 at its ends indicated at 33 and 34 are provided to receive the electric leads from the switch.

A sealed glass envelope magnet reed switch 35 is mounted in the slot 32 and its leads 30 and 28 extend through the end recesses 33 and 34, respectively, and are then bent to lie in slots 36 and 37 and thence pass downwardly and out of the housing 10 through openings provided in the bottom wall thereof.

The reed switch 35 is illustrated in the enlarged view, FIG. 12, which has been broken away to show the contacts in their normally open position. These contacts will close when the magnetic field is aligned with the reeds and will open again when the field is turned transversely of the switch of substantially 90° to its aligned position. The configuration of the block 11 is shown in FIGS. 13 and 14. When the block 11 is to be positioned in the housing 10, the reed switch assembly shown in the lower portion of FIG. 11 is placed in the block, the switch 35 lying in the recess 32, and the leads 28 and 30 extending through the passages 34 and 37 and 33 and 36 respectively; the block is then inserted in the housing 10 by sliding it downwardly along a guide 40 on one side and guide 42 on the other, the guide 42 being engaged by a lower foot or extension 43 on the block 11. The switch may now be assembled, the cylinder 12 first being positioned in the bearing recess 17 and the slide 13 then being placed against the block with a shoulder or stop 45 which engages the bottom of the cap 14 as a stop to limit the upward movement of the slide. When placing the slide in position, the spring 21 is seated on the pin 22 and on an opposite seat 47 formed on the slide. The adapter fitting 23 of the desired length is then mounted within the slide

13 and the cover 14 is placed over the housing with the slide 13 extending into and slidably fitting in the recess of the collar. The adapter 16 is then positioned in the push button cap 15 and inserted in the passage 24 in the adapter 23 and the switch assembly then appears as indicated in the sectional view FIG. 15.

When the slide is in its biased position in the switch assembly, the pin 18 on the magnetic cylinder lies in the slot 20. Thus, when the key or button cap 15 is depressed to move the slide downwardly, the cylinder 12 is rotated in the recess 17 and in the assumed position of the switch and magnet, as illustrated, the magnet is moved from a position out of alignment with the reed switch 35 to a position in alignment therewith, whereupon the switch is held closed.

The housing and the various components thereof are constructed of suitable synthetic plastic materials. The materials of the block 11 and the cylinder 12 are selected to have a low coefficient of friction, so that the cylinder rotates easily within the cylindrical bearing 17. For example, the block 11 may be constructed of acrylonitrile-butadiene-styrene commonly known as ABS, and the rotor may be constructed of nylon. Cylinder 12 is formed to provide a longitudinal slot wherein the magnet indicated at 48 in FIGS. 16 and 17 may be positioned and suitably bonded to the cylinder. It will be observed that the type of operation of the switch may be changed by changing the position of the magnet 48 with respect to the reed switch 35, and while locating the pin 18 to hold the cylinder 12 in a normal upper position, but with the magnet in alignment with the reeds of the switch 35, the switch is converted to a normally closed switch which is opened upon pressing the button 15 to rotate the cylinder 12. The cap 14 has a lower flange 50 which constitutes the covering base for the cap. This flange conforms to the configuration of the top of the housing 10 and may be secured by making it a tight frictional fit or, if desired, it may be cemented in position.

The arrangement of the magnet in the cylinder 12 and the large bearing surface provided about the periphery of the cylinders provides an easy operating mechanism and one which is effectively free from inaccurate or incorrect operation during vibration or jarring of the mechanism. This provides an improved decreasing of undesirable inertial effects and undesired torque forces.

In the event that it is desired to operate the switch to alternate "off" and "on" positions on each depression of the button, a "fly back" action may be employed. For the purpose of simplifying the drawings, this action has not been illustrated as it is not essential to an understanding of the invention. Such "fly back" actions are employed for example in stop watches and are well known for such purposes.

The interior of the housing 10 about the slide 13 provides space affording the mounting therein of an indicator light, by way of example, in a suitable socket 53 formed on the bottom wall of the casing, or alternatively cemented in position on that wall. For purposes of using a pilot light or indicator light in this manner, the button 15 is made of translucent material so that the light which is located directly below the passage 24 in the slide 13 will pass upwardly through the passage and the central opening of the adapter 16, indicated at 54, and will provide a visual indication of the actuation of the push button circuit.

In addition to the indicator light, other components or circuitry such as small integrated circuit units may be arranged within the space provided within the housing 10. Thus, by way of example, a diode 56 potted in a plastic block 57 may be mounted in one corner of the interior of the housing 10, the block 57 being made of a configuration to fit between the foot 43 and the block 11 and the lamp base 53. Openings 58 and 60 are provided in the bottom of the housing so that leads 61 and 62 for the diode may extend from the diode outwardly from block 57 and downwardly through the bottom wall of the housing 10. Diode 56 may be connected in the circuitry associated with the switch 35 in any manner, depending upon the application for which the switch is employed. The diode

may, for example, be applied for the purpose of isolating the output circuit of the switch.

The indicator lamp employed with the switch assembly is preferably replaceable, in which case the cover 14 is made removable to provide ready access to the interior of the switch for such replacement.

The switch as disclosed above may be utilized in banks of switches of like construction and for this purpose the housing 10 is provided with projecting beaded flanges 64 on one sidewall and complementary slots 65 in the opposite sidewall which are of a configuration to fit about flanges 64 of an adjacent switch, the dimensions of the flanges 64 and slot 65 being such as to provide a good frictional engagement for holding adjacent housings in position with respect to one another. It will be apparent from this arrangement that a row or bank of switches may be formed from a selected number of switches by sliding the flanges and slots of the adjacent switches together.

In FIG. 18, the arrangement of switches of this invention in a keyboard is illustrated.

The general arrangement for attaching switches in multiple assemblies is illustrated. For the purposes of assembly, two lateral spacing or frame members 68 and 69 have been illustrated as providing a plurality of offsets of rows of the switches 10. Five switches 10 have been shown as inserted in the five positions available in the end member 68 and additional switches are arranged in longitudinal rows as represented by the first row, wherein two switches have been shown in place and a third in position ready for insertion in the next spacing block of the row. The spacing blocks indicated at 71 are employed between the switches in each row to secure the desired spacing selected with respect to the size of the push button caps 15 which are to be employed. The assembly of the five rows of switches 10 extending between the lateral members 68 and 69 is mounted on a circuit board or other suitable mounting plate 72 and the various electric leads extend downwardly from the switches 10 through holes provided in this plate. Furthermore, each of the switches is provided with the positioning lug 27 and locating pin 26 and suitable openings are provided in the plate to accommodate these lugs and pins. Each row of switches 10, including the spacers 71 provides a substantially rigid bar or beam and the plate 72 may be of very light construction as it is not required to carry the entire load of the assembled switches. The plate 72 is, of course, carried on whatever supporting structure is provided in the particular computer or other apparatus with which the keyboard is to be employed. Obviously, various other offset arrangements of the lateral members or end pieces 68 and 69 may be employed, depending upon the desired relative arrangement of the keys 15, the different forms illustrated in FIGS. 18, 19 and 20 are presented merely by way of example, the bead flanges and complementary slots of FIGS. 19 and 20 being indicated as 64a and 65a, respectively. The single spacers 71 are of a construction illustrated in FIG. 21, each spacer being a simple rectangular block, having attaching bead flanges as indicated at 64a and complementary slots 65a on the opposite sides of the spacer. It will be apparent that the rectangular configuration of the switches 10 provides a simple and effective arrangement for building up a circuit board in the manner indicated in FIG. 18. The compact construction of the switch, including the diagonal arrangement and mounting of the switches 35 makes it possible to provide a so-called "low silhouette" switch construction. At the same time, by utilizing extension members 23 of greater length, the height of the switch assembly may be selected as desired.

I claim:

1. A push button switch comprising:
  - a housing,
  - a cylindrical rotor, and a support member therefor, means for removably positioning said support member in said housing,
  - said member having a cylindrical bearing for receiving said rotor,

a reed-type switch and means for mounting said switch adjacent said bearing,  
 a permanent magnet carried by said rotor and having its poles in a line substantially parallel to a diameter thereof and adjacent said switch,  
 a slide movable transversely of said bearing in a plane adjacent said support member,  
 an eccentric pin on said rotor,  
 said slide having a slot therein transverse to its direction of movement and positioned to receive said pin for rotating said rotor upon linear movement of said slide,  
 a cover for said housing having an opening for access to said slide,  
 means for biasing said slide toward said cover, and  
 push button means aligned with said opening for moving said slide against the force of said biasing means to rotate said magnet for actuating said switch.  
 2. A push button switch as set forth in claim 1 wherein said support member comprises a block of nonmagnetic material, and said housing includes guides for positioning said block

therein.

3. A push button switch as set forth in claim 2 wherein said block is of flat generally rectangular configuration and said guides position said block adjacent one inside wall of said housing and wherein said switch is positioned between said block and said wall.

4. A push button switch as set forth in claim 2 wherein said slide moves in a path substantially parallel to the inner face of said block and said switch is mounted diagonally of said block.

5. A push button switch as set forth in claim 2 wherein said block and said rotor are constructed of synthetic plastic materials having a low coefficient of friction.

6. A push button switch as set forth in claim 2 wherein said block is of rectangular configuration and has flat faces and including a slot formed in said block adjacent the inner wall of said housing for receiving said reed switch.

7. A push button switch as set forth in claim 6 wherein said slot extends diagonally of the rectangular face of said block.

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