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MAGNETIC SWITCHING DEVICE

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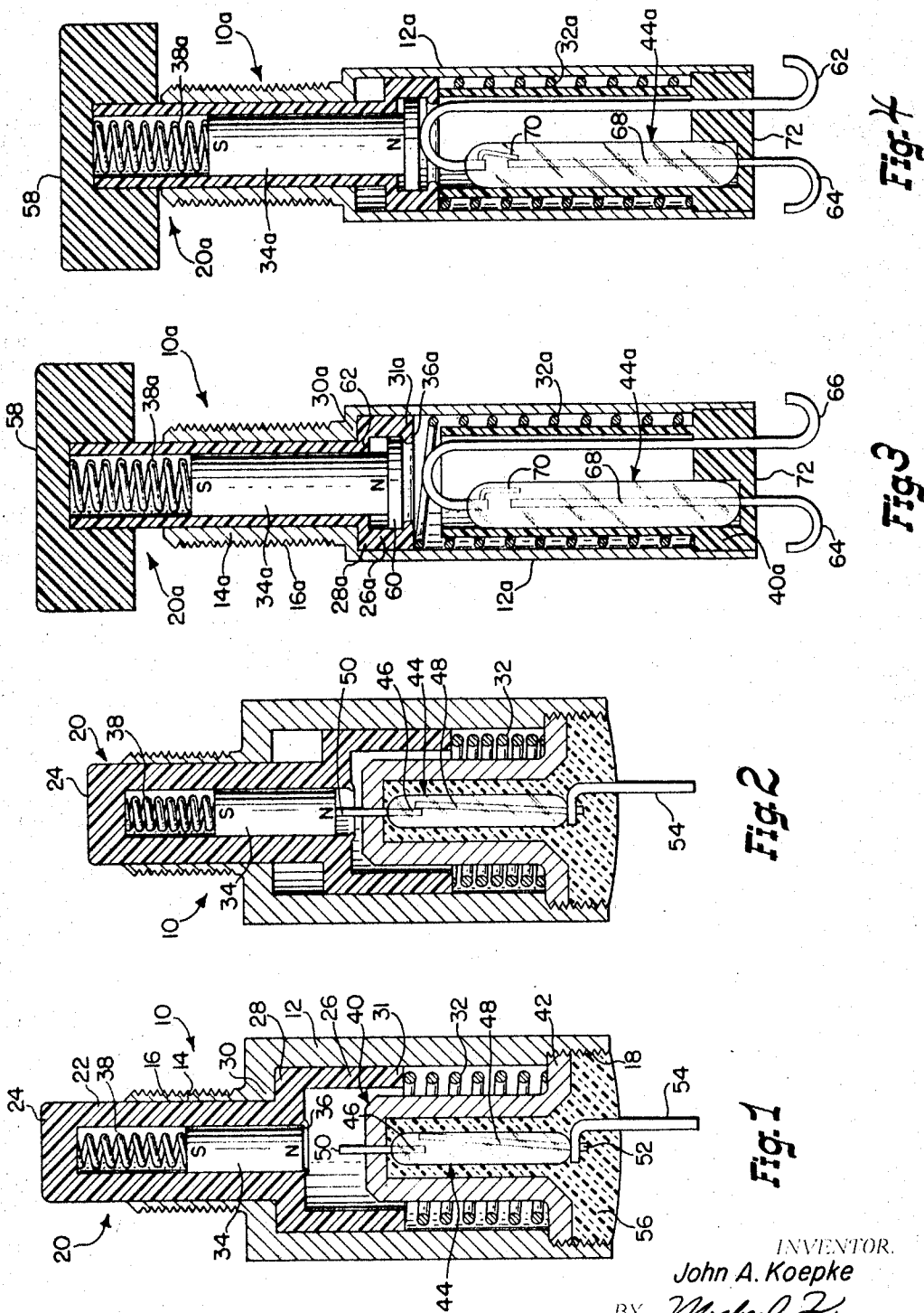


Fig. 2

Fig. 1

Fig. 4

Fig. 3

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MAGNETIC SWITCHING DEVICE

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8 Claims

ABSTRACT OF THE DISCLOSURE

A magnetic switching device including a push button operated reed switch wherein a magnet carried by the push button is arranged in a predetermined magnetic relationship relative to the reed switch.

Reed switches incorporating reed elements are capable of millions of operations without failure, and thus are used for a wide variety of end uses. The reed switch can be controlled either through permanent magnets or through an electrical coil. In many situations, the permanent magnet controlled reed switch device is preferable for compact, inexpensive switch applications, and is to this type of switching device that the present invention is directed. Specifically, the present invention is directed to a novel form of push button actuated reed switch device as will be discussed in detail below.

It is one object of the present invention to provide a new and improved push button reed switch device.

Another object of the present invention is to provide a push button reed switch device wherein a predetermined magnetic relationship is established between a magnet carried by the push button relative to the magnetically responsive reed elements of the reed switch.

A further object of the present invention is the provision of a push button reed switch device which, in addition to the above, is compact, reliable, highly sensitive, capable of being protected from high pressure environmental uses, and is otherwise well adapted for the purposes intended.

These and other objects and advantages of the present invention are attained by the provision of a magnetic switching device comprising a housing, a hollow elongated push button slidably mounted at one end of the housing and including first biasing means associated therewith which normally urges the outer end of the push button outwardly of the housing for engagement and depression thereof by a user against the first biasing means, a longitudinally aligned bar magnet mounted within the hollow push button and having second biasing means associated therewith which normally urges the bar magnet toward the inner end of the push button, a reed switch mounted at the other end of the casing in spaced relationship to the push button, the reed switch including coacting reed elements each having a terminal means which is externally disposed of the reed switch, one of the terminal means being arranged relative to the elongated push button for engagement by the exposed magnetic pole of the bar magnet carried by the push button upon depression and movement of the push button toward the reed switch, whereby the coacting reed elements are magnetically responsive to each other for opening and closing a circuit with which the magnetic switching device is associated, the bar magnets being moved against the force of the second biasing means upon engagement with one of the terminal means to permit over travel movement of the push button relative to the reed switch.

Reference is now made to the drawings wherein:

FIG. 1 is a fragmentary sectional view of a push button

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reed switch device constructed in accordance with the teachings of the present invention;

FIG. 2 is a fragmentary sectional view of the switch device shown in FIG. 1, but illustrating the manner in which the reed elements of the normally open reed switch are brought into contact with one another upon actuation and depression of the push button;

FIG. 3 is a sectional view of a modified form of push button switch device constructed in accordance with the teachings of the present invention; and

FIG. 4 is a sectional view of the switch device shown in FIG. 3, and depicting the actuation of the push button which causes the closing of the magnetic circuit by the contacting engagement of the reed elements associated with the reed switch.

Two forms of push button reed switch devices are shown in the drawings, and reference will first be made to the FIGS. 1-2 embodiment, and the differences of the FIGS. 3-4 embodiment will be compared therewith.

As shown in FIGS. 1-2, the push button reed switch device 10 includes a cylindrical hollow housing 12 which encloses the various elements of the push button reed switch device 10. An upstanding collar 14 is provided at the upper end of the housing 12, and this collar is externally threaded at 16 to receive a nut or ferrule (not shown) for mounting the push button reed switch device 10 relative to an apertured supporting panel or the like. The housing 12 further includes an internally threaded portion 18 at the lower end thereof which cooperates with the other elements of the push button switch device as will be described.

An elongated hollow push button 20 is disposed within the housing 12 and includes an elongated finger depressible section 22 which extends upwardly through the annular collar 14 to position the upper end 24 of the push button a sufficient distance above the annular collar 14 for engagement and depression thereof as will be presently described. The push button 20 further includes an enlarged annular foot section 26 thereby forming at the juncture of the finger depressible section 22, an external shoulder or flange 28 which cooperates with the internal shoulder or flange 30 of the housing 12 in limiting upper or outward movement of the push button 20 in a manner which will be apparent. The lower end 31 of the hollow push button 20 is adapted to engage a coil spring 32 or other equivalent biasing means which normally urges the push button 20 to the position shown in FIG. 1 of the drawing.

The push button 20 further includes a bar magnet 34 which is positioned within the hollow portion of the finger depressible section 22 at the lower end thereof. Downward movement of the bar magnet 34 is restricted by the inwardly directed shoulder 36. The bar magnet 34 is normally urged in a downward direction, as viewed in FIG. 1 of the drawing, by the coil spring 38 which is trapped between the bar magnet 34 and the upper end 24 of the finger depressible section 22. The coil spring or other equivalent biasing means will provide over travel movement of the push button 20 as the bar magnet 34 is brought into engagement with an exposed terminal of the reed switch as will be described. It is to be noted that the bar magnet 34 is of the type which provides opposite magnetic poles at opposite ends thereof, and for the discussion that is to follow, the lower exposed pole of the magnet will be designated as a north pole and the upper pole will be designated as a south pole. It will be recognized, however, that this magnetic pole relationship may be reversed without affecting the functioning of the push button reed switch device as shall become apparent.

The lower end of the housing 12 receives a hollow casing 40 which provides a number of functions. In the first place, the hollow casing 40 includes an enlarged ex-

ternally threaded flange 42 which mates with the internal thread 18 of the housing 12 to position the casing as shown in FIG. 1 of the drawing. Secondly, the flange 42 serves as the lower stop for the coil spring 32 which is trapped between it and the lower end 31 of the hollow push button 20. In this manner, the coil spring 32 or other equivalent biasing means is capable of being trapped as illustrated to normally urge the push button 20 outwardly of the housing 12 for engagement and depression thereof by a user in operating the switch device.

Several other important features can be attributed to the hollow casing 40. It will be noted that the hollow portion of the casing 40 receives the reed switch 44 which comprises an elongated envelope of glass or other insulated material having a pair of magnetic contact reeds 46, 48, at least one of which is resilient, the reed contacts 46, 48 being integrally connected respectively to the exposed terminals 50, 52 of the reed switch. The upper exposed terminal 50 extends through the upper or top panel of the hollow casing 40 and is disposed for engagement by the exposed magnetic north pole of the bar magnet 34. The lower terminal 52 is connected to an L-shaped terminal connector 54 which projects outwardly from the lower end of the casing 12. It will be noted that while the reed switch 44 is vertically positioned by the hollow casing 40, there is still a circumferential space about the reed switch 44 to permit the introduction of an epoxy sealing compound 56 for surrounding the reed switch 44 and the hollow casing 40 as well as providing a support for the terminal connector 54. The epoxy sealing compound is designed to protect and seal the reed switch against environmental forces such as pressure and the like within prescribed specifications.

The operation of the push button reed switch device 10 will be apparent from a comparison of FIGS. 1 and 2 of the drawings. The push button switch device 10 is operated by compressing the upper end 24 of the push button 20 against the force of the coil spring 32 to position the bar magnet into engagement with the terminal 50. When this occurs, as seen in FIG. 2, the bar magnet 34 will be moved against the force of the coil spring 38, thereby permitting the bar magnet to continue providing the same amount of magnetic flux to the terminal 50, and at the same time enabling the push button 20 to over travel relative to the other elements of the push button switch device. In this way, continued magnetic flux will be established through the bar magnet and the terminal 50 without disrupting or damaging the mounting of the terminal 50 relative to the glass envelope of the reed switch 44. In this respect, it is to be noted that the coil spring 38 has a spring rate which will attain these particular objectives.

As the flux of the permanent bar magnet 34 is transmitted through the terminal 50, it will cause a magnetically responsive relationship to be established between the magnetic contacts 46, 48 to move the latter into contact with the former. This will complete an electrical circuit through the reed switch 44, the terminal connector 54 and the conductor (not shown) connected therewith, the other conductor (not shown) being connected to the housing 12 which is formed from an electrically conductive metal which carries the current to the terminal 50 through the electrically conductive metal casing 40. When the push button 20 is released, the magnet 34 will be returned from the position shown in the FIG. 2 to that shown in FIG. 1 where, because of its magnetic strength and position relative to the terminal 50, will no longer have any magnetic influence upon the magnetic contact reed 46, 48 of the reed switch 44. This will, of course, open the circuit with which the push button reed switch device 10 is associated it is subsequently operated in the manner just described.

Reference is now made to FIGS. 3-4 of the drawing for a description of the other illustrated embodiment of the present invention. Since the FIGS. 3-4 embodiment is generally similar to the FIGS. 1-2 embodiment, like ref-

erence numerals will be employed with the suffix *a* used to designate like or corresponding parts of the FIGS. 1-2 embodiment.

It will be noted that many of the corresponding or like parts shown in the FIGS. 3-4 embodiment are substantially elongated as compared with the FIGS. 1-2 embodiment. At the upper end of the pushbutton 20a, there is provided a snap on cap 58 which provides an enlarged finger portion for the push button 20a. The cap 58 also serves to trap the coil spring 38a between it and the bar magnet 34a. It will be noted that the bar magnet 34a is provided with an enlarged foot 60 at the lower north pole thereof which is trapped between the inwardly directed shoulder 36a at the lower end of the push button 20a and a second inwardly directed shoulder 62 spaced upwardly therefrom to limit the vertical movement of the bar magnet 34a.

It will be noted that the hollow casing 40a and the reed switch 44a are substantially modified as compared with the FIGS. 1-2 embodiment. The hollow casing 40a, in the FIGS. 3-4 embodiment, also functions as a lower stop for the coil spring 32a as well as a support for the reed switch 44a, and additionally closes the end of the push button reed switch device 10a to protect the glass envelope of the reed switch 44a from shock or damage. Further, the hollow casing 40a comprises an insulating rather than electrically conductive member as in the FIGS. 1-2 embodiment.

The reed switch 44a includes a pair of terminal elements 64, 66 which project from the lower end of the push button reed switch device 10a, which terminal elements are integrally connected to the reed contacts of the reed switch 44a. Specifically, the terminal element 64 is integrally connected to the rigid or inflexible reed contact 68 while the terminal element 66 is integrally connected to the resilient or flexible reed contact 70. The terminal elements 64, 66 are adapted to be projected through complementary apertures formed in the base 72 of the hollow casing 48, the base 72 also having an opening of sufficient size to receive the glass envelope portion of the reed switch 44a as illustrated. The terminal element 64, 66 of the reed switch 44a thus aid in vertically positioning the reed in the manner illustrated in the drawing.

It will be noted that each of the terminal elements 64, 66 have a reversely curved lower end to facilitate the attachment of wire conductors thereto, while the upper end of the terminal element 66 also is reversely curving to provide an abutment surface in line with the magnet 34a. This will permit the magnet 34a to be brought into contact with the upper reversely curved portion of the terminal element 66 to introduce magnetic flux therethrough to cause the flexible finger 70 to move from FIG. 3 to FIG. 4 position in opening and closing a circuit with which the push button switch device is to be associated.

The operation and functioning of the push button reed switch device 10a shown in the FIGS. 3-4 embodiment is generally the same as discussed in connection with the FIGS. 1-2 embodiment. Depression of the push button 20a through the enlarged cap 58 will position the lower north magnetic pole of the magnet 34a into contact with the reversely curving upper portion of the terminal element 66 associated with the reed switch 44a to introduce magnetic flux therethrough, and thereby cause the movement of the flexible reed contact 70 from the position shown in FIG. 3 to that shown in FIG. 4. Over travel movement of the push button 20a relative to the reed switch 44a is also provided as the result of the compression of the coil spring 38a, although the movement is somewhat restricted in view of the inwardly directed shoulder 36a, 62 associated with the push button 20a. In all other respects, however, the operation and functioning of the push button reed switch device 10a is similar to that described in connection with the FIGS. 1-2 embodiment.

From the foregoing, it will now be appreciated that the present invention contemplates a unique push button reed switch device which attains the objects of the invention.

While the preferred embodiments of this invention have been shown and described herein, it is obvious that many structural details may be changed without departing from the spirit and scope of the appended claims.

I claim:

1. A magnetic switching device comprising a housing, a hollow elongated push button slidably mounted at one end of said housing and including first biasing means associated therewith normally urging the outer end of said push button outwardly of said housing for engagement and depression thereof by a user against said first biasing means, a longitudinally aligned bar magnet mounted within the hollow push button and having second biasing means associated therewith normally urging said bar magnet toward the inner end of said push button, a reed switch mounted at the other end of said casing in spaced relationship to said push button, said reed switch including coacting reed elements each having a terminal means externally disposed of the reed switch, one of said terminal means being arranged relative to the elongated push button for engagement by the exposed magnetic pole of the bar magnet carried thereby upon depression and movement of the push button toward the reed switch, whereby the coacting reed elements are magnetically responsive to each other for opening and closing an electrical circuit with which the magnetic switch device is associated, the bar magnet being moved against the force of the second biasing means upon engagement with one of said terminal means to permit overtravel movement of said push button relative to said reed switch.

2. The magnetic switching device as defined in claim 1 wherein said first and second biasing means each comprises a coil spring.

3. The magnetic switching device as defined in claim 1

wherein said second biasing means has a substantially lower spring rate than said first biasing means.

4. The reed switch as defined in claim 1 wherein the reed switch is mounted within a hollow casing received by said housing at an end opposite said push button, said reed switch being disposed within and connected to said casing, and means associated with said casing to protect the reed switch from pressure differentials.

5. The reed switch as defined in claim 4 wherein said last mentioned means comprises an integral cover device associated with the casing.

6. The switch as defined in claim 4 wherein said last mentioned means comprises a setting compound which encapsulates the reed switch within the hollow casing.

7. The switch as defined in claim 1 wherein the one terminal means positioned for magnetic influence from the push button carried bar magnet is reversely bent back upon itself for the full height of the reed switch device, said reversely bent portion of the terminal element serving to position and maintain the reed switch in upright position within the switching device.

8. The switch device as defined in claim 7 wherein the reversely bent portion of the exposed terminal means associated with one of the reed elements is resiliently biased away from the reed switch to aid in securing the reed switch in proper position within the switching device.

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