May 13, 1969 G. W. E. NIEUWHOF 3,444,493

MAGNETICALLY OPERATED REED SWITCH ASSEMBLY

Filed Aug. 29, 1966

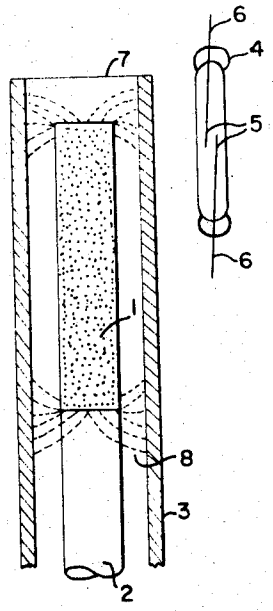


FIG. 1

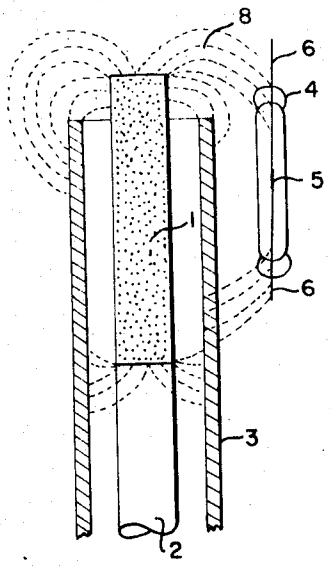


FIG. 2

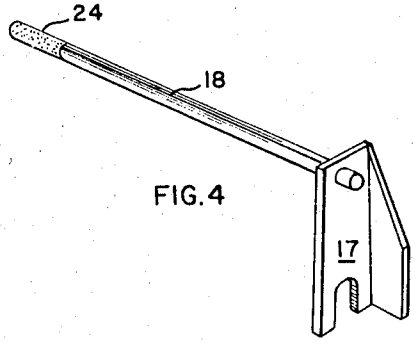


FIG. 4

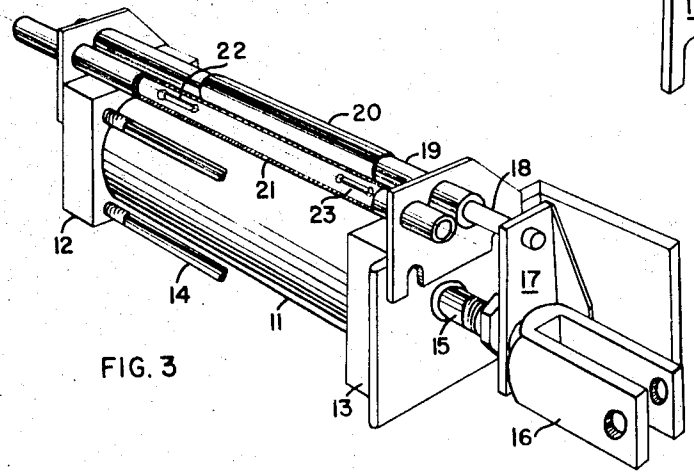


FIG. 3

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United States Patent Office 3,444,493 Patented May 13, 1969

3,444,493

MAGNETICALLY OPERATED REED SWITCH ASSEMBLY

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Filed Aug. 29, 1966, Ser. No. 575,686
Int. Cl. H01h 51/28, 1/66, 9/02
U.S. Cl. 335—206 1 Claim

ABSTRACT OF THE DISCLOSURE

A magnet operated reed switch wherein a permanent magnet on the end of a slidable rod within a ferromagnetic shield tube is arranged to close the contacts of one or other of two reed switches positioned adjacent each end of the tube, when the magnet is exposed at the end of the shield tube adjacent the appropriate reed switch. The slidable rod would be connected to the mechanism whose travel is to be limited e.g., a piston in a hydraulic cylinder and the length of the shield tube would be of such length as to allow the switching action of the reed switches to occur at the desired position of travel of the slidable rod.

This invention relates to magnetic switching apparatus and more particularly to a method and apparatus using magnetic reed switches as limit switches.

Limit switches for controlling moving mechanisms are in widespread use and the standard device used for this operation is the small relay or micro-switch. These devices are satisfactory for many applications but being basically mechanical devices are subject to break-down and malfunctioning. There are many applications especially in the nuclear reactor field where it would be most desirable to have a switch mechanism for controlling operating mechanism that has a much higher reliability factor than present devices especially the micro-switch.

It is therefore an object of the present invention to provide a switching mechanism that is rugged, inexpensive, and most particularly, reliable to a very high degree.

It is another object of the invention to provide a switching mechanism that has a very small reset travel distance of the switch.

It is another object of the invention to provide a switching mechanism that can be readily employed to sense quite accurately a position of a mechanical part through the wall of a pressurized system.

Applicant has found that these and other objects of the invention may be achieved by using a magnetic reed switch as the switching device and operating this reed switch by means of a magnet connected to the operating mechanism and moveable inside a shielding tube such that when the magnet is inside the shielding tube the reed switch is open and when the magnet protrudes beyond the end of the shielding tube the reed switch contacts will close. It has been found that a very small movement of the protruding magnet will result in a relatively large change in the magnetic field strength in the location of the reed switch.

In drawings which illustrate an embodiment of the invention:

FIGURE 1 is a cross section of the switching device in idealized form showing the magnet and the reed switch in the open or non-operative state,

FIGURE 2 is a cross section similar to that of FIGURE 1 but with the magnet protruding from the shield tube and the reed switch in the closed or operative state,

FIGURE 3 is a view partially broken showing a limit switch arrangement for a hydraulic cylinder, and

FIGURE 4 is a view of the magnet operating device of FIGURE 3.

Referring to FIGURE 1 a permanent magnet **1** is fixed on the end of a rod **2** which would be connected to the mechanism the motion of which it is wished to control. The magnet is positioned, e.g. cemented in position with epoxy resin, inside a shielding tube **3** having an open end **7** adjacent a magnetic reed switch **4** having reed contacts **5** and end leads **6**. In the position shown the magnetic flux **8** of the magnet is contained by the shield tube **3** and little or no flux passes through the reed switch. In FIGURE 2 the magnet protrudes beyond the end of shield tube **3** and in this case some of the lines of magnetic flux **8** pass through the reed switch **4** causing the contacts **5** to close. End leads **6** would be suitably connected to external electro-mechanical operating devices (not shown) for stopping the movement of rod **2**. Because the reed switch is closed at a relatively precise position of the magnet **1** as it comes out of the end of the shield tube **3**, it will be seen that a switch device that may be employed as a limit switch is achieved. This arrangement provides a high rate of change of magnetic field strength in the neighbourhood of the reed switch which gives the desirable small reset travel of the switch.

FIGURE 3 shows the device of FIGURES 1 and 2 adapted to an actual working device in this case a hydraulic or pneumatic cylinder **11** having end plates **12** and **13** and tie rods **14**. Piston rod **15** is connected to yoke **16** which in turn would be connected to a mechanism to be operated. A bracket **17** attached between piston rod **15** and yoke **16** carries a pushrod **18** on the end of which is fixed a permanent magnet **24** (see FIGURE 4). Pushrod **18** works inside a tube **19** mounted on brackets on end plates **12** and **13**. A shielding tube **20** encircles tube **19** for a predetermined portion of its length. A second tube **21** is mounted adjacent and parallel to tube **19**. Reed switches **22** and **23** are mounted inside tube **21** at predetermined locations and would be connected by end leads (not shown) to external circuits and operating devices. The length of shield tube **20** and the location of the two reed switches are chosen such that the reed switches will operate at the desired position in its travel of the magnet **24**, push rod **18** and thus piston rod **15**.

Tubes **19** and **21** are made of non-magnetic material, for example, copper. Shielding tube **20** is made of a ferromagnetic material. In an actual device built this tube was a split tube formed from a sheet of transformer plate.

The arrangement of FIGURE 3 is by way of example only. Other limit switch arrangements using the invention will readily suggest themselves. Reed switches having very reliable operating characteristics are readily available commercially. These rugged devices make the present invention adaptable to many conditions where the standard limit switches might not give the necessary performance and reliability.

The permanent magnet described above might be replaced by an electro-magnetic device such as a coil wound on a core but this would require the use of a power source for energization which would probably make its use less attractive than the permanent magnet.

What is claimed is:

1. Magnetic switching apparatus for limiting the reciprocal travel between first and second relatively moving mechanical components comprising:

(a) a first magnetic reed switch having normally open contacts connected to said first component at a first location,

(b) a second magnetic reed switch connected to said first component at a second location,

(c) a shielding tube made of magnetic material fixed to said first component and having its open ends positioned adjacent said first and second reed switches, and

(d) a permanent magnet attached by means of an extended member to said second component, said magnet adapted to travel within said shielding tube on relative motion between said components,

(e) the location of said reed switches and the length of said shielding tube being chosen such that the said magnet will protrude alternately from the ends of the said shielding tube to cause the contacts of the respective switches to close abruptly at the predetermined limits of reciprocal motion between the said components.

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