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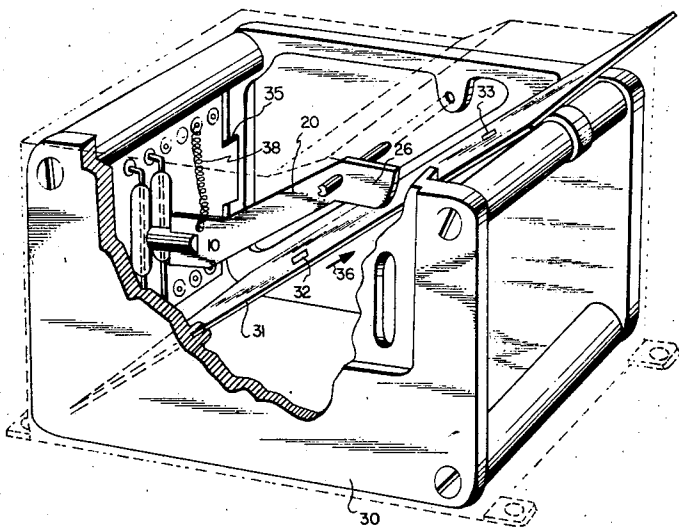
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Primary Examiner—Robert K. Schaefer
Assistant Examiner—H. J. Hohausner
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[54] **DIGITALLY OPERABLE MAGNETIC REED SWITCHES**
2 Claims, 4 Drawing Figs.

[52] U.S. Cl..... **200/46,**
335/205, 235/61.114
[51] Int. Cl..... **H01h 43/08**
[50] Field of Search..... **200/46;**
235/61.114; 335/205, 206, 207

[56] **References Cited**
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3,430,200 2/1969 Barney 200/46

ABSTRACT: A magnetic reed switch is operated in a digital switching mode with one state established by positioning a magnet at a stable position which holds the contacts open by passing equal magnetic flux components through the two reeds in opposite sense from one pole face of a longitudinal permanent magnet positioned adjacent the overlap region of the reeds. As the magnet is moved slightly from its stable position the switch contacts close. In one embodiment holes in punched card documents are used to move the magnetic field enough to produce on-off digital switching signals. In such applications mechanical linkages provide amplification of movements to assure a digital switching action by moving the magnetic field between two defined stable states.



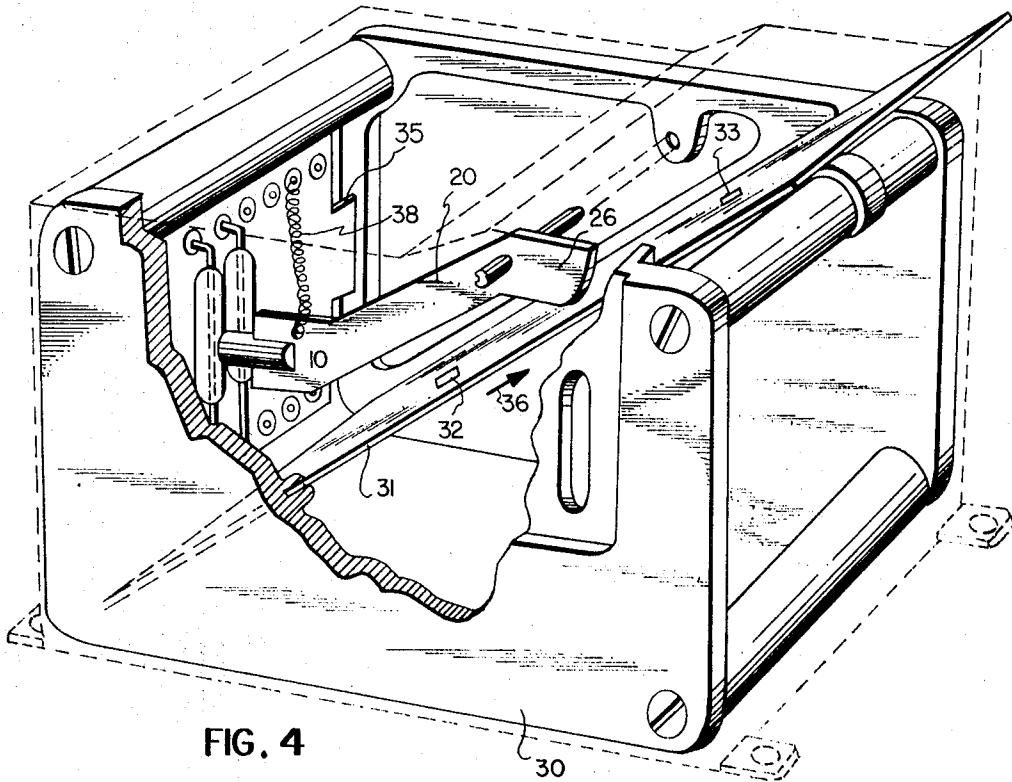


FIG. 4

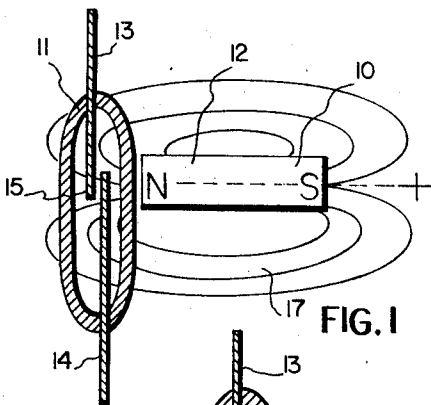


FIG. 1

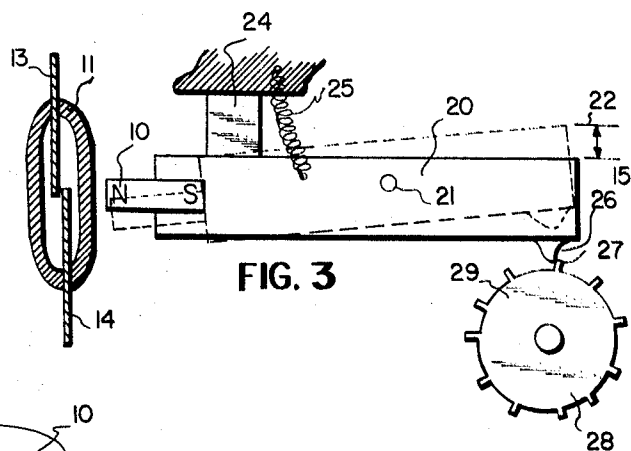


FIG. 3

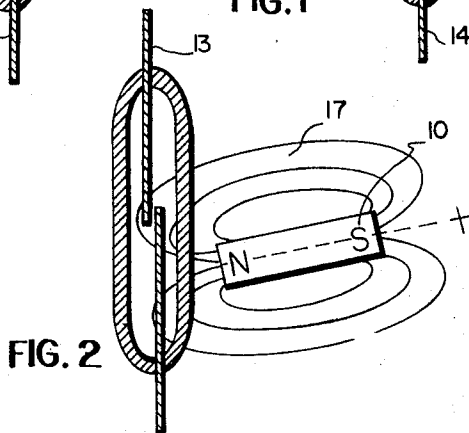


FIG. 2

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DIGITALLY OPERABLE MAGNETIC REED SWITCHES

This application deals in general with switching devices, and in particular, relates to operation of magnetically actuated reed switches by changes of a magnetic field, generally provided by a permanent magnet which might be moved about a known path near the reeds.

Various modes of operation are used to provide operation of magnetic glass reed switches by a magnetic field. Examples of these switches operable as key switch configuration are found in my U.S. Pat. No. 3,251,962. Other applications for position sensing include that for sensing tape loops as found in my U.S. Pat. No. 3,358,199. These switches are also operated in relay form by solenoid generated magnetic fields as shown in my U.S. Pat. No. 3,389,308. In some of these and other prior art modes of operation switching is attained by analog movements of magnets alongside reed switches. The variations of manufacturing tolerances such as magnetic field strength, reed position, etc. tend to make such switches nonuniform and uncertain in operation at any particular position. Expensive adjustments need be made for critical applications in many of these devices.

A particular mode of operation is described in my U.S. Pat. No. 3,233,061 wherein a permanent magnet is placed axially alongside the switch and is pivoted relative to the reed axis. While this mode of operation provides a definite set of conditions for on-off switching, the switches cannot be conveniently placed side-by-side without danger of interference, and a considerable extent of motion is required for switching operation.

Accordingly, it is a general object of this invention to provide an improved digital on-off mode of operation with magnetic reed switches.

A more specific object of the invention is to provide a switch sensitive to very small changes of position of the magnetic field.

Another object of the invention is to provide magnetic switches which may be located closely alongside each other without interference.

Another object of the invention is to provide position sensing means providing digital signals in response to changes of position of the order of magnitude of the thickness of holes in a punched card document or the like.

Therefore, in accordance with this invention there is provided a digital mode of operation for magnetic reed switches by placing one magnetic pole of an axial magnet in a stable position adjacent the overlapped faces of planar blade members to produce substantially equal and opposite magnetic flux in the two reeds, thereby holding the reeds open and providing for closure with slight movements away from the stable position tending to unbalance the magnetic flux in the two reeds. One embodiment of the invention comprises a digital reader for a plurality of adjacent columns on punched card documents, to sense changes in the thickness of the card as a punched aperture appears to thereby provide reliable digital switching signals.

These and further features and objectives of the invention will be recognized by reference to the following more detailed description of the invention and the accompanying drawing, in which:

FIG. 1 is a schematic sketch in plan view of a reed switch in its null position with contacts open,

FIG. 2 is a schematic sketch in plan view of a reed switch in its operated position with contacts closed,

FIG. 3 is a schematic sketch in elevation view of a displacement sensing embodiment of the invention, and

FIG. 4 is a perspective view of a punched card document reader configuration afforded by the invention.

It may be seen from FIG. 1 that a permanent magnet 10, having an axial field is positioned alongside glass reed switch 11 so that its axis 12 is substantially normal the generally longitudinal axis of the two reed switch blades 13 and 14 with the N pole facing the blades 13 and 14 at the overlap region 15 to

provide a flux path 17 which flows substantially equally and oppositely in sense through the respective switch blades 13 and 14 to thereby hold them open in a zero or null position. The blades 13 and 14 are shown in edge view with their blades extending into the drawing and with faces disposed toward the open end face of the N pole of magnet 10.

From FIG. 2 it is seen that a slight movement of magnet 10, such as by pivoting or transverse motion of pole N will unbalance the flux field 17 portion flowing into the two switch blades enough to cause the reed contacts to close. This mode of operation becomes much more sensitive to slight changes in magnetic field configuration than other modes of operation which generally rely upon an analog motion of sufficient magnitude to assure a change in switch position.

In FIG. 3 the magnet 10 is carried by lever 20, which is pivoted about axis 21, so that a small displacement 22 such as 0.015 inches will serve by the amplification of the moment of the pivot arm to provide a movement of the magnet say in the order of 0.060 inches, to reliably assure a digital on-off action in the reed switch contacts 13, 14. A stop 24 or other suitable mounting means may be provided to include spring 25 for example, thereby holding the magnet 10 and switch 11 in a stable null position whenever the pivot sensing arm member 26 is not engaging the projections 27 on cam wheel 28 which in this embodiment serves as positioning means. The stop 24 may be alternatively replaced by the wheel surface portions 29 if desired, which retain the magnet 10 in a stable position at null whenever projections 27 are not displacing the sensing member 26.

This principle is used in connection with the punched document reader embodiment of FIG. 4. Thus, a case 30 is provided for processing a punched card document 31 with a plurality of columns of punched codes, 32, 33 past the sensing arms 26' of a plurality of side-by-side levers 20', each of which carry magnets 10 to face blades of side-by-side switches 11 on printed circuit card 35. If the card is scanned as shown by arrow 36, a set of digital signals is provided in the manner described in connection with FIG. 3. The card surface may serve as a rest for the pivot arm 20' which has sensor member 26' forced into apertures by spring bias member 38. The card may be backed up by a plate member (not shown) if desired to retain the switches in a known stable position when no cards are present. It is noted apertures can be coded with either closed or open switch positions merely by positioning of the overlap positions of reed switches 11 in appropriate positions adjacent the open face pole of cylindrical magnets 10.

The nature of the invention is defined in the foregoing description, and those features of novelty believed descriptive of the spirit of the invention are set forth with particularity in the appended claims.

What is claimed is:

1. Switching apparatus sensitive to changes of magnetic field configuration to provide an on-off type digital signal, comprising in combination,

a reed switch having a pair of magnetically responsive planar blade members held in generally axial alignment with faces overlapping in a region providing freedom of movement between the blades to open and close electrical contacts between the two blades,

means providing in a stable position an axial magnet with one pole directed substantially normally to the generally axial alignment of said reeds and disposed toward the faces of said blades at the overlap region to provide magnetic flux in such intensity and so balanced between said blades to open the electrical contact between the two blades,

means reorienting said magnet to unbalance the flux in said blades enough to close the electrical contact between the blades, wherein the means reorienting said magnet comprises a permanent magnet and movable pivoted lever carrying said magnet, thereby responsive to a small physical pivoting displacement to unbalance the flux provided in said stable position and including punched document

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processing means, wherein the pivoted lever is positioned to sense apertures in a punched document and is so proportioned to move the switch contacts from open to closed position in response to presence and absence of punched code positions in said punched documents.

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2. Apparatus as defined in claim 1, wherein the punched documents have side-by-side coded columns of punched apertures independently sensed by different ones of said magnetic means carried on a set of side-by-side pivoted levers.

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