

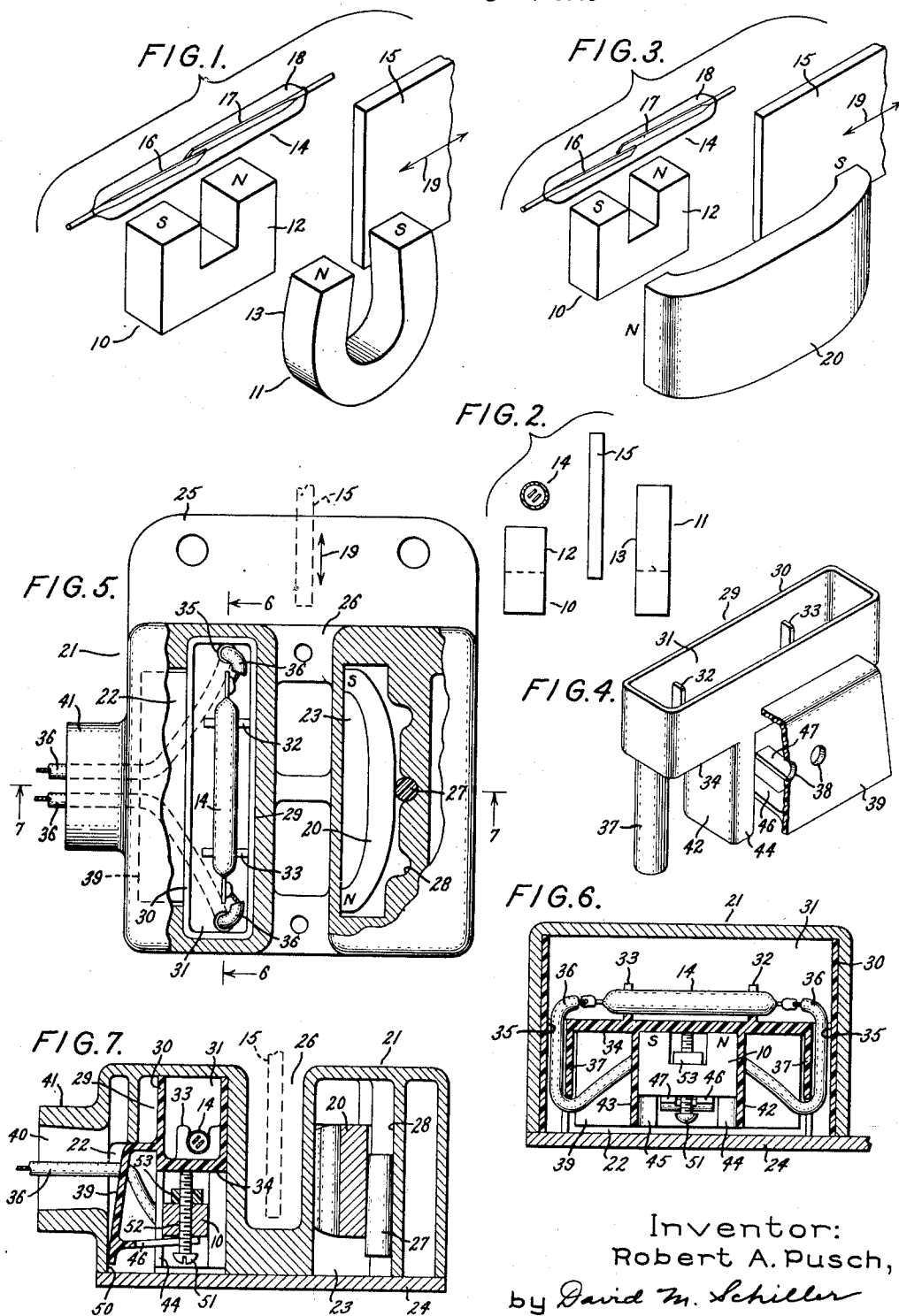
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VANE OPERATED MAGNETIC REED SWITCH

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VANE OPERATED MAGNETIC REED SWITCH
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This invention relates to switches and has particular relation to limit switches of the magnetic vane-operated type.

Switches of the magnetic vane-operated type have previously been constructed to include magnetic flux producing means and a magnetic reed switch positioned in the path of the magnetic flux. The reed switch is operated in response to movement of a magnetic vane relative to the reed switch and relative to the magnetic flux, and the vane is effective in response to arrival at a point in its path of travel to alter the magnetic flux pattern sufficiently for operating the reed switch.

Switches of the type described have been widely employed as limit switches wherein the switch is operated in response to arrival of a movable device, such as an elevator car, at a particular point in its path of travel to effect a control function. The magnetic vane is ordinarily carried by the elevator car, and it can be appreciated that movements of passengers and/or loads in the car can cause the magnetic vane to be shifted out of its original path of travel so as to assume a path different from and substantially parallel to the original path. Vane-operated switches of previous design have been sensitive to such vane shifting and have undesirably operated in response to arrival of the leading edge of the vane at different points along its various paths of travel other than at an activation plane perpendicular to the paths of vane travel. In addition, shifting of the vane in dimensions perpendicular to the axis of vane travel while the car is stopped has heretofore resulted in operations of the switch. In many installations such erratic operation of the switch cannot be tolerated, and it is highly desirable that operation of the switch be insensitive to vane shifting and that the switch operate only in response to arrival of the leading edge of the vane at a particular activation plane, regardless of the direction and amount of shift of the vane out of its original path of travel.

It is therefore a primary object of the invention to provide a novel and improved magnetic vane-operated switch which operates only in response to arrival of the leading edge of the vane at a particular activation plane perpendicular to a number of possible paths of vane travel regardless of which of such paths is assumed by the vane.

It is another object of the invention to provide an improved magnetic vane-operated switch which includes a magnetic reed switch positioned with respect to a magnetic field such that operation of the reed switch in response to movement of a magnetic vane through the field is insensitive to positions of the leading edge of the vane other than at a particular activation plane perpendicular to paths along which the vane travels.

In one form of the invention the vane-operated switch includes a magnetic reed switch as the switching element. Conventionally, such reed switches include a pair of elongated flexible magnetic contacts having overlapping ends which are spaced from each other in a direction perpendicular to the direction of elongation of the contacts. These contacts are normally sealed in a glass container with ends of the contacts projecting outside the container to serve as terminals. The reed switch is positioned relative to a pair of spaced, generally U-shaped permanent magnets so as to be located adjacent one of the magnets externally of the magnetic field established between the magnets.

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In the preferred form the two magnets are of different strength and are positioned in spaced relation such that the pole faces of the stronger magnet face the side faces of the weaker magnet. The magnets are arranged with opposite poles of the two magnets adjacent each other such that a magnetic field is established in the space between the magnets which defines a continuous loop and which creates a force of attraction between the magnets. The reed switch is positioned adjacent the pole faces of the weaker magnet outside the magnetic field such that a negligible amount of magnetic flux traverses the magnetic contacts of the reed switch in the absence of a magnetic vane between the magnets. The contacts of the reed switch are therefore normally open, and such contacts will be closed in response to passage of the magnetic vane into the space between the two magnets.

With the described arrangement the reed switch will be closed in response to arrival of the leading edge of the vane at a particular activation plane perpendicular to the axis of vane travel regardless of which one of a number of parallel axes the vane travels along. In other words, the vane can approach the activation plane along an axis which is closer to one magnet or along another axis which is closer to the other magnet, and the reed switch will be closed only when the vane arrives at the activation plane regardless of which of these axes the vane travels along.

Desirable operational characteristics may be provided by adjusting the reed switch relative to its associated magnet. To illustrate this, the position of the activation plane which is perpendicular to the path of vane travel may be varied by adjustment of the flux traversing the reed switch from the weaker magnet. In addition, the differential between the two points along the path of vane travel at which the reed switch closes and opens may be adjusted by rotating the reed switch about its axis to a selected position.

The permanent magnets and reed switch are mounted within a nonmagnetic housing formed to provide a passage between the magnets through which the vane is adapted to travel. The housing is arranged so that the vane may approach the space between the magnets from a plurality of different directions as desired. The reed switch and the weaker magnet are supported by a plastic mounting member which is secured within the housing. The plastic mounting member includes a part which supports the weaker magnet, and such magnet is conveniently mounted for adjustment relative to the reed switch so as to permit variation of the spacing therebetween.

Other objects and advantages of the invention will become apparent from the following description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a diagrammatic representation with parts shown in perspective of one embodiment of the vane-operated switch;

FIG. 2 is a diagrammatic representation in end elevation of the switch of FIG. 1;

FIG. 3 is a diagrammatic representation with parts shown in perspective of another embodiment of the invention;

FIG. 4 is a perspective view with a part broken away of a member for mounting the reed switch and one magnet of the switch;

FIG. 5 is a view in top plan of the switch with parts shown in section and with parts broken away showing in particular the mounting member of FIG. 4 within the switch housing;

FIG. 6 is a view in section taken along the line 6—6 of FIG. 5; and

FIG. 7 is a view in section taken along the line 7—7 of FIG. 5.

Referring now to the drawings there is diagrammatically represented in FIG. 1 one embodiment of the vane-operated switch of the present invention. The switch includes a pair of magnetic flux producing members shown in the form of a pair of permanent magnets 10 and 11, each of generally U-shaped configuration and having north poles and south poles designated respectively by the letters N and S adjacent the pole faces. The pole faces of each magnet lie in a common plane, and it is noted with reference to FIG. 2 that the plane of the pole faces of magnet 10 is somewhat lower than the plane containing the pole faces of magnet 11. It is understood that electromagnet devices may be utilized in place of permanent magnets if desired.

In the illustrated embodiment magnets 10 and 11 are positioned in a pair of spaced parallel planes with the poles of the magnets of opposite polarity generally opposed to each other. The poles of the magnet 10 are spaced in a direction generally parallel to the direction of spacing of the poles of the magnet 11 and generally perpendicular to the direction of spacing of the magnets. The pole faces of each magnet are in a common plane with these planes being parallel to each other and parallel to the direction of spacing of the magnets. With such an arrangement magnetic flux emanating from the north poles of magnets 10 and 11 passes across the space between the magnets to the adjacent south poles of the magnets 10 and 11, and magnetic flux also travels between the side faces 12 and 13 of the magnets 10 and 11. The magnetic field so established between the magnets 10 and 11 creates a force of attraction between such magnets.

According to the present invention, a magnetic reed switch is associated with one of the permanent magnets so as to be located externally of the magnetic field established between the magnets. The magnets 10 and 11 are of different sizes and establish magnetic fields of different strengths, the magnet 10 being the weaker of the two magnets, and the reed switch 14 is positioned above the poles of the magnet 10 as best shown in FIG. 2. As will presently appear, the reed switch 14 and magnet 10 are positioned such that the switch 14 is in a normally open condition in the absence of a magnetic vane 15 of iron or steel in the space between the permanent magnets, and is closed in response to passage of the vane 15 into the space between the magnets.

The reed switch 14 may be of any suitable construction and is illustrated as comprising a pair of elongated magnetic flexible contacts 16 and 17 extending along parallel axes with their ends overlapping and spaced in a direction perpendicular to such axes. The contacts 16 and 17 are sealed within a glass tube 18, and when magnetic flux is passed through the contacts 16 and 17, they are attracted to each other and their overlapping ends engage. The magnetic vane 15 is shown in FIG. 1 positioned for movement in opposite directions along an axis passing between the permanent magnets parallel to the planes defined by the pole faces of the magnets. When the vane 15 is positioned externally of the space between the magnets, the contacts 16 and 17 are open inasmuch as negligible magnetic flux traverses the contacts from the magnet 10, such flux being attracted to the magnet 11.

It has been observed that by positioning the reed switch 14 externally of the magnetic field established between the magnets 10 and 11, very desirable operating characteristics of the switch may be realized. In vane-operated switches heretofore constructed which include magnetic reed switches, undesirable operating characteristics have been obtained in that the reed switch is operated at different points along the axis of vane travel depending upon which of a number of parallel axes the vane travels along. The vane-operated switch of the present invention avoids such undesirable performance and provides operation of the reed switch only in dependence upon the arrival of the leading edge of the vane at a plane perpendicular to

the axis of travel of the vane regardless of which one of a plurality of parallel axes the vane travels along. Such desirable operation is realized by locating the reed switch outside of the magnetic field wherein the influence of the magnetic contacts upon the activating flux pattern of the field is minimized.

To illustrate the operation of the switch shown in FIG. 1 let it be assumed that the vane 15 is reciprocable along a horizontal axis represented by the double headed arrow 19, and that the vane 15 is positioned externally of the space between the magnets and is moving toward the magnets as viewed in FIG. 1 or toward the observer as viewed in FIG. 2. The contacts 16 and 17 of the reed switch 14 are normally open inasmuch as substantially all of the magnetic flux from the magnet 10 is attracted to the magnet 11 with very little flux from the magnet 10 traversing the contacts 16 and 17. When the vane 15 arrives at a selected point in its path of travel intermediate the magnets 10 and 11, sufficient flux from the magnet 11 is shunted by the vane to substantially eliminate the attractive force of the magnet 11 on flux from magnet 10 which allows flux from the magnet 10 to traverse the contacts 16 and 17 of the reed switch 14. When this occurs the contacts 16 and 17 are closed. Very little magnetic flux from the magnet 10 traverses the vane 15 for the reason that the magnet 10 is spaced further from the vane than from the reed switch 14, whereby substantially all of the flux from magnet 10 traverses the contacts of the reed switch. By positioning the switch 14 externally of the field between the magnets 10 and 11 according to the present invention, closure of the switch 14 is entirely independent of the lateral and vertical positions of the vane 15 as viewed in FIG. 2, and occurs only when the leading edge of the vane arrives at a particular activation plane which is perpendicular to the axis of vane travel regardless of which of a number of parallel axes the vane travels along.

In FIG. 3 there is illustrated a further embodiment of the invention, and parts shown in FIG. 3 which are similar to parts shown in FIG. 1 are represented by the same reference numerals. The embodiment of FIG. 3 differs from that of FIG. 1 in the configuration of the magnet 20 corresponding to the magnet 11 of FIG. 1. The magnet 20 of FIG. 3 is of generally U-shaped configuration and includes a pair of short legs connected by an elongated base section. The legs terminate in north and south magnetic poles which are positioned to face the side face 12 of the magnet 10 such that the resulting magnetic field between the magnets creates a force of attraction therebetween. It is noted that the pole faces of the magnet 10 are in a plane generally parallel to the direction of spacing of the magnets and generally perpendicular to the plane of the pole faces of the magnet 20. Operation of the switch shown in FIG. 3 is similar to that previously described for the switch of FIG. 1.

The vane-operated switches of FIGS. 1 and 3 are adapted to be mounted in suitable housings and a housing for mounting the switch shown in FIG. 3 will now be described. Referring now to FIG. 5 there is illustrated in top plan a housing designed to mount all parts of either one of the switches of FIGS. 1 and 3. The housing comprises a body 21 formed of a suitable nonmagnetic material and having a pair of spaced pockets 22 and 23 which open at the bottom of the body as viewed in FIGS. 6 and 7. The body 21 is attached to a base plate 24 which closes the open ends of the pockets 22 and 23, and which includes a portion 25 having openings through which suitable securing means may extend to be attached to a mounting structure for securing the switch to such structure.

The magnets 10 and 20 are adapted to be positioned within the pockets 22 and 23 respectively in the manner shown in FIGS. 5-7. The body 21 is formed with a slot 26 intermediate the two pockets which slot is proportioned to permit the passage of the vane therethrough.

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As best shown in FIGS. 5 and 7 the magnet 20 is positioned within the pocket 23 and is retained therein in a wedged condition by means of one or more pins 27 preferably formed a plastic material and which fit within recesses 28 formed in a sidewall of the pocket 23. The magnet 10 and reed switch 14 are supported within the pocket 22 by a mounting member 29 shown in detail in FIG. 4 and preferably formed of a flexible plastic material. The member 29 includes a box-like portion 30 having a cavity 31 containing a pair of longitudinally spaced recessed parts 32 and 33 adapted to support the switch 14. The base 34 of the box portion 30 includes a pair of openings 35 (see FIGS. 5 and 6) at each end thereof through which extend wires 36 connected to the terminals of the switch 14. These wires extend through parallel hollow legs 37 extending from the base 34 of the box portion 30, and from the legs 37 through a pair of spaced openings 38 in a wall 39 movably attached to a side of the box portion and normally biased away from the plane of such side. The wires 36 are led through the openings 38 and through a passage 40 in an extension 41 forming an integral part of a side of the body 21.

In order to support the magnet 10, the member 29 includes a pair of spaced legs 42 and 43 depending from the base 34 of the box portion and having respectively turned flanges 44 and 45 forming channels in which edges of the magnet 10 are adapted to seat. The inner surface of wall 39 carries a pair of spaced projections 46 and 47 which extend outwardly therefrom beneath the base 34 of the box portion to engage the bottom surface of the magnet 10 when such magnet is positioned within the channels formed by the flanges of legs 42 and 43. When the member 29 is operatively positioned with respect to the body 21, the relative positions of the parts are as shown in FIG. 7, wherein the wall 39 is pressed inwardly toward the legs 42 and 43 so that the projections 46 and 47 extend through the space between the legs 42 and 43 into engagement with the lower surface of the magnet 10. The lower portion of the wall 39 engages an inner side surface 50 of the body 21. Prior to the insertion of the member 29 into the pocket 22, the reed switch 30 and the wires 36 are drawn through the legs 37 and the openings 38. The member 29 may be secured within the pocket 22 in any suitable manner such as by a staking operation.

In the switch of the present invention the position of the activation plane along the axis of vane travel may be readily adjusted. Such adjustment includes a magnetic screw 51 formed of iron or steel which extends loosely through an opening 52 formed in the magnet 10 into threaded engagement with a piece 53 preferably formed of plastic and positioned captive between the legs of the magnet 10. The magnetic screw 51 operates to shunt magnetic flux between the poles of the magnet 10 away from the reed switch 14. It can be appreciated that as the screw is rotated to extend a greater portion of its end out of the piece 53, a greater portion of the magnetic flux will be shunted between the poles, and a correspondingly smaller portion of flux will traverse the contacts 16 and 17 of the reed switch. Rotation of screw 51 in a direction to move it upwardly to the point at which the end of the screw engages the base 34 of the box portion operates as a fine adjustment, and thereafter, rotation of screw 51 in the same direction affords a coarse adjustment in that such rotation is effective to displace the magnet 10 downwardly as viewed in FIG. 7 with respect to the reed switch 14.

When the vane 15 is moved between the magnets to a point wherein the switch 14 is closed, a certain amount of movement of the vane 15 in the reverse direction is required to again cause the contacts 16 and 17 to open. The differential between the two points along the path of travel of the vane 15 at which the switch 14 is opened and closed may be readily varied by rota-

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tion of the switch 14 about its axis. The effect of rotating the switch 14 about its axis is to vary the point at which the contacts 16 and 17 will open in response to reverse movement of the vane 15, and a maximum differential between the opening and closing points is realized when the switch 14 is rotated to a position wherein a minimum area of material of the contacts 16 and 17 is exposed for receiving flux from the magnet 10. Conversely, a minimum differential between the opening and closing points is obtained by rotating the switch 14 to a position wherein a maximum area of material of the contacts 16 and 17 is exposed to receive flux from the magnet 10.

While I have shown and described a particular embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from my invention in its broader aspects and I, therefore, intend in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a vane-operated switch, a nonmagnetic housing formed with a pair of spaced pockets opening at a common side of the housing and a slot between the pockets, a pair of generally U-shaped permanent magnets each having magnetic poles of opposite polarity and exhibiting different pole strengths, the stronger one of said magnets being mounted within one of said pockets with its pole faces facing said slot, a mounting member including an open box portion having a base and a flexible leg spaced from the base, said mounting member being positioned within the other of said pockets with the box portion opening away from the open end of the associated pocket and with the flexible leg spaced from the base towards the open end of the associated pocket, the weaker one of said magnets being positioned between said leg and said base with its pole faces facing said base, the poles of the two magnets being relatively disposed to establish a magnetic field in the slot creating a force of attraction between the magnets, a magnetic switch within said box portion including a pair of elongated, overlapping magnetic contacts extending substantially in the direction of spacing of the poles of the weaker magnet, said magnetic switch being positioned externally of the magnetic field so that substantially no magnetic flux traverses the contacts whereby the contacts are normally open in the absence of a magnetic vane in said slot, said contacts being closed by mutual attraction in response to passage of magnetic flux from the weaker magnet through the contacts resulting from passage of the vane through the slot, and means attached to the housing closing the open ends of said pockets.

2. In a vane-operated switch, a pair of magnetic flux producing devices each having spaced magnetic poles of opposite polarity, one of said devices exhibiting a greater pole strength than the other of said devices, said devices being positioned in spaced relation with the poles of one device generally opposed to dissimilar poles of the other device such that a magnetic field is established between the devices which creates a force of attraction between the devices, the pole faces of each device defining a plane and the weaker device having a side face generally perpendicular to the plane of its pole faces, said devices being positioned with the planes of their pole faces extending generally perpendicular to each other, and with the plane of the pole faces of the stronger device extending generally parallel to and facing a plane including the side face of the weaker device, the plane of the pole faces of the weaker device being generally parallel to the direction of spacing of the devices, and a magnetic switch including a pair of elongated, overlapping magnetic contacts; said contacts being closed by mutual attraction in response to the passage of a mag-

netic flux component therethrough in the direction of elongation, said magnetic switch being positioned externally of the magnetic field adjacent to and facing the pole faces of the weaker device such that its contacts are normally open and extend substantially in the direction of spacing of the poles of the weaker device, said devices being spaced sufficiently to allow the passage of a magnetic vane therebetween, said contacts being closed in response to passage of magnetic flux therethrough from said weaker device resulting from passage of the vane between the devices.

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