June 10, 1952 D. H. MacDONALD ET AL 2,600,309

FLOW-RESPONSIVE ELECTRICAL SWITCH-MEANS

Filed Feb. 14, 1950 2 SHEETS—SHEET 1

Fig. 1.

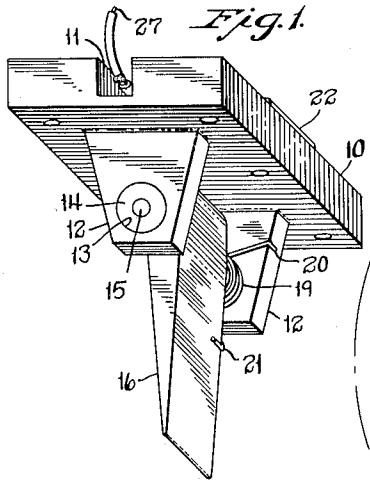


Fig. 2.

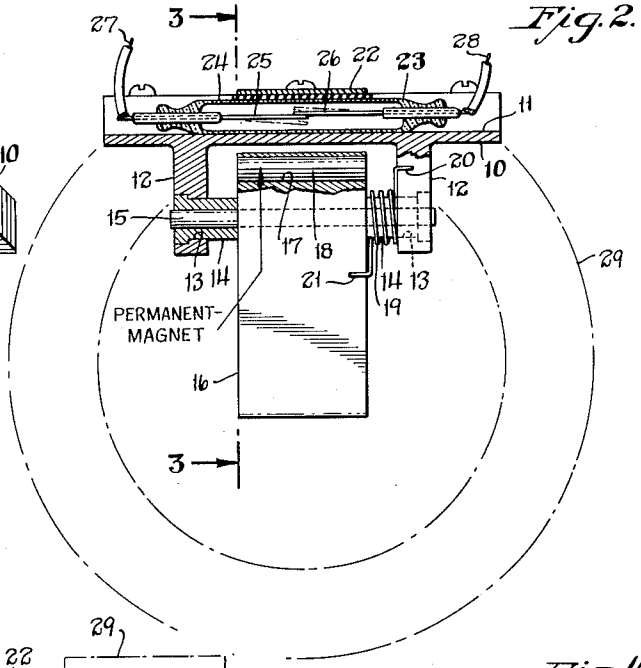


Fig. 3.

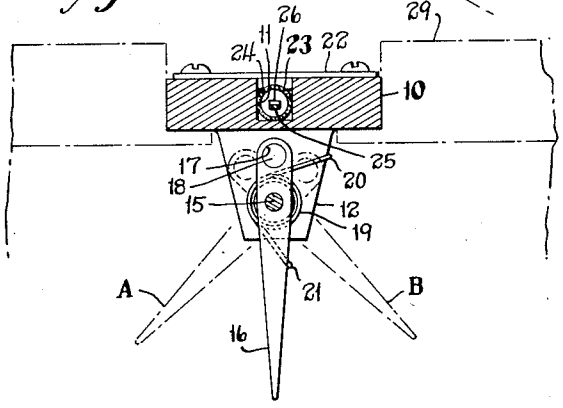


Fig. 4.

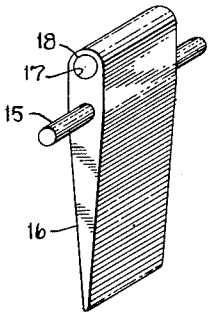
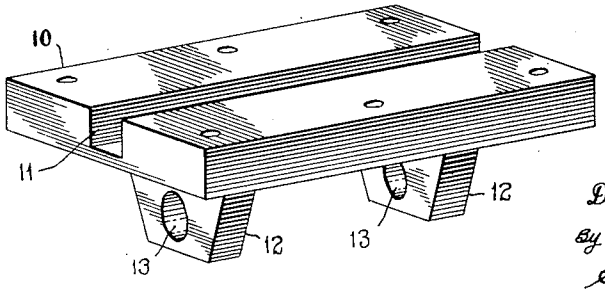


Fig. 5.



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Fig. 6.

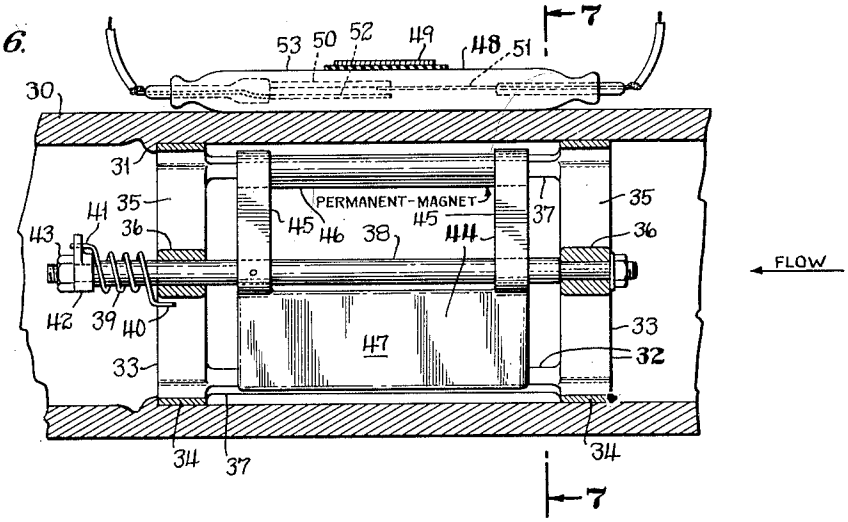


Fig. 7.

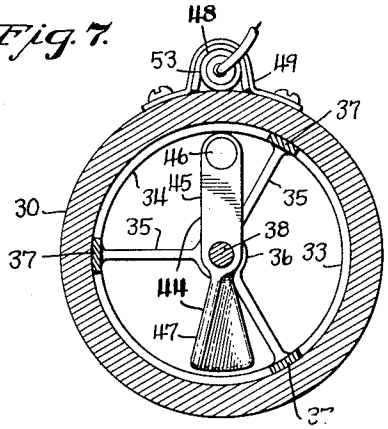


Fig. 8.

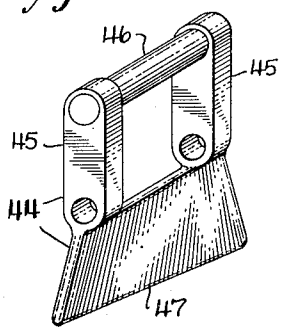
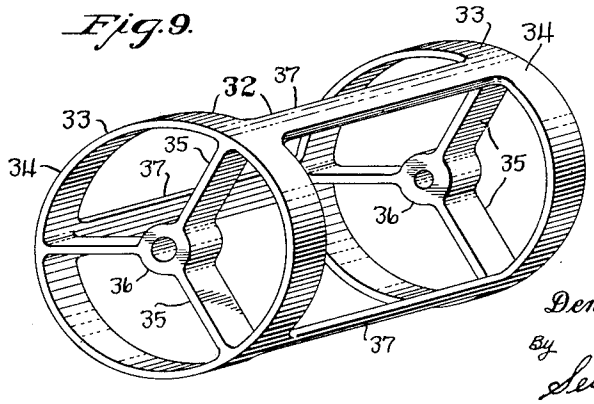


Fig. 9.



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FLOW-RESPONSIVE ELECTRICAL SWITCH MEANS

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4 Claims. (Cl. 200—81.9)

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The present invention relates to flow-responssive electrical switch-means, i. e., switch-means actuated by the flow of fluid, and which latter term is intended to connote not only liquids and gases, but also flowable comminuted solids.

The present invention contemplates the employment in a unique combination of a well known magnetic switch having a pair of complemental members which are formed of magnetic material, and wherein one or both of which may be moved with respect to the other to effect the opening or closing of an electrical circuit when influenced by magnetic flux. The present invention contemplates an actuating-vane which is designed and adapted to be moved by the movement of a fluid, and which has permanent-magnet means influencing the said switch as the vane is moved by the fluid flow.

One of the main objects of the present invention is to provide superior flow-responsive electrical switch-means of the character referred to and which will effectuate the actuation of one or more electrical contacts without requiring the employment of electrical or mechanical connections to the actuating-vane.

Another object of the present invention is to provide superior flow-responsive electrical switch-means of the character referred to which will not cause the repeated rapid opening and closing of the contacts as a result of minor fluctuations in the movement of the vane.

Other objects and advantages will appear to those skilled in the art from the following, considered in conjunction with the accompanying drawings.

In the accompanying drawings, in which certain modes of carrying out the present invention are shown for illustrative purposes:

Fig. 1 is a perspective view of one form which a flow-responsive electrical switch-means may assume in accordance with the present invention;

Fig. 2 is a view partly in elevation and partly in central section through the frame and the magnetically-operated switch;

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 2;

Fig. 4 is a perspective view of the actuating-vane detached, together with its pivot-shaft and permanent-magnet;

Fig. 5 is a perspective view of the frame or mounting-means, detached;

Fig. 6 is a view partly in central longitudinal section and partly in elevation of another form of flow-responsive electrical switch-means which may be constructed in accordance with the present invention, together with a portion of a conduit or pipe, which latter is shown in section;

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Fig. 7 is a transverse sectional view taken on the line 7—7 of Fig. 6;

Fig. 8 is a perspective view of the actuating-vane illustrated in Figs. 6 and 7, together with its permanent-magnet; and

Fig. 9 is a perspective view of the frame or mounting-means of Figs. 6 and 7.

The showing of Figs. 1 to 5 inclusive

In Figs. 1 to 5 inclusive there is shown a flow-responsive electrical switch-unit which includes a frame or mounting-member generally designated by the reference character 10 and preferably formed of nonmagnetic material such, for instance, as aluminum, brass, synthetic resin, etc. The said frame is, in the instance shown, provided in its outer face with a switch-receiving groove 11, and is provided on its opposite or inner face with two similar laterally-spaced-apart lugs 12—12. Each of the said lugs is provided with an aperture 13 arranged in axial alignment with the similar aperture in the other lug.

Respectively mounted in the apertures 13 of the respective lugs 12—12 of the frame 10, is one of two similar antifriction bushings 14—14 providing bearings for the respective opposite ends of a pivot-shaft 15, as is especially well shown in Fig. 2. The said pivot-shaft rigidly mounts a plate-like actuating-vane 16 intermediate the inner and outer ends of the latter and provides for the swinging movement of the said actuating-vane with respect to the frame or mounting-means 10. In its outer end (the end adjacent the frame 10), the actuating-vane 16 is formed with a recess or socket 17 extending from edge to edge thereof in substantial parallelism with the pivot-shaft 15. Fitted into the socket or recess 17 with sufficient friction to be retained therein, is a cylindrical bar-magnet 18 which may be formed of any suitable permanent-magnet material such, for instance, as hardened carbon steel, cobalt steel, or one of the numerous alloys of aluminum, nickel, cobalt and iron, or the equivalent of the same. The bar-magnet 18 is preferably so magnetized as to have its opposite ends of opposite polarities respectively.

Encircling the projecting portion of the right-hand bushing 14 (as viewed in Fig. 2), is a torsion spring 19 having an outer arm 20 engaged with one face of the adjacent lug 12, and having an opposite or inner arm 21 engaged with one face of the actuating-vane 16. The said torsion spring may be set to hold the actuating-vane 16 in any

desired idle position such, for instance, as in the position indicated by the full lines in Fig. 3, or the position indicated by the broken lines A also indicated in Fig. 3.

Located in the groove 11 in the outer face of the frame 10 and held therein by means of a retaining-plate 22, is a magnetically-operated switch generally designed by the reference character 23. The said switch comprises a sealed tubular casing 24 formed of glass or other suitable insulating material, and enclosing a pair of cooperating magnetically-permeable members 25 and 26 projecting toward each other from the respective opposite ends of the casing 24 and with their inner ends in slightly overlapping relationship. The outer ends of the members 25 and 26 may have electrical leads 27 and 28 respectively connected thereto, as is indicated in Fig. 2. The members 25 and 26 just referred to are formed of nonpermanent magnetic material such, for instance, as soft iron, silicon, steel, or the like, and in the instance shown, are pre-set so that in the absence of magnetic flux flowing therethrough, their respective overlapping inner ends will be spaced apart, though capable of being drawn into engagement (as shown by full lines in Fig. 2), when subjected to magnetic flux from the bar-magnet 18 or its equivalent.

The leads 27 and 28 may extend to any desired electrical instrumentality such, for instance, as a visual or audible signal or indicator.

In Figs. 2 and 3, the elements previously described are shown as associated with a conduit or pipe indicated by broken lines and designated by the reference character 29. The said conduit or pipe may, if desired, be in the form of a conduit or pipe-fitting capable or being interposed in a longer conduit.

For purposes of description, it may be assumed that the torsion spring 19 is so set as to hold the actuating-vane 16 in the position indicated by the broken lines A in Fig. 3, when there is zero or slow flow through the conduit 29. Under these conditions, the permanent-magnet 18 will be sufficiently remote from the switch 23 to permit the flexible members 25 and 26 thereof to remain apart, and thus interrupt the circuit between the leads 27 and 28.

Now, when the flow of material through the conduit 29 reaches the desired predetermined velocity, it will swing the vane 16 so as to bring the permanent-magnet 18 sufficiently close to the switch 23 to magnetize the members 25 and 26 thereof sufficiently to cause their respective inner ends to move into engagement with each other to thus close a circuit between the leads 27 and 28. This closing of the circuit may be utilized in any desired manner to indicate the fact, as for instance, by connecting either a visual or audible signal to the said leads.

Following the engagement of the inner ends of the members 25 and 26 of the switch 23 as above described, the said members will not separate should the velocity of the fluid through the conduit 29 slightly slacken to thus cause the spring 19 to swing the vane 16 slightly backwardly, since the magentic flux from the permanent-magnet 18 will be much more effective in holding the members 25 and 26 together after the same have been brought together than would be the case in initially bringing them together from relatively widely separated conditions. The effectiveness of the magnetic flux being, as is well known, inversely, as the square of the distance between the magnetic members.

Now, let it be assumed, that rather than to close a circuit when the flow through the conduit 29 or its equivalent reaches a predetermined velocity, it is desired to open a circuit. With such requirements in mind, the spring 19 or its equivalent may be so set as to normally permit the vane 16 to stand substantially in the position in which it is indicated by full lines in Fig. 3. Under these conditions, the members 25 and 26 of the switch 23 will be normally held in engagement by the flux from the permanent-magnet 18. Now, when the velocity of the material flowing through the conduit 29 is sufficient to overcome the spring 19 and to swing the vane 16 to the right of the center line (as viewed in Fig. 3), the permanent-magnet 18 will be progressively moved away from the switch 23 and thus ultimately sufficiently weaken its effective flux to a value which will permit the magnetic members 25 and 26 to separate and open the circuit. The position last referred to may, for convenience of description, be considered as being substantially the position indicated by the broken lines B in Fig. 3.

To make use of the flow-responsive electrical switch-mechanism of the present invention, it is not necessary that the same have its actuating-vane placed in a conduit or the like since, obviously, the unit comprising the parts 10 to 28 inclusive may be placed in open space so as to be impinged upon by a flow-stream such, for instance, as when placed within the range of an electric fan blowing freely into space.

The showing of Figs. 6 to 9 inclusive

The flow-responsive electrical switch-mechanism illustrated in Figs. 6 to 9 inclusive is designed and adapted to have its permanent-magnet move in a plane substantially transverse to the direction of flow of material through a conduit, all as will presently be described.

The structure of Figs. 6 to 9 inclusive includes a conduit 30 which is preferably formed of nonmagnetic material such, for instance, as a thermoplastic synthetic resin which may have its interior upset or displaced to provide a stop-shoulder 31 as is indicated in Fig. 6. Mounted within the conduit 30 and seated at one end against the abutment or stop-shoulder 31 is a skeletonized frame or mounting-member generally designated by the reference character 32. The said frame is preferably formed of synthetic resin, aluminum, brass or other suitable nonmagnetic material and comprises two similar end-members each generally designated by the reference character 33. Each of the said end-members includes a thin rim or felly 34, a plurality of radial spokes 35 and a central hub 36, as is especially well shown in Fig. 9. The respective end-members 33—33 are held in axially spaced-apart relationship by three (more or less) connecting-bars 37. The elements 34, 35, 36 and 37 may be conveniently molded or cast integrally with each other.

Each of the hubs 36 of the frame 32 has a central aperture which is in axial alignment with the similar aperture in the companion hub. The two apertures receive with a turning fit the respective opposite end-portions of a pivot-shaft 38 which, in the instance shown, extends longitudinally substantially coaxially with the conduit or tube 30. The pivot-shaft 38 projects beyond the left-hand end-member 33 (as viewed in Fig. 6), and is there encircled by a torsion spring 39 having an inner end 40 seated against an edge of one of the spokes 35 and having an outer end 41 engaged with an adjusting-member 42. The

said adjusting-member is mounted on the pivot-shaft 38 with capacity for being turned with respect thereto, but is normally held in any predetermined position of rotational adjustment by means of a clamping-nut 43 indicated in Fig. 6. By turning the adjusting-member 42 with respect to the pivot-shaft 38, the tension of the spring 39 may be increased or decreased, as desired.

Rigidly secured to the pivot-shaft 38 in a position intermediate the respective opposite end-members 33—33 of the frame 32, is an actuating-vane generally designated by the reference character 44. The said vane includes two radially-projecting spaced-apart arms 45—45, both of which are apertured at their outer ends and receive with a tight friction fit the respective opposite ends of a bar-magnet 46. The said bar-magnet is made of permanent-magnet material and is preferably magnetized so as to have its opposite ends of opposite polarities respectively. The actuating-vane 44 also includes a tail or deflecting-portion 47 located on the side of the pivot-shaft 38 opposite to the arms 45—45 and preferably having a helical configuration or twist of relatively-coarse pitch.

Mounted upon the exterior of the conduit 30 and extending in substantial parallelism with the longitudinal axis thereof, is a magnetically-operated switch generally designated by the reference character 48 and secured in place on the said conduit by means of a suitable clamp 49.

The particular switch 48, chosen for purposes of illustration, is fundamentally the same as the previously-described switch 23, but differs therefrom to the extent that it serves to open an electrical circuit when the magnetic flux applied thereto is greatest. The said switch 48 includes three members 50, 51 and 52 sealed within a casing 53 formed of glass or other suitable insulating material. The members 51 and 52 are part of the above-mentioned circuit, while the member 50 is merely an abutment for the movable member 51 and is not in any way connected with said circuit. The members 50 and 51 are formed of nonpermanent magnetic material capable also of conducting electric current and of the general character described in connection with the description of the members 25 and 26 of the switch 23. The member 52 is preferably formed of non-magnetic material such, for instance, as brass but also having capacity for conducting electricity. The member 51 is, in the instance shown, pretensioned so as to normally engage with the non-magnetic member 52 in the absence of a strong magnetic flux. When the switch 48 is subjected to a strong magnetic flux such, for instance, as from the permanent-magnet 46, the member 51 will be flexed into engagement with the complemental member 50 and out of engagement with the nonmagnetic member 52.

In view of the description of operation of the structure of Figs. 1 to 5 inclusive, it is believed that a detailed description of the operation of the structure of Figs. 6 to 9 inclusive, is not required other than to say that the flow of material through the conduit 30 or its equivalent will cause the fluid to impinge upon the deflecting-portion 47 of the vane 44, and thus swing the same about an axis substantially parallel with the longitudinal axis the conduit 30 and cause the actuation of the switch 48, as desired, either into an open-circuit or closed-circuit position. It may be further noted that the spring 39 may be tensioned to hold the vane 44 in any desired predetermined position in the absence of a fluid-flow through the conduit and to yieldingly resist the turning of the vane as the exigencies of various conditions may require.

The invention may be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the invention, and the present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

We claim:

1. A flow-responsive electric switch-mechanism for a conduit having an uninterrupted flow passage, comprising a vane entirely located and pivotally mounted intermediate its ends in said uninterrupted flow passage of the conduit and having its vane parts on the opposite sides, respectively, of its pivot axis so arranged and coordinated that they are in the path of fluid advancing at the same velocity when flowing and the resultant pressure of the fluid passing through said conduit in one direction and impinging on said vane parts will turn said vane unidirectionally; a permanent magnet carried by one of said vane parts; and an electric switch having companion contact-members of which at least one member is of nonpermanent magnetic material and in magnetic relation with said permanent magnet throughout a certain rotary range of said vane.

2. A flow-responsive electric switch-mechanism for a conduit having an uninterrupted flow passage, comprising a flat vane entirely located and pivotally mounted intermediate its ends in said uninterrupted flow passage of the conduit for rotation about an axis parallel to the plane of said vane and transversely of said conduit so that the entire vane is in the path of fluid advancing at the same velocity when flowing, the surface area of said vane to be impinged by flowing fluid being a fraction of the cross-sectional area of said flow passage and the parts of said vane on opposite sides, respectively, of said pivot axis having different surface areas so that the resultant pressure of fluid passing through said conduit in one direction and impinging on said vane parts will turn said vane unidirectionally; a permanent magnet carried by one of said vane parts; and an electric switch having companion contact-members of which at least one member is of nonpermanent magnetic material and in magnetic relation with said permanent magnet throughout a certain rotary range of said vane.

3. A flow-responsive electric switch-mechanism for a conduit having an uninterrupted flow passage, comprising a flat vane entirely located and pivotally mounted intermediate its ends in said uninterrupted flow passage in the conduit for rotation about an axis parallel to the plane of said vane and transversely of said conduit so that the entire vane is in the path of fluid advancing at the same velocity when flowing, the surface area of said vane to be impinged by flowing fluid being a fraction of the cross-sectional area of said flow passage, and a first part of said vane on one side of its pivot axis being longer and having a larger surface area than the remaining part of said vane on the other side of its pivot axis so that the resultant pressure of fluid passing through said conduit in one direction and impinging on said vane parts will turn said vane unidirectionally; a permanent magnet carried near the end of said remaining vane part; and an electric switch having companion contact-mem-

bers of which at least one member is of nonpermanent magnetic material and in magnetic relation with said permanent magnet throughout a certain rotary range of said vane.

4. A flow-responsive electric switch-mechanism for installation in a cut-out in a conduit, comprising a bracket of nonmagnetic material adapted to be mounted in said cut-out so as to close and seal said conduit thereat, said bracket having inner depending mounting provisions adapted to extend in the interior of said conduit; a flat vane pivotally mounted intermediate its ends on said mounting provisions for rotation about an axis parallel to the plane of said vane and transversely of said conduit, a first part of said vane on one side of its pivot axis being longer and having a larger surface area than the remaining part of said vane on the other side of its pivot axis so that the resultant pressure of fluid passing through said conduit in one direction and impinging on said vane parts is adapted to turn said vane unidirectionally, and said remaining vane part extending with its end into close proximity to said bracket in a certain angular position of said vane; a permanent magnet carried by said remaining vane part at said end thereof; and an electric switch carried by said bracket on the outside thereof and having companion contact-members of which at least one member is of nonpermanent magnetic material and in magnetic relation with said permanent magnet throughout a certain rotary range of said vane.

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