June 10, 1952 D. H. MacDONALD ET AL 2,600,011

FLUID-FLOW RESPONSIVE ELECTRICAL SWITCH DEVICE

Original Filed Feb. 14, 1950

Fig. 1.

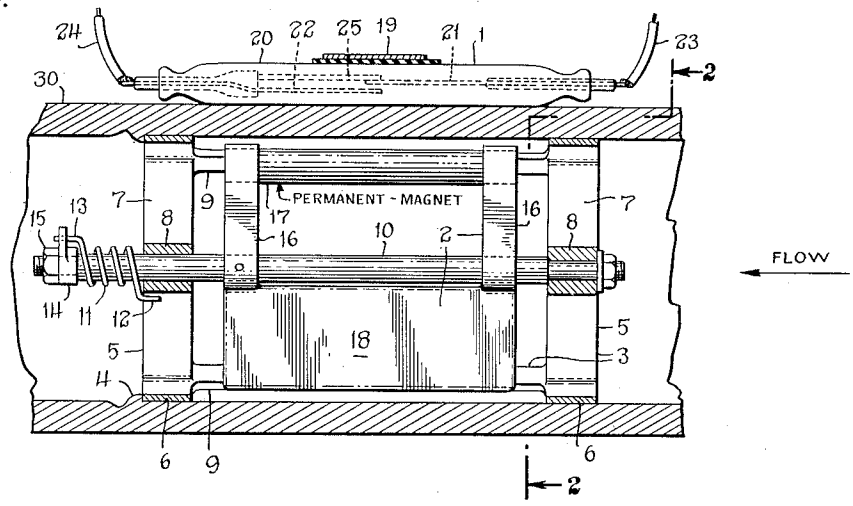


Fig. 2.

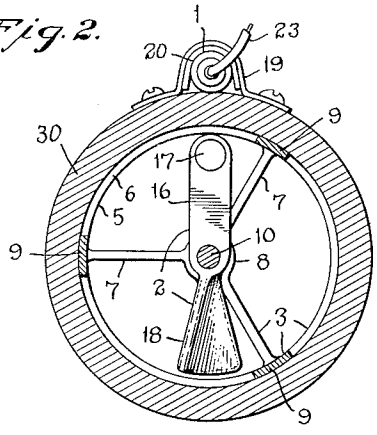


Fig. 3.

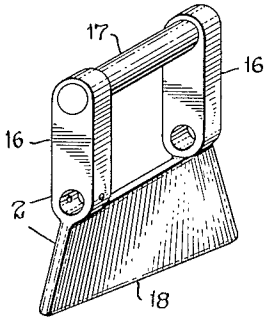
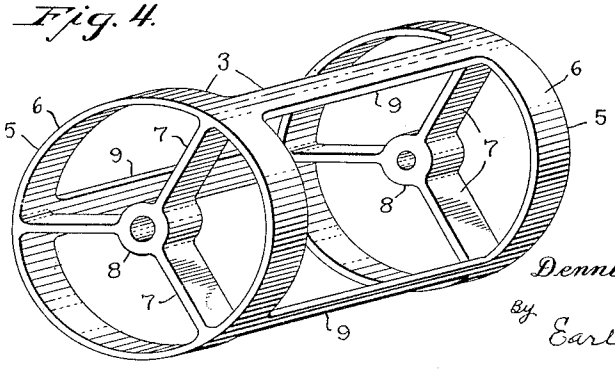


Fig. 4.



Inventors
Dennison H. MacDonald
Edgar A. Poe
By Earle & Steward
Attorneys

Patented June 10, 1952 2,600,011

UNITED STATES PATENT OFFICE

2,600,011

FLUID-FLOW RESPONSIVE ELECTRICAL SWITCH DEVICE

Dennison H. MacDonald, East Haven, and Edgar A. Poe, Milford, Conn., assignors to Revere Corporation of America, Wallingford, Conn., a corporation of Connecticut

Original application February 14, 1950, Serial No. 144,072. Divided and this application January 24, 1951, Serial No. 207,482

10 Claims. (Cl. 200—81.9)

1

This invention relates to fluid-flow responsive electrical switch devices, and especially to switch devices of the type of which the actuators are subjected to and powered by the flowing fluids, and are magnetically coupled with the switch-contacts for their operation.

This application is a division of our co-pending application Serial No. 144,072, filed February 14, 1950.

It is the primary object of the present invention to provide a flow-responsive electrical switch device of this type of which the actuator is accurately displaced in response to any flow rate of a fluid within an unusually wide range.

It is another object of the present invention to provide a flow-responsive electrical switch device of this type of which the actuator is in its fluid-flow responsive displacement practically undisturbed by vibration, shock, acceleration and deceleration, or change in position to which the switch device may be subjected, thereby rendering the latter useful especially, though not exclusively, in aircraft installations or other rollable or portable equipment.

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 longitudinal sectional view, partly in elevation, of an installed flow-responsive electrical switch device embodying the present invention;

Fig. 2 is a section through the switch device as taken on the line 2—2 of Fig. 1;

Fig. 3 is a perspective view of a prominent operating-element of the switch device; and

Fig. 4 is a perspective view of another prominent element of the instant switch device.

Referring to the drawings, and especially to Fig. 1 thereof, there is shown a fluid-flow responsive switch device which in its components is provided partly inside and partly outside of a conduit 30 that is preferably formed of nonmagnetic material such as a thermoplastic synthetic resin, for instance.

The switch device comprises, in the present instance, a switch proper which is provided on the outside of the conduit 30 and designated by the reference numeral 1, and a switch-actuator 2 which is carried by a frame 3 on the inside of the conduit 30. The frame 3 is, as shown in Figs. 1 and 2, received in the conduit 30 and rests

2

with one end against an abutment or stop-shoulder 4 which is provided in the conduit 30, as by upsetting or otherwise displacing the interior thereof. The frame 3 is preferably formed of synthetic resin, aluminum, brass or other suitable nonmagnetic material, and comprises two similar end-members 5 of which each includes a thin outer rim 6, a plurality of radial spokes 7 and a central hub 8 (see also Fig. 2). The end-members 5—5 are held in axially-spaced apart relation by a plurality (in the present instance 3) connecting-bars 9. The elements 6, 7, 8 and 9 of the frame 5 may conveniently be molded or cast integrally with each other.

Each of the hubs 8 of the frame 3 is provided with a central aperture which is in axial alignment with the aperture in the companion hub. The apertures in the hubs 8—8 receive with a turning fit the respective opposite ends of a pivot-shaft 10 which, in the present instance, extends coaxially of the conduit 30. The pivot-shaft 10 projects beyond the left-hand end-member 5 (as viewed in Fig. 1), and is there encircled by a torsion-spring 11 having an inner end 12 seated against an edge of one of the spokes 7 and having an outer end 13 engaged with an adjusting-member 14. The adjusting-member 14 is mounted on the pivot-shaft 10 with capacity for being turned with respect thereto, but is normally held in any predetermined position of angular adjustment by means of a clamping-nut 15 which is threadedly received by the adjacent end of the pivot-shaft 10 (Fig. 1). By turning the adjusting-member 14 with respect to the pivot-shaft 10, the tension of the spring 11 may be increased or decreased, as desired.

Rigidly secured to the pivot-shaft 10 in a position intermediate the respective opposite end-members 5—5 of the frame 3 is the switch-actuator 2. This switch-actuator includes two radially-projecting spaced arms 16—16, both of which are apertured at their outer ends and receive with a press fit the respective ends of a bar magnet 17. The bar magnet 17 is made of permanent-magnet material, and is preferably magnetized so as to have its opposite ends of opposite polarities. The switch-actuator 2 also includes a tail or vane 18 opposite the arms 16—16. The vane 18 preferably has a helical configuration or twist of relatively coarse pitch, as is best shown in Figs. 2 and 3.

Mounted externally of the conduit 30 and extending in substantial parallelism with the longitudinal axis thereof, is the switch proper 1 which is secured in place on said conduit by means

of a suitable clamp 19. The switch comprises, in the present instance, a sealed tubular casing 20 formed of glass or other suitable insulating material, and enclosing a pair of cooperating contact-members 21 and 22 which project toward each other from the opposite ends, respectively, of the casing 20 and have their inner ends in slightly overlapping relation with each other. The outer ends of the contact-members 21 and 22 may have electrical leads 23 and 24, respectively, connected thereto (Fig. 1). Further provided in the sealed tubular casing 20 is an abutment member 25 which extends substantially parallel to but spaced from the contact member 22. At least the members 21 and 25 are formed of nonpermanent magnetic material such, for instance, as soft iron, silicon, steel, or the like, and the contact-member 21 is, in the present instance, pre-tensioned so as normally to engage its companion contact-member 22 in the absence of a substantial magnetic flux from the permanent bar magnet 17 of the switch-actuator 2. Accordingly, in the absence of a substantial magnetic flux from the permanent magnet 17 the instant switch 1 is normally closed to close an electric circuit of which the contact-members 21 and 22 form parts thereof, while the presence of a substantial magnetic flux from the permanent magnet 17 of the switch-actuator 2 causes attraction of the members 21 and 25 (Fig. 1) and according opening of the switch 1. Instead of having the contact-members 21 and 22 of the instant switch 1 normally closed in the absence of any substantial magnetic flux, these contact-members 21 and 22 may normally be open as shown in one example in our aforementioned copending application, Ser. No. 144,072, in which event the magnetic flux from the permanent magnet 17 of the switch-actuator 2 would close the switch when the former is moved into magnetic coupling relation therewith.

In operation, fluid flowing through the conduit 30 will impinge upon the twisted vane 18 of the switch-actuator 2 and thereby turn the latter in the frame 3 in the conduit to an extent commensurate with the flow rate of the fluid, to cause operation of the switch 1 as desired, either into open circiut or closed circuit position, as the case may be. It may also be noted that the spring 11 may be tensioned to hold the switch-actuator 2 in any desired predetermined angular position in the absence of a fluid flow through the conduit 30, and yieldingly to resist the turning of the switch-actuator 2 as the exigencies of various conditions may require. As shown in the present instance, the spring 11 is pre-tensioned to hold the switch-actuator 2 normally in maximum magnetically-coupled relation with the switch 1 (Figs. 1 and 2), and the contact-members 21 and 22 of the switch are normally held open by the magnetic flux from the magnet 17 of the switch-actuator 2. Under these circumstances, the switch 1 will close when the fluid flow through the conduit 30 is at a rate sufficient to turn the switch-actuator 2 from effective magnetic coupling relation with the contact-members 21 and 22, as will be readily understood.

The instant flow-responsive switch device is especially noteworthy in that, by virtue of the provision of the twisted vane 18 on the actuator 2 and the torsion-spring 11, the actuator 2 is accurately displaced angularly in response to any fluid-flow rate within an unusually wide range. Further, the switch-actuator 2 of the instant switch device is, by virtue of the same provisions of the twisted vane 18 and the torsion-spring 11, practically undisturbed in its fluid-flow responsive displacement by vibration, shock, acceleration and deceleration, or change in position, to which the switch device may be subjected, thereby rendering the latter useful especially, though by no means exclusively, in aircraft installations or other rollable or portable equipment.

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 electrical switch device, comprising a conduit; a switch part carried by said conduit and having two companion contacts of which at least one contact is of nonpermanent magnetic material and movable into and out of engagement with the other contact; and a switch-actuator journaled in said conduit for rotation about an axis substantially parallel to that of said conduit, said actuator having a permanent magnet spaced from its rotary axis and moving to and from magnetic coupling relation with said one contact on rotation of said actuator in opposite directions, respectively, as well as a vane generally inclined to the axis of said conduit and adapted to be impinged and angularly displaced by fluid flowing through said conduit at varying rates.

2. A flow-responsive electrical switch device, comprising a conduit having an axial flow-passage therethrough; a switch-actuator journaled in the flow-passage of said conduit for rotation about an axis substantially parallel to that of said conduit, said actuator having a permanent magnet spaced from its rotary axis and a vane generally inclined to the axis of said conduit and adapted to be impinged and angularly displaced by fluid passing through the flow-passage of said conduit at varying rates; and a switch part on said conduit outside said flow-passage, said switch part having two companion contacts of which at least one contact is of non-permanent magnetic material, is movable into and out of engagement with the other contact and is in magnetically-coupled relation with said permanent magnet within a certain rotary range of said actuator.

3. A flow-responsive electrical switch device as set forth in claim 2, in which said switch part is carried by said conduit externally thereof, and said conduit is of non-magnetic material at least in the region thereof adjacent said one contact.

4. A flow-responsive electrical switch device as set forth in claim 2, further comprising yielding-means in the flow-passage of said conduit normally urging said actuator into a predetermined angular position.

5. A flow-responsive electrical switch device as set forth in claim 2, further comprising a torsion-spring in the flow-passage of said conduit anchored with its ends to said conduit and actuator, respectively, and normally urging said actuator into a predetermined angular position.

6. A flow-responsive electrical switch device for a conduit having an axial flow-passage therethrough, said device comprising bearing provisions mountable in the flow-passage of the conduit; a switch-actuator journaled in said bearing

provisions and adapted for rotation about an axis substantially parallel to that of the conduit, said actuator having a permanent magnet spaced from its rotary axis and a vane generally inclined to said rotary axis and adapted to be impinged and angularlly displaced by fluid passing through the flow-passage of the conduit at varying rates; and a switch part mountable on the conduit outside the flow-passage therethrough, said switch part having two companion contacts of which at least one contact is of non-permanent magnetic material, is movable into and out of engagement with the other contact, and is adapted to be in magnetically-coupled relation with said permanent magnet within a certain rotary range of said actuator.

7. A flow-responsive electrical switch device as set forth in claim 6, further comprising a torsion-spring anchored with its ends to said bearing provisions and actuator, respectively, and normally urging said actuator into a predetermined angular position.

8. A flow-responsive electrical switch device as set forth in claim 6, further comprising mounting-means for said switch part on the outside of said conduit.

9. A flow-responsive electrical switch device, comprising a conduit having an axial flow-passage therethrough; a switch-actuator journaled in the flow-passage of said conduit for rotation about the axis of said conduit, said actuator having on one side of its rotary axis a permanent magnet extending into close proximity to the circumference of the flow-passage in said conduit, and having on the opposite side of its

rotary axis a vane inclined to said rotary axis and adapted to be impinged and angularly displaced by fluid passing through the flow-passage of said conduit at varying rates; and a switch part on said conduit outside said flow-passage, said switch part having two companion contacts of which at least one contact is of nonpermanent magnetic material, is movable into and out of engagement with the other contact and is in magnetically-coupled relation with said permanent magnet within a certain rotary range of said actuator.

10. A switch-actuator unit for use with a switch part provided on the outside of a non-magnetic conduit and having companion contacts of which one contact is of nonpermanent magnetic material and is movable to and from engagement with the other contact, said unit comprising bearing provisions mountable on the inside of the conduit; and an actuator journaled in said bearing provisions and adapted for rotation about an axis substantially parallel to that of the conduit, said actuator having a vane generally inclined to its rotary axis and adapted to be impinged and angularly displaced by fluid passing through the conduit at varying rates, and also having a permanent magnet spaced from said rotary axis and adapted to be magnetically-coupled with the movable contact of the switch part within a certain rotary range of said actuator.

DENNISON H. MacDONALD.
EDGAR A. POE.

No references cited.