June 10, 1969 J. R. OTTO ET AL 3,449,535

FLUID OPERATED SWITCH

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FIG. 1

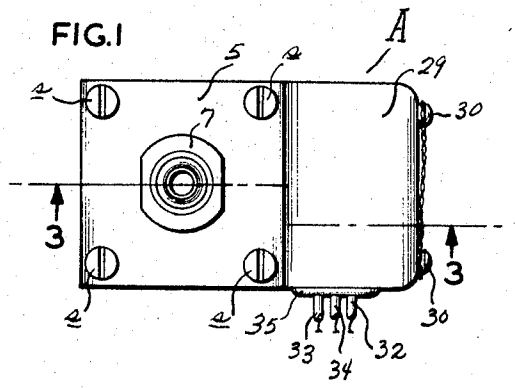


FIG. 2

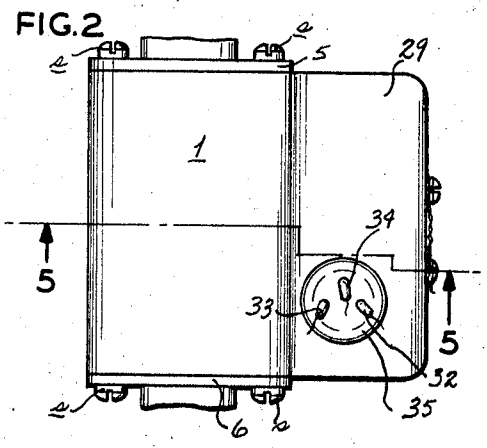


FIG. 3

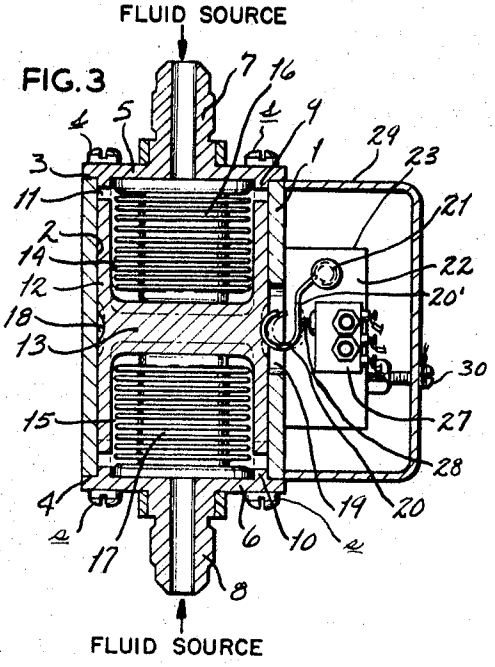


FIG. 4

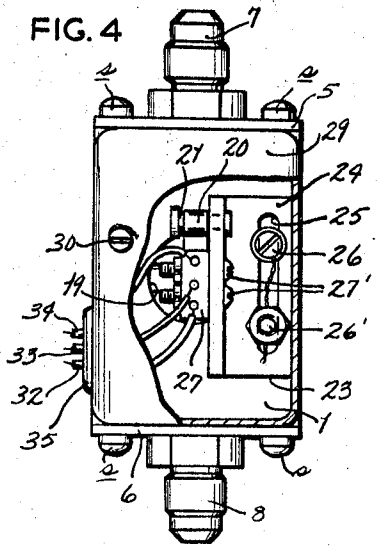
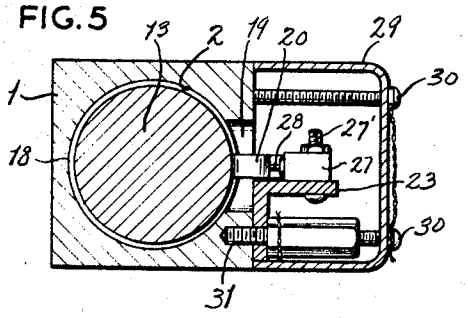


FIG. 5



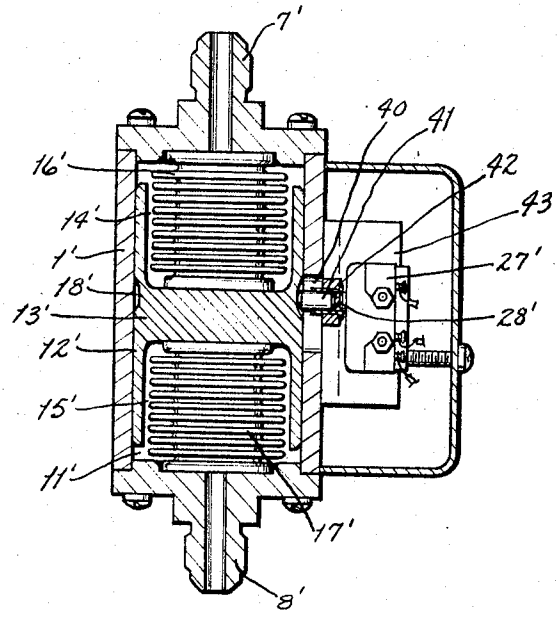
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FIG. 6



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FLUID OPERATED SWITCH

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U.S. Cl. 200—82 10 Claims

ABSTRACT OF THE DISCLOSURE

A fluid operated switch having a housing with a piston disposed therein, fluid pressure sensitive elements connected to opposite sides of the piston, said elements being connected to sources of fluid for causing movement of said piston responsive to a pressure differential in said elements, an electric switch disposed adjacent the housing and a switch actuator engaged at one end to said switch and at the other end to said piston for switch-operating movement consequent to travel of said piston.

This invention relates in general to pressure sensitive devices and, more particularly, to a switch adapted for operating responsively to a pressure differential in fluid systems.

It is an objective of the present invention to provide a switch adapted for circuit controlling operation responsive to pressure differential in a fluid system, wherein the media may be liquid or gaseous, such as especially encountered in aerospace fluid systems.

It is another object of the present invention to provide a switch of the type stated which incorporates hermetically sealed pressure sensing elements for precluding contact between the fluid media and actuating mechanisms or electrical elements of the switch, thereby conducing to the long effective life of the switch, as well as eliminating any potential danger when the fluid medium is hazardous.

It is another object of the present invention to provide a switch of the character stated incorporating pressure sensing elements which in movement responsive to applied fluid pressure are substantially frictionless so as to thereby obviate any possible explosions or fires by reason of ignition of the fluid medium through sparks.

It is a further object of the present invention to provide a fluid operated switch which is of extreme sensitivity so that a pressure differential in the order of one (1) pound per square inch will operate the switch.

It is a further object of the present invention to provide a switch of the character stated which incorporates means for adjusting same for predetermined pressure settings, as well as to prevent overtravel of switch actuating components.

It is a still further object of the present invention to provide a device which may be readily adapted for a multiplicity of purposes, such as for use to sense the pressure drop across a restriction in the path of flow of the fluid; or to serve as a proportional indicator, a potentiometer, etc.

It is a still further object of the present invention to provide a fluid operated switch which is economical in construction, efficient and reliable in operation; which is free from delicate components so as to be capable of withstanding continued, heavy usage.

Other objects and details of the present invention will be apparent from the following description when read in connection with the accompanying drawing (two (2) sheets), wherein

FIGURE 1 is a top plan view of a fluid operated switch constructed in accordance with and embodying the present invention.

FIGURE 2 is a front elevational view.

FIGURE 3 is a vertical transverse sectional view taken on the line 3—3 of FIGURE 1.

FIGURE 4 is an end elevational view in partial section, taken on the right hand side of FIGURE 1.

FIGURE 5 is a horizontal transverse sectional view, taken on the line 5—5 of FIGURE 2.

FIGURE 6 is a vertical transverse sectional view taken substantially on the line 3—3 of FIGURE 1 but illustrating another form of fluid operated switch constructed in accordance with and embodying the present invention.

Referring now by reference characters to the drawings which illustrate practical embodiments of the present invention, A generally designates a fluid operated switch, comprising a body **1** formed from a four-sided block, having a bore **2** extending throughout its length from its upper to its lower end **3, 4**, respectively.

Secured upon the said upper end and lower end, as by screws *s*, are upper and lower end plates **4, 6**, respectively, which are integrally provided with axially aligned conduit fittings **7, 8**, respectively, for communication with bore **2**. Formed on the inwardly presented surfaces of said plates **5, 6**, are relatively shallow, inwardly projecting rings or annuli **9, 10**, respectively, having an outside diameter substantially equivalent to the diameter of bore **2**, for projection thereinto with the outer surfaces of said rings **9, 10** abutting the adjacent confronting inner face portion of bore **2**.

Said bore **2**, together with end plates **5, 6**, co-operate to define a chamber **11**, within which is received a plunger **12** for axial reciprocal, slideable movement therein, being of free-floating character. Said plunger **12** is of circular cross-section and of general H-shape in vertical section (see FIGURE 3) in that the same integrally comprises a central transverse partition **13**, and endwise opening compartments **14, 15** on either side thereof; the latter being delimited by the adjacent face of partition **13**, and the proximate side wall portions of said plunger **12**. Said plunger **12** is of a length less than the distance between the end faces of opposed rings **9, 10** of plates **5, 6** which rings serve as stops for limiting the travel of plunger **12** within chamber **11**. The thickness of rings **9, 10** is substantially the same as that of the side wall portions of compartments **14, 15**.

Disposed within each of the compartments **14, 15** is a pressure sensing element **16, 17**, respectively, each of which comprises a bellows assembly; said latter abutting at their inner end against the adjacent confronting face of partition **13** of plunger **12**, and at their outer ends abutting against the inner faces of the related end plates **5, 6**. Each bellows assembly **16, 17** is in communication with the proximate conduit fitting **7, 8**, respectively, and are hermetically sealed so that fluid received therein is denied contact with any elements of the switch thereby preventing malfunction of the switch through undesired contact with the fluid media.

Bellows assemblies **16, 17** are extremely sensitive to pressure, so that the same are longitudinally expansible, or travel, under applied fluid pressure, causing resultant axial movement of plunger **12**, within chamber **11**, dependent upon the relative fluid pressure within said bellows assemblies **16, 17**. As shown in FIGURE 3, the pressures within the said bellows assemblies **16, 17** are equal so that plunger **12** is in centered relationship, being equidistant from the detent surfaces of rings **9, 10**. Overtravel of the bellows **16, 17** in both directions is prevented by abutment of plunger **12** against either ring **9, 10**, so that the said bellows **16, 17**, are protected against such potential damage.

Formed in the outer surface of the partition portion of plunger **12** is a groove **18**, which registers with a relatively

enlarged opening **19** in the adjacent wall portion of body **1** through which latter projects the curvate, hook-forming, free end of a switch actuator **20** formed preferably from flat spring stock. Said actuator **20** at its opposite end is mounted upon a pin **21** projecting from the leg **22** of an angle bracket **23**, the other leg **24** of which is mounted upon the outer adjacent surface of body **1** (see FIGURES 4, 5). Leg **24** of bracket **23** is provided with a vertically extending slot-like aperture **25**, for allowing vertical adjustment of said bracket **23**, with respect to the retaining bolts **26**, **26'** extending therethrough.

Also mounted, as by screws **27'**, upon leg **22** of angle bracket **23** is a micro-switch **27**, having the conventional actuating button **28** which at its outer end is immediately adjacent the central relatively linear portion **20'** of actuator **20**. Bracket **23** together with micro-switch **27** and actuator **20** carried thereon is enclosed by a housing **29** maintained in position by bolts **30** which are threadedly engaged within openings **31**, tapped in the proximate portion of body **1** (see FIGURE 5). Micro-switch **27** is connected to the related electrical system or circuit (not shown or forming a part of the present invention) as by leads **32**, **33**, **34**, which are led outwardly of housing **29** through an opening therein (not shown) carrying a grommet **35**.

The free end of actuator **20** is curved on a radius for normal complementary reception within groove **18** of plunger **12** and thorugh the bias of the mounting of said actuator, the same will be normally urged into said groove **18**. With the plunger **12** in balanced position, wherein the pressures exerted thereon by bellows **16**, **17** are equal, actuator **20** will be urged into groove **18**, and hence away from actuating button **28** of micro-switch **27**. Upon the development of a relatively greater pressure in either bellows assemblies **16**, **17** so as to cause travel of said plunger **12** in a direction away from the bellows assembly having the greater pressure, a camming action will develop between the hooked or curvate end of actuator **20**, and the wall portions of plunger **12** adjacent groove **18** so as to force said actuator **20** against its normal bias as it leaves groove **18** thereby applying a force against actuating button **28** of micro-switch **27** for tripping of the latter. When the fluid pressure in the system returns to a balanced state, the plunger **12** will be returned to centered position, with the curvate end of actuator **20** being restored to groove **18**, with release of switch-tripping contact with actuating button **28**.

In view of the foregoing, a normal differential of the pressures within sensing elements **16**, **17** will effect travel or floating of plunger **12** so as to bring about switch tripping action. It is obvious that switch **27** may be so set as to be closed or opened by the movement of plunger **12**. The extreme sensitivity of bellows assembles **16**, **17** to the pressure of the received fluids whether the same be liquid or gaseous, will allow for switch action upon development of small differentials, such as in the order of one (1) pound per square inch. Since said sensing elements **16**, **17** are hermetically sealed, all the operating parts of device A are protected against damage contact with fluids which may in many instances be quite hazardous as well as restrictive of the component elements.

In view of the foregoing, it is apparent that switch A is peculiarly adapted for reliable functioning over a long life and having a sensitivity to differential of pressures within a fluid pressure system so as to be adaptable for utilization in a multiplicity of industrial applications.

It is quite obvious that switch A may be modified for myriad purposes, such as for instance by setting one of the two bellows assemblies **16**, **17** at a fixed absolute pressure, so that with the other bellows assembly being adapted for expansion, the system could be used as a aneroid or absolute pressure sensor. With the said pressure sensors as provided by said bellows assemblies **16**, **17**, it is apparent the present invention could be readily designed for use as a proportional indicating device, a potentiometer, as a flow indicator and the like. It is further manifest that if plunger **12** were replaced by a piston, the bellows assemblies **16**, **17** would render the resultant structure capable of serving as a valve which could shut off, restrict or proportionally divide fluid flow.

Bellows assemblies **16**, **17** are adaptable for use with different fittings and with a variety of mounting configurations. Fittings **7**, **8** which are adapted for use with tubing by other types of well-known fittings may be used with equal effectiveness.

Another feature of the present invention is the adjustability of same since the desired positioning of angle bracket **23** will permit of pre-determined pressure settings by reason of movement of the actuator and micro-switch assembly longitudinally. By means of a slot **36** formed in leg **22** of bracket **23**, pin **21** may be adjusted for preventing actuating button **28** from being overtraveled due to tolerance built up of the various parts.

With reference being made to FIGURE 6, A' generally designates a fluid operated switch which is substantially similar to fluid switch A above described in that the same incorporates a body **1'**, communicating with conduit fittings **7'**, **8'**, at its opposite ends and internally having a chamber **11'** for slideably receiving therein a plunger **12'** being of general H-shape with a central partition **13'** and endwise opening compartments **14'**, **15'** for receiving pressure sensing elements **16'**, **17'**, each of which comprises a bellows assembly; there being a groove **18'** formed in the outer face of partition **13'**; all of said components and elements being of like construction as the corresponding components and elements of fluid operated switch A described hereinabove. The wall portion of body **1'** is provided with an enlarged opening **40** which registers with groove **18'** of partition **13'** for extension therethrough of a cylindrical actuator **41** having a rounded outer end for projection into said groove **18'** and for camming relationship with the marginal portions thereof; said actuator **41** being disposed for axially slideable movement within an annular socket **42** carried upon a bracket **43** suitably mounted upon outer face of the proximate portion of body **1'**; said bracket **43** being substantially structurally identical with bracket **23** above described. Bracket **43** mounts a micro-switch **27'** having an actuating button **28'** which said switch and button are identical with switch **27** and button **28** described hereinabove. Said button **28'** projects into the said socket **42** for normal abutment against the inner end face of actuator **41**.

Thus, upon axial movement of plunger **12'** within chamber **11'** pursuant to pressure differentials between the said bellows assemblies **16'**, **17'**, camming engagement will develop between the marginal portions of groove **18'** and the rounded outer end of actuator **41** so as to cause same to move inwardly, or in a direction toward micro-switch **27'**, thereby forcing button **28'** inwardly and bringing about the desired operation of micro-switch **27'**. Upon return of plunger **12'** to centered position within chamber **11'**, actuator **41** will be thereby released for outward movement into the position shown in FIGURE 6 which will be effected by release of the normal bias upon actuator button **28'**, resulting in the prearranged operation of micro-switch **27'**.

It will be seen that switch A' incorporates a cylindrical, bullet-like actuator which is slideably movable along its longitudinal axis and restrained against non-axial movement by socket **42**. Thus, reliable and constant action will be assured.

It should be understood that changes and modifications in formation, construction, and arrangement and combination of the several parts of the fluid operated switch may be made and substituted for these herein shown and described without departing from the nature and principle of our invention.

We claim:

1. A fluid operated switch comprising:

(a) means defining a housing;

(b) a plunger slideably received within said housing for reciprocal travel therein and having a pair of compartments;

(c) fluid pressure sensitive means disposed in each of said compartments for effecting sliding movement of said plunger;

(d) a circuit switch disposed adjacent said housing; and

(e) switch actuator means engaged to said switch and connected to said plunger for operatively interengaging said switch and said plunger for tripping of the former upon movement of the latter.

2. A fluid operated switch as defined in claim **1**, and further characterized by:

(b) said plunger being of general H-shape in cross-section, having a central partition portion and a compartment on either side of said partition, each of said compartments opening through the adjacent end of said plunger; and

(c) said fluid pressure sensitive means being disposed in each of said plunger compartments;

(f) a source of fluid; and

(g) means connecting said source of fluid to the fluid pressure sensitive means in each of said plunger compartments.

3. A fluid operated switch as defined in claim **2**, and further characterized by:

(c) said fluid pressure sensitive means comprising bellows assemblies disposed in each of said plunger compartments, each assembly engaging the adjacent confronting face of said central partition.

4. A fluid operated switch as defined in claim **3**, and further characterized by:

(b) said plunger being of less length than the said housing; and

(h) stop means provided in said housing for limiting the travel of the plunger therein.

5. A fluid operated switch as defined in claim **4**, and further characterized by:

(i) said housing having end plates;

(h) said stop means comprising an annulus integrally formed on the inner face of each end plate; and

(b) said plunger being of circular cross-section.

6. A fluid operated switch as defined in claim **2**, and being further characterized by:

(a) said housing having an opening in one side portion thereof;

(d) said switch being disposed adjacent said housing opening;

(e) said switch actuator means comprising an arm projecting through said housing opening for engaging said plunger and being presented in operative relationship to said switch; and

(j) means for mounting said arm.

7. A fluid operated switch as defined in claim **6**, and further characterized by:

(b) said plunger having a groove provided in its outer surface substantially intermediate its length in normal registration with said housing opening; and

(e) said switch actuator arm having a curvate portion for normal disposition within said groove for camming action with said plunger upon travel thereof for effecting switch operation.

8. A fluid operated switch as defined in claim **7**, and further characterized by:

(j) said switch actuator arm being resiliently mounted for being biased into engaged relationship at its curvature end wtihin said plunger groove; and

(d) said circuit switch having a control button presented proximate said switch actuator arm for operative engagement thereby upon travel of said plunger.

9. A fluid operated switch as defined in claim **8**, and further characterized by:

(k) means for adjusting the setting of said switch and actuator arm with respect to said plunger.

10. A fluid operatetd switch as defined in claim **2** and further characterized by:

(e) said switch actuator means comprising a cylindrical member;

(l) means defining a support for said switch actuator for slideable movement thereof.

References Cited

UNITED STATES PATENTS

2,753,414	7/1956	Stevenson	200—82
3,194,915	7/1965	Andersen	200—83

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