Jan. 31, 1967 R. SIMONIN, JR 3,301,977

ADJUSTABLE (DIFFERENTIAL) ACTUATION VALUE PRESSURE SWITCH

Filed Feb. 23, 1965 2 Sheets-Sheet 1

FIG. 1.

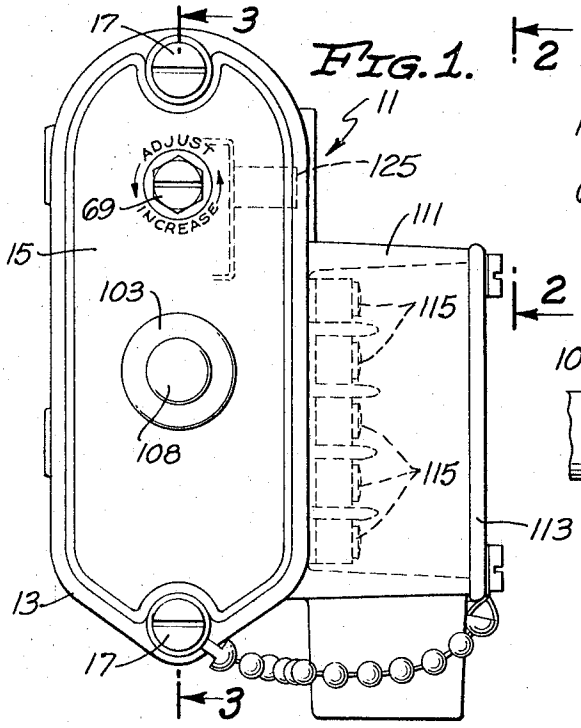

FIG. 2.

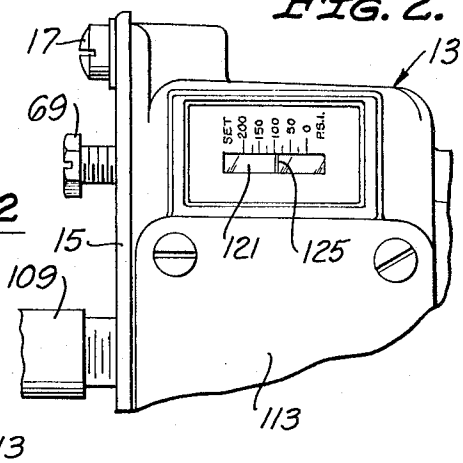

FIG. 3.

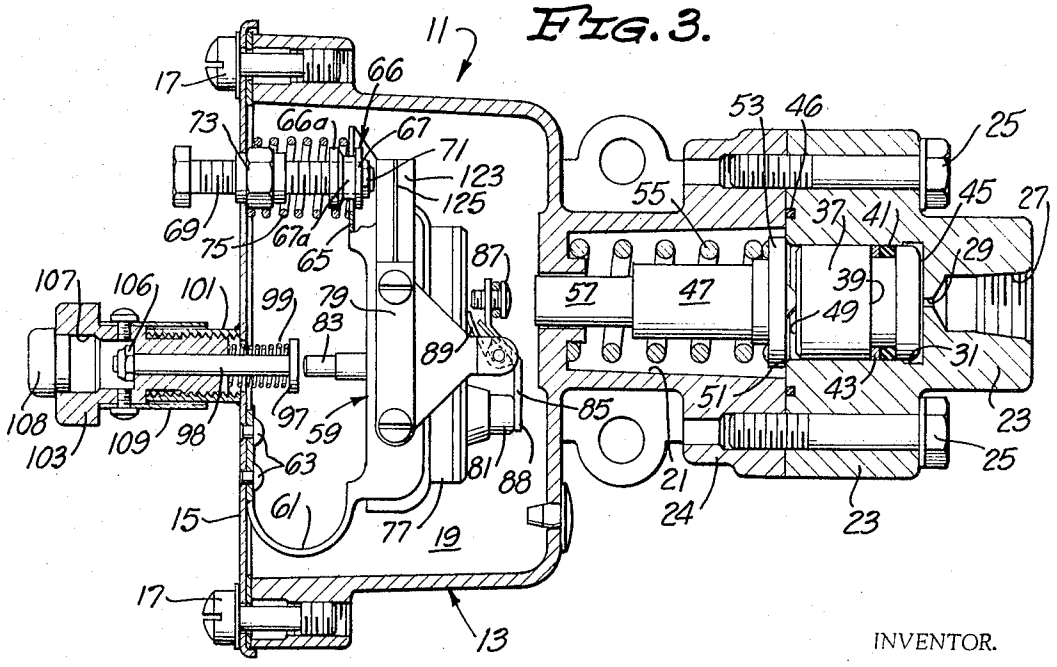

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FIG. 4.

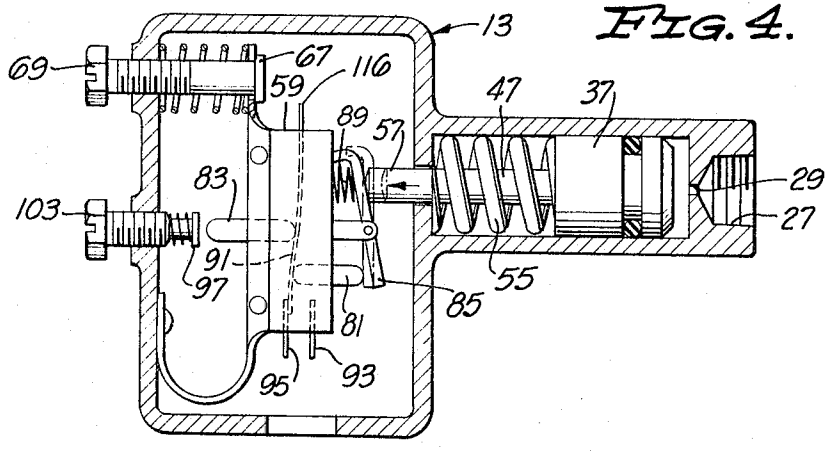


FIG. 5.

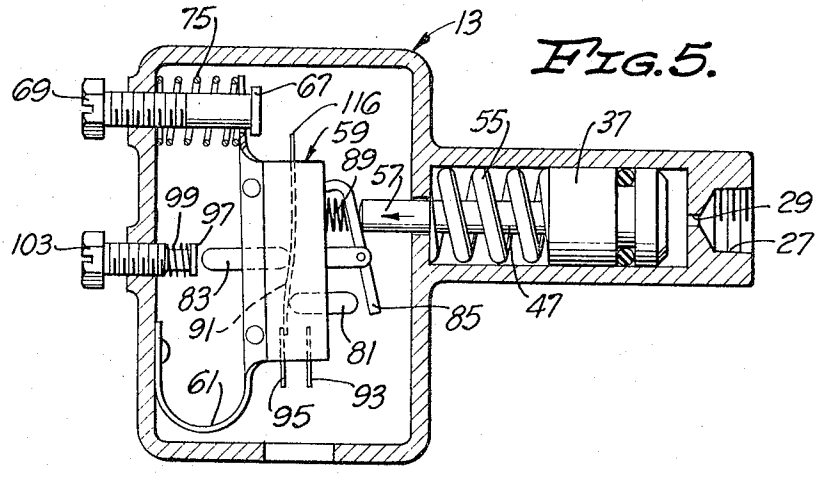
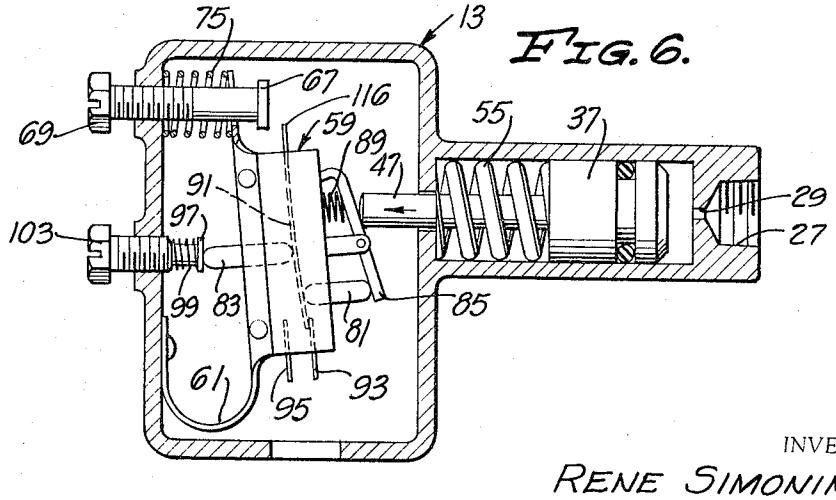


FIG. 6.



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ADJUSTABLE (DIFFERENTIAL) ACTUATION VALUE PRESSURE SWITCH

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4 Claims. (Cl. 200—82)

This invention relates to the switch art and more particularly to adjustable differential actuation value pressure switches.

It is frequently necessary or desirable to provide electrical switches which are actuated in response to a predetermined change in fluid pressure. Such a pressure switch will usually include a pressure responsive element operable to open or close a switch in response to a predetermined pressure change. For some applications, it is desired to use such a pressure switch which will, for example, open at a given pressure level and close at a pressure level somewhat below the opening pressure. It is such a differential pressure switch having means for adjusting the opening and closing pressures that is described and claimed herein.

It is an object of this invention to provide a completely adjustable differential pressure switch, the adjustments on which may be quickly and easily accomplished by control knobs preferably extending outside of the housing.

Another object of this invention is to provide a pressure switch in which the movements of the switch blade between an open and a closed position are controlled by a pressure responsive actuator which moves the entire switch.

A further object of this invention is to provide a pressure switch in which a switch blade is normally biased to one position and a pressure responsive actuator restrains the biasing means and moves the entire switch to cause the switch blade to move to a second position.

A further object of this invention is to provide a pressure switch in which the settings which actuate the opening and closing thereof are adjustable by adjusting a limit of travel of the switch and the position of an abutment relative to the switch.

A still further object of this invention is to provide a pressure switch in which the switch causing opening and closing of the electrical circuit is adjustable by adjusting the limit of travel of the switch to establish a decreasing pressure setting and the position of a flange abutment relative to the switch to establish an increasing pressure setting.

Another object of this invention is to provide novel linkages and details of construction for an adjustable differential pressure switch.

Briefly stated, the objects of the invention may be accomplished by providing a support and a manual reset switch mounted for movement relative to the support and having a switch blade movable between a first position and a second position. Restrainable means engage the switch blade and bias it to a first position. Actuator means responsive to fluid pressure are operable to restrain the restrainable means from biasing the switch blade and for moving the switch relative to the support. An abutment is provided in the path of movement of the switch to cause the switch blade to move to the second position in response to a predetermined movement of the switch. According to another aspect of the invention, the position of the abutment relative to the switch may be adjusted and a stop is provided to limit the travel of the switch in one direction.

The invention, both as to its organization and method of operation together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings.

In the drawings:

FIG. 1 is a plan view of an adjustable differential pressure switch embodying the teachings of the present invention;

FIG. 2 is an enlarged fragmentary elevational view taken along line 2—2 in FIG. 1;

FIG. 3 is a partial sectional view taken along line 3—3 of FIG. 1;

FIG. 4 is a simplified partial sectional view similar to FIG. 3 showing the actuator rod just after it engages the restraining means;

FIG. 5 is a partial sectional view similar to FIG. 4 showing the switch moved slightly upwardly by the actuator rod in response to an increasing fluid pressure; and

FIG. 6 is a partial sectional view similar to FIG. 4 showing the switch blade just after it has been snapped to the second position.

With reference to FIGS. 1 and 3, an adjustable differential pressure switch **11** is shown. The adjustable differential pressure switch **11** includes a body or housing **13** having a cover, top wall or support **15** secured to the upper end thereof by a pair of screws **17**, a chamber **19**, and a stepped bore or spring cavity **21**. The body **13** also includes a fitting or end portion **23** and a main body **24** secured together by screws **25**. A threaded pressure sensing port **27** and an axially aligned small orifice **29** expose a cylinder or fitting bore **31** to a source of varying fluid pressure.

Slidably mounted in the fitting bore **31** is a piston **37** having a groove **39** for an O-ring **41** and a back-up ring **43**. Thus fluid pressure passing through the pressure sensing port **27** and the orifice **29** may act on a face **45** of the piston **37**, but such fluid under pressure is prevented by the O-ring **41** and the back-up ring **43** from entering the spring cavity **21** of the body **13**. Another O-ring **46** seals the interface between the end portion **23** and the main body **24**.

An actuator rod **47** abuts a back face **49** of the piston **37** and rests on a seat **51** in the position shown in FIG. 3. The actuator rod **47** may be of various shapes but preferably has a flange **53** against which a coil spring **55** may abut to force the latter into a seating relationship with the seat **51**. An end **57** of the actuator rod **47** extends upwardly into the chamber **19**. Thus, fluid pressure acting through the pressure sensing port **27** will tend to force the piston **37** and the actuator rod **47** upwardly against the resilient force of the coil spring **55**.

A switch preferably a manual reset switch **59** is mounted in the chamber **19** at one end by a spring bracket **61** which is secured to the support **15** by a plurality of rivets **63**. The spring bracket **61** is preferably curved and possesses sufficient resilience to allow movement of the switch **59** in a manner hereinafter described.

The other end of the switch **59** has an apertured plate **65** which receives a bushing **66** having a flange **66***a* and a flange **67** spaced by and integral with a tube portion **67***a*. The apertured plate **65** slidably receives the tube portion **67***a* of the bushing **66**. The bushing **66** is slidably mounted on a threaded decreasing pressure or low level adjusting screw **69** by a nut or stop **71** which halts downward motion of the switch **59**. A threaded self-locking nut **73** which is secured to the support **15** threadedly receives the decreasing pressure adjusting screw **69**

to hold the latter in the properly adjusted position, and a coil spring 75 which surrounds the adjusting screw 69 urges the switch 59 downwardly against the stop 71. Thus, the bushing 66, the adjusting screw 69 and the spring bracket 61 mount the switch 59 for movement along a path and the spring bracket 61 and the spring 75 constitute switch biasing means for urging the switch 59 in one direction along said path.

The switch 59 includes a switch housing 77, a bracket 79, a low level or decreasing pressure button 81, and an increasing pressure or high level button 83. A lever 85 having a screw 87 threadedly secured in one end thereof is pivotally mounted to the bracket 79, the other end 88 of the lever being urged by a spring 89 into engagement with the decreasing pressure button 81. Both the buttons 81 and 83 are telescopically received by the switch housing 77 and are operative to urge a switch blade 91 (shown somewhat diagrammatically in FIGS. 4 through 6) between a pair of fixed contacts 93 and 95, i.e., movement of the decreasing pressure button 81 inwardly into the switch housing 77 operates to urge the switch blade 91 into engagement with the fixed contact 95. Conversely, movement of the increasing pressure button 83 inwardly into the switch housing 77 causes the switch blade 91 to move into engagement with the fixed contact 93. The buttons 81 and 83 may or may not engage the switch blade 91. The details of a manual reset switch construction which allows buttons such as the buttons 81 and 83 to move a switch blade between fixed contacts are well known in the prior art and are not discussed in detail herein.

The switch 59 being of the manual reset type employs a switch blade which will snap into engagement with a fixed contact when it is urged beyond a given point. It should be understood that engagement of the switch blade 91 with either of the fixed contacts 93 or 95 may be operative to either open or close the switch, or both of the contacts 93 and 95 may complete separate external circuits.

Thus, with the elements of the adjustable differential pressure switch 11 disposed as shown in FIG. 3, the spring 89 pivots the end 88 of the lever 85 into engagement with the decreasing pressure button 81. The force of the spring 89 moves the decreasing pressure button 81 inwardly into the switch housing 77 to urge the switch blade 91 upwardly into engagement with the fixed contact 95. Thus, this pivotally mounted levers arrangement and the button 81 constitute restrainable means for biasing the switch blade 91 into a first position.

An adjustable abutment is mounted on the support 15 and is responsive to movements of the switch 59 for urging the switch blade 91 to a second position in which it engages the fixed contact 93. A flange or abutment 97 is formed at one end of a plunger 98 which extends through the support 15 and is biased to the right by a coil spring 99 which can exert a force sufficient to cause the switch blade 91 to snap into engagement with the fixed contact 93. In the positions of FIGS. 3 and 4 the abutment 97 is spaced from the button 83. An internally threaded tube 101 is welded to the support 15 and receives a threaded high level or increasing pressure adjusting knob 103 in which the plunger 98 is slidably mounted. A nut 106 in a recess 107 in the adjusting knob 103 limits movement of the plunger 98 to the right under the force of the spring 99. The recess 107 is closed by a cap 108 and a skirt 109 is secured to the adjustment knob 103 and extends toward the support 15. Thus, by rotating the adjustment knob 103, the position of the flange 97 with respect to the support 15 and the switch 59 can be varied.

Means are also provided to house the terminals of the switch. A terminal housing section 111 (FIG. 1) which is preferably integral with the body 13 and has a removable cover 113 is provided. A plurality of terminals 115, at least some of which are suitably electrically connected to the fixed contacts 93 and 95, and to a common terminal 116 by electrical connections (not shown), are provided within the terminal housing 111. Thus, the terminals 115 may be used to connect the pressure switch 11 to an external circuit.

The operation of the device is as follows:

The pressure switch 11 is first connected by means of the pressure sensing port 27 to a source of fluid pressure, the pressure changes of which are to control the switch 59. When the pressure is at some predetermined low level, the elements of the present invention will be disposed as shown in FIG. 3. Thus, the spring 89 acts through the lever 85 to hold the switch blade 91 in a first position in engagement with the fixed contact 95 and the switch 59 is resiliently held in a first location abutting the stop 71. As the pressure sensed through the port 27 increases, the piston 37 will move to the left as viewed in FIG. 3, thereby forcing the end 57 of the actuator rod 47 to the left. As the pressure continues to increase, the piston 37 and the actuator rod 47 continue their leftward movement until the end 57 engages the screw 87 in the lever 85 and urges the latter against the force of the spring 89 to pivot counterclockwise as shown in FIG. 4. At this point it should be noted that FIGS. 4 through 6 are provided only to clearly show the operation of the pressure switch and, accordingly, the construction shown therein is simplified from that depicted in FIGS. 1 through 3. With further increases in pressure, the lever 85 will be rotated until the screw 87 abuts the switch housing 77 (FIG. 5) and the lever 85 no longer urges the button 81 to bias the switch blade 91 against the fixed contact 95. The switch blade 91, however, remains in engagement with the fixed contact 95.

Additional pressure increase causes the actuator rod 47 to urge the switch 59 to the left against the force of the spring bracket 61 and the coil spring 75 until the button 83 contacts the abutment 97. The spring 99 affords sufficient resistance to the leftward movement of the increasing pressure button 83 to arrest it. Accordingly, additional leftward movement of the switch 59 causes relative movement between the latter and the button 83 to thereby effect movement of the switch blade 91 into engagement with the fixed contact 93 (FIG. 6).

Thus, when the switch 59 is moved to this second location, it moves the switch blade 91 to a second position.

Upon a reduction in fluid pressure, the spring 55 will move the piston 37 and the actuator rod 47 to the right, thereby allowing the spring bracket 61 and the coil spring 75 to move the switch 59 a corresponding distance to the right. As the pressure continues to decrease, the plate 65 on the switch housing 77 will engage and come to rest back at the first location on the stop 71, thereby arresting the rightward movement of the switch 59. The switch blade 91 remains in the second position in contact with the fixed contact 93 until the actuator rod 47 has moved still further to the right to allow the spring 89 to force the lever 85 and the low level button 81 clockwise to snap the switch blade to the position shown in FIG. 4, i.e., in engagement with the fixed contact 95.

It is apparent that a higher pressure is required to move the switch blade from the fixed contact 95 to the fixed contact 93 than to move the switch blade from the contact 93 to the contact 95. That is, to move the switch blade 91 into engagement with the fixed contact 93, the pressure sensed at the port 27 must be sufficiently great to move the piston 37 and the switch 59 to the far leftward position shown in FIG. 6. However, to move the switch blade 91 back into engagement with the fixed contact 95, the pressure at the port 27 must be reduced sufficiently to allow the switch 59 to come to rest against the stop 71 and to allow the lever 85 to rotate a sufficient distance to return the switch blade to the fixed contact 95.

The pressure at which the switch blade 91 moves from one fixed contact to the other is completely adjustable in the following manner. To increase the pressure at which the switch blade moves from the fixed contact

95 to the fixed contact 93, the adjustment knob 103 is screwed to the left away from the support 15, thereby moving the flange 97 outwardly, away from the button 83 and toward the support 15. Thus, the switch 59 must move further to the left before the button 83 engages the flange 97 so that further leftward movement of the switch 59 will move the switch blade 91 to the position shown in FIG. 6. Of course, turning the adjusting knob 103 in the opposite direction will reduce the pressure required to move the switch blade 91 to the position shown in FIG. 6.

To adjust the decreasing pressure or the pressure at which the switch blade 91 is forced from the fixed contact 93 to the fixed contact 95, the low level adjusting screw 69 is turned to move the stop 71. Turning the adjusting screw 69 inwardly or to the right reduces the pressure required to move the switch blade 91 to the position shown in FIG. 4 and moving the adjusting screw to the left has the opposite effect. Thus, the pressures at which the switch 59 is operable are completely and quickly adjustable by turning the appropriate controls which are positioned external to the body 13.

Another important feature of this invention is the provision of a dial which permits the user of the pressure switch 11 to read the pressures at which the switch 59 will operate. In FIG. 2, a transparent window 121 is provided with markings to indicate numerous pressure settings. The switch 59 is provided with an extended portion 123 (FIG. 3) having a line or narrow flange 125 thereon which extends to a point closely adjacent the window 121 and is visible through the latter as shown in FIG. 2. Thus, the decreasing pressure setting and any pressures thereabove to which the switch 59 may be exposed are determinable by the readings appearing at the window 121. Suitable calibrations may also be provided for example on the tube 101 to indicate the increasing pressure setting.

Many changes, modifications, and substitutions may be made by one having ordinary skill in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. A differential pressure switch exposed to varying fluid pressures comprising:
- a support;
- a switch mounted for movement toward and away from said support and having a switch blade movable between a first position and a second position;
- switch biasing means biasing said switch away from said support;
- restrainable means biasing said switch blade to said first position;
- means responsive to the pressure rising to a first level for restraining said restrainable means from biasing said switch blade;
- actuator means responsive to pressures above said first level for moving said switch against the force of said switch biasing means toward said support;
- an abutment mounted on said support;
- means movable with said switch into engagement with said abutment for moving said switch blade into said second position after said engagement occurs; and
- means to adjust the position of said abutment relative to said support to thereby adjust the pressure at which said switch blade is moved into said second position.

2. A differential pressure switch exposed to varying fluid pressures comprising:
- a support;
- a switch mounted for movement toward and away from said support and having a switch blade movable between a first position and a second position;
- a stop secured to said support;
- switch biasing means biasing said switch away from said support and into engagement with said stop;

- restrainable means biasing said switch blade to said first position;
- means responsive to the pressure rising to a first level for restraining said restrainable means from biasing said switch blade;
- actuator means responsive to the pressure rising above said first level for moving said switch out of engagement with said stop against the force of said switch biasing means toward said support;
- means moving said switch blade to said second position in response to a predetermined movement of said switch toward said support; and
- means to adjust the distance between said stop and said support.

3. A differential pressure switch exposed to varying fluid pressures, comprising:
- a support;
- a switch movably secured to said support and having a switch blade movable between a first position and a second position;
- means urging said switch blade to said first position when the pressure is below a first level;
- pressure responsive means moving said switch toward said support along a predetermined path from a first location to a second location when the pressure increases to a second level;
- a stop spaced from and secured to said support, said first location being defined by the engagement of said switch and said stop, said second location being nearer said support than said first location;
- abutment means mounted on said support for urging said switch blade to said second position when said switch is in said second location;
- resilient means moving said switch against the force of said pressure responsive means from said second location to said first location when the pressure decreases to an intermediate level;
- means adjusting the distance between said stop and said support thereby adjusting the disposition of said first location and the value of said intermediate level of pressure; and
- means adjusting the distance between said abutment means and said support thereby adjusting the disposition of said second location and the second pressure level.

4. A differential pressure switch exposed to varying fluid pressures comprising:
- a housing having a cylinder and a chamber;
- a fluid pressure responsive piston mounted for movement in said cylinder;
- an actuator rod movable in response to said piston and extending from said piston toward said chamber;
- a switch housing having a switch blade movable between a first position and a second position and mounted to a wall of said chamber, said switch housing being movable by said actuator rod from a first location to a second location;
- a stop secured to said wall of said chamber;
- means to adjust the distance between said stop and said wall;
- first resilient means urging said switch away from said wall and into engagement with said stop to define said first location of said switch housing;
- an abutment secured to said wall;
- means to adjust the distance between said wall and said abutment;
- a lever pivotally mounted intermediate its ends to said switch housing, one of said ends being engageable by said actuator rod;
- first button means on said switch housing movable to urge said switch blade to said first position, said button means being engageable by the other end of said lever;

second resilient means rotating said lever so that said other end engages said first button means to move said switch blade to said first position; and

second button means in said switch housing cooperating with said abutment in said second location of said housing for urging said switch blade to said second position.

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