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PRESSURE DIFFERENTIAL SWITCH WITH RANGE BALANCE ADJUSTMENT

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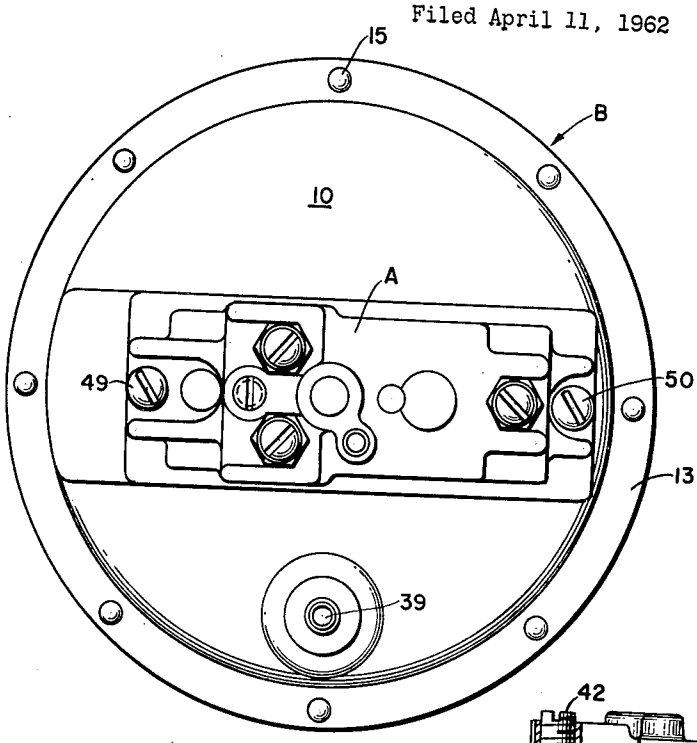

FIG. 1.

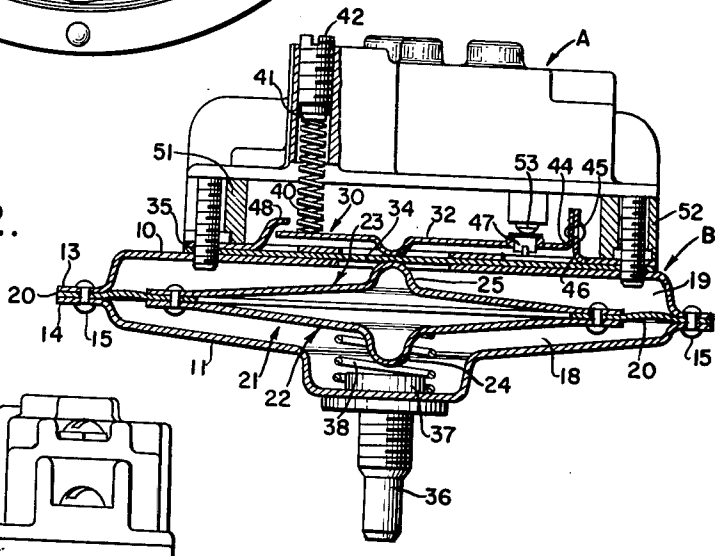

FIG. 2.

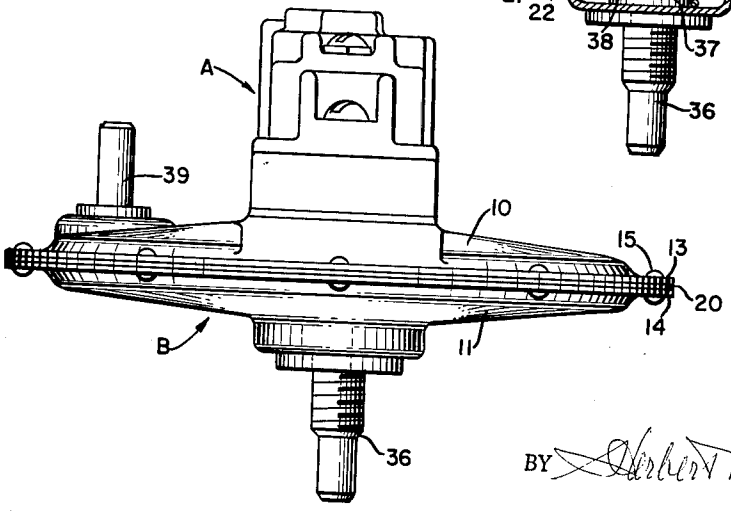

FIG. 3.

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PRESSURE DIFFERENTIAL SWITCH WITH RANGE BALANCE ADJUSTMENT

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The present invention relates to pressure control means for electric switches.

An object is to provide in combination with the operating pin of an electric switch, a pressure control adapted for actuation with respect to very low pressures, vacuum, or pressure differentials, including means operatively associated therewith for producing a given operating differential with a fixed or an adjustable switch operating range.

Another object is to provide a novel pressure-electric control of overall small size and simplicity, whereby the usual extra levers and connections of the prior art to produce a given differential or an operating range are eliminated.

Still another object is to provide a novel pressure control with a range adjustment, whereby the operating point of the control is adjustable and maintains contact force with the operating pin or the like of a switch to be actuated by the control,

With the above and other objects and advantages of the invention in view, the invention is best understood by reference to the accompanying drawing, wherein an embodiment of the invention is illustrated.

In the drawing:

FIGURE 1 is a top plan view of the invention showing the switch unit mounted on the pressure differential control unit;

FIGURE 2 is a side view of the invention shown in FIGURE 1 with the switch and pressure differential control mostly in cross section; and

FIGURE 3 is a side elevation view of the complete device shown in the foregoing figures.

Referring in detail to the drawing and first with particular reference to FIGURE 2, there is shown an electric switch casing A mounted on a housing B of a static pressure differential control, which provides the pressure sensing function of the invention.

For example, as shown in FIGURE 2 the housing B is formed by two opposed dome-shaped covers 10 and 11 each having annular flanges 13 and 14 suitably secured together as by rivets 15. Thus secured together the covers provide an interior area which is divided into a pressure chamber 18 and a pressure chamber 19 by a flexible membrane 20 of suitable material and a plate diaphragm 21.

The plate diaphragm 21 is comprised of two plates 22 and 23 each centrally formed with axially aligned outwardly projecting hollow thrust buttons 24 and 25, respectively. Each plate at each peripheral edge thereof is secured to each other with each side of the flexible membrane 20 sandwiched therebetween. The plate diaphragm 21 is smaller than the interior of the housing B, so that the terminal circumferential edge of the plate diaphragm 21 leaves an annular flexible portion of the membrane 20 free for movement in response to pressure conditions in the respective adjacent chambers 18 and 19 on either side thereof; and the plate diaphragm 21 is in floating movement therewith.

The outer peripheral surface of the flexible membrane 20 is secured between the opposed surfaces of the respective flanges 13 and 14 of the dome-shaped covers 10 and 11, by the rivets 15, which hold the covers together.

The flexible membrane 20 serves as a means to seal the pressure chamber 18 from the adjacent pressure chamber 19 and the plate diaphragm 21 connected to the flexible membrane serves the purpose of keeping the effective area of the pressure sensing unit B to an operational maximum. Also, the plate diaphragm 21 by virtue of the thrust button 25 of plate 23 serves to transmit the resultant pressure of the spring biased arm 30 to actuate a suitable snap switch, not shown, housed in the electric switch casing A.

The switch actuator arm 30 intermediate the length thereof is formed with a pressed out thrust button 32, which is directly aligned with the thrust button 25 of plate diaphragm 23. However, the chamber 19 of the pressure housing B is sealed from the superposed switch housing A by a flexible membrane seal 34 secured between the exterior of the top of the cover 10 and a mounting plate 35 for the actuating arm 30, whereby resultant movement of the respective thrust buttons 25 and 32 is imparted through flexing the membrane seal 34.

The center of the lower cover 11 of the housing B is countersunk and coupled to a fitting 36, which connects with suitable means, not shown, for sensing required pressure. A collar 37 is brazed concentrically around the pressure sensing coupler opening and fits within the lower convolution of a coiled stabilizing spring 38. The upper convolution of the spring encircles the button 24 of the diaphragm plate 22. This spring 38 is thus compressed at each end and is used to keep all parts under stress to reduce variations, which may occur from repositioning of component parts. Under some conditions of operation, the spring 38 will permit the lower of the two pressures in the respective chambers 18 and 19 to be connected to the condition responsive control fitting 36. Thus in a vertical position of the unit this would be the lower fitting.

The cover plate 10 at an offset point thereof is provided with a countersunk portion for a fitting 39, hereinafter called, the upper fitting. This upper fitting is normally the low pressure fitting with respect to the lower fitting 36, and fitting 39 may be connected to any suitable pressure, such as static or a desirable reference pressure.

The flexible seal 34 between the thrust button 25 and the switch actuator arm button 32 seals the upper chamber 19 from the atmosphere and thus this chamber only contains static or a desirable reference pressure.

The main switch actuator arm 30 is engaged at the free end thereof by the lower convolution of a range spring 40. This spring extends into a socket 41 in the housing A into contact at the upper convolution thereof with an adjustable screw 42. The screw 42 may be adjusted to obtain the required operating range of the switch control unit. For example, by the oppositely biased springs 38 and 40, the plate diaphragm 21 may be balanced and the snap switch operated from the balanced position with minimum diaphragm movement.

The opposite end of the main switch actuator arm 30 is pivoted by a spring hinge 44 secured by a rivet 45 to an upstanding lug 46 of the mounting plate 35, see FIGURE 2. A movable switch button operator 47 is carried by the control arm 30 adjacent the hinge 44 and to the right of the thrust button 32. This button is threaded into the arm 30 so as to be adjustable with respect to an operator pin 53 of a snap switch positioned directly above the same in casing A. Also, the base plate 35 is formed with an upstanding lug 48, which projects vertically above the free end of the main control arm 30 and serves as a stop for the said arm, to thereby prevent the control arm from being overstressed.

The switch housing A is supported on the housing

plate or cover 10 by spacer portions 51 and 52 and threaded bolt members 49 and 50, which bolt members thread into the cover through openings in the switch base plate 35 and the flexible membrane 34, which seals out atmospheric air from the interior chamber 19 of the housing B.

The switch housing A may enclose any suitable precision type snap switch means and the housing is interchangeable with the housing B of the static pressure differential control by virtue of the threaded bolt members 49 and 50, whereby when the housings A and B are assembled together a sustained or constant contact force between the control arm button 47 and the downwardly extending switch operating pin or button 53 is provided.

Operation

While the foregoing description is more or less impliedly written as though the complete assembly is in a vertical position, as illustrated in FIGURE 2, it is equally efficient in operation in any position. For example, a pressure increase admitted through the sensing control fitting 36 will cause the plate diaphragm to move toward the control arm. This movement is transmitted through the flexible seal 34 by thrust button 25 to button 32 of the main control arm 30, to thereby cause engagement of the main arm operator button 47 into engagement with snap switch operator pin 53.

The force on the control arm 30 may be altered, if necessary, by adjusting the range screw 42, to thereby regulate the spring bias on the arm, which is respectively related to the pressures in the chambers 18 and 19. Thus generally a differential function is incorporated by the control arm into an operatively associated electric switch by setting the force-movement of the control to a given factor with respect to the operating pin of the connected switch. The range movement of the switch mechanism per se may also be regulated by a variation of the spring in the switch and any change of the switch differential movement from the differential pressure control means gives a proportion deflection of the range spring. Thus the differential function of this control has been incorporated into the switch function, by setting the force-movement to a given factor. Also a change of the switch movement differential in casing A gives a proportional deflection of the range spring 40. This force change added to the force change of the switch results in obtaining the movement differential to produce a resultant or a desired operating pressure differential in the control.

Without further description it is believed that the advantages of the present invention over the prior art is apparent and while only one embodiment of the same is illustrated, it is to be expressly understood that the same is not limited thereto as various changes may be made in the combination and arrangement of the parts illustrated, as will now likely appear to others and those skilled in the art. For a definition of the scope or limits of the invention, reference should be had to the appended claims.

What is claimed is:

1. A pressure differential control snap switch with a casing, an elongated actuating arm, having upper and lower sides, a thrust button portion on the arm extending below said arm, an operating pin in said switch engaged with said actuating arm during depression and retraction of said pin during operation of said switch, said control including a housing having top and bottom walls, said housing being secured to said casing of said switch, said snap switch being confined in said switch casing, said actuating arm being in constant engagement with said pin, a mounting plate for said arm with a central opening, said plate having an upstanding lug, said arm being pivoted to said lug, a pair of pressure chambers in said housing, one chamber being below the top wall and responsive to static pressure and the other chamber being above the bottom wall and being responsive to variable pressure, a plate diaphragm in said housing, a flexible membrane seal connected to said plate diaphragm and secured between said top and bottom walls of said housing, said flexible membrane seal and said plate diaphragm forming a dividing wall between said chambers, an opening in the top wall of said housing next to said pressure chamber in registry with the said central opening in the mounting plate, a second flexible membrane seal secured between said mounting plate over the exterior of the top wall of said housing, whereby said differential control chambers are isolated from ambient atmospheric pressure around the switch operating pin, said thrust button portion extending below said arm being in contact with the said second membrane seal, a second thrust button carried by said plate diaphragm in opposed alignment with said arm thrust button in contact with each opposite side of said membrane seal, a range spring means engaged with said switch actuating arm, and an oppositely acting spring with respect to said range spring engaged with said plate diaphragm in said variable pressure chamber for maintaining each of said respective opposed thrust buttons with opposed movement-force in constant contact with said second membrane seal.

2. A pressure differential control snap switch with a casing, an elongated actuating arm, having upper and lower sides, a thrust button portion on the arm extending below said arm, an operating pin in said switch engaged with said actuating arm during depression and retraction of said pin during operation of said switch, said control including a housing having top and bottom walls, said housing being secured to said casing of said switch, said snap switch being confined in said switch casing, said actuating arm being in constant engagement with said pin, a mounting plate for said arm with a central opening, said plate having an upstanding lug, said arm being pivoted to said lug, a pair of pressure chambers in said housing, one chamber being below the top wall and responsive to static pressure and the other chamber being above the bottom wall and being responsive to variable pressure, a plate diaphragm in said housing, a flexible membrane seal connected to said plate diaphragm and secured between said top and bottom walls of said housing, said flexible membrane seal and said plate diaphragm forming a dividing wall between said chambers, an opening in the top wall of said housing next to said pressure chamber in registry with the said central opening in the mounting plate, a second flexible membrane seal secured between said mounting plate over the exterior of the top wall of said housing, whereby said differential control chambers are isolated from ambient atmospheric pressure around the switch operating pin, said thrust button portion extending below said arm being in contact with the said second membrane seal, a second thrust button carried by said plate diaphragm in opposed alignment with said arm thrust button in contact with each opposite side of said membrane seal, a range spring means engaged with said switch actuating arm, and an oppositely acting spring with respect to said range spring engaged with said plate diaphragm in said variable pressure chamber for maintaining each of said respective opposed thrust buttons with opposed movement-force in constant contact with said second membrane seal, and combined range adjustment and reset means for varing the bias action of said range spring in opposition to said diaphragm spring.

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