Oct. 22, 1968 H. R. CHAPIN 3,407,277

PRESSURE SWITCH

Filed Oct. 22, 1965

FIG. 1

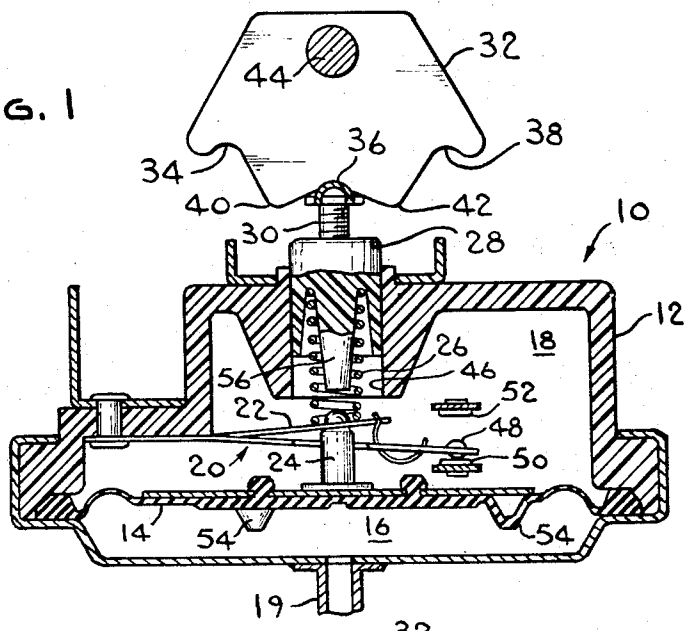
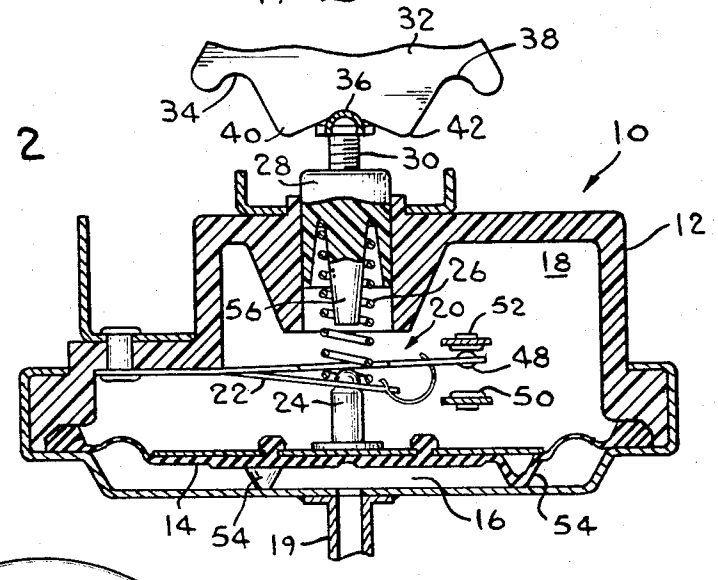


FIG. 2



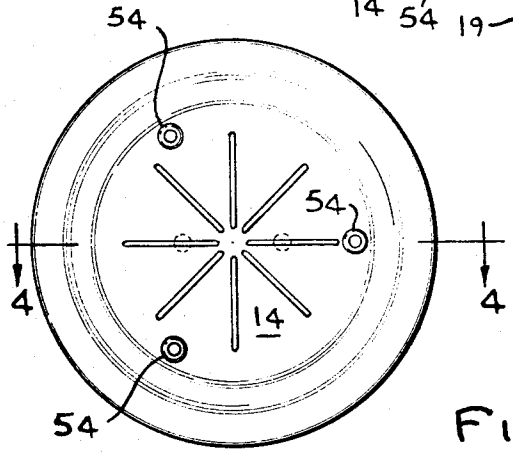


FIG. 3

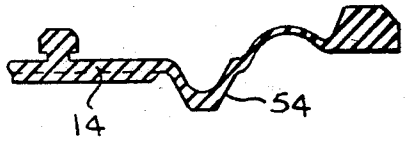


FIG. 4

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PRESSURE SWITCH

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ABSTRACT OF THE DISCLOSURE

This disclosure relates to a pressure switch wherein an overcenter snap switch is movable between a trip position and a reset position on the basis of a pressure condition which acts on a diaphragm and against a spring, the spring opposing diaphragm movement in response to increased pressure on the diaphragm. In accordance with this disclosure resilient lugs are arranged on the diaphragm so as to engage the pressure switch housing to limit diaphragm movement in a reset direction. The lugs limit expansion and relaxation of the calibrating spring to an amount insufficient to relax the calibrating spring to such an extent that it can shift its seat, but the resiliency of the lugs permits them to accommodate overtravel.

This invention relates to pressure switches.

A typical pressure switch includes a snap switch (generally a toggle or overcenter switch), a diaphragm connected to the switch to exert an operating force on the switch in accordance with a particular pressure condition, and a compression calibrating spring acting in opposition to the force exerted by the diaphragm. Such pressure switches are generally operable between trip and reset positions with the calibrating spring being adjustable to determine the pressures as which trip and reset occur. In some instances pressure switches have been observed to lose their prescribed calibration in that, in operation they did not maintain the trip and reset actuating points established at initial calibration. It has been discovered that this loss of calibration was a result of the calibrating spring, on moving in a direction toward reset, being relaxed to such a degree that it shifted its seat. When its seat shifts the force exerted by the spring in opposition to the diaphragm force is varied thereby disturbing the desired calibration of the pressure switch.

This invention is concerned with this problem of loss of calibration and has a general object to provide a pressure switch construction which will hold a prescribed calibration and thereby provide consistent operating characteristics over extended operation and through the full range of calibrating spring adjustment.

For the achievement of this and other objects, this invention proposed an arrangement which limits the movement of the diaphragm in the reset direction, and correspondingly the expansion and relaxation of the calibrating spring, to an amount insufficient to relax the calibrating spring to such an extent that it can shift its seat.

Other objects and advantages will be pointed out in, or be apparent from, the specification and claims, as will obvious modifications of the embodiment shown in the drawings, in which:

FIG. 1 is a section view of a pressure switch embodying this invention;

FIG. 2 is a partial section view of the pressure switch illustrating operative engagement of the calibrating spring relaxation limiting means;

FIG. 3 is a bottom view of the diaphragm; and

FIG. 4 is an enlarged view of the relaxation limiting means.

With particular reference to the drawing, pressure switch **10** includes an outer housing **12** of conventional

construction. Diaphragm **14** is supported within the housing and divides the housing interior into pressure chamber **16** and switch chamber **18**. Chamber **16** is adapted to be connected to source of pressure through conduit **19**. A double throw toggle type snap switch **20** is mounted in chamber **18** and its operating tongue **22** is connected to diaphragm **14** through actuator post **24**. Calibrating spring **26** is suitably connected to oppose diaphragm movement, for example having one end bearing on or directly on the switch tongue as illustrated. The opposite end of spring **26** is seated in a movable adjusting cap **28** to oppose the actuating force exerted on the switch by the pressure acting on the diaphragm.

The force with which spring **26** opposes the force exerted by the diaphragm is adjustable by varying the position of cap **28**. This adjustment can be accomplished in any suitable manner, for example through a conventional construction of screw **30** and adjusting cam **32**. Screw **30** is threaded into cap **28** and cam **32** includes a plurality of lands **34**, **36** and **38** separated by raised portions **40** and **42**. Cam **32** is supported for rotation on shaft **44** and the radial distance between the shaft and the lands is different so that the position of cap **28** in bore **46** can be varied by selective engagement of screw **30** in one of the lands which correspondingly varies the compressive force exerted by spring **26** against the diaphragm force.

As illustrated in FIG. 2 the pressure switch is in a reset position. The diaphragm will bow upwardly as the pressure in chamber **16** and on the underside of the diaphragm increases. At a particular "trip" pressure, determined by the adjusted position of cap **28**, switch **20** will go over center moving movable contact **48** from "reset" contact **52** to "trip" contact **50** with the pressure switch assuming its "trip" position as shown in FIG. 1. As the pressure in chamber **16** decreases the diaphragm will move downwardly under the influence of spring **26** toward a reset position. At a particular pressure acting on the underside of the diaphragm the switch will reset. That is, at the reset pressure determined by spring **26** tongue **22** is moved overcenter and movable contact **48** switches from "trip" contact **50** to "reset" contact **52**.

In moving toward the "reset" point the calibrating spring is expanding and it has been discovered that this expansion of the spring can proceed to such an extent that relaxation of the spring is sufficient to permit the spring to shift its seat and thereby disturb the desired calibration set into the pressure switch. The pressure switch of this invention solves this problem by limiting movement of the diaphragm, and correspondingly expansion of the calibrating spring, in the reset direction. This is achieved by providing limit stops between the underside of the diaphragm and housing **12**. Specifically, a plurality of lugs **54** are provided on the underside of the diaphragm and extend toward housing **12**. The lugs **54** engage the housing in reset position, as illustrated in FIG. 2, and limit movement of the diaphragm such that the calibrating spring cannot expand to a point where the spring can shift its seat. Under normal operating conditions the lugs hold the diaphragm so that spring **26** is at all times maintained under some degree of compression between cap **28** and actuator post **24**. Thus, the spring does not relax and it maintains the seating necessary to hold the desired calibration. In normal operation the lugs design is such that reset occurs before the lugs engage the housing so that the lugs do not interfere with reset operation.

The number of lugs can be varied as desired, for example satisfactory results have been obtained by using three lugs equi-angularly spaced around the operational center of the diaphragm (i.e. in line with actuator post **24**).

In some applications a manual reset is provided as well as automatic reset. In such applications arrangements such as that illustrated are used. More particularly, rotation of cam **32** to engage either rise **40** or **42** with screw **30** moves cap **28** downwardly a sufficient distance to engage finger **56** with actuator post **24** and move switch tongue **22** overcenter to reset the switch. It will also be noted that as the cam is rotated to selectively engage one of the lands with screw **30** the switch is moved through reset by the action of rise **40** or **42** on the screw and cap. To insure reset this movement is generally in excess of that which would be necessary to just engage lugs **54** with the housing. The force exerted on manual reset overcomes the support furnished by lugs **54** and to accommodate this additional movement, or overtravel, the lugs are generally made of resilient material so that they compress and do not interfere with manual reset movement and, moreover, so that they automatically return the diaphragm and actuator post to the desired position after release of the manual reset force to thereby prevent relaxing and shifting of the spring. Movement past the lower limit determined by the lugs is not detrimental in manual reset because the cap **28** is being moved downwardly and the spring is maintained in compression during this reset movement. Preferably lugs **54** are molded as an integral part of the diaphragm and are hollow as illustrated in FIG. 3 which contributes to their being capable of accommodating overtravel.

Although but one embodiment of the present invention has been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

I claim:

1. A pressure responsive control comprising, in combination,

a housing,

control means in said housing and movable between first and second operative positions,

a diaphragm in said housing and connected to said control means and operative in response to a change in a pressure condition on said diaphragm to move said control means toward said first operative position,

spring means connected to said control means and exerting a force on said control means in opposition to the force exerted through said diaphragm and in a direction toward said second operative position,

and motion limiting means in said housing and arranged to limit movement of said diaphragm in the direction toward said second operative position when said control means has assumed said second operative position so that spring force is maintained between said spring means and said diaphragm in said second position and said spring means maintains a preselected calibration, said motion limiting means further characterized by being resilient and collapsible, and in response to a force applied to said diaphragm in excess of said spring means force will yield to accommodate overtravel of said diaphragm in the direction of movement toward said second operative position, and will automatically return the diaphragm to desired position after release of said excess force.

2. The pressure responsive control of claim **1** including means supporting said spring means to exert a compressive force on said control means in opposition to said diaphragm force,

and wherein said motion limiting means limits said diaphragm and spring means motion to maintain said spring means under compression at all times.

3. A pressure switch comprising, in combination,

a housing,

switch means in said housing movable between trip and reset positions,

a diaphragm in said housing and connected to said switch means to move said switch means toward said trip position in response to a change in a pressure condition on said diaphragm,

spring means connected to said switch means and seated to exert a force on said switch means in opposition to the force exerted through said diaphragm and in a direction toward said reset position,

said diaphragm having a surface facing toward a wall of said housing, said surface moving away from said housing wall as said switch means is moved toward its trip position and toward said housing wall as said switch means is moved toward its reset position,

and motion limiting means in the form of hollow resilient lugs arranged intermediate said diaphragm surface and said housing wall and operative to limit movement of said diaphragm in a direction toward said housing wall when said switch means has assumed said reset position so that spring force is maintained between said spring means and said diaphragm in said reset position and said spring means maintains a preselected calibration, said lugs being resilient and collapsible, and in response to a force applied to said diaphragm in excess of said spring means force will yield to accommodate overtravel of the diaphragm in the direction of movement toward said reset position, and will automatically return said diaphragm to desired position after release of said excess force.

4. The pressure switch of claim **3** including

adjusting means connected to said spring means and operative to adjust said spring means to vary the force exerted thereby in opposition to the force exerted through said diaphragm,

and means connected to said switch means and selectively operable to move said switch means to said reset position substantially independent of the pressure on said diaphragm.

5. The pressure switch of claim **3** wherein said lugs are connected to and movable with said diaphragm toward and away from said housing wall and engage said housing wall when said switch means reaches said reset position.

6. The pressure switch of claim **5** wherein said hollow lugs are integral with said diaphragm.

7. The pressure switch of claim **6** wherein said spring means is supported to exert a compressive force on said switch means and said lugs limit relaxation of said spring means to maintain said spring means in compression and securely seated at all times.

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