Nov. 13, 1956 J. MERCIER 2,770,694

PRESSURE SWITCH

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Fig. 1.

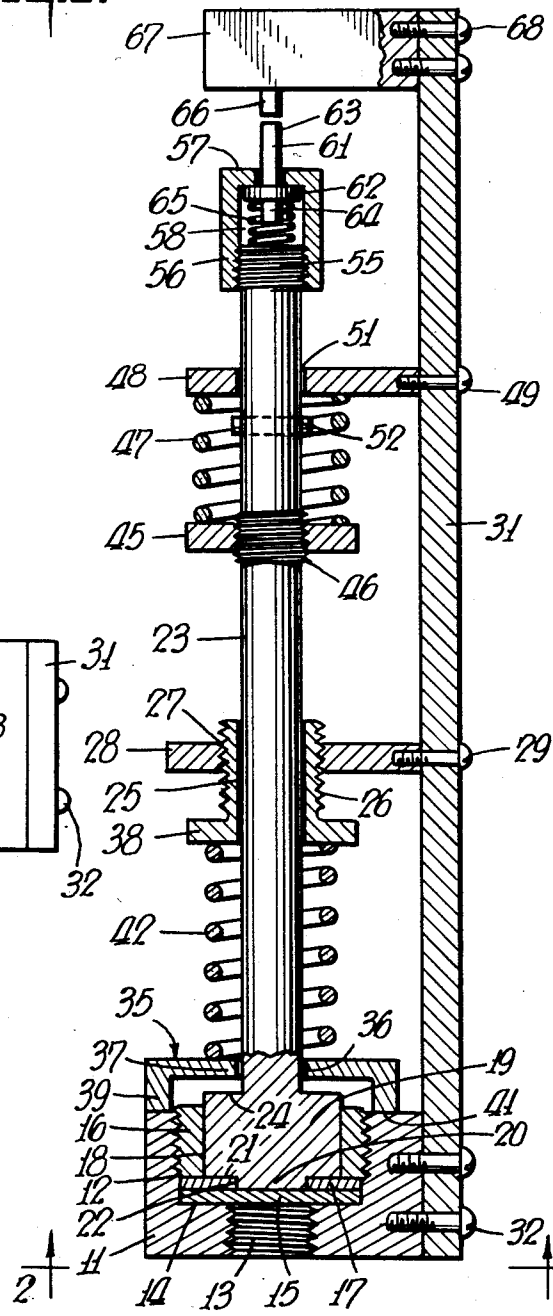
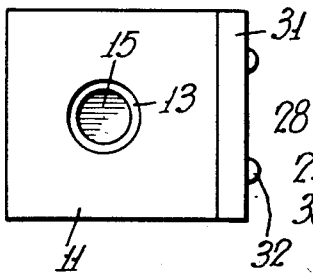


Fig. 2.



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PRESSURE SWITCH

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This invention relates to pressure switches, more particularly of the type which includes a microswitch controlling an electric motor operating a pump which determines the pressure applied to the switch.

As conducive to an understanding of the invention, it is noted that where a microswitch is connected to an electric motor controlling a pump which determines the pressure in a fluid line and such microswitch is controlled by the pressure in such line, where such microswitch requires a predetermined force for actuation and a considerably lesser force to retain it actuated, there will be a relatively great differential between the predetermined line pressure required initially to actuate the microswitch, and the reduced line pressure which is sufficiently low to permit the switch to be de-actuated and consequently the pressure in the line cannot be maintained within relatively narrow limits.

It is accordingly among the objects of the invention to provide a pressure switch which includes a conventional microswitch which requires a predetermined force for actuation and a considerable lesser force to retain it actuated, yet which will permit actuation and cutoff of said microswitch within relatively narrow limits of pressure and which may readily be adjusted to vary the limits of actuation and cutoff, which pressure switch is neat, compact and may readily be fabricated from relatively inexpensive materials and is not likely to become deranged even with long continued use.

According to the invention, means are provided to connect a source of pressure to react against one end of a slidably mounted rod. A stud is slidably mounted at the other end of said rod and movable longitudinally thereof, said stud having resilient means associated therewith normally urging the stud to its outermost position, means being provided to limit the longitudinal movement of said stud. Resilient means operatively connected to said rod restrain movement thereof until the pressure reacting against the end of said rod rises to a predetermined amount at which time the rod will move a predetermined distance. Means are provided to restrain movement of said rod beyond such predetermined distance until the pressure has risen to a second predetermined amount greater than the first predetermined amount at which time the rod will move a second predetermined distance and the movement of the stud will be restrained. A microswitch is associated with said rod and has a plunger adapted to be engaged by said stud and normally resiliently urged to a position in which the microswitch is not actuated. The resilient means associated with the plunger exerts a greater force than that of the resilient means associated with the stud so that said plunger will be actuated only after said rod has moved in response to said second predetermined pressure and the movement of said stud is restrained.

In the accompanying drawings in which is shown one or more of various possible embodiments of the several features of the invention,

Fig. 1 is a longitudinal view of the pressure switch partly in cross section, and

Fig. 2 is an end view thereof taken along line 2—2 of Fig. 1.

Referring now to the drawings, the pressure switch desirably comprises a body portion **11**, preferably a rectangular block which has a bore **12** therethrough of reduced diameter at its inlet end **13** forming an annular shoulder **14**. Positioned on shoulder **14** is a flexible disc or diaphragm **15** which may be of rubber and which seals the inlet **13**, said diaphragm being securely retained on said shoulder by an externally threaded sleeve **16** screwed in the correspondingly threaded portion of bore **12**, a washer **17** being interposed between diaphragm **15** and said sleeve **16**.

Slidably mounted in the bore **18** of sleeve **16** is a piston **19** which desirably has an axial extension **20** at end **21** thereof which extends through the opening **22** of washer **17** and engages the inner surface of diaphragm **15**, said extension **20** being longitudinally aligned with the inlet **13** of the block **11**.

The piston **19** desirably has an axial piston rod **23** rigid with the other end **24** thereof and preferably formed integral therewith. The piston rod desirably extends through the bore **25** of an adjustment screw **26** which is mounted in the threaded opening **27** of a bracket **28** affixed as by screws **29** and extending laterally outward from a rigid mounting strip **31** affixed at one end as by screws **32** to the block **11**.

Encompassing the piston rod **23** is a substantially cup-shaped follower **35** which has an axial bore **36** through the floor **37** thereof through which said rod **23** extends. The follower **35**, which is positioned between the block **11** and the head **38** of screw **26**, desirably has its rim **39** normally retained against the rim **41** of block **11** by a coil spring **42** encompassing rod **23** and compressed between the head **38** of screw **26** and the follower **35**.

Means are provided normally to urge the piston rod **23** axially into the bore **18** of sleeve **16** toward diaphragm **15** until the end **21** of piston **19** is seated on washer **17**, in which position the floor **37** of the follower will be slightly spaced from the end **24** of piston **18**. To this end a nut **45** is screwed on the threaded portion **46** of piston rod **23** and a coil spring **47** encompassing said rod **23** is compressed between said nut **45** and a bracket **48** affixed as by screws **49** and extending laterally outward from mounting strip **31**, said rod **23** extending through an opening **51** in said bracket **48**.

Means are desirably provided to limit the longitudinal movement of piston rod **23** by the action of the pressure against diaphragm **15**. Although any suitable means may be used for this purpose, in the illustrative embodiment herein shown, a pin **52** extends transversely through rod **23** and is normally spaced from bracket **48** when the piston **19** is seated on washer **17**.

Affixed to the free end **55** of piston rod **23** and extending beyond the latter is a sleeve **56** which desirably has an inturned lateral flange **57** at its outer end. Although the sleeve may be affixed to rod **23** in any suitable manner, in the illustrative embodiment herein shown the sleeve is internally threaded so that it may be screwed on the correspondingly threaded end **55** of piston rod **23**.

Extending longitudinally through the bore **58** of sleeve **56** and protruding beyond the flange **57** is a stud **61** which desirably has a collar **62** affixed thereon between the ends **63** and **64** of the stud and positioned in the bore **58** of said sleeve. The stud **61** is normally urged outwardly from sleeve **56** by a coil spring **65** positioned in bore **58** and compressed between the collar **62** and the end **55** of piston rod **23**, the spring **65** retaining the collar **62** against flange **57** in which position the end **64**

of the stud 61 will be spaced from the end 55 of piston rod 23.

The end 63 of stud 61 is normally slightly spaced from the plunger 66 of a conventional microswitch 67 affixed by screws 68 to strip 31 and extending laterally outward therefrom, said plunger being normally retained in fully extended position by suitable resilient means (not shown) in said microswitch when the end 21 of piston 19 is seated on washer 17.

Although the pressure switch above described may have any suitable dimensions, in the embodiment herein shown to illustrate the invention, the spring 65, when fully compressed exerts a force of 12 ounces. When the piston 19 is seated on the washer 17, and the rim 39 of follower 35 is seated on rim 41, the floor 37 will be spaced from the end 24 of the piston 19 by .01 inch. With the piston 19 and follower 35 thus positioned, the end 64 of stud 61 will be spaced from end 55 of piston rod 23 by a distance of .02 inch; the end 63 of the stud will be spaced from plunger 66 by a distance of say, .001 inch and stop pin 52 will be spaced from bracket 48 by a distance of .03 inch.

The microswitch 67 is desirably of the type that requires a force of 20 ounces to overcome the resilient means associated with plunger 66 for actuation and 4 ounces to retain the switch in such actuated position.

With the inlet 13 of the pressure switch, connected for example, to a line through which fluid is being forced under pressure created by a pump driven by an electric motor, if it is desired to stop the motor if the pressure in the line rises above, say 2000 p. s. i., and to start the motor if the pressure falls below, say 1950 p. s. i., the tension on spring 47 is adjusted by rotating nut 45 until a pressure of 1950 p. s. i. or more against diaphragm 15 would initially move piston 19 against follower 35 and the tension of spring 42 is adjusted by rotating screw 26, to 50 p. s. i. for a combined spring tension which requires over 2000 p. s. i. to be overcome.

When the pressure of the fluid in inlet 13 rises to above 1950 pounds, the diaphragm 15 will be forced inwardly and will cause the piston 19 to move outwardly of the bore 18 in sleeve 16, inasmuch as the tension of spring 47 of 1950 pounds will be overcome. The piston 19 and piston rod 23 will move until the end 24 of the piston abuts against the floor 37 of follower 35, a distance of illustratively .01 inch.

As a result, the end 63 of stud 61 which is slightly spaced from the plunger 66 of the microswitch by a distance of say .001 inch, will move into engagement with such plunger. As the force required to move the plunger 66 inwardly is 20 ounces and as the spring 64 when fully compressed has a maximum force of 12 ounces, it is apparent that no movement will be effected of the plunger 66 and the stud 61 will move into the bore 58 of sleeve 56.

Inasmuch as the follower 35 is restrained from movement by the spring 42, the combined tensions of springs 42 and 47 must be overcome before the rod 23 can move further.

When the pressure inlet 13 rises to over 2000 p. s. i., the combined forces of springs 42 and 47 will be overcome and the end 24 of piston 19 will move the follower 35. By reason of the stop 52, the maximum amount that the rod 23 can move is .03 inch, and as such rod has already moved .01 inch, as previously described, an additional movement of .02 inch will be imparted thereto. By reason of such movement of rod 23, as the end 64 of stud 61 was normally spaced .02 inch from the end 55 of rod 23, and as such stud 61 has already moved inwardly into sleeve 56, approximately .01 inch, such additional movement of .02 inch of the rod 23 will cause the end 64 of stud 61 to abut against end 55 and the stud 61 will thereupon be moved by rod 23 against plunger 66 with sufficient force to overcome the 20 ounces normally applied to the plunger. As a result, the microswitch 67 will be actuated to cut off the motor actuating the pump and the pressure in inlet 13 will gradually fall.

When such pressure drops to, say 1950 pounds p. s. i., the combined forces of springs 42 and 47 of 2000 pounds will be sufficient to move the piston rod 23 and the piston 19 connected thereto away from plunger 66 so that the piston 19 will move into the bore 18 of sleeve 16 until the rim 39 of follower 35 seats on rim 41 of block 11, such movement being a distance of .02 inch. In this position, the force exerted by spring 42 against rod 23 will be reduced to zero, and by reason of the 1950 p. s. i. pressure against diaphragm 15, the end 24 of the piston 19 will be retained against the floor 37 of follower 35.

By reason of such movement of rod 23, and the tension of spring 65 against collar 62 and stud 61, the end 64 of stud 61 will be moved away from the end 55 of rod 23 by a distance of .01 inch and the 12 ounce tension of spring 64 will be sufficient to overcome the 4 ounce tension on plunger 66 to retain the microswitch in actuated condition. When the pressure in the line drops below 1950 pounds, the force of spring 47 will move rod 23 and hence piston 19 will move further into sleeve 16 until the end 21 seats on washer 17 at which time the end 24 of the piston will be spaced from follower 35 by a distance of .01 inch. This additional movement of .01 inch of the rod 23 will cause the flange 57 of sleeve 56 to move against collar 62 and hence the end 63 of stud 61 will be moved slightly away from the plunger by a distance of illustratively .001 inch, so that the force of 4 ounces thereon will be sufficient to actuate the microswitch to again complete the circuit to the motor driving the pump.

From the operation of the pressure switch above described, it is apparent that the pressures required to operate the microswitch 67 may readily be varied. Thus, if the spring 42 is set for 100 pounds and the spring 47 is set for 1900 pounds, although the microswitch will still be actuated to cut off the motor when the pressure in inlet 13 arises above 2,000 pounds, the motor will not again be energized until the pressure drops to below 1900 p. s. i. This operation is achieved by reason of the fact that when the pressure in inlet 13 drops to, say 1950 p. s. i., the combined forces of springs 42 and 47 which are sufficient to overcome the pressure of 1950 p. s. i. will move the piston rod 23 and hence the piston 19 will move into sleeve 16 until the rim 39 of follower 35 seats on rim 41 of block 11 and the force exerted by spring 42 will be reduced to zero. At this time the piston rod 23 will have moved .02 inch, and as spring 65 will still be urging stud 61 against plunger 66 with a force of greater than 4 ounces, the plunger 66 will not be released. When the pressure drops to below 1900 pounds, the force of spring 47 of 1900 pounds will be sufficient to overcome such pressure and the piston rod will move an additional .01 inch so that the plunger 66 will be released.

With the construction above described, a highly efficient compact pressure switch is provided which will actuate a microswitch upon pressure differentials which may be adjusted from a relatively small amount to a relatively large amount.

As many changes could be made in the above construction, and many apparently widely different embodiments of this invention could be made without departing from the scope of the claims, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A pressure switch for operating the resiliently urged control member of a microswitch, comprising a slidably mounted member, means to connect a source of pressure to said member to effect movement thereof, resilient means operatively connected to said member to restrain

movement thereof until the pressure has risen to a predetermined amount, means to restrain movement of said member after it has moved a predetermined distance in response to the rise in pressure to such predetermined amount, said means including a second resilient means reacting against said member after it has moved such first determined distance, and restraining movement of said member until the pressure rises above a second predetermined amount greater than the first amount, a second member slidably mounted on said first member and movable longitudinally thereof, means to limit the movement of said second member in two directions, and resilient means normally urging said second member to its outermost position.

2. The combination set forth in claim 1 in which said pressure switch includes a base having a bore therethrough having means at one end for connections of such source of pressure, a flexible diaphragm at the other end of said bore sealing the latter, said first slidably mounted member having one end thereof adjacent said diaphragm whereby upon flexing of said diaphragm upon application of pressure thereto force will be exerted against said movable member.

3. The combination set forth in claim 1 in which the first slidably mounted member has a lateral projection and the resilient means operatively connected to said member to restrain movement thereof comprises a coil spring reacting against said lateral projection.

4. The combination set forth in claim 1 in which said first slidably mounted member comprises a rod having a nut screwed on a threaded portion thereof and the resilient means operatively connected to said member to restrain movement thereof compresses a coil spring encompassing said rod and reacting against said nut.

5. The combination set forth in claim 1 in which the means to restrain movement of said member after it has moved a predetermined distance comprises a collar encompassing said slidably mounted member and slidable with respect thereto, a fixed stop to limit the movement of said collar in one direction and a coil spring encompassing said member and reacting against collar normally to retain the latter against said stop, said member having a lateral projection rigid therewith adapted to engage said collar to move the latter against the tension of said coil spring when the pressure rises above a second predetermined amount.

6. A pressure switch for operating the resiliently urged control member of a microswitch, comprising a support, a member slidably mounted in said support, means to connect a source of pressure to said member to effect movement thereof, a lateral projection on said member, a coil spring encompassing said member and compressed between said lateral projection and said support to restrain movement of said member until the pressure has risen a predetermined amount, a collar encompassing said member and slidable with respect thereto, a fixed stop to limit the movement of said member toward the means to connect a source of pressure thereto, a second coil spring encompassing said member and reacting against said collar normally to retain the latter against said stop, said member having a second lateral projection rigid therewith adapted to engage said collar to move the latter against the tension of said coil spring when the pressure rises above a second predetermined amount greater than the first, a second member slidably mounted on said first

member and movable longitudinally thereof, means to limit the movement of said second member in two directions, and resilient means normally urging said second member to its outermost position.

7. The combination set forth in claim 6 in said first slidable member has a sleeve affixed at the end thereof opposed to the end having the means to connect a source of pressure thereto, said sleeve extending longitudinally of said member and having an inwardly extending stop at its other end, said second slidable member is positioned in said sleeve and protrudes beyond the outer end thereof, said second slidable member having a lateral projection adapted to abut against the stop in said sleeve to limit the outward movement of said member, the resilient means normally urging said slidable member to its outermost position comprising a coil spring in said sleeve compressed between said lateral projection and the end of said first slidable member.

8. The combination set forth in claim 6 in which means are provided to adjust tension of said coil springs.

9. The combination set forth in claim 6 in which means are provided to limit the movement of said first slidable member.

10. The combination set forth in claim 6 in which the second lateral projection on said slidable member is normally spaced from said collar before the pressure has risen to such first predetermined amount.

11. The combination set forth in claim 6 in which means are provided to limit the movement of said first slidable member and said second slidable member is designed to abut against said first slidable member before the latter has reached the limit of its movement.

12. A pressure switch for operating the resiliently urged control member of a microswitch, comprising a base having a bore therethrough, a piston slidably mounted in said bore, a piston rod affixed at one end to said piston, a mounting strip affixed at one end to said base spaced from and extending parallel to said rod, means on said strip slidably mounting said rod, a coil spring encompassing said rod and reacting against the latter to urge said piston into said bore, means to connect a source of pressure to said base to react against said piston to effect movement thereof out of said bore against the tension of said coil spring, a collar encompassing said piston rod adjacent said piston, a coil spring encompassing said rod and reacting against said collar to retain the latter against said base, said piston being adapted to abut against said collar upon rise of pressure above a predetermined amount to move said collar away from said base. a stud slidably mounted at the free end of said rod and movable longitudinally thereof, resilient means to urge the stud away from said rod, means to limit the outward movement of said stud.

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