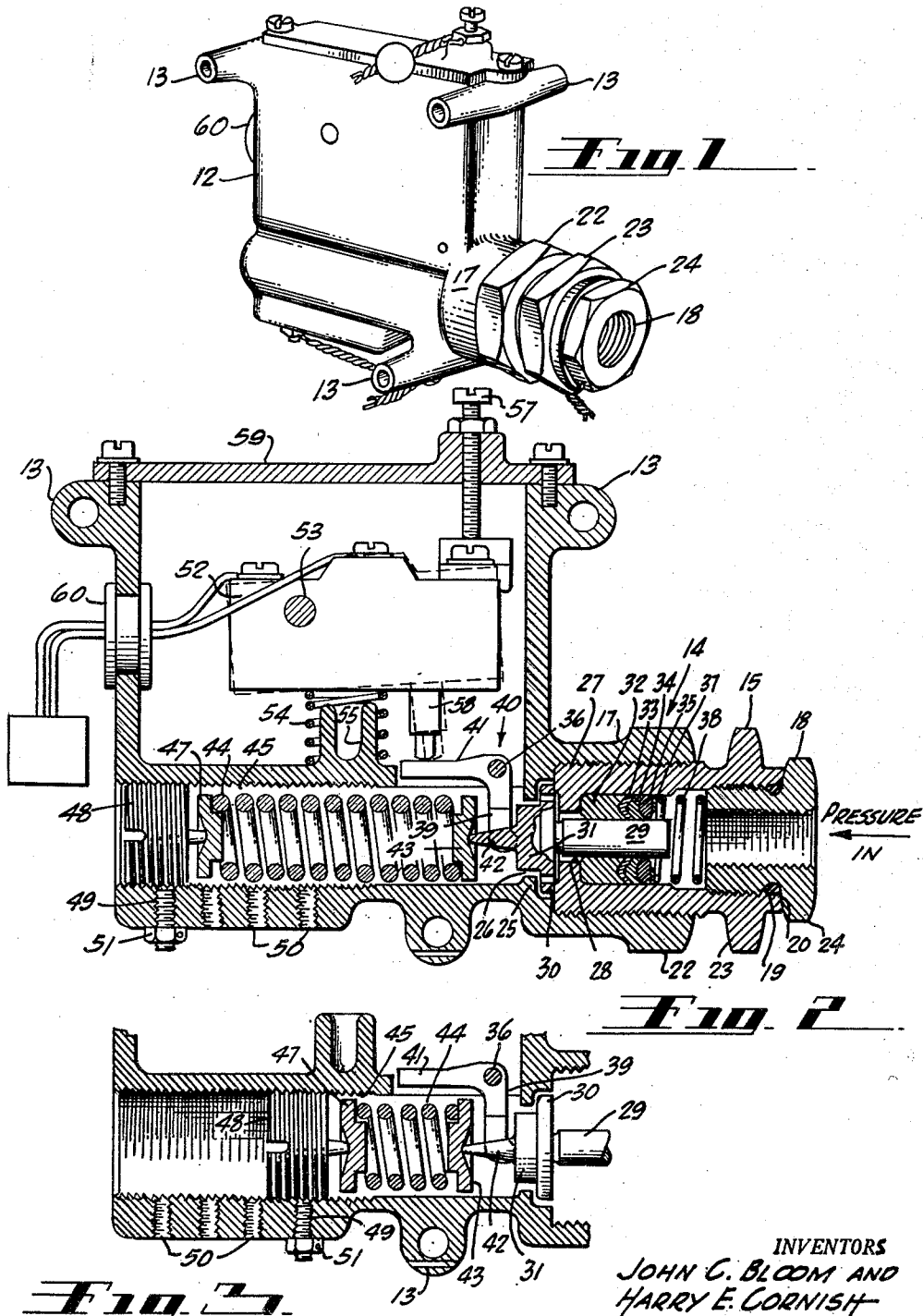


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J. C. BLOOM ET AL
PRESSURE CONTROLLED DEVICE

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2,803,718

PRESSURE CONTROLLED DEVICE

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1 Claim. (Cl. 200—82)

This invention relates to a pressure controlled device, and more particularly to a device adapted to respond to pre-selected hydraulic fluid pressures to cause the actuation of a snap-acting electric switch for the operation of indicator or auxiliary circuits in airplanes.

Pressure-responsive electrical switches are widely used and, particularly in airplane applications, it is mandatory that they be light in weight, compact, fast-acting, operatively reliable, and easily adjustable over a wide range of pre-selected pressures. Many existing switches fail to meet these exacting requirements. They fail under surge and acceleration loads; they are slow in responding to the pressure stimuli; and they are incapable of ready adjustment.

The present invention comprising a spring-loaded, pressure-responsive piston operatively connected to a snap-acting electric switch, provides all the desirable characteristics in a light, compact unit capable of easy manufacture. The switch embodies means for limiting the movement of the piston so that a momentary high pressure surge will not damage the mechanism, as frequently occurs in the previous Bourdon or diaphragm type pressure devices. The same movement limiting means enables the switch to respond to a pressure stimulus almost instantaneously, there being no necessity for the piston to travel through a relatively long path to reach its proper operating point. In some embodiments of the present invention the stroke of the piston has been successfully reduced to between .001 and .004 inch resulting in a response time of the order of a few milliseconds. This is obviously a very important factor to be considered in present day high speed airplanes. If desired, the stroke length may be lengthened to approximately $\frac{3}{64}$ of an inch, and the very rapid response characteristics will still be retained.

Another important feature of the invention is the provision for easily adjusting its operating pressure ranges. Accessible from the outside of the switch housing is the spring which opposes the piston movement. The compression of this spring may be easily adjusted, with a simple screwdriver, to obtain a substantial number of different operating pressures with each selected spring. In addition, the spring may be easily and quickly removed and another, of different physical properties, inserted, it, of course being capable of adjustment to obtain selected operating pressures. This adjustment feature, while important to all airplane operators, is particularly advantageous to military operations where, frequently far removed from supply depots, it becomes necessary to revise operating pressure requirements.

The various features of the present invention are illustrated in a preferred form in the accompanying drawing in which:

Figure 1 is a perspective view of the casing enclosing the switch of this invention;

Figure 2 is a longitudinal sectional view in elevation through the casing, showing the relation of the working parts; and

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Figure 3 is a sectional view similar to the lower part of Figure 2 showing the biasing spring set to a new position to provide a different operating pressure for the switch.

As shown, the switch comprises a housing or body member 12, with lugs 13 disposed thereon for convenient mounting, and having a connection 14 adapted to join with a hydraulic fluid line (not shown) to receive the fluid pressure impulses. The connection 14 consists of a sleeve 15 threadedly engaged within an extended portion 17 of the housing 12, and a bushing 18 threadedly engaged within the sleeve and having an O ring 19 arranged in an annular groove 20 to stop any leakage which might work its way through the engaged threads of the sleeve and bushing. The housing, sleeve, and bushing forming the connection 14 all have integral, hexagonal, wrenching surfaces, as at 22, 23, and 24, to permit easy assembly of the connection either in place or at the bench.

The extended portion 17 of the housing 12 is provided with a transverse wall 25 having a bore 26 therethrough, which provides passage for a portion of a piston, the shoulder of said transverse wall at the bore further providing a stop for the movement of the piston. The sleeve 15 which is threaded into the portion 17 is likewise provided with a transverse wall 27 at its inner end, having a bore 28 therethrough which in turn provides a stop shoulder. Piston 29 is mounted coaxially within sleeve 15, and is provided with an annular enlargement or flange 30 which is located between transverse walls 25 and 27. The shank of the piston is guided in sleeve bearing 32, and is sealed against the leakage of pressure fluid by the chevron rings 33 and 34 of Teflon and rubber-like compound, respectively. A backup ring 35 holds the sealing rings in place against the bearing sleeve, and it in turn is surmounted by a washer 37 yieldingly held in place by coil spring 38. The lower arm 39 of bell crank 40 bears against the face of the boss 31 which extends forwardly from the annular enlargement 30 of piston 29, and the upper arm 41 engages a switch plunger. The bell crank 40 is pivotally mounted on pin 36. The tip of the conical section 42 of piston 29 engages the dished central portion of disk 43, which is biased by spring 44, located in bore 45. The spring is backed up by a second disk 47 and a threaded plug 48. When the plug 48 is adjusted to its desired position, it compresses spring 44, which in turn applies a biasing force to the piston 29 to retain it in its rightward position as seen in Figure 2, the enlargement 30 engaging transverse wall 27. In this position the gap between the enlargement and wall 25 is of the order of .002 inch. Therefore the total axial movement of the piston 29 is so small that the variation in biasing pressure of the spring is negligible. This is desirable, particularly when the spring is to be adjusted to different pressures. With any degree of compression, the change in the spring force caused by movement of the piston is negligible. In any adjusted position of the plug 48, the set screw 49 may be engaged in one of the threaded lockports 50 to retain the plug in its adjusted position, the set screw 49 being locked in place with locknut 51.

A standard snap-acting electric switch 52 is carried within the casing 12, and pivotally mounted on shaft 53 for purposes of adjustment. A coil spring 54 is located around boss 55, and its upper end engages the switch 52 and urges it upwardly as shown in Figure 2. Adjusting set screw 57 may be moved to any desired position to urge the switch 52 against the pressure of spring 54 to the desired position of adjustment. Normally, with the hydraulic pressure off, the screw 57 is moved downwardly until all the slack is taken out of plunger 58 of the switch which engages the horizontal arm 41 of bell crank 40. Thus, the slightest movement leftward of piston 29 will cause movement of plunger 58 and electrical actuation of switch 52.

To permit ready access to the switch, a detachable cover plate 59 is provided. Grommet 60 allows the connecting wires from the switch to be conducted to the outside and connected into the electrical circuit being operated.

Prior to inserting the pressure switch into the hydraulic circuit, spring 44, selected to give the desired operating pressure range, e. g., 125 to 150 pounds per square inch, is inserted in the bore 45. Then the axial position of plug 48 along bore 45 is adjusted until the piston 29 is actuated at the desired operating pressure, e. g., 135 pounds per square inch. When the proper axial position of plug 48 is determined, set screw 49 is inserted in the proper lockport 50 and tightened against it. Locknut 51 is then positioned on the set screw and safety wired in place.

At the same time that the pressure setting of spring 44 is being set, adjustment screw 57 is tightened down on the switch 52 so that all of the pretravel or slack in the movement of plunger 58 is removed. In this manner positive operation of the switch is insured because the plunger 58 causes the actuation of the switch at almost the instant that piston 29 begins to rotate the bell crank.

In operation the pressure switch receives fluid pressure through connection 14 and this pressure is transmitted to the pressure face exposed at the left end of piston 29. As long as the fluid pressure remains below a preselected figure, e. g., the previously mentioned 135 pounds per square inch, movement of piston 29, and consequently of bell crank 40, is restrained by the action of disk 43 and spring 44. When the fluid pressure against the face of the piston 29 reaches the pre-selected figure, the piston moves longitudinally, the boss 31 causing bell crank 40 to rotate about its pivot, thereby moving plunger 58 to operate the switch. The pretravel or slack in the switch plunger 58 having been previously removed by the proper setting of adjustment screw 57, very positive operation of the switch is insured because the smallest rotation of crank 40 will cause the plunger to move the .001 to .004 inch required to cause a standard snap-acting switch to operate. As soon as the pressure on the face of piston 29 diminishes to a point below the pre-selected operating pressure, spring 44 acting on the piston through disk 43 will cause the piston to move longitudinally to the right, rotating bell crank 40 in a counter-clockwise direction, and thereby permitting switch plunger 58 to move downward and open or close the circuit, as the case may be.

It is well known that in fluid circuits there are frequent, momentary pressure surges caused by a number of different factors. The surges cause Bourdon and diaphragm type pressure switches to fail completely, and in the present invention, if unprovided for, would permit rotation of the bell crank 40 to such a degree as to cause the switch plunger 58 to exceed its allowable travel limits. It is obvious, however, that if a pressure surge occurs in the present construction transverse wall 25 will engage annular enlargement 30, and the high loads are absorbed by the strong switch housing, rather than by the delicate, sensitive electric switch mechanism.

The piston movement limiting means serves another and very important function. As mentioned previously, it is imperative that this type of device respond almost instantaneously, particularly when it is used in a warning circuit. In this invention, as the pressure reaches the pre-selected point, e. g. 135 pounds per square inch, the piston moves, forcing its annular enlargement against the transverse wall, and compressing the spring slightly. Even though the pressure may continue to rise, e. g. to 270 pounds per square inch, the spring is not compressed any more than the original small amount and the spring, therefore, operates practically instantaneously when the pressure recedes rapidly from the 270 p. s. i. point. If the travel limiting means were absent, the spring would

become severely compressed when the pressure increased greatly beyond the operating pressure, and it would require a relatively long response period for the spring to operate the piston when the pressure subsequently receded. In addition, of course, if the pressures become sufficiently high, the spring may actually be deformed, thereby changing its spring constant, and causing the switch to be actuated at an improper pressure point. With the travel limiting means, no such deformation of the spring may occur.

While the presently preferred form of the invention has been illustrated and described herein, it will be appreciated that various changes may be made in the construction and arrangement of the parts without departing from the spirit of the invention, and it is intended that all such changes shall be embraced within the scope of the following claim.

We claim:

A pressure controlled switch comprising; a housing member having a cylindrical extended portion thereon, and having therein two axially aligned bores, one of said bores being contained in said extended portion of said housing, and said bores being separated by an inwardly projecting transverse wall having a hole therethrough; a snap-acting electric switch pivotally mounted in said housing, said switch having an operator and being spring biased whereby it tends to rotate about said pivot; an adjustment screw disposed so as to oppose the aforesaid rotational tendency of said switch; a pivotally mounted crank disposed to contact the operator of said switch; a flanged, pressure-responsive piston adapted to rotate said crank and whose flange engages said inwardly projecting transverse wall in one of said bores whereby to limit the axial movement of said piston; a spring means located in the other of said bores, said spring means reacting against said piston; a plug located in the said other of said bores, said plug being threadedly engaged with said bore so as to permit adjustment of the axial position of said plug to permit the compression of said spring to be changed to a pre-selected level; lockports disposed perpendicular to the longitudinal axis of said spring-containing bore; a set screw in one of said lockports and tightened down on said plug to prevent change in its pre-selected axial position; and a fluid connection comprising the said extended portion of said housing, a sleeve threadedly engaged therewith, and a bushing engaged with said sleeve, said connection being adapted to receive pressure impulses from an external fluid circuit and transmit them to said pressure responsive piston.

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