May 12, 1964 D. L. GRIFFITH 3,133,171

PRESSURE SWITCH

Filed June 15, 1961 2 Sheets-Sheet 1

Fig. 2.

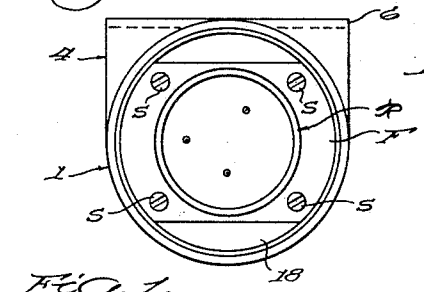


Fig. 3.

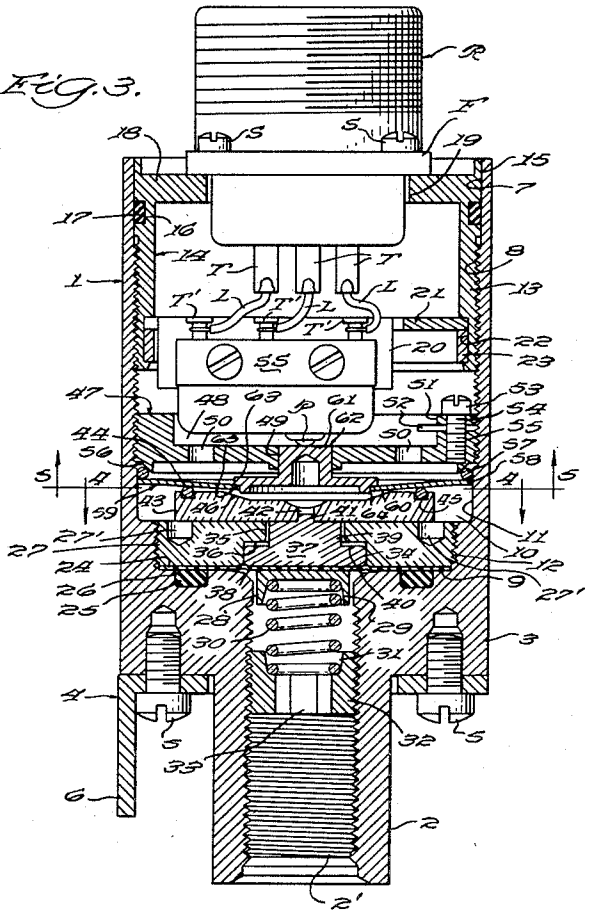


Fig. 1.

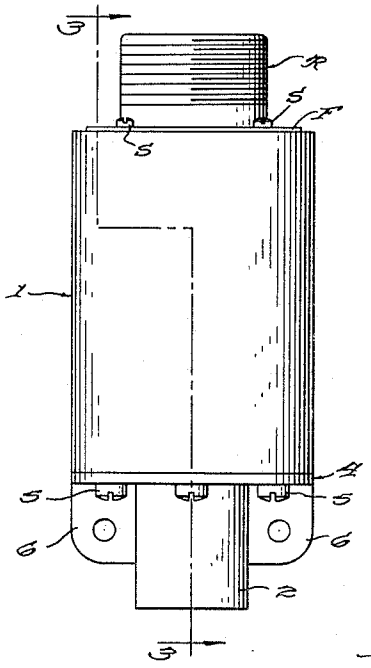


Fig. 4.

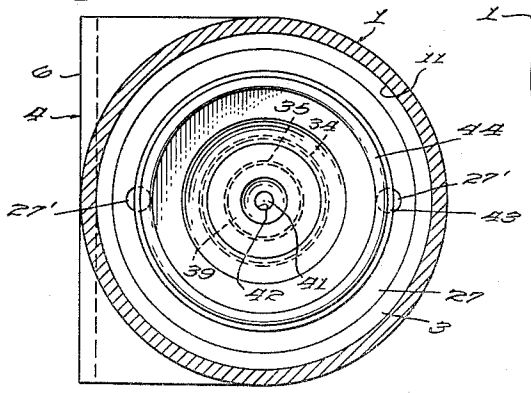
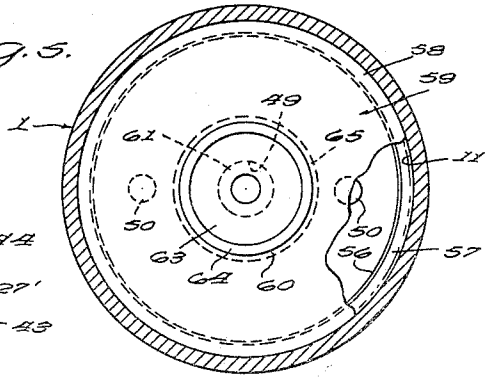


Fig. 5.



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May 12, 1964 D. L. GRIFFITH 3,133,171

PRESSURE SWITCH

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Fig. 6

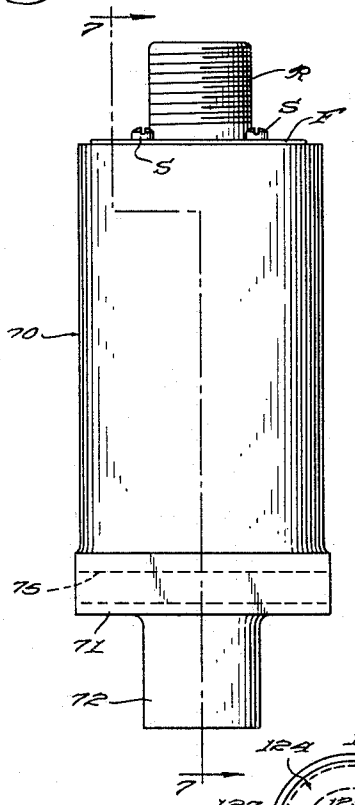


Fig. 7.

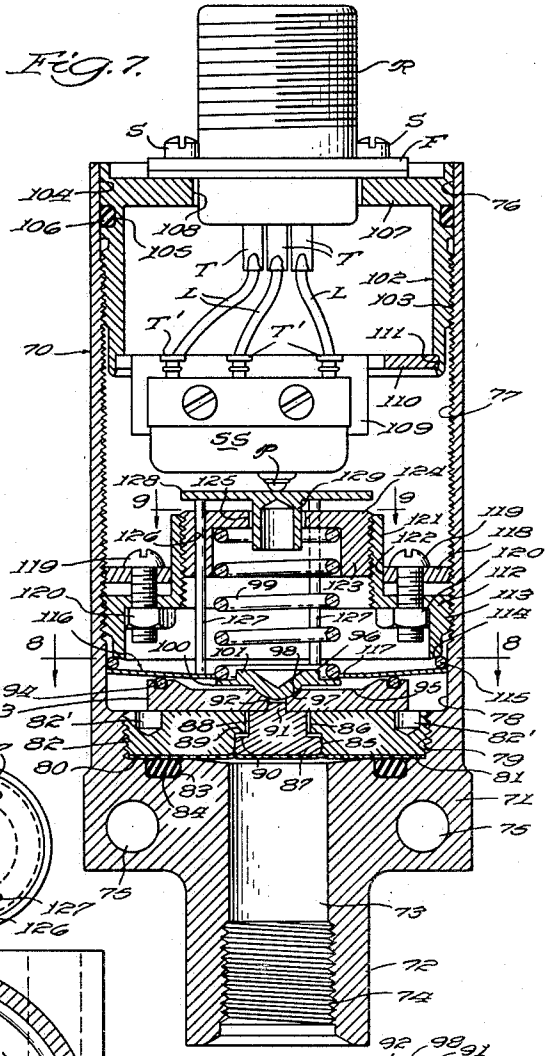


Fig. 9.

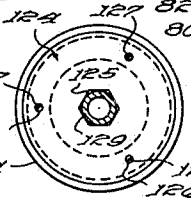


Fig. 8.

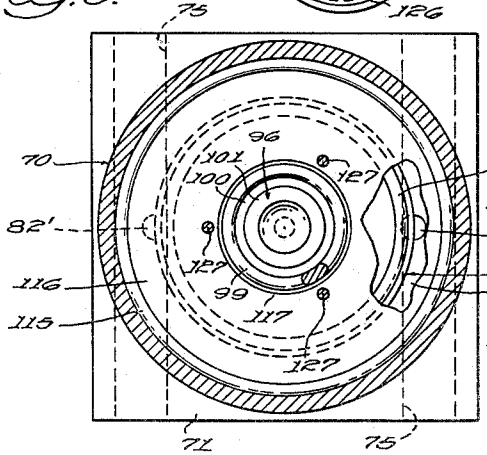


Fig. 10.

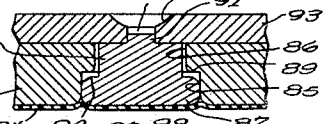
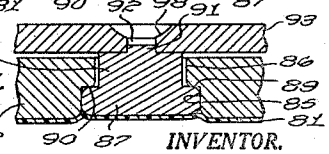


Fig. 11.



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United States Patent Office 3,133,171 Patented May 12, 1964

3,133,171

PRESSURE SWITCH

Donald L. Griffith, Sun Valley, Calif., assignor to Custom Component Switches, Inc., Burbank, Calif., a corporation of California

Filed June 15, 1961, Ser. No. 117,312
10 Claims. (Cl. 200—83)

This invention relates to pressure responsive switch actuators and more particularly to an improved form thereof characterized by great accuracy, small size, and a design thereof permitting a wide range of pressure responsiveness with a minimum of substitution of component parts.

The principal objects of the invention are to provide a pressure responsive switch actuator having a pressure responsive means operable by snap action to effect action of an electric switch means and characterized by simplicity of construction, accuracy of operation, susceptibility for economical manufacture, capacity for ready adaptability to a wide spectrum of operating pressure ranges by substitution of component parts and adjustability to accurately establish the upper and lower limits of the dead band within which the device operates.

With the foregoing objects in view, together with such additional objects and advantages as may subsequently appear, the invention resides in the parts, and in the construction, combination and arrangement of parts, described, by way of example, in the following specification of certain presently preferred embodiments of the invention reference being had to the accompanying drawings which form a part of said specification and in which drawings:

FIG. 1 is a side elevational view of a first embodiment of the invention,

FIG. 2 is a top plan view of the embodiment shown in FIG. 1,

FIG. 3 is an enlarged scale, longitudinal, sectional view taken on the line 3—3 of FIG. 2,

FIG. 4 is a transverse sectional view taken on the line 4—4 of FIG. 3,

FIG. 5 is a transverse sectional view taken on the line 5—5 of FIG. 3 with certain of the parts broken away to show construction concealed thereby,

FIG. 6 is a side elevational view of the second embodiment of the invention,

FIG. 7 is a longitudinal sectional view taken on the staggered line 7—7 of FIG. 6,

FIG. 8 is a transverse sectional view taken on the line 8—8 of FIG. 7; certain parts being broken away to show construction details concealed thereby,

FIG. 9 is fragmentary transverse sectional view taken on the line 9—9 of FIG. 7, and

FIGS. 10 and 11 are greatly enlarged, fragmentary views taken on the axial line of the device and showing the diaphragm and plunger actuated thereby in actuated and re-actuated positions, respectively.

Referring first to FIGS. 1 through 5, the illustrated first embodiment of the invention comprises a hollow, cylindrical body member 1 having a reduced diameter internally threaded axially disposed nipple end 2 protruding from an end wall 3 and having a threaded bore 2′ disposed co-axially with the axial line of said body member; said bore affording connection to a source of actuating pressure. To outer end face of the end wall 3 may serve as a mounting face for a bracket 4 secured by any suitable means as, for example, screws 5 to afford means for mounting the body unit in any desired position. The bracket 4 may have any desired mounting means as, for example, the mounting flange 6.

The interior surface of the open end of the body member 1 comprises first a smooth sealing surface 7, followed

by an internally threaded portion 8 extending from the surface 7 to a point spaced from the inner face 9 of the end wall portion 3, a clearance space 10 defined by a smooth surface 11 of not greater diameter than the minor diameter of the threaded portion 8 and a sealing nut engaging threaded portion 12 of lesser diameter than the diameter of the surface 11 and bottoming on the end wall face 9.

Threadedly engaging the outermost portion of the threads 8 is the threaded body portion 13 of a switch mounting sleeve 14 having a smooth outer end 15 engaging the surface 7 and having a peripheral groove 16 housing a gasket 17. The outer end wall 18 of the switch mounting sleeve is provided with an opening 19 to which one end of an electrical receptacle element R extends; said receptacle having a flange F secured to the end wall 18 by screws S. Externally of the end wall 18, the receptacle R is provided with connector means for electrical connection with a circuit and internally of said wall it carries terminals T for connection by leads L to the terminals T′ of a plunger operated snap switch unit SS of the type which is inherently biased to normally occupy one of two positions. The switch unit is secured to a bracket 20 extending parallel to the axial line of the sleeve 14 and which is carried by a plate 21 disposed in a groove 22 on the inner face of the switch mounting sleeve, said plate being secured therein by a snap ring 23; the switch being so positioned as to extend beyond the inner end of the sleeve 14.

It will be understood that any type of receptacle can be employed and that, if desired, the leads from the switch can be led directly therefrom through the opening in the switch mounting sleeve without the use of an interposed receptacle. It will be understood also that any type of switch of a size small enough to fit within the space available may be used so long as it is a snap switch having contact devices inherently biased to assume a normal position when not forcibly displaced therefrom and an operating means capable of being disposed at least substantially in the axial line of body member 1. Thus, the switch may be a single throw switch of single or multiple pole type and biased to either a normally closed or a normally open position, or it may be a single or multiple pole double throw switch normally biased to one of its two positions. For this reason, the said electrical components comprising the receptacle, the switch and the interconnecting leads have been designated by letters rather than by numerals. The switch SS includes an operating plunger P projecting from the side thereof remote from the terminals, said plunger being disposed for movement substantially in the axial line of the body member 1 and being normally spring biased to tend to project further out of the switch case when the switch is in its normal position. In the description of the operation of the illustrated embodiments of the invention, movement from a normally occupied position will be designated as "actuation" and movement toward a normally occupied position will be termed "re-actuation."

The bore 2′ of the nipple end 2 extends through the end wall 3 of the body member and is closed by a flexible diaphragm 24 lying on the inner face 9 of said end wall; said diaphragm being clamped against said end wall and against a resilient gasket 25 disposed in a concentric groove 26 in said inner face by a disc-like externally threaded clamping member 27 engaging the threaded portion 12 of the body member 1 and having spanner wrench sockets 27′, 27′ by which it is thus seated. The gasket 25 thus prevents the escape of pressure fluid from the pressure chamber formed by the portion of the bore 2′ of the nipple adjacent to the diaphragm 24. Loosely mounted in the bore 2′ and having a flat face engaging the diaphragm 24 is a circular shoe element 28 having a

shallow recess 29 in its opposite face affording a socket for one end of a compression spring 30, and the other end of said spring engages a corresponding socket 31 in a nut element 32 engaging the threads of the bore 2' beyond the portion thereof engaged by a connection to a source of pressure. Adjustment of the nut 32 increases or decreases the yielding bias applied by the spring 30 and shoe element to the diaphragm; said nut element having a non-circular axial hole 33 extending therethrough for engagement by wrench means to effect adjustment thereof.

The clamping member 27 has an axially disposed opening extending therethrough comprising a larger diameter bore 34 preferably slighter greater in diameter than the bore 2' at the side thereof adjacent the diaphragm 24 and extending about half the thickness of the clamping member and continuing as a co-axially disposed smaller diameter bore 35 to the opposite side of the member 27, the bore portions 34 and 35 at the juncture thereof forming a shoulder 36. Mounted for limited reciprocable movement in the bore portions 34 and 35 is a correspondingly stepped diameter plunger member 37 comprising a head portion 38 closely fitting the bore 34 and resting on the diaphragm 24 opposite the member 28 and a shank portion 39 of considerably lesser diameter than the bore 35; the said head and shank portions forming a shoulder 40 opposite the shoulder 36.

The length of the head and shank portions of the plunger 37 are substantially equal to the thickness of the clamping member 27 and the distal end of the shank portion 39 terminates in a co-axially disposed, short locating stud 41 which engages a hole 42 in the center of a heavy disc-like pressure plate 43 normally lying on the outer face of the clamping member 27; said pressure plate being of somewhat less diameter and thickness than the space bounded by the wall portion 11 of the body 1. The face of the pressure plate 43 remote from the clamping member 27 is provided with an annular rib 44 of hardened material which, for example, may be conveniently formed as a hard wire ring disposed in a groove 45 in the face of the pressure plate. Inwardly of this rib, the said surface of the pressure plate is slightly dished as at 46 to afford operating room for certain other portions to be presently described.

Threadedly engaging the innermost end of the threaded surface 8 of the body member 1 and disposed inwardly of the switch SS, is a disc-like adjusting member 47 having a shallow, circular recess 48 in the face thereof adjacent the switch affording clearance for the switch and further having an axial bore 49 extending therethrough as well as diametrically opposite holes 50, 50 for engagement by a wrench. The peripheral wall 51 formed by the recess 48 is provided with a slot 52 extending therethrough at one point thereon and a clamp screw 53 extends freely through a hole 54 at the outer end face of the wall 51 and threadedly engages a hole 55 at the other side of the slot 52 whereby tightening said screw tends to draw the portions of the wall separated by the slot toward each other and thus releasably clamps the adjusting member 47 against rotative movement.

The side of the member 47 adjacent the pressure plate 43 at the peripheral edge thereof is provided with an inwardly sloping peripheral face 56 which engages a wire ring 57 closely fitting the inner face 11 of the body member 1. Resting on the opposite side of the ring 57 is the outer peripheral edge 58 of the concave side of a Belleville spring 59 of which the convex side at a point between the said outer periphery and the inner periphery 60 rests on the annular rib 44 of the pressure plate. The preferred form of Belleville spring is one having a H.T. ratio of 1.4:1 or greater whereby it partakes of snap action when moved from its normal configuration to and past a flat condition. Slidably movable in the bore 49 in the adjusting member 47 is the shank 61 of a switch operating plunger 62, the distal end of said shank being in contact with the plunger P of the switch. The plunger 62 includes a head portion 63 having a reduced diameter portion 64 extending through the hole defined by the inner periphery 60 of the Belleville spring and into the clearance space 46 of the pressure plate; the juncture of said head and reduced diameter portions 63 and 64 forming a shoulder 65 which rests on the concave face of the Belleville spring.

Assuming that the device is installed and connected to a source of pressure, in the absence of pressure of a magnitude intended to operate the switch, the component parts are in the position shown in FIG. 3. When the pressure reaches actuating magnitude, the pressure on the diaphragm 24 and shoe 28 will cause them to move the plunger 37 and the pressure plate 43 carried thereby against the opposition offered by the Belleville spring 59 until the Belleville spring goes just beyond its flat condition whereupon it moves by snap action as far as the plunger 62 will permit it to go; said snap action movement communicated to the plunger 62 causing actuation of the switch SS. The applied pressure will, of course, cause the diaphragm 24 and the pressure plate means to follow the snap action of the Belleville spring as far as permitted by the shoulders 36 and 40 and will operate to prevent re-actuation of the Belleville spring and switch until there has been a pressure drop of sufficient magnitude to allow the combined re-actuation bias of the Belleville spring and switch to return to their respective normal positions which, of course, is also by snap action.

In assembling a switch actuator embodying the present 'nvention, after a diaphragm has been installed together with the pressure plate plunger and has been secured by the clamping member and the opposite face of the diaphragm is engaged by the biasing shoe and spring biasing means installed in the nipple bore 2', a pressure plate having a peripheral, Belleville spring engaging rim of the desired diameter is installed. While it will be noted in FIG. 3 that the rib 44 engages the Belleville spring about midway between the outer and inner diameters thereof, it will be obvious that it is possible to substitute other pressure plates having peripheral ribs engaging the Belleville spring at any desired radial distance from the said inner periphery thereof. When engaging the Belleville spring at any line intermediate the inner and outer peripheries this pressure plate acts on the Belleville spring as a force operating on a lever of the third order, the fulcrum being the outer periphery of the Belleville spring as it engages the ring 57. Thus a given Belleville spring can be made to respond to different ranges of pressures simply by the use of pressure plates having spring engaging ribs of different diameters. To continue with the description of the assembly of the device, the Belleville spring and plunger 62 and ring 57 are next installed followed by screwing in the adjusting member 47 which is screwed down into the threads 8 of the body member 1 until the Belleville spring is caused to snap in opposition to applied fluid pressure of a predetermined magnitude, or, alternatively, in the absence of such applied pressure is caused to snap and then the adjusting ring is backed off a predetermined amount. The adjusting ring is then locked against rotative movement by the screw 53. The bias of the spring 30 is adjusted so that the actuation and re-actuation of the Belleville spring occurs within the ranges of pressure change for which the switch is intended and, with actuating a pressure applied to the diaphragm and the entire assembly, the switch carrying unit is screwed into the body member 1 until the switch mounted thereon is actuated. It will be understood that the foregoing recitation of assembly steps is merely by way of showing in logical order, the interrelation of the various parts and the mode by which to the merest substitution of various pressure plates having various diameters of ribs engaging a Belleville spring, otherwise iden-

tical actuating assemblies can be built to serve various ranges of pressures. It will also be obvious that such ranges can be further varied by changes in the diameters of the head portions 38 of the diaphragm engaging plungers 37 accompanied, of course, by suitable clearance in the associated clamping members for the diaphragm and suitable provision for the diaphragm engaging shoe if necessary.

In the first embodiment of the invention, the helical spring 30 combines with the pressure imposed load on the diaphragm to oppose and overcome the bias of the Belleville spring. In the second embodiment of the invention shown in FIGS. 6, 7, and 8, the reverse is true and an adjustable helical compression spring is employed to combine its bias with that of the Belleville spring to oppose the pressure imposed load on the diaphragm. In other respects, however, the said second embodiment has the same advantages and achieves the same objectives as the first embodiment.

The second embodiment of the invention comprises a hollow, cylindrical body member 70 open at one end and having an end wall 71 at the other end from the outer face of which a reduced diameter nipple end 72 projects in axial alignment with the body member and having an axially disposed bore 73 extending therethrough and through the end wall 71; the outer end of the bore 73 being threaded as at 74 to afford connection with a source of pressure. Any suitable mounting means may be provided as, for example, parallel bores 75, 75 extending through the end wall 71 laterally spaced from and normal to the axial line of the body 70, it being noted in FIG. 8 that the sides of the end wall portion of the body 70 form a rectangle of slightly greater diameter than the diameter of the cylindrical portion of the said body to afford opposite parallel faces at the opposite ends of the bolt holes 75, 75.

The internal surface of the body 70 from the open end thereof comprises a smooth surface portion 76 followed by a threaded portion 77 having a root diameter not greater than the diameter of the portion 76, a short smooth portion 78 having a diameter not greater than the minor diameter of the threaded portion 77 and a short threaded portion 79 of lesser diameter than the portion 78 which bottoms out on the inner face 80 of the end wall portion 71 of the body 1. A flexible diaphragm 81 is seated on the end wall face 80 and is secured thereon by a threaded, disc-like clamping member 82 provided with spanner wrench sockets 82', 82'; said member engaging the threaded portion 79 of the body and the body end wall having a circular groove 83 formed therein in which a resilient ring gasket 84 is compressed by the diaphragm to form a seal to prevent the escape of pressure fluid. The end face 80 of the body 70 between the groove 83 and the bore 73 is slightly concave for a purpose to be noted later.

The clamping member 82 is provided with stepped larger and smaller bores 85 and 86 axially aligned with the axial line of the body 70 and a stepped diameter plunger is mounted for limited reciprocable movement in said bores; said plunger comprising a head portion 87 disposed in and closely fitting the bore 85 and a shank portion 88 of considerably lesser diameter than the bore 86 disposed in that bore. The bores 85 and 86 form a shoulder 89 and the plunger head and shank 87 and 88 form an opposing shoulder 90; the lengths of the bores and the plunger portion housed therein being such that when the diaphragm is seated against the clamping member by pressure, the end of the plunger head is moved slightly into the bore 85 (see FIG. 11), and at the same time, the end of the shank portion 88 is projected beyond the opposite face of the clamping member. The distal end of the plunger shank 87 terminates in a short locating stud 91 engaged by an axially disposed hole 92 in a pressure plate 93 which is generally similar to the pressure plate 43 of the first embodiment in that it is provided with a circular rib 94 adapted to engage a Belleville spring and, within the area bounded by said rib, is reduced in thickness as at 95 to provide clearance for a spring seat element 96. The hole 92 extends through the pressure plate and at the side thereof opposite the clamping member terminate in a concave spherical seat 97 of somewhat less than hemispherical extent and in which the complementary end portion 98 of a spring seat member 96 is mounted for self-aligning engagement with one end of a helical compression spring 99 engaging the shoulder 100 on the spring seat member and is held against lateral movement thereon by the pilot end 101 of the spring seat member. When the device is in its normal position with the pressure plate seated on the outer surface of the clamping member 82, the plunger on which it is mounted is moved toward the diaphragm with the head portion 87 thereof moved inwardly beyond the inner face of the clamping member and thus also moving the diaphragm with it, said movement being accommodated by the concave face of the end wall 80 of the body 70 to which reference has heretofore been made. Since at that time, the pressure plate is resting on the outer surface of the clamping member, the force of the Belleville spring is not transmitted to the diaphragm.

Mounted in the outer end of the body 70 is a mounting sleeve 102 for the electrical components of the device; said sleeve having a threaded portion 103 engaging the outer end of the thread 77 and a smooth portion 104 engaging the surface 76 of the body; said smooth portion having a peripheral groove 105 housing a resilient gasket 106 to seal the joint between the surfaces. The sleeve member 102 includes an end wall 107 having an axial opening 108 extending therethrough for reception of one end of a flange receptacle R fixed thereto by screws S extending through the flange F; said receptacle externally of said end wall having means for electrical connection with a source of energy and having terminals T at its other end for connection by leads L to the terminals T' of a switch SS carried by a bracket 109 formed as part of a plate 110 which is spun into a groove 111 in the innermost end of the sleeve 102. The case of the switch SS is disposed beyond the inner end of the sleeve means 102 and carries an operating plunger P which is disposed substantially in the axial line of the body 70 and in the normal position of the switch extends further out from the switch case than when moved to its opposite position by pressure induced actuation of the actuator means. Mounted in the body 70 and threadedly engaging the innermost portion of the thread 77 is an adjusting ring member 112 having a skirt portion 113 depending below the threaded portion thereof and terminating in a frustoconical end face 114 which engages a wire ring 115 closely fitting the wall portion 78 of the body 70 and lying on the outer periphery of the concave side of a Belleville spring 116, the convex side of which, intermediate the inner and outer peripheries thereof, rests on the rib element 94 of the pressure plate 93. The inner periphery 117 of the Belleville spring loosely surrounds the innermost end of the coil spring 99. The Belleville spring 116 like that shown in the first embodiment of the invention is preferably of the type having snap action characteristics and rotation of the adjusting ring member to move it axially toward the Belleville spring will thus impose an initial bias on the Belleville spring approaching the point at which snap action will occur so that slight additional load imposed by pressure through the pressure plate 93 will cause the Belleville spring to partake of snap action. Associated with and spaced from the side of the adjusting ring 112 opposite the skirt portion 113 is an externally threaded locking ring 118 which also engages the threads 77. The locking ring and adjusting ring are interconnected by screws 119, 119 extending therethrough and engaging nuts 120, 120 whereby they may be urged toward each other axially of the body mem-

ber to lock both rings against rotative movement from any position to which they may have been adjusted.

The adjusting ring includes an axially disposed, internally threaded sleeve portion 121 extending outwardly through an opening 122 in the locking ring and threadedly engaging the threads of said sleeve portion is the inwardly extending skirt 123 of a spring adjusting cap 124 which engages the outer end of the spring 99 and by rotative adjustment varies the load imposed on the spring seat element 96 and pressure plate 93 exerted by the spring 99. The end wall of the cap 124 is provided with an axially disposed polygonal opening 125 extending therethrough which affords means for wrench engagement with the cap for adjusting rotation thereof.

The skirt portion 123 of the cap is provided with a series of three holes 126 extending parallel to the axial line of the body 70 and spaced from the axial line of the body 70 at equal distances and also at equal distances from each other. Freely slidable in said holes is one each of a series of three rods 127, each of which at one end thereof rests on the Bellville spring 116 adjacent the inner periphery thereof and which at the other end extends beyond the outer end face of the cap 124; said other ends of said rods supporting a switch plunger operating plate 128 which is constantly yieldingly engaged by the switch plunger P and which at its opposite face is provided with a tubular stud portion 129 loosely slidably engaging the sides of the opening 125 at the minor diameters thereof. As pressure causes the Belleville spring to snap, the rods 127 will be moved thereby to cause the plate 128 to move the switch plunger into the switch sufficiently to cause the switch to be actuated and upon a predetermined magnitude of pressure drop, the Belleville spring will re-actuate with snap action allowing the switch also to re-actuate by its own inherent snap action.

In general, the procedure in assembling switches of the type shown in FIGS. 6 through 9 is similar to that previously described. The adjusting ring is adjusted to achieve the desired reference to the point of actuation of the Belleville spring after which the biasing spring 99 is adjusted to cause the snap action incident to actuation of the Belleville spring to occur at the desired magnitude of pressure. The switch carrying sleeve member and associated electrical connections is likewise similarly installed; it being noted that in both embodiments of the invention, the switch actuating plunger P is located in the axial line of the body member so that rotative adjustment of the switch mounting sleeve does not change the lateral position of the plunger. In the second embodiment of the invention as in the first embodiment, the electrical connections and the switch itself can be of any form desired so long as it will fit within the body member and possesses an actuating plunger means that can be located at least substantially in the axial line of the body member. It will be obvious also with reference to the second embodiment that the receptacle can be dispensed with and that the leads L whether two, three or more in number, can extend through the opening in the end wall 107 for connection to the circuit with which the device is associated.

Referring finally to FIGS. 10 and 11, there is shown in greatly enlarged scale, the relative positions of the diaphragm and the plunger contacted and operated by the diaphragm. While these figures relate to the second embodiment of the invention, the corresponding portions of the first embodiment are identical and so far as the actuation hereinafter described is concerned, such description applies to both embodiments of the invention.

The total movement of the diaphragm and plunger incident to pressure induced actuation of the Belleville spring is of the order of about .007". It has been found that by the selection of proper material, a very thin diaphragm can be used even in the presence of pressures of the order of over 7,000 p.s.i. if the diaphragm is not caused to encounter any sharp edges. It is also important that the diaphragm shall not take any permanent deformation incident to use. For this reason the plunger head closely fits the bore therefor in the clamping member and the diaphragm engaging face of the clamping member bordering the bore 85 is rounded as is also the corner of the plunger head bounding the diaphragm engaging face thereof. When subjected to pressure of the magnitude at which the device is designed to operate, the diaphragm is forced at least partially into the groove formed by the meeting corners of the plunger head and the bore therefor. Because of the close fit between the plunger head and the bore, the diaphragm material will not be extruded into the space between them. While the selection of a proper type of diaphragm material is dictated somewhat by the character of use and the pressures to which the diaphragm is to be subjected, the material known as "Mylar" has been found to be satisfactory at the highest pressures above mentioned.

In Patent 2,824,919 there is disclosed the use of adjusting means to overcome the inherent variations of Belleville springs of seemingly identical character. The present invention achieves these objectives by the use of the springs 30 and 99 in the same manner as in the said patent. The present invention goes beyond that earlier concept in that, as has been pointed out, it affords means for using substantially a standard assembly of parts requiring only the substitution of a few parts to provide a line of pressure switches which will respond to selected pressure ranges in a broad extent or spectrum of pressures. In general, these changes relate to the variation in diameter of the pressure plate shoulder which engages the convex side of the Belleville spring as well as the change in diameter of the pressure responsive area of the pressure plate operating plunger.

While in the foregoing specification there has been disclosed certain presently preferred embodiments of the invention, it will be understood that the invention is not limited to the precise details of construction thus disclosed by way of example, and it will be understood that the invention includes as well all such changes and modifications in the parts and in the construction, combination and arrangement of parts as shall come within the purview of the appended claims.

I claim:

1. In a pressure operated electrical switch means, a body member having a chamber in which fluid pressure is exerted and a port affording connection of said chamber with a source of fluid pressure, a flexible diaphragm constituting a pressure responsive wall of said chamber, a rigid, backup wall on the side of said diaphragm opposite the side thereof subjected to pressure, a reciprocable plunger extending through an opening in said wall and contacting said opposite face of said diaphragm, a snap action spring and means actuated thereby normally holding said plunger in a position moving siad diaphragm away from said rigid wall, a snap action electric switch device mounted on said body member and including an actuator biased to normally maintain a predetermined position, devices extending between said snap action spring and said actuator effective upon snap action of said spring to effect complementary movement of said actuator and consequent snap action of said switch device, and means on said backup wall and said reciprocable plunger effective to prevent permanent distortion of said diaphragm incident to pressure induced movement thereof.

2. In a pressure operated electrical switch means, a hollow tubular body structure having a chamber in which fluid pressure is exerted and a port affording connection of said chamber with a source of fluid pressure, a flexible diaphragm constituting a pressure responsive wall of said chamber, a rigid backup wall means on the side of said diaphragm exterior of said chamber, a reciprocable plunger extending through said wall and contacting said exterior side of said diaphragm for pressure responsive

movement therewith, means on said wall and said plunger effective to limit the extent of pressure responsive movement exerted on said plunger by said diaphragm, a snap action spring means mounted within said body member and devices actuated by said spring means and engaging said plunger normally effective to hold said diaphragm in a position capable of movement in response to presence of a predetermined pressure in said chamber, a snap action electric switch device mounted on said body member and including an actuator biased to normally maintain a predetermined position, devices extending between said snap action spring and said actuator effective upon snap action of said spring to effect complementary movement of said actuator and consequent snap action of said switch device, and means on said backup wall and said reciprocable plunger effective to prevent permanent distortion of said diaphragm incident to pressure induced movement thereof.

3. In a pressure operated electrical switch means, a body member having a chamber in which fluid pressure is exerted and a port affording connection of said chamber with a source of fluid pressure, a flexible diaphragm constituting a pressure responsive wall of said chamber, a rigid, backup wall on the side of said diaphragm opposite the side thereof subjected to pressure, a reciprocable plunger extending through an opening in said wall and contacting said opposite face of said diaphragm, a snap action spring and means actuated thereby normally holding said plunger in a position moving said diaphragm away from said rigid wall, a switch mounting means mounted on said body member for adjustment toward and away from said snap action spring means, a snap action electric switch device fixed to said mounting means for adjustment therewith and having a reciprocable operating element biased to normally maintain a predetermined position, devices extending between said operating element of said switch and said snap action spring means effective to transmit snap action movements of said snap action spring means to said element, and means for preventing permanent distortion of said diaphragm incident to pressure induced movement thereof.

4. In a pressure operated electrical switch means, a body member having a chamber in which fluid pressure is exerted and a port affording connection of said chamber with a source of fluid pressure, a flexible diaphragm constituting a pressure responsive wall of said chamber, a rigid, backup wall on the side of said diaphragm opposite the side thereof subjected to pressure, a reciprocable plunger extending through an opening in said wall and contacting said opposite face of said diaphragm, a snap action spring and means actuated thereby normally holding said plunger in a position moving said diaphragm away from said rigid wall, a switch mounting means mounted on said body member for screw threaded adjustment toward and away from said snap action spring means, a snap action electric switch device fixed to said mounting means for adjustment therewith and having a reciprocable operating element biased to normally maintain a predetermined position, devices extending between said reciprocable element and said snap action spring means effective to transmit snap action movements of said snap action spring means to said reciprocable element, and means for preventing permanent distortion of said diaphragm incident to pressure induced movement thereof.

5. In a pressure operated electrical switch means, a hollow tubular body structure having a chamber in which fluid pressure is exerted and a port affording connection of said chamber with a source of fluid pressure, a flexible diaphragm constituting a pressure responsive wall of said chamber, a rigid backup wall means on the side of said diaphragm exterior of said chamber, a reciprocable plunger extending through said wall and contacting said exterior side of said diaphragm for pressure responsive movement therewith, means on said wall and said plunger effective to limit the extent of pressure responsive movement exerted on said plunger by said diaphragm, a snap action Belleville spring disposed within said body structure and having the outer periphery thereof engaging an abutment means carried by the interior surface of said body structure the portion of said Belleville spring inwardly of said abutment means being movable with snap action between a normally occupied position and a fluid pressure induced position, devices interposed between said plunger and a point on said Belleville spring radially inwardly of said outer periphery thereof normally effective to cause said plunger to maintain said diaphragm in a position capable of movement in response to the presence of a predetermined pressure in said chamber in a direction to effect snap action of said Belleville spring from the normally occupied position thereof, a snap action electric switch device mounted on said body structure and including an actuator biased to normally maintain a predetermined position, devices interposed between the inner periphery of said Belleville spring and said switch actuator effective upon snap action of said Belleville spring to effect snap action of said switch device, and means on the adjacent diaphragm engaging surfaces of said wall and said plunger effective to prevent permanent distortion of said diaphragm incident to pressure induced movement thereof.

6. In a snap action pressure switch means, a hollow, tubular body member open at one end and having an end wall at the other end thereof, a port affording connection to a source of fluid pressure projecting outwardly from said end wall and extending through said end wall into the interior of said body member, a flexible diaphragm disposed on the inner face of said end wall and closing said port with resultant formation of a pressure chamber at the inner end of said port, means clamping said diaphragm against said end wall face and forming a backup wall for said diaphragm, a plunger having an end face engaging the side of said diaphragm engaged by said clamping means mounted for reciprocable movement in said clamping means, means for limiting the extent of pressure induced movement of said plunger deriving from said diaphragm, means on the diaphragm engaging faces of said clamping means and said plunger effective to prevent permanent distortion of said diaphragm by pressure in said chamber, spring means for normally biasing said plunger for movement of said diaphragm in a pressure opposing direction, an electric switch and other devices actuated by pressure induced movement of said plunger effective to actuate said switch.

7. A pressure switch means as claimed in claim 6 in which said plunger biasing spring means comprises a snap action Belleville spring.

8. A pressure switch means as claimed in claim 6 in which said electric switch is a snap switch normally spring biased to a predetermined one of two positions.

9. A pressure switch means as claimed in claim 6 in which said plunger includes a head portion having said diaphragm engaging face and in which said head portion is guided in a bore in said clamping means.

10. A pressure switch means as claimed in claim 6 in which the edges defining said end face of said plunger and said plunger guiding bore on the diaphragm engaging face of said clamping means are rounded to preserve the integrity of said diaphragm.

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