April 17, 1956 J. B. LOVICK 2,742,544

SWITCH ACTUATING MECHANISM

Filed Aug. 24, 1953

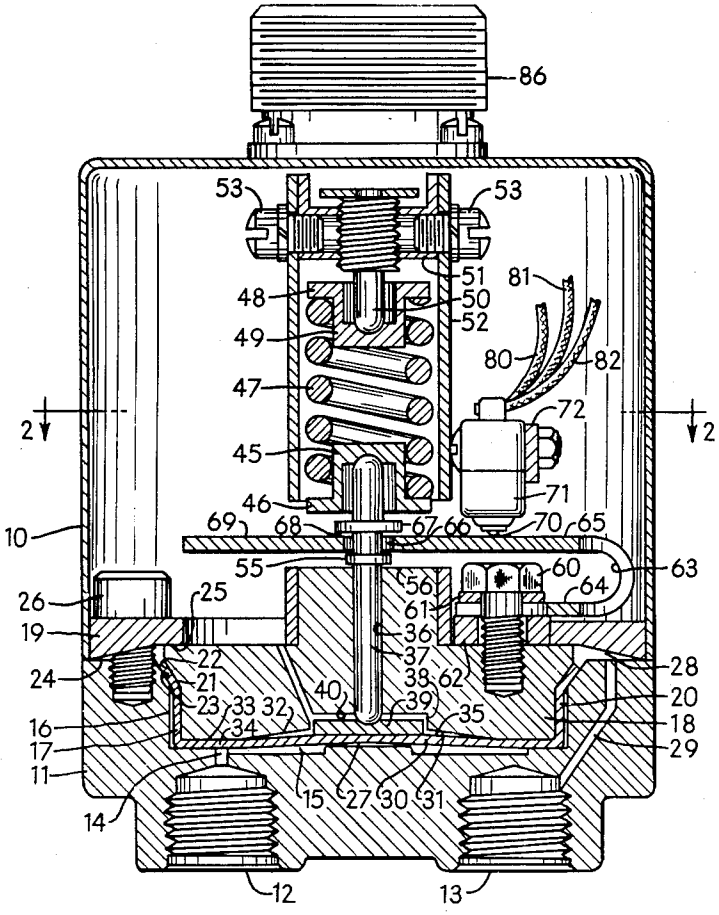

Fig. 1

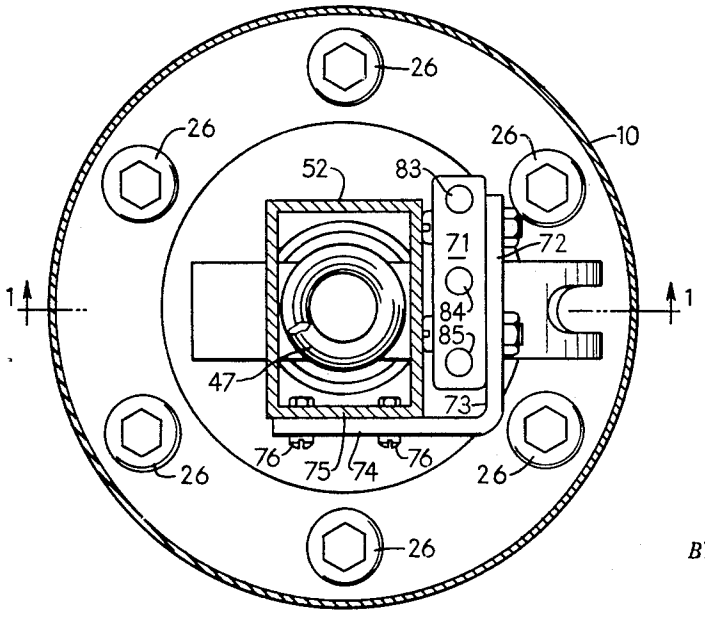

Fig. 2

INVENTOR.
JOHN B. LOVICK
BY William W Hayliger

United States Patent Office 2,742,544 Patented Apr. 17, 1956

2,742,544

SWITCH ACTUATING MECHANISM

John B. Lovick, Sun Valley, Calif., assignor to Aero Instrument Company, North Hollywood, Calif., a corporation of California

Application August 24, 1953, Serial No. 375,892

8 Claims. (Cl. 200—83)

This invention relates to actuating mechanism for electric switches, and more particularly to a novel pressure actuated diaphragm type actuating mechanism for an electric switch, which mechanism is particularly well adapted to high pressure operation.

It is an object of the invention to provide in pressure type switch actuating mechanism a novel diaphragm constructed and mounted in such a way that full and effective displacement of the diaphragm may be obtained without causing movable portions thereof to pass through the central or median plane of the diaphragm, thereby prolonging the useful life of the diaphragm and of the switch actuating mechanism as a whole.

It is another object of the invention to provide in pressure type switch actuating mechanism a novel switch actuating means which is positioned and constrained by diaphragm actuated elements in such a way as to permit adjusting the displacement effecting operation of the switch relative to the displacement of the diaphragm so that sensitivity of switch operation in accordance with small changes in the pressures exerted on the diaphragm may be realized.

It is another object of the invention to provide in pressure type switch actuating mechanism a novel means for mounting and compressing a diaphragm between base members so that compressive loads will be evenly distributed across all portions of the diaphragm contacted by the base members.

It is another object of the invention to provide in pressure type switch actuating mechanism a novel means for transferring pressure loads from the diaphragm to a plunger member bringing about switch operation, so that stress concentrations in the diaphragm will be minimized and the useful life of the diaphragm greatly prolonged.

It is a further object of the invention to provide in pressure type actuating mechanism a novel means for relieving pressure loads on a movable diaphragm member when the pressures exceed a predetermined amount, so that the diaphragm structure will withstand pressures greatly in excess of actuating pressure.

Other objects and advantages will become apparent from a consideration of the following description and the appended claims in conjunction with the accompanying drawings wherein:

Figure 1 is a sectional view illustrating the details of the present invention; and

Figure 2 is a cross-sectional view taken along line 2—2 of Figure 1.

With continued reference to the drawings, the switch actuating mechanism illustrated has a cover 10 which is supported on a base member 11, in the lower portion of which two ports 12 and 13 are formed. Port 12 communicates by means of duct 14 with the inside surface 15 of base member 11, which surface forms the lower or internal face of the cylindrically cupped portion 16 of base member 11. A cup-shaped diaphragm 17 which is fitted around a cylindrically shaped second base member 18 is held within the cup-shaped portion 16 of base

member 11 by means of an annular retaining ring 19. The diaphragm wall 20 includes a flanged portion 21 which engages flanged portion 22 of base member 18, and angularly overlaps and engages the beveled wall portion 23 of base member 11 when the diaphragm is inserted within cup-shaped portion 16 of base member 11.

Ring 19 overlaps an annular surface portion 24 of base member 11 and a raised annular surface portion 25 of base member 18, and bears against these surfaces. A series of cap screws 26 are equi-spaced around the annular portion of retaining ring 19 which overlaps surface 24 of base member 11, and screws 26 are threadedly engaged therewith. Screws 26 and retaining ring 19 provide means for exerting compressive loads downwardly against surface 25 of the base member 18 in such a way that the compressive loads and stresses are evenly distributed and transferred across the flanged portion 21 of diaphragm wall 20 from flanged portion 22 of base member 18 to beveled surface portion 23 of base member 11, which takes the reaction loads. The even distribution of the compressive loads across flanged portion 21 of the diaphragm provides a tight annular fluid seal between beveled portion 23 of base member 11 and the flanged portion 21 of the diaphragm so as to prevent the escape of highly pressurized fluids entering port 12 and bearing against the under side 27 of diaphragm 17. Should the seal fail and fluid leak between beveled surface 23 and flanged portion 21 of the diaphragm, the fluids will exit from the space 28 between base members 11 and 18 and retaining ring 19 via duct 29 and port 13.

The diaphragm itself is preferably a cup-shaped thin-walled metallic body having end face or wall 30 which is dished inwardly toward end face 31 of base member 18 by virtue of the operation in which cylindrical base member 18 is pressed into the slightly smaller cup-shaped diaphragm body or walled portion 20. The end face 31 of base member 18 includes a dished wall portion 32 disposed inwardly into the base member 18 and away from the diaphragm wall 30. End face 31 also includes a flat annular portion 33 disposed radially outwardly from dished portion 32, and against which bears the annular portion 34 of the wall 30 of the diaphragm. The curvature of the dished portion of the diaphragm is preferably made less than the curvature of the dished portion 32 of end face 31 of base member 18 to provide a chamber 35 existing therebetween when the diaphragm is not displaced upwardly toward end face 31 by fluid pressure.

The base member 18 has formed therein a cylindrical aperture 36 within which a movable member such as the slidable plunger 37 is fitted. The lower portion of the plunger projects downwardly into a cylindrical chamber 38 formed in end face 31 of base member 18, and a cylindrical plate member or doubler 39 is fitted within chamber 38 between the dished portion 30 of the diaphragm and the lower end of the plunger 37. When the diaphragm is deflected upwardly as by fluid pressure, the loads are transferred from the dished portion of the diaphragm to the plate member, and to the plunger 37. When pressure loads are transferred to the plate member, the diaphragm will flex upwardly with respect to the plate member at points adjacent the periphery thereof, and stress concentrations will occur within the diaphragm at these points. However, the provision of the plate member between the diaphragm and plunger precludes the formation of dangerously high stress concentrations which would otherwise arise were the loads transferred directly to the plunger from the diaphragm, since the stress concentrations are annularly distributed in the embodiment shown. Thus there is provided a means for distributing the compressive loads transferred from the diaphragm to a movable member so as to minimize stress concentrations in the diaphragm and greatly prolong the

useful life thereof. It will also be noted that upward displacement of diaphragm wall 30 is limited by the engagement of the upper surface of plate member 39 with the wall 40 of chamber 38.

The opposite end of plunger 37 engages the internal end surface of cup 45. Cup 45 has a flanged portion formed thereon, which is engaged by a compression spring 47. The opposite end of spring 47 engages a similar flange 48 on cup 49, and the internal end wall of cup 49 is engaged by an axially adjustable plunger 50. Plunger 50 is threaded and engages an adjusting nut 51 which is retained in position with respect to cylindrical housing 52 by means of machine screws 53. Spring 47 is compressed a predetermined amount by adjustable plunger 50 so that plunger 37 may be displaced or compressed upwardly only after a predetermined load is exerted upwardly thereon by the diaphragm wall 30, the load corresponding to a predetermined pressure exerted against the under side 27 of the diaphragm wall 30. Plunger 37 has attached thereto an abutment means such as flange 55 formed thereon, the abutment being provided to engage the wall 56 of base member 18 to limit downward travel of the plunger toward the diaphragm. Downward travel of the plunger is limited in order that the displaceable diaphragm wall 30 will not be forced to pass over or through its centered position, relative to the annular wall portion 34 thereof. Thus the diaphragm wall 30 will remain disposed upwardly toward wall portion 32 of base member 18 at all points of displacement during operation, and stresses in the diaphragm associated with passing 'over-center' will not be encountered, thereby greatly prolonging the life of the diaphragm.

In operation, fluid pressure is exerted on the under side 27 of the diaphragm. Spring 47 is initially compressed so that fluid pressure exerted on the under side of the diaphragm must exceed a predetermined amount before the diaphragm 17, plate member 39, and plunger 37 will be displaced upwardly.

It will be especially noted that upward displacement of the diaphragm 17 is limited by base member 18, since as the diaphragm wall or face 30 is displaced upwardly through chamber 35, successive annular portions of the diaphragm wall 30 will come into engagement with or be relieved by the dished wall 32 of the base member 18. Similarly, engagement of the plate member 39 with wall 40, after upward travel thereof through chamber 38, will preclude further upward movement of the portion of the diaphragm engaging plate member 39. Fluid pressure in excess of that necessary to upwardly displace the diaphragm may then be exerted against the under side of the diaphragm without damaging the diaphragm itself, since the loads on the diaphragm are transferred directly to base member 18. Thus the diaphragm is never called upon to withstand tensile stresses in excess of the yield point of the material thereof. The loads are instead taken in compression and transferred directly to the base member 18. Thus there is provided a sensitive pressure actuated mechanism which will bring about plunger displacement at relatively low pressures in the neighborhood of 80 p. s. i., and yet will withstand very high pressures in the neighborhood of 3000 p. s. i. without damaging the pressure actuated mechanism. When the fluid pressure is reduced to approximately 60 p. s. i., the spring force exerted by spring 47 will overcome the fluid pressure and force plunger 37, plate 39, and diaphragm 17 downwardly so as to move the diaphragm wall 30 away from dished wall 31 of base member 18.

Mounted on base member 18 by means of a cap screw 60 and washers 61 and 62 is a switch actuating element comprising a U-shaped flat spring 63. The flat spring includes a leg 64 which is rigidly held between washers 61 and 62, and a leg 65 which extends transversely with respect to plunger 37 and is engaged or constrained thereby. The plunger passes through an aperture 66 formed on the plunger 37 engages a ridge 68 formed on the upper surface 69 of leg 65 adjacent aperture 66.

Also engaging the upper surface 69 of leg 65 is a switch actuating plunger 70 protruding downwardly from the body 71 of an electric switch comprising a microswitch in the embodiment illustrated. The switch body is mounted on one leg 72 of a bracket 73, and another leg 74 of the bracket is adjustably fastened to wall 75 of the housing 52 by means of bolts 76. These bolts may be loosened to permit slidable adjustment of leg 74 of the bracket so as to move the switch plunger 70 parallel to the upper surface 69 of leg 65 of the flat spring, toward or away from the plunger 37. Three wires 80, 81, and 82 are joined to terminals 83, 84, and 85 on switch body 71. The opposite ends (not shown) of these wires are joined to terminals associated with the electrical connector 86.

The leg 65 of the flat spring element is at all times constrained or loaded in bending by flange 67 on plunger 37 so that as plunger 37 moves downwardly or upwardly, leg 65 moves with it. Thus, movement of plunger 37 will bring about corresponding movement of the switch plunger 70 so as to actuate the switch element. One advantage residing in the use of the flat spring element 63 is found in the constant loading thereof by plunger 37, whereby diaphragm actuated movement of plunger 37 is accurately reflected in movement or actuation of the switch plunger 70. The amount of displacement of the switch plunger 70 relative to the amount of displacement of the plunger 37 may be advantageously increased or decreased by moving the bracket and switch assembly toward or away from plunger 37 as described supra, thereby achieving a fine adjustment in the switch actuating displacement relative to the pressure induced displacement of the plunger 37.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is, therefore, to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims, and all changes which come within the meaning and range of equivalency of the claims are, therefore, intended to be embraced therein.

I claim:

1. An improved pressure operated switch assembly, comprising a metal base having opposite ends, a recess formed in one of said ends and a fluid pressure inlet communicating between the bottom of said recess and the other of said ends, said base including an angular seat extending around said recess at the side thereof in spaced relation to said recess bottom, a metal backer including an end face carried in said recess and dished away from the bottom thereof, said backer having an angular shoulder spaced opposite said seat, a cupped metallic diaphragm including a flange disposed between said seat and shoulder and a transverse bottom wall stretched over and dished toward the end face of said backer to form a clearance therebetween adapted to be closed upon pressure induced deflection of said diaphragm wall against said end face for unloading said diaphragm when said fluid pressure exceeds a predetermined value, means reacting against said base for urging said backer toward said base to compressively load said flange between said seat and said shoulder providing a pressure seal therebetween, an electric switch positioned externally of said base and backer, and switch actuating means extending through said backer and operatively connected between said diaphragm wall and said switch for transmitting pressure induced deflection thereto.

2. The invention as defined in claim 1 in which said means urging said backer toward said base comprises a metallic load ring overlapping said backer and the side of said base, said ring engaging one and being spaced

from the other of said backer and said base, and threaded means interconnecting said ring and said other to uniformly urge said backer toward said base.

3. The invention as defined in claim 2 in which said ring is spaced from said base side and engages said backer, and in which said threaded means comprise screws interconnecting said ring and said base side.

4. The invention as defined in claim 1 in which said switch actuating means includes a central plunger extending through said backer toward said diaphragm, said plunger having a convex end, a spring urging said plunger toward said diaphragm, and a central pressure plate interposed between the end of said plunger and one side of said diaphragm to transfer fluid pressure loads from said diaphragm to said plunger, said plate having a concave seat adapted to receive the end of said plunger.

5. The invention as defined in claim 4 in which said backer has a central recess formed in said end face to accommodate said pressure plate, said recess having a depth substantially equal to the thickness of said plate providing for seating of said plate against the inner wall of said recess upon seating of said diaphragm against said end face.

6. The invention as defined in claim 4 including threaded adjusting means operatively connected to said spring for varying the load exerted by said spring on said plunger.

7. The invention as defined in claim 4 including a

transversely extending flat spring having an opening formed therein to accommodate extension of said plunger therethrough, means mounting said electric switch in engagement with said spring and for positional adjustment along a transverse portion of said flat spring whereby the amount of movement transmitted to said switch by said spring may be varied, means mounting said flat spring for deflection in the direction of movement of said plunger, and a shoulder carried by said plunger and engageable against said flat spring for effecting switch actuating displacement thereof on diaphragm induced movement of said plunger.

8. The invention as defined in claim 7 in which said plunger carries a second shoulder adapted to close against a wall carried by said backer to intercept deflection of said plunger toward said diaphragm prior to over-center movement of said diaphragm toward said recess bottom upon fluid pressure unloading of said diaphragm.

References Cited in the file of this patent

UNITED STATES PATENTS

1,231,561	Briggs	July 3, 1917
1,466,243	Neal	Aug. 28, 1923
1,712,657	Frankenberg	May 14, 1929
2,647,968	Byam	Aug. 4, 1953