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PRESSURE ACTUATED ELECTRICAL SWITCH

Filed Jan. 1, 1945

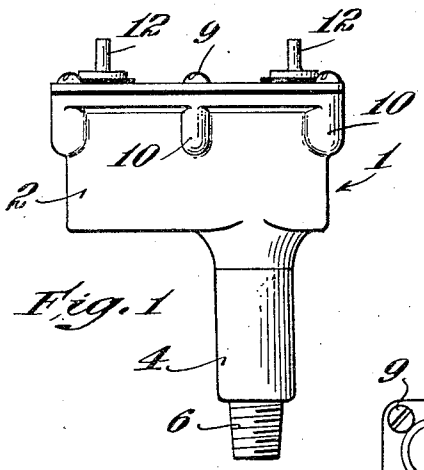


Fig. 1

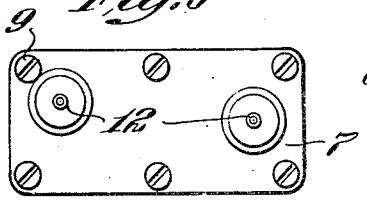


Fig. 3

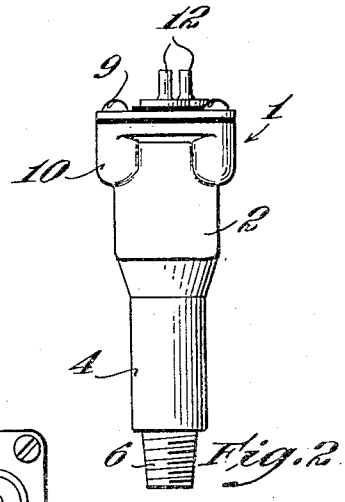


Fig. 2

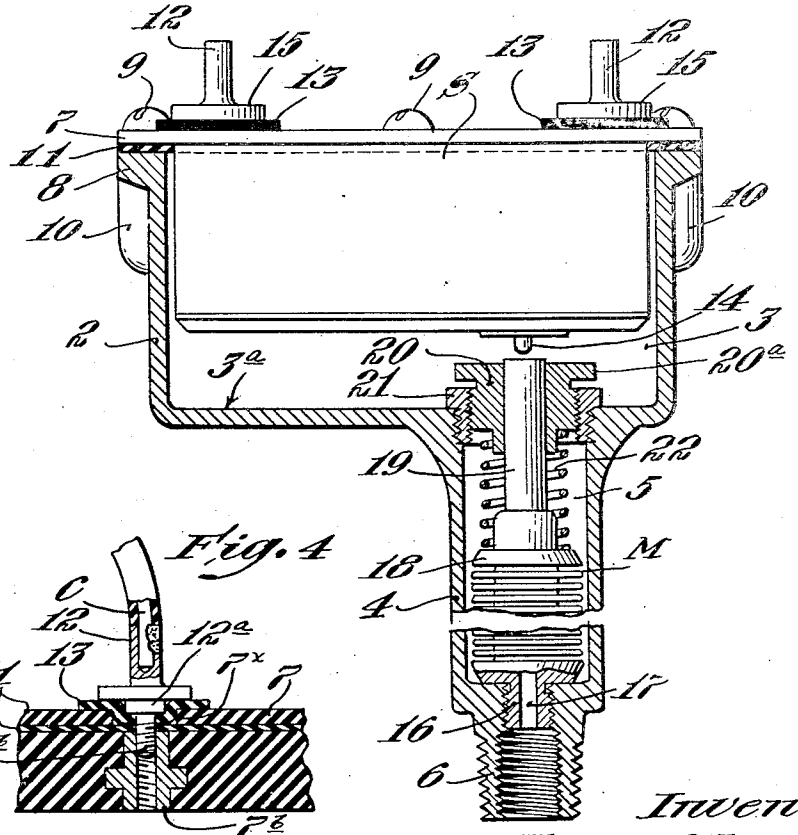


Fig. 4

Fig. 5

Inventor.
Henry G. Leupold
by Roberts Cushman & Groover
Att'ys.

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PRESSURE ACTUATED ELECTRICAL SWITCH

Henry G. Leupold, Cambridge, Mass., assignor to United Electric Controls Company, South Boston, Mass., a corporation of Massachusetts

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3 Claims. (Cl. 200—83)

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This invention pertains to electric switches of the pressure-responsive type, and is more particularly related to switches designed, for example, for aeronautical use, and which, during use, may be exposed to greatly varying atmospheric pressure.

Pressure-actuated switches are used in aeronautics for the automatic control of oil pumps, etc., and for such use must necessarily be very reliable but also very sensitive to fluctuations in fluid pressure, either liquid or gaseous. Usually such switch devices employ as the pressure-responsive element a diaphragm or the like, commonly of the metallic bellows or Sylphon type. Such devices may be made sufficiently sensitive to variations in fluid pressure to insure the desired nicety of control, but, as usually constructed, such devices really respond to differential pressures, that is to say, the difference in pressure prevailing at any given time between the internal and external fluid pressure to which the device is subjected. Thus, if the exterior of the instrument be exposed to the atmosphere, its operation will be affected by barometric changes. For ordinary use, such barometric changes would not seriously interfere with the operation of such an instrument, but when the switch is installed in an aeroplane, the barometric variations to which it is exposed are so great as seriously to affect its operation. Obviously it is not practical to readjust such a device (even if adjustment be provided for) to compensate for the rapidly changing air pressure encountered during the flight of an aeroplane.

One principal object of the present invention is to provide a pressure-actuated electrical switch whose operation is not affected by changes in the pressure of the ambient medium. A further object is to provide a pressure switch device unaffected by barometric variations and in which the switch proper may be a snap-action switch of the type commonly known as a micro or "mu" switch.

Switch devices of this type customarily include means for externally loading the pressure-sensitive element (motor) to determine the pressure at which it will effectively operate; usually provision is made for adjusting the load. However, as heretofore designed, the adjustment of the load has ordinarily involved movement of the switch unit as a whole and/or a variation of the normal stress on the switch spring—thus seriously affecting the operation of the switch and detracting from the accuracy of the device as a whole.

A further object of the present invention is to

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provide a pressure-actuated switch device having provision for varying the external load on the pressure motor, but so designed that variation in the load is accomplished without changing the position of the switch unit as a whole or in any manner imposing stress upon or varying the normal stress of the switch spring.

For aeronautical use and for naval use, particularly for use in submarines, every accessory, including such minor parts as a pressure switch, must be as light in weight and as small as possible. A further object of the invention is to provide a pressure-actuated electrical switch device which is very small and compact; light in weight; very reliable although very sensitive; which is relatively inexpensive to make; easy to install; adjustable to different requirements; and whose operative parts are accurately protected by a strong and rigid case.

Other and further objects and advantages of the invention will be pointed out in the following more detailed description and by reference to the accompanying drawing wherein

Fig. 1 is a side elevation of the switch to actual size;

Fig. 2 is an end elevation of the switch;

Fig. 3 is a plan view of the switch device;

Fig. 4 is a vertical section to larger scale showing the complete device but with the switch unit in side elevation; and

Fig. 5 is a fragmentary section, to large scale, through the upper part of the casing of the switch unit.

Referring to the drawing, the numeral 1 designates the improved switch device as a whole. As here illustrated, this device comprises a rigid housing which, in a preferred embodiment, comprises a unitary body portion which may, for example, be a metal casting or which may be moulded from a suitable plastic composition. This body portion, as illustrated, comprises the upper part 2 (Fig. 4) defining a chamber 3 for the reception of the switch unit S, and a lower portion 4, here shown as of more or less cylindrical, tubular form constituting a supporting stem and defining a chamber 5 for the reception of the pressure motor M. As illustrated, this stem portion 4 terminates at its lower end in a nipple 6 which, as here illustrated, is screw threaded both internally and externally for convenience in attaching it to a fluid pressure container, for instance a pipe or capillary tube leading from a bulb or other receptacle (not shown) containing an expansible or volatile fluid.

As illustrated, the switch unit S is of generally

conventional type, being a snap action switch of the type commonly referred to as a "mu" or micro switch. Since switches of this type constitute a common and well known article of commerce, it is unnecessary to go into detail in respect to the switch mechanism per se.

As here illustrated the casing of this switch unit S comprises a metal top plate 7 of such size that its margin extends outwardly beyond the vertical sides of the body of the switch unit casing. This top member 7 overlies the upper wall 7a (Fig. 5) of the switch unit and forms a cover for the upper part 2 of the housing. As illustrated, the outwardly extending marginal portion of the top member 7 overlies the upper edge of the part 2 of the housing, this upper edge being thickened to form a rim 8 so as to provide a good bearing. The part 7 is removably secured to the housing by screws 9 which extend down into screw-threaded bores in bosses 10 formed on the exterior of the housing. In order to provide an air-tight joint between the member 7 and the rim portion 8 of the housing, suitable packing 11, for instance a gasket of rubber or equivalent material, is interposed between the part 7 and the rim 8, so that when the screws 9 are tightened, an airtight joint is formed between the housing proper and its cover 7.

To prevent entrance of air to the housing at the points where the electrical conductors C (Fig. 5) enter the switch unit, the latter are soldered into elongate metallic socket members 12, each having a peripheral shoulder 12a, and being screw threaded at its lower end at 12b for engagement with an internally threaded switch terminal 7b set into the top wall 7a of the switch unit casing. The plate 7 is provided with an opening 7x, coaxial with each of the respective terminals 7b, the opening 7x being of a diameter larger than the part 12b but smaller than the part 12a. A resilient annular gasket 13 underlies the part 12a and when the member 12 is screwed down into member 7b, the gasket 13 is compressed and bowed down in opening 7x, thus forming a tight seal and preventing air from entering the housing.

The switch unit is provided with the usual actuating pin 14, it being noted that the chamber 3, which receives the switch unit, is of such depth that the lower end of this actuating pin is disposed at a substantial distance above the floor 3a of this chamber, the pin 14 being substantially coaxial with the motor chamber 5.

The lower part of the stem 4 is provided with an internally srew-threaded bore or duct, coaxial with the bore in the nipple portion 6, which receives a screw-threaded nipple 17 projecting from the lower head of the pressure motor M. This pressure motor is here illustrated as of the metallic bellows type having an interior chamber to which the only access is provided by the bore 17 in the nipple 16. The nipple 16 is screw threaded into the bore in the stem 4, so as to provide a leak-tight joint between the head of the motor and the stem 4. If necessary, suitable packing may be inserted between the lower head of the motor and the inner surface of the stem 4, or the screw threads on the nipple 16 may be coated with a suitable plastic or fluid packing material before the parts are assembled. The upper head 18 of the pressure motor carries an upwardly directed pin-operating, motion-transmitting rod 19 which as here shown is axially aligned with the switch pin 14. This rod is guided to move freely in a bore in an adjusting nut 20, preferably having a knurled actuating head 20a, and which as here illustrated has threaded engagement with internal threads in a bearing sleeve 21 which is externally screw threaded to engage screw threads at the upper end of the stem 4.

A loading spring 22 has one end bearing against the upper head 18 of the motor device and its other end bearing against the inner or lower end of the adjusting nut 20. By turning the nut 20 relatively to the sleeve 21, the spring 22 may be compressed more or less, thereby varying the external load on the motor M so as to adjust the motor to respond to different fluid pressure acting on its interior.

It may be noted that while the member 19 is arranged directly below the lower end of the switch pin 14, so that upward movement of the member 19 may operate the pin 14, there is no positive connection between the parts 19 and 14, and that the actuation of the nut 20 for the purpose of varying the load on the motor does not in any way affect or change the position of the pin 14. Thus adjustment of the motor load is made without changing the normal position of the switch parts and without changing the stress of the switch spring or springs. Moreover, if it be desired for any reason to remove the switch unit from the housing, for example for repairs or replacement, this may be done simply by removing the screws 19 and lifting the switch unit out of the housing, such operation having no effect whatever upon the adjustment of the external motor load. Thus when the switch unit is restored to its operating position, the switch is in readiness for use without necessitating readjustment or calibration.

Since the screw-threaded connection between nipple 16 and the housing provides a leak-tight union at that point, and since the gaskets at 11 and 13 effectively prevent the movement of pressure fluid, for instance air, into or out of the switch housing, the motor M is thereby completely shielded from the effects of changes in the pressure of the ambient medium for instance from changes in barometric pressure, and thus the operation of the motor depends entirely upon variations in pressure of the fluid admitted to its interior through the passage 17. The operation of the switch is thus completely independent of barometric changes, so that, when used for aeronautical purposes, it may be depended upon to operate at the desired internal pressure, regardless of the height at which the aeroplane may be flying.

While a certain desirable embodiment of the invention has been illustrated by way of example, it is to be understood that the invention is broadly inclusive of any and all modifications and equivalent constructions falling within the scope of the appended claims.

I claim:

1. An instrument of the class described wherein a switch unit, having an actuating pin, is associated with a pressure motor within a rigid housing, the latter comprising a hollow body portion and a removable cover, characterized in that the switch unit includes a top plate constituting the cover for the housing and the body of the switch unit depends from the cover into the hollow body portion of the housing, and in having means for securing the cover leak-tight to the body of the housing, the switch unit having terminals which extend leak-tight through the top plate, the motor comprising an inlet nipple which is fixed leak-tight in a bore in the wall of the housing

body, the motor also including a part which moves, in response to pressure variations, in a rectilinear path coaxial with the switch pin, and a rigid element for transmitting motion from said movable motor part directly to the switch pin.

2. An instrument as set forth in claim 1, characterized in that the pressure motor is a metallic bellows coaxial with the actuating pin of the switch, a spring for loading the bellows, and adjusting means within the body of the housing for varying the load imposed by the spring.

3. An instrument as set forth in claim 1, characterized in that the motion-transmitting element is an elongate pin coaxial with the switch pin, but free from the latter, a rigid guide sleeve for said motion-transmitting pin, said sleeve having threaded engagement with a part of the housing, and a loading spring for the motor, one end of said spring abutting said sleeve, the latter being operative, by rotation relatively to the housing, to vary the load imposed by the spring upon the motor.

HENRY G. LEUPOLD.