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AMBIENT PRESSURE RESPONSIVE SWITCH

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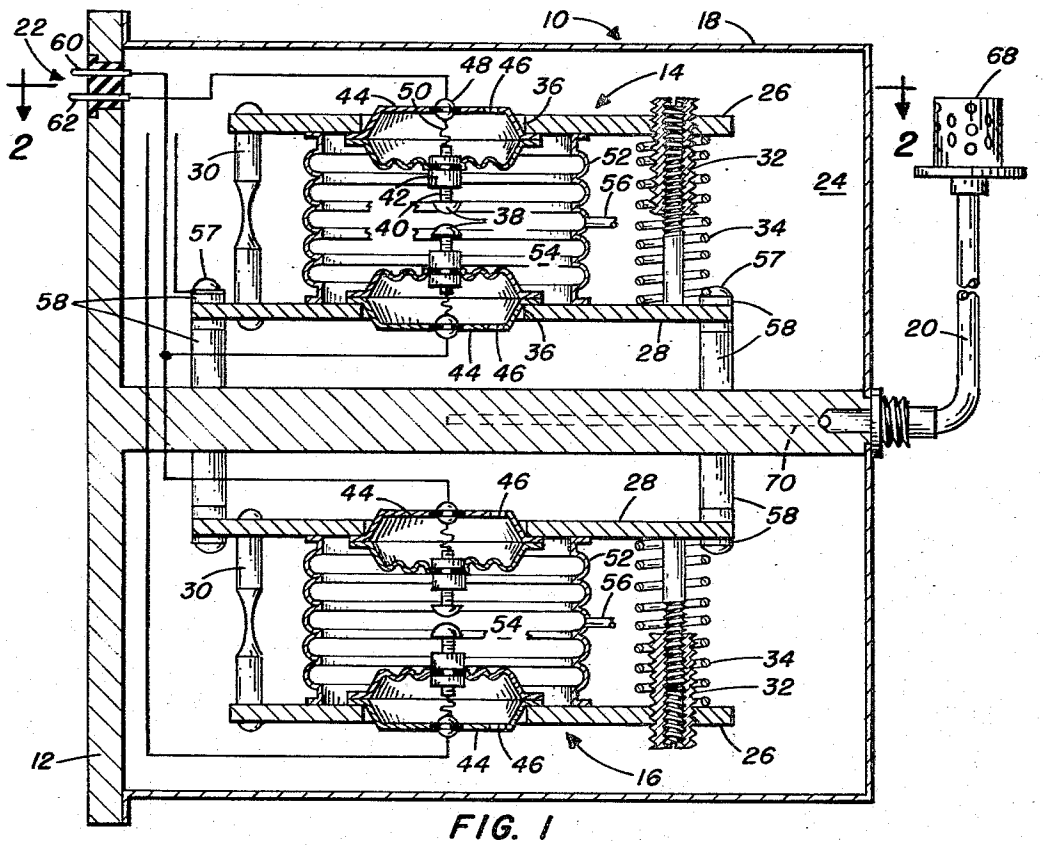



FIG. 1

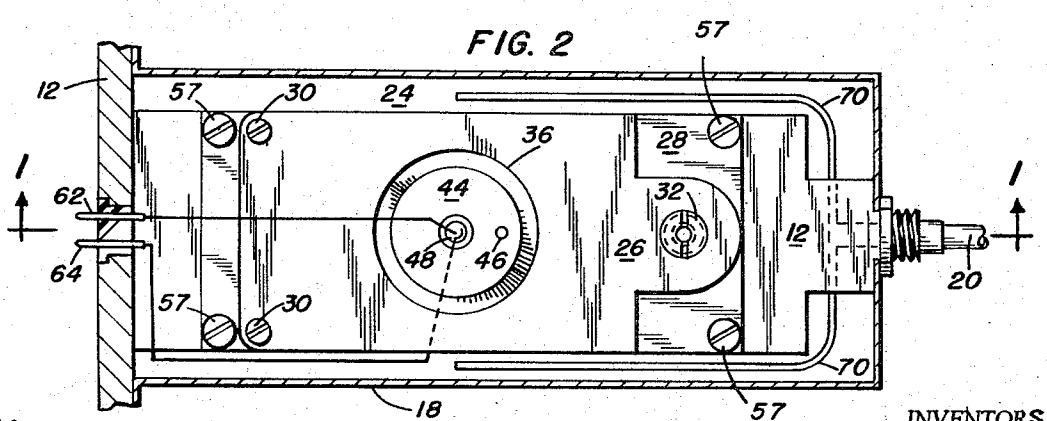



FIG. 2

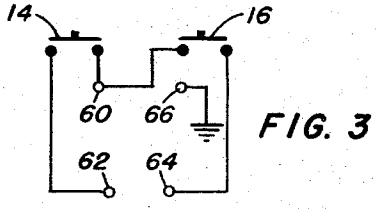



FIG. 3

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# AMBIENT PRESSURE RESPONSIVE SWITCH

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## ABSTRACT OF THE DISCLOSURE

A pressure responsive electric switch designed to make or break an electric circuit in response to changes in ambient pressure. A pair of pre-set diaphragms and a metallic bellows forms a reference pressure chamber which is acted upon when the desired ambient pressure is reached at which a circuit is intended to be completed or broken. Facing contact buttons on each diaphragm, electrically connected, facilitate a making or breaking the circuit depending on the reference pressure and the ambient pressure conditions. The reference pressure chamber is isolated from ambient pressure pulsations and from air impurities by an attenuator means between the ambient environment and a housing surrounding the reference pressure chamber.

This invention relates to electrical switches designed to make and/or break an electric circuit in response to changes in ambient pressure as, for example, where the switch is carried aloft by an airborne device in which an electric circuit is to be made and/or broken at some preselected altitude. Such switches may be required to respond quickly, reliably, and with a high degree of accuracy while at the same time they must be capable of withstanding severe vibrational and gravity stresses, otherwise, the circuit to be controlled may be prematurely made or broken.

Accordingly, it is an object of the present invention to provide an electrical switch which will be actuated in response to changes in ambient pressure.

Another object of the present invention is to provide a pressure actuated switch for making and/or breaking an electric circuit.

Yet another object of the present invention is the provision of protection means for diaphragm type switch elements.

A further object of the present invention is to provide a pressure actuated electrical switch having micrometric adjusting means for changing the spacing between the switch contacts.

Still a further object of the present invention is to provide a pressure actuated electric switch having means for eliminating any sudden pulsations in the pressure that actuates the switch.

A further object of the present invention is the provision of a pressure actuated switch having a high degree of accuracy and which is immunized from vibrational and gravity stresses.

Other objects, advantages and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings wherein:

FIG. 1 is a side elevation view taken along line 1—1 of FIG. 2;

FIG. 2 is a top view of the switch taken along line 2—2 of FIG. 1; and

FIG. 3 is a schematic diagram showing the electrical wiring between the two switch elements and the plug mounted in the base.

Referring now to FIG. 1, the switch 10 is shown as



made up of a base 12, two switch elements 14, 16 shock mounted on the base and a cover or housing 18 having a pressure sensing tube 20. Each of the switch elements are electrically connected to a coupling means, such as plug 22, for connecting the switch elements into a circuit. The cover and base make up a housing means having a pressure chamber 24 therein and it is the pressure within this chamber 24, as sensed by pressure tube 20, which actuates the switch elements.

Since the two switch elements are identical, only one need be described in detail. The switch elements have a support structure made up of an upper plate 26 and a lower plate 28 held in substantially parallel spaced relation to each other by hinge pins 30 and by differential screw adjusting means 32. A spring 34 biases the plates apart against the holding action of the differential screw. Each of the plates have coaxial circular openings 36 for receiving diaphragms.

The diaphragms are made of a material having matched thermal characteristics such as, for example, Ni-Span C and are usually formed with a series of corrugations as shown in FIG. 1. A pair of hemispherical contacts 38 are fixed on the ends of conductors 40 which project through seals 42 made of suitable insulating material.

Each of the diaphragms overlie the circular openings of the plate and are attached at their peripheral or marginal edges to the plate. Dish-shaped protective covers 44 are also attached to the plates and project through the circular openings of the mounting plates. Each cover has a pressure sensing opening 46 and an insulated contact 48 extending through the cover. A flexible electrical connection 50 is made between the contact carried by the diaphragm and the contact carried by the protective cover. The inner opposed surfaces of the plates are connected by a flexible wall member in the form of a metallic bellows 52 which forms a reference pressure chamber 54 around one side of both of the diaphragms. A tube 56 extends from the bellows for pressurizing the reference chamber and which may be sealed after the corrected reference pressure has been established.

The adjustment means for the switch elements is a differential screw 32 which enables micrometric longitudinal adjustment for each turn of the screw. One side of the mounting plates are rigidly attached to hinge pins 30 such that the pins are bent by the action of the differential screw in raising or lowering the opposite side of the upper plate. The distance between the contacts are thus adjusted by the pivotal movement of the upper plate.

Each of the switch elements are attached by screws 57 to base 12. Rubber shock mounts 58 are employed to ensure that the switch elements will withstand severe vibrational and gravity stresses. The contacts 48 in the diaphragm protective covers are electrically connected to a four terminal plug 22 mounted in the base.

As shown in FIG. 3 one contact of each switch element is electrically connected to a common terminal 60 and the other contact of each switch element is electrically coupled to terminals 62, 64, respectively. Terminal 66 is electrically grounded to the switch casing. It will be understood, however, that the switch elements may be connected such that they operate independent circuits, operate in parallel in the same circuit, or operate in series in the same circuit.

The housing 18 is sealed to the base member 12 in order to form pressure chamber 24 around the switch elements. A tube 20 extends from the outside casing to the pressure source which is to operate the switch elements. A filter means 68 connected to the end of tube 20 eliminates most of the dust or dirt particles from the inside of the pressure chamber. Two attenuator tubes 70

extend from the pressure tube into chamber **24** and which because of their diameter to length ratio act to eliminate any pulsations in the pressure that is sensed.

In operation, the reference chambers **54** of each switch element are pressurized and the contacts of each element are adjusted by means of differential screw **32** so that the contacts touch or separate when a predetermined pressure acts upon the diaphragms. Each switch element can be adjusted so as to be actuated at the same or different pressures. The pressure which is to act on the switch element is sensed by pressure tube **20** through filter means **68** and acts within pressure chamber **24** via attenuator tubes **70**. This pressure acts upon the opposed diaphragms of each switch element and against the reference pressure in reference chambers **54**. When the predetermined pressure within chamber **24** is attained, the contacts of each switch touch each other or separate from each other depending upon whether the switch is designed to open or close the electric circuit into which the switch has been connected.

It should be noted that the protective covers **44** effectively prevent accidental rupturing of the diaphragms by effectively eliminating access to the diaphragms except via the small pressure sensing openings **46**. Thus, contact with the diaphragm by tools, such as screw drivers, or by any moving object is prevented. Furthermore, the flexible electrical connection **50** between conductor **48** in the protective cover and conductor **40** in the diaphragm allows for unrestricted movement of the diaphragm.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

**1.** A pressure responsive switch apparatus comprising:

at least one switch element, said element including a pair of opposed, spaced apart diaphragms, a resilient bellows between said diaphragms, said diaphragm and bellows constituting a reference pressure chamber, means for pressurizing said reference pressure chamber to a predetermined pressure, a pair of coacting contacts carried by said diaphragms within said reference pressure chamber, said contacts, respectively, being electrically connected through said diaphragms into an electric circuit;

a housing completely surrounding said switch element so as to form a sealed pressure chamber therearound, said switch element being mounted within and wholly spaced from the walls of said housing;

coupling means mounted on a wall of said housing for connecting said contacts into the electric circuit; and

sensing means mounted on a wall of said housing for attenuating turbulent pressure within said pressure chamber, said sensing means including a pressure tube exterior of said housing and a pair of attenuator tubes interior of said housing, whereby actuation of said switch element is effected through said sensing means as the pressure within said pressure chamber acts upon said opposed diaphragms, against the pressure in said reference pressure chamber, and, when the predetermined pressure within said reference pressure chamber is attained, said contacts touch or separate for either closing or opening the electric circuit.

**2.** The apparatus of claim **1** wherein said switch element further includes:

a pair of substantially parallel supporting plates each having an opening therein, one of said diaphragms spanning each opening; and

a protective cover secured over each opening for protecting said diaphragms from accidental rupture, each said cover having apertures therein allowing communication between said pressure chamber and the exterior of said diaphragms.

**3.** The apparatus of claim **2** wherein said switch element further includes means for adjusting said plates towards and away from one another to set the spacing of said contacts.

**4.** The apparatus of claim **3** wherein said sensing means further includes a filter mounted on the open end of said pressure tube for preventing dust and dirt particles from entering said pressure chamber.


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