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J. F. EDWARDS, JR

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MULTIPOSITION PRESSURE-ACTUATED SWITCH

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FIG. 1.

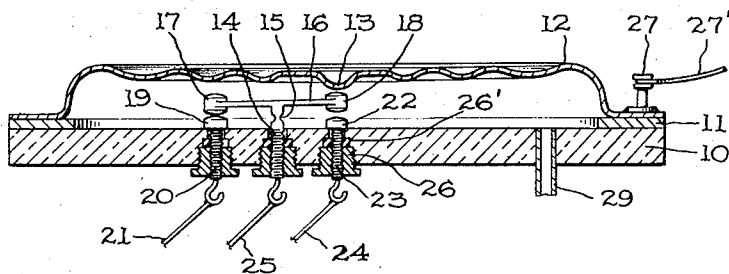


FIG. 2.

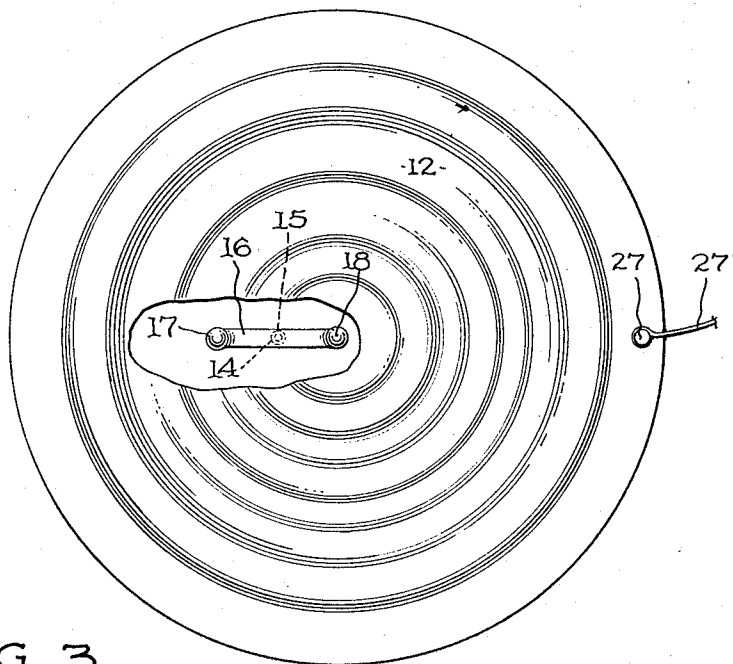
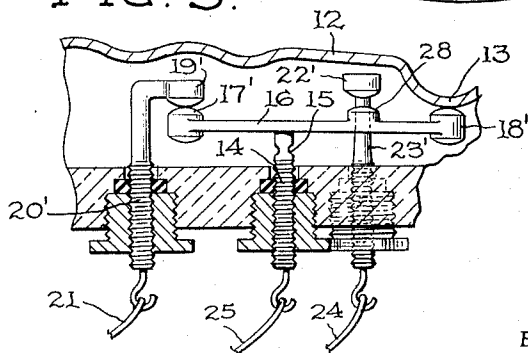


FIG. 3.



INVENTOR

JOHN F. EDWARDS, JR.

BY

K. G. Doub

ATTORNEY

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MULTIPOSITION PRESSURE-ACTUATED SWITCH

John F. Edwards, Jr., Baltimore, Md., assignor to Bendix Aviation Corporation, Baltimore, Md., a corporation of Delaware

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5 Claims. (Cl. 200—83)

This invention relates to encapsulated pressure-responsive switches of that type wherein electrical contacts, connected into one or more electrical circuits to be controlled, are enclosed in a sealed chamber, which may be evacuated and/or filled with an inert gas at some predetermined pressure, the switching operation or operations being accomplished automatically at a selected pressure or pressures over a known range, such as the pressures which exist at varying altitudes.

An object of the invention is to provide a simple, dependable switch of the type specified which is capable of switching a multiple of circuits in or out at varying pressures or altitudes in a predetermined sequence.

Another object is to provide an encapsulated pressure responsive switch wherein the switch contact elements are constructed in a manner such as to be free of mechanical linkage and/or unstable spring components capable of producing backlash or other lost motion which tend toward faulty operation.

Another object is to provide a hermetically sealed diaphragm-actuated multiple-contact switch which is unusually simple in construction and which may be readily adjusted externally of the capsule in which the switch contacts are housed.

The foregoing and other objects and advantages will become apparent in view of the following description taken in conjunction with the drawing, wherein:

Fig. 1 is a substantially central transverse-vertical section through a switch according to the invention;

Fig. 2 is a top plan view of the switch of Fig. 1, showing the diaphragm wall partly broken away to expose the switch contact mechanism; and

Fig. 3 is a detail of an alternate type of switch contact arrangement.

The switch assembly comprises a hermetically sealed capsule, which in the example shown consists of a base 10, formed of insulating material such as fused alumina or the like. To one side of the outer peripheral portion of this base plate there is connected a weldable ring 11, which may be made of high nickel steel, fused to the alumina surface by means of a pure nickel high-temperature bond. The yieldable pressure-responsive wall section of the capsule preferably consists of a metallic diaphragm 12, formed in a manner such as to provide a central inwardly-projecting electrical and mechanical contact 13. In practice, the diaphragm is made of a metal alloy, marketed under the trade name Ni-Span "C"; it may be blanked from sheet metal stock, shaped and heat-treated to obtain the desired characteristics relating to flexibility, elasticity, deflection, spring-rate, etc. The flat peripheral edge portion of the diaphragm is then welded or otherwise secured to the ring 11. However, the capsule need not necessarily be of the diaphragm type; it could be in the form of a bellows or other chambered member having one or more pressure-responsive movable walls.

The switch contact structure comprises a T-shaped member which may be fabricated from Ni-Span "C" wire

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or rod stock. The vertical leg (vertical as viewed in Fig. 1) 14 of the T has its upper or inner end swaged prior to spring-tempering to provide a flexible necked pivot portion 15. This flexure pivot should have a degree of flexibility such as will permit the crosshead 16 of the T to rock through the desired contact make-and-break range and return to its original preset position. The crosshead 16 may be welded or otherwise secured on the upper end of the leg 14, or the entire T section could be formed as an integral member, the essential feature being the flexible pivot 15. This construction results in restraint to all motion other than a rocking action about the necked area or pivot 15, which latter motion is resiliently opposed.

The opposite ends of the crosshead 16 have secured thereto contacts 17 and 18, which may be of the precious metal type to ensure against burning and oxidation but may be made of any material suitable for the use to which the switch is to be put. A relatively stationary or fixed contact is located in the line of travel of the movable contact 17; it is secured to or formed integral with a stem 20, adjustably fixed in the base 10 and terminating at its lower end in a terminal hook or eye, to which is connected a circuit wire 21, forming part of an electrical circuit, not shown. Another relatively stationary or fixed contact 22 is located in the line of travel of the contact 18, and like the contact 19, is secured on a stem 23, adjustably fixed in the base 10 and terminating in its lower or outer end in a terminal hook or eye, to which is connected a circuit wire 24, which may form part of the same circuit as the wire 21 or a separate electrical circuit, depending upon the functions to be performed by the circuitry. Another circuit wire 25 is connected to a terminal eye formed on the lower or outer end of the T-shaped leg or stem 14; and the circuit wire 25 may likewise be interconnected with the other circuitry or constitute a separate circuit, as required. The stems 20, 14 and 23 are illustrated as being adjustably threaded through anchoring nuts 26, which act to compress sealing gaskets 26', the function of which is to effectively seal the base 10 against leakage at these points. Any other suitable mounting and sealing means may be adopted as found convenient or desirable. A terminal 27 is shown secured as by welding on the external peripheral surface of the diaphragm 12 to enable insertion of the diaphragm into electrical circuitry, indicated by wire 27'.

In the example illustrated in Figs. 1 and 2 of the drawing, the crosshead 16 is initially biased in a counter-clockwise direction, bringing contact 17 normally in engagement with contact 19 and locating contact 18 intermediate the central diaphragm contact 13 and fixed contact 22. In this arrangement, contacts 17 and 19 will be separated when the pressure exterior of the switch capsule increases to some predetermined value. In the event the reverse operation is desired, the contacts may be arranged as illustrated in Fig. 3, wherein contacts which perform in general the function of analogous contacts of Fig. 2 are identified by similar reference numerals with the addition of a prime ('). In the position of the parts as shown in Fig. 3, it may be assumed that the external pressure is that which prevails at ground level, at which time the diaphragm contact 13 is in engagement with the contact 18' and has stressed the bar 16 in a clockwise direction, bringing the contact 17' in engagement with the contact 19' and moving contact 28 clear of contact 22'. As altitude is gained and external pressure decreases, the capsule 12 will expand, permitting contacts 28 and 22' to close and, depending upon the degree of stress imposed on the bar 16, permitting contacts 17' and 19' to separate. This is just one of many different

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contact arrangements that can be employed to adapt the switch to varying circuit conditions.

The tube 29 is used to evacuate the capsule chamber to the desired degree of internal pressure in a manner well understood by those having a knowledge of the art.

Operation

In the example shown in Figs. 1 and 2, it can be assumed that a circuit is completed from wire 21 across contacts 19 and 17, crosshead 16, stem 14 and wire 25. Starting with the circuit closed across these contacts, the following make-and-break operations will occur in sequence as the external pressure increases:

(a) Contact 13 will engage contact 18 and a circuit will be completed from wire 21 across contacts 19 and 17, crosshead 16, contacts 18 and 13, diaphragm 12 and wire 27', which may in this instance constitute the ground side of the circuit; (b) as the pressure continues to increase, crosshead 16 rocks clockwise and separates contacts 17 and 19, breaking the circuit from wire 21 and leaving a circuit completed from wire 25 across contacts 18 and 13, diaphragm 12 and wire 27'; (c) upon a further increase in pressure, contact 18 engages contact 22 and a circuit is completed from wire 25 across contacts 18 and 22 and wire 24, and this circuit would also be linked with the circuit including the diaphragm 12 and wire 27'.

The operation of the switch of Fig. 3 is substantially the reverse of that of Figs. 1 and 2, as heretofore noted.

The foregoing make-and-break examples are listed simply for the purpose of illustration. Obviously, many different circuitry arrangements may be controlled across the switch, and the movable and stationary contacts could be designed for single double-pole operation, to adapt the switch to such circuitry.

It will be seen that there are no moving parts, such as jointed mechanical linkage or unstable spring elements which tend to move out of preset tolerances, or which in certain instances tend to produce backlash or other lost motion leading to faulty operation. Furthermore the T section 14, 15, 16 may be made of metallic material which has spring integrity equal to that of the diaphragm itself and therefore offers no degradation of performance during the switching sequence.

What is claimed is:

1. An encapsulated switch including a movable pressure-responsive wall and a relatively fixed wall defining therebetween an enclosed chamber, a contact projecting inwardly from and movable with said movable wall, a plurality of spaced fixed contacts located in said chamber and having terminal stems projecting through said relatively fixed wall exteriorly of said chamber, a substantially T-shaped member having a leg in the form of a rigid terminal stem also projecting through said fixed wall and a crosshead located in said chamber, and a plurality of movable contacts carried by said crosshead and ar-

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anged to cooperate with said movable wall contact and said spaced fixed contacts, the leg of said T having a flexible pivot portion about which said crosshead is rockable from and back to its original preset position.

2. An encapsulated switch including a pressure-responsive diaphragm and a relatively fixed wall defining therebetween an enclosed chamber, a contact projecting inwardly from and movable with said diaphragm, a plurality of spaced fixed contacts located in said chamber and having terminal stems projecting through said wall exteriorly of said chamber, a substantially T-shaped member having a leg in the form of a rigid terminal stem also projecting through said wall and a crosshead located in said chamber, movable contacts located on opposite extremities of said crosshead and arranged to cooperate with said diaphragm contact and said spaced fixed contacts, the leg of said T which projects inwardly into said chamber having a portion thereof rendered flexible to provide a pivot about which said crosshead is rockable from and back to its original preset position.

3. A switch as claimed in claim 2 wherein said crosshead is biased to a position such that one of the contacts carried thereby normally engages one of said fixed contacts.

4. An encapsulated switch including a movable pressure-responsive diaphragm and a relatively fixed wall defining therebetween an enclosed chamber, the central portion of said diaphragm being formed with a mechanical and electrical contact which projects inwardly into said chamber, a pair of spaced fixed contacts located in said chamber and having terminal stems projecting through said wall exteriorly of the chamber, a substantially T-shaped member having a leg in the form of a rigid terminal stem also projecting through said wall and a crosshead located in said chamber, that portion of said latter stem which projects into said chamber being formed at least in part of resilient material to permit said crosshead to rock about said stem, and a pair of movable contacts located on opposite extremities of said crosshead for co-operation with said spaced fixed contacts.

5. A switch as claimed in claim 4 wherein the leg of said T is comprised of metallic material and has its upper extremity formed with a necked portion adjacent the crosshead which is treated during fabrication to provide a resilient flexure point about which said crosshead is rockable.

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