United States Patent

[11] **3,585,334**

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[54] **POSITION INDICATING ELECTRICAL SWITCH UNIT**
8 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **200/168,** 200/167
[51] **Int. Cl.** **H10h 9/04**
[50] **Field of Search** ..... 200/168 A—168 G, 167 R

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ABSTRACT: A mechanically operated switch unit having an electrical snap action switch in which the switching is effected in an hermetically sealed atmosphere but yet the unit has a removable cover to enable adjustment and/or repair in the field. The switch is protected from excessive movement which could destroy it by having the actuator movement structurally limited and by operating the switch inversely so that it is normally closed when not actuated, the latter also making the unit essentially free from vibration actuation.

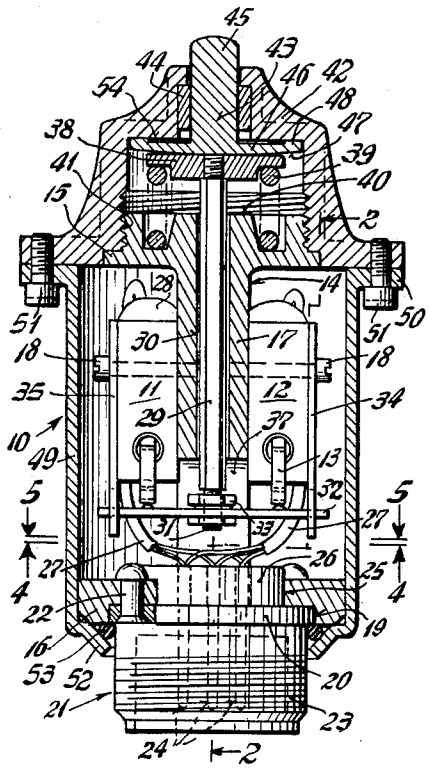


Fig. 1

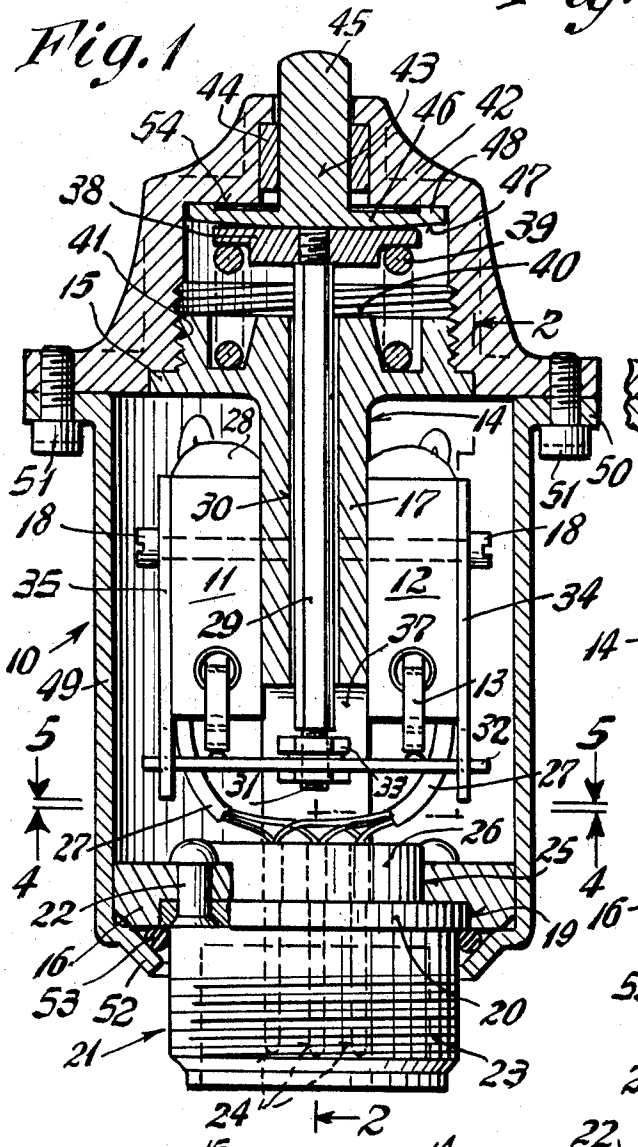


Fig. 3

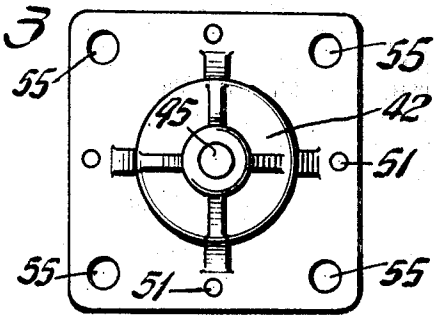


Fig. 2

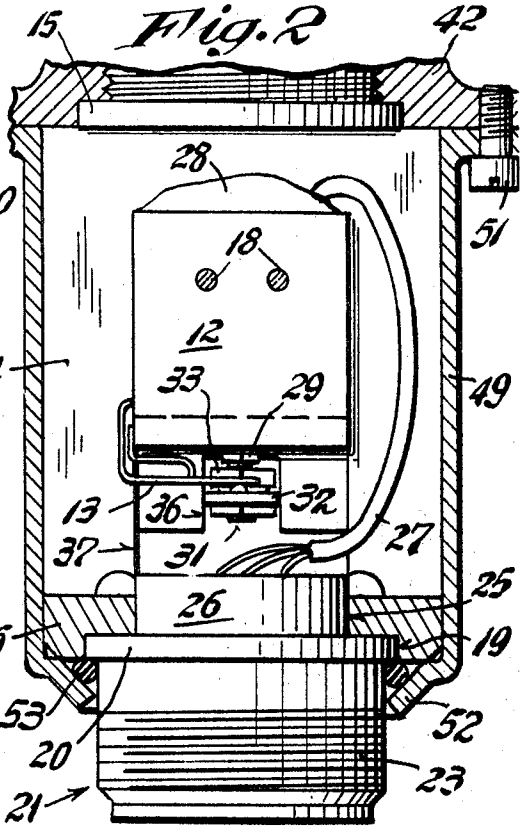


Fig. 4

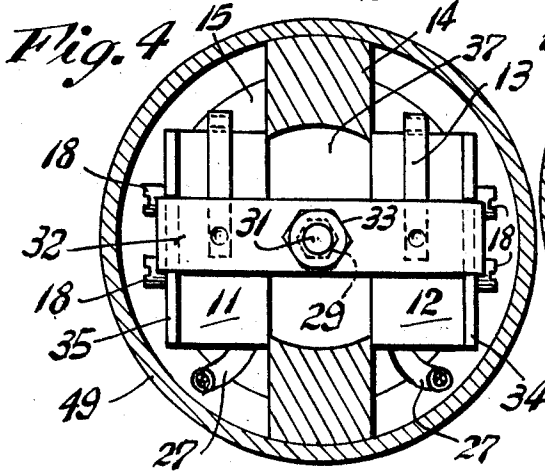
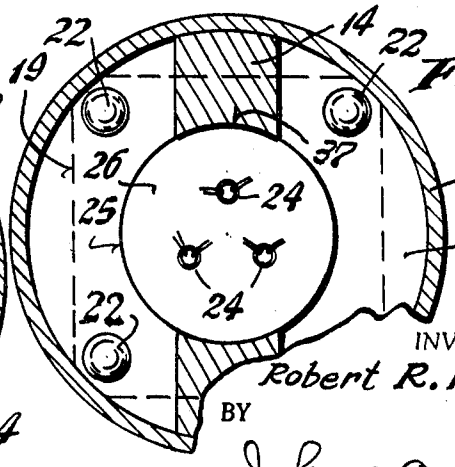


Fig. 5



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POSITION INDICATING ELECTRICAL SWITCH UNIT

The position indicating switch unit herein disclosed has particular utility when used to provide an electrical signal indicating whether or not a movable structure is at a particular position. One such structure could be the landing gear of an aircraft and the switch unit is utilized to provide a signal that a wheel is either down or up by the switch being positioned to be mechanically operated in one of these positions. In such a use, it is also required that the switch be rendered unaffected by or effect environmental conditions and hence the switches are made to be hermetically sealed. Such sealing in heretofore suggested units prevented maintenance of the unit by field personnel with the result that a complete unit was replaced when necessary rather than attempt repairs or adjustment on the unit. The replacement of a complete unit caused the substitution to be quite expensive as opposed to replacing just the malfunctioning part or adjusting the unit while it was in place. Moreover, attempts to provide adjustment of operation in the unit in the field, had required additional exterior adjusting mechanism which cooperated with the switch and, while enabling adjustment made the unit quite expensive and complex.

It is accordingly an object of the present invention to provide a position indicating electrical switch unit in which the switching is effected in an hermetically sealed environment but yet in which the unit is capable of being repaired and/or adjusted in the field without destroying the seal.

Another object of the present invention is to achieve the above object with a switch unit which is relatively economical to manufacture, capable of withstanding relatively large mechanical forces without detriment and durable in use.

A further object of the present invention is to provide a position indicating electrical switch unit that achieves the above objects and may be easily repaired or adjusted by field personnel but yet which is substantially incapable of being inadvertently destroyed by said personnel.

In carrying out the present invention, the herein disclosed switch unit includes a body having a web formed with spaced apart flanges. A plunger assembly is mounted on one flange and has a portion extending outwardly of the unit to be operated by a movable structure whose position is desired to be indicated by the unit. Supported on the other flange is an electrical connector to which exterior wiring may be connected and the signal utilized.

Mounted on the web portion is an hermetically sealed snap action switch such as disclosed in my U.S. Pat. No. 3,431,378 and assigned to the assignee of the present invention. The switch is of the snap action movable blade type and the switching components are contained within an hermetically sealed casing with an operating arm effecting actuation of the switch through the casing.

The plunger assembly includes a plunger that is connected to the actuating arm such that in one position of the plunger the switch is normally open while in another position the switch is held closed. The plunger is normally biased outwardly to cause the switch to be held in its closed position but when the movable structure forces the plunger inwardly it frees the actuating arm for movement and the switch moves to its normally open position. The movement of the switch from a normally closed to a normally open position provides a different connection in the switch terminals which effectively constitutes an electrical signal as the term is herein used.

The plunger includes a rod that is supported by the web and a link which engages the actuating arm of the switch. The switch if fixedly mounted on the web and to permit adjustment of the actuation point of the switch, the link is connected to the rod to be adjustable along the length of movement of the rod. A cover consisting essentially of a relatively thin sheet metal can covers the switch and the actuating link and accordingly extends from one flange to the other. However, the cover is removable to permit access to the switch exterior and the adjustable link to thereby enable adjustment by field personnel even when the switch is mounted and in use.

A cap is connected to the cover to complete the switch enclosure and supports an operating button having an exterior projection which serves to transmit switch operating motion to the plunger assembly. The extent of outward movement of the plunger assembly is controlled by the button engaging a surface of the cap while the inward movement of the plunger assembly is controlled by the plunger abutting the adjacent flange of the body. Thus the outward movement of the plunger assembly which caused the switch to be held at its normally closed position is closely controlled to prevent extended overtravel of the switch actuator arm while the inward movement of the plunger to enable actuation of the switch to its normally open position is limited by the plunger assembly engaging a rigid flange. Moreover, as the inward movement is a releasing movement of the switch substantial plunger travel is permissible without harm to the switch.

Other features and advantages will hereinafter appear.

In the Drawings:

FIG. 1 is a substantially axial section of the position indicating electrical switch unit of the present invention, somewhat enlarged.

FIG. 2 is a partial section taken on the line 2–2 of FIG. 1.

FIG. 3 is a plan view, somewhat reduced.

FIG. 4 is a section taken on the line 4–4 of FIG. 1.

FIG. 5 is a section taken on the line 5–5 of FIG. 1.

Referring to the drawing, the position indicating electrical switch unit of the present invention is generally indicated by the reference numeral 10 and includes a pair of electrical snap action switches 11 and 12 though it will be understood that only one may be utilized if desired. The switches 11 and 12 are identical and of the type shown in my above-noted U.S. patent. Each is contained within an hermetically sealed casing and has an actuating arm extending outwardly therefrom so that movement of the arm will effect operation of its associated switch. The arm for the switch 12 is indicated by the reference character 13.

The unit includes a unitary body 14 having a first flange 15 and a second flange 16 disposed on opposite ends of a web portion 17. Screws 18 extend through the switches 11 and 12 and thread into the web portion 17 to hold the switches in fixed relation to the body.

The second flange 16 is formed with a rectangular cutout 19 on its outer surface which receives a rectangular flange 20 of a typical pin-type electric connector 21. Rivets 22 extend through the flanges 16 and 20 to secure the connector 21 to the body. The connector 21 is of essentially conventional construction having an exterior threaded portion 23 and contact pins 24 supported therewithin and is adapted to be secured to a mating connector that is attached to an external multiwire cable. The flange 16 has a circular cutout 25 to receive the inner portion 26 of the connector 21 with wires 27 extending from the three switch terminals to the inner ends of the pins. For sealing the connection between the wires and the switch terminals they are preferably covered by a hardened epoxy such as shown as 28.

The plunger assembly for operating the switches 11 and 12 includes an hexagonal rod 29 which extends through an aperture 30 formed in the body to terminate in a lower threaded end 31. A flat link 32 is mounted on the threaded end 31 by a pair of nuts 33.

The flat link 32 extends to have its end portions engage the actuator arms of the switches 11 and 12 and is moved along the axis of the rod 29. Additionally, plates 34 and 35 are supported on the web by the screws 18 with each of the plates having a cutout 36 through which the ends of the link 32 extend in order to prevent rotation of the link. The web 17 is cut out as at 37 to permit the link 32 to extend outwardly therefrom and also to permit access to the adjusting nuts 33.

The upper end of the rod 29 extends from the first flange 15 and is threadedly connected to a disc 38. Positioned between the disc 38 and the first flange is a spring 39 that is under compression and is utilized to urge the plunger assembly outwardly. The inward movement of the assembly is limited by the inner surface of the disc 38 engaging a surface 40 of the first flange 15.

The first flange **15** is formed with an exteriorly threaded portion **41** which threadingly mates with a cap **42**. An actuator button **43** is supported for axial movement in the cap **42** by an annular bearing **44** and includes a projecting portion **45** that extends beyond the cap. The button **43** further includes an enlarged circular portion **46** that is formed to provide a somewhat spherical lower surface **47** which engages the flat upper surface of the disc **38**. The upper surface of the portion **46** is formed with an annular flange **48** that engages the interior of the cap.

A substantially cylindrical cover **49** has one end formed to provide an out-turned lip **50** by which it may be secured to the cap **42** as by screws **51**. The other end of the cover **49** is formed to provide an in-turned lip **52** which abuts the exterior of the second flange **16**. Preferably an O-ring **53** is inserted therebetween to effect a dust tight connection.

The cover **49** essentially protects the switch from dust and physical harm but yet does not effect an hermetic seal. The cover may easily be removed by unscrewing the screws **51** and with its removal, the operating portions of the switch may be adjusted, inspected, tested or replaced without destroying the hermetic sealing of the contacts of the switches **11** and **12** wherein the switching action occurs.

The spring **39** urges the plunger assembly outwardly until there is engagement between the flange **48** and the interior of the cap **42** at the surface indicated by the line **54**. The extent of outward movement of the plunger is accordingly limited and may be closely controlled and also the extent of movement of the link **37** on the actuating arms of the switches are closely controlled. Accordingly, the overtravel movement of the actuating arms is positively controlled and limited to that which is less than could cause detriment to the switches. Movement of the plunger assembly inwardly caused by the structural movement to be sensed on the projecting portion **45**, is limited by engagement of the surface **40** by the disc **38** and thus further inward movement of the plunger is accordingly also closely controlled. With such an actuating movement, the link **32** will move downwardly permitting the switch arms **11** and **12** to assume their normally open position to which they are conventionally biased and where they will remain until the spring **39** is capable of again urging the plunger assembly outwardly by removal of the actuating force on the button **43**. As the inward movement of the plunger is effectively pretravel movement to the switches, a substantial movement is permitted as pretravel movement will not cause harm to the switches. Moreover, by having the switches maintained in their normally closed position by the spring **39**, the switches are exceedingly resistant to being actuated by vibration.

As shown in FIG. **3**, the cap **42** may be formed to have a rectangular periphery with holes **55** formed therein for permitting the switch to be mounted in a position on a structure where it will cause the button **43** to be located to be actuated by a movable member. The switch will accordingly provide an electrical signal of the position of the member by the member causing the plunger to be forced inwardly to shift the connection in the switches from normally closed to a normally open position.

When the switch unit **10** is mounted by use of the holes **55** in use, removal of the cover may be effected by field personnel by removing the screws **51** without requiring the removal of the whole unit. The actuating locations of the switches **11** and **12** may then be adjusted by movement of the nuts **33**. Also, the different parts of the switch unit may then be inspected and/or repaired as they are rendered accessible.

The engagement of the somewhat spherical surface **47** of the button and the flat surface of the disc tends to permit the button to have rotational movement during its actuation to maintain its free movement. Moreover, the annular flange **48** provides clearance of the remainder of the upper surface of the button from the cap and tends to prevent dirt from causing cocking of the actuator button. The particular arrangement of the button and plunger assembly as hereinbefore disclosed has been found to render the switch of the present invention relatively economical to manufacture without decreasing the positiveness of actuation by reason of the parts being capable of accommodating manufacturing tolerances without introducing misalignment which could cause binding between the parts.

It will accordingly be understood that there has been disclosed a position indicating electrical switch unit which is capable of providing an electrical signal indicative of the position of a movable structure. The unit utilizes a snap action switch that is contained within an hermetically sealed atmosphere with the remainder of the unit being unsealed to be accessible for adjustment, repair or part replacement by field personnel without affecting the sealing. Moreover, the unit is constructed and arranged to limit movement effecting the switch to a range which is not capable of causing harm to the switch.

Variations and modifications may be made within the scope of the invention and portions of the improvements may be used without others.

I claim:

1. A position indicating electrical switch unit comprising a body formed to have a web extending between two spaced flanges, an electrical switch having an hermetically sealed case and an actuating arm extending therefrom with the actuating arm in one position causing closing of the switch and in another position causing opening of the switch, an electrical connector secured on one of the flanges, means electrically connecting the connector and the switch, means mounting the switch on the web between the flanges, switch actuating means supported by the body including a projecting portion extending outwardly from the other flange and an actuating arm engaging portion whereby movement of the projecting portion effects the shifting of the switch from one position to the other and a cover removably mounted on the body and covering at least said engaging portion and switch.

2. The invention as defined in claim **1** in which the actuating arm is biased to its open position and in which there are means for urging the switch actuating means to cause said switch to be at its closed position where said switch is normally maintained in the absence of forcible movement of the switch actuating means from its closed position.

3. The invention as defined in claim **2** in which the body includes a removable cap mounted on the other flange through which the projecting portion extends and is mounted for movement toward and away from the body and in which there are means for limiting the outward movement of the switch actuating means and hence the overtravel movement of the actuating arm by engagement with the cap.

4. The invention as defined in claim **3** in which there are means on said other flange for limiting inward movement of the switch actuating means.

5. The invention as defined in claim **3** in which the switch actuating means includes a rod positioned in an aperture formed in the web for longitudinal movement and having one end connected to arm engaging portion, connecting means being adjustable longitudinally of the rod to enable adjustment of the engaging portion with respect to the rod's position.

6. The invention as defined in claim **5** in which the other end of the rod extends beyond the other flange, an abutment member secured on the other end of the rod and a surface formed on said flange for engaging the abutment member to limit the inward switch opening movement of the rod.

7. The invention as defined in claim **5** in which the other end of the rod extends beyond the other flange, an abutment member secured on the other end of the rod, spring means urging the abutment member and rod outwardly to a switch closing position, the projecting portion includes an inner portion within the cap engageable with the abutment member and in which the means for limiting the outward movement includes the inner portion engaging the cap.

8. The invention as defined in claim **7** in which the engagement between the inner portion and the abutment member includes a pair of surfaces with one surface being essentially flat and the other surface being essentially spherical.