Dec. 16, 1952 M. S. SNELL 2,622,163

ELECTRICAL SWITCH

Filed June 7, 1950

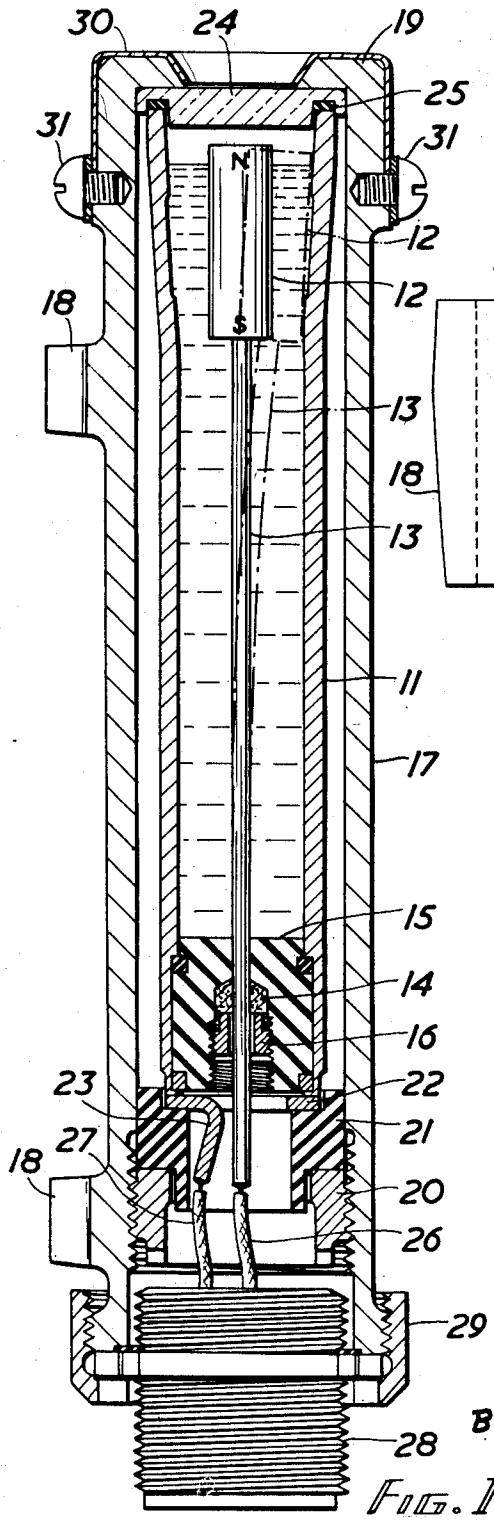


FIG. 1.

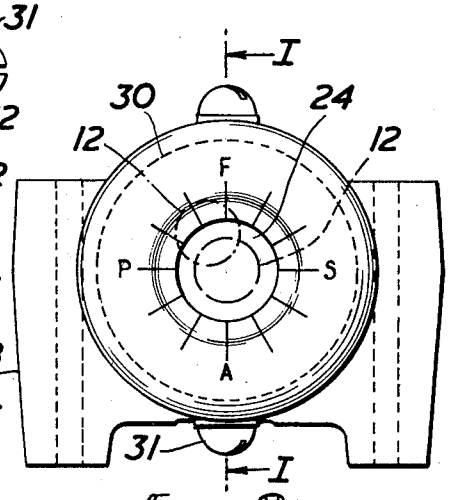


FIG. 2.

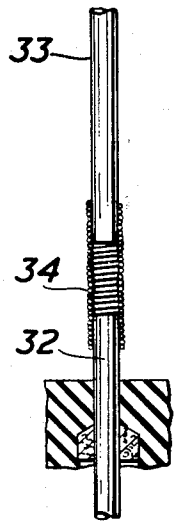


FIG. 3.

Inventor
Maurice Saxon Snell

By Reynolds, Beach & Christensen
Attorneys

Patented Dec. 16, 1952

2,622,163

UNITED STATES PATENT OFFICE

2,622,163

ELECTRICAL SWITCH

Maurice S. Snell, Sutton's Mill, Cranham, England, assignor to Dowty Equipment Limited, Cheltenham, England

Application June 7, 1950, Serial No. 166,719
In Great Britain June 7, 1949

8 Claims. (Cl. 200—52)

1

This invention relates to electrical switches such as are suitable for installation in aircraft in order to indicate abnormal acceleration or deceleration, which latter is merely negative acceleration, and intended to be included in the latter term, and/or to initiate automatically actuation of one or more services, for instance fire preventing or fire resisting services, as a consequence of the aircraft crashing. If a switch for this or similar purpose is to be satisfactory and dependable, it must be so designed as to operate without failure when called upon despite a very long period of inoperation. An electrical switch in accordance with the invention has been devised with this end in view, and comprises two mutually magnetically attractive elements of which one is fixed and the other is spring-controlled (as by being, for example, inherently resiliently flexible) to be displaceable in accordance with acceleration, and the distribution of the magnetic flux is such that only after the spring-controlled element has been displaced a distance corresponding to a predetermined acceleration, such as would accompany a crash landing, is the spring-controlled element caused to contact and remain against the fixed element, thereby effecting closure of the switch, and indicating, for example, the direction of the displacing force.

Either one of the two elements may be constituted by a permanent magnet, and the fixed element may be an annulus surrounding the spring-controlled element which latter tends to assume a position co-axially with respect to the fixed element.

It is preferred to immerse the elements in liquid with a view to hydraulically damping the movements of the spring-controlled element, and in fact to eliminate, as far as is possible, vibrations of the element, leaving it subject primarily to amplitude effects rather than to the effects of vibration or of attitude. The displaceable element may be spring-controlled by being carried by a resilient stem.

The critical acceleration value at which the influence of the magnet becomes dominant is determined by various factors, and the switch may include means whereby this critical value may be adjusted. Thus if the spring-controlled element is carried by a resilient stem, the effective length of the stem may be adjustable.

The preferred embodiment of the invention will now be described with reference to the accompanying drawings, of which Figure 1 is a sectional elevation, Figure 2 is an end view as seen looking down upon the upper end of Figure 1, and Figure 3 is a fragmentary view of a detail modification.

2

As shown, the switch comprises a fixed contact in the form of a soft iron cylinder 11, and a movable contact in the form of a permanent magnet 12 mounted at the upper end of a resilient stem 13. The stem 13, which may be made of spring brass, is located axially with respect to the cylinder 11 by being clamped by a rubber or like packing 14 housed in a stuffing-box 15 of insulating material. The packing 14 is clamped around the stem 13 by a hollow screw 16 screwed into the housing 15. The switch assembly is housed within a light-alloy casing 17 having four lugs 18 which are apertured to receive fixing screws by which the switch may be mounted on a vertical panel. The casing 17 has an inturned flange 19 at its upper end and the switch assembly is secured within the casing by a hollow screw 20 screwed into the lower threaded end of the casing. The screw 20 engages an insulating distance piece 21 which engages a brass washer 22 having a terminal tongue 23. The upper end of the switch assembly includes a transparent disc 24 formed at its under side with an annular channel in which is disposed a rubber sealing ring 25. The electrical connections with the permanent magnet 12 and soft iron cylinder 11 are established through corresponding leads 26 and 27 extending from a suitable plug or socket connector 28 located at the lower end of the casing 17 by a flanged nut 29. The upper end of the casing 17 is fitted with a metal cover 30 which is held in an angular setting by screws 31 clamping the lower edge of the cover 30. The cover 30 forms a dial by having markings such as those seen in Figure 2. The purpose of these markings will hereinafter be explained.

It will be seen that the upper end of the soft iron cylinder 11 is slightly bell-mouthed so that when the permanent magnet 12 engages the inner surface of said cylinder it will engage said surface at each end of the magnet, as indicated in broken lines in Figure 1, and will remain so engaged. The space inside the cylinder 11 contains hydraulic liquid up to the level indicated for the purpose of damping the vibratory movements of the magnet 12.

The switch illustrated has been devised more especially for use as a crash switch on aircraft, and the stem 13 carrying the permanent magnet 12 is so rated as to its stiffness that the magnet 12 will have to move a distance corresponding to an acceleration of approximately 100 ft. per second per second before the magnet 12 engages and

remains in contact with the cylinder 11. In manufacture it is advisable for each switch to be adjusted under test to suit the desired acceleration at which it is to close. For this purpose the switch may be mounted on a swivelling arm which is rotated at a known speed at which the switch should close under the action of centrifugal force and complete the circuit through an indicating lamp or other device forming part of the test equipment.

If the aircraft to which the switch is fitted should crash, the acceleration imparted to the permanent magnet will cause the latter to engage the surrounding cylinder and so complete an electrical circuit which will initiate actuation of the required services, such as fire resisting services. Subsequent inspection of the switch will give an indication of the direction in which the crash occurred, as the dial at the upper end of the casing will show this direction, as indicated in Figure 2 where the magnet 12 is shown as having engaged the cylinder a little to the port side of the forward direction.

The presence of the damping liquid serves to prevent closure of the switch due either to transient accelerations in excess of the predetermined critical acceleration, or to the permanent magnet tending to build up a high amplitude under external vibrations at the resonant frequency of the magnet. The liquid will not appreciably affect movement under the influence of acceleration.

In the modification shown in Figure 3, the stem of the permanent magnet is formed in two substantially rigid parts 32 and 33 which are united in co-axial alignment by an initially tensioned coil spring 34 which holds the magnet against displacement unless the magnet is subjected to a predetermined acceleration which though less than the critical acceleration is nevertheless of comparatively substantial magnitude.

Naturally, an aircraft may be expected to serve a long time before, if ever, it crashes. Throughout its useful life such a switch as this must remain always ready to function instantly, automatically, and perfectly. It is believed that a switch in accordance with the invention will not deteriorate with age and that it will be reliable after a long period of inactivity; due chiefly to the absence of static friction in the operation of the switch, and to the absence of the possibility of rusting, corrosion, or wear of parts which must move relatively during operation. The permanent magnet 12 will be free to move as a result of normal accelerations and there is no likelihood of the switch making contact except when the predetermined critical acceleration has been reached. Moreover, and this is particularly desirable upon an aircraft, which assumes various attitudes during maneuvering, the switch of this invention is not materially affected by the attitude of the aircraft, nor by its changes of attitude.

I claim:

1. An electrical crash-operated switch for installation upon an aircraft, comprising a first, annular member and a second member normally centralized within the annular member, the two members being mutually magnetically attractive, one thereof being fixed and the other being formed as a weight mass and having a support arranged to permit it to approach the fixed member under the influence of acceleration, spring means operatively connected to said movable member, of an effective strength, with relation to the distribution of magnetic flux, to resist such approach with a force such that acceleration of a critical value or greater is required to effect contact of said two members, and serving to return said members to relatively centralized position following displacement of the movable member by acceleration of value less than such critical value, and to hold them substantially relatively centralized under the influence of gravity, regardless of the attitude of the aircraft, and electric circuit means including leads to the respective members, such circuit means being broken normally by the centralization of the movable member, but closable by supercritical acceleration, and held closed by the consequent contact of the movable member with the fixed, mutually magnetically attractive, member.

2. A switch according to claim 1, wherein the annular member is formed as a casing housing the centralized second member, and a liquid filling said casing to an extent to hydraulically damp movements of the movable member.

3. A switch according to claim 1, wherein the fixed annular member is formed as a casing housing the centralized member, the latter constituting the movable weight mass, and a liquid filling said casing, interposed between the two members for hydraulically damping the movements of said movable mass.

4. A switch according to claim 1, wherein the centralized member constitutes the movable weight mass member, and the annular member is fixed, and including a flexible stem on one end whereof said movable weight mass member is mounted, said stem constituting both the support for said weight mass member and the spring means operatively connected to said member, and means fixed relative to the fixed member, supportingly and fixedly engaged with the opposite end of said stem.

5. A switch according to claim 4, wherein the stem is formed as a unitary rod of a selected inherent flexible resiliency.

6. A switch according to claim 4, wherein the stem is formed of two substantially rigid parts axially aligned and spaced apart, and a tight coiled spring axially aligned with and secured to the spaced adjacent ends of said two rigid parts, and constituting the spring means affording lateral resilience to the stem.

7. A switch according to claim 4, including means to adjust the effective length of said stem.

8. A switch according to claim 1, including a fixed transparent disc centered in prolongation of the centralized position of the weight mass, and having angularly distributed markings to indicate the direction of switch-closing movement.

MAURICE S. SNELL.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,055,153	Ferguson	Mar. 4, 1913
1,846,966	Hausse	Feb. 23, 1932
1,870,347	Roberts	Aug. 9, 1932
2,302,283	Yarnall	Nov. 17, 1942
2,464,886	O'Reilly	Mar. 22, 1949

FOREIGN PATENTS

Number	Country	Date
446,230	Great Britain	Apr. 27, 1936