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N. E. FULLER

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MAGNETIC FLOAT SWITCH

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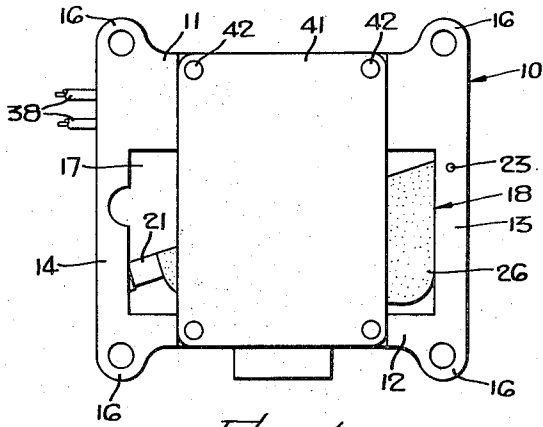


FIG. 1.

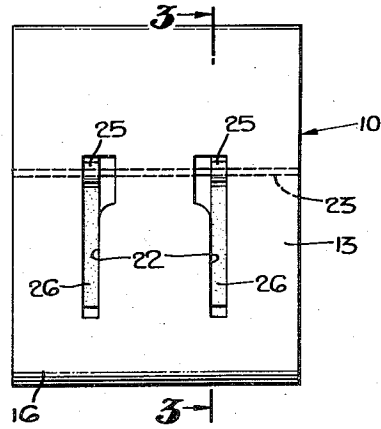


FIG. 2.

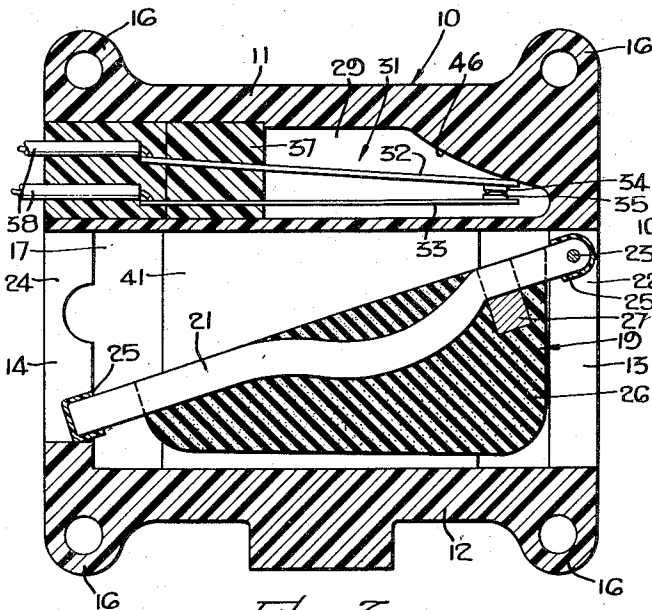


FIG. 3.

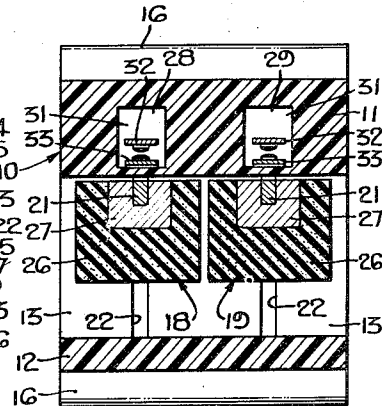


FIG. 5.

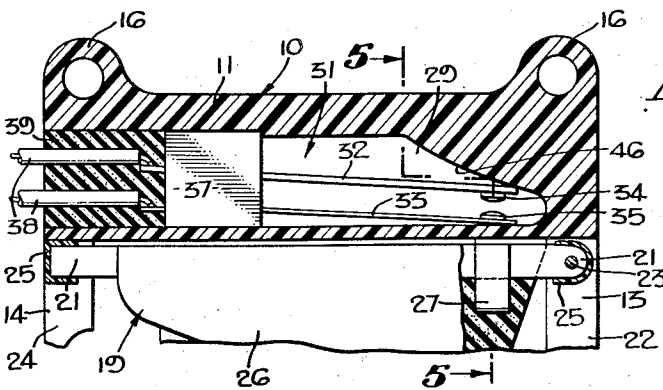


FIG. 4.

NORMAN E. FULLER,
INVENTOR.

BY

W. T. Allen
ATTORNEY

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MAGNETIC FLOAT SWITCH

Norman E. Fuller, North Long Beach, Calif., assignor to Royal Jet, Incorporated, Alhambra, Calif., a corporation of California

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12 Claims. (Cl. 200—84)

This application relates to float switch apparatus, and more particularly to a magnetic float switch which indicates when a gas tank of an airplane is in a predetermined filled condition.

There are several situations in which it is necessary to provide means for indicating to an operator of an airplane when one of the gas tanks of the plane is in a predetermined filled condition, for example, full. One such situation is during in-flight refueling, since it is then impossible for an operator to determine when a tank is full unless special indicator means are employed. During in-flight refueling, there is considerable sloshing of the fuel in the tank, which tends to impair the operation of a float switch, and there is also considerable danger that any electrical contacts which are exposed to the liquid and vapor within the tank may result in an explosion or fire.

In view of the above factors characteristic of float switches, it is an object of the present invention to provide a float switch the contacts of which are disposed in a chamber which is effectively sealed from the liquid within the tank, said contacts being directly operated by magnet means the elevation of which is varied by a float device.

A further object is to provide a magnet element associated with a float element and pivotally mounted to a casing so that upon raising of the level of the liquid within a tank the magnet element will be brought into sufficiently close proximity to a magnetizable switch element to operate the same, the switch element being disposed in a separate chamber completely sealed from the liquid within the tank.

A further object is to provide a float switch which is so constructed as to be relatively immune to the effects of sloshing of fuel contained within a gas tank.

These and other objects and advantages of the invention will be more fully set forth in the following specification and claims considered in connection with the attached drawing to which they relate.

In the drawing:

Figure 1 is a side elevational view of a float switch embodying the present invention;

Figure 2 is an end elevation of the float switch, as viewed from the right in Figure 1;

Figure 3 is an enlarged longitudinal sectional view taken along line 3—3 of Figure 2 and showing the associated float and magnet in their lower positions permitting closure of the switch contacts;

Figure 4 corresponds to the upper portion of Figure 3 but shows the float and magnet in their upper positions effecting opening of the switch contacts; and

Figure 5 is a transverse sectional view taken along line 5—5 of Figure 4 and viewed in the direction of the arrows.

Referring to the drawing, the magnetic float switch may be seen to comprise a generally rectangular casing 10 having upper and lower walls 11 and 12 and right and left end walls 13 and 14, respectively. The casing 10 is

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formed of an insulating and sealing material, preferably a plastic or synthetic such as "Bakelite," and is provided at its four corners with transverse bosses 16 having openings through which bolts, not shown, may be inserted for the purpose of mounting the casing within a fuel tank.

Formed in the central portion of casing 10 is a rectangular opening 17 in which are mounted a pair of float and magnet elements 18 and 19 in laterally adjacent relationship. In particular, each float and magnet element 18 and 19 comprises a pivot and guide bar 21 which is preferably formed of metal. One end of each pivot bar is pivoted at the upper end of a vertical slot 22 in right casing end wall 13 by means of a horizontal shaft 23, the latter being press fit through wall 13 as shown in Figure 2. The free end of each bar 21 extends into a vertical slot 24 in left casing end wall 14, said slot 24 operating as a guide slot to prevent excessive lateral movement of the free bar end. There is, however, sufficient clearance between the free end of bar 21 and the side walls of slot 24, and also sufficient play at the connection between the pivoted guide bar end and horizontal shaft 23, to permit substantial freedom of movement of the float and magnet elements in all directions. In order to prevent undesired vibration and chatter of the bars 21 in the slots therefor, a vibration-absorbing sleeve 25 is provided around each bar end. Such sleeve may be formed of "teflon" or the like.

Each float and magnet element additionally comprises a float member 26 adapted to float in the gasoline or other liquid contained within the tank. Float member 26 comprises a generally triangular block of a porous, buoyant, gasoline-resistant material such as a suitable sponge, synthetic or plastic. A preferred material is manufactured under the trademark "blown Hycar" by the Rubbertex Company.

Each float member 26 is cast around the associated pivot and guide bar 21 so that the latter is embedded therein. Preferably, the shape of float member 26 is such that one end wall thereof will be vertical and adjacent end wall 13 of casing 10 when guide bar 21 is pivoted to its lowermost position as shown in Figure 3, the bottom wall of the float member 26 then being horizontal. The remaining or upper wall of float member 26 lies generally in the plane of guide bar 21 and is adapted to come into close proximity with the underside of upper casing wall 11 when the float member is in its uppermost position as shown in Figure 4.

Mounted around guide bar 21 generally adjacent pivot shaft 23 is a U-shaped permanent magnet 27 the poles or ends of which project upwardly as best shown in Figure 5. The magnet 27 is mounted both by the guide bar 21 and by the material of float member 26 which surrounds the same. Magnet 27 is formed of a suitable permanent magnet material such as "Alnico."

The upper casing wall 11, which is made relatively thick as best shown in Figures 3—5, is formed with a pair of parallel elongated horizontal chambers 28 and 29 disposed, respectively, above float and magnet elements 18 and 19. Each of the chambers 28 and 29 is sealed by the material of casing 10, and by sealing material as will be described below, against entrance of any gas or liquid. A control or switch element 31 is mounted in each chamber 28 and 29, and comprises upper and lower generally horizontal contact arms 32 and 33 having, respectively, electrical contacts 34 and 35 at their free ends which are disposed above the respective magnets 27.

The contact arms 32 and 33 are mounted at their remaining ends in a block 37, formed of a suitable insulating plastic, which is inserted into the end of the chamber for the respective switch. The block 37, together with electrical conductors 38 leading to the ends of contact arms 32 and 33, are sealed in position by a suitable pot-

ting compound 39. The conductors or wires 38 are so insulated as to be able to withstand the gasoline or other liquid in the tank in which the float switch is mounted, and may lead to a pilot light or other indicator, or to an automatic device adapted to shut off the inflow of fuel after operation of the float switch.

The upper contact arm 32 is relatively stiff and rigid and may be formed of any suitable electrically conductive material. Lower contact arm 33, on the other hand, is made of a strip of relatively flexible spring-material which is characterized by both electrical conductivity and by magnetizability. Lower arm 33 is mounted sufficiently close to the thin partition between the switch chamber and opening 17 to be magnetically attracted by magnet 27 when the latter is at or near the upper position shown in Figure 4.

In order to minimize sloshing of gasoline or other liquid into and out of the rectangular opening 17 in which the float and magnet elements 18 and 19 are movably mounted, a pair of rectangular side plates 41 are mounted on the sides of casing 10 as by screws 42. As shown in Figure 1, the side plates extend vertically for substantially the full height of casing 10, but are not sufficiently wide to cover the portions of rectangular opening 17 adjacent casing end walls 13 and 14. Thus, gasoline may freely enter the portions of opening 17 adjacent both vertical edges of each side plate 41 in order to effect raising and lowering of the float and magnet elements 18 and 19. The amount of gasoline which enters through such openings during mere sloshing of the liquid in the tank, such as occurs prior to complete filling of the tank, will not, however, be sufficient to effect full elevation of the float and magnet elements 18 and 19.

In the operation of the magnetic float switch of the invention, the casing 10 is mounted within a fuel tank or the like, for example by means of bolts or screws extending through the openings in bosses 16 and into a side wall of the tank at the upper portion thereof. When the tank is empty, the force of gravity will cause the float and magnet elements 18 and 19 to pivot to their lowermost positions shown in Figures 1 and 3, at which the free end of each pivot and guide bar 21 rests on the lower end of the corresponding vertical slot 24. The contacts 34 and 35 will then be in their closed or touching condition, due to the resilience of lower contact arms 33 which effects an upward spring bias tending to cause the contacts to close.

As liquid is introduced into the tank, for example during in-flight refueling, it will enter the opening 17 adjacent side plates 41 as soon as the liquid level reaches the height of the float switch. The side plates 41 will, however, prevent substantial upward pivoting of float and magnet elements 18 and 19, due to sloshing or the like, until the liquid level is actually at or above the elevation of the float switch. When the liquid level reaches such height, the resultant floating of float members 26 causes upward pivoting of pivot bars 21 about their axis 23 until magnets 27 come into close adjacency with upper casing wall 11 beneath contacts 35 of flexible magnetizable lower contact arms 33. The magnetic attraction of each magnet 27 for the associated contact arm 33 then effects downward bending of contact arm 33 to the lower position shown in Figures 4 and 5, which results in breaking of contact between contacts 34 and 35. This breaks the circuit to the pilot or other element, and indicates that the tank is in a full condition.

As soon as the level of the liquid has lowered to below that of the float switch, float and magnet elements 18 and 19 will pivot downwardly due to the effect of gravity, there being insufficient magnetic attraction between arms 33 and magnets 27 to prevent such downward pivoting. When the lower contact arms 33 are no longer sufficiently attracted by their associated magnets 27, they spring upwardly to cause lower contact 35 to again come into engagement with upper contact 34.

It is an important feature of the invention that the contacts 34 and 35 are completely isolated from the vapor and gasoline within the fuel tank, which eliminates any possibility of explosion and fire. Furthermore, the arcing and wear at the contacts 34 and 35 is minimized due to the fact that the chambers 28 and 29 are sealed and may contain a suitable inert gas such as dry nitrogen.

In order to provide the correct spacing between contacts 34 and 35 at the free ends of arms 32 and 33, the upper walls of chambers 28 and 29 at their ends opposite blocks 37 are formed as sloping cam surfaces 46. Cam surfaces 46 are shaped to bend arms 32 downwardly during insertion of blocks 37 and their associated arms into chambers 28 and 29, until contacts 34 are spaced the exact desired distance above the thin partitions between chambers 28 and 29, and opening 17. In this manner the permissible movement of contacts 35 is regulated precisely.

While the particular apparatus herein shown and disclosed in detail is fully capable of attaining the objects and providing the advantages hereinbefore stated, it is to be understood that it is merely illustrative of the presently preferred embodiments of the invention and that no limitations are intended to the details of construction or design herein shown other than as defined in the appended claims.

I claim:

1. A magnetic float switch, which comprises a unitary molded plastic casing adapted to be mounted within a fuel container, said casing being formed with a sealed chamber separated from the main interior chamber of said casing by a relatively thin partition, intake means to admit fuel from said container into said main chamber in said casing, a float element mounted in said main chamber and pivotally connected to said casing, said float element being adapted to pivot from a lower position to an upper position upon raising of the fuel level in said main chamber, a permanent magnet mounted on said float element and disposed adjacent said thin partition when said float element is in said upper position, and a magnetic switch element mounted in said sealed chamber and disposed for magnetic actuation by said magnet when the latter is disposed adjacent said thin partition and said float element is in said upper position, and means freely venting said main chamber to said fuel container as the fuel level rises and falls.

2. The invention as claimed in claim 1, in which said float element comprises a block of lightweight buoyant material in which is embedded a pivot arm, said pivot arm being pivoted at one end to said casing, and in which said magnet is generally U-shaped and is embedded in said block around said pivot arm.

3. The invention as claimed in claim 2, in which the other end of said pivot arm is movably mounted in a vertical guide slot in said casing.

4. A magnetic float switch, which comprises a generally rectangular casing formed of non-magnetic material and adapted to be mounted within a fuel tank of an airplane, said casing having a relatively thick upper wall and having a generally rectangular opening formed therethrough below said upper wall, a pivot bar pivotally connected to one end wall of said casing at a point relatively adjacent said upper wall, the free end of said pivot bar being slidably mounted in a vertical guide slot in the other end wall of said casing, a float block formed of buoyant material and mounted on said pivot bar to effect upward and downward pivoting thereof due to variation in the liquid level in said casing, a permanent magnet mounted on said pivot bar relatively adjacent said one end thereof and adapted to come into close proximity to said upper wall when said pivot bar is in an upward pivoted position, and a pair of switch contact arms mounted in a sealed chamber in said upper wall, one of said contact arms being formed of resilient magnetizable material and having a free end disposed ad-

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adjacent said magnet for actuation thereby when said magnet is in close proximity to said upper wall.

5. The invention as claimed in claim 4, in which said float block is generally triangular in shape and is formed of a porous plastic material.

6. The invention as claimed in claim 4, in which slosh-blocking plates are mounted on said casing over the central portion of said opening.

7. The invention as claimed in claim 4, in which said sealed chamber in said upper wall is formed with a cam surface adapted to be engaged by the other of said contact arms to determine the position thereof.

8. A unitary magnetic float switch assembly comprising a molded plastic housing provided with a thin wall dividing the same into a fluid tight switch chamber and a float chamber adapted to open into a liquid containing chamber, float means captively but movably supported in said float chamber, permanent magnet means carried by said float means with a portion thereof adapted to be positioned against said thin plastic wall when the liquid raises said float means to a predetermined level, and biased switch leaf means sealed within said switch chamber closely beside the inner side of said thin wall in position to be actuated by said magnetic means when said float means is elevated and free to assume a different switch position when the liquid level lowers the float means.

9. A float switch as defined in claim 8 characterized

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in that said plastic housing comprises a unitary molding having limited liquid flow passages between said float chamber and the exterior of said housing.

10. A float switch as defined in claim 8 in which said closed switch chamber includes means dividing the same into a plurality of switch chambers each separated from said float chamber by a thin plastic wall, and independent electric switches sealed in said switch chambers and having insulated leads extending to the exterior of the housing for connection in electrical circuits.

11. A float switch as defined in claim 8 characterized in that said plastic housing includes integral mounting lugs with openings to receive mounting fasteners.

12. A float switch as defined in claim 10 characterized in that said float means includes independent pivotally supported float and permanent magnet assemblies each movable toward and away from an associated one of said thin walls and the switch sealed therewithin.

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