Sept. 28, 1954 A. J. BUCHTENKIRCH 2,690,484

FLOAT SWITCH

Filed July 28, 1952 2 Sheets-Sheet 1

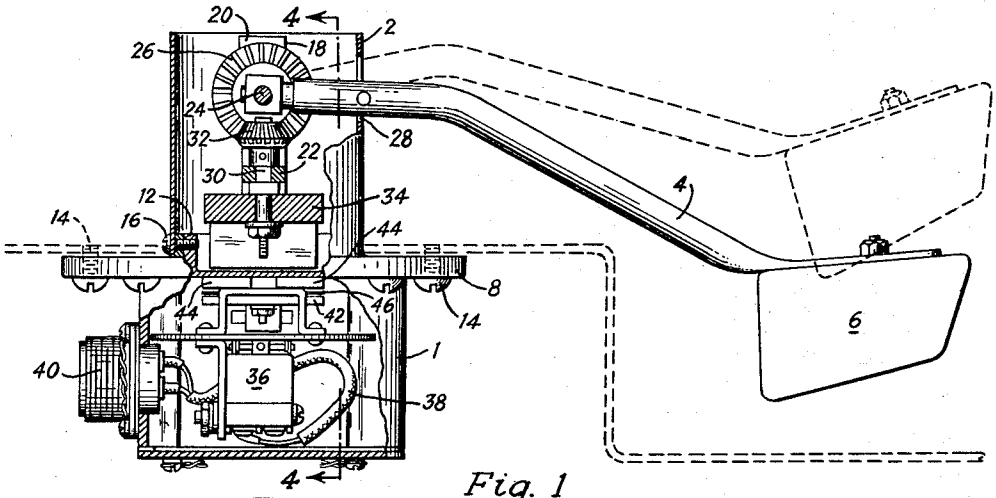


Fig. 1

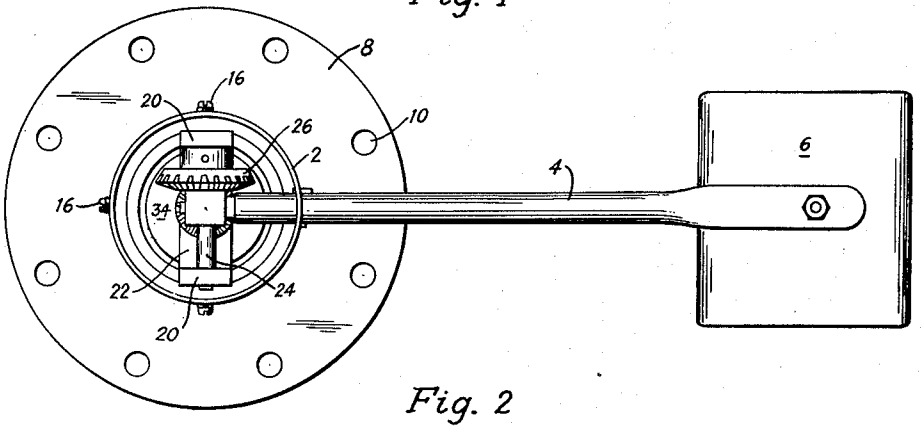


Fig. 2

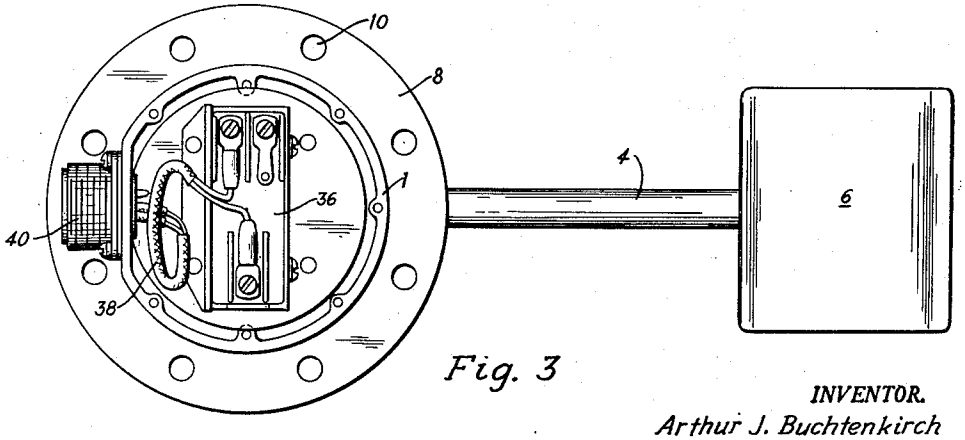


Fig. 3

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FLOAT SWITCH

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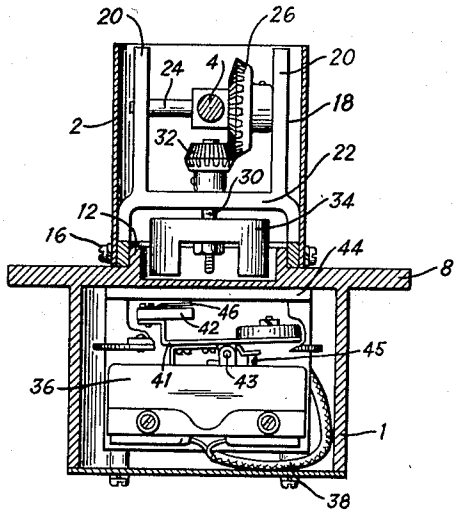


Fig. 4

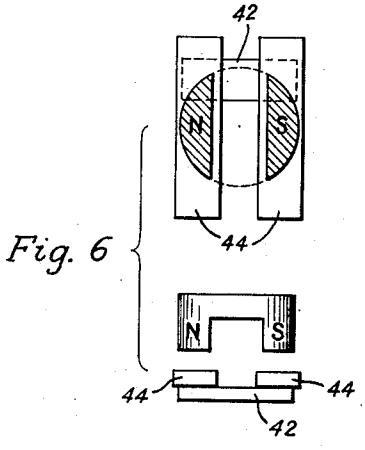


Fig. 6

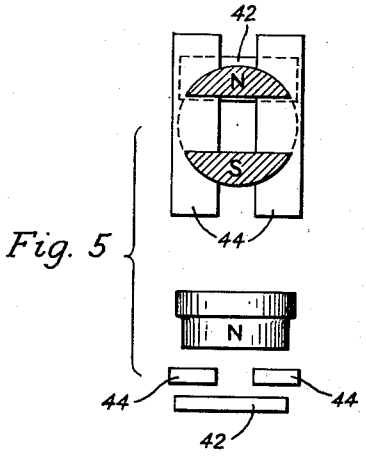


Fig. 5

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FLOAT SWITCH

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12 Claims. (Cl. 200—84)

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This invention relates generally to switches and more particularly to a float type switch adapted to be used in fuel tanks for controlling the operation of fuel pumps.

In certain types of fuel tanks, it is desirable to provide an automatic device for shutting off a fuel pump associated with the tank when the fuel tank is empty or almost so. Since the electrical switch which controls the pump is ordinarily positioned outside of the fuel tank, means must be provided for translating the fall of the level of fuel within the tank into a force which will actuate the switch on the outside of the tank. In the past this has been accomplished by providing a float device within the tank which raised and lowered with the level of the liquid; a diaphragm was inset in the bottom wall of the tank and was moved inwardly and outwardly of the bottom wall through appropriate linkage by the rise and fall of the float. The movement of the diaphragm mechanically actuated a switch on the outside of the tank which controlled the operation of the fuel pump.

A device such as this had several serious disadvantages. The diaphragm was sensitive to pressures within the fuel tank and could be distended by an unusual pressure build-up so as to operate the switch cutting off the fuel pump, even though there was ample fuel in the tank. Moreover, it was extremely difficult to provide a tight seal between the resilient diaphragm and the metal edge portions of the tank wall adjacent the recess in which it was inserted. This increased the possibility of leakage of fuel or fuel vapor and was highly undesirable. Moreover, the deleterious action of the liquid fuel on the diaphragm gave it a comparatively short life.

The present invention aims to overcome these and other objections by providing a float switch which is not effected by pressure changes within the tank. Moreover it does not require insertion of any resilient device into the bottom of the fuel tank, there being no direct mechanical movement between the float mechanism within the tank and the switch outside of the tank. Further, a switch of the present construction is extremely durable and does not contain any parts which will be deleteriously affected by the action of fuel thereon.

An object of the present invention is to provide an improved float switch for use in fuel tanks.

Another object of the present invention is to provide an improved switch which is not affected by pressure changes in a fuel tank and which is actuated only by the rise and fall of the liquid in the tank.

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Another object of the present invention is to provide an improved float switch which does not require mechanical movement through a wall of the fuel tank.

Still another object of the present invention is to provide an improved float switch which is durable in construction and will afford a long wearing life.

Still another object of the present invention is to provide an improved float switch which will not be affected by minor changes or movements in the level of fuel within a tank, but which shuts off only when the fuel has reached a dangerously low level.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

A preferred embodiment of the invention has been chosen for purposes of illustration and description and is shown in the accompanying drawings, forming a part of the specification, wherein:

Fig. 1 is a cross sectional side view of a float switch of the present invention;

Fig. 2 is a top plan view of the present invention;

Fig. 3 is a bottom plan view of the present invention;

Fig. 4 is a sectional view taken along the line 4—4 of Fig. 1.

Fig. 5 is a diagrammatic view illustrating the magnetic action when the switch is in open position; and

Fig. 6 is a diagrammatic view illustrating the magnetic action when the switch is in closed position.

Referring to Figs. 1 and 2, the invention comprises a bottom housing 1 which is adapted to be mounted on an outerside of the fuel tank, shown in dotted outline, and a top housing 2 which is adapted to be mounted on the inside of the fuel tank. A lever arm 4 is pivotally mounted within the housing 2 and has a buoyant float 6 secured to its free end.

The bottom housing 1 is preferably cylindrical in shape. It may be open at the bottom and terminates at the top in a mounting plate or flange 8 having a series of apertures 10 provided in a peripheral portion thereof and spaced one from the other, as shown in Fig. 3. A circular collar 12 projects above the plate 8; the collar 12 may be of smaller diameter than the bottom housing 1

and is adapted to be inserted into a recess of corresponding diameter in a wall of the fuel tank as shown. The bottom housing may be secured to the bottom wall of the tank by screws 14 inserted through the apertures 10.

After the collar 12 has been inserted through the recess in the fuel tank, and the housing 1 secured to the outside of the tank, the top housing 2 may be inserted over the collar from within the tank and secured to the collar 12 by screws 16 or other means.

Fixedly mounted within the top housing 2 is a U-shaped frame 18 comprising two vertical legs 20 and a horizontal leg 22. The frame 18 serves as a support for the remaining mechanism within the top housing 2. Journalled within an upper portion of said frame 18 is a transverse shaft 24 to which is keyed or otherwise secured the lever arm 4 and a large bevel gear 26. A slot 28 in a rear wall of the top housing 2 permits vertical movement of the lever arm 4 through a limited arc. When the lever arm 4 moves up or down it rotates the transverse shaft 24 which is journalled in the frame 18 and likewise causes rotation of the large bevel gear 26. A vertical shaft 30 is journalled in a central portion of the horizontal leg 22 of the frame 18. A small bevel gear 32 which meshes with the large bevel gear 26 is secured to the upper end of said vertical shaft 30. On the lower end of the shaft there is secured a U-shaped magnet 34, so that as the vertically disposed shaft 30 rotates the small gear 32 and the U-shaped magnet 34 likewise rotate.

From the description thus far it is seen that when the buoyant float 6 rises and falls with the level of the liquid in the fuel tank, it raises and lowers the lever arm 4. The motion of the lever arm rotates the large bevel gear 26 which meshes with the small bevel gear 32. Rotation of the small gear 32 in turn rotates the vertical shaft 30 which also causes the magnet 34 to rotate. Since the driving gear 26 is larger than the driven gear 32, a comparatively limited vertical motion of the lever arm 4 is translated into a relatively greater rotary movement of the magnet 34. The extent of movement of the lever arm 4, and correspondingly, the rotation of the magnet 34 is limited by the size of the slot 28 in the housing 2.

Positioned within the bottom housing 1 is a quick-acting switch 36 adapted to be connected to an electric fuel pump (not shown) by means of wiring 38 and an electrical connecter 40 mounted on the outside of the bottom housing. The connecter shown is of the plug-in and screw thread type but any connecter may be utilized with equally good results. Referring to Figs. 1 and 4, the quick-acting switch 36 may be of any suitable type but is preferably a small size switch such as that widely known as a "microswitch"; in such switches when the member 41 turns about a pin, it causes a movable part of the switch 36 to close against an adjacent contact.

Referring to Figs. 1 and 4 the quick-acting switch 36 may be actuated by a movable armature member 42 mounted on the pivoting member 41. Spaced above the movable armature 42 and extending transversely of it are two stationary armature members 44. Referring to Figs. 1 and 5, when the fuel tank is empty, a spring (not shown) within the microswitch 36 retains the movable armature 42 in its open position spaced from and out of contact with the stationary armature members 44. In this position, the electrical circuit to the fuel pump is open and the fuel pump will not operate. It will be noted that in this

position, shown diagrammatically in Fig. 5, the magnet 34 is turned so that the poles of the magnet are above the stationary armature members 44. The magnetic circuit is through the poles and the stationary armature members 44; there is no magnetic field running through the movable armature 42 to attract it upwardly.

When there is fuel within the tank and the float 6 is in a raised position the magnet is rotated as previously described so that a portion of its north and south poles are both above the movable armature 42, as shown in Fig. 6. This creates a magnetic field running through the north and south poles of the magnet and the movable armature 42. The magnetic attraction raises the movable armature 42 until it is in face contact with the stationary armature members 44, overcoming the resistance of the spring within the microswitch 36. When the movable armature 42 raises to this closed position the pivot member 41 pivots about a pin 43 and depresses a lever arm 45. This closes the microswitch contact, the electrical circuit to the pump is completed and the pump will operate. As the fuel is used up in the tank, the float 6 and the lever arm 4 slowly settle, revolving the magnet 34 until it is in a position like that shown in Fig. 5. At some point between the two positions shown in Figs. 6 and 5 the magnetic field through the movable armature 42 will be broken and it will be snapped downwardly by the spring within the microswitch, opening the circuit and shutting off the fuel pump. A flexible skirt 46 of non-magnetic material is preferably secured to the upper surface of the movable armature 42. When the armature 42 is in the closed position, as shown diagrammatically in Fig. 6, the skirt 46 is interposed and prevents direct face contact between the movable armature 42 and the stationary armature members 44. This prevents the movable armature 42 from "binding" or becoming stuck to the stationary armature members 44 and insures instantaneous opening of the movable armature when the magnet is rotated.

Although in the figures the magnet has been shown as being revolved 90 degrees for illustrative purposes, it will be understood that a smaller angle of rotation can be used for actuation of the contact bar 42. A rotation of approximately 45 degrees has been found satisfactory.

The various component parts of the float switch shown herein are preferably made of a light weight metal such as aluminum, magnesium or the like, although any suitable material may be used. The housing 1 and mounting plate 8 are preferably of a non-magnetic material. For the float 6 it has been found preferable to use a laminated cork construction although any type of float construction which will give the required buoyancy may be employed.

Although the present invention has been described chiefly in connection with fuel pumps, it will be understood that the inventive concept herein disclosed is not so limited and that a float switch of this construction can be used in any installation where it is sought to provide an electrical switch responsive to the rise or fall of liquid.

The advantages of a float switch of this type are obvious. The elimination of any mechanical linkage between the microswitch enclosed within the bottom housing and the float and gear mechanism enclosed within the top housing makes possible the installation of a float type mechanism without the risk of leakage, such as is found when a diaphragm type of apparatus is used. A

liquid and vapor tight seal may be provided between the mounting plate 8 and the bottom of the fuel tank. The electric microswitch is actuated by magnetism passing through the metal flange or bulkhead 8; there are no parts which will deteriorate or be made permeable by the reaction of the gasoline or other fuel on them. A switch of this construction is not effected by changes of pressure or atmosphere within the tank. Moreover the differential gearing allows considerable vertical movement of the float such as would be occasioned by the rise and fall of the liquid from movement or vibration of an aircraft in flight without actuation of the switch. It is only when the float has sunk below a critical attitude that the magnet is rotated sufficiently to shunt out the magnetic field and open the microswitch. Since the movable armature 42 is spring loaded it opens instantly to effect an immediate breaking of the fuel pump circuit. A device of this kind is durable in construction and inexpensive to manufacture. It need not be replaced periodically but should last the life of the tank in which it is installed.

As various changes may be made in the form, construction and arrangement of the parts herein without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention I claim:

1. A device of the class described comprising the combination of a mounting plate; means at one side of said plate, including an armature member movable toward and away from the plate for actuating said means, to open and close an electric contact; a magnet at the opposite side of said plate and adjacent the armature member; means rotatably supporting said magnet; means for rotating said magnet with respect to the armature member to place poles of the magnet into and out of adjacency to the armature member for attracting and releasing it, and at least a single stationary armature member disposed intermediate a portion of said movable armature member and said mounting plate adapted to carry a portion of a magnetic field of said magnet.

2. A device as claimed in claim 1, in which there is provided a pair of said stationary armature members, and said stationary armature members are located adjacent opposite ends of said movable armature member.

3. A device of the class described comprising the combination of a mounting plate; means at one side of said plate, including an armature member movable toward and away from the plate for actuating said means, to open and close an electric contact; a magnet at the opposite side of said plate and adjacent the armature member, means rotatably supporting said magnet, a gear operatively connected with said magnet and rotatable therewith, a second gear meshing with said first gear, and means operatively connected with said second gear to rotate it and thereby rotate said magnet.

4. A device as claimed in claim 3, in which the means operatively connected with said second gear comprises a rod member and a float secured to the rod member.

5. A device as claimed in claim 3, in which said gears are of the bevel type and are mounted for rotation about axes disposed substantially at right angles to each other.

6. A device of the class described comprising the combination of an armature member movable toward and away from a magnet member for opening and closing an electric contact, a magnet member adjacent said armature member, and means for rotating one of said members with respect to the other to place them into and out of operative registry with each other comprising a pair of gears operatively connected with one of said members and a float arm operatively connected with one of said gears for rotating it.

7. A device of the class described comprising the combination of an armature member movable toward and away from a magnet for opening and closing an electric contact, a magnet adjacent said armature member, and means for rotating said magnet with respect to the armature member to place the armature member and magnet into and out of operative registry with each other comprising a pair of gears operatively connected with said magnet and a float arm operatively connected with one of said gears for rotating it.

8. A device as claimed in claim 7, in which means is provided for limiting the extent of movement of said float arm, to thereby limit the extent of movement of said gears and rotation of said magnet.

9. A device of the class described comprising the combination of a mounting plate; means at one side of said plate, including an armature member movable toward and away from the plate for actuating said means to open and close an electric contact, at least a single stationary armature member disposed intermediate a portion of said movable armature member and said mounting plate, a skirt member of non-magnetic material disposed intermediate said movable armature member and at least one of said stationary armature members; a magnet at the opposite side of said plate and adjacent said movable armature member; and means for rotating said magnet with respect to said movable armature member to place the magnet into and out of adjacency to said movable armature member for attracting and releasing it.

10. A device as claimed in claim 9 in which said skirt member is of a flexible, non-magnetic material and secured to the movable armature member.

11. A device of the class described comprising the combination of a mounting plate, means at one side of said mounting plate to open and close an electric contact, said means comprising a first armature member movable toward and away from said plate for actuating said means and a second armature member disposed intermediate a portion of said movable armature and said plate, a magnet member at the opposite side of said plate and adjacent said means, and means for causing relative rotation between said first means and said magnet member to place said magnet member into and out of attracting position with respect to said first armature member.

12. A device as claimed in claim 11 in which said plate member is comprised of substantially non-magnetic material.

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