May 29, 1956 K. R. LUNG 2,748,220

SEAL FLOAT SWITCH

Filed April 29, 1955

FIG-1

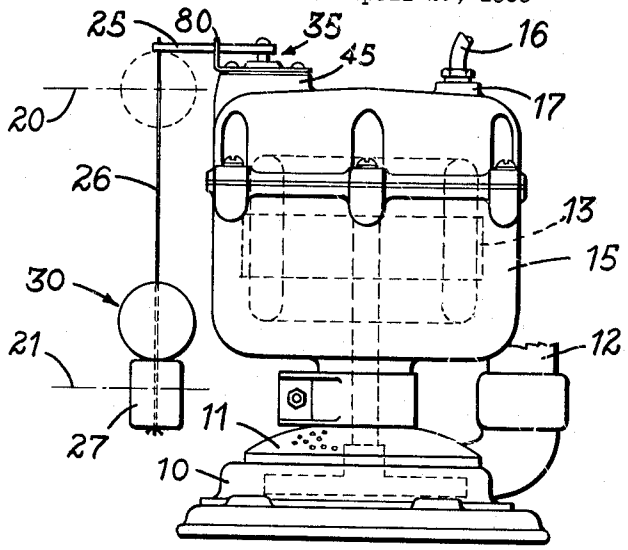


FIG-6

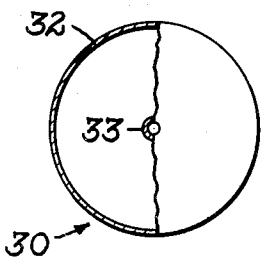


FIG-2

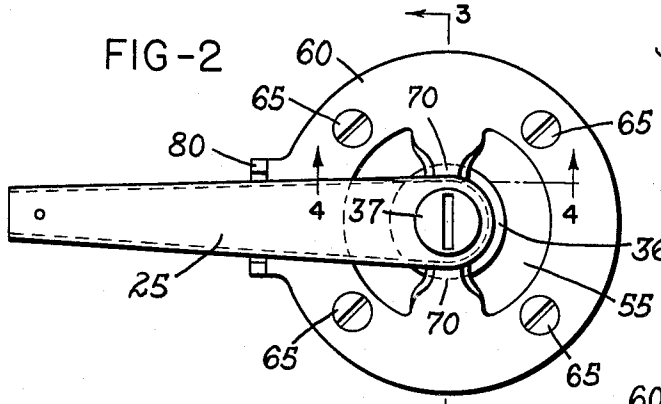


FIG-4

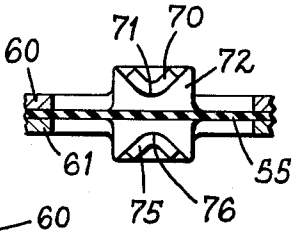


FIG-3

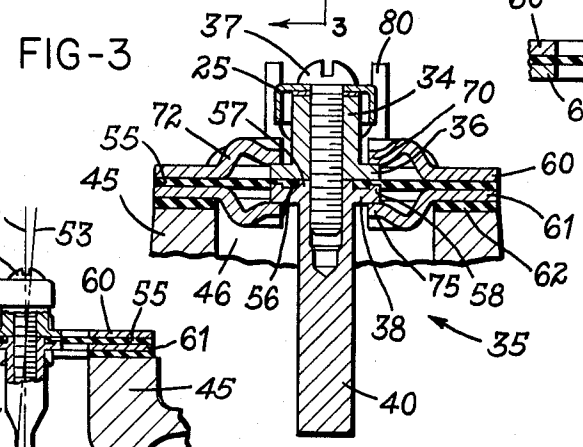
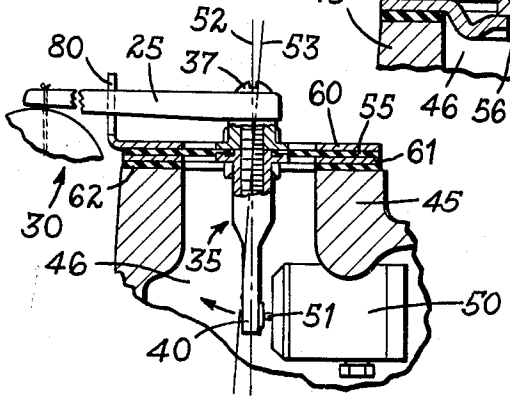


FIG-5



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SEALED FLOAT SWITCH

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Application April 29, 1955, Serial No. 504,782

7 Claims. (Cl. 200—84)

This invention relates to a liquid level responsive switch control especially adapted for use with sump or drain pumps and the like.

It is a primary object of this invention to provide an improved switch control mechanism which is responsive to the level of a body of liquid and which is particularly adapted for controlling an electrically driven pump to maintain the level of the liquid within certain predetermined heights.

Another object of the invention is to provide such a liquid level control incorporating readily obtainable parts in the control mechanism and thus to simplify the construction and maintenance of such controls.

A further object is to provide such a control mechanism which maintains the liquid level between predetermined spaced upper and lower limits, rather than at one predetermined level, and thereby increases the longevity of the entire pumping unit by avoiding frequent starting and stopping of the pump.

An additional object of this invention is to provide a sealed control mechanism for a switch which is mounted within a sealed housing, wherein the operating mechanism for the switch includes an arm fulcrumed at both sides of a sealing diaphragm to eliminate excessive strain upon the diaphragm due to flexure thereof during unequal pressure conditions within and without the sealed housing.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawing and the appended claims.

In the drawing—

Fig. 1 shows a submergible cellar draining pump incorporating the improved control devices of the present invention;

Fig. 2 is a top view on an enlarged scale of the switch control seen in Fig. 1;

Fig. 3 is a section taken along line 3—3 of Fig. 2;

Fig. 4 is a partial section taken along line 4—4 of Fig. 2;

Fig. 5 is an enlarged view, partly in section and partly in elevation, showing the interrelation of the liquid level control and the switch operating construction; and

Fig. 6 is an enlarged top view, partly in section and partly in elevation of the float seen in Fig. 1.

Referring to the drawing, which illustrates a preferred embodiment of the invention, and particularly to Fig. 1, there is shown a submergible cellar draining pump construction including an impeller housing **10** having a screened inlet **11** and an outlet pipe **12**. The motor parts indicated generally at **13** for driving the impeller in housing **10** are incorporated with a sealed casing **15** and are supplied with electric current through a conduit **16** which is sealed to housing **15** by a suitable sealing mechanism indicated generally at **17**. This submergible cellar draining pump is disclosed in more detail in my copending application for Pumps Serial No. 504,781, filed of even date herewith, and assigned to the same assignee as the present application.

In order to avoid frequent turning on and off of the pump, it is desirable to allow the liquid to accumulate for a certain period of time, and when the liquid level reaches a certain predetermined height, to energize the pump and reduce the liquid level to a predetermined lower height. These upper and lower liquid level limits are indicated generally in Fig. 1 by lines **20** and **21**, respectively, and in operation, water or other liquid to be pumped is permitted to accumulate up to the level of line **21**. Assuming that the pump has just ceased to operate, the liquid level will begin at level **21** and rise around the pump housing **15** until it reaches level **20**, at which point the housing **15** will be substantially completely submerged. When the liquid reaches this height, the pump is energized and continues to operate until the liquid level has been reduced to a height corresponding to line **21**, at which the time the pump is automatically shut off.

The mechanism which controls this operation of the pump includes lever arm **25** having a cord **26**, of nylon, wire or the like, attached to one end thereof, and a weight **27** is carried at the lower end of cord **26**. A float **30** is retained on cord **26** but is movable between a lower position wherein it rests upon weight **27**, as seen in full lines in Fig. 1, and an upper position, seen in dotted lines in Fig. 1, wherein it presses against the end of lever arm **25**. The float may be of any convenient construction so long as it is freely movable up and down the cord **26**, and it is shown as formed of a hollow ball **32** (Fig. 6) having a tube **33** passing therethrough and secured to the surface of ball **32** where it intersects such surface. A passage is thus provided through the float through which cord **26** may pass as in the assembly seen in Fig. 1.

The lever arm **25** is attached at its other end to an upper portion **34** of a composite switch operating arm identified generally as **35**. Upper portion **34** has an outwardly extending compression plate **36** at its lower surface and a central bore through which a connecting screw or bolt **37** is passed. The lower portion of the switch operating arm **25** includes a pressure plate **38** and a downwardly extending switch operating member **40**. The upper portion of member **40**, centrally of plate **38**, is suitably bored and tapped to engage the threads of bolt **37**.

The housing **15** has a boss **45** at the upper edge thereof, and there is on opening **46** within this boss to provide access to a switch **50** which controls the pump operating motor **13**. The switch **50** may be a commercially available snap-action toggle switch of the type which requires a definite force to throw the switch to either its on or off position. The operating member of switch **50** is shown diagrammatically at **51** as engaging the member **40**, and in this position the switch is off and the motor is not energized, the center line of arm **35** being indicated at **52**. The relative position of the switch operating arm when the switch **50** is on is indicated by the vertical center line **53** in Fig. 5.

The switch operating arm **35** extends through opening **46** and is supported by a diaphragm **55** having a central aperture **56** through which bolt **37** and a central shoulder **57** on plate **38** may pass. The bolt **37** serves to draw the upper arm portion **34** and compression plate **36** toward pressure plate **38**, and thus the central portion of diaphragm **55** surrounding opening **56** is clamped between plates **36** and **38**. An outer annular shoulder **58** is provided on plate **38** to provide for further clamping action between plates **36** and **38** and to assure a liquid tight joint between the operating arm and diaphragm **55**.

Diaphragm **55** is supported in sealing relation on boss **45**, extending across opening **46**, by a pair of complementary annular mounting plates **60** and **61** between which diaphragm **55** is sandwiched as seen in Fig. 3. An annular gasket **62** is placed between lower plate **61** and the surface of boss **45**, and a number of mounting bolts

65 (Fig. 2) extend through plates 60 and 61, diaphragm 55 and gasket 62, and into boss 45 to clamp these parts in position in sealing relation with the opening 46.

The operating arm 35 is mounted for tilting movement about a point adjacent the center of diaphragm 55, in order to avoid undue flexure of that diaphragm. This mounting is provided by a pair of ears 70 on mounting plate 60 which are of generally V-shape in cross-section, and which extend radially inwardly from mounting plate 60. The apex 71 of each ear is arranged generally in horizontal alignment with the upper surface of plate 60 as shown in Fig. 4. An integral upwardly extending portion 72 attaches the ears to the remainder of plate 60. Ears 75, having the same configuration as ears 70, extend radially inwardly from lower plate 61, with the apex 76 of these ears being in generally horizontal alignment with the lower surface of plate 61. When the assembled operating arm 35 is clamped through diaphragm 55, the plates 36 and 38 (having the central portion of diaphragm 55 sandwiched therebetween) are of such composite thickness as to fit loosely between the apexes 71 and 76. Arm 35 is thus fulcrumed for tilting movement to swing the switch operating member 40 away from member 51, as indicated by the center line 53 in Fig. 5. The fulcrum members are provided by both sets of ears 70 and 75, respectively, and thus the operating arm is fulcrumed both above and below diaphragm 55.

Since motor housing 15 is completely sealed, and since the heat from the operation of the motor within this housing may result in some pressure increase therewithin, it is desirable to fulcrum arm 35 from above as well as from below. Otherwise, if the pressure within housing 15 should become sufficiently high to force diaphragm 55 upwardly and disengage plate 38 from ears 75, there would be no support for controlling the tilting movement of arm 35.

An upwardly extending bifurcated member 80 extends from the periphery of mounting plate 60 to provide a guide for lever arm 25, and thereby to prevent excessive lateral movement of the arm which might unduly strain diaphragm 55. Thus, lever arm 25 is free to move only in a substantially vertical plane to rock operating arm 35 between the on and off positions indicated by vertical center lines 52 and 53 in Fig. 5. The normal weight of the operating arm and lever arm, together with the pressure of any water which covers diaphragm 55 when the pump is completely submerged, acts to automatically press plate 60 upon the lower ears 75. Whenever the pressure within housing 15 exceeds the weight of these members, the diaphragm 55 will be flexed upwardly to a very slight extent, until plate 36 rests against ears 70, and under such conditions tilting of arm 35 will take place about ears 70 as a fulcrum point.

In operation, once the water level begins to rise above the lower level 21, the weight of the water displaced by weight 27 begins to neutralize the downward force on lever arm 25 exerted by the combined weights of float 30 and weight 27. When weight 27 is completely immersed, the float 30 rises along cord 26 until it reaches its upper position and presses against lever arm 25. As the water continues to rise about float 30, it exerts an upward force against lever arm 25 and forces operating arm 35 to tilt about one or the other of fulcrum ears 70 or 75, until arm 35 reaches the on position indicated by center line 53. As previously pointed out, switch 50 is a snap-acting toggle switch, and the mechanism therein (not shown) will not act to close the switch until arm 35 has reached its tilted position. At this time the switch snaps on and the motor is energized to drive the pump and lower the liquid level until it again approaches level 21. As the water level recedes, float 30 eventually is supported above the water on weight 27, and together with the weight of the uncovered portion of weight 27, finally acts to exert sufficient force through lever arm 20 and operating arm 35 to snap switch 50 off. The pump is then deenergized and remains so until the liquid again rises to its upper level 20.

It will thus be seen that the present invention provides a liquid level responsive control for a submergible pump which embodies economical and easily maintained construction, and which provides a completely sealed enclosure for the pump control switch. The diaphragm support construction, together with the upper and lower fulcrum members, eliminates most of the stress on the diaphragm 55 and thereby appreciably increases the useful life of the diaphragm and prevents leakage into housing 15 which might damage the motor and switch enclosed therein.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. A float operated sealed switch assembly including the combination of a switch, a housing enclosing said switch and having an opening therein, an operating arm extending through said opening and having means on the end thereof within said housing for operating said switch, a diaphragm covering said opening and having an aperture therethrough for receiving said operating arm, means for fixing said diaphragm in sealing relation to said operating arm and said housing to cover said opening, fulcrum means adjacent said diaphragm and supporting said operating arm for tilting movement to actuate said switch operating means, a lever arm attached to said operating arm outwardly of said housing, a weight, means for suspending said weight from said lever arm into a body of liquid, and a float retained on said suspending means and freely movable between said lever arm and said weight for selectively exerting forces thereon in response to changes in the liquid level.

2. A control for a switch enclosed in a sealed housing, comprising a diaphragm adapted to cover an opening in said housing adjacent the switch, said diaphragm having an aperture therein arranged to overlie the opening, a pair of mounting plates having complementary annular portions receiving the periphery of said diaphragm therebetween and arranged to support said diaphragm in sealing relation across the opening in the housing, a switch operating arm including means extending through said aperture and clamping the portions of said diaphragm surrounding said aperture in sealing relation to said operating arm, one end of said operating arm including means for engaging the switch to effect operation thereof, a lever arm attached to said operating arm on the opposite side of said diaphragm from said switch engaging means, and fulcrum means carried by said mounting plates and supporting said operating arm for tilting movement in response to movement of said lever arm for operating said switch.

3. A control for a switch enclosed in a sealed housing, comprising a diaphragm adapted to cover an opening in said housing adjacent the switch, said diaphragm having an aperture therein arranged to overlie the opening, a pair of mounting plates having complementary annular portions receiving the periphery of said diaphragm therebetween and arranged to support said diaphragm in sealing relation across the opening in the housing, a switch operating arm including means extending through said aperture and clamping the portions of said diaphragm surrounding said aperture in sealing relation to said operating arm, one end of said operating arm including means for engaging the switch to effect operation thereof, and fulcrum means carried by said mounting plates and supporting said operating arm for tilting movement to operate said switch.

4. A control for a switch enclosed in a sealed housing, comprising a diaphragm adapted to cover an opening in

the housing adjacent the switch, said diaphragm having an aperture therein arranged to overlie the opening, a switch operating arm, a pressure plate adjacent one end of said arm and extending transversely thereof, said pressure plate being of greater area than said diaphragm aperture, a compression plate having substantially the same area as said pressure plate, means extending through said diaphragm aperture for clamping said pressure plate and said compression plate together with that portion of said diaphragm surrounding said aperture sandwiched between said plates, a lever arm connected to said compression plate, a pair of mounting plates having complementary annular portions receiving the periphery of said diaphragm therebetween and arranged to support said diaphragm in sealing relation across the opening in the housing, and a fulcrum member carried by one of said mounting plates and supporting the assembled said pressure plate and compression plate for tilting movement in response to movement of said lever arm.

5. A control for a switch enclosed in a sealed housing, comprising a diaphragm adapted to cover an opening in the housing adjacent the switch, said diaphragm having an aperture therein arranged to overlie the opening, a switch operating arm, a pressure plate adjacent one end of said arm and extending transversely thereof, said pressure plate being of greater area than said diaphragm aperture, a compression plate having substantially the same area as said pressure plate, means extending through said diaphragm aperture for clamping said pressure plate and said compression plate together with that portion of said diaphragm surrounding said aperture sandwiched between said plates, a lever arm connected to said compression plate, a pair of mounting plates having complementary annular portions receiving the periphery of said diaphragm therebetween and arranged to support said diaphragm in sealing relation across the opening in the housing, fulcrum members carried by each of said mounting plates and engaging both said pressure plate and said compression plate to support the assembled said plates for tilting movement in response to movement of said lever arm, and said fulcrum members being ears of generally V-shape in cross-section integral with said mounting plates and extending radially inwardly thereof to support the assembled said pressure plate and compression plate both from above and from below for tilting movement in response to movement of said lever arm.

6. A control for a switch enclosed in a sealed housing, comprising a switch operating arm extending into said housing through an opening therein, said arm having means on the end thereof within said housing for operating the switch, a diaphragm for covering the opening in the housing and having an aperture therethrough for receiving said operating arm, means for fixing said diaphragm in sealing relation to said operating arm and to the housing to cover the opening including a pair of mounting plates having complementary annular portions receiving the periphery of said diaphragm therebetween and arranged to support said diaphragm in sealing relation across the opening in the housing, and fulcrum members including ears of generally V-shape in cross-section integral with said mounting plates and extending radially inwardly thereof on opposite sides of said diaphragm to support said switch operating arm for tilting movement to control the switch.

7. A control for a switch enclosed in a sealed housing, comprising a diaphragm for covering an opening in said housing adjacent the switch, said diaphragm having an aperture therein adapted to overlie the opening, upper and lower mounting plates having complementary annular portions receiving the periphery of said diaphragm therebetween for fixing said diaphragm in sealing relation to the housing across the opening therein, a switch operating arm including means extending through said aperture and clamping the portions of said diaphragm surrounding said aperture in sealing relation to said operating arm, one end of said operating arm having means for engaging the switch to effect operation thereof, fulcrum means adjacent said diaphragm and supporting said operating arm for tilting movement to effect operation of said switch engaging means, a lever arm attached to said operating arm on the opposite side of said diaphragm from said switch engaging means, and guide means on said upper mounting plate receiving said lever arm and preventing excessive lateral movements thereof with respect to said operating arm.

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