# United States Patent [19]

**Cade**

[11] **3,916,130**

[45] **Oct. 28, 1975**


[54] **PRESSURE SWITCH FOR A SUMP PUMP**


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[73] Assignee: **Houdaille Industries, Inc.,** Buffalo, N.Y.



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[21] Appl. No.: **456,076**

[52] **U.S. Cl.** ..... **200/83 C;** 73/302; 200/51 R; 339/117 P

[51] **Int. Cl.²** ..... **H01H 35/32**

[58] **Field of Search** ..... 200/51 R, 61.2, 61.21, 200/61.6, 81 R, 81.9 R, 83 R, 83 C, 83 T, 83 W, 83 Q, 83 D, DIG. 5, DIG. 31; 339/117 R, 117 P, 35; 340/240, 244 R, 244 A, 244 B, 244 D, 245; 137/392; 92/40; 73/262, 271, 269, 290 R, 302, 303, 410; 116/118 R



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[57] **ABSTRACT**

A control switch mechanism for controlling a submersible sump pump, not provided with an integrally associated control mechanism, in which a housing is provided with electrical plug-in contact adapted to be inserted in a common electrical power outlet, for example of the wall type, with the housing structure supported thereat, the housing structure also containing an electrical outlet socket into which the electrical connecting cord of the sump pump is inserted. The plug-in contacts and outlet socket of the structure are adapted to be operatively connected by means of a pressure responsive switch, the air pressure at the switch being controlled by the pressure of the liquid to be pumped, so that when the liquid level thereof has increased to a predetermined value, said pressure responsive switch will be actuated by the air pressure thereat, means being provided responsive to liquid pressure at the discharge side of such a pump for effecting the supply of air to the system to maintain the same fully charged with air, thus compensating for any loss of air into the liquid being pumped, or otherwise.


**5 Claims, 2 Drawing Figures**

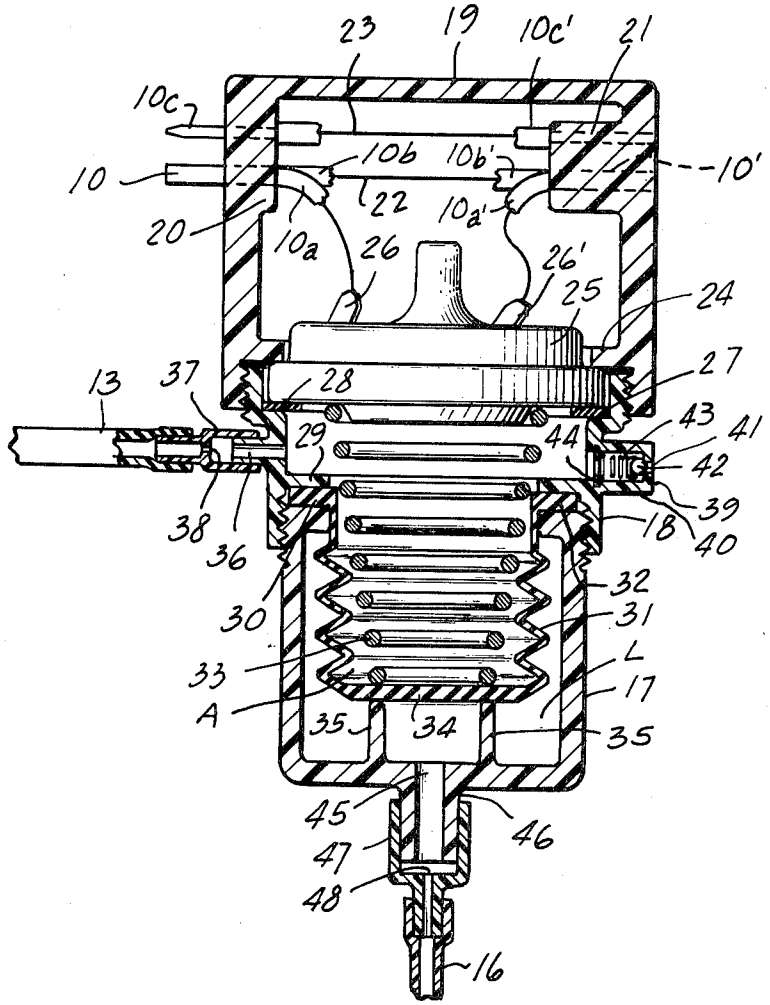


Fig. 1

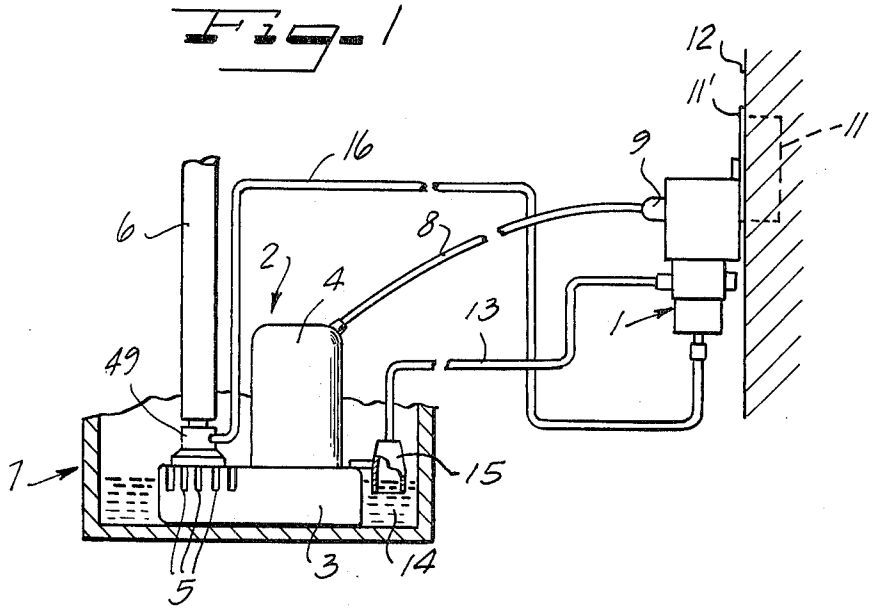
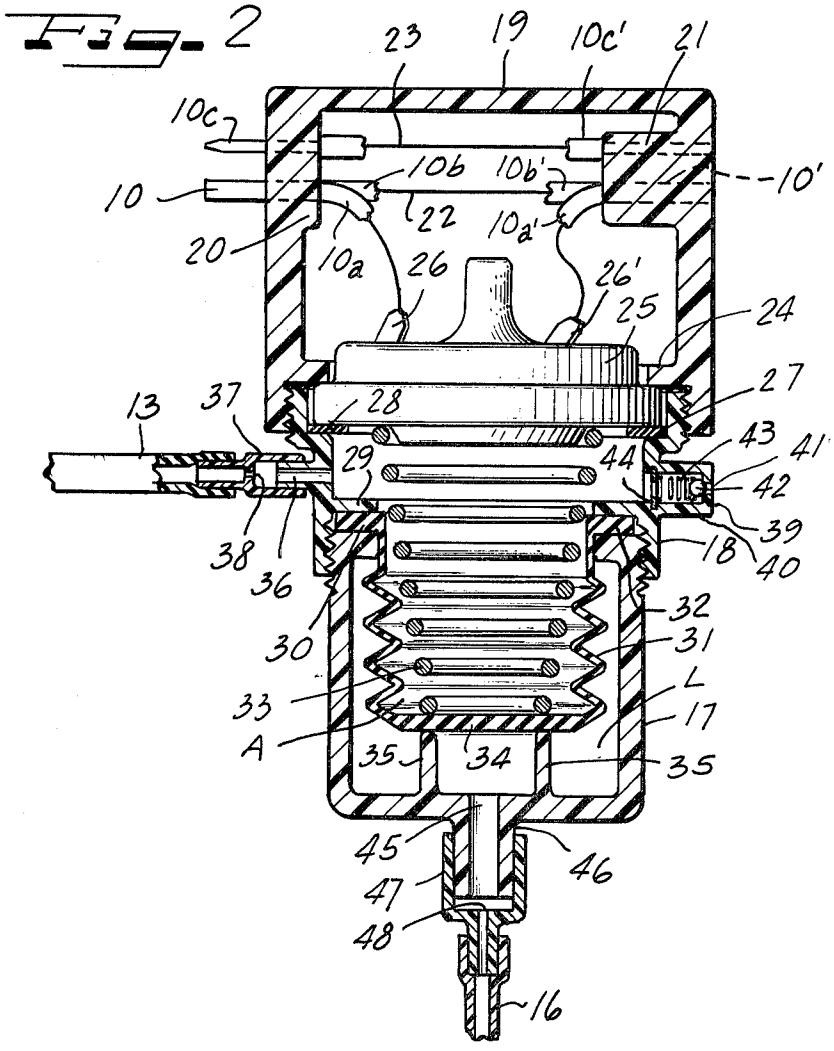

12
11'
11
16
9
6
8
2
4
13
1
49
7
15
3
14
5

Fig. 2


23
19
10c'
21
10c
10b
10b'
10
10'
22
10a'
20
10a
26
26'
25
24
27
13
37
28
43
41
29
44
42
38
39
36
18
40
30
32
31
33
L
17
A
35
34
35
45
46
47
48
16

# PRESSURE SWITCH FOR A SUMP PUMP

## BACKGROUND OF THE INVENTION

The invention is directed to a pressure responsive structure adapted to be employed for the control of sump pumps and the like which have no integrally associated control means, i.e. pressure responsive means for actuating such sump pumps on a predetermined rise in the liquid to be pumped.

Many sump pumps are provided with a built-in pressure responsive switch which is adapted to actuate the electric motor of the pump when the liquid level to be pumped reaches a predetermined height. Pressure responsive switches of this type are usually employed with submersible types of sump pumps, while the vertical stand-up sump pump, in which the motor is disposed well above the liquid level, usually employs a float-actuated type of switch mechanism, with the switch normally being disposed at the very top of the structure, for example, mounted on the motor. It will be appreciated that where a submersible pump is involved, the pressure switch electrical lines must be sealed suitably with respect to the liquid being pumped, and if the switch fails to properly operate the pump must be removed and repaired. This in turn will normally entail disconnection of the pump discharge line, often in the form of a rigid or semi-rigid metal or plastic type, necessitating a down period during which the pump is inoperable.

## BRIEF SUMMARY OF THE INVENTION

The present invention therefore is directed to the provision of a pressure responsive switch mechanism adapted to be operated by changes in height of the liquid to be pumped, in which control mechanism may be readily operatively interposed between an electrical wall outlet or like end of power cord of the pump involved with the control mechanism being remote from the pump structure at a location convenient for replacement or repair. The mechanism thus is completely divorced from the pump structure itself so that the pump, in an emergency, may be operated without the control mechanism. The pressure responsive switch, in turn, is adapted to be controlled by fluctuation of the level of the liquid to be pumped, by means of a relatively small tube or conduit which extends from the control unit to a convenient location at which the free end of the tube is so disposed with respect to the liquid to be pumped that upon rise in the liquid level to a predetermined height sufficient air pressure will be present at the switch to effect actuation thereof.

Means comprising a spring-biased bellows and check-valve means are also provided, with the bellows being contractable responsive to liquid pressure at the discharge side of the pump when operating, and adapted to draw air into the system when the pump operation ceases, whereby the system is maintained fully charged with air, thus compensating for any loss of air into the liquid being pumped, or otherwise.

The entire structure may be quite compact and relatively inexpensive, and as emersion of the switching mechanism into the liquid is eliminated, problems relating to sealing, corrosion and/or other deterioriation of parts from the liquid contacting exposed portions of the switch are avoided.



## BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, wherein like reference characters indicate like or corresponding parts:

FIG. **1** is a semi-diagrammatic view of a submersible pump structure and the application of the present invention thereto; and

FIG. **2** is a vertical sectional view of a pressure responsive mechanism embodying the invention.

## DETAILED DESCRIPTION OF THE INVENTION

### General Construction

Referring to the drawings and more particularly to FIG. **1**, the reference numeral **1** indicates generally a control structure adapted to control a submersible type pump or the like indicated generally by the numeral **2**, having a pump body **3** adapted to be powered by a suitable electric motor **4**, with the pump body having a plurality of liquid inlets **5** and a discharge port to which is operatively connected a dischare pipe or conduit **6**, with the pump **2**, in the example illustrated being disposed at the bottom of a suitable sump indicated generally by the reference numeral **7**, from which liquid is to be pumped.

The electric motor **4** is provided with a connecting power cord **8** terminating at its free end in a standard electrical plug **9**, which normally will be of the three-prong type with the third terminal providing a grounding connection.

As illustrated in FIG. **2**, the structure **1** is provided with plug-in type contacts, indicated generally by the reference numeral **10**, which generally correspond to the comparable contacts carried by the plug **9** and which are adapted to be inserted directly into a wall type socket or the like, such as the socket **11** illustrated in FIG. **1** which may be of the usual wall type having a cover plate **11'** and mounted directly on a wall surface **12**.

As hereinafter described in detail, the structure **1** is adapted to contain a pressure responsive switch, the operation of which is controlled by a sensing tube or conduit **13** extending from the structure **1** with its free end adapted to be operatively disposed with respect to the liquid **14** contained within the sump **7**, the free end of the conduit **13** in the example illustrated being connected to an inverted cup-shaped air bell **15**, illustrated in the present example as being supported by the pump **3**, with the lower end of the bell disposed in the liquid.

The structure **1** is also connected, by tube or conduit **16** with the discharge side of the pump **3**, the latter in the example illustrated being provided with a suitable fitting **49**, to which the pipe **6** is connected, and which is provided with a suitable stem to which the tube **16** may be attached.

In operation, upon a predetermined rise in liquid level with respect to the adjacent end of the conduit **13**, the pressure responsive switch contained in the structure **1** will be actuated to complete electric connection from the outlet **11** to the electric motor **4** and actuate the pump. Such operation will continue until the liquid level in the sump **7** drops to a predetermined level with respect to the end of the conduit **13**, at which time the pressure responsive switch will open thereby discontinuing operation of the motor **4**.

As subsequently discussed in detail, the connection to the pump discharge side forms a part of means for insuring that the portion of the system actuated pneu-

matically will always be adequately charged with air, for efficient operation of the system.

It will be appreciated that with this construction all of the control mechanism is contained in the housing **1**, remote from the pump structure as well as from the liquid to be pumped, with the control mechanism merely requiring interposition between the plug **9** and the outlet **11**, the tube **16** connected to the pump, and the tube **13** operatively disposed with respect to the liquid to be pumped.

In the event of failure of the control mechanism to properly operate, it may be readily replaced, the pump being operated continuously, if desired, merely by inserting the plug **9** directly into the outlet **11**, or likewise may be repaired without shut-down of the pump.

As the control structure is remote from the liquid being pumped, it is not subject to corrosive or other deteriorative action, for example, as a result of condensation in the switch mechanism, etc.

## Details of construction

Referring to FIG. **2**, the housing of the structure **1** is constructed from three primary components, a bottom member **17**, an intermediate member **18** and a top member **19**, all of which may be formed in suitable manner from a suitable material, as for example as molded plastic components, which are adapted to be suitably secured together, the construction illustrated employing mating threads between the respective components. Obviously, suitable aperture flanges or the like and cooperable screws can be employed if desired, or the housing structure may be otherwise suitably configurated.

The plug-in contacts **10** comprise a pair of spring contacts **10*a*** and **10*b***, only the terminal end of the contact **10*b*** being illustrated in FIG. **2**, and a ground pin **10*c***, all of which are suitably supported from an enlargement **20** on the top member **19**. In like manner the top member **19** is provided with an enlargement **21** which carries socket contacts **10*a'*** and **10*b'***, as well as a suitable socket contact **10*c'*** adapted to receive the ground pin **10*c*** of a three-terminal cord plug. As illustrated, the contacts **10*b*** and **10*b'*** are adapted to be connected by a conductor **22** and the pin **10*c*** and pin socket **10*c'*** connected by a conductor **23**.

The top member **19** is also provided with an internal annular flange **24** upon which is adapted to seat the adjacent portion of the pressure responsive switch **25**, the latter having respective terminals **26** and **26'**, respectively connected by conductors to the contacts **10*a*** and **10*a'*** whereby the electrical circuit between the plug-in contacts **10** and the socket contacts **10'** are operatively connected over the pressure switch **25**.

The intermediate housing member **18** is provided with an annular shoulder **27** which is opposed to the adjacent portion of the switch **25** whereby the latter may be disposed between the flange **24** and the shoulder **27**, a suitable sealing gasket **28** being interposed between the shoulder **27** and the pressure switch, whereby upon screwing the respective members **18** and **19** together, the switch will be clamped in position with the junction between the switch and the member **18** being sealed by the gasket **28**.

As illustrated, the intermediate member **18** is likewise provided with an internal flange **29**, the lower face of which is adapted to have seated thereon the annular flange **30** of a flexible bellows **31**, with the flange **30** of the bellows being clamped between the opposed faces of the flange **29** of the member **18** and an inwardly directed flange **32** on the lower housing member **17**. The bellows flange **30** thus not only functions to support the bellows **31** but also forms the sealing means between the intermediate member **18** and the lower member **17**. The bellows is adapted to be urged in expanding direction by a compression spring **33**, seated at its upper end on a portion of the housing of the pressure switch **25**, and at its lower end on the bottom **34** of the bellows. The lower housing member **17** may also be provided with upwardly extending projections **35** upon which the bottom **34** of the bellows may rest when the latter is in expanded condition.

The intermediate member **18** is provided with a nipple **36** communicating with the interior of the chamber A, formed by the member **18** and bellows **31**, to which nipple the adjacent end of the tubing **13** is operatively connected, thus connecting the bell member **15** with the interior of the chamber A, hereinafter referred to as the "air chamber." In the embodiment illustrated, the adjacent end of the tubing **13** is connected to the nipple **36** by an adapter **37** which has a restricted orifice **38** and thus forms a restriction to high air flow through the tubing **13**. The member **18** is also provided with a check valve **39**, comprising a hollow tubular body portion **40**, integrally connected with the member **18**, the outer end of which is provided with an air inlet port **41** adapted to be normally closed by a ball member **42**, urged into closed position by a very weak spring **43**, the inner end of which is retained in fixed position by suitable means such as a lock ring **44**.

The lower end of the housing member **17** is provided with a water inlet port **45**, a nipple **46** being integrally formed with the member **17**, to which the tubing **16** is operatively connected. In the present instance, the tubing is illustrated as being connected to the nipple **46** by an adapter **47**, having a surge restricting orifice **48** therein operative to prevent any surge or shock loads resulting from liquid pressure in the line **16**, from reaching the chamber L defined by the member **17** and bellows **31**, hereinafter referred to as the "liquid chamber." The lower free end of the tubing **16** may be connected to the discharge side of the pump by means of the fitting **49** which is threaded or otherwise attached to the discharge outlet of the pump **3**, with the fitting **49** being provided with a suitable nipple to which the tubing **16** may be attached.

## OPERATION

With the device installed as schematically illustrated in FIG. **1**, the check valve **39** will be in closed condition and the pressure of air in the bell **15**, tubing **13**, and air chamber A will be dependent upon the height of the liquid **14** in the sump **7**, such air pressure increasing with increase in height of such liquid level. At this time, the bellows **31** is in expanded position as a result of the action of the spring **33**, and upon the air pressure in the chamber A reaching a predetermined design value the pressure switch **25** will be actuated to effect a connection between contacts **26** and **26'** thereof, thus completing a circuit between the plug **9** of the pump motor and the power supply outlet **11**. With the starting of the pump and the creation of liquid pressure in the discharge line **6** thereof, such pressure will also be transmitted through the tube **16** to the liquid chamber L, and as such liquid is considerably greater than the forces exerted by the spring **33**, the bellows will contract, reversing the air flow through the tube **13**

whereby a corresponding portion of the air in the chamber A will be forced out to the bell member **15,** thus clearing the same of any liquid that may have entered the bell and tubing during actuation of the pressure switch **25.**

As the level of the liquid **14** drops, due to operation of the pump, the air pressure in the chamber A will likewise drop until finally a liquid level is reached at which the air pressure in the chamber A is insufficient to actuate the pressure switch, causing the same to open the connection between terminals **26** and **26'**, and thereby open the power circuit to the motor **4** causing the same to stop. Upon deactuation of the pump **3** pressure of the discharge side of the pump will likewise drop to a point where the spring **33** can restore the bellows **31** to its original position, illustrated in FIG. **2,** with air being admitted during such expansion of the bellows through the air inlet port **41,** the ball member **42** of the air inlet check valve readily opening in opposition to the action of the very weak spring **43,** which spring preferably merely exerts a sufficient force on the ball **42** to insure operative seating of the ball in closed position.

While normally the liquid level in the sump **7** will be such that little or no flow of air would take place through the tubing **13** as the bellows **31** expands such remote possibility may be eliminated by the provision of the adapter **37,** which forms a greater restriction to air flow through the tube **13** than that offered by the check valve **39** whereby air will be supplied, for all practical purposes, exclusively from the exterior of the structure through the check valve **39.** Thus, each time the pump is actuated and deactuated the system will be recharged with air, eliminating any possibility of the air chamber becoming waterlogged, for example, as a result of air dissolving in the liquid being pumped.

The surge restricting structure, comprising in the example illustrated, the adapter **47,** obviously can be disposed anywhere between the discharge side of the pump, i.e. fitting **49** (FIG. **1**) and the chamber L, and may be suitably constructed in dependence upon its location. Likewise, while I have illustrated such surge restricting means as being in the form of a fixed orifice, obviously it could be of different construction, as for example, a limited flow check valve in which flow through the tubing **16** from the discharge side of the pump to the chamber L is restricted but upon the deactuation of the pump substantially unrestricted flow is permitted in the reverse direction.

While there may be some tendency of the air in the system, particularly in the bell **15** to dissolve in the liquid being pumped, assuming such liquid will accept it, under most conditions, the pump will be actuated at sufficiently close intervals to insure the system being adequately charged with air at all times. However, if the application of the pump should be such that excessively long intervals are involved between operation of the pump, provision may be made for manually actuating the pump whereby the same may be briefly operated for a sufficient period to insure proper operation of the recharging mechanism, or if desired suitable timing means may be employed to periodically run the pump for an adequate length of time.

Having thus described my invention it will be obvious that although various minor modifications might be suggested by those versed in the art, it should be understood that I wish to embody within the scope of the patent granted hereon all such modifications as reasonably, and properly come within the scope of my contribution to the art.

I claim as my invention:

**1.** A control switch mechanism for controlling a sump pump, particularly a submersible pump, having no integrally associated control mechanism, comprising a housing structure having electrical plug-in contacts extending therefrom for insertion in an electrical power outlet, an electrical outlet socket in said housing structure into which the electrical connecting cord of a sump pump to be controlled is to be inserted, a pressure responsive switch disposed in said housing structure and electrically connected intermediate said plug-in contacts and said socket to selectively complete an electrical connection therebetween, said housing having an air chamber therein and an adjacent water chamber therein, said chambers being separated by an expandable bellows, whereby the division of the total combined volume of said chambers may be varied, resilient means acting on said bellows operative to urge the latter in a direction to expand said air chamber to maximum volume and contract the water chamber to minimum volume, said housing structure having an air supply port therein and an actuating-air port therein, which ports communicate with said air chamber, and further having a water supply port communicating with said water chamber, said pressure switch having the actuating pressure side thereof operatively communicating with said air chamber, a low pressure check valve normally closing said air supply port, tubing means operatively connected to said actuating-air port, the open end of which is adapted to be so disposed with respect to the liquid to be pumped by said sump pump that such liquid will exert a pressure on the air in said tube, whereby the air pressure at a predetermined liquid level will effect actuation of said pressure responsive switch, and tubing means operatively connected to said water supply port adapted to be connected to such a sump pump at the discharge side thereof whereby said water chamber may be supplied with liquid at the pump discharge pressure, said resilient means being so calibrated that the action thereof on said bellows is less than the liquid discharge pressure thereon whereby, during operation of the sump pump, said bellows will be collapsed with the volume of said liquid chamber at a maximum and that of said air chamber at a minimum, said resilient means being operable, upon deenergization of such a pump, to expand said air chamber to maximum volume with air being supplied thereto through said air supply port.

**2.** A control switch mechanism according to claim **1,** comprising in further combination, an air bell, comprising an inverted cup-shaped member having an open bottom end, and provided with a port at its upper end, said tubing means having its free end connected to said port, said open end having a cross-sectional area considerably greater than that of said tubing means.

**3.** A control switch mechanism according to claim **1,** comprising in further combination, surge restricting means operatively disposed in the liquid path between said water chamber and the discharge side of such a pump, operative to prevent excessive liquid surge in said water chamber resulting from actuation of such a pump.

**4.** A control switch mechanism according to claim **1,** comprising in further combination, means disposed in the air path between said air chamber and the free end of said tubing means associated with said actuating air

port high flow therethrough whereby resistance to entry of air into said chamber is less through said low-pressure check valve than through said actuating air port.

**5.** A control switch mechanism for controlling a sump pump, particularly a submersible pump having no integrally associated control mechanism, comprising a pressure responsive switch, support means for said switch forming an air chamber operatively communicating with the actuating pressure side of said switch, means communicating with said chamber for controlling the air pressure therein in response to the height of liquid to be pumped, and means to be responsive to the operation of such a sump pump to be controlled for supplying atmospheric air to said chamber to maintain the system operatively charged with air, wherein said air supply means comprises a bellows, defining a portion of the wall structure of said air chamber, and movable to a position providing maximum volume in said air chamber, means to be operable in response to the operation of such a pump for contracting said bellows, and means for admitting atmospheric air into said chamber when the bellows is expanded following termination of operation of such pump to be controlled.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

# CERTIFICATE OF CORRECTION

PATENT NO. : 3,916,130

DATED : October 28, 1975

INVENTOR(S) : George I. Cade

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 21, "dischare" should be --discharge--.

Column 4, line 66, "pressure" should be inserted after "liquid".

Column 7, line 2, Claim 4, "air" should be inserted before "chamber".

Signed and Sealed this

*twenty-second* Day of *June 1976*

[SEAL]

*Attest:*

**RUTH C. MASON**
*Attesting Officer*

**C. MARSHALL DANN**
*Commissioner of Patents and Trademarks*