March 27, 1956 E. J. SCHAEFER 2,739,536

SUBMERSIBLE SUMP PUMP CONTROL

Filed July 31, 1952

Fig. 1.

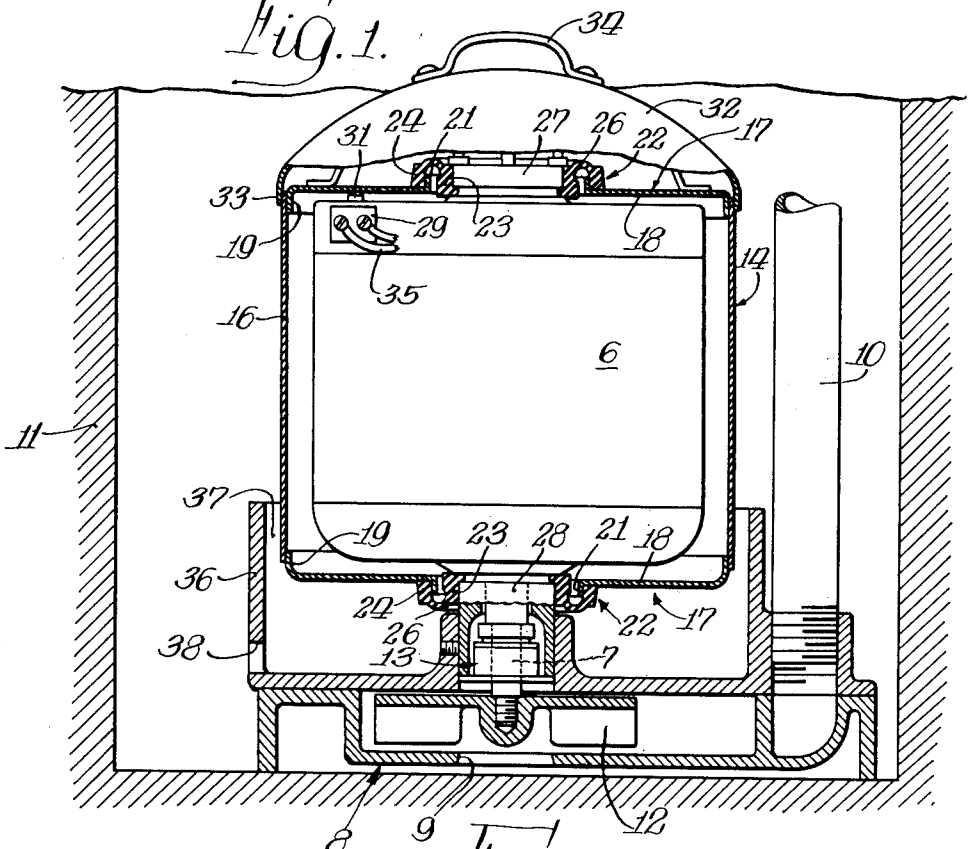
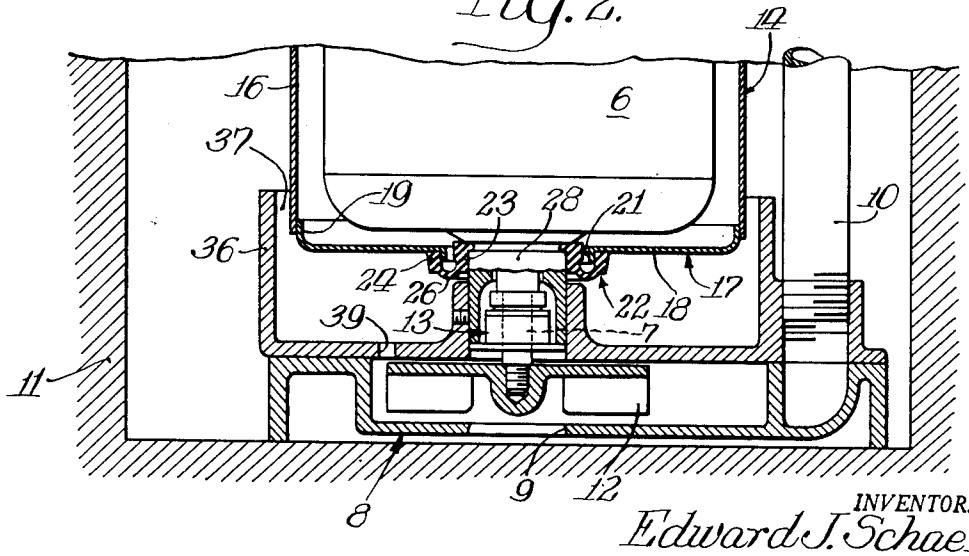


Fig. 2.



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SUBMERSIBLE SUMP PUMP CONTROL

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6 Claims. (Cl. 103—26)

This invention relates generally to sump pumps and more particularly to a novel control means for a sump pump of the submersible type.

In my copending U. S. Patent No. 2,662,206, issued December 8, 1953, I have described and claimed a sump pump arrangement wherein the electric motor for the pump unit is of the submersible type and is positioned immediately adjacent to the pump unit. The motor is rendered submersible by means of a generally cylindrical shell or enclosure which includes a flexible diaphragm means adapted to actuate a control switch for the motor in response to changes of water level outside the enclosure. Preferably, the diaphragm means constitutes an end portion of the motor enclosure and, in addition, the diaphragm means is preferably arranged so that the entire motor enclosure functions as a float control.

With the sump pump arrangement comprising my earlier invention the pump is automatically turned on when the water in the sump reaches a predetermined maximum level sufficient to deflect the diaphragm means and actuate the control switch. The pump continues to operate until the water in the sump recedes to a minimum level such that the head of water in the sump is insufficient to deflect the diaphragm means or lift the float whereupon the control switch ultimately returns to its normal off position. Thus, it will be seen that the device functions to maintain the water in the sump at a certain minimum level but in no case is the sump actually pumped to substantial emptiness.

In my copending application S. N. 211,544, filed February 17, 1951, now U. S. Patent No. 2,625,107, issued January 13, 1953, I have described and claimed a control means adapted to be used in combination with a sump pump arrangement of the type disclosed in my earlier copending application for the purpose of insuring continued operation of the pump until the sump is substantially dry. The present invention relates to a different type of control means for accomplishing the same general result.

Accordingly, a primary object of my invention is to provide a novel sump pump arrangement adapted to empty a sump or the like to substantial dryness.

A further object of the invention is to provide novel auxiliary control means for a float controlled sump pump which insures continued operation of the pump for a predetermined time after the level in the sump falls below the minimum level for actuation of the float control.

Another object of the invention is to provide a novel submersible sump pump arrangement having a motor enclosure including main control means for the motor and an auxiliary control device adapted to cooperate with the main control means for insuring operation of the pump until the sump is substantially empty.

Other objects and advantages of the invention will become evident from the subsequent detailed description taken in conjunction with the accompanying drawing wherein:

Fig. 1 is a vertical sectional view of a sump pump arrangement comprising one specific embodiment of my invention; and

Fig. 2 is a view similar to Fig. 1 but showing a modified form of the invention.

Referring first to Fig. 1 of the drawing, wherein one specific embodiment of my invention is shown merely by way of illustration, the device comprises an electric motor 6 of a conventional type having a rotor shaft 7 depending therefrom. Disposed below the motor 6 and immediately adjacent thereto is a centrifugal pump unit 8 of a conventional type having an inlet 9 and an outlet 10 and arranged so that the pump casing supports the weight of the motor. The device is shown as disposed at the bottom of a sump 11. The pump impeller, indicated at 12, is secured at the lower end of the shaft 7 and the latter is provided with a suitable rotating seal 13 to prevent entry of water to the motor through the shaft outlet.

Surrounding the motor 6 for rendering the latter submersible is an enclosure, indicated generally at 14, which comprises a cylindrical body portion 16 supported on the motor 6 by means of a pair of substantially identical upper and lower end portions designated generally by the reference numeral 17. The body portion 16 is preferably formed from relatively thin corrosion-resistant metal such as stainless steel.

Each of the end portions 17 of the enclosure 14 comprises a deflectable diaphragm means including a relatively thin annular element 18 which may be of metal. The outer marginal or peripheral edge of each of the elements 18 is turned inwardly toward the motor 6 to provide a flange or rim 19 which is rigidly secured and sealed, preferably by welding, to the inner periphery of the body portion 16 of the enclosure 14. The inner marginal or peripheral edge of each element 18 is turned outwardly away from the motor 6, as at 21, and is flexibly attached to the motor 6 by means of an annular connecting collar, indicated generally at 22. The collars 22 are preferably formed from a resilient material such as rubber or the like and are generally U-shaped in cross-section. Thus, each of the collars 22 is formed with relatively heavy concentric inner and outer ring portions 23 and 24, respectively, which are interconnected adjacent their outermost edges by a relatively thin integral connecting portion 26. The collars 22 are secured to the elements 18 by means of the outwardly turned edges 21 of the latter which are flared outwardly to a slight extent in order to provide a snug engagement with the inner periphery of the collar portions 24. The inner portions 23 of the collars 22 fit snugly around the upper and lower hub portions of the motor 6, as indicated at 27 and 28, respectively.

Thus, the combination of the enclosure 14 with the upper and lower end portions or diaphragm means 17 forms a water-tight casing which renders the motor 6 submersible and at the same time constitutes a float which is free for limited movement in a vertical direction upon flexing of the connecting portions 26 of the collars 22, as hereinafter described.

For automatically regulating the operation of the motor 6, a control switch 29 having a depressible spring-pressed operating member or button 31 is mounted adjacent the upper portion of the motor 6 with the operating button 31 facing the upper annular element 18 in operative relation therewith. The switch 29 is of the toggle or snap action type in which a spring normally urges the toggle arrangement toward one of its over-center positions and a substantial force sufficient to overcome the spring pressure is required to effect movement of the toggle to its opposite over-center position. It will be understood that the enclosure 14, which is sealed to the upper and lower ends of the motor 6 by the end diaphragm means 17, will function as a float when the motor and pump unit are disposed at the bottom of a sump. Thus, as the water level in the sump rises, the enclosure 14 containing trapped air is lifted upwardly relative to

the motor 6 by the buoyant effect of the water, the flexible connecting portions 26 of the collars 22 permitting this upward movement. Upon upward movement of the enclosure 14, the upper element 18 also moves upwardly and permits the operating button 31 to move outwardly under spring action whereby to complete the electrical circuit for the motor 6 and thereby start the pump 8 in operation. Similarly, as the water level in the sump recedes during operation of the pump 8, the weight of the enclosure 14 causes the latter to move downwardly whereupon the upper element 18 engages the switch button 31 and ultimately the force applied to the button 31 depresses the latter to shut off the motor.

Means comprising a bridge member and guide screws (not shown in detail in the drawing) is provided at the upper end of the motor for guiding and limiting the vertical movement of the float enclosure 14 relative to the motor 6. Details of this structure are described fully in my aforementioned Patent No. 2,662,206 and need not be repeated here. A dome-shaped cover 32 is detachably mounted over the upper end of the device with the depending skirt portion thereof fitting over and frictionally engaging the upper end of the body 16 of the enclosure 14, as at 33. A handle 34 is fastened to the cover 32 for raising and lowering the entire unit. Suitable electric wires, indicated at 35, are also provided for conducting electric current to the switch 29 and the motor 6, the wires 35 entering the motor enclosure through suitable seal means (not shown).

As the motor 6 heats up during operation, the temperature of the air trapped inside of the enclosure 14 may vary as much as 50° C. Under such circumstances it is desirable to compensate for varying air pressure in order to avoid the possibility that an increase in air pressure inside the enclosure might cause movement of the enclosure relative to the motor and thereby effect the operation of the device independently of any change of water level. However, the provision of substantially identical diaphragm means 17, i. e. diaphragm means having substantially the same exposed areas, at the top and bottom of the cylindrical portion 16 of the enclosure 14 balances out the effect of varying air pressure within the enclosure and leaves the upward and downward movement of the enclosure 14 dependent solely upon external pressure. In other words, even if the pressure of the air surrounding the motor 6 and within the enclosure 14 should increase, the net force tending to move the enclosure 14 relative to the motor 6 will be zero because the force acting against the upper diaphragm means 17 tending to move the enclosure 14 upwardly will be counteracted by a substantially identical force acting against the lower diaphragm means 17 tending to move the enclosure 14 downwardly. The cover 32 is provided with suitable means (not shown) for permitting drainage of water from the space between the cover 32 and the upper diaphragm means 17 and also for preventing air from being trapped in this space.

From the foregoing description it will be seen that the main control means for the sump pump unit comprises the diaphragm means 17 which are deflectable in response to changes in liquid level outside the enclosure 14 for actuating the control switch 29. With this main control means alone the pump shuts off at a predetermined minimum water level in the sump which corresponds to the level at which the buoyant or lifting effect is lost and the weight of the float 14 shuts off the switch 29. Such operation is satisfactory in many cases, but in other situations it may be desirable to have the sump emptied to substantial dryness. The primary feature of the present invention involves an auxiliary control means which supplements and cooperates with the main control means to insure continued operation of the pump until the sump is substantially empty, as hereinafter described in detail.

Broadly speaking, the auxiliary control means which constitutes the principal feature of my invention comprises an auxiliary liquid receptacle or sump disposed adjacent the lower end of the float enclosure 14 and adapted to maintain a predetermined liquid level therearound for holding the float enclosure 14 in its raised position even after the level in the main sump 11 has receded below the minimum level otherwise required for actuation of the main pump control switch 29. The auxiliary liquid receptacle or sump is provided with an orifice or gravity discharge opening of predetermined size so that the liquid drains from the auxiliary sump rather slowly thereby insuring operation of the pump until the main sump is substantially empty.

Thus, it will be understood that the slowly receding liquid level in the auxiliary sump provides a means for the delayed actuation of the float enclosure 14 and the control switch 29 independently of the liquid level in the main sump 11.

In the embodiment of the invention illustrated in Fig. 1 of the drawing, the auxiliary liquid receptacle or sump is provided by means of an upright wall 36 which extends around the upper portion of the pump housing to define a relatively shallow open reservoir or sump 37. As will be clearly seen from the drawing, the upper end of the auxiliary sump wall 36 extends upwardly beyond the lower end of the float enclosure 14 so that the latter is subjected to the buoyant effect of the liquid level in either the main sump 11 or the auxiliary sump 37. A discharge orifice 38 of predetermined size is provided adjacent the bottom of the auxiliary sump wall 36 to permit liquid to drain slowly from the auxiliary sump 37. By proper selection of the size of the orifice 38, it will be understood that the drainage time for the auxiliary sump 37 can be readily controlled in order to obtain continued operation of the pump for a sufficient period of time to empty the main sump 11.

When the water level in the main sump 11 is relatively high such as to cause the float enclosure 14 to be lifted upwardly and thereby actuating the switch 29, the water contained in the auxiliary sump 37 will have no particular effect on the operation of the unit since the effect of the high water level in the main sump is sufficient to keep the pump in operation. However, as the water level in the main sump 11 recedes, the tendency is for the float enclosure 14 to move downwardly, as described above, with the result that the switch 29 would eventually be shut off if there were no other force acting on the float enclosure 14. By means of the present invention when the water level in the main sump 11 recedes below the upper end of the auxiliary sump wall 36, the buoyant effect of the liquid retained within the auxiliary sump 37 continues to urge the float enclosure 14 upwardly thereby insuring continued operation of the pump unit 8 until the level in the auxiliary sump 37 becomes so low that it no longer actuates the float enclosure 14. During this continued or prolonged operation of the pump unit 8, the main sump 11 is pumped to substantial emptiness and ultimately the float enclosure 14 moves downwardly to shut off the motor.

As previously mentioned, the size of the auxiliary sump 37 and the drainage orifice 38 will of course be proportioned in accordance with the size of the main sump 11 so that the prolonged period of operation of the pump unit 8 is adequate to permit the main sump 11 to be substantially emptied. The relatively small amount of water which will continue to drain from the auxiliary sump 37 into the main sump 11 after the motor 6 has been shut off will be relatively inconsequential. As a practical matter, the effect of the auxiliary sump arrangement is to impart a time delay in the operation of the pump unit, and the auxiliary sump and its discharge orifice can be constructed initially to insure prolonged operation of the pump unit 8 for a sufficient time to drain the maximum size sump in which the unit is likely to be installed.

Fig. 2 of the drawing illustrates a slightly different means of dicharging liquid from the auxiliary sump, the structure of the unit being otherwise the same as in Fig.

1. The same reference numerals are employed in Fig. 1 and Fig. 2 to illustrate similar parts of the devices. In this form of the invention the discharge orifice, indicated at **39**, is provided in the bottom wall of the auxiliary sump which also constitutes the upper wall of the pump housing. In addition, the orifice **39** is positioned substantially above the outer periphery of the impeller **12**. When the pump is in operation, it will be understood that as long as sufficient liquid is present in the main sump **11** to be drawn in through the suction **9** of the pump unit, there will be little or no tendency for liquid to drain by gravity from the auxiliary sump **37** through the orifice **39**. The fluid pressure of the liquid within the pump chamber under the centrifugal influence of the rotating impeller **12** will ordinarily be greater than the pressure induced by the small head of water in the auxiliary sump **37** so as to prevent drainage of liquid from the auxiliary sump **37** through the orifice **39**. However, after the main sump **11** has been pumped to substantial dryness, the pumping chamber of the pump unit **8** will be empty and liquid can then readily drain from the auxiliary sump **37** through the discharge orifice **39** until the auxiliary sump level is low enough to permit the float enclosure **14** to shut off the motor **6**. Thus, in this embodiment of the invention the auxiliary sump is drained only after the water in the main sump has been removed to substantial emptiness.

As a result of the combination of the main control means comprising the deflectable diaphragm and the auxiliary control means constituting the principal feature of the present invention, I am able to control the operation of the pump to insure that the sump is pumped to substantial dryness. The main control means functions primarily to reduce the water level in the sump to a certain minimum point and thereafter the float enclosure surrounding the pump motor is actuated by the liquid retained in the auxiliary sump. Consequently, it may be said that the main control means functions in response to changes in liquid level in the sump, whereas the auxiliary control means functions independently of the liquid level in the sump. Thus, the auxiliary control means constitutes an important adjunct to a submersible sump pump of the type described in the present application and in my earlier copending application. This feature is of particular importace in a situation wherein it is desirable to maintain a sump in a substantially dry condition rather than merely maintaining the water level at some predetermined minimum.

Although the invention has been described in connection with certain specific structural embodiments, it will be understood that various modifications and equivalent structures may be resorted to without departing from the scope of the invention as defined in the appended claims.

I claim:

1. In a motor driven sump pump adapted to be disposed at the bottom of a sump, a pump unit, an electric motor connected to said pump unit, a casing structure around said motor to render the same submersible, a control switch for said motor within said casing structure, said casing structure including diaphragm means disposed in operative relation with said switch and deflectable in response to changes in liquid level outside said casing structure for actuating said switch, and an auxiliary liquid chamber having an upright wall with a fully open top and disposed around the lower portion only of said casing structure for maintaining a quantity of liquid around said lower portion independently of the liquid level in the sump, said chamber having a discharge opening adjacent the bottom thereof for permitting liquid to drain slowly from the chamber after the liquid level in the sump has receded below its minimum effective level whereby the liquid in said auxiliary chamber effects prolonged operation of the pump to permit pumping of the sump to substantial emptiness.

2. The device of claim 1 further characterized in that said discharge opening is provided in the upright wall of said chamber to permit liquid to drain from the chamber into the sump.

3. In a motor driven sump pump adapted to be disposed at the bottom of a sump, a pump unit, an electric motor connected to said pump unit, a control switch for said motor, casing structure around said motor to render the same submersible, main control means for said pump unit comprising a flexible diaphragm constituting an end portion for said casing structure and deflectable in response to changes in liquid level outside said casing structure for actuating said switch, and auxiliary control means comprising an open liquid reservoir with a fully open top and an upright wall disposed around the lower portion only of said casing structure and adapted to maintain a supply of liquid therearound independently of the liquid level in the sump, said reservoir having a discharge opening permitting liquid to drain slowly therefrom whereby the liquid level in said reservoir is adapted to effect deflection of said diaphragm after the liquid in the sump has receded below its minimum effective level whereby to effect prolonged operation of the pump unit until the sump is substantially empty.

4. In a motor driven sump pump adapted to be disposed at the bottom of a sump, a pump housing containing a pump, an electric motor mounted above the pump housing and connected to the pump, a casing structure surrounding the motor to render the same submersible, a control switch for said motor within said casing structure, said casing structure including diaphragm means disposed in operative relation with said switch and deflectable in response to changes in liquid level outside said casing structure for actuating said switch, and an upright wall extending from the upper portion of said pump housing and having a fully open top disposed in radially spaced relation around the lower portion only of said casing structure whereby to define an auxiliary liquid reservoir adapted to contain a supply of liquid in operative relation around the lower portion of said casing structure and independently of the liquid level in the sump, said reservoir having a discharge opening permitting liquid to drain slowly therefrom whereby the liquid level in said reservoir is adapted to effect deflection of said diaphragm means after the liquid in the sump has receded below its minimum effective level whereby to permit prolonged operation of the pump until the sump is substantially empty.

5. In a motor driven sump pump adapted to be disposed at the bottom of a sump, a pump, an electric motor connected to said pump, a casing surrounding said motor to render the same submersible, a control switch for said motor within said casing, said casing including diaphragm means disposed in operative relation with said switch and deflectable in response to changes in liquid level outside said casing for actuating said switch, and structure defining a housing for said pump and an auxiliary liquid reservoir around the lower portion of said casing, said reservoir being adapted to maintain a liquid level around the lower portion of said casing independently of the liquid level in the sump, and said structure having a fluid passage between said reservoir and the interior of said pump housing to permit liquid to drain from the reservoir into the pump housing.

6. The device of claim 5 further characterized in that said pump comprises a rotating impeller and said fluid passage opens into said pump housing adjacent the periphery of said impeller.

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