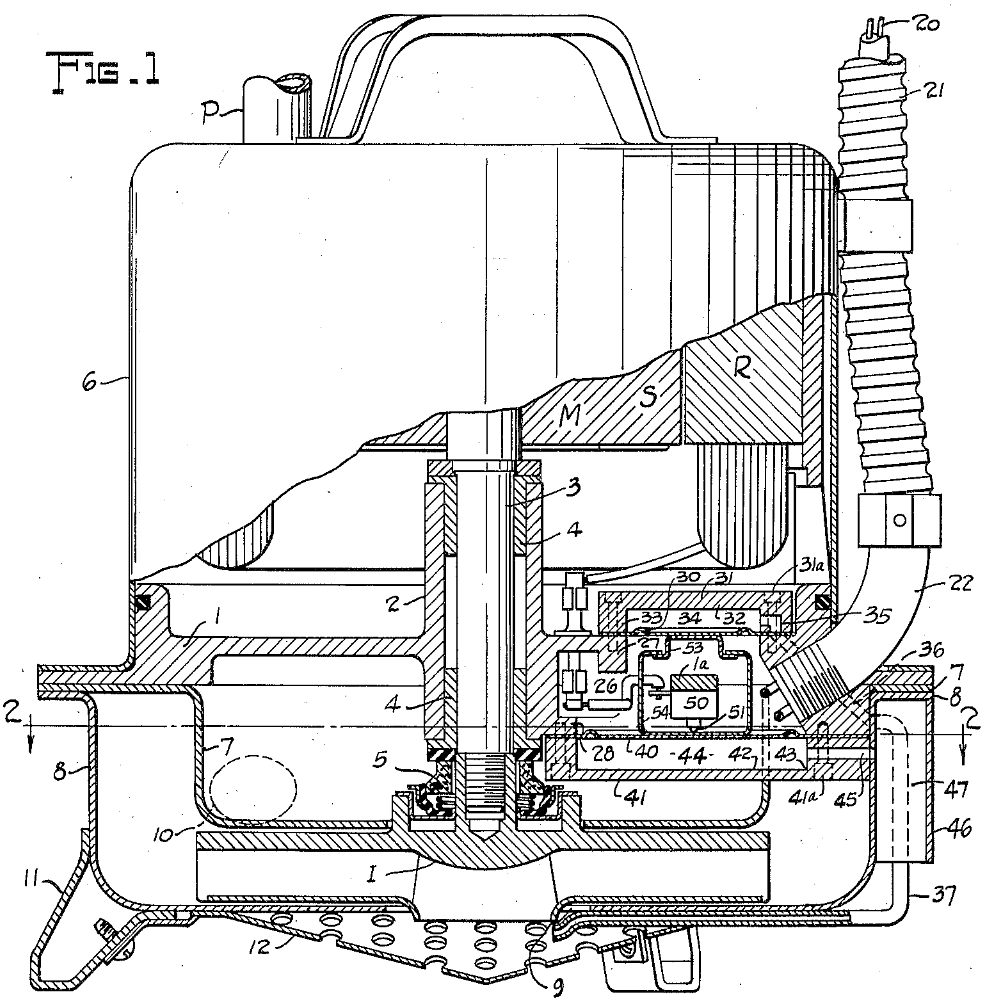
Jan. 31, 1961 H. W. KAATZ 2,969,740

PUMP CONTROL

Filed May 27, 1957 2 Sheets-Sheet 1

FIG. 1



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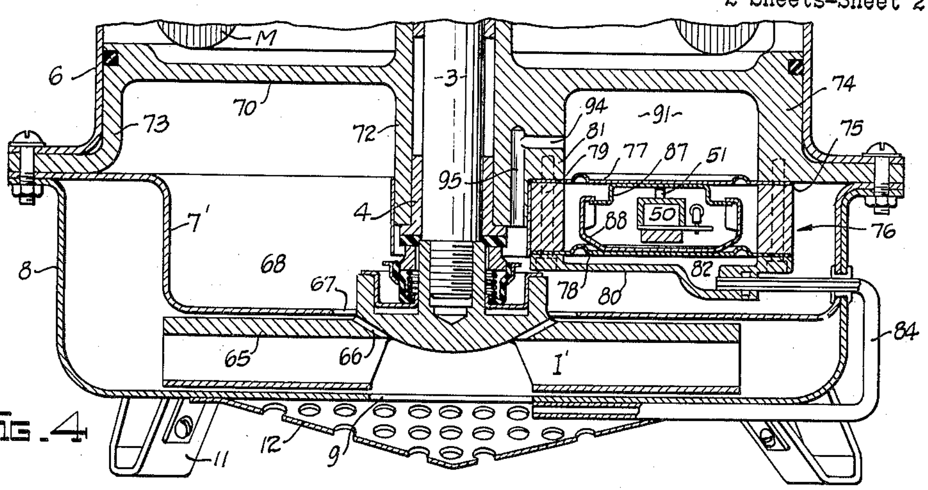

FIG. 4

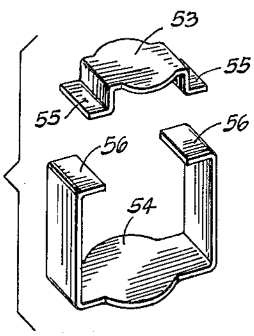

FIG. 3

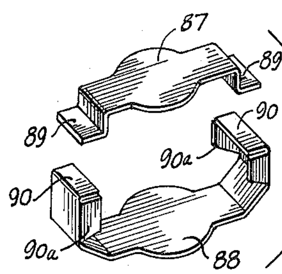

FIG. 5

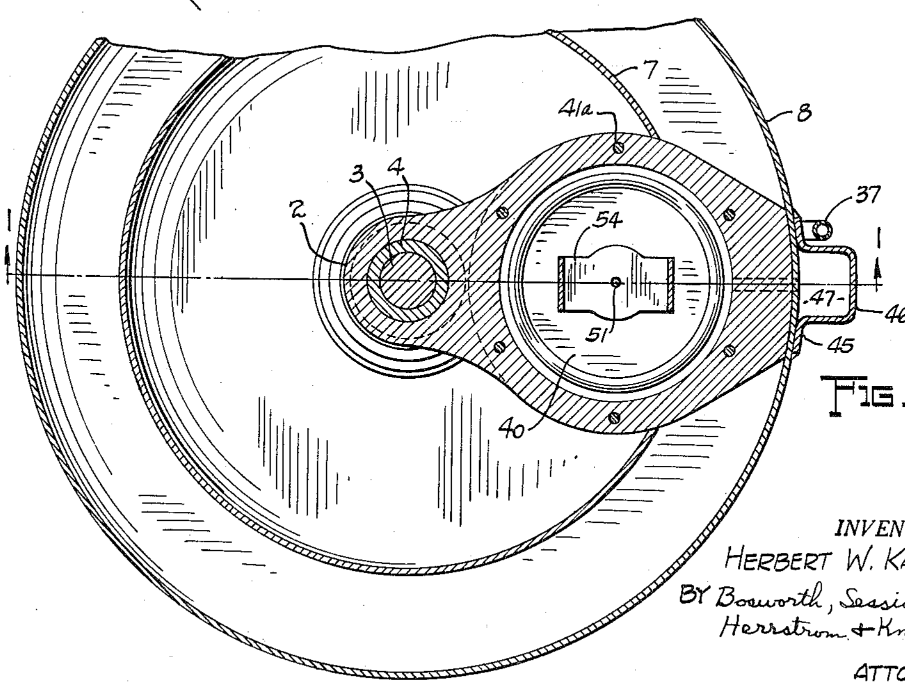

FIG. 2

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PUMP CONTROL

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This invention relates to submersible pumps and controls and more particularly to methods and means for automatically controlling the operation of such a pump in response to static and pumping pressures.

A general object of this invention is to provide an efficient, fool-proof, compact and automatic pump control. A further object is to provide a control for submersible pumps which may be located within the pump housing and integrated with the pump structure. Another object is to provide a pump control responsive to a predetermined level of the liquid to be pumped to actuate the pump and to the vacuum developed at the eye of the pump impeller when the pump is operating for controlling the operation of the pump after its actuation. A further object is the provision of a pump control which is responsive to the vacuum developed at the eye of the pump impeller during the operation of the pump to control the operation of the pump after the pump has been actuated and which more specifically responds to impeller eye vacuum when liquid is being pumped to maintain the pump in operation and to a reduction in such vacuum consequent upon the pumping of air to deactuate the pump.

Other objects include the provision of a submersible pump control which is breatherless, that is, a submersible control which operates in a sealed chamber and does not require a breather tube or the like to communicate air to the control chamber; the provision of a pump control responsive to static pressure to actuate the pump in which the impeller eye vacuum is utilized to relieve the actuating pressure; the provision of a submersible pump control which is preserved from corrosion and like effects of water and damp conditions and therefore has a long life and requires little service; and the provision of a pressure responsive pump control adapted to accomplish one or more of the aforesaid objects.

These and other objects and advantages of my invention will appear from the following description of preferred and modified embodiments thereof, reference being made to the appended drawings in which:

Figure 1 is a vertical section of a pump control embodying my invention together with the pump with which it is associated.

Figure 2 is a horizontal section taken along the line 2—2 of Figure 1.

Figure 3 is a perspective view of a part of the control shown in Figure 1.

Figure 4 is a vertical section of a pump control embodying a modification of my invention together with a portion of the pump with which it is associated.

Figure 5 is a perspective view of a part of the modified control of Figure 4.

Referring now to the drawings and particularly Figures 1 and 2 thereof, a pump control embodying the preferred form of my invention is shown as an integral part of the motor pump unit which it is to control, although it is to be understood that my control may be used with other motor pump units and other motor pump units

may be adapted for use with my control and further that a control embodying my invention may be secured to the outside of or be housed separately from the motor and be operatively connected therewith by suitable ports, pipes and/or conduits.

Briefly the motor pump unit shown comprises a motor M having a stator S and a rotor R mounted for operation on the upper side of a one-piece rigid base member 1. The member 1 has a central post 2 bored to permit motor shaft 3 to extend therethrough to engage and drive the pump impeller I on the lower side of the base member. Suitable bearings 4 disposed within the bore of the central post support the rotor and maintain alignment of the running parts of the pump. The impeller I is vertically spaced from the base member as shown and the lower end of the shaft is sealed to the base member by a running seal indicated generally at 5.

The motor is sealed within a bell-shaped motor casing or housing 6 which extends over the entire motor and is secured at its lower end to and in water-tight relation with the upper side of the base member 1. Dish shaped shroud guard 7 and impeller cover 8 are secured to the under side of the base 1. The cover 8 surrounds the impeller and defines the volute, and the shroud guard 7 closely overlies the back shroud of the impeller I thereby protecting against unnecessary eddies and cross-currents within the volute and increasing the efficiency of the pump. An inlet opening 9, through which the liquid to be pumped is drawn, is provided in the cover 8 adjacent the eye of the impeller and a discharge outlet 10, through which the liquid is discharged into a suitable pipe P, is provided in the side wall of the cover 8. The pump motor unit is supported on suitable legs 11 and a screen 12 protects the inlet opening 9 and prevents debris from reaching the impeller.

Power is transmitted from a suitable source to the motor through wires or leads 20 in a flexible water-proof cable 21 connected by a fitting 22 to the side of the base member 1, the mechanical connections of the power cable to the pump unit being properly sealed to make the whole pump unit submersible. The power leads are connected to the motor through an automatic pressure responsive control system preferably carried on the underside of the base member which is the subject of the present invention.

A preferred form of pump control to which my invention is addressed is shown in Figures 1 and 2 and is conveniently although, as previously noted, not necessarily located within the housing of the pump which it controls. As shown in Figures 1 and 2 my control is adapted to actuate the motor pump unit in response to the static pressure of a predetermined liquid level, to maintain the pump actuated in response to the negative pressure or vacuum developed at the eye of the impeller while liquid is being pumped and to deactuate the pump in response to the reduction of the vacuum or negative pressure when the pump begins to pump air.

The portion of the base member 1 which is viewed at the right in Figures 1 and 2 is formed with an opening 26 the upper end of which is defined by an annular section 27 and the lower end by a similar section 28. The diameter of the opening 26 at the upper end, that is, the inside diameter of section 27, is substantially smaller than the diameter of the lower part of the opening at section 28 for reasons which will appear more fully below. The upper part of opening 26 is closed by a pressure sensitive diaphragm 30 secured along its marginal edges to the section 27 by a cap 31 and screws 31*a*, the end wall 32 of the cap being vertically spaced from the diaphragm. The side wall 33 of cap 31 together with its end wall 32 and the diaphragm define a vacuum chamber 34 on the top side of the diaphragm. In order that the pressure in chamber 34 may substantially correspond to the pressure at the eye of impeller I, chamber 34 communicates with the intake of the pump by means of channel 35 in cap 31, transverse passage 36 in base member 1 and cover 8 and tube 37 which opens adjacent the inlet and impeller eye.

The lower end of opening 26 is closed by flexible diaphragm 40 sealed against and secured to the lower annular section 28 by a cap 41, similar to cap 31, and screws 41*a*. The end wall 42 of cap 41 is vertically spaced from the diaphragm 40 and together with the cap side wall 43 and diaphragm 40 defines a static pressure chamber 44. Passage 45 in the cap wall and cover 8 provides communication between the chamber 44 and the exterior of the motor pump unit. A downwardly opening skirt 46 is secured to the exterior of the cover 8 and surrounds the open end of passage 45. Rising liquid traps air within the skirt and the static pressure of the liquid is communicated to the chamber 44 by the trapped air.

A motor control switch 50, preferably of the normally-open single-throw type with a spring loaded operating plunger 51, is supported on an integral projection 1*a* of the base member 1, within the opening 26, between the upper diaphragm 30 and the lower diaphragm 40 with its operating plunger extending downwardly in operative relation with the static pressure responsive diaphragm 40. The switch 50 is connected in electrical series with the power source and motor M and the plunger 51 functions to close the switch and circuit when depressed and to open the switch and circuit when released.

In order that plunger 51 and switch 50 be responsive to forces exerted by both diaphragms 30 and 40, a two-piece saddle assembly, see Figure 3, comprising an upper inverted U-shaped part 53 and lower U-shaped part 54 is disposed around, that is, circumscribes switch 50. The upper part 53 has lower out-turned side flanges 55 which underlie and are separable from corresponding in-turned upper flanges 56 on part 54. The base portion of upper part 53 is secured as by gluing or otherwise to the central portion of diaphragm 30, and the base portion of lower part 54 passes under plunger 51 and is similarly secured to diaphragm 40. Accordingly the parts of the saddle 53 and 54 will engage and transmit force and movement to each when the diaphragms are displaced away from each other by the forces acting on the respective diaphragms with a net movement in the direction of the greater force, but will disengage and have no effect on each other when the diaphragms are displaced toward each other.

Consequently, lower static pressure responsive diaphragm 40 and lower saddle part 54, which are in operative relation with plunger 51, may move upwardly and depress the plunger even though upper impeller eye vacuum responsive diaphragm 30 be in equilibrium or displaced downwardly by the differential pressures across it, but may only be displaced downwardly by the release force of plunger 51 when not restrained against such downward displacement by upper diaphragm 30 acting through the saddle. Correspondingly only upward displacement of diaphragm 30 in response to the differential pressure across it is transmitted by the saddle parts 53 and 54 against the release force of the plunger 51, although a relaxation of such upward displacement may, by reducing the force acting against the plunger, permit the same to extend or open without directly acting thereon.

Lower diaphragm 40 is therefore adapted to depress switch plunger 51 in response to static pressure of the liquid to be pumped acting on the underside thereof via skirt chamber 47, passage 45 and chamber 44 and upper diaphragm 30 is adapted, acting through saddle parts 53 and 54, to maintain the plunger depressed or "on" in response to the partial vacuum or negative pressure developed at the eye of the impeller when liquid is pumped acting on the upper side thereof via tube 37, passages 36 and 35, and chamber 34.

The lower diaphragm 40 has an effective area such that the diaphragm, in response to the static pressure of the predetermined height of liquid level at which the pump is to be actuated, will exert a force sufficient to overcome the combined force resulting from the operating force of the switch and the weight of the saddle part 54. The upper diaphragm 30 has an effective area such that the diaphragm, in response to the vacuum developed at the eye of the impeller when the pump is pumping liquid will exert a force greater than the combined force resulting from the operating force of the switch, the weight of the saddle parts and the resistance of diaphragm 40 to displacement by the saddle part 54, but, in response to the vacuum developed when the pump is pumping air, will exert a force less than the said combined force.

In operation, a motor pump unit, having associated therewith a preferred embodiment of my control, is placed, for example, in a substantially dry sump with the switch 50 open and the motor at rest. As water collects in the sump, the level thereof rises enveloping the lower edge of skirt 46 and trapping air in chamber 47. Thereafter continued rising of the water level causes the pressure of the trapped air in chamber 44 to increase proportionately with the head or static pressure of the sump water. Lower diaphragm 40 being responsive to the pressure in chamber 44 then exerts a continually increasing upwardly directed force on switch plunger 51. When the force exerted by diaphragm 40 is sufficient to overcome the counterforce of the spring effect of switch 50 plus the weight of the saddle part 54, plunger 51 is depressed closing switch 50 and the circuit and actuating the pump. The static pressure also acts upon diaphragm 30, via tube 37, passages 36 and 35 and chamber 34 but this pressure has no effect on plunger 51 as it displaces the diaphragm 30 toward diaphragm 40.

In a given control, the diaphragm area, switch operating force, and weight of the saddle assembly is fixed, hence hydrostatic pressure or depth of the liquid to be pumped is the only variable affecting the initial actuation of the switch. The level at which the control actuates the pump is conveniently predetermined during manufacture by varying the diaphragm area, switch spring rate and/or weight of the saddle assembly or, alternatively, means may be incorporated in the control for varying the resistance to response of diaphragm 40 and therefore the force (liquid level) necessary to displace the diaphragm to depress the plunger.

With the motor energized, the pump operates to pump liquid from the sump. Immediately the level of liquid in the sump drops reducing the static pressure on lower diaphragm. Simultaneously, however, a partial vacuum or negative pressure is developed at the eye of the rotating impeller and is communicated to the chamber 34 above upper diaphragm 30 by means of tube 37, passage 36 and passage 35, and acts upon diaphragm 30. Since the pressure above diaphragm 30 thus becomes substantially less than the pressure under the same diaphragm, an upward force is transmitted by diaphragm 30 through saddle parts 53 and 54 to switch plunger 51 to hold the switch in the "on" position. Impeller eye vacuum thus becomes the condition to which the control is responsive for keeping the motor circuit closed, and the pump will continue to operate as long as that vacuum is present, that is, as long as the impeller pumps liquid.

As the pump continues to operate, the level of the water in the sump drops till it reaches the plane of the intake opening 9 in the bottom of the impeller casing. Thereupon the water seal breaks, the impeller begins to draw air and the vacuum at the impeller eye is substantially reduced. The pressure within the chamber 34 above diaphragm 30 abruptly rises so that the differential pressure across diaphragm 30 is reduced, the force exerted by the diaphragm **30** on switch plunger **51** falls below that required to maintain the plunger depressed whereupon it extends, opening the switch and circuit and deactuating the motor. The control and pump are thus reset and ready for another pumping cycle.

It will be noted that operation of the control is fully automatic and insures substantially complete removal of liquid from the place being serviced provided the pump unit rests on the bottom thereof. If the user desires that the volume of liquid in the collection area should not be reduced below a predetermined amount, the pump unit can be elevated from the bottom correspondingly and by suitable supports to satisfy the needs of the user. The control is protectively integrated with the rigid sturdy pump structure so that the sensitive pressure responsive components cannot be damaged through handling or tampering. The controls are isolated from deleterious contact with the liquid and are preserved from deterioration from such causes.

A modified form of my invention is shown in Figure 4 together with a pump motor unit which is substantially similar to that shown in Figures 1 and 2, and like reference characters refer to like parts. In this instance however the back shroud **65** of the impeller **I′** is pierced or formed with a plurality of pressure relief or bleed holes **66** adjacent the hub of the impeller and leading from the eye and the shroud guard **7′** is formed with a central opening **67** of sufficient diameter to permit the bleed holes **66** to communicate with the space **68** above the guard, which functions to reduce recirculation of the pumped fluid across the back of the impeller and through the bleed holes, as well as to eliminate eddies and crosscurrents above the impeller. This structure permits the partial evacuation of the space **68** during operation of the pump thereby reducing the thrust on the bearings and increasing the efficiency of the pump. This form of my control is especially adapted for use with a pump having an impeller with bleed holes and an overlying shroud guard although it may also be adapted for use with other pumps.

The modified control also has two pressure sensitive diaphragms acting on a single motor switch, as described above, and is also responsive to the hydrostatic pressure of a predetermined level of the liquid to be pumped to actuate the pump, but in this modification the impeller eye vacuum developed during operation of the pump is used both to control the pump after actuation and to relieve positively the initiating static pressure.

The base member **70** on which the motor is mounted generally conforms to the shape of the base member **1** described above and has a continuous annular horizontal portion conveniently formed integral with the central post **72** and side wall **73**. The underside of the right, as viewed, portion of the base member is formed with a cylindrical section **74** on the bottom surface **75** of which the motor control assembly **76** is mounted.

The control assembly comprises an upper diaphragm **77** and a lower diaphragm **78** spaced apart by a ring **79**. A bottom cap **80** covers the lower diaphragm and screws **81** secure the cap, ring and diaphragms to the section **74** of the base member. The cap is spaced from the lower diaphragm as shown to form an impeller eye vacuum chamber **82**. A tube **84** leads from chamber **82** through cap **80**, shroud guard **7′** and cover **8** and has its open end adjacent the inlet opening **9** and impeller eye. The tube **84** provides means for communicating the pressures existing at the inlet opening to the chamber **82**.

Motor control switch **50** is supported on an integral projection of diaphragm ring **79** between the diaphragms and is connected in electrical series with the motor and power source as, for example, in the manner described with the preferred embodiment of my invention. The operating plunger **51** of switch **50** is in this instance disposed toward and in operable relation with the upper diaphragm **77**. A saddle assembly consisting of an upper inverted U-shaped part **87** and a lower U-shaped part **88**, see Figure 5, each with interlocking but separable flanges **89** and **90**, respectively, surrounds the switch in the same manner as the saddle described in connection with Figure 1. The upper saddle part **87**, however, is not secured to the upper diaphragm **77** and hence upward movement of the upper diaphragm merely results in separation of the diaphragm and saddle part. The lower saddle part **88** is secured as by gluing or otherwise to the lower diaphragm and hence moves in both directions with the lower diaphragm. Sides or wing pieces **90***a* on the lower part **88** prevent sidewise displacement of flanges **89** on the upper part and thus prevent relative rotational movement between lower part **88** and the floating upper part **87**. As in the preferred form of my invention, force is transmitted between the saddle parts only when they are displaced apart and not when they are displaced toward each other. Accordingly a net displacement of either diaphragm toward the other will have no effect on the other diaphragm or the remote saddle part. Further, in this form of my invention however displacement of the upper diaphragm away from the lower diaphragm will have no effect on the saddle or the lower diaphragm, and displacement of the lower diaphragm away from the upper diaphragm will affect only the upper saddle part and not the upper diaphragm, since the upper diaphragm is not secured to the upper saddle part. Thus the plunger **51** is depressed and the switch and circuit closed in response to a predetermined pressure on diaphragm **77**, and the plunger is maintained depressed by a negative pressure acting on diaphragm **78**, but a pressure on diaphragm **78** or a negative pressure on diaphragm **77** has no effect on the operation of the switch. Therefore the static pressure chamber **91** which overlies the upper diaphragm and is formed by the interior of the cylindrical section **74** may be positively relieved of the actuation pressure as by communication with the eye of the impeller without however causing premature deactuation of the pump. To this end passages **94** and **95** are formed in section **74** and interconnect the chamber **91** with the space **68**, thereby providing means in conjunction with the bleed holes **66** and central opening **67** of shroud guard **7′** for communicating the pressures extant at the impeller eye to the upper diaphragm.

In operation the pump and associated control are disposed, for example, in a sump with switch **50** open and the motor off. As the liquid collects around the pump unit and the liquid level rises, the increasing static pressure of same is impressed on both the upper and lower diaphragms **77** and **78** through the trapped air in the chambers **91** and **82**, respectively, adjacent the diaphragms. The upward movement of the lower diaphragm **78** resulting therefrom merely causes the saddle parts to separate and has no effect on the switch. Downward movement of the upper diaphragm however depresses the switch plunger until, in response to a predetermined head of collected water, the switch turns on and energizes the motor.

As the pumping action starts, suction developed adjacent the intake opening reduces the pressure in chamber **82** under lower diaphragm **78**, and the differential pressure across the lower diaphragm results in a downward force on the lower saddle part **88** which is transmitted to upper saddle part **87** which holds the switch plunger depressed. The same suction likewise reduces the pressure in chamber **91** positively relieving the chamber of the actuation pressure and creating a differential pressure across the upper diaphragm **77** which develops an upward force. However, as previously set forth the latter force will have no effect on the plunger since diaphragm **77** is not secured to the upper saddle part **87**.

When the level of the liquid has been reduced below the plane of the pump inlet opening **9**, impeller **I′** draws air and the impeller eye vacuum is substantially reduced. The pressure in the chamber **82** is correspondingly increased and the differential pressure across the diaphragm 78 substantially equalized, and hence the force exerted by the diaphragm 78 drops below that required to hold the switch plunger depressed. The circuit and switch thereupon open deactuating the pump and the control and pump are ready for another cycle of operation.

Adjustment of controls embodying my invention for operative response to selected heights of sump liquid level may be provided by adjustably pre-loading the static pressure responsive diaphragm by suitable means.

Other modifications, changes and improvements to the above described forms of my invention may occur to those skilled in the art without departing from the scope and precepts of my invention. Accordingly I do not wish my patent necessarily limited to the precise embodiments and modifications of the invention herein particularly described nor in any manner inconsistent with the progress by which my invention has promoted the art.

I claim:

1. In a submersible pump having a motor, an impeller driven thereby, a base plate supporting said motor and impeller and an intake opening, the improvement of a control for turning said motor on and off, said control comprising vertically spaced, opposed first and second pressure sensitive diaphragms, a motor control switch disposed between said diaphragms, a first saddle member secured to the inner surface of said first diaphragm and in operative relation with said switch, a second saddle member secured to the inner surface of said second diaphragm, each said saddle member transmitting its responses to the other only when said saddle members are moved apart, means to communicate the static pressure of the liquid to be pumped to the outer surface of said first diaphragm, and means to communicate the vacuum developed at the eye of the impeller when said liquid is being pumped to the outer surface of said second diaphragm, said control actuating said pump when the liquid to be pumped has reached a predetermined level and deactuating said pump when the level of said liquid has been reduced below the level of said intake.

2. A control for a pump having a motor and an impeller driven thereby, said control comprising vertically spaced first and second pressure sensitive diaphragms, a switch for turning said motor on and off, said switch being disposed in operable relation with said first diaphragm, means interconnecting said diaphragms and transmitting the responses of one diaphragm to the other when said diaphragms are moved apart, means communicating the static pressure of the liquid to be pumped to the side of said first diaphragm away from said second diaphragm, and means communicating the vacuum developed at the eye of the impeller when liquid is being pumped to the side of said second diaphragm away from said first diaphragm, said control actuating said pump when the liquid to be pumped has reached a predetermined level and deactuating said pump when liquid is no longer being pumped.

3. In a submersible pump having a motor, a back shrouded impeller rotatably driven thereby, a base plate supporting said motor and impeller and disposed therebetween, a shroud shield overlying said shroud and defining, with said base plate, a volute sub-chamber, an aperture in said shroud shield and pressure relief holes in said impeller providing communication between the eye of the impeller and said sub-chamber, and having a recess in said base plate, the improvement of a control for actuating and deactuating said pump comprising a first pressure sensitive diaphragm closing said recess and defining together with said recess a static pressure chamber, an annular switch ring, a second pressure sensitive diaphragm vertically spaced from said first diaphragm by said switch ring and defining with said switch ring and said first diaphragm a switch chamber, and a cap member having annular engagement with said second diaphragm and defining with said second diaphragm an impeller eye vacuum chamber, means providing communication between said static pressure chamber and said volute sub-chamber, and means for communicating the vacuum developed at the eye of the impeller when liquid is being pumped to said impeller eye vacuum chamber, a motor control switch having an operating plunger disposed in said switch chamber, substantially U-shaped first and second saddle members disposed in said switch chamber and being in fixed rotational relationship with each other, said saddle members having complementary flanges, the complementary flanges of the said saddle members mutually engaging each other and transmitting force and movement when said members are moved apart and separating and having no control with each other when said members are moved together, said first saddle member being in contact with said plunger and in operable relation with said first diaphragm, said second saddle member being secured to said second diaphragm, said control actuating said pump in response to the static pressure of a predetermined liquid level, maintaining said pump actuated in response to the impeller eye vacuum developed when liquid is pumped and deactuating said pump when liquid is no longer pumped and the vacuum is reduced.

4. A control for a pump having a motor, a back shrouded impeller driven thereby, and pressure relief means for relieving the thrust on said back shroud, said control comprising vertically spaced first and second pressure sensitive diaphragms, means including said pressure relief means for communicating the pressures existing at the impeller eye to the outer surface of said first diaphragm, and means for communicating the vacuum developed at the eye of the impeller when liquid is pumped to the outer surface of said second diaphragm, a switch for turning the motor on and off, means whereby said first and second diaphragms may independently control said switch, said first diaphragm actuating said switch in response to the static pressure of a predetermined liquid head, and said second diaphragm actuating said switch in response to the vacuum developed at the eye of the impeller when liquid is pumped and deactuating said switch when said vacuum is reduced.

5. A pump control for actuating and deactuating a pump adapted to pump liquid and having a motor and an impeller rotatably driven by said motor, said impeller having an eye at which a vacuum is developed when said impeller pumps said liquid, said control comprising a switch chamber in communication with the atmosphere, switch means disposed in said switch chamber and connected in electrical series with said motor for turning said motor on and off, first and second pressure sensitive diaphragm means defining a portion of said switch chamber, means communicating the static pressure of at least a predetermined height of liquid to be pumped to said first diaphragm means, means communicating the pressure at the said impeller eye to said second diaphragm means, and means transmitting the response of said first diaphragm means, to said static pressure of said predetermined height of said liquid to be pumped, to said switch means to actuate said switch means to turn said motor on, transmitting the response of said second diaphragm means, to the vacuum developed at said impeller eye when said liquid is being pumped, to said switch means to maintain said switch means actuated and motor on, said switch means deactuating and turning said motor off when said response of said second diaphragm means is relieved upon reduction of said impeller eye vacuum consequent to said impeller pumping air.

6. The control according to claim 5 wherein said last named means comprises first and second saddle members, said first saddle member being in operable relation with said first diaphragm means and said switch means, said second saddle member being secured to said

second diaphragm means, said saddle members transmitting force and motion to each other when moved apart and having no effect on each other when moved toward each other.

7. The control according to claim 6 in which said first and second saddle members are U shaped and have oppositely turned, interlocking flanges, respectively, and said first saddle member is secured to said first diaphragm means.

8. A control for a submersible pump having a motor, an impeller rotatably driven by said motor, and an intake adjacent the eye of said impeller, said control comprising a housing defining a switch chamber, aligned vertically spaced first and second pressure sensitive diaphragms forming a part of said housing, and a saddle disposed within said switch chamber and interconnecting said diaphragms, said saddle comprising first and second substantially U shaped members, said first and second saddle members being secured to said first and second diaphragms, respectively, said first saddle member having inturned side flanges and said second saddle member having outturned side flanges underlying said inturned side flanges of said first saddle member, said flanges engaging each other and transmitting force and movement of one saddle member to the other when said saddle members are moved apart and separating when said saddle members are moved toward each other, a switch for turning said motor on and off, said switch being mounted in said switch chamber and being circumscribed by said saddle members, said switch having an operating plunger extending therefrom, said plunger being in contact with and operable by said first saddle member, first cap means overlying said first diaphragm, said first cap means having an end wall vertically spaced from said first diaphragm and with said first diaphragm defining a static pressure chamber, means for communicating the static pressure of a predetermined height of liquid to said static pressure chamber whereby to displace said first diaphragm and turn said switch on in response to a predetermined static pressure, second cap means overlying said second diaphragm, said second cap means having an end wall vertically spaced from said second diaphragm and with said second diaphragm defining an impeller eye vacuum chamber, means providing communication between said intake and said impeller eye vacuum chamber whereby to displace said second diaphragm and keep said switch on in response to the vacuum developed at the eye of the impeller when liquid is being pumped and to turn said switch off when the vacuum is reduced consequent to the level of the liquid being reduced below the intake.

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