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ADJUSTABLE AUTOMATIC CONTROL FOR A PUMP

Filed June 8, 1965

2 Sheets-Sheet 1

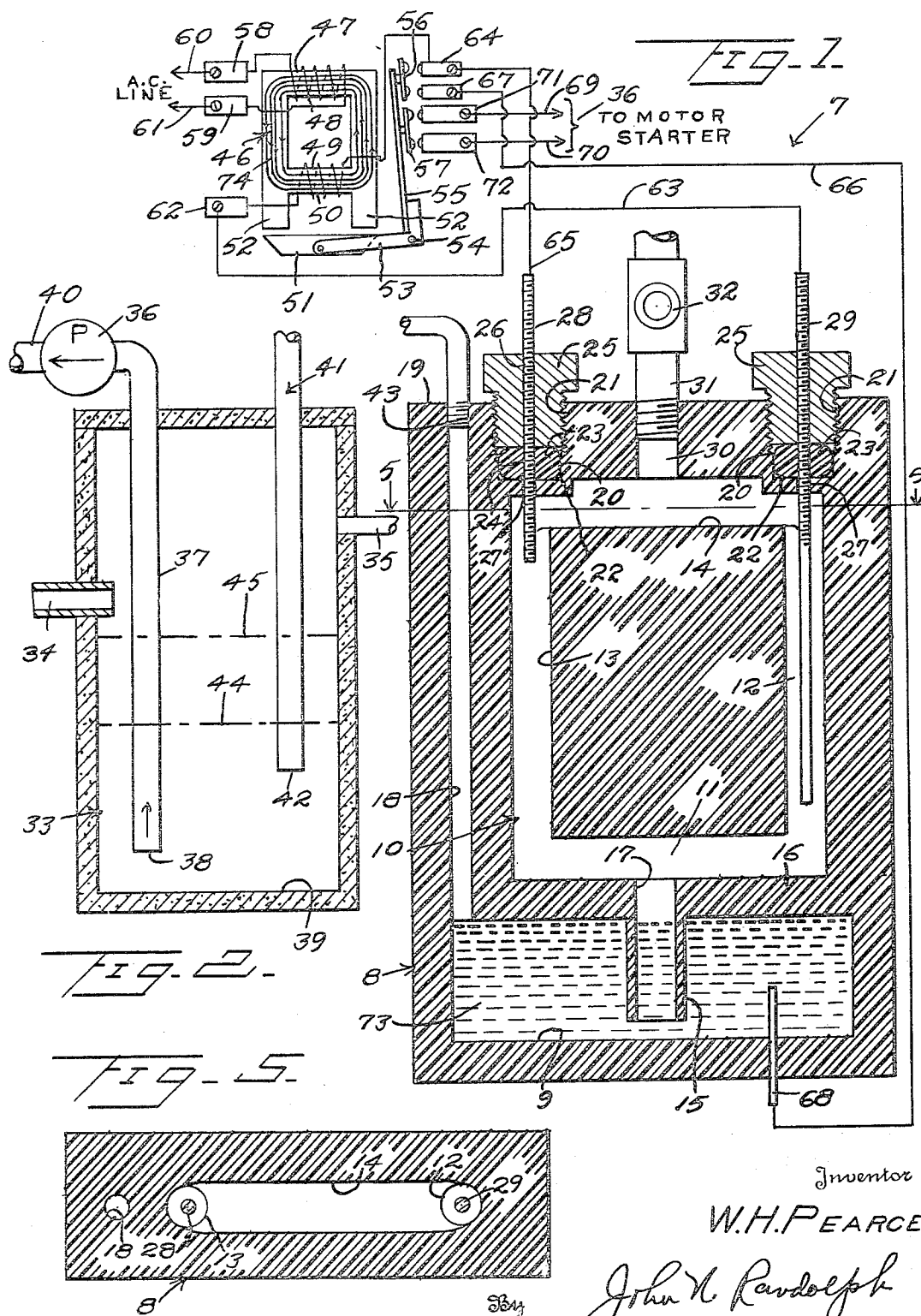


Fig. 2.

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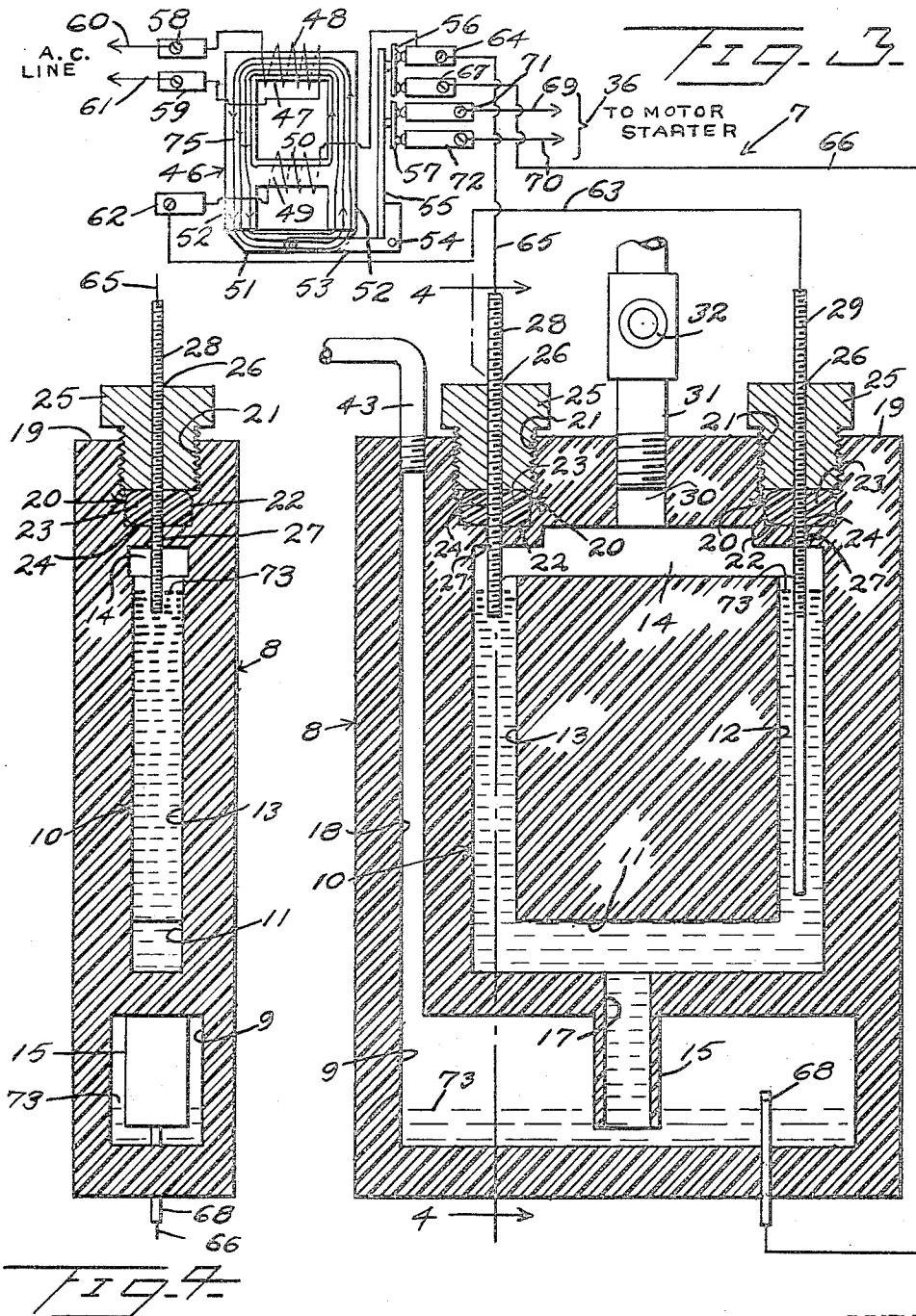
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1

3,303,785 ADJUSTABLE AUTOMATIC CONTROL FOR A PUMP

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This invention relates to an automatic control for a pumping unit, and more particularly to a control which may be manually adjusted to vary the levels at which a liquid to be pumped will automatically effect starting and stopping of a pumping unit associated therewith.

One of the primary objects of the present invention is to provide a control which may be located remote from a receptacle the pump of which is automatically controlled thereby, and wherein the ratio between the specific gravity of two different liquids is utilized in effecting an automatic operation of the control.

A further object of the invention is to provide a control which will visually indicate the liquid level in a receptacle which is disposed remote from the control and which may be located under ground and otherwise concealed.

A further object of the invention is to provide a pump control wherein electric switch contacts through which an electric circuit is completed to an electric pump are not located in the liquid to be pumped and are thereby protected from corrosion.

Various other objects and advantages of the invention will hereinafter become more fully apparent from the following description of the drawings, illustrating a presently preferred embodiment thereof, and wherein:

FIGURE 1 is a vertical sectional view taken substantially along a plane as indicated by the line 1-1 of FIGURE 5, showing the control in an electric circuit interrupting position, including a diagrammatic illustration of the electric system thereof;

FIGURE 2 is a vertical sectional view partly in side elevation and on a greatly reduced scale relative to FIGURE 1, illustrating a receptacle and associated parts, the liquid level within which is controlled by the adjustable automatic pump control;

FIGURE 3 is a view corresponding to FIGURE 1 but showing the control in an electric circuit closing position;

FIGURE 4 is a vertical sectional view through the control taken substantially along the line 4-4 of FIGURE 3, and

FIGURE 5 is a horizontal sectional view taken substantially along a plane as indicated by the line 5-5 of FIGURE 1.

Referring more specifically to the drawings, the adjustable automatic pump control 7 includes a block 8 of electrical insulating material, preferably plastic, having a large cavity forming a reservoir 9 in the bottom portion thereof. The block 8 has a rectangular passage, designated generally 10, disposed above the reservoir 9, including a bottom portion 11, side portions 12 and 13, which extend upwardly from the ends of the portion 11, and a top portion 14 which connects with the upper ends of the side portions 12 and 13 and extends therebetween. The block 8 has a sleeve or tubular portion 15 which extends downwardly from a part 16 thereof which separates the passage portion 11 from the reservoir 9 and which tubular portion 15 terminates above but adjacent the bottom of the reservoir 9. The portion 16 has an opening or bore 17 which communicates with the upper end of the tube or sleeve 15 and with the passage portion 11 and which combines with the tube 15 to form a passage connecting the reservoir 9 to the passage 11. A passage 18 extends upwardly from the reservoir 9 and opens out-

2

wardly from the upper end 19 of the block 8, said passage 18 being disposed at one side of and spaced from the passage 10.

The upper portion of the block 8 is provided with two corresponding upwardly opening sockets 20, one of which is disposed above the passage portion 12 and the other of which is disposed above the passage portion 13. The sockets 20 open outwardly of the upper end 19 of the block and each includes a threaded upper portion 21 and a somewhat restricted lower portion 22. A sealing ring 23, preferably of a yieldable plastic material, is disposed in each socket portion 22 and is provided with a central bore 24. A gland or follower 25 threadably engages in each socket portion 21. Each gland 25 has a centrally disposed threaded bore 26 extending therethrough. The bores 26 align with the bores 24 and with bores 27 which are formed in the block 8 and extend between the passage 10 and the sockets 20.

A threaded rod 28 extends threadably through the bore 26 of one gland 25, through the bore 24 of the packing 23 located therebeneath, and through the bore 27 disposed beneath said packing 23. The lower end of said rod 28 extends into the passage portion 13. A rod 29 extends in the same manner through the other gland 25, the other packing 23 and the other bore 27, into the passage portion 12. The rod 29 is longer than the rod 28 and has its lower end disposed below the lower end of said rod 28.

The upper part of the block 8 has a vent port or passage 30 located between the sockets 20 and which communicates with the passage portion 14 and opens outwardly of the top surface 19 of the block. The lower end of a vent pipe 31 is threadably mounted in the passage 30, and said vent pipe has an open upward end, not shown, opening to the atmosphere. A manual shut-off valve 32 is mounted in the pipe 31 above the block 8.

In order to illustrate one application and use of the adjustable control 7, a receptacle 33, such as a sewer pit, is illustrated in FIGURE 2 and is shown provided with an inlet 34 and an overflow outlet 35 which is disposed above the level of the inlet 34. An electric pump 36 has an inlet conduit 37 communicating therewith which is provided with an inlet end 38 which opens into a receptacle 33, near the bottom 39 thereof. The pump 36 has an outlet conduit 40 leading therefrom. A tube or pipe 41 has one end portion 42 extending downwardly into the receptacle 33, the open end of which opens into said receptacle near its bottom 39. The other end 43 of the pipe 41 is secured and sealed in the upper end of the passage 18, as seen in FIGURES 1 and 3. A broken line 44 represents a low liquid level in the sewer pit or receptacle 33, and a broken line 45 represents a high liquid level therein. The conduit ends 38 and 42 are disposed below the low liquid level line 44 and the inlet 34 and outlet 35 are disposed above the high liquid level line 45.

The electric system of the control 7 is illustrated in FIGURES 1 and 3 and includes a laminated relay core 46 having an upper bar 47 on which a primary coil 48 is disposed, and a lower bar 49 on which is wound a secondary coil 50. An armature 51 is disposed beneath the legs 52 of the core 46 which extends downwardly from the lower bar 49. The armature 51 is connected to one end of a lever 53 which is pivoted at 54. An arm 55 of electrical insulating material is connected to the lever 53, adjacent the pivot 54, and is disposed at an angle to said lever. The arm 55 carries two movable contact bridges 56 and 57.

The ends of the primary coil 48 are connected to two terminals 58 and 59. Conductors 60 and 61 lead from the terminals 58 and 59 to a conventional source of alternating electric current. One end of the secondary coil 50 is connected to a terminal 62 which is also connected

by the conductor 63 to the rod 29. The other end of the secondary coil 50 is connected to a terminal 64 which is also connected by conductor 65 to the rod 28. A conductor 66 connects a terminal 67 to an electrode 68 which extends into the bottom of the reservoir 9. Conductors 69 and 70 which form parts of an electric circuit of the electric motor of the pump 36 are connected to two terminals 71 and 72, respectively.

Reservoir 9 contains mercury, as seen at 73. The tube 41 is filled with air except for the liquid in the end portion thereof which is disposed in the sewer pit 33, between the liquid level therein and the tube end 42. When the liquid level in the sewer pit or receptacle 33 is at approximately the level as indicated by the line 44, substantially no pressure will exist in the tube 41 or the passage 18, and the mercury 73 will be disposed, as seen in FIGURE 1, to substantially fill the reservoir 9 and the sleeve 15. The mercury as thus disposed is out of contact with the rods 28 and 29, which form an upper electrode and lower electrode, respectively, and the armature 51 will be in its position of FIGURE 1 with the magnetic flux which is set up by the primary coil 48, as indicated by the arrow tipped lines 73 in FIGURE 1, flowing through the lower bar 49. The voltage thus produced in the secondary coil 50 will not cause current to flow through said coil since a circuit is not completed between the electrodes 28 and 29. As the conductor bridge 57 is out of engagement with the terminals 71 and 72, said terminals form an open switch so that the pump motor circuit is maintained deenergized.

Assuming that the valve 32 is in an open position for venting the upper end of the passage 10, as the liquid rises in the sewer pit 33 from its lower level 44, air is compressed in the tube 41 and passage 18 for forcing the mercury 73 to rise through the sleeve 15 and bore 17 into the bottom passage portion 11 and thence upwardly through the two legs 12 and 13 of the passage 10. Assuming that the liquid in the sewer pit 33 is water, for each foot that the liquid rises in the sewer pit, the mercury 73 will be caused to rise 0.8826 inch in the bore 17 and passage 10.

The parts of the electric system will retain their positions of FIGURE 1 until the mercury 73 has risen sufficiently in the passage legs 12 and 13 not only to contact the lower electrode 29 but also to contact the upper electrode 28. When this occurs, as seen in FIGURE 3, current will flow through the mercury between the electrodes 28 and 29, through the conductors 63 and 65, the terminals 62 and 64 and the secondary coil 50 to set up a bucking action in the lower bar 49 of the core 46. This will divert the lines of magnetic force to the core legs 52, as indicated by the arrow tipped lines 75 in FIGURE 3, to set up an electrical attraction which will pull the armature 51 into contact with the legs 52, as seen in FIGURE 3. The movement of the armature 51 causes a clockwise swinging movement of the lever 53 and the arm 55 for moving the conductor bridge 56 into engagement with the terminals 64 and 67 and the conductor bridge 57 into engagement with the terminals 71 and 72. The bridging of the terminals 71 and 72 will complete the electric circuit in which the motor of the pump 36 is interposed to effect operation of the pump for extracting liquid from the receptacle 33 through the conduits 37 and 40. The bridging of the terminals 64 and 67 will complete a holding circuit from the electrode 29 through the conductor 63, secondary coil 50, the conductor bridge 56, conductor 66 and the mercury 73 between the electrodes 29 and 68, for maintaining the parts in their positions of FIGURE 3 until the mercury has fallen in the passage 10 to below the level of the lower end of the lower electrode 29 for breaking the electrical connection between electrodes 29 and 68, so that the armature 51 can return to its position of FIGURE 1. The armature 51 will remain in its position of FIGURE 1 until the liquid level again rises from approximately the level 44 of FIGURE 2 to the level 45,

to repeat the aforescribed operation. It will be apparent that when the armature 51 resumes its position of FIGURE 1 that the conductor bridge 57 will disengage the terminals 71 and 72 to break the motor circuit, and the conductor bridge 56, at the same time, disengages the terminals 64 and 67 to break the electrode holding circuit.

Upper electrode 28 can be adjusted in its gland 25 to vary the location of the lower end thereof in the passage leg 13, thereby regulating the extent to which the liquid can rise in the receptacle 33 before operation of the pump 36 commences. Similarly, the lower electrode 29 can be adjusted in its gland 25 to vary the location of the lower end thereof in the passage leg 12 to thereby vary the extent that the liquid can fall in the sewer pit 33 before the pump ceases to operate.

The valve 32 may be closed so that air will be compressed in the upper part of the passage 10 as the mercury rises therein, to provide another means for adjusting the amount of rise of the liquid level in the sewer pit which must occur before the pump 36 is rendered operative. Likewise, by closing the valve 32 while the mercury 73 is in the upper part of the passage 10, as seen in FIGURE 3, a partial vacuum is created in the upper part of the passage 10 as the mercury falls, resisting downward movement of the mercury for maintaining the pump motor circuit closed until the liquid level in the sewer pit has fallen to below the level 44, and to assist in lifting the mercury in the passage 10 so that it will bridge the electrodes 28 and 29 before the liquid has risen in the sewer pit to the level 45.

The control 7 could also function with the receptacle 33 if it contained different liquids having different specific gravities so as to form layers of the different liquids in said receptacle 33. By utilizing the aforementioned adjustment, the control could be adjusted for removing only one of the kinds of liquids from the receptacle which could be selected at will depending upon whether the conduit end 38 was submerged in the lower liquid or extended only into the upper liquid.

Since the block 8 is formed of a transparent material, the level of the mercury 73 therein may be viewed for determining the liquid level of the receptacle 33, even though said receptacle is located remote from the control 7, underground or otherwise completely concealed.

Since the extent that the mercury rises and falls in the block 8 is only a small fraction of the amount of rise and fall of the liquid in the receptacle 33, due to the differences in the specific gravities of the two liquids involved, the block 8 can be very small in comparison to the receptacle 33.

The block 8 may be formed of halves having recessed faces which are secured together as by heat sealing.

Various modifications and changes are contemplated and may be resorted to without departing from the function or scope of the invention, as hereinafter defined by the appended claims.

I claim as my invention:

1. In combination with a liquid containing receptacle including a liquid inlet and an electric pump for extracting liquid from said receptacle and having an inlet opening into the receptacle; a pump control comprising a block of electrical insulating material, said block being internally recessed, an upper electrode and a lower electrode extending into the recess of the block, a liquid of electrical conducting material partially filling the recess and normally disposed below the electrodes, compressible pressure responsive means communicating with the bottom portion of the receptacle and with a part of the recess of the block for pressuring said part of the recess when the liquid level rises in the receptacle to cause the liquid in the recess to rise into engagement with the lower electrode and thereafter into engagement with the upper electrode, and an electric system having a circuit including the pump motor and said electrodes and which is closed by the liquid of the recess contacting both elec-

5

trodes, said electric system including a third electrode disposed in a bottom part of the recess and forming with said lower electrode a second holding circuit for retaining said first mentioned circuit closed, after the initial closing thereof, until the liquid of the recess moves out of contact with the lower electrode, said recess of the block having a vent opening to the atmosphere and disposed above the upper and lower electrodes, and means for selectively closing said vent for impeding the rise of the liquid in the recess or for impeding the fall of said liquid.

2. In a combination as defined by claim 1, the liquid in said recess having a specific gravity substantially greater than the specific gravity of the liquid in said receptacle whereby the rise and fall of the liquid in the recess is substantially less than the rise and fall of the liquid in the receptacle.

3. In a combination as defined by claim 1, said compressible pressure responsive means comprising a tube

6

containing air and forming the sole connection between said receptacle and the block, whereby said block may be disposed remote from the receptacle.

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