

Jan. 8, 1935.

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1,987,466

PUMP CONTROL

Filed March 6, 1933

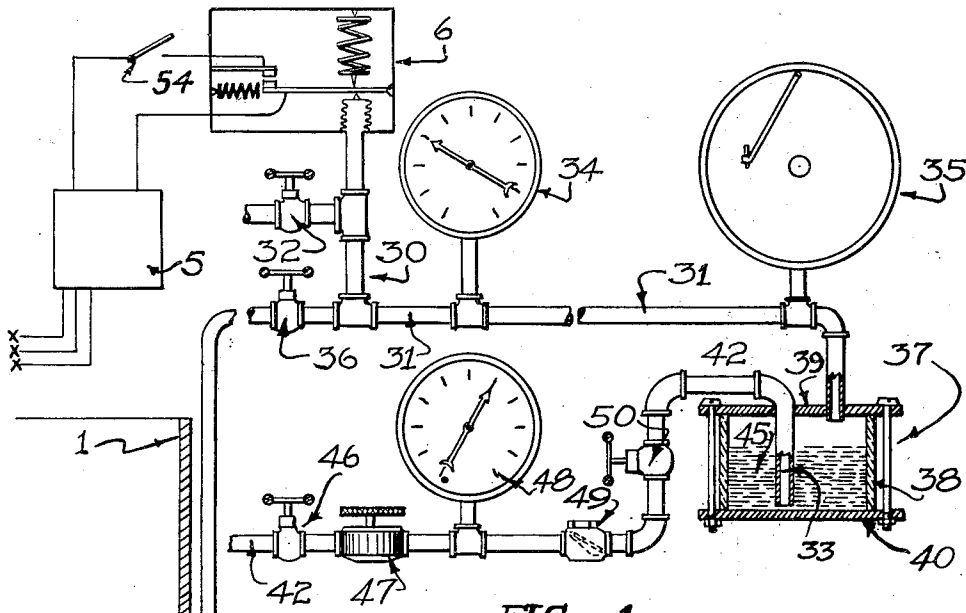


FIG. 1

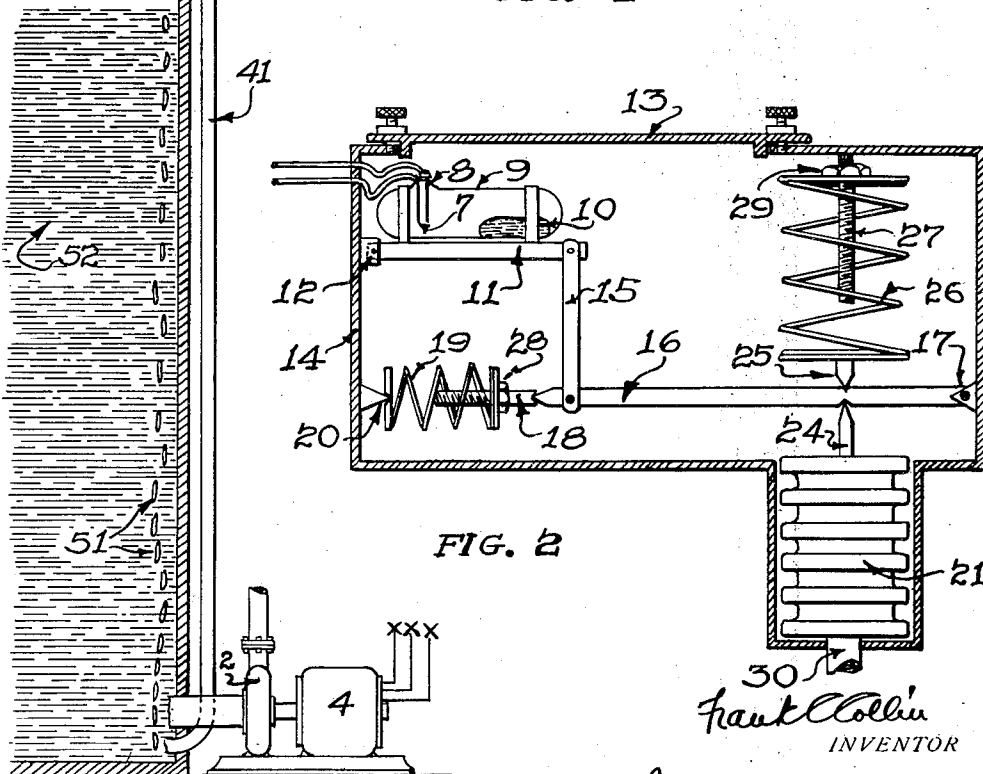


FIG. 2

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1,987,466

PUMP CONTROL

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Application March 6, 1933, Serial No. 659,810

2 Claims. (Cl. 103—25)

The present invention relates broadly to pumping systems and more especially to pump control devices.

The present invention is adapted more especially for use with sewage disposal plants wherein the disposal liquids and solids are received in a well which must be emptied when the liquids therein have reached a predetermined level.

In devices of this character, the apparatus requires setting and adjustment from time to time. Heretofore the control apparatus has been at the well and adjustments were made by observing the height of the liquid in the well and then setting the controls accordingly. This was a very difficult job and usually required at least two operators. The present invention comprises constructions whereby adjustment of the control device may be made remote from the well in the gage house, to operate the pump when the liquids in the well reach predetermined levels. These adjustments can be made independently of the liquid height in the well and may be easily made by one operator.

Another feature of the present invention resides in constructions whereby the control connection in the well is substantially a stationary part which is automatically retained free of fouling with materials in the well by the normal operation of the apparatus.

Referring now to the drawing:

Fig. 1 comprises a diagrammatic illustration of the complete system.

Fig. 2 comprises a schematic illustration of the control and contacts for operating a starting box of an electric motor connected with a pump.

The well 1 is adapted to receive sewage, or other liquid, and to require the liquids and solids to be withdrawn from the well from time to time when the liquids have reached a predetermined height to prevent the well from overflowing. The outlet from the well comprises a pump 2 driven by an electric motor 4, which is under control of a starting box 5 of a type commercially common in the art. The starting box 5 for the electric motor is operated by a pressure control device 6. This pressure control device may be of various forms, but preferably comprises a pair of contacts 7 and 8, extending through an envelope 9 of glass, or other material, containing a quantity of mercury 10, sufficient to immerse the ends of the controls 7 and 8 only when the envelope is tipped to cause the mercury to flow toward the end of the envelope 9 in which the contacts 7 and 8 are mounted. This envelope 9 is mounted on an arm 11 pivoted at 12 to the casing 14 of the control

device, which may be provided with a removable panel 13 to permit access to make necessary adjustments. The arm 11 is connected with the link 15 which is attached to an operating arm 16. This operating arm 16 is provided with a pivot 17, also mounted on the casing 14, and the free end of the operating arm 16 connects with an adjustment rod 18 which is forced against the end of the operating arm 16 by means of an overthrow spring 19 pivoted at 20 on the casing 14. The connection between the overthrow spring 19 and the adjustment rod 18 is preferably a screw thread connection so that an adjustment may be made to control the effective strength of the overthrow spring 19. A syphon bellows 21 is connected with a knife edge post 24 which bears against the lower edge of the operating arm 16. Opposed to the knife edge post 24 is a knife edge stud 25 connected with a regulator spring 26 that is mounted on a screw threaded adjustment post 27 carried by the casing 14, so that the effective strength of the regulator spring 26 may be adjusted. Suitable lock nuts 28 and 29 may be provided for the overthrow spring 19 and the regulator spring 26.

The syphon bellows 21 is connected by pipe 30 with the main pipe 31. A needle throttle-valve 32 opening to atmosphere is connected in the main pipe 30 for the purpose of regulating the effective pressure in main pipe 31 while adjusting the control device to determine the limits through which the control device will operate. The main pipe 31 carries a footage gage 34 and a recording gage 35. The main pipe 31 is also provided with a cut-off valve 36 which is also used during adjustment of the control device, as will later be explained. The main pipe 31 connects with a sight feed chamber 37 having transparent side walls 38 and being hermetically closed by top and bottom members 39 and 40. The main pipe 31 is connected with a well pipe 41, which preferably, is located outside of the well and connects with the interior of the well adjacent the lower portion thereof. By mounting the well pipe 41 outside of the well, the side walls of the well are clear for cleaning and also fouling of the exterior of the well pipe 41 is obviated. However, where wells have been dug and have been in operation the device may be installed by locating the pipe 41 within the well so that the lower open end of the pipe 41 is near the bottom of the well.

A pressure pipe 42, connected with a suitable supply of compressed air (not shown) as is well understood by those skilled in the art, terminates

in an extension 33 which extends beneath the surface of liquid 45 in the sight feed chamber 37. This pressure pipe 42 is provided with a cut-off valve 46 and with an adjustable pressure regulator 47 which may be set to reduce the pressure coming through the cut-off valve 46 to a predetermined pressure on the outlet side of the pressure regulator. The pressure pipe 42 is connected to a pressure gage 48 and is provided with a check valve 49 to prevent back flow of pressure through the sight feed chamber 37. The pressure pipe 42 is also provided with a throttle needle valve 50 so that a predetermined volume of air under pressure may be admitted in a given time through the sight feed chamber into the main pipe 31.

In the operation of the device it may be assumed that the well 1 is forty feet deep, and that the electric motor 4 shall be started to operate the pump 2 to discharge material from the well when the liquid in the well reaches a height of thirty-five feet. The pressure of the liquid in the bottom of the well will depend upon the density of the materials in the well, and in sewerage disposal plants this density may vary slightly from time to time depending upon the character of the materials being received. The pressure on the bottom of the well where the liquid reaches a height of thirty-five feet in the well may vary from fifteen to seventeen pounds, per square inch. An air pressure of, for example, forty-five pounds per square inch may be maintained in the pressure pipe 42 on the inlet side of the pressure regulator 47. This pressure of forty-five pounds per square inch may be reduced by the pressure regulator to maintain a pressure of thirty-five pounds per square inch on the gage 48. The throttle needle valve 50 may be adjusted in such manner as to cut down the volume of flow of compressed air into the sight chamber 37 and into the main pipe 31, so that the volume of flow beyond the needle valve 50 is not sufficient to establish a substantial abnormal back pressure in the main pipe 31. The pressure in the main pipe 31, however, is at all times sufficient to force compressed air through the well pipe 41 in such manner that at all times a substantial volume of air bubbles 51 flow through the liquid 52 in the well 1. This construction, utilizing air flowing through the pipe 41 at all times keeps the end of this pipe free from solids and danger of fouling, and where the volume of air through the needle valve 50 is controlled in such manner as to obviate abnormal back pressure, the pressure indicated on the pressure gage 34 on the main pipe 31 will substantially equal the hydrostatic pressure of the liquid 52 in the well 1 at the mouth pipe 41. The pressure in the main pipe 31 may read on the gage 34 and the recording pressure gage 35 will make a permanent record thereof. These gages are preferably arranged to read in feet instead of pounds pressure per square inch, so that the gage 34 and the recording gage 35 may read directly as to substantially the height of liquid in the well 1. The gages may also be scaled to read in pounds per square inch if desired.

Assume that it is desired that the pump 2 shall be operated to commence discharging the contents of the well 1 when the liquid in the well reaches a height of thirty-five feet and that the pump 2 shall stop operations when the liquid in the well has reached a lower level of four feet. In order to adjust the apparatus to operate within these limits, the cut-off valve 36 in

the main pipe 31 is closed. The needle valve 32 in the pipe 30 is then opened until the pressure in the main pipe builds up so that the gage 34 reads just below thirty-feet, thereby producing an artificial pressure in the main pipe 31 equivalent to a hydrostatic pressure of thirty-five feet in the well 1, which pressure is communicated to the syphon bellows 31. The regulator spring 26 is now adjusted so that the arm 16 is almost ready to trip. The needle valve 32 is slightly closed causing the pressure in the main pipe to rise so that the gage 34 indicates full thirty-five feet. The adjustment of the regulator spring 26 should be such as to permit the operating arm 16 to rise and allow the overthrow spring 19 to snap this arm upward, due to the combined effect of the pressure in the syphon 21 and the action of the overthrow spring 19. Thus the adjustment for the high level operation of the pump has been accomplished.

To adjust for the low level, the needle valve 32 is opened to permit escape of pressure from the main pipe 31 until the gage 34 reads just above four feet. The overthrow spring 19 is now adjusted until the action of the regulator spring 26 is nearly sufficient to swing the operating arm 16 in a downward direction against the pressure in the syphon bellows and the effectiveness of the overthrow spring 19. The needle valve 32 is further opened until the gage 34 reads four feet, at which time the adjustment of the overthrow spring 19 should be such as to permit the regulator spring 26 to snap the operating arm 16 in a downward direction to the lower limit of its movements. When the arm 16 snaps upward the mercury 10 in the envelope 9 flows over the contacts 7 and 8, thereby closing the control circuit for the starting box of the motor 4 and permitting the starting box to close the motor operating circuit, thereby starting the operation of the motor. When the arm 16 snaps downward the contacts 7 and 8 are opened and the motor stops.

The limits for the operation of the device having now been set and determined, the cut-off valve 36 is opened full and the needle throttle valve 32 is closed. The system is now ready for operation, and when the liquids in the well rise to thirty-five feet the pump will be automatically started and continue operation until the liquids in the well reach four feet, at which time the pump will be stopped and will not resume operation until the liquid in the well again reaches thirty-five feet. The control circuit may be provided with a hand switch 54 so that the motion may be cut out if desired.

The present invention has the advantage of permitting complete control of a remotely located well and pumping system by manipulation of devices located in the gage house at a distant control board, which board carries the necessary gages for information of the operators of the plant and also the controls for operating the pumps. A very great advantage of the present system resides in the construction whereby the controls may be set and adjusted at the operating board by a single operator without necessity of checking against the liquids in the well.

I claim:

1. A device of the class described comprising in combination, a well to receive liquids, a pump to discharge liquids from said well, an electric motor to drive said pump, a pressure pipe having an open end located adjacent the bottom of said well, valve means to control a volume of compressed air flowing through said pipe to cause

air to be discharged from the lower end of said pipe at a pressure substantially equal to the hydrostatic pressure on the lower end of said pipe, a footage gage connected with said pipe to indicate the pressure in said pipe corresponding to said hydrostatic head, a pressure regulator adapted to regulate the pressure of compressed air fed to said pipe, an adjustable pressure operated switch adapted to start and stop said electric motor at predetermined pressure limits of compressed air in said pipe produced by back pressure of hydrostatic pressure in said well, means to isolate said switch from said hydrostatically produce pressure while said switch is being subjected to the pressure of compressed air from said pipe, and a manually operated control valve to control the compressed air pressure effective on said switch while being so isolated.

2. A device of the class described comprising in combination, a well adapted to receive liquids, a pump operatively connected with said well, an electric motor to drive said pump, a pipe having an open end terminating within the liquid in said well and adapted to supply a continuous stream of fluid under pressure into said well, means to control the volume of said fluid under pressure flowing from the open end of said pipe in such manner that the pressure in said pipe bears a definite relation to the hydrostatic pressure in said well at the open end of said pipe, pressure operated means operatively connected with said pipe and being adapted to start and stop said motor when predetermined pressure limits are reached in said pipe, and valve means comprising an isolating valve to isolate the pressure operated means from the effect of hydrostatic pressure in said well and a manually operated vent valve connected with the fluid carrying pipe anterior to the isolating valve to permit adjustment of said control means independently of the hydrostatic pressure in said well.

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