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AUTOMATIC CONTROL UNIT FOR DEEP WELL JET PUMPS

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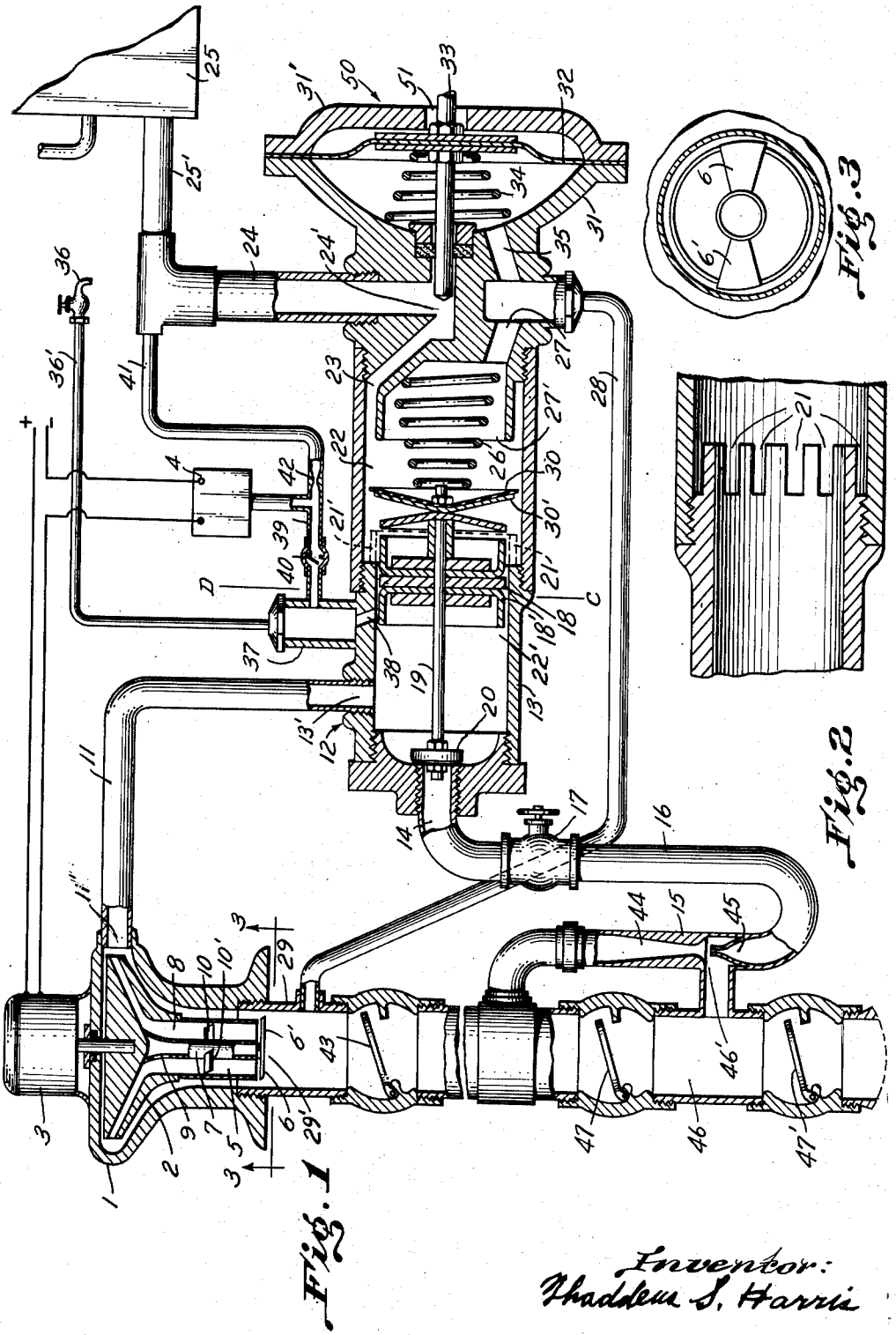


Fig. 1

Fig. 2

Fig. 3

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AUTOMATIC CONTROL UNIT FOR DEEP WELL JET PUMPS

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2 Claims. (Cl. 103—5)

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This invention relates to an automatic control unit for use in connection with jet type deep well pumps. This control unit is especially designed to provide more sure build up of drive pressure, after an idle period, and that the required degree of drive pressure will be maintained as the water level in the well goes to lower levels. Some of the features of this control unit have already been described in my earlier patents, and the present construction shows and describes a combination of such old features with added new features, all combined into one compact unit. Another advantage gained by this unit is that it provides a foundation for using a fresh water tap which can not be used ordinarily.

Figure 1 illustrates a sectional view of the complete installation with the control unit shown enlarged in proportion to other parts.

Figure 2 shows a still more enlarged sectional and surface view of Figure 1 on the line C—D.

Figure 3 is a sectional view on line 3—3 of Figure 1.

Referring to Figure 1, 1 is the pump containing a centrifugal impeller 2 which is driven by motor 3 under control of pressure switch 4. To the lower intake casing of the impeller is attached the tubular casing 5 which extends downward toward the intake pipe 29, and has fixed in its lower end the two impeller blades 6, 6', so disposed as to drive the water into the casing 5, when the impeller rotates.

A tube 7, of small diameter extends up through the center of casing 5 to the top of the impeller intake passage 8. Tube 7 is open at the bottom and supported by the blades 6, 6', but at the top it connects with the impeller passage by only the small air port 9. Supplementary impeller blades 10, 10' are fixed to tube 7 to assist in lifting the water and at the same time give it a rotary movement. The automatic control unit 12 comprises the cylindrical casing 13 to which is fixed the diaphragm chamber casing 50. The intake port 13' into casing 13 is connected by pipe 11 to the pump discharge port 11'. The discharge port 14 from casing 13 is connected by pipe 16 to the jet 45 of jet unit 15, said pipe 16 containing a manually controlled shut off valve 17.

A pipe 29 connects the intake port 29' of pump 1 to the top of the Venturi tube 44, of jet unit 15. A passage 46 connects the intake of the Venturi tube to the water of the well, with a foot valve 47' preferably connected into passage 46.

The plunger assembly 18 is carried by the plunger rod 19, which also carries valve 20 which controls port 14. The casing 13 is preferably of

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slightly greater diameter in the portion or chamber 22, to the right of the plunger assembly 18. A plunger cup 18' is fixedly mounted on rod 19 and is disposed to move in that smaller chamber 22' of the casing 13 but adjacent to the larger portion, or chamber 22. The inner surface of the wall of this portion of casing 13, over which plunger cup 18' moves is cut away in a series of slits 21, 21' better shown in Figure 2. Plunger cup 18' is so disposed that when it is moved to the right from its normal position, as shown, it eventually uncovers one end of the slits 21 and so allows water to pass around the plunger cup 18' and into the right end of the casing chamber 22.

Passage 23 extends from chamber 22 and has the controlled port 24' opening into passage 24. Passage 24 is connected by passage 25' with storage tank 25. A passage 27 also opens into chamber 22 by the large port 27'. Passage 27 is extended to the pump intake port by the pipes 28 and 29. A valve member 30 is fixed to the plunger rod 19 to control port 27'. The rim of valve 30 is in flexible relation with rod 19, with a supporting disc 30' behind it, so that as pressure builds up on the left side of plunger cup 18' the plunger cup will continue to move to the right after valve 30 has closed port 27', this continued movement being sufficient to cause the plunger cup to uncover one end of the slits 21. A spring 26 is dispossed to move the plunger assembly and rod to the left so that, normally, port 14 is closed by valve 20, while port 27' is open and the plunger cup 18' covers the slots 21, checking the flow around the plunger cup and into chamber 22. But port 27', being normally open, there is a free flow from tank 25, through passages 25, 24, 23, 27, 28 and 29 to the pump intake, when the pump first starts, port 24' also being normally open.

One side 31 of the diaphragm chamber casing 50 is fixed to the tubular casing 13, with the passages 23, 24, and port 24' being contained in the wall which is integral to chamber 22 and the diaphragm chamber casing 31. The diaphragm 32 carries the control rod 33 which extends into passage 24 to control port 24', thereby further controlling the flow which passes through slits 21, thence to passage 23. This side 31 of the diaphragm chamber casing has the port 35 which opens into passage 27, being thereby connected, by pipes 28 and 29 to the pump intake port 29'. The opposite side of the diaphragm chamber casing 31' has the opening 51 communicating with the atmosphere, and a spring 34 is disposed to support the diaphragm against atmospheric pressure when a reduced pressure from the pump

intake is communicated to the chamber of the diaphragm casing 31 through port 35.

A fresh water tap 36 is connected to port 37 by pipe 36', and a small passage 38 extends from port 37 to casing 13. A passage 39 connects port 37 to a pressure control switch 4, with a check valve 40 connected into this passage. Pressure switch 4 is connected to passage 24 by passage 41, one portion of passage 41 being very reduced in diameter as at 42.

The check valve 43 is preferably placed in pipe 29. The jet unit 15 has the usual Venturi tube 44, disposed in front of the jet 45. A bypass passage 46' connects the intake into the jet chamber 46 with the discharge end of the venturi, and a check valve 47 is connected into this bypass passage. A foot valve 47' is preferably connected to the well intake to the jet, and to pipe 29, in case the jet is not operating.

In its operation the advantages of this pumping plant are as follows: Check valve 43 and automatic check 20 are normally closed while the pump is idle, so that the tank pressure is carried by these valves, instead of the foot valve 47', as is ordinarily the case. This provides that it is never required to service a leaky foot valve at the bottom of the well, in order to keep the pump from starting at frequent intervals.

At very low water levels, of course a leaky foot valve will allow water to escape from the piping regardless of these check valves. In this case this water must be replaced from the tank before the pump can build up any sufficient discharge pressure. Ports 27' and 24' are normally open while the pump is idle. So when the pump starts it draws water from the tank 25 through passages 24, 27 and pipe 28. This flow enables the pump to quickly build up discharge pressure, moving the plunger cup 18' to open valve 29, so that water may be discharged to the jet supply pipe 16, and thence to the main intake pipe 29, replenishing any lack of water in these pipes.

The discharge pressure then increases further to move plunger cup 18' against pressure of spring 26 so that valve 30 closes the passage from tank to the pump intake as the pump goes into normal operation. Then as the discharge pressure builds up still further the plunger cup 18' compresses the flexibile mounted valve 30 with the plunger cup uncovering one end of the slits 21, allowing water to begin flowing around plunger cup 18' and to the tank by passages 23 and 24.

If, at any time, the jet does not develop enough lifting power to fully supply the pump the intake pressure registers a higher degree of vacuum than normal. This is communicated to the diaphragm by the passages 28 and 35. Spring 34 is of such strength that this very low pressure in casing 31 allows atmospheric pressure to move diphragm 32 and rod 33 to partly close port 24'. Less water then flows to the tank and more water and more pressure is delivered to the jet 45, until its lifting power becomes sufficient to properly supply the pump intake.

It is to be understood that the control unit 12 may be used with any type of pump which generates a high degree of intake vacuum, and which will discharge water at the required high pressure to operate the jet. As is well known, for a given jet unit, more pressure is required to lift a given amount of water as the water level in the well becomes lower. For very deep wells the pressure required may be more than can be efficiently provided by a centrifugal pump in which case some other type pump may be used to advantage. Also smaller piping may be used when higher operating pressures are used making it possible to obtain greater capacity from small wells which are also very deep wells, in which case this control unit becomes especially valuable, making it possible for even a constant capacity pump to operate efficiently over a considerable range of lifts.

When it is desired that the pumping plant operate efficiently at very great depths and also at water levels much above this maximum depth, this control unit may be used to advantage with the automatic jet unit which is described in applicant's Patent No. 2,327,637, issued August 24, 1943. By substituting this special jet unit for the usual ordinary jet, a comparatively small increase in drive pressure greatly multiplies the jet boosting power, so that the use of control unit 12 does not automatically increase the drive pressure much above the maximum tank pressure, even in serving the deepest well, and using only a single jet unit.

I claim as new:

1. In a jet type deep well pumping plant, the combination of a pump with an intake port and a discharge port, means for operating said pump, a storage tank, a jet booster unit comprising a conical diffuser tube with a jet nozzle disposed at its smaller end, a passage from the large end of said diffuser tube to said pump intake port; an automatic control unit, said unit comprising a tubular casing, a plunger cup disposed in said casing dividing it into an intake chamber and a discharge chamber, an intake port into said intake chamber, said port being connected by a closed passage to said pump discharge port, a discharge port from said intake chamber, said intake chamber discharge port being connected by a passage to said jet nozzle, a plunger rod carried by said plunger cup, a valve fixed to said rod, said valve being disposed to control said discharge port, a spring disposed to normally hold said valve closed, a repriming port opening into said discharge chamber, said repriming port being connected by a passage to said pump intake port, a valve flexibly fixed to said plunger cup, said valve being disposed to control said repriming port, a discharge passage from said discharge chamber, said discharge passage being extended to connect with said tank, a controlled port interposed in said passage, a plurality of slits cut in the inner surface of the wall of said tubular casing in that portion where said plunger cup normally rests, said slits being disposed to allow a flow around said plunger cup and into said discharge chamber only when said plunger cup is moved to compress said spring and said flexibly mounted valve, a diaphragm chamber casing, a diaphragm across said casing dividing it into two parts, a portion of one of said parts being fixed to and integral with a portion of said tubular casing, a discharge passage being contained in said integral part, a valve rod carried by said diaphragm, said valve rod extending into said last mentioned discharge passage with the end of said rod being formed as a valve to control said controlled port, a passage from the valve side of said diaphragm chamber casing, said last mentioned passage being extended to said pump intake port, an opening through the opposite part of said diaphragm chamber casing, said opening communicating with the atmosphere, a spring disposed to normally cause said controlled port to remain open, said spring also being disposed to

support said diaphragm against atmospheric pressure.

2. An automatic control unit comprising a tubular casing, a plunger cup disposed in said casing forming an intake chamber and a discharge chamber, an intake port into said intake chamber, a discharge port from said intake chamber, a plunger rod carried by said plunger cup, a valve fixed to said rod, said valve being disposed to control said discharge port, a spring disposed to normally hold said valve closed, a repriming port opening into said discharge chamber, a flexible valve fixed to said plunger rod, said valve being disposed to control said repriming port, a discharge passage from said discharge chamber, a controlled port interposed in said passage, a plurality of slits cut in the inner surface of the wall of said tubular casing in that portion where said plunger cup normally rests, said slits being disposed to allow a flow around said plunger cup only when said plunger cup is moved to compress said spring and said flexible valve, a diaphragm chamber casing, a diaphragm across said casing dividing it into two parts, a portion of one of said parts being fixed to and integral with a portion of said tubular casing, discharge passage being contained within said integral casing part, a valve rod carried by said diaphragm, said valve rod extending into said last mentioned discharge passage with the end of said rod being formed as a valve to control said controlled port, a port in the integral part of said diaphragm chamber casing, an opening through the opposite portion of said diaphragm casing, said opening communicating with the atmosphere, a spring disposed to support said diaphragm against atmospheric pressure and normally maintain said controlled port open.

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