Nov. 10, 1959 C. M. BLISS 2,911,916

VALVE FOR DIRECT PRESSURE SHALLOW WELL PUMPING SYSTEM

Filed Oct. 1, 1953

FIG. 7.

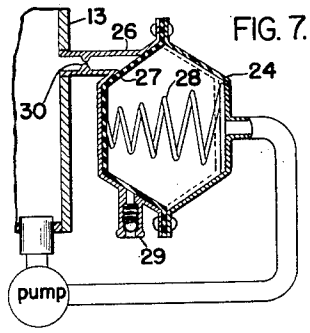


FIG. 1.

FIG. 2.

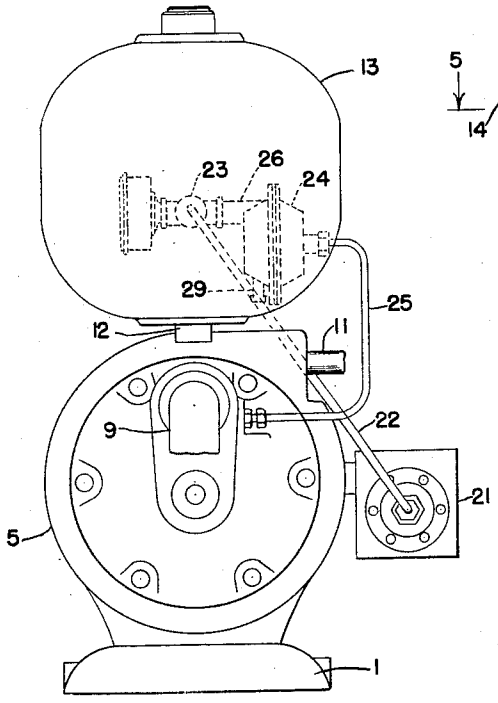


FIG. 3.

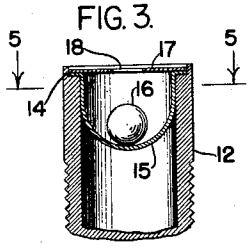


FIG. 4.

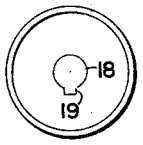


FIG. 5.

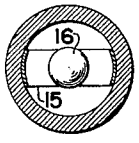
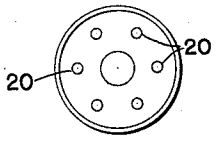


FIG. 6.



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United States Patent Office 2,911,916
Patented Nov. 10, 1959

2,911,916

VALVE FOR DIRECT PRESSURE SHALLOW WELL PUMPING SYSTEM

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Application October 1, 1953, Serial No. 383,671

8 Claims. (Cl. 103—25)

This invention relates to an automatic pumping system, and more particularly to a valve for a water pumping apparatus in which water is delivered directly from the pump to a faucet or other outlet.

A direct pressure pumping system may employ a pump of the shallow well jet type, a pneumatic tank, and various automatic controls. The tank may be considerably smaller than those used in conventional pumping systems where the water is discharged from the tank as the water is delivered directly from the pump to the discharge outlet when the pump is operating rather than from the pressure tank to the outlet. Since less space is required with a small tank the entire system may often be placed under a sink, or in some other small space. This is particularly advantageous in small homes such as lake cottages. The initial cost of such a compact system is substantially lower than that of the conventional system.

Heretofore, in the utilization of a direct pressure system that could be located in a small space several factors have reduced the efficiency of such a system and raised the cost of maintenance to a point where widespread use of the system was not economically feasible. The use of a smaller tank in the direct pressure system means that the pump will have to operate more often than in conventional systems, for there is no large supply of stored water from which water can be initially delivered before the pressure decreases substantially. In addition, it has been found that water tends to fill the tank completely, leaving no air reservoir or cushion at the top and preventing the air volume control from acting. When this happens, the pressure rises instantly, thereby shutting off the pump. When the pump stops the pressure immediately falls and the pump restarts. Sometimes the pump will start and stop more than six times per minute, which results in extreme wear on the pressure switch and motor, thereby necessitating frequent and costly repairs.

This invention is directed toward incorporating the advantages of the direct pressure system, while substantially eliminating the disadvantages outlined above.

In carrying out the invention, a novel valve arrangement has been incorporated between the pump and the tank, which is designed to prevent the pump from starting more than three times per minute and which allows the air volume control to function properly. Maintenance and replacement costs are thereby greatly reduced.

The drawing furnished herewith illustrates the best mode of carrying out the invention as presently contemplated and set forth hereinafter.

In the drawing:

Figure 1 is a side elevational view of the automatic pumping system with parts in section;

Fig. 2 is an end view of the system from the right side of Figure 1;

Fig. 3 is an enlarged sectional view of the valve shown in Fig. 1;

Fig. 4 is a top plan view of the valve assembly shown in Fig. 3;

Fig. 5 is a sectional view taken on line 5—5 of Fig. 3;

Fig. 6 is a top plan view of the valve corresponding to the view of Fig. 4 but illustrating another embodiment of the invention; and

Fig. 7 is a diagrammatic view of the air volume control valve assembled with the tank and pump with the control valve enlarged.

Referring to the drawing, there is illustrated a pumping apparatus comprising a base **1** on which is supported a motor **2** that drivingly actuates a centrifugal pump **3** within the pump chamber **4** of the pump housing **5** through shaft **6**.

Centrifugal pump **3** is connected to jet pump **7** within chamber **4** by a venturi tube **8**. Water from a well, not shown, is drawn into tube **8** through inlet pipe **9** and a passage **10** around jet pump **7** by the action of the centrifugal and jet pumps. The water is discharged from the centrifugal pump into chamber **4**. A portion of the water discharged from pump **3** is delivered through a discharge passage or outlet **11** at the top of the chamber to the household outlets or the like, not shown, another portion circulates through the chamber and flows through jet pump **7** and back into venturi tube **8** to operate the jet pump, while a further portion flows through a second outlet and the short passageway and valve **12** at the top of housing **5** and into the pneumatic tank **13** located above housing **5** and secured thereto by valve **12**.

The construction and operation of the valve and the component parts of the valve forms the primary basis of the invention herein. The valve **12** is suitably secured to tank **13** and is threaded at its lower end into an annular flange provided on the top of pump housing **5**. The upper end of valve **12** is recessed to provide an annular shoulder **14** which receives the complementary flanged ends of a narrow, curved metallic strip **15** to support the strip therefrom.

Strip **15** is preferably made of brass, but any other suitable material may be used and the strip may take any desired shape so long as it does not hinder the flow of water through valve **12**.

A valve ball **16** is normally disposed on the seat provided by curved strip **15** and is actuated to an up and down position by the water flow through valve **12** to open and close the valve, as hereinafter described. As can be observed in Fig. 5, the strip **15** has sufficient width to stop the descent of ball **16**, but permits flow of water through the valve when the ball is resting on the strip. The valve ball is made of plastic, glass or resin or other suitable material which is light enough to be carried upwardly by a stream of water passing through the valve but heavy enough to fall back to its initial position once the upward flow of water through the valve is stopped.

A small circular plate **17** extends across the upper end of the valve **12** and is secured to valve **12** on top of the flanged ends of strip **15** to provide a seat in the upper end of valve **12** for ball **16**. A circular opening **18** is provided in the center of plate **17**, the diameter of which is about two-thirds the diameter of ball **16**.

In the embodiment shown in Fig. 4 a leakage slot **19** extends in plate **17** from opening **18** for a slight distance therefrom. In the embodiment shown in Fig. 6 a series of relatively small holes **20** are disposed circumferentially around the margin of central opening **18** and function similarly to slot **19**. Leakage openings may be provided by any other suitable openings in plate **17**.

Under operation of the system as will be described hereinafter when ball **16** is resting in opening **18** under the force of the upward flow of water to tank **13** through valve **12** only a slight amount of water passes to tank **13** from pump chamber **4** through either slot **19** or holes **20** whichever are employed. However, when ball **16** is resting on strip **15** then water can pass freely through opening

18 and through the valve 12 from tank 13 to pump chamber 4.

In order to electrically operate the motor and pump a pressure switch 21 is secured to pump housing 5 and operates to turn motor 2 on and off, depending upon the pressure in tank 13 exerted on switch 21 through tube 22, which is connected to switch 21 at one end and fluidly connected through fiitting 23 to tank 13 at the other end. Pressure switch 21 can be set to operate motor 2 at any desired range of pressures, the usual range being from 30 to 50 pounds. Thus a 30 pound pressure will close the switch to start the motor and 50 pounds pressure will open the switch to cut off the motor.

It is necessary that an air reservoir be maintained in tank 13 otherwise the tank would completely fill with water and the pressure therein would instantly rise in the tank when the pump started due to the incompressibility of the water to operate pressure switch 21 and shut off the pump as soon as it started and would immediately fall when the pump stops and again immediately start the pump. This is prevented by an air volume control 24 for supplying air to tank 13 whenever needed.

Control 24 is fluidly connected to the suction side of pump chamber 4 through pipe 25 and also to tank 13 through connection 26. The control 24 is preferably similar to that described in United States Letters Patent 2,183,421 issued on December 12, 1939 to F. E. Brady, although any other suitable control may be used.

The structure and operation of the control 24 is illustrated diagrammatically in Fig. 7 wherein the control is shown connected at one side directly to the tank 13 through tube 26 and then to the pump by pipe 25 and to the lower portion of tank 13 through valve 12. The control comprises a diaphragm 27 suitably secured to the center of the housing of control 24. A spring 28 normally holds the diaphragm in the position shown in Fig. 7 which is in the left side of the control. However, when the pump starts suction is created on the right side of the diaphragm through pipe 25 sufficient to overcome spring 28 and draws the diaphragm to the right as illustrated by the dotted lines. A check valve 29 is secured to the lower end of control 24. Valve 29 is closed when the diaphragm 27 is to the left, the position shown in Fig. 7. However, when the diaphragm is moved to the right or dotted position check valve 29 opens to permit air to enter the control 24 if the water level in the tank is above tube 26 when the pump starts. This is due to the fact that the air will overcome the check valve before any quantity of water will flow into the valve from tank 13 as flow of water to the valve is restricted by restrictions 30 inside tube 26. However, if the water in tank 13 is not above tube 26 only air from the tank 13 is drawn into the control as the check valve 29 remains closed. In both of the discribed situations when the pump stops the diaphragm is moved to the left by spring 28 and forces the air from the control back into the tank through tube 26.

The size of the leakage slot 19 determines the length of time required to raise the pressure in tank 13 sufficiently to actuate switch 21 and cut off motor 2 at whatever pressure the switch may be set. The length of time determined by the size of slot 19 to raise the pressure in the tank to cut off switch 21 is sufficient to permit air volume control 24 to operate as described above to supply air to the tank. In the embodiment illustrated in Fig. 6 the holes 20 can be varied in size or in number to obtain the restricted flow of fluid to the tank 13 when the pump is operating that predetermines the length of time required to raise the pressure in tank 13 to actuate switch 21 and cut off motor 2.

Referring now to the operation of the pumping apparatus described assume that pump 3 has filled tank 13 to its full rated pressure and that motor 2 has been shut off, the following sequence of operations will then ensue:

As water is drawn from the system through discharge opening 11 the water is initially drawn from tank 13 at

which time ball valve 16 is resting on strip 15 and water can flow from the tank to chamber 4 through opening 18. After a short period of time the pressure within tank 13 drops to a predetermined pressure which actuates switch 21 to close an electrical contact and start motor 2. Shaft 6 is rotatably driven by motor 2 and in turn drives pump 3, which then draws water from the well through pipe 9, passage 10 and venturi tube 8. Pump 3 then delivers water into chamber 4. Water is thereupon discharged through outlet 11, and circulates through chamber 4 and through jet pump 7. Also water flows into tank 13 through valve 12.

As water is pumped through valve 12 valve ball 16 is carried upwardly by the force of the water until it seats itself in opening 18 of valve seat 17. The flow of water to tank 13 is thereby shut off. except for a small regulated stream which passes through leakage slot 19 in valve seat 17. The slot restricts water flow into tank 13 so that the pressure will not build up in the tank so as to actuate presure switch 21 and shut off motor 2 until a predetermined length of time has elapsed such as at least 12 seconds, delay from the time pump 3 starts. Control 24 in the meantime has been placed into operation and is given sufficient time during the pumping cycle to move to a position to supply air to tank 13 through valve 29. When no more water is being taken from the system, pump 3 will continue to pump water through valve 12 into tank 13 until the pressure in the tank is high enough to actuate pressure switch 21, to shut off motor 2 and stop pump 3.

Subsequently, since the flow of water upwardly through valve housing 12 has been halted, valve ball 16 drops away from valve seat 17 and again comes to rest on strip 15. Thus, when water is again drawn from the system, it will initially be delivered from tank 13 downwardly through opening 18 and valve 12, pump chamber 4 and from there through outlet 11 to a faucet or other discharge unit. Once the pressure in tank 13 lowers to a predetermined point, pressure switch 21 is again actuated to start motor 2, and the cycle as described above is repeated.

Although the value of the invention has been described with reference to the strip 15 and ball 16 other ball and cage arrangements can be employed or other valves with means for restricting passage of liquid in one direction may be employed.

The valve of the invention permits employment of a compact direct pressure pumping unit with a small tank and wherein frequent starts and stops are eliminated.

Various modes of carrying out the invention are contemplated as within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

I claim:

1. In an automatic pumping system of the direct pressure shallow well type, a pneumatic storage chamber, pumping means, means to actuate said pumping means, a pressure control connected to said storage chamber and to the actuating means and operated by pressure in the chamber to start and stop the actuating means, an inlet connected to the pumping means for flow of liquid to the pumping means from a well or the like, an outlet connected to the pumping means for discharge of pumped liquid from the system direct from the pumping means when the latter is in operation, a second outlet for connecting the pumping means to the storage chamber for flow of liquid from the pumping means to the storage chamber upon actuation of the pumping means and wherein the liquid is stored under pressure; a valve disposed between the second outlet and the storage chamber with said valve comprising, means responsive to liquid flow through said second outlet toward said storage chamber for restricting the flow of liquid into said storage chamber when the pumping means is in operation, said last-

named means being inoperative when the pumping means is inoperative to provide substantially unrestricted flow of liquid from the storage chamber as liquid is drawn from the system; and an air volume control connected to the storage chamber to control the volume of air within the storage chamber with said control having means to supply air to the tank when the pump ceases operation to provide an air reservoir in the top of the tank and thereby maintain a liquid level in the tank preventing rapid repeated operation of the pump.

2. In an automatic pumping system of the type wherein the pump in operation discharges liquid directly from the system without passage of the fluid through the storage tank of the system and having an air inlet control with a connection secured to said tank with means for passage of air to the control when the pump is operating and then to the tank when the pump ceases operation, and a pressure switch actuated by the pressure in said tank to start and stop the pump, the combination of a valve disposed between the pump and tank, said valve comprising a vertical cylindrical casing enclosing a valve chamber and having an annular shoulder at its upper end, a curved support strip disposed within said casing and extending downwardly within said chamber and having flanged ends which rest on said annular shoulder, a valve ball disposed on the lower inner portion of said support strip and free to move vertically from said strip, a circular valve seat supported by said annular shoulder a substantial distance above said valve ball with a central opening therein, the said ball closing said opening when the pump is operating and liquid is being pumped to the tank through the valve chamber, and apertures means in said valve sat providing for leakage of fluid through the valve when the opening therein is closed by the valve ball to provide for entry of air to the tank from the air inlet valve and thereby prevent rapid build up of pressure in the tank by the flow of water thereto.

3. The apparatus of claim 2 in which the means allowing leakage through the valve comprises a slot extending for a slight distance from said opening.

4. The apparatus of claim 2 in which the means allowing leakage through the valve comprises a series of relatively small circumferentially spaced holes disposed approximately at the midpoint of the radius of said seat.

5. In combination with a direct pressure water supply system having a pump disposed within a housing, a discharge passage adjacent said pump, an actuating means connected to drive said pump, a pressure tank mounted on said housing, a pressure control means responsive to pressure within said tank for starting and stopping the pump actuating means, an air inlet valve having a connection secured to said tank for the passage of air to the tank immediately after operation of the pump ceases, a passageway disposed between the pump and tank; and a check valve disposed in said passageway with said valve comprising, means responsive to flow of water through said passageway toward the tank to restrict the flow of water from the pump to the tank to provide a time delay permitting adequate receipt of air from the air inlet valve to prevent rapid actuation of the pressure control means by build up of water pressure in the tank said second-last named means being inoperative when the pump is not operative to permit generally free flow of water from the tank when the discharge passage is open.

6. In a direct pressure water supply system in combination with a pressure tank, a housing connected to said tank and having an inlet and a discharge passage separate from said tank, means including a pump within said housing for supplying water from said inlet to said tank and to discharge passage, an air inlet valve having a connection secured to said tank for the passage of air immediately after operation of the pump ceases; and a control valve disposed between the tank and pump, said control valve comprising, means responsive to the flow of water toward said tank for restricting the flow of water to the tank to provide a time delay permitting adequate receipt of air from the air inlet valve to prevent the rapid build up of water pressure in the tank, said control valve being inoperative when the pump is not operating to provide free flow of water from the tank when the discharge passage is open.

7. In combination in an automatic pumping system of the direct pressure type, a pump with an inlet and a discharge outlet, a motor adapted to actuate said pump, a storage tank, an air inlet control having a connection secured to said tank for passage of air to the tank when the pump ceases operation, a connection between the tank and pump comprising an enclosed passage for flow of liquid therebetween, a cage secured in said passage, a plate closing the passage at the tank end and having a central opening therein, additional opening means in said plate, and a ball disposed between the cage and plate, said ball normally resting on said cage to provide for flow of liquid from the tank through said central opening and passage and rising to close the central opening when the pump is in operation under the force of liquid flowing through the passage to said tank, the said additional opening means providing restricted flow of liquid from the pump to the tank when the ball closes the central opening to provide a time delay interval for liquid pressure build-up in the tank for adequate flow of air thereto from the air inlet control when the pump ceases operation and thereby establish a predetermined water pressure in the tank to prevent intermittent rapid actuation of the pressure switch.

8. In a direct pressure pumping system, the combination comprising, a pump having an inlet for liquid, a motor for actuating said pump, a storage tank connected through a passageway to said pump, an air inlet control connected to said tank for discharging air into said tank when the pump ceases operation; and a valve disposed in said passageway with said valve comprising, means responsive to liquid flow through said passageway toward said tank to restrict flow of liquid from said pump into said tank during operation of the pump to provide a time delay sufficient to maintain an adequate air supply in the tank from said control and prevent sudden pressure buildup, said means being inoperative when said pump is not operating to permit unrestricted flow of liquid from said tank through said passageway.

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