

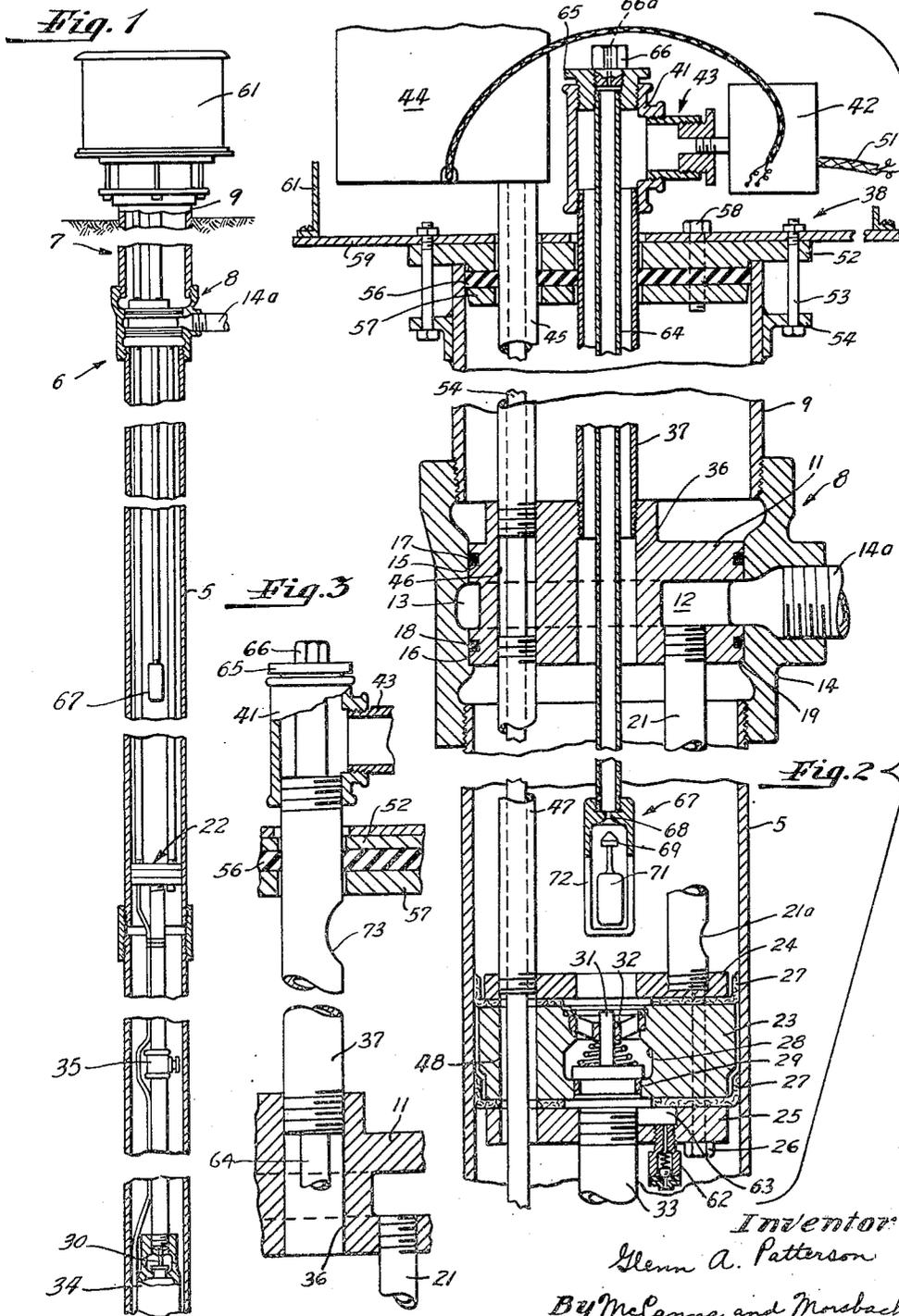
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PUMPING SYSTEM

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PUMPING SYSTEM

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This invention relates to water systems of the type in which water is pumped from a well or the like to a pneumatic pressure storage means and thence passes to service, the pump and storage means being automatically controlled.

An important object of the invention is the provision of a water system wherein the conventional storage tank is eliminated and the water is stored below ground.

Another object is the provision of a water system wherein the water is stored under pneumatic pressure within the well casing.

A further object is to provide a complete water system located at the well so that the electrical wiring and controls may be remote from buildings.

Another object is to provide a water system wherein all portions of the system are under greater than atmospheric pressure to eliminate possibility of leakage into the system.

Other objects and advantages will appear from the following description and the accompanying drawings, in which:

Figure 1 is a fragmentary vertical section through a well showing the invention;

Fig. 2 is a fragmentary section showing the pitless underground discharge unit, the packer and the riser pipe, and

Fig. 3 is a fragmentary section of a modified form showing the well seal and the pitless underground discharge unit.

This is a continuation in part of my copending application Serial No. 414,449, filed March 5, 1954, entitled "Pumping System," and now abandoned in favor of the present application.

The invention contemplates the provision of a complete water system directly at the well which may be and usually is located at a distance from a building as is commonly required by well codes permitting electrical wiring to be conducted directly from an outside transformer to the well and eliminating the necessity for the wiring to enter the house or the like. While the embodiment herein shown is arranged for use with a submersible type pump, the invention is not to be construed as limited thereto since other specific pump structures may be embodied therein within the scope of the invention.

Referring first to the Figure 1, there is shown a well casing which extends from a point above the ground down into the well opening in accordance with standard practice in cased wells. The well casing includes a conventional casing tube 5 for the well, the upper end of which terminates at a point such as indicated at 6, below the frost level in the ground. Attached to the top of the casing tube in a water tight manner is a pitless underground unit indicated generally by the numeral 7 which customarily comprises a discharge head assembly 8 and a casing extension 9 of somewhat greater inside diameter than the casing tube, the casing extension extending to a point above the ground level.

Disposed within the discharge head 8 is a packer unit

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or thimble indicated generally by the numeral 11 (see Fig. 2) which is constructed to form a casing seal across the discharge head and comprises a casting having a chamber 12 communicating with an annular passage 13 in the discharge body 14 of the head assembly. The discharge body has a service pipe 14a leading therefrom and communicating with the passage 13. The thimble has spaced annular grooves 15 and 16 carrying O-ring seals 17 and 18 cooperating with a bore on the inside of the discharge body to seal the interface between the thimble and the discharge body above and below the annular passage 13. The discharge body has an annular shoulder 19 against which the lower side of the thimble bears for the purpose of supporting the thimble and associated mechanism in the well.

A delivery pipe 21 has its upper end threaded into the thimble 11 and communicates with the chamber 12, the lower end of the delivery pipe being threaded into a packer indicated generally by the numeral 22 (Fig. 1) which forms a casing seal below the thimble to define a fluid reservoir there between. The delivery pipe has an inlet opening 21a in the side thereof adjacent its lower end for the passage of water from the reservoir to the pipe. The packer comprises a body 23 having upper and lower plates 24 and 25 secured thereto by cap screws 26, conventional cup leathers 27 being interposed between the body and the plates and bearing against the inner surface of the casing to effect a seal. The lower end of the delivery pipe 21 is threaded into the plate 24 thereby interconnecting the thimble and the packer. The body 23 has a central opening 28 in which is mounted a conventional valve seat 29 and carries a spring-pressed check valve 31 supported in a conventional cage 32 secured in the opening in the usual manner. The upper plate 24 is centrally apertured in registration with the opening 28 of the body.

The lower plate 25 has a central threaded opening for the reception of a riser pipe 33 positioned for communication with the space above the packer by way of the central opening 28 in the body. The riser pipe 33 extends from the packer downwardly into the well, and in this instance is connected to a pump 34 (Fig. 1) immersed in the water of the well having therein a check valve 30, a conventional bleeder valve 35 being interposed in the pipe. The invention is herein illustrated in connection with a pump of the type in which the pump and motor are both submerged in the water of the well, but it will be understood that this form of pump is selected for purpose of illustration and the invention may be embodied with other well known types of pumps.

Attached to the upper side of the thimble 11, in communication with a central passage 36 is a drop pipe 37 which extends upwardly through the casing extension 9 and through a conventional well seal 38 closing the upper end of the casing extension. Suitably a pipe T 41 is secured to the upper end of the drop pipe 37 and supports a conventional pressure switch 42 through suitable fittings 43. Through this means the pressure switch 42 communicates with the upper end of the reservoir through the drop pipe 37, the T 41 and fittings 43. Also carried above the well seal is a conventional control box 44 housing the usual controls for the motor of the pump, such as the motor starting switch, capacitors and overload protection device. The control box is mounted on a pipe 45 threaded into an opening 46 in the thimble 11 and extending upwardly through the seal. The pipe 45 communicates with a pipe 47 which extends between the thimble and the packer 22, and is threaded into the packer in communication with an opening 48 in the packer, to provide a conduit extending from the control box through the packer for the passage of a cable 49 comprising the usual electrical conduits, this cable extending from the

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control box down through the well and connecting to the motor and pump 34. The control box 44 and pressure switch 42 are connected together and to a suitable source of power such as the commercial power distribution lines through conductors such as indicated at 51. The pipe 45 is open to atmosphere through the control box so that this conduit serves to admit air to the well casing below the packer.

The well seal 38 on the upper end of the casing extension may be of any desired construction suitable for forming an effective casing seal to prevent the passage of fluid. The embodiment shown comprises an upper plate 52 having a peripheral recess for the reception of the upper end of the casing extension and to provide a flange for the reception of bolts 53 which pass through an annular flange 54 welded to the exterior of the casing extension to secure the seal to the casing extension. A disk-shaped gasket 56 is disposed against the undersurface of the plate 52 and a second plate 57 is provided on the underside of the gasket. The plates and gasket have openings for the passage of the pipes 37 and 45 and a plurality of cap screws 58 pass through the upper plate and gasket and are threaded into the lower plate so that when the cap screws are drawn up the resilient gasket is compressed and expanded to effect a fluid seal around the pipes and against the inner face of the casing extension. Suitably a plate 59 is attached to the well seal by the bolts 53, the plate carrying a housing 61 enclosing the controls for protection against the elements.

The space between the thimble and the packer forms a pressure storage chamber for storing water under pneumatic pressure, water passing from the pump into this chamber through the riser pipe 33 and past the check valve 31, the check valve closing when the motor stops to retain the water in the reservoir under pressure. Air is supplied to the chamber by means of an air charging device comprising the bleeder valve 35 and a snifter valve 62. This snifter valve is of the usual construction and normally comprises a ball spring pressed against a seat. The snifter valve is connected to an offset passage 63 communicating with the chamber 29 of the packer, being arranged to open against the action of the spring to admit air into the passage 28 below the check valve and likewise into the riser pipe 33. With this arrangement, when the pump stops at the end of a pumping cycle, the bleeder valve 35 opens in the usual way permitting the water held in the riser pipe between the bleeder valve and the check valve 31 to bleed out, this snifter valve 62 permitting entrance of air. Thus, within a comparatively short space of time, that portion of the riser pipe between the bleeder valve and the check valve will become filled with air. Consequently, when the pump starts on its next pumping cycle, the upwardly moving column of water in the riser pipe forces this air past the check valve and into the pressure chamber.

The air charging system just described is of the type in which an excess of air is charged into the chamber. With such systems means is provided to release the excess of air, and in the present embodiment this comprises an automatic air volume control. In the embodiment shown this comprises a vent tube 64 threaded into a pipe bushing 65 in the T 41 and extending down through the pipe 37 and passage 36 into the reservoir. The bushing 65 has a plug 66 having vent opening 66a for the passage of air therethrough. Attached to the lower end of the vent tube is an air relief valve 67 having a port 68 providing communication between the vent tube and the reservoir. A valve member 69 is carried on a float 71 retained within a perforate cage 72. When the level of the water in the reservoir is above the float the buoyancy of the float holds the valve member against the port to prevent the passage of water outwardly therethrough and when the water level drops below the float the weight thereof carries the valve member down to open the port and permit the escape of air from the reservoir through the vent.

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In the embodiment shown in Fig. 2 the reservoir comprises the space between the thimble 11 and the packer 22, and both the air and water are confined within this space except that the tube 37 and its extension to the pressure switch 47 will be filled with air. In the embodiment shown in Fig. 3 the space within the casing extension 9 is utilized as at least a part of the air expansion chamber. The only change in the structure of Fig. 2 necessary to accomplish this is to open the pipe 37 into the space between the thimble 11 and the well seal 38 which may be accomplished by providing an opening 73 as shown in Fig. 3, thereby permitting communication between the pipe 37 and the interior of the casing extension.

Operation

Assuming that the system has been installed as described and the pump has cycled a sufficient number of times to bring the proper ratio of air and water into the pressure storage chamber, opening of the usual valves in the service line 14a or associated piping brings about a flow of water from the lower portion of the reservoir through the opening 21a into pipe 21, thence through chamber 12 and out through the service pipe 14a, the water being forced out by the pressure within the storage chamber. This flow is accompanied by a reduction in pressure within the storage chamber and when this reaches a preselected minimum, the pump is automatically started in response to operation of the pressure switch. In systems of this character the pressure switch, as is well known, is arranged to close the circuit to the motor at a low pressure setting and open the circuit at an elevated pressure setting, both of which settings are adjustable within the switch in order to give the necessary pressure characteristics at the faucets in the system. Thus, when the pressure within the pressure chamber reaches this low setting of the pressure switch, the pump 34 is started in response to operation of the pressure switch 42. At the outset of pump operation the volume of air carried in the riser pipe above the bleeder valve will be forced into the pressure chamber past the check valve 31 followed by a flow of water and the pump will continue to operate until the pressure within the chamber reaches the cut-out pressure for which the switch 42 is set. During this operation air is free to flow down the pipes 45 and 47 into the casing below the packer. When the pump stops at the end of each cycle, the bleeder valve 35 reopens allowing the upper end of the riser pipe to again fill with air preparatory to the next pumping cycle.

As previously mentioned, the distance between the bleeder valve 35 and the check valve 31 is selected so that with repeated cycling of the pump more air will be introduced in the chamber than is necessary to maintain the desired air to water ratio. The excess of air is vented off through the air release valve 67, and to this end the float is positioned in the reservoir so that when the liquid level within the chamber reaches its lower predetermined level, the weight of the float and the valve 69 acts to open the valve. This vents off air allowing the pressure within the tank to fall until the pump restarts. As the level of water within the chamber rises, it lifts the float and causes reclosing of the air valve 69, the pump continuing to operate until the pressure on the air in the tank reaches the cut-out pressure for which the switch 47 is set. An important feature of this construction lies in the fact that the float and air vent system is effective in determining the length of the pumping interval by regulating the air to water ratio in the tank. Thus, when the vent tube 64 is of such length that the float is located in the upper portion of the chamber, the water level in the chamber will be high and a relatively small proportion of air with respect to water will exist. Therefore the introduction of only a small amount of water into the chamber will elevate the pressure to the cut-out setting and stop the pump. The same is true with respect to the starting of the pump, the withdrawal

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of only a relatively small amount of water acting to drop the pressure to restart the pump. The reverse is, of course, true, and when the float is positioned low in the chamber, a relatively large amount of water will be displaced between the stop and start pressures of the system. This is of advantage in adapting the system to the condition of the well. Where the system is installed in a free flowing well with plenty of water, the float can be set at a low point in the chamber to provide a maximum amount of water usage between pumping cycles. When the system is installed in a well in which the water supply is limited, the float can be adjusted to ride high in the chamber and as a result, the pump will operate through a shorter pumping interval with increased frequency so that the water in the well does not draw down to a point where the pump no longer receives its full capacity of water.

Referring to Fig. 3, it will be seen that by providing the opening 73, the space within the casing extension 9 may be used to form at least part of the air storage capacity of the chamber, thereby enabling the packer 22 to be placed at a higher point in the casing for the same water capacity or this opening may be incorporated to increase the capacity of the system over what it would have with the arrangement shown in Fig. 2.

It will be seen that according to the invention the ordinary casing of the well forms the pressure storage tank of the water system so that no additional tank is necessary for this purpose. Furthermore, the entire pumping system is carried on the casing through the thimble 11 which bears against the shoulder 19 for this purpose. As a result, the entire mechanism may be withdrawn from the well casing through the casing extension 9 which is of slightly greater diameter than the well casing. An important further advantage of this construction is that the water is stored under pressure in the pressure tank below ground level so that the water does not heat up as is commonly the case with the usual pressure storage tanks. Another advantage lies in the fact that the entire system is under a positive pressure so that any leakage is in an outwardly direction and contamination of the water supply cannot occur. A further advantage lies in the fact that power for operation of the system can be brought in directly from the commercial power lines and does not need to pass through buildings such as the house. Therefore, in the event of fire, the pumping system will most likely be maintained in operation. In addition, this type of construction obviates many of the difficulties associated with separate storage tanks such as "sweating" of the tank. Furthermore, service lines can radiate directly from the well as distinguished from the house where the storage tank is located in the basement. Another advantage lies in the fact that the pump delivers directly into the pressure chamber so that there is a minimum of loss through pipe friction. While the apparatus has been described in connection with conventional water supply systems, it will be obvious that many of the features thereof are equally applicable to pumping other liquids and the application is not to be construed as limited to solely the pumping of water.

I claim:

1. A pneumatic pressure storage system comprising a well closure extending from a point above ground downwardly into the well comprising a conventional well casing tube, a casing extension and a discharge head connecting the casing tube and casing extension, said discharge head having a lateral outlet pipe connection, a lower packer seal spanning the casing above the lower end thereof in annular sealing engagement with the inner surface of the casing, said packer seal having an inlet passage, a second packer seal disposed in said discharge head having a discharge chamber communicating with the lateral pipe connection, the second packer seal including means for sealing the interface between the packer and the discharge head above and below said

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chamber to form, with the casing tube and lower packer seal, a liquid reservoir, means communicating with said inlet passage for pumping liquid from the well into the reservoir, means communicating with the reservoir for charging air into the reservoir to provide an air cushion in response to the introduction of liquid into the reservoir, a pressure switch communicating with the reservoir to control the operation of the pumping means in response to changes in pressure in the reservoir, means for venting excess air from the reservoir, and conduit means extending from said chamber downwardly in the reservoir to a point near the lower packer seal for drawing off liquid from the reservoir through said chamber and outlet connection.

2. The combination of claim 1, including a conduit connecting the casing tube space below the lower packer seal to atmosphere, said conduit extending through the reservoir out of communication therewith.

3. The combination of claim 1 wherein said pumping means is disposed in the well below the lower packer seal and is supported on the lower packer seal by a riser pipe through which liquid is pumped to the reservoir, a check valve is provided in the vicinity of the lower packer seal to prevent return flow from the reservoir, a second check valve is disposed below the first mentioned check valve and the aforesaid means for charging air to the reservoir comprises means for draining a portion of the liquid from the riser pipe between the check valves and replacing the same air while the pumping means is inactive.

4. The combination of claim 1 wherein said means for venting excess air from the reservoir comprises a float actuated air release valve inside the reservoir and an air release conduit extending upwardly therefrom through said second packer seal and into communication with the atmosphere.

5. The combination of claim 1 wherein said conduit means comprises a pipe interconnecting said lower packer seal and said second packer seal, the pipe having an opening adjacent the lower packer seal for the entrance of liquid.

6. A pneumatic pressure storage system comprising a well closure extending from a point above ground downwardly into the well comprising a conventional well casing tube, a discharge head secured to the upper end of the well tube below ground level having a lateral discharge connection and a casing extension secured to the discharge end and extending upwardly to a point above ground level, the casing, extension and discharge head being connected in superimposed fluid-tight relation, a lower packer seal spanning the casing above the lower end thereof in annular sealing engagement with the inner surface of the casing, said packer having an inlet passage, a second packer seal disposed in said discharge head having a discharge chamber communicating with the lateral discharge connection and including means for sealing the interface between the packer and the discharge head above and below said chamber to form, with the casing tube and lower packer seal, a liquid reservoir, an upper well seal spaced upwardly from the second packer seal spanning the casing extension, a riser pipe depending from the lower packer seal communicating with said inlet passage, pumping means attached to said riser pipe for pumping liquid from the well into the reservoir through the riser pipe, an air charging device for charging air into the reservoir, and means for releasing excess air from the reservoir through said upper well seal.

7. A pneumatic pressure storage system comprising a well closure extending from a point above ground downwardly into the well comprising a conventional well casing tube, a discharge head secured to the upper end of the well tube below ground level having a lateral discharge connection and a casing extension secured to the discharge end and extending upwardly to a point above ground level, the casing, extension and discharge head being connected in superimposed fluid-tight relation, a lower packer seal spanning the casing above the lower end

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thereof in annular sealing engagement with the inner surface of the casing, said packer having an inlet passage, a second packer seal disposed in said discharge head having a discharge chamber communicating with the lateral discharge connection and including means for sealing the interface between the packer and the discharge head above and below said chamber to form, with the casing tube and lower packer seal, a liquid reservoir, an upper well seal spaced upwardly from the second packer seal spanning the casing extension, said upper seal forming, with the second packer seal and the casing extension, an upper chamber, a riser pipe depending from the lower packer seal connecting with said inlet passage, pumping means attached to said riser pipe for pumping liquid from the well into the reservoir through the riser pipe, an air charging device for charging air into the reservoir, means for releasing excess air from the reservoir through said upper seal, a drop pipe connecting the upper well seal and the second packer seal spanning the upper chamber, and means connecting the second and lower packer seals for removal of the packer seals, riser pipe and pump as a unit with removal of the upper well seal.

8. The combination of claim 7 having a pressure switch located above the upper well seal, said drop pipe being in open communication with the reservoir and the pressure switch for controlling operation of the pumping means in response to pressure changes in the reservoir.

9. The combination of claim 8 wherein the drop pipe is imperforate and is secured to the upper seal and the second packer seal in fluid-tight relation to prevent communication between the reservoir and said upper chamber.

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10. The combination of claim 8 having means providing communication between the reservoir and the upper chamber to retain in the upper chamber at least a portion of the air providing the air cushion for the reservoir.

11. The combination of claim 8 wherein said means for releasing excess air comprises an air release conduit within the drop pipe extending from the reservoir to a point at atmospheric pressure above the upper well seal and a float actuated air release valve secured to the air release pipe within the reservoir.

12. The combination of claim 6 having an air vent conduit extending downwardly in the well enclosure, the upper end thereof being open to atmosphere and the lower end thereof opening into the casing tube space below the lower packer seal to admit air into the well, said conduit being imperforate between its ends.

13. The combination of claim 12 wherein said pumping means comprises a submersible electric motor pump secured to the riser pipe within the water in the well and conductors for supplying electrical energy thereto extending downwardly into the well through said air vent conduit.

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