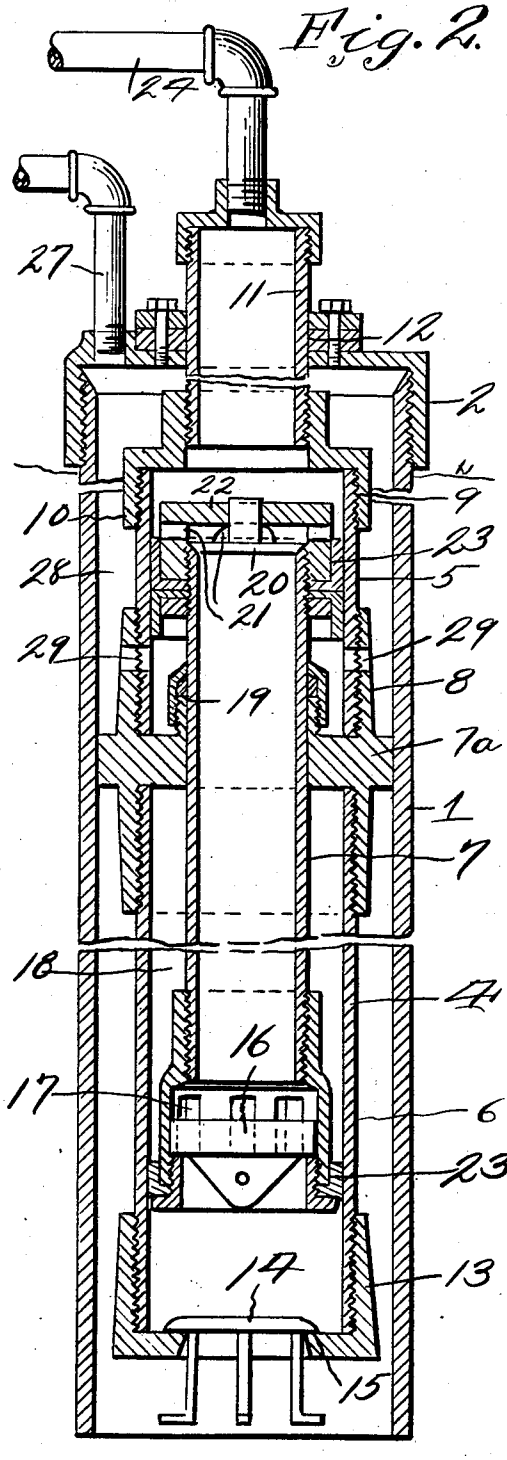
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LIQUID PUMP

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Fig. 2.



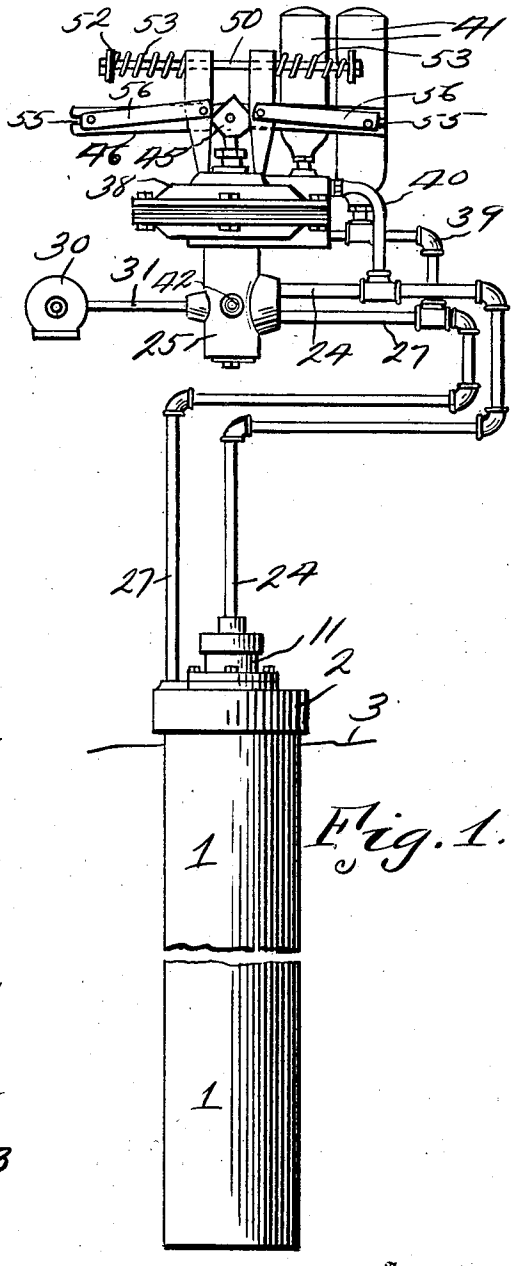


Fig. 1.

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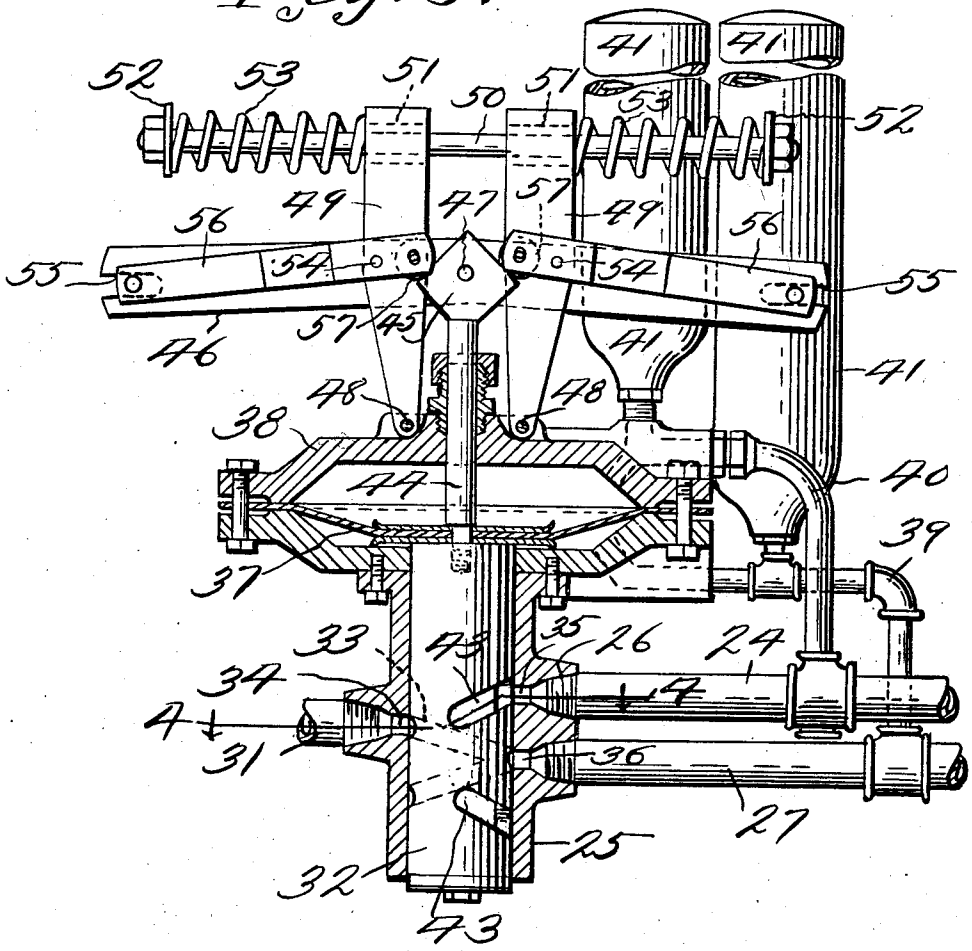
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LIQUID PUMP

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Fig. 3.



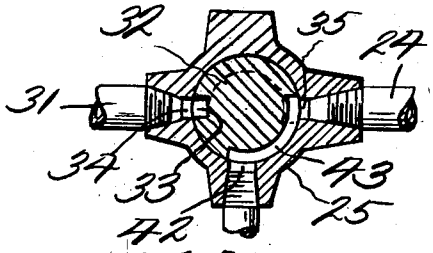


Fig. 4.

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LIQUID PUMP

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Application September 28, 1934, Serial No. 745,979

13 Claims. (Cl. 103—46)

The invention relates to well pumping devices, particularly to a device for deep well pumping wherein the columnar weight of the liquid in the well casing is too heavy for ordinary pumping purposes and the columnar weight is utilized for maintaining a balance of the liquid during the pumping operation.

A further object is to provide a piston cylinder within the well casing and provided with a reciprocating double piston therein actuated by a pump alternately applying pressure to the column of liquid around the cylinder within the casing and to the upper end of the piston for intermittently lifting liquid on its upward strokes and which liquid has been previously trapped above the lower piston on a previous down stroke.

A further object is to provide a reciprocating piston in the pipe circuit and diaphragm controlled for alternately applying pressure in one direction and the other for varying the direction of movement of the pumping piston within the well casing.

A further object is to provide the reversing piston with a casing having a diaphragm casing on the upper end thereof and a full stroke rod having a cam member to which a cross bar is pivoted and rollers between which the cam member moves in its upward and downward movement to full stroke upper and lower positions; said cam member and rollers maintaining said full stroke positions. Also to mount the rollers on pivoted arms through which a rod extends and coiled springs on the rod and cooperating with the outer sides of the pivoted arms for normally forcing the same towards the opposite sides of the cam.

A further object is to provide the reversing piston casing with a pressure intake pipe leading to a pump and with spaced pipes leading to the well casing and piston cylinder and valves or ports in the control valve and positioned whereby when the control piston is in extreme positions pressure will be admitted to one or the other of the pipes leading to the well. Also to provide ports in the control piston and alternately placed into registration with the pipes and with discharge pipes leading from the device for discharging liquid from the well on the upward strokes of the well piston.

A further object is to provide bypass pipes from the well pipe to opposite sides of the diaphragm whereby pressure built up above the columnar pressure will act on the diaphragm for reversing the pumping operation and the movement of the lifting piston. Also to provide cushioning cylinders in connection with the pipe lines to take up the jar in the system incident to the velocity of the liquid.

With the above and other objects in view the invention resides in the combination and arrangement of parts as hereinafter set forth, shown in the drawings, described and claimed, it being understood that changes in the precise embodiment of the invention may be made within the scope of what is claimed without departing from the spirit of the invention.

In the drawings:

Figure 1 is a view in elevation of the pump system.

Figure 2 is an enlarged vertical transverse sectional view through the well casing and parts therein.

Figure 3 is a view in elevation of diaphragm control mechanism, parts being shown in vertical longitudinal cross section to better show the structure.

Figure 4 is a horizontal sectional view taken on line 4—4 of Figure 3.

Referring to the drawings, the numeral 1 designates the well casing, particularly of the type used in connection with deep wells, for instance oil wells of the non-flowing type and 2 a cap carried by the upper end of the casing, and which is disposed above the ground level 3. Disposed within the well casing 1 in spaced relation to the inner periphery thereof is a stationary cylinder 4 which comprises an upper section 5 and a lower section 6. The cylinder 4 is elongated and may be of any length desired, depending upon the amount of liquid it is desired to lift on each reciprocation of the lifting piston 7.

The cylinder sections 5 and 6 are connected together by a spacing member 7a, which engages the inner periphery of the casing 1 as clearly shown in Figure 2, and is provided with internally threaded flanges 8 in which the adjacent ends of the cylinder sections 5 and 6 are threaded. Threaded at 9 on the upper end of the cylinder section 5 is a reducing coupling 10 in the reduced portion of which the discharge tube 11 is threaded, and which discharge tube extends upwardly through the packing 12 in the cap 2, and through which tube liquid discharged from the device is forced upwardly on the upward strokes of the piston 7. Threaded on the lower end of the cylinder 4 is a cap 13 in which is vertically movable a disc valve 14 which cooperates with a valve seat 15 and when unseated on the upward strokes of the piston 7 allows fluid to enter the lower end of the cylinder 4 so that upon the downward

strokes of the piston 7 said fluid will unseat the lower piston valve 16 and allow the trapped fluid to pass through the ports 17 into the hollow cylinder 6 in the chamber 18 where upon further upward strokes of the piston the trapped fluid will be forced back through the port 17 and thence upwardly through the hollow piston 7, which is slidably mounted in the packed gland 19, unseating the upper valve 20 and allowing the trapped fluid to be forced through the discharge ports 21 in the cap 22 carried by the upper end of the piston and into the chamber of the cylinder 4 above the piston, where it can pass upwardly through the tube 11. The piston 7, at its upper and lower ends is provided with packing rings 23, preferably of the cup type for preventing escape of fluid around the piston.

Connected to the upper end of the discharge tube 11 is a discharge pipe 24 which is connected to the control piston casing 25 at 26, and connected to the casing 25 is a pipe 27, which discharges into the casing chamber 28 above the member 7a, so that pressure may be intermittently supplied to the column of liquid in the casing chamber 28 for applying pressure to the underside of the upper piston 23 through the apertures 29 for forcing the piston intermittently upwardly for the intaking operation and unseating of the disc valve 14. Pressure is intermittently applied to the upper end of the piston 7 through the pipe 24.

Any kind of pump 30 may be used; however, a conventional form of pump is shown and supplies pressure to the casing 25 through the pipe 31 and this pressure is alternately supplied to the pipes 24 and 27 for changing the liquid balance within the well structure. To accomplish this result a vertically movable control piston 32 is provided within the casing 25 and is provided with a V-shaped port 33 in the periphery of the piston which is adapted to cross-connect the pressure supply port 34 with the ports 35 and 36 according to whether the piston 32 is in upper or lower position; it being shown in lowered position in Figure 3, and at which time pressure is passing through the pipe 27 for forcing the piston 7 upwardly for the intaking operation and when the piston 7 is stopped in its upward movement by engaging the under side of the reduced coupling 10, the liquid balance in the device is overcome, thereby causing pressure to engage the under side of the diaphragm 37 within the diaphragm casing 38 through the pipe 39. This action will cause upward movement of the piston valve to cross-connect ports 34 and 35 in the casing 25 and supply pressure to the upper side of the piston 7 through pipe 24 and tube 11 thereby forcing the piston 7 downwardly, for the reverse operation.

As the piston 7 moves downwardly during the above operation, disc valve 14 seats and the weighted valve 16 is unseated, therefore the trapped fluid passes through the ports 17 into the chamber 18 around the piston 7, and when the piston reaches the end of its stroke there is a back pressure through the pipe 24, which causes an overbalancing of pressure in the system which will be applied to the upper side of the diaphragm 37 through the branch pipe 40, thereby causing a reverse operation. The above operation continues during the entire pumping operation. Branch pipes 39 and 40 are preferably provided with air cushioning cylinders 41, for taking up the shock incident to the velocity of flow of the material. It will be noted that the fluid forced upwardly alternately through pipes 24 and 27 will be discharged transversely through the discharge port 42 in the casing 25, as the ports 43 in the control piston are alternately placed in registration therewith and with the ports 35 and 36.

It is advantageous to obtain a quick reversing of the operation and movement of the piston 32, and to accomplish this result, the piston is provided with an upwardly extending rod 44 which extends through the upper side of the diaphragm casing 38, and is provided with a rectangularly shaped cam 45, which has mounted thereon substantially horizontally disposed bar 46 at 47. Pivotally connected at 48 to the upper side of the diaphragm casing 38 are upwardly extending rocker arms 49, the upper ends of which are connected together by a rod 50 which extends therethrough and preferably through elongated apertures therein. Interposed between the outer sides of the arms 49 and washers 52, carried by the outer end of the rod 50 are expansion springs 53 for normally forcing the free ends of the arms 49 towards each other.

Pivotally connected at 54 to the arms 49 and slidably connected at 55 to the outer ends of the bar 46 are rock levers 56, the inner ends of which are provided with rollers 57 which are engaged by the rectangularly shaped cam member 45 which has opposite corners horizontally disposed so that when the diaphragm forces the cam above or below the rollers there will be a quick movement incident to the rock levers 56 being moved at the same time as the bar 46 and the spring action forcing the arms 49 towards each other will quickly complete the movement in either direction.

From the above it will be seen that a balance liquid well pump is provided which is quick in operation and one wherein the weight of the liquid column is utilized for balancing the fluid pressure, consequently the overbalancing of pressure can be easily overcome by a pump, pressure from which is alternately applied to the liquid columns in a manner whereby it will force upwardly or downwardly the piston for raising and trapping fluid to be lifted by successive operation.

Where the device is used in connection with the lifting of liquids which would damage the diaphragm, a sliding piston may be substituted therefor if desired.

The invention having been set forth what is claimed as new and useful is:

1. A well pumping device comprising a well casing, a hollow cylinder within said casing in spaced relation thereto, a flange carried by said cylinder and forming the casing into upper and lower compartments with the upper portion of the cylinder in the upper compartment and the lower portion of the cylinder in the lower compartment, a double piston within the cylinder, said double piston having a chambered portion slidably mounted in the flange, a valve carried by the lower piston, a valve carried by the upper piston, valve means for trapping fluid in the lower end of the cylinder upon upward movement of the piston, said valve means in the lower piston forming means whereby upon downwardly movement of the chambered member connecting the pistons fluid trapped in the lower end of the cylinder will be transferred to a position within the chamber of the cylinder above said valve means and upon upward movement of the pistons said last named fluid will be transferred into the chambered member connecting the pistons

and forced upwardly through the valve control means carried by the upper piston.

2. A pressure well pump comprising a well casing into the lower end of which fluid rises, said well casing having a stationary cylinder therein of smaller diameter, means for dividing the well casing and cylinder into upper and lower chambers, a reciprocating hollow piston rod within the cylinder, a valve carried by the lower end of the piston rod and past which liquid passes to the lower chamber of the cylinder upon downward movement of the piston, a valve carried by the upper end of the piston rod and past which fluid is forced on the upward strokes of the piston rod and means for alternately applying pressure to the upper chamber of the casing and the upper chamber of the cylinder whereby said piston will be forced upwardly and alternately applying pressure to the upper end of the piston for forcing said piston downwardly.

3. A well pumping device comprising a well casing, a cylinder within said casing in spaced relation thereto, a partition dividing said cylinder and well casing into upper and lower chambers, a hollow piston rod slidably mounted in said partition, an upper valved piston carried by the piston rod within the upper chamber of the cylinder, a lower valved piston carried by the lower end of the piston rod, means for alternately applying pressure to the upper and under sides of the upper piston within the upper chamber of the cylinder, said valved lower piston forming means whereby upon downward movement of the piston rod fluid trapped in the lower end of the lower cylinder chamber will be transferred to said chamber above the valved piston and upon upward movement of the piston rod fluid within the lower chamber above the lower piston will be forced upwardly through the piston rod.

4. A device as set forth in claim 3 wherein the lower piston comprises a vertically movable weighted disc valve, and ports in the piston to the sides of the valve and positioned whereby when the disc valve is in lowered position the lower portion of the ports are closed and when in upper position the lower portion of said ports are opened.

5. A device as set forth in claim 3 including disc valves carried by the valved pistons, said disc valves alternately opening and closing the ports.

6. A device as set forth in claim 3 including a disc valve carried by the lower end of the cylinder, said disc valve being opened upon upward strokes of the piston and closed upon downward strokes, the valved lower piston being controlled by a disc valve opened on the downward stroke of the piston and closed on the upward strokes thereof.

7. A device as set forth in claim 3 including ports of communication between the upper chambers of the casing and the upper chamber of the cylinder, whereby pressure is admitted to the underside of the upper valved piston around the hollow piston rod.

8. A device as set forth in claim 3 including a diphragm controlled piston, a pressure supply source in connection with said diaphragm control piston, a discharge pipe from the well cylinder, a pressure supply pipe from the upper chamber of the cylinder chamber, ports in the diaphragm controlled piston positioned whereby pressure from the pressure source of supply will be alternately applied to said pressure pipe and discharge pipe and means whereby when the pressure on either of said pipes is unbalanced pressure on the diaphragm will be shifted from one side to the other and the piston moved for the reversing operation and means for discharging lifted liquid from the discharge pipe through ports in the piston.

9. The combination with a well pumping device having a reciprocating piston therein reciprocated by an overbalancing pressure in a pressure supply pipe and a discharge pipe, of a diaphragm controlled piston having ports alternately registerable with said pipes upon overbalancing of pressure, a casing in which said diaphragm controlled piston is slidably mounted, branch pipe connections between said pipes and opposite sides of the diaphragm for shifting pressure from one side to the other for the reversing operation, a source of pressure supply and ports carried by the diaphragm control piston and adapted to register with discharge ports in the diaphragm control casing.

10. A device as set forth in claim 9 including cushioning cylinders carried by the branch pipes.

11. A device as set forth in claim 9 including spring control means in connection with the diaphragm controlled valve whereby there will be a relatively quick movement of the diaphragm at the time of shifting of the piston.

12. A device as set forth in claim 9 including a piston rod carried by the diaphragm, a rectangularly shaped cam member carried by said piston and having upwardly and downwardly converging cam surfaces, upwardly extending pivoted arms at opposite sides of the cam, roller carrying arms pivoted to the upwardly extending arms and having rollers cooperating with complementary cam surfaces of the cam, the outer ends of said roller arms having a loose connection with the horizontal arm carried by the cam, a rod extending through the upper ends of the upwardly extending arms and springs carried by said rods and cooperating with the outer sides of the upwardly extending arms for normally forcing the same towards each other.

13. The combination with a well pumping device having a reciprocating piston therein reciprocated by an overbalancing pressure, a pressure supply pipe connected to said pumping device, a discharge pipe connected to said pumping device, a source of pressure supply for said pipes, of a control member having ports alternately registering with said pressure supply pipe and discharge pipe, said control member being controlled by an alternate overbalancing of pressure in the pressure supply pipe and discharge pipe.

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