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2,299,692

PUMPING APPARATUS

Filed May 21, 1940

2 Sheets-Sheet 1

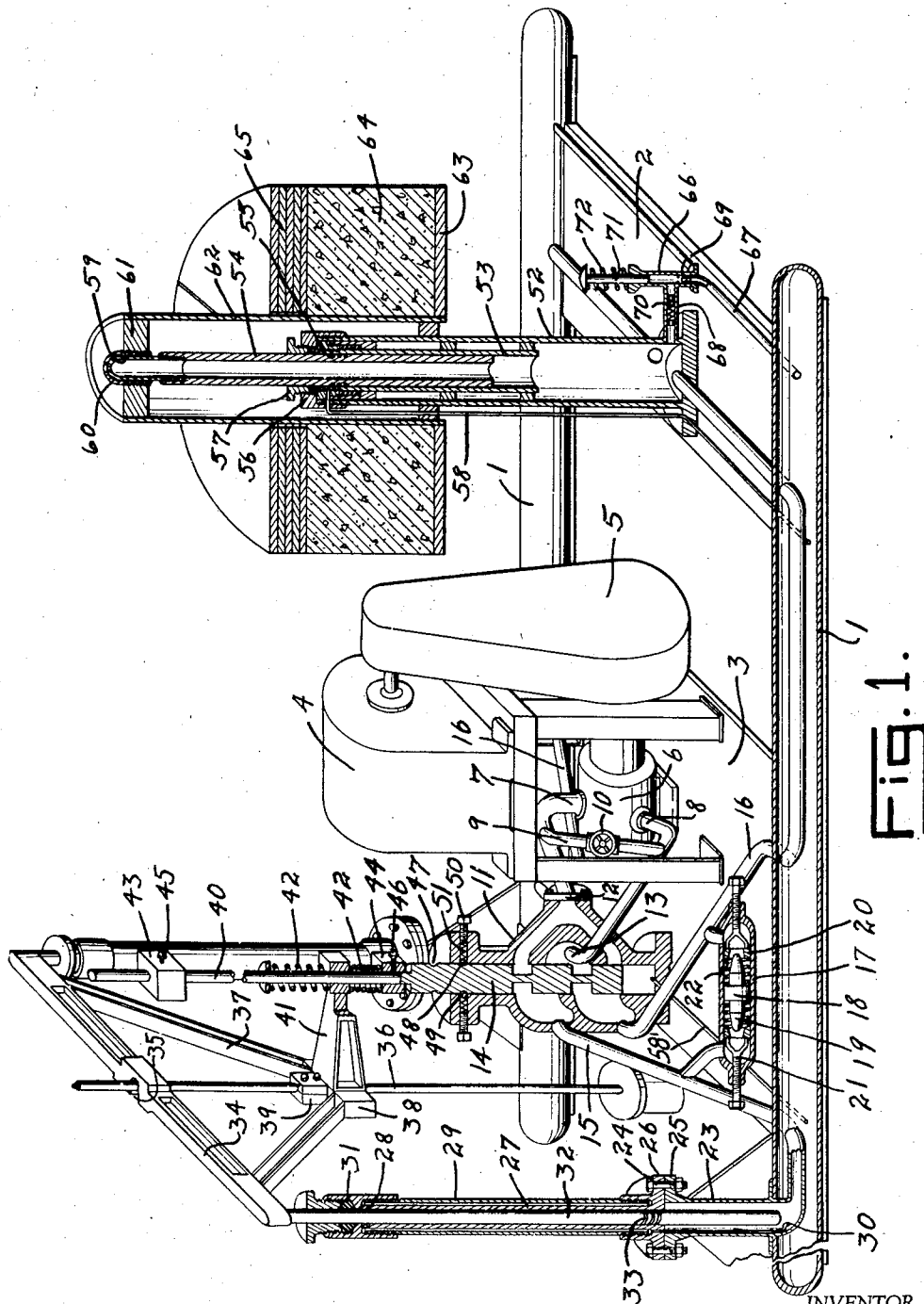


Fig. 1.

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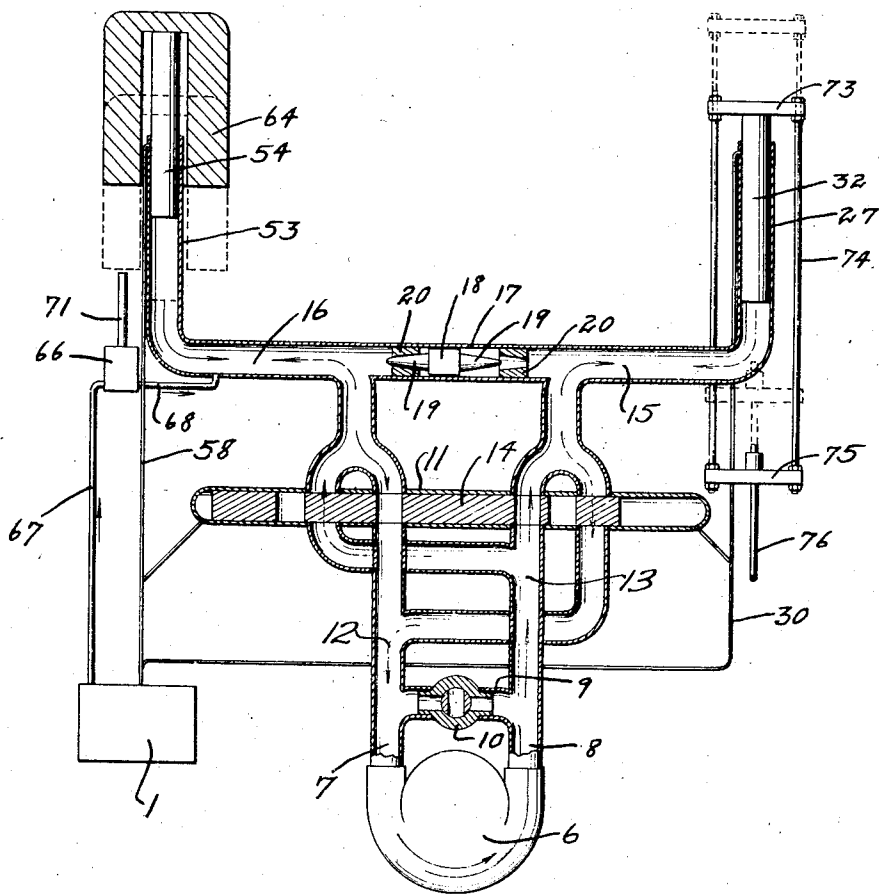


Fig. 2.

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2,299,692

PUMPING APPARATUS

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Application May 21, 1940, Serial No. 336,331

2 Claims. (Cl. 60—52)

This invention relates to pumping apparatus and particularly to a means for pumping liquid from deep wells. One object of this invention is to provide such a device in which the pumping element reciprocates through a cycle, the timing and extent of which may be controlled accurately and at the will of the operator.

Another object of this invention is to provide a device of the character referred to in which the transmission of power is accomplished through the medium of hydraulic transmission in a system which may be maintained full at all times.

Another object of this invention is to provide such a device in which the weight of the reciprocating pumping parts is counterbalanced with a substantially constant force.

Another object of this invention is to provide a means for maintaining a liquid transmission system of the type set forth filled to a predetermined degree.

Another object of this invention is to provide a means for absorbing the shock which would otherwise be encountered in the reversal of the direction of movement of the parts in a reciprocating pumping system employing a hydraulic transmission.

Another object of this invention is to provide a construction in which a unidirectional hydraulic pumping mechanism may be utilized for the purpose of driving reciprocating deep well pumping mechanism with the least possible consumption of power and with the least possible shock and wear and tear on the apparatus.

Another object is to provide a means for maintaining the liquid to be supplied to the transmission system at substantially the same temperature as the liquid within the system.

Another object is to provide a means whereby the liquid transmission system may be rendered inoperative, to permit free movement of the prime mover.

Another object of this invention is to provide a structure in which the necessity for high pressure stuffing boxes will be eliminated.

Another object is to provide a counterweight structure for a device of the character referred to, which structure will be cheap to construct and easy to adjust and at the same time readily handled whenever it may become necessary to obtain access to and work upon the support therefor.

Another object of this invention is to provide a novel and advantageous means for supporting the pumping rods.

Other objects and advantages of this invention will become apparent from the following description, taken in connection with the accompanying drawings.

In the drawings:

Fig. 1 is a perspective view illustrating a pumping apparatus constructed in accordance with this invention, parts of the same being broken away and shown in cross section for the purpose of illustration.

Fig. 2 is a diagrammatic view showing the hydraulic flow cycle employed in the device illustrated in Fig. 1.

Referring more in detail to Fig. 1, the apparatus is adapted to rest upon a frame comprising a pair of hollow beams 1, joined together by means of cross members 2 and 3. The source of power in this illustration is the motor 4, which may be of any desired type, and which, through any conventional driving mechanism 5, propels the rotary pump 6. This rotary pump 6 is provided with intake 7 and output or exhaust line 8. These lines may be joined by a by-pass line 9, controlled by a manual valve 10.

The intake and exhaust from the pump 6 are connected to a slide valve 11 at the points 12 and 13, respectively. The active element of the slide valve 11 is the slide 14 and movement of this slide, as will readily be seen, will serve to connect the inlet and outlet of the pump 6 alternately to the lines 15 and 16. When in the position shown in Fig. 1, the inlet to the pump is in communication with the pipe 15 and the outlet from the pump is in communication with the pipe 16.

It will be understood that in actual practice there are two pipes 15 and two pipes 16 because in the form illustrated there are two power cylinders, as will be presently described.

The driving mechanism just described is mounted on the cross member 3 in Fig. 1 and these parts are positioned between the cylindrical hollow supports 1.

Between the pipes 15 and 16 there is also connected a cylindrical shock absorbing device 17 having a piston 18 therein. This piston 18 is provided with oppositely extending tapered plungers 19 adapted to engage respectively within the openings through the orifice members 20. These orifice members 20 are adjustable toward and away from each other by means of the screws 21, and between each of these orifice members and the piston 18 is a spring 22. These springs 22 serve to normally center the piston 18 between the orifice members 20 but it will be seen,

that when the piston 18 is moved toward either one or the other of these orifice members, the tapered plunger on one end of the piston will enter the opening in such orifice member and gradually choke the passage therethrough until it substantially closes the same.

The pipes 15 and 16 both extend into one of the hollow support members 1 and through such support member for a substantial distance. The pipe 15 then emerges into communication with the cylinder support 23 to which is secured, by means of bolts 24 through the flanges 25 and 26, a power cylinder 27. This power cylinder 27 has lateral openings therefrom at 28 adjacent its upper end and surrounding the power cylinder 27 is a jacket 29 just slightly larger than the power cylinder so as to provide an annular space about the power cylinder and in communication with the power cylinder at its upper end. This annular space is connected through a small drain tube 30 with the interior of the hollow member 1. To the upper end of the sleeve 29 is secured a low pressure stuffing box 31 which serves principally as a means for wiping any liquid from the plunger 32 as that plunger is withdrawn from the cylinder 27. The plunger 32 is provided at an appropriate point of its length with suitable piston rings 33, or the like.

It will be appreciated that there are two of the power cylinder assemblies such as just described, one on either side of the device. Suspended on the upper end of each of the plungers 32 is a beam 34, this beam having a notch 35 adjacent its central portion for the purpose of accommodating the upper end of the polish rod 36. Extending downwardly and toward each other from points adjacent the opposite ends of the beam 34, are suspension arms 37 carrying a block 38 between them. This block 38 is adapted to support a clamping member 39 for clamping the polish rod 36 and suspending it from a point below the points of suspension of the beam 34 on the plungers 32. There is thus provided a balanced suspension for the polish rod 36.

Extending laterally from the block 38, and having a part surrounding the rod 40 which forms a part of the slide 14 is an arm 41 for operating the valve slide 14.

Above and below the arm 41 and surrounding the rod 40 are coiled springs 42, and at predetermined spaced points above and below the arm 41 respectively are timing blocks 43 and 44, secured against sliding on the rod 40 by means of setscrews 45 and 46, respectively. The slide 14 is provided at a suitable point with depressions 47 and 48 adapted to receive spring pressed balls 49, held in place by screws 50 and springs 51. These balls tend to hold the slide valve releasably against movement from one extreme position to the other.

It will be seen that when the polish rod 36 moves upwardly, the arm 41 will travel upwardly along the rod 40 until the upper end of the spring 42 engages the block 43. Thereupon, the tension upon the spring 42 will increase until it becomes great enough to move the slide 14 despite the action of the spring pressed balls 48. The slide will then move with a snap action to its uppermost position, being urged to such position by the spring 42. This reverses the direction of flow of the liquid so that the polish rod will begin to move downwardly and when it reaches its lower end the same action will take place in the opposite direction so as to again reverse the flow of the liquid used in the transmission system.

The pipe 16 extends in the opposite direction from the cylinder supports 23 and emerges from the hollow member 1 to enter the lower end of a counterbalance chamber 52. Within this chamber is a cylinder 53 and a plunger 54 is reciprocable within the cylinder 53, the same having piston rings 55, or the like, thereon to form a substantial seal within the cylinder 53. The cylinder 53 is supported by suitable means, such as the cap 56 at the upper end of the chamber 52 and this cap carries a stuffing box 57 capable of resisting low pressure and wiping any liquid from the plunger 54. Any liquid leaking past the piston rings 55 will be drained back through the small drain tube 58 into the interior of the hollow member 1.

Mounted on the upper end of the plunger 54 is a plug 59 having a rounded upper end adapted to receive a second plug 60, which, through the medium of a head 61, suspends the hollow counterweight stem 62. This stem 62 carries a supporting plate 63 at its lower end and resting on this supporting plate 63 is an annular counterweight 64. This counterweight may be of concrete or of any other desirable substance. On its upper surface the counterweight is supplied with a plurality of small annular counterweights 65, which are removable and which may be employed to adjust the total counterweight to the exact value desired.

Adjacent the lower end of the counterweight chamber 52 is a small pump cylinder 66 having its inlet communicating through a pipe 67 with the interior of the hollow member 1 and having its outlet communicating with the lower end of the chamber 52 through a pipe 68. Check valves 69 and 70 are provided in said respective pipes 67 and 68 to prevent flow therethrough from the chamber 52 toward the hollow member 1. The plunger 71 is slidably mounted in the cylinder 66 and is normally held in the upper position by a spring 72.

It will be seen that when the liquid in the transmission system leaks therefrom, in an amount such as to cause the counterweight to move downwardly an excessive amount on any stroke, the counterweight will strike the upper end of the plunger 71 forcing it downwardly and injecting a small amount of liquid into the lower end of the chamber 52.

There is also a drain tube 58' between the space below the lower end of the slide 14 and the hollow member 1 permitting communication between these parts.

The foregoing structure is set forth in diagrammatic form in Fig. 2 of the drawings wherein like numerals indicate corresponding parts, one of the principal differences between the structure shown in Fig. 1 and that shown in Fig. 2 being that in Fig. 2 only a single power cylinder is illustrated and the suspension of the polish rod is by means of a cross head 73 resting on the upper end of the power piston, a pair of suspension bolts 74 extending downwardly from the opposite ends thereof, and a second cross head 75 at the lower ends of these bolts. The polish rod 76 is suspended from the cross head 75 at a position centrally thereof.

In operation, the hollow members 1 will be partly filled with operating liquid to provide a liquid supply. The entire transmission system, including the pump 6, the pipes 7 and 8, the valve 11, the pipes 15 and 16, and the cylindrical chambers 23 and 52, will likewise be substantially filled with this operating liquid. A suf-

ficient amount of such liquid will be placed in this system so that when the counterweight is in its lowermost position of operation, the power plungers 32 will be in their uppermost position.

With the by-pass valve 10 open, the motor 4 will be started to act through the gearing 5 and drive the pump 6. The pump may be brought up to speed easily because it will be doing substantially no work, the liquid being by-passed from the output 8 through the by-pass 9 and into the inlet 7.

When the pump has been brought up to speed, the valve 10 may be closed, whereupon if it be assumed that the parts are in the position shown in Fig. 1, liquid from the output from the pump will be forced through the valve 11 and the pipe 16 into the counterbalance chamber 52, thus serving to lift the counterbalance higher. This movement will be accentuated by the weight of the sucker rods hanging on the polish rod 36 and forcing the plunger 32 downwardly. Liquid will thus be forced from below these plungers through the pipes 15 and the valve 11 to the intake 7 of the pump. When the arm 41 reaches the lowermost position, so that the spring 42 therebelow becomes sufficiently compressed against the block 44, which is the condition shown in Fig. 1, the valve slide 14 will be shifted to its lower position and the balls 49 will enter the uppermost notches 47. This shifting of the valve slide 14 will cause the output from the pump 6 to be directed into the pipe 15, thus reversing the direction of flow in this pipe. At the same time, the input to the pump will be connected to the pipe 16 so as to take fluid from the counterbalance chamber 52.

In order to absorb the shock of reversing the direction of flow in the liquid in the pipe 15 and the reversing of the direction of movement of the plunger 32 and the rods and other parts carried thereby, a portion of this fluid is deflected into the shock absorber 17, where it acts upon the piston 18 to move it toward the right as seen in Fig. 1. This movement toward the right at first takes place very freely being opposed only by the spring 22 but as the tapered plunger 19 begins to enter the opening in the orifice member 20, flow from the space ahead of the piston 18 is choked down and the piston is thus slowed to a stop. In the meantime, however, the shock of reversing the flow in the pipe 15, together with the reversal of all of the mechanical parts connected to the plunger 32 will have been taken up and the movement in the opposite direction may proceed.

When the plunger 32 reaches the uppermost limit of its intended travel, the upper spring 42 will become compressed and will act to move the rod 40 upwardly, thus again reversing the flow of fluids in the pipes 15 and 16 and allowing the plunger 32 to move downwardly while raising the counterweight 64. The shock of this reversal is taken in the same manner by the same piston 18.

As heretofore noted, any leakage from any of

the cylinders or from the space below the valve 14 will be drained back into the liquid supply within the member 1. The liquid within the system will be replenished as such leakage occurs by the pump 66, as hereinbefore described.

During the operation of the device, the liquid being employed in the transmission of power will naturally become heated. In order to avoid the injection of cold liquid into the heated liquid in the transmission system, the pipes 15 and 16 pass through the members 1, which constitute the fluid supply reservoir, as hereinbefore mentioned, and thus maintain the supply of liquid in the fluid reservoir at substantially the same temperature as the fluid being used in the transmission system.

It will be seen that the stroke of the well pumping device just described may be varied at the will of the operator by merely shifting the blocks 45 and 46 upon the rod 40. Thus, not only may the length of the stroke be varied, but the travel of the rods may be as a whole raised or lowered.

Having described my invention, I claim:

1. In a pumping apparatus, a pair of chambers each having an inlet port remote from its upper end, a gravity depressed plunger operable in each chamber, a pump plunger connected to one of said first mentioned plungers to be operated thereby, a unidirectional pump, means for connecting said pump to said chambers to receive liquid from one chamber and force it into the other, a liquid transmission medium in said chambers, pump and connecting means, means carried by one of said plungers for reversing the connections between said chambers and said pump when said plunger reaches each end of its stroke, a cylinder having one end connected to each of said chambers, a piston slidably mounted within said cylinder, a choke opening on each side of said piston, and means closing said choke opening on movement of said piston to check movement of said piston.

2. In a pumping apparatus, a pair of chambers each having an inlet port remote from its upper end, a gravity depressed plunger operable in each chamber, a pump plunger connected to one of said first mentioned plungers to be operated thereby, a unidirectional pump, means for connecting said pump to said chambers to receive liquid from one chamber and force it into the other, a liquid transmission medium in said chambers, pump and connecting means, means carried by one of said plungers for reversing the connections between said chambers and said pump when said plunger reaches each end of its stroke, a cylinder having one end connected to each of said chambers, a piston slidably mounted within said cylinder, a choke opening on each side of said piston, means closing said choke opening on movement of said piston to check movement of said piston, and resilient means on each side of said piston for normally retaining it in a central position within said cylinder.

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