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VALVE HEAD FOR OIL OPERATED WELL PUMPS

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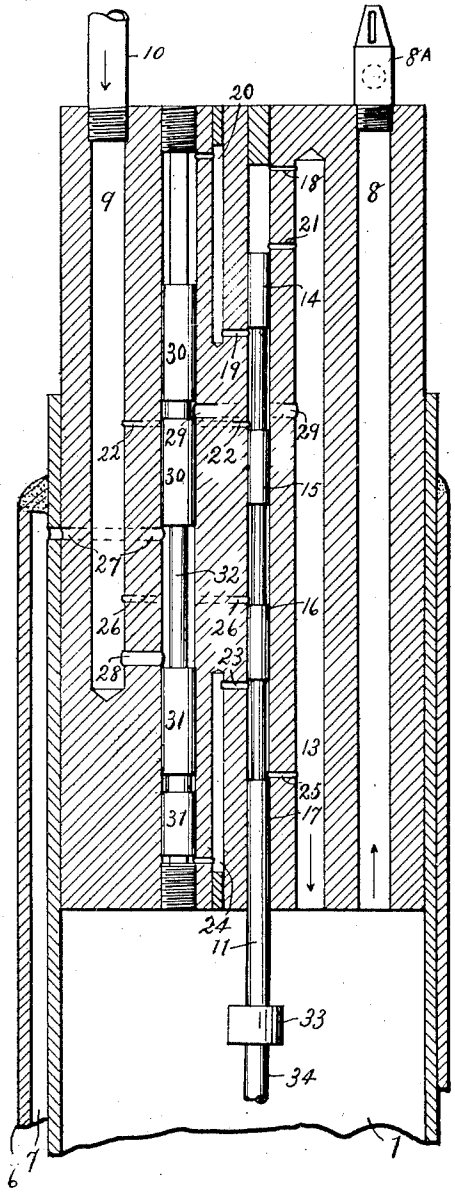


Fig. 1.

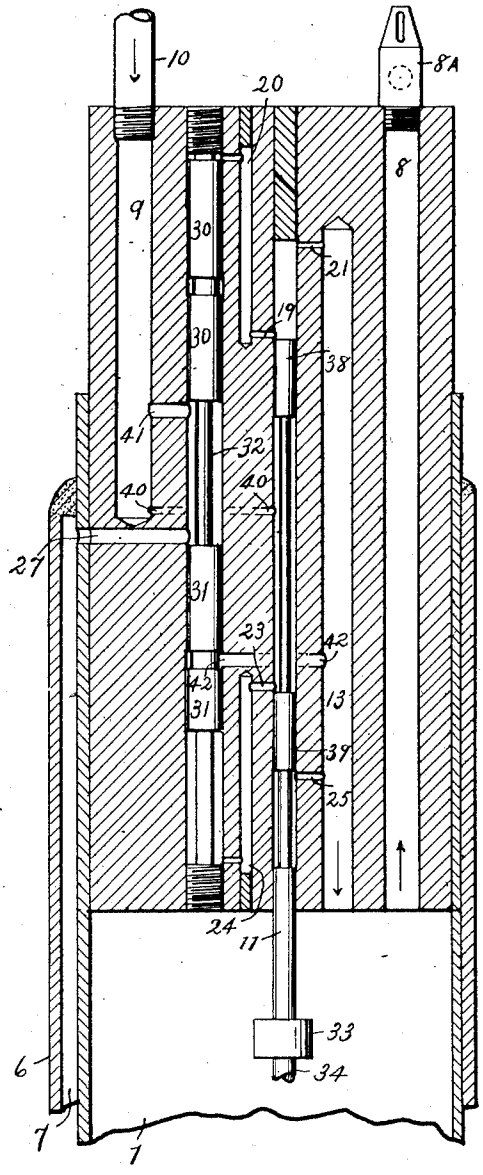


Fig. 2.

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Fig. 3

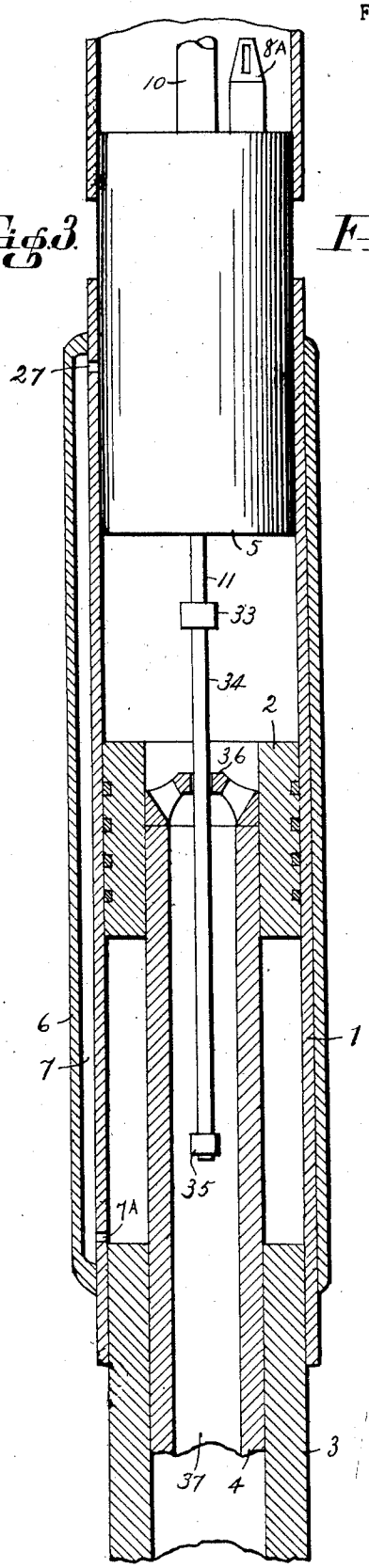
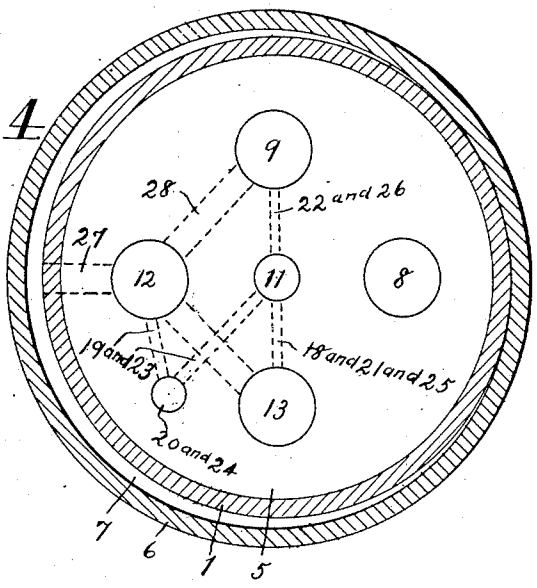


Fig. 4



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UNITED STATES PATENT OFFICE.

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VALVE HEAD FOR OIL-OPERATED WELL PUMPS.

Application filed December 26, 1924. Serial No. 758,298.

The present invention refers mainly to the valve mechanism and system of ports or oil ways necessary to the operation of a device for pumping oil from very deep wells and operated by oil under pressure. The objects being to provide a system of valves that will have long life in operating such a pump under heavy pressures, to make a valve head in which, by a certain arrangement of ports, the heavy pressures exerted on the valves are partly balanced and to provide means whereby the oil used to operate the valve head and the piston of the pump is discharged through the valve head into the same cylinder which operates to elevate oil from the well to the surface of the ground. Other objects may appear hereinafter.

With reference to the drawings,—

Fig. 1 shows in sectional elevation all the valves and ports of the valve head forming the basis of the present invention.

Fig. 2 is a view in vertical elevation of the valves and ports shown in Fig. 1 and having some modification. This view and also Fig. 1 shows the valves and ports not in proper relative position but rather extended out on a common vertical plane.

Fig. 3 is an elevation, partly in section, of the valve head and its pumping cylinder piston and plunger.

Fig. 4 is a transverse sectional view of the valve head, the view being in part diagrammatical and showing by dotted lines all the transverse connecting ports for longitudinal bores.

The deep well oil operated pump of which the above mentioned valve head is an essential part, comprises, with reference to Fig. 3, a cylinder 1 having a piston 2. A second cylinder 3 forms a lower extension of the cylinder 1 and carries a plunger 4 which is fixed to the under side of the piston 2. In the top of the cylinder 1 is the valve head 5 and surrounding the cylinder is a jacket 6 placed eccentrically so as to form a channel 7 along one side from top to bottom, the jacket 7 being welded to the cylinder at top and bottom.

The valve head 5, more specifically, comprises a through bore 8 having a ball check valve 8^a screwed into the top end thereof and forming the discharge means for that part of the cylinder 1 above the piston 2, an inlet bore 9 into which it is intended to connect a high pressure oil feed conduit 10, which extends to the surface of the ground, a pilot valve bore in the center carrying a pilot valve 11, a master valve bore carrying a master valve 12 and an under discharge bore 13 opening into the top of the cylinder 1.

The pilot valve is provided in Fig. 1 with piston sections 14, and 15 at the top and 16 and 17 at the bottom. A small vent port 18 connects the top of the pilot valve bore with the under discharge bore 13. Near the top a small port 19 connects the pilot valve bore with the top end of the master valve bore through a longitudinal bore 20. Above the port 19 a small port 21 connects the pilot valve bore with the under discharge bore 13 and below the port 19 a small port 22 connects the pilot valve bore with the inlet bore 9. At the bottom of the pilot valve bore a small port 23 connects that bore with the bottom end of the master valve bore through a longitudinal bore 24. Below the port 23 a port 25 connects the pilot valve bore with the under discharge bore 13 and above the port 23 a port 26 connects the pilot valve bore with the inlet bore 9. The pistons 14 and 15 formed at the top of the pilot valve operate, by a sliding movement of the valve, to open and close alternately ports 21 and 22 to port 19 and the pistons 16 and 17 at the bottom of the pilot valve operate to alternately open and close ports 25 and 26 to port 23.

The master valve bore is connected with the side channel 7 by a big cross port 27 and is also connected with the inlet bore 9, below the port 27, by a port 28 and above the port 27, by a port 29 with the under discharge bore 13. The master valve 12 carries a piston 30 at the top and a piston 31 at the bottom connected by a recessed section 32 which by a sliding movement of the valve to the top and bottom of its bore alternately opens and closes port 27 to the ports 28 and 29.

The pilot valve extends into the cylinder 1 and is provided with a coller 33, a stem 34 and a second collar 35 at the lower end of

the stem. The piston 2 and plunger 4 are provided with a central bore 37 in which is disposed a trip 36 adapted to operate the pilot valve through the collars 33 and 35 by the stroking of the pump, the stem 34 depending into the bore 37 the length of the pumping stroke. In the bore of the plunger a foot valve, not shown, is mounted, the bore acting as the inlet means for that part of the cylinder above the piston 2.

In the modification shown in Fig. 2 all the longitudinal bores are the same as in Fig. 1, the change being mainly in the form of the pilot valve and its ports as follows: The pilot valve is provided with a piston 38 at the top end, there being but one cross port 40 connecting the inlet bore with the pilot valve bore. The upper piston 38 is designed to open and close alternately port 40 and port 21 to port 19 and the lower piston 39 to open and close alternately port 40 and port 25 to port 23. Another change being in the position of the large ports connecting into the master valve bore. Where in Fig. 1 the inlet port 28 is below and the outlet port 29 is above the port 27, in Fig. 2 an inlet port 41 is above and an outlet port 42 is below the port 27. Thus in Fig. 1 when the pilot valve is pulled down the master valve is moved to the bottom of its bore and in Fig. 2 when the pilot valve is pulled down the master valve is moved to the top of its bore but in each case effecting the same result.

The master valve is formed with hollow ends and the master valve bore is closed at top and bottom with screwed plugs 43 and 44, respectively, and having extensions 45 and 46 which have a loose fit in the hollow ends and when seated therein form the top and bottom stops for the valve.

The pump herein set forth is designed to operate on high pressure oil admitted to the cylinder 1 under the piston 2 which forces the piston up to discharge oil from the well which enters the space above the piston through the foot valve and bore 37. The down stroke of the piston and plunger is effected by gravity and the oil under the piston which actuated it to the top of the stroke is discharged through the valve head into the top or pumping end of the cylinder. On account of a differential of piston areas created by the area of the plunger fixed to the under side of the piston a lesser volume of oil is used to operate the pump upwardly than the volume occupying the space above the piston. Therefore in its operation the pump delivers to the surface of the ground more oil than it takes to operate it, the volume of net oil being equal, theoretically, to the effective volume of the plunger.

In the operation of the present invention with high pressure oil in the bore 9 a small volume passes through the port 22, pilot valve bore, port 19 and bore 20 into the master valve bore and forces the master valve to the bottom of its bore, the oil under the master valve passing out through port 23, bore 24, pilot valve bore and port 25 into the bore 13. In the cylinder, at the time of this action, is a volume of well oil drawn in by the downward movement of the piston and plunger. With the master valve in this position high pressure oil passes from the bore 9 through port 28, master valve bore, port 27, channel 7 and a port 7^a into the cylinder 1 below the piston 2, thus forcing it up and discharging the oil above it out through the bore 8 and check valve 8^a. When the piston reaches the top of its stroke and engages the collar 33 the pilot valve is moved up thus admitting high pressure oil from the bore 9 by port 26, pilot valve bore, port 23 and bore 24 to the bottom of the master valve bore thus forcing the master valve to the top of its bore, the oil above the master valve passing into the bore 13 through port 19, bore 20, pilot valve bore and port 21. With the master valve in this position the high pressure oil is cut off and the port 7^A channel 7 and port 27 are open to the bore 13 through the master valve bore, between pistons 30 and 31 and port 29. Thus by the weight of the piston 2 and plunger 4 the oil under the piston is forced into the top of the cylinder from which it is subsequently discharged with other oil from the well to the surface of the ground.

When the piston 2 reaches the bottom of its stroke the collar 35 is engaged by the trip 36 and the pilot valve is again pulled down thus completing the cycle.

It will be noted by following through the bore 13 and ports 29, 21 and 25 that, during the up stroke of the piston 2 when the top end cylinder 1 is under a pressure equal to the static head of oil from the pump to the surface of the ground, that certain pistons of both the master valve and the pilot valve, which have on one side the high pressure oil from the bore 9, have on the other side the static pressure above mentioned and the pressures on opposite sides are therefore in part balanced thus to some extent lengthening the life of the valves.

It will be seen by the foregoing that the upper end of the cylinder 1 is a pumping end and that the lower end is an actuating end and they are so designated in the claims.

It is to be understood that outside of the modifications shown in Fig. 2, other changes might be made in the invention as set forth without departing from the spirit thereof as claimed.

Having thus described our invention, we claim:

1. In an oil operated well pump in combination with a cylinder having a pumping end and an actuating end and adapted

to operate in a vertical position with the pumping end above the actuating end, a piston for the cylinder, a plunger fixed to the piston and depending through the lower end of the cylinder and adapted to the purpose of decreasing the area of the actuating side of the piston, an inlet means for the pumping end of the cylinder, a discharge means for the pumping end of the cylinder and a port for the actuating end of the cylinder, a valve head mounted in the pumping end of the cylinder comprising a body member, an inlet bore adapted to receive oil under pressure, a discharge bore opening into the pumping end of the cylinder, a master valve bore, a pilot valve bore, an inlet port connecting the inlet bore with the master valve bore, a discharge port connecting the master valve bore with the above mentioned discharge bore, a port connecting the master valve bore with the port of the actuating end of the cylinder, a master valve mounted slidably in the master valve bore and having pistons adapted to open and close alternately the inlet and discharge ports, above named, to the port communicating with the actuating end of the cylinder, inlet ports connecting the inlet bore with the pilot valve bore, a port connecting the pilot valve bore with the top end of the master valve bore, a port connecting the pilot valve bore with the bottom end of the master valve bore, discharge ports connecting the pilot valve bore with the discharge bore, a pilot valve slidably mounted in the pilot valve bore and having pistons adapted to open and close alternately the inlet and discharge ports, last above mentioned, to the ports connecting with the master valve bore and means for operating the pilot valve by the stroking of the piston within the cylinder.

2. In an oil operated well pump in combination with a cylinder having a pumping end and an actuating end and adapted to operate in a vertical position with the pumping end above the actuating end, a piston for the cylinder, a plunger fixed to the piston and depending through the actuating end of the cylinder and adapted to the purpose of decreasing the area of the under side of the piston, an inlet means for the pumping end of the cylinder, a discharge means for the pumping end of the cylinder, and a port for the actuating end of the cylinder, a valve head operatively mounted relative to the cylinder, an inlet bore for the valve head, a discharge bore for the valve head communicating with the pumping end of the cylinder, valves for the valve head adapted to operate the piston upwardly through a discharging stroke and to then transfer the fluid which was required to operate the piston upwardly into the pumping end of the cylinder and means for operating the valves by the stroking of the piston.

3. In an oil operated well pump in combination with a cylinder having a pumping end and an actuating end and adapted to operate in a vertical position with the pumping end above the actuating end, a piston for the cylinder, a plunger fixed to the under side of the piston and depending through the actuating end of the cylinder and adapted to decrease the area of the under side of the piston, an inlet means for the pumping end of the cylinder, a discharge means for the pumping end of the cylinder, and an inlet and discharge port for the actuating end of the piston, a valve head operatively mounted relative to the cylinder, an inlet bore for the valve head adapted to receive actuating fluid under pressure, valves for the valve head for operating the piston by high pressure fluid from the inlet bore and adapted to be operated by the stroking of the piston and means for partly balancing the pressure on the valves of the high pressure fluid from the inlet bore with the pressure of the discharging column of fluid extending from the pump to the surface of the ground.

4. An oil operated well pump in combination with a cylinder having a pumping end and an actuating end and adapted to operate in a vertical position with the pumping end above the actuating end, a piston for the cylinder, a plunger fixed to the under side of the piston and extending through the actuating end of the cylinder and adapted to the purpose of decreasing the area of the under side of the piston, an inlet means for the pumping end of the cylinder, a discharge means for the pumping end of the cylinder and an inlet and discharge port for the actuating end of the cylinder, a valve head operatively mounted relative to the cylinder, an inlet bore for the valve head, a discharge bore for the valve head, connecting with the pumping end of the cylinder, valves for the valve head adapted to operate the piston upwardly through a discharging stroke by high pressure fluid from the inlet bore and to then transfer the fluid, used to actuate the piston upwardly, into the pumping end of the cylinder during a downward movement of the piston, means for partially balancing the pressure on the valves of the high pressure fluid from the inlet bore with the static head of the fluid discharged by the pump and extending to the surface of the ground, and means for operating the valves by the stroking of the piston.

5. In an oil operated well pump in combination with a pumping cylinder operated by fluid under pressure, a valve head operatively mounted relative to the cylinder,

valves mounted in the valve head for operating the cylinder and ports connecting with the cylinder and with the valves adapted to discharge the fluid required to actuate the cylinder into the pumping chamber thereof whereby the actuating fluid is subsequently discharged with the fluid upon which the pump is operating.

6. In an oil operated well pump in combination with a pumping cylinder adapted to be operated by fluid under pressure, a valve head operatively mounted relative to the cylinder, valves mounted in the valve head for operating the cylinder and ports disposed relative to the static pressure against which the pump is operating whereby the said static pressure opposes the working pressure of the operating fluid against the valves.

7. In an oil operated well pump in combination with a pumping cylinder adapted to be operated by fluid under pressure, a valve head operatively mounted relative to the cylinder, valves mounted in the valve head for operating the cylinder, ports connecting with the valves and with the cylinder adapted to conduct actuating fluid to an actuating end of the cylinder and from the actuating end of the cylinder to a pumping end of the cylinder and means comprising an arrangement of the above mentioned ports adapted to balance the working pressure of the actuating fluid upon the valves with the static pressure against which the pump is working.

8. In a valve head, in combination, a body member having certain bores and ports as follows: an inlet bore adapted to conduct an actuating fluid, an under discharge bore, for the purpose set forth, a pilot valve bore, a master valve bore, an inlet port connecting the inlet bore with the master valve bore, a discharge bore connecting the master valve bore with the under discharge bore and suitably spaced from the inlet port, a third port connecting with the master valve bore between the two ports first above mentioned; a master valve mounted in the master valve bore and having pistons adapted to open and close alternately the inlet and the discharge ports to the third port aforesaid, ports connecting the inlet bore with the pilot valve bore, ports connecting the pilot valve bore with the under discharge bore, a port connecting the pilot valve bore with one end of the master valve bore, a port connecting the pilot valve bore with the other end of the master valve bore, a pilot valve mounted in the pilot valve bore and having pistons adapted to open and close the ports of the pilot valve bore in such a manner as to cause a proper movement of the master valve in its bore and a stem for operating the pilot valve.

In testimony whereof, we have hereunto signed our names to this specification.

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CHARLES H. McWILLIAMS.