July 7, 1925. 1,544,898

A. G. GAGE ET AL

OIL OPERATED WELL PUMP

Filed March 27, 1924 2 Sheets-Sheet 1

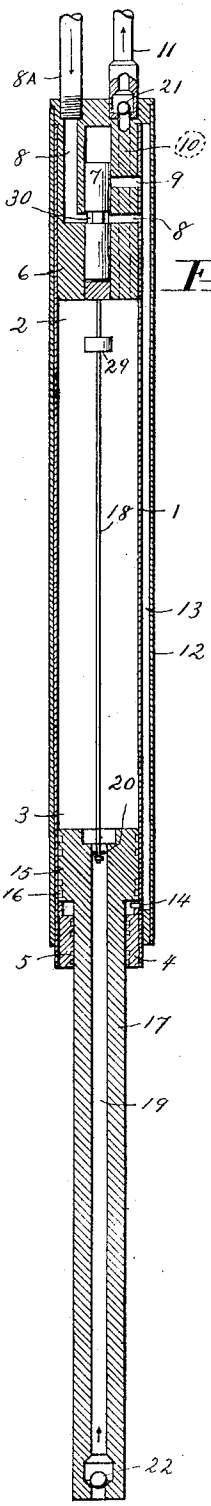


Fig. 1.

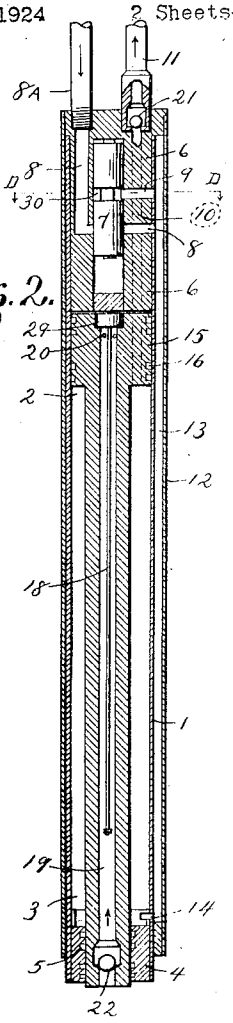


Fig. 2.

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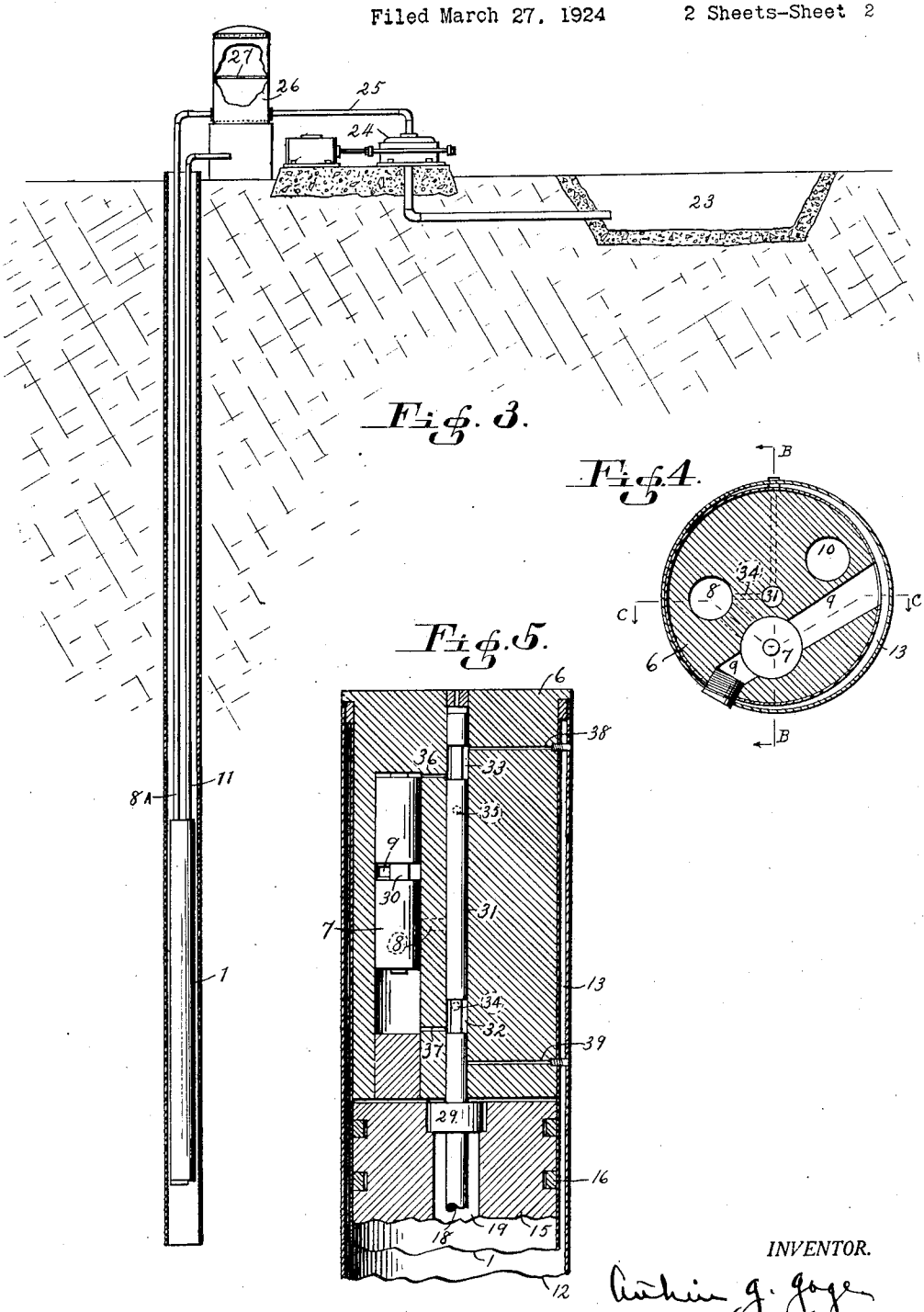


Fig. 3.

Fig. 4.

Fig. 5.

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UNITED STATES PATENT OFFICE.

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OIL-OPERATED WELL PUMP.

Application filed March 27, 1924. Serial No. 702,423.

To all whom it may concern:

Be it known that we, ARTHUR G. GAGE, CHARLES H. McWILLIAMS, and LEWIS M. KELLOGG, all citizens of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented new and useful Improvements in an Oil-Operated Well Pump, of which the following is a specification.

Our invention relates to improvements in pumps adapted particularly to pump oil from deep bored wells, the objects being to provide a piston pumping device which can be operated in a deep bored well without the use of the conventional sucker rods, to make a piston pump that will operate in the bottom of a well casing by means of oil forced down the well under high pressure and to provide a deep well pump in which a discharge or pumping stroke is had by the introduction of high pressure actuating fluid and a return or filling stroke is effected by means of gravity thus necessitating the use of very few working parts.

With reference to the drawings:

Fig. 1 is an elevation in vertical section of the pumping device forming the subject of the present invention and shown at the beginning of a discharging stroke, the upper portion being sectioned on line CC Fig. 4.

Fig. 2 is an elevation in section of the device illustrated in Fig. 1 and shown at the end of a discharging stroke.

Fig. 3 is a general view, in elevation, of the entire device.

Fig. 4 is an enlarged transverse view taken on line DD Fig. 2.

Fig. 5 is an enlarged longitudinally sectioned view of the top portion of the device taken on line BB Fig. 4.

The present invention consists of a cylinder 1 having a pumping end 2 and an actuating end 3. At the lower end of the cylinder is fitted a plug 4 having a central bore carrying packing rings 5 and at the upper end a valve head 6. The head is provided with a bore carrying piston valve 7 having a central channel 30, an inlet port 8, 8, connecting with an inlet conduit 8^A, a discharge port 9, 9 and a central bore carrying a pilot valve 31 having recesses 32 and 33. The bore of the pilot valve is provided with ports 34 and 35 (shown by dotted lines in Figs. 4 and 5) connecting with the inlet port 8. It is provided with ports 36 and 37 connecting it with the top and bottom end of the bore of the valve 7, and discharging ports 38 and 39. A bore 10 is formed through the valve head opening into the top of cylinder 1 at the bottom and connecting at the top with a discharge conduit 11. The cylinder 1 is surrounded by a casing 12 fitting closely at one side and spaced on the opposite side to form a channel 13 which is in open communication with the ports 8, 8 and 9, 9 of the valve head and with a port 14 leading into the bottom of the actuating end of the cylinder.

A piston 15 having rings 16 is carried within the cylinder, there being a plunger 17 formed integral therewith extending down through the plug 4. A valve stem 18 depends from the pilot valve 31 and into a central bore 19 of the piston 15 and plunger 17. On the lower end of the stem 18 is a collar adapted to engage lugs 20 positioned in the top of the bore 19. The discharge conduit 11 carries a check valve 21 and the bore of the plunger 17 a foot valve 22.

The device is designed to operate in a vertical position within a well casing, the actuating fluid being pumped from a capacity tank 23 by a high duty pump 24, the discharge conduit 25 of which is connected with the inlet conduit 8^A. For the reason that the device in the well is a single acting pump a capacity chamber 26 is mounted on the discharge 25 and adapted to receive the oil delivered by the pump 24 during that part of the cycle of the well pump in which the high pressure actuating oil is not required. The top portion of the chamber 26 carries a body of air, there being a close fitting float 27 adapted to ride upon the oil to prevent an excessive absorption of air into the fluid body.

In the present invention the upper end of the cylinder 1 is designated as the pumping end and the lower end of the cylinder as the actuating end.

The actuating end of the cylinder is decreased in its piston area and volume by the area and volume of the plunger 17 therefore the pressure of the oil used to actuate the device must be greater than the pressure of the standing column of oil from the device to the surface of the ground. To illustrate this feature in comparative figures: If the standing column of oil, in the discharge conduit 11, extending to the surface of the

ground is 1000 pounds per square inch and the piston area is decreased by the plunger to one-half then the pressure required in the high pressure end of the cylinder to move the piston upwardly would be 2000 pounds per square inch plus a necessary pressure to overcome all resistances. Thus, in theory, for every one gallon of actuating oil delivered down the well at 2000 pounds pressure there will be delivered out of the well against 1000 pounds pressure two gallons of oil, one of which represents the net gain of the operation.

In the operation of the device, the piston 15 being in the position shown in Fig. 1 the high pressure oil delivered by the pump 24 passes into the port 8 across the recess 30 of the valve 7 into the channel 13 and through the port 14 into the bottom of the cylinder. The piston then moves upwardly discharging the oil above it through the bore 10 and conduit 11. When the piston 15 reaches the top of the cylinder a collar 29 on the valve stem 18 is engaged by the piston and moves the pilot valve upwardly into the position shown in Fig. 5. In this position of the pilot valve the recess 32 opens the port 34 admitting high pressure oil, from the port 8, to the under side of the piston valve 7 which moves that valve to the top of its bore, the oil in the bore above the valve 7 escaping by the port 36 channel 33 and port 38 into the well. In this position of the valve 7, as shown in Fig. 5, its channel 30 connects the channel 13 with the well through port 9, 9 and, the high pressure oil from the port 8 being cut off, the piston 6 and plunger 17 moves downwardly by gravity forcing the oil out the lower end of the cylinder into the well and causing the upper end of the cylinder to fill with oil from the well through foot valve 22 and bore 19 this downward movement being designated as the filling stroke of the pump. When the piston settles to the bottom of the cylinder the collar on the lower end of the stem 18 is engaged by the lugs 20 and the pilot valve 31 is pulled down which movement opens the port 35 allowing high pressure oil to pass into the top of the bore of the valve 7, by the channel 33 and port 36. The valve 7 then moves down to the bottom of its bore and high pressure oil then passes from the port 8 through channel 13 and port 14 into the bottom of the cylinder thus again beginning a discharging stroke of the device. The oil in the bore under the valve flows out into the well by the port 37 channel 32 and port 39. It will be noticed that the pumping end of the cylinder is not only used to pump fresh oil from the formation, but, for the reason that the actuating oil is discharged into the well casing and the well casing acts as a conduit for the actuating oil thus discharged in delivering it to the vicinity of the inlet port of the pump the same cylinder is used to return to the surface of the ground the actuating oil pumped into the well also therefore in a sense the well casing performs an office in the operation of the device. The stroke of the device may be as much as 20 feet giving ample weight in the plunger and piston to return them by gravity to a starting position. Should the plunger be made short or otherwise not have sufficient weight to return the piston to the bottom of the cylinder with proper velocity it will be readily seen that a weight bar may be suspended from the bottom of the plunger to make up the deficiency and thus obtain any required velocity in the filling stroke.

It is obvious that the form of the valves and their operating mechanism may be altered and that many other changes might be made in the device as shown without departing from the spirit thereof as claimed.

Having thus described our invention we claim:

1. In an oil operated well pump, in combination, a cylinder having an actuating end and a pumping 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 extending out through the actuating end of the cylinder and adapted to the purpose of decreasing the area of the piston on its actuating side, an inlet bore extending longitudinally through the plunger and piston into the pumping end of the cylinder, a foot valve mounted in the inlet bore, a valve head mounted in the pumping end of the cylinder, a discharge port for the pumping end of the cylinder formed through the valve head, a check valve mounted in the discharge port, a master valve mounted in the valve head, a pilot valve mounted in the valve head and having a stem depending into the inlet bore formed in the piston and plunger, means for operating the pilot valve through its stem by the stroking of the piston, an actuating oil inlet port for the valve head, ports connecting the actuating oil port with the master valve and with the pilot valve, ports connecting the pilot valve with the master valve and ports connecting the master valve with the actuating end of the cylinder, the piston and plunger constituting a weight for returning the piston to the bottom or actuating end of the cylinder.

2. In combination in an oil operated well pump a cylinder having an actuating end and a pumping end and adapted to operate in a vertical position with the pumping end above the actuating end, a piston for the cylinder, a plunger formed integral with the piston and extending out through the actuating end of the cylinder and adapted to the purpose of decreasing the area of the

piston on its actuating side, an inlet bore extending axially through the plunger and piston and opening into the pumping end of the cylinder, a foot valve mounted in the inlet bore, a valve head mounted in the top of the pumping end of the cylinder, a tubular shell surrounding the cylinder eccentrically disposed forming a channel on one side from top to bottom of the cylinder, the shell being tightly sealed to the cylinder at top and bottom, a port formed in the wall of the cylinder affording communication between the side channel and the actuating end of the cylinder below the piston, a master valve mounted in the valve head, a pilot valve mounted in the valve head and having a stem depending into the bore of the piston and plunger, means for operating the pilot valve through its stem by the stroking of the piston, an actuating oil inlet port for the valve head, ports connecting the oil inlet port with the master valve, ports connecting the oil inlet port with the pilot valve, ports connecting the pilot valve with the master valve, whereby the pilot valve may cause an operation of the master valve by means of a portion of the actuating oil, ports connecting the master valve with the side channel, a discharge port formed in the valve head for the pumping end of the cylinder and a check valve for the discharge port, the piston and plunger constituting a weight adapted to return the piston to the actuating end of the cylinder.

3. In an oil operated well pump, in combination, a cylinder having an actuating end and a pumping end and adapted to operate in a vertical position the actuating end being the lower end, a piston for the cylinder, a plunger formed integral with the piston and extending down through the actuating end of the cylinder and adapted to the purpose of decreasing the actuating area of the piston over the pumping area, an inlet bore extending axially through the piston and plunger and having fixed therein a foot valve, a valve head mounted in the top of the pumping end of the cylinder, valves for the valve head adapted to be operated by the stroking of the piston, a tubular shell surrounding and sealed at top and bottom to the cylinder providing an actuating oil channel along the side thereof, a port communicating with the valves of the valve head and with the side channel, a port connecting the side channel with the actuating end of the cylinder below the piston and a discharge port for the pumping end of the cylinder and having a check valve, the piston and plunger constituting a weight adapted to return the piston, after being actuated through a pumping stroke, to the actuating end of the cylinder.

4. In combination in an oil operated well pump a cylinder having an actuating end and a pumping end and adapted to operate in a vertical position, the actuating end being the bottom end and the pumping end being the top end, a piston for the cylinder, a plunger fixed to the piston and extending down through the actuating end of the cylinder, and adapted to the purpose of decreasing the area of the under or actuating side of the piston, inlet and discharge means for the pumping end of the cylinder, a valve head for the cylinder, an inlet port adapted to supply actuating fluid to the valve head, a channel connecting the valve head with the actuating end of the cylinder and means mounted in the valve head adapted to pass actuating oil to and from the actuating end of the cylinder, the piston and plunger constituting a weight adapted to effect a stroke of the piston and plunger from the pumping end to the actuating end of the cylinder.

5. In an oil pump adapted to be suspended in a well casing, in combination, a cylinder having an actuating end and a pumping end and adapted to operate in a vertical position, the pumping end being the upper end and the actuating end being the lower end, a piston for the cylinder, a plunger fixed to the under or actuating side of the piston and depending through the actuating end of the cylinder and adapted to the purpose of decreasing the area of the under or actuating side of the piston, an inlet bore for the pumping end of the cylinder formed axially through the piston and plunger and having a foot valve, a valve head for the cylinder, an inlet port adapted to supply actuating oil to the valve head, a channel connecting the valve head with the actuating end of the cylinder, a valve mounted in the valve head and adapted to pass actuating oil through the channel into the actuating end of the cylinder and from the actuating end of the cylinder exterior the valve head, the well casing adapted to conduct the oil discharged from the valve head into proximity to the inlet bore of the plunger and piston and a discharge means for the pumping end of the cylinder, the piston and plunger constituting a weight adapted to return the piston from the pumping end of the cylinder to the actuating end of the cylinder.

6. In an oil pump adapted to be suspended in a well casing, in combination, a cylinder adapted to operate in a vertical position and having an actuating end and a pumping end, the actuating end being the lower end and the pumping end being the upper end, a piston for the cylinder, a plunger fixed to the piston and extending out through the lower end of the cylinder and adapted to the purpose of decreasing the area of the under side of the piston, inlet means for the pumping end of the cylinder, discharge means for the pump-

ing end of the cylinder, means for admitting a high pressure actuating fluid to the actuating end of the cylinder, means for discharging fluid from the actuating end of the cylinder out into the well casing and the well casing adapted to conduct the fluid discharged from the actuating end of the cylinder into the vicinity of the inlet means for the pumping end of the cylinder, the piston and plunger constituting a weight adapted to pull down the piston from the pumping end to the actuating end of the cylinder.

7. In an oil operated well pump, in combination, a cylinder adapted to operate in a vertical position and having an actuating end and a pumping end, the actuating end being the lower end and the pumping end being the upper end, a piston for the cylinder, a plunger fixed to the piston and extending down through the actuating end of the cylinder and adapted to the purpose of decreasing the area of the under side of the piston, inlet means for the pumping end of the cylinder, discharge means for the pumping end of the cylinder, means for admitting an actuating fluid to the actuating end of the cylinder and means for discharging the actuating fluid from the actuating end of the cylinder, the piston and plunger forming a weight for returning the piston from the pumping end of the cylinder down to the actuating end of the cylinder.

8. In combination in an oil operated well pump, a cylinder adapted to operate in a vertical position and having an actuating end and a pumping end, the pumping end being above the actuating end, a piston for the cylinder, a plunger fixed to the under side of the piston and extending out through the actuating end of the cylinder and adapted to the purpose of decreasing the area of the actuating side of the piston over that of the pumping side, a packing means surrounding the plunger below the actuating end of the cylinder adapted to prevent leakage of fluid therefrom, inlet means for the pumping end of the cylinder, discharge means for the pumping end of the cylinder, means for admitting an actuating fluid to the actuating end of the cylinder and means for discharging the actuating fluid from the actuating end of the cylinder, the piston and plunger forming a weight for returning the piston from the pumping end of the cylinder to its actuating end.

9. In an oil operated well pump in combination, a cylinder adapted to operate in a vertical position and having an actuating end and a pumping end, the pumping end being 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 piston on its actuating or under side, inlet means for the pumping end of the cylinder, discharge means for the pumping end of the cylinder and means for admitting a fluid under pressure to the actuating end of the cylinder to operate the piston through a pumping stroke, the piston and plunger constituting gravity means for returning the piston through a filling stroke.

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

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