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OIL WELL PUMP

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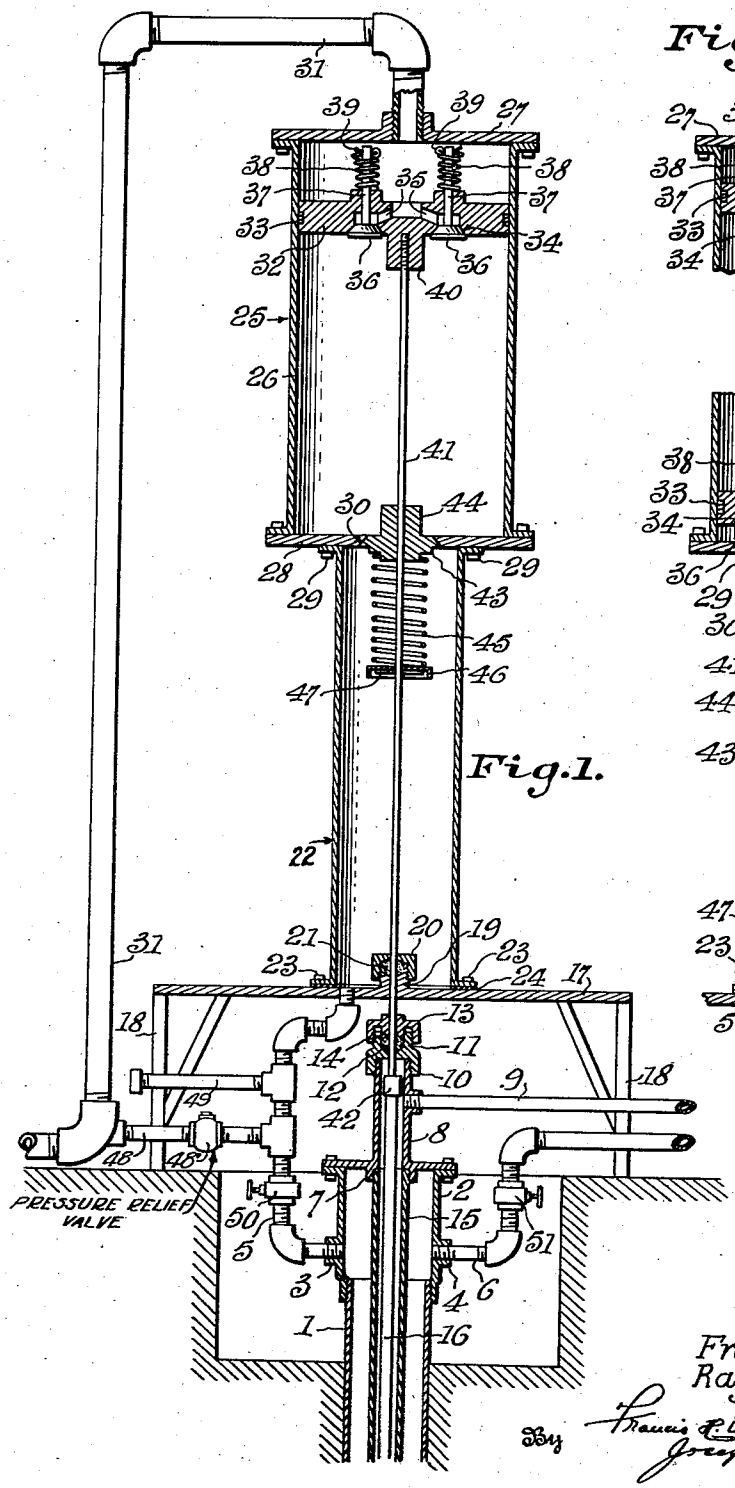
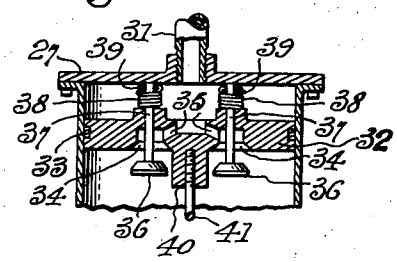


Fig.1.

Fig.3.



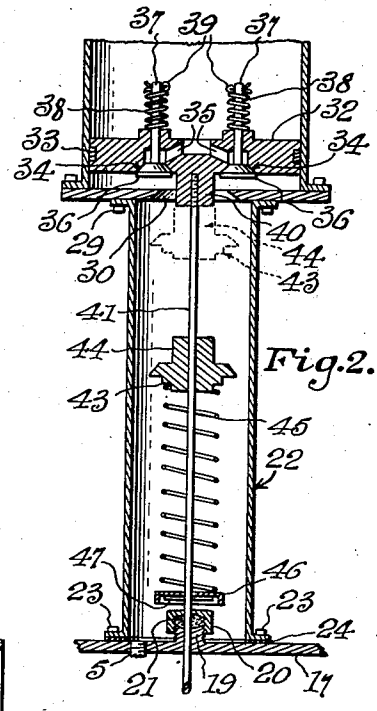


Fig.2.

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OIL WELL PUMP

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1

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without payment to us of any royalty thereon.

This invention relates to pumps and more particularly to motor-driven, drilled-well pumps which utilize a high pressure source of gas to operate the pump motor.

The pump motors contemplated by this invention are especially adapted for use in pumping oil from wells which contain natural gas under high pressure. In practicing the invention, the sucker rod of a standard reciprocating oil pump is connected to a piston by a connecting rod and the piston reciprocated by periodically admitting natural gas from the well to the cylinder surrounding the piston and withdrawing the gas therefrom. The gas under high pressure is admitted to the cylinder where it advances the piston. As the piston approaches the end of its stroke the supply of gas to the cylinder is shut off and means actuated to exhaust the gas in the cylinder through the body of the piston and from the cylinder through an exhaust line. The return stroke of the piston is effected by gravity, utilizing the weight of the piston as well as that of the elements secured thereto, to return the piston to its initial position.

It is an object of this invention to provide a new and improved motor-driven, oil well pump which is operated by gas under high pressure.

Another object of this invention is to provide a motor-driven, oil well pump which is operated by natural gas supplied under high pressures by an oil well.

Still another object of this invention is to provide a motor-driven, oil well pump having a cylinder, a piston therein which may be operated by admitting gas under high pressure to the cylinder and means for exhausting the gas from the cylinder through the body of the piston to permit the latter to return to its initial position.

A further object of this invention is to provide a motor-driven, oil well pump which is simple, inexpensive and easily transported and assembled in the field.

Other objects of the invention will be apparent from the following description of the invention and the accompanying drawing in which:

Figure 1 is a side elevational view partly in cross-section showing the pump motor;

Figure 2 is a fragmentary view in cross-section of the lower portion of the cylinder of the pump

2

motor showing the piston at the end of its downward stroke; and

Figure 3 is a fragmentary view in cross-section of the upper portion of the cylinder of the pump motor showing the piston at the end of its upward stroke.

Referring to the drawing, the uppermost section of a casing 1 lining an oil well has a casing head 2 secured thereto. The opposite sides of the casing head 2 are provided with the interiorly threaded ports 3 and 4 which are adapted to engage the exteriorly threaded ends of the pipe lines 5 and 6, respectively. The top of the casing head 2 is provided with an opening around the lower edge of which is formed an interiorly threaded flange 7 and around the upper edge thereof a pipe 8. The side of the pipe 8 has a threaded opening formed therein which is adapted to engage the threaded end of an outlet pipe 9. The upper end of the pipe 8 is exteriorly threaded to engage an interiorly threaded cap 10 having an exteriorly threaded hollow extension 11 formed thereon. The space within the hollow extension 11 is adapted to receive the packing material 12 and function as a seal. An interiorly threaded cap 13 provided with a lug 14 on the lower face thereof is adapted to engage the threaded extension 11 on the cap 10 and compress the packing material 12. The threaded flange 7 engages the threaded end of the uppermost section of an oil conduit 15 positioned within the casing 1. The conduit 15 extends downwardly in the casing 1 to the oil level in the well and has a standard reciprocating oil pump, which is not illustrated, attached thereto. The reciprocating elements of the oil pump are connected to a sucker rod 16 which extends upwardly in the oil conduit 15 into the pipe 8 formed on the casing head 2. Oil may thus be conducted from the well by the conduit 15 into the pipe 8 and thence through the outlet pipe 9 to a suitable collecting means. The natural gas in the well passes through the casing 1 into the casing head 2 and thence through the ports 3 and 4 to the pipe lines 5 and 6.

The casing head assembly described has a platform mounted thereover, comprising a plate 17 and a plurality of braced legs 18. The plate 17 has a threaded lug 19 formed on the upper face thereof and a vertical passage which extends through both the lug 19 and the plate 17 in alignment with the sucker rod 16. An interiorly threaded cap 20 having an opening in the top thereof engages the threaded lug 19 and is adapted to receive and compress the packing material 21. A large pipe 22, the ends of which

are flanged, is secured to the plate 17 with its center line aligned with vertical passage in the plate 17. The pipe 22 is secured to the plate 17 by the bolts 23 which pass through openings provided in the flange formed in the end of the pipe 22. A gasket 24 is positioned between the plate 17 and the pipe 22 to form a gas tight joint and enable the pipe 22 to function as a gas reservoir. The plate 17 has a threaded opening formed therein which engages the threaded end of the pipe line 5. The threaded opening is located in the plate 17 so that the pipe line 5 communicates with the chamber formed by the pipe 22. A cylinder 25 comprising a wall 26, an upper head 27 and a lower head 28 is mounted on the upper end of the pipe 22 and is secured thereto by the bolts 29 which pass through openings provided in the flange formed in the upper end of the pipe 22. The lower head 28 of the cylinder 25 has a valve port 30 formed therein and the upper head 27 thereof is provided with a threaded opening which is adapted to engage the threaded end of an exhaust pipe 31. The cylinder 25 contains a piston 32 having sealing rings 33. The piston 32 is provided with a plurality of valve ports 34 which communicate with the exhaust side of the piston 32 through the passages 35. The valve ports 34 are adapted to receive the valves 36 which are mounted on the vertical valve rods 37. The valve rods 37 pass through openings provided in the piston 32 and are normally forced upwardly by the coiled springs 38 which are secured on the valve rods 37 by the pins 39. The coiled springs 38 are compressed sufficiently to force the valve rods 37 upwardly and seat the valves 36 in the valve ports 34 to close the latter. A depending lug 40 is formed at the center of the piston 32 on the intake side thereof. The depending lug 40 is provided with a threaded opening which is adapted to engage the threaded end of a connecting rod 41. The connecting rod 41 extends downwardly therefrom, through the valve port 30 in the lower head 28, the chamber formed by the pipe 22, the openings in the cap 20, the plate 17 and the lug 19 formed thereon, thence through the caps 10 and 13 into the pipe 8. In the pipe 8 the connecting rod 41 is secured to the sucker rod 16 with a sleeve coupling 42. A valve 43 having a lug 44 formed on the upper face thereof is provided with a vertical opening through which the connecting rod 41 passes. The valve 43 is adapted to slide on the connecting rod 41 and close the valve port 30. A coiled spring 45 is mounted on the connecting rod 41 below the valve 43 and is adapted to seat the valve 43 in the valve port 30 when the piston 32 is at its uppermost position in the cylinder 25 as shown in Fig. 1. The lower end of the coiled spring 45 is fixed with respect to the connecting rod 41 by a flanged plate 46 supported by a pin 47 which passes through an opening provided in the connecting rod 41.

The exhaust pipe 31 which is connected to the upper head 27 of the cylinder 25 is adapted to conduct gas from the exhaust end of the cylinder 25 to the atmosphere or a gas collector. The exhaust pipe 31 and the pipe line 5 are connected by a pipe 48 which contains a pressure-responsive safety valve 48', Fig. 1, that functions to relieve any excessively high gas pressures communicated to the pipe line 5. A pipe 49 connected to the line 5 may be employed to conduct gas to other nearby pumping units. The pipe lines 5 and 6 are provided with flow control valves 50 and 51, respectively. The pipe line 5 is thus adapted to conduct gas from the well to the chamber formed by the pipe 22. The pipe line 6 is adapted to bleed gas from the casing head 2 if conditions necessitate.

In operation, the platform with the pipe 22 and the cylinder 25 mounted thereon is placed over the casing head assembly and the connecting rod 41 attached to the sucker rod 16. The caps 10 and 13 are tightened to compress the packing material 12 and prevent the escape of oil from the pipe 8. The weight of the piston 32, the rods 16 and 41 and the reciprocating elements of the oil pump exert a downward pull on the piston 32 causing it to move to the position shown in Fig. 2. As the connecting rod 41 moves downwardly the coiled spring 45 secured to the connecting rod 41 by a flanged plate 46 and the valve 43 resting freely on the top of the coiled spring 45 move to the position shown in Fig. 2. The valve 50 in the pipe line 5 is then opened to permit natural gas under high pressure from the well to pass from the casing head 2, through the pipe line 5 into the chamber formed by the pipe 22. The gas passes through the valve port 30 into the cylinder 25. The pressure builds up rapidly and the gas forces the piston 32 to move upwardly, which in turn draws the connecting rod 41 upwardly. As the connecting rod 41 moves upwardly, the coiled spring 45 moves the valve 43 toward the valve port 30. Near the ends of the upward or power stroke of the piston 32, the valve 43 closes the valve port 30, preventing further flow of the gas into the cylinder 25. The expansion of the gas in the cylinder 25 and the momentum of the piston 32 causes the latter to continue to move upwardly. As the piston 32 approaches the end of its power stroke, the valve rods 37 strike the cylinder head 27. The movement of the valve rods 37 and the valve 36 is stopped and as the piston 32 continues to move the valve ports 34 are opened as shown in Fig. 3. The coiled springs 38 on the valve rods 37 are compressed by the piston 32 and cushion the latter as it completes its upward stroke. The expanding gas in the cylinder 25 passes through the valve ports 34 and the passages 35 to the exhaust side of the piston 32. The exhaust gas flows rapidly from the cylinder 25 through the exhaust pipe 31 to the atmosphere or a gas collector. The exhaust gas escapes rapidly owing to the high pressure attained in the cylinder 25 during the upward stroke of the piston 32, and as the gas pressure on the lower face of the piston 32 drops, the latter begins its downward stroke. The downward stroke of the piston 32 is accelerated by the weight of the elements attached thereto as well as its own weight. The valve 43 remains seated in the valve port 30 during most of the downward stroke of the piston 32 due to the pressure of the gas in the chamber 22. The residual gas in the cylinder 25 below the piston 32 is thus compressed as the latter moves downwardly. The compressed gas tends to cushion the piston 32 and retards its movement near the end of its downward stroke. As the piston 32 reaches the bottom of the cylinder 25, the lug 40 strikes the lug 44 on the valve 43, unseating the latter, opening the valve port 30, and is forced by the impact of the lug 40 on the lug 44 to the position shown in solid lines in Fig. 2. The gas in the pipe 22 is then free to flow into the cylinder 25 and again force the piston 32 upwardly. The reciprocating movement of the piston 32 and the rods 16 and 41 attached thereto actuates the oil pump in the well, causing the

oil to rise in the conduit 15 to the pipe 8 and flow through the outlet pipe 9.

The operation of the pump motor contemplated by this invention depends upon a high pressure source of gas. Ordinarily, the natural gas supplied by the oil well from which the oil is withdrawn is used to actuate the pump motor. In some oil fields, however, the pressure of the gas from the wells is too low to operate the motors disclosed herein efficiently. In the absence of a natural source of high pressure gas, an air compressor may be employed to force air under high pressure into the chamber formed by the pipe 22. The operation of the pump motor contemplated by this invention depends upon the cycle of operation of the valves 37 and the valve 43 and functional cooperation thereof at the proper instant to obtain the maximum benefit of the intake and exhaust of the expanding gas. The operating cycle of these elements obviously may be varied by the design of the valve actuating elements. It is apparent that many different embodiments of this invention may be made without departing from the spirit and scope thereof and therefore it is not intended to be limited except as indicated in the appended claims.

Having thus described our invention, what we claim as new and wish to secure by Letters Patent is:

1. A gas operated motor comprising a cylinder having intake and exhaust ports, a piston in said cylinder adapted for movement therein between said intake and exhaust ports, said piston having a plurality of ports for conducting gas from the intake side to the exhaust side thereof, a plurality of valves normally adapted to close the ports in said piston, a plurality of valve actuating means mounted on said piston and connected to said valves, means for introducing gas into said cylinder through said intake port to actuate said piston, means to close said intake port when said piston approaches the end of its power stroke, said valve actuating means being operable responsive to the movement of said piston after said intake port in closed to open said valves and permit the flow of gas through the ports in said piston from the intake side to the exhaust side thereof, said valve actuating means including a plurality of rods adapted to pass

through corresponding openings provided in said piston, and spring means mounted on the ends of said rods adjacent the exhaust side of said piston, said valves being connected to the other ends of said rods and said spring means being adapted to force said rods toward the exhaust end of said cylinder and seat said valves in the ports provided in said piston.

2. A gas operated motor comprising a cylinder having intake and exhaust ports, a piston adapted for movement in said cylinder between said intake and exhaust ports, a connecting rod secured to said piston and extending from said cylinder, a valve slidably mounted on said connecting rod adapted to close said intake port, means for introducing gas into said cylinder through said intake port to actuate said piston, means operably responsive to the movement of said connecting rod to close said intake port with said valve as said piston approaches the end of its power stroke and means associated with said piston and operably responsive to the movement thereof to permit the flow of gas through said piston from the intake side to the exhaust side thereof.

3. An apparatus in accordance with claim 2 characterized in that said intake valve closing means operably responsive to the movement of said connecting rod comprises a spring means having one end fixed with respect to said connecting rod and the other end thereof adapted to support said intake valve.

4. An apparatus in accordance with claim 2 characterized in that said intake valve has an upwardly extending lug formed thereon and that said piston has a depending lug formed on the intake side thereof adapted to engage the lug on said intake valve and unseat said intake valve as said piston approaches the end of its downward stroke.

5. An apparatus in accordance with claim 2 characterized in that said means for introducing gas into said cylinder comprises a gas chamber, said chamber being adapted to supply gas to said cylinder through said intake port and provide gas under pressure for retaining said intake valve in its closed position during the downward stroke of said piston.

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