

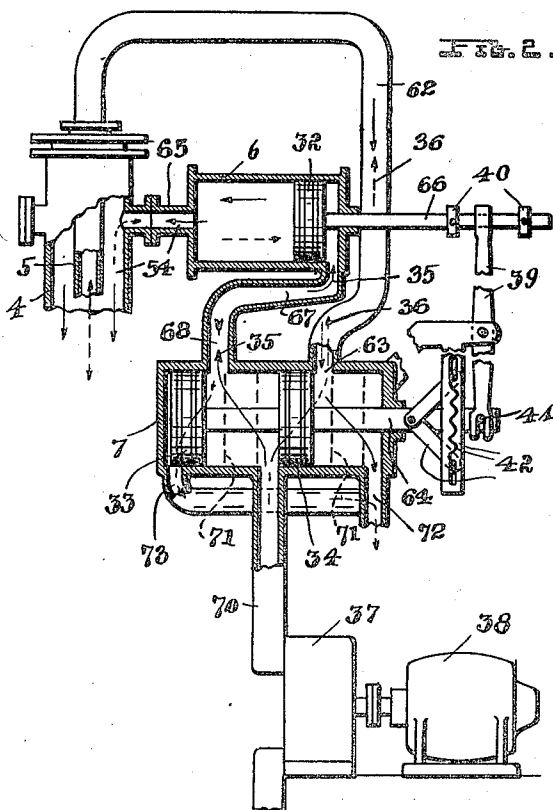
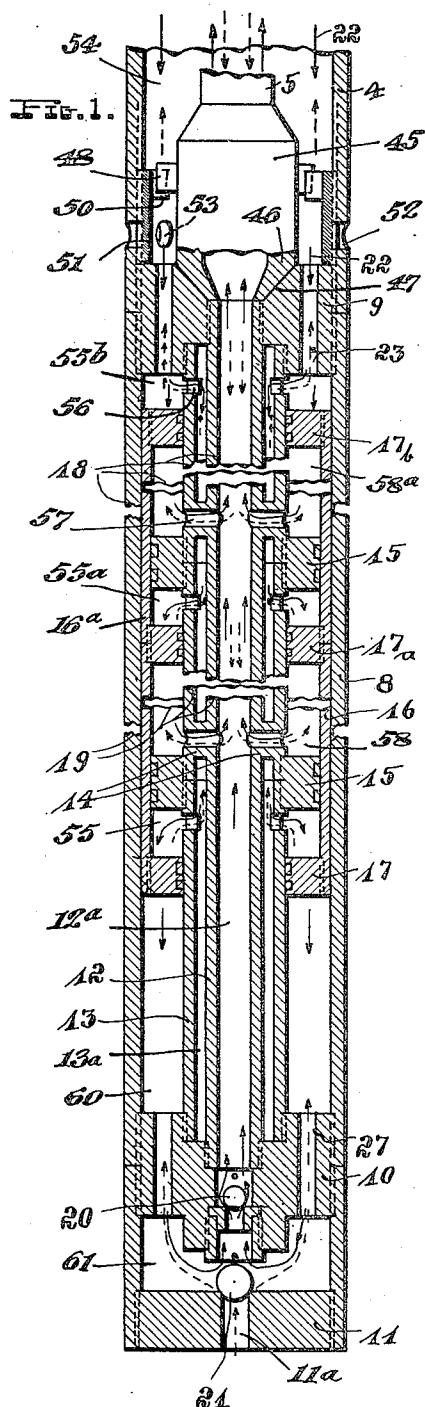
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PUMPING APPARATUS

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PUMPING APPARATUS

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Our invention relates to fluid operated pumps and particularly to a fluid operated pump especially adapted for use in oil wells.

One of the objects of this invention is to provide an apparatus designed so that the pressure line is and can be used for the production line.

Another object is to provide a balanced pumping apparatus operative near the bottom of a well or at least near the point from which matter is drawn so that the volume of matter produced in any one stroke or certain distinctive operation must be nearly equal to the pressure applied to the pumping apparatus.

Another object is to provide an apparatus in which the operating volume represents a corresponding value to the operating force or pressure applied to the apparatus.

Another object is to provide a pumping apparatus made of a certain number of stages to operate with equally efficient results in wells of different depths.

Another object is to provide a pumping apparatus to operate at and with the same pressure or force in wells of different depths to result in practically the same production.

Another object is to provide a pumping apparatus to operate under two practically equal volumes on the opposite operative sides of the apparatus so that the discharged volume or production alone comprises materially the value of lift of the apparatus in weight and difference in elevation.

Other objects will appear from the following description and appended claims as well as from the accompanying drawing, in which—

Fig. 1 is a fragmentary longitudinal mid-sectional view of a simple pumping apparatus embodying our invention.

Fig. 2 is a fragmentary side elevation of an operating mechanism connected to the upper ends of the pumping apparatus illustrated in Fig. 1.

The simple form of our invention, as shown in Fig. 1 of the drawing, includes an outer shell 8 which extends downwardly from a pipe or casing 4 within a well, the outer shell 8 being connected to the pipe 4 by means of

an upper partition 9. By means of a lower partition 10, an inlet valve casing 11 is secured to the lower end of the shell 8, this casing having an inlet opening 11a adapted to be closed by a check valve having the form of a ball 21. Within the outer shell 8 an inner tubular member 12 extends between the upper and lower partitions 9 and 10. Surrounding the inner tubular member is an intermediate tubular member 13, and at proper intervals interconnecting nipples 14 are extended radially from the inner member 12 to the intermediate tubular member 13. The inner and intermediate members 12 and 13 form an axial structure within the pump casing or shell 8 in which are provided a central axial passage 12a and an annular passage 13a. Supported on this central structure are stationary pistons 15 consisting of annular bodies secured to the intermediate tubular member 13. Cooperating with the stationary pistons 15 is a plunger 16 which is of tubular type and consists of a cylindrical shell 16a and radially inwardly projecting annular walls so placed as to form heads 17a and 17b. The outer surface of the shell 16a engages the inner surface of the outer shell 8 with such closeness that a practical seal is formed between the plunger 16 and the outer shell 8.

The upper end of the passages 23 and the upper end of the axial passage 12a constitute, respectively, primary and secondary fluid ports through which the pump mechanism communicates with the interior of the casing 4 and the interior of the oil tube 5. As previously herein explained, it is desirable to provide a means for draining the casing 4 before the casing is withdrawn from the well, and for this purpose we have provided a valve sleeve 51 adapted to be moved by the lower end of the oil tube 5 which removably engages one of the ports of the pump, preferably the secondary port formed by the upper end of the axial passage 12a.

All the several parts of the main housing of the pumping apparatus as well as of the plunger between the broken lines 18 and 19, forming a complete independent stage of the whole pumping apparatus, can either be left

out or duplicated or multiplied to any extent depending entirely on the requirements, as when to be used in more or less deep wells, to produce any desired or required power or lift by or while eventually not materially changing the pressure in the outside operating mechanism, as will be understood from further explanation given hereafter.

The lower partition wall 10 has a central opening therein containing a downwardly closing check valve 20 which communicates with the lower end of the axial passage 12a. The upper and lower partition members are provided with vertical passages 23 and 27 for providing communication with the end portions of the interior of the outer shell 8. Extending downwardly within the casing 4 by which the outer shell 8 is suspended in a well, is an inner column pipe 5 having a head 45 on its lower end provided with a conical engagement portion 46 adapted to engage a seat 47 in the upper face of the upper partition 9. The inner pipe 5 may be lowered into the casing 4 after the casing has been assembled in the well, and the head 45 at the lower end thereof provides a means for connecting the interior of the inner pipe 5 with the axial passage 12a. Lugs 48 projecting from the head 45 engage lugs 50 carried by a ring 51 forming a rotary valve for closing drainage openings 52 in the lower end of the casing 4. By rotating the sleeve or ring 51, it is possible to bring openings 53 therein into engagement with the openings 52 of the casing 4 and to thereby drain from the interior of the casing 4 the column of oil which resides therein. Lifting the central pipe 5 so as to remove the head 45 from engagement with the seat 47 will result in drainage of the inner pipe 5. This eliminates possibility of a wet job in pulling the pump.

The pressure of fluid in the annular space 54 within the casing 4 and surrounding the inner member 5 is transmitted in the direction of the arrows 22 through the passages 23 into the upper pumping pressure chamber 55b above the head 17b within the outer shell 8. Between the respective heads 17a and 17 and the stationary pistons 15 thereabove, pumping pressure chambers 55a and 55 are formed. All of the pressure chambers 55, 55a and 55b communicate through radial openings 56 with the annular space 13a within the central stationary structure of the pump. The nipples 14 provide radial passages 57 connecting between the axial passage 12a and retracting pressure chambers 58 and 58a formed below the plunger heads 17a and 17b. Between the lower plunger head 17 and the lower partition 10 a pumping cylinder 60 is formed which communicates through the axial passages 27 with the oil inlet passage 61 formed between the inlet valve casing 11 and the lower partition wall 10.

The upper end of the inner pipe 5 communicates through piping 62 with the secondary port 63 of a slide valve mechanism 7 in which valve pistons 33 and 34 are moved by means of a rod 64 having a quick throw mechanism 42 attached to its outer end. The upper end of the casing 4 is connected through fittings 65 with a cylinder 6 having a piston 32 therein from which a piston rod 66 extends outwardly through the wall of the cylinder. The rightward end of the cylinder 6 is connected by means of a pipe 67 with the primary port 68 of the slide valve mechanism 7. A pump 37 driven by a motor 38 forces fluid under pressure through piping 70 into the slide valve mechanism 7. The operation of the pumping mechanism shown is substantially as follows:

Assuming that the plunger 16 is in raised position and that the complete interior structure of the pumping mechanism is filled with oil, fluid under pressure from the pump 37 is directed through the slide valve mechanism into the rightward end of the cylinder 32, where it forces the piston 32 in leftward direction. This movement of the piston 32 exerts pressure through the fitting 65 on the column of oil in the space 54, which pressure is in turn exerted through the passages 23, 13a, and 56, against the upper faces of the plunger heads 17, 17a, and 17b, causing the plunger to move downwardly and to force the oil in the pumping cylinder 60 downwardly through the passages 27 into the inlet chamber 61 and to force the oil from the inlet chamber 61 up through the check valve 20 into the axial passage 12a. At the same time the downward movement of the heads 17a and 17b collapses the retracting pressure chambers 55 and 55a so as to force oil therefrom into the axial passage 12a, causing an upward movement of oil through the central pipe 5 and an overflow of the excess oil therefrom through the pipe 62, the port 63 of the slide valve mechanism, and the outlet 72 thereof. As the piston 32 approaches the leftward end of the cylinder 6, a collar 40 on the rod 66 engages the upper end of a lever 39, causing its lower end to exert rightward pressure against a pin 41 carried on the piston rod 64 so as to move the pistons 33 and 34 in rightward direction. When the rightward movement of the piston rod 64 has been carried through a predetermined distance, the quick throw mechanism 42 operates to quickly move the rod 64 in rightward direction so as to throw the pistons 33 and 34 into the positions indicated by dotted lines 71, thereby bringing the pressure pipe 70 of the pump 37 into communication with the pipe 62 and bringing the rightward end of the cylinder 6 into communication with the outlet port 73 of the valve mechanism 7. The pressure of the pump 37 is in this manner transferred to the column of oil within the

inner pipe 5 so that an excessive pressure is exerted through the passages 57 against the lower faces of the pistons 17a and 17b, causing the lifting of the plunger 16 to the raised position in which it is shown in Fig. 1.

The check valve 20 being closed, the foot valve 21 opens, and oil from the well is drawn into the inlet chamber 61 and the pumping cylinder 60. The raising of the plunger 16 also results in oil being forced from the pumping pressure chambers 55, 55a, and 55b so as to produce an upward movement of oil in the space 54, with the result that the piston 32 is moved rightwardly, the oil in the rightward portion thereof is discharged through the pipe 67 and the ports 68 and 73, and the lever 39 is actuated in conjunction with the quick throw mechanism 42 to return the pistons 33 and 34 to their initial positions, in which they are shown in full lines in Fig. 2, thereby again placing the piston 32 and the column of oil in the space 54 under pumping pressure. This cycle of operation automatically continues as long as no gas pockets are formed and the pump 37 is kept in operation.

The pump mechanism hereinbefore disclosed is operated by hydrostatically balanced columns of oil, and reciprocation of the plunger 16 is accomplished by alternately placing an excess of pressure on these columns of oil. The multiple piston construction enables the plunger 16 to be made of any desired length and with any number of heads thereon in accordance with the depth of the well and the pumping conditions encountered. The actual pumping of oil is accomplished by change of size of the pumping cylinder 60 which is situated at the lower end of the pump structure adjacent to the inlet opening and the inlet chamber through which oil is drawn in from the well.

A feature of the invention also exists in the use of a central or axial passage 12a through which oil is conducted from the pumping cylinder 60 through the zone of the remaining parts of the pumping mechanism into a pipe which conducts the pumped oil to the surface of the ground. When it is desired to remove the pump from the well, rotation of the inner pipe 5 will accomplish opening of the drain ports 52 in the manner hereinabove described.

Having thus described our invention, we claim:

1. A fluid operated pump of the character described, including: an outer shell adapted to be secured to the lower end of a casing; an inner tubular member within said outer shell, there being an annular pumping cylinder formed between the lower parts of said outer shell and said inner tubular member; a check valve at the lower end of said inner tubular member; an inlet valve; walls providing passage means connecting said pumping cylinder

with said check valve and said inlet valve; an annular pumping piston in said pumping cylinder; and hydraulic means above said piston and between said outer shell and said inner tubular member for reciprocating said annular pumping piston.

2. A fluid operated pump of the character described, including: an outer shell adapted to be secured to the lower end of a casing; an inner tubular member within said outer shell, there being an annular pumping cylinder formed between the lower parts of said outer shell and said inner tubular member; a check valve for preventing reverse flow from said inner tubular member; an inlet valve; walls providing passage means connecting said pumping cylinder with said inlet valve and the lower end of said tubular member; an annular pumping piston in said pumping cylinder, said pumping piston sliding on said inner tubular member; and hydraulic means above said piston and between said outer shell and said inner tubular member for reciprocating said annular pumping piston.

3. A fluid operated pump of the character described, including: an outer shell adapted to be secured to the lower end of a casing; an inner tubular member within said outer shell, there being an annular pumping cylinder formed between said outer shell and said inner tubular member; a check valve for preventing reverse flow from said inner tubular member; an inlet valve; walls providing passage means connecting said pumping cylinder with said inlet valve and the lower end of said tubular member; an annular pumping plunger in the annular space between said shell and said inner tubular member consisting of a cylindrical wall having an annular pumping head projecting radially inwardly from the lower end thereof in said pumping cylinder; an annular pressure head projecting radially inwardly at the upper end of the annular pumping plunger; a stationary annular piston extending outwardly from said inner tubular member in position between said upper and lower heads of said pumping plunger, forming within said pumping plunger a pumping pressure chamber and a retracting pressure chamber, there being also a pumping pressure chamber above said upper head of said annular plunger; and wall means in said pump providing passages for delivery of fluid under pressure to said pumping pressure chambers and said retracting pressure chamber.

4. A fluid operated pump of the character described, including: an outer shell adapted to be secured to the lower end of a casing; an inner tubular member within said outer shell, there being an annular pumping cylinder formed between said outer shell and said inner tubular member; a check valve for preventing reverse flow from said inner tubular member; an inlet valve; walls providing pas-

sage means connecting said pumping cylinder with said inlet valve and the lower end of said tubular member; an annular pumping plunger in the annular space between said shell and said inner tubular member consisting of a cylindrical wall having an annular pumping head projecting radially inwardly from the lower end thereof in said pumping cylinder; an annular pressure head projecting radially inwardly at the upper end of the annular pumping plunger; a stationary annular piston extending outwardly from said inner tubular member in position between said upper and lower heads of said pumping plunger, forming within said pumping plunger a pumping pressure chamber and a retracting pressure chamber, there being also a pumping pressure chamber above said upper head of said annular plunger; wall means in said pump providing passages for delivery of fluid under pressure to said pumping pressure chambers and said retracting pressure chamber; and a fluid pipe extending upwardly from said pump and from the upper end of said inner tubular member.

5. A fluid operated pump of the character described, including: an outer shell adapted to be secured to the lower end of a casing; an inner tubular member within said outer shell, there being an annular pumping cylinder formed between said outer shell and said inner tubular member; a check valve for preventing reverse flow from said inner tubular member; an inlet valve; walls providing passage means connecting said pumping cylinder with said inlet valve and the lower end of said tubular member; an annular pumping plunger in the annular space between said shell and said inner tubular member consisting of a cylindrical wall having an annular pumping head projecting radially inwardly from the lower end thereof in said pumping cylinder and a plurality of annular pressure heads extending inwardly above said annular pumping head, there being spaces between said annular heads; stationary annular pistons projecting outwardly from said inner tubular member into said spaces between said heads so as to form in said pumping plunger pumping pressure chambers and retracting pressure chambers, there being a pumping pressure chamber above the uppermost of said annular pressure heads; and wall means in said pump providing passages for delivery of fluid under pressure to said pumping pressure chambers and said retracting pressure chambers.

6. A fluid operated pump of the character described, including: an outer shell adapted to be secured to the lower end of a casing; an inner tubular member within said outer shell, there being an annular pumping cylinder formed between said outer shell and said inner tubular member; a check valve for preventing reverse flow from said inner tu-

bular member; an inlet valve; walls providing passage means connecting said pumping cylinder with said inlet valve and the lower end of said tubular member; an annular pumping plunger in the annular space between said shell and said inner tubular member consisting of a cylindrical wall having an annular pumping head projecting radially inwardly from the lower end thereof in said pumping cylinder and a plurality of annular pressure heads extending inwardly above said annular pumping head, there being spaces between said annular heads; stationary annular pistons projecting outwardly from said inner tubular member into said spaces between said heads so as to form in said pumping plunger pumping pressure chambers and retracting pressure chambers, there being a pumping pressure chamber above the uppermost of said annular pressure heads; wall means in said pump providing passages for delivery of fluid under pressure to said pumping pressure chambers and said retracting pressure chambers; and a fluid pipe extending upwardly from said pump and from the upper end of said inner tubular member.

7. A fluid operated pump of the character described, including: an outer shell adapted to be secured to a casing; an annular plunger in said shell consisting of a cylindrical wall having an annular, inwardly projecting pumping head at its lower end and an annular, inwardly projecting head above said pumping head; a stationary annular piston in the space between said heads of said plunger; an inner tubular member extending through said plunger and supporting said stationary piston, said tubular member having a primary passage communicating with the space above said stationary piston and a secondary passage communicating with the space between said stationary piston and said annular pumping head and with the space above said pressure head; and wall means for delivery of fluid under pressure to said primary and secondary passages of said inner tubular member.

8. A fluid operated pump of the character described, including: an outer shell adapted to be secured to the lower end of a casing; an annular pumping plunger in said shell having a plurality of annular heads projecting inwardly therefrom, there being annular spaces between said heads; an inner tubular member extending through said plunger, said inner tubular member having stationary annular pistons projecting into the spaces between said heads of said plunger so as to form pumping pressure chambers and retracting pressure chambers, there being a pumping cylinder formed below the lowermost of said heads of said plunger, said inner tubular member having a primary passage communicating with said retracting

pressure chambers and a secondary passage communicating with said pumping pressure chambers; means for delivering fluid under pressure to said primary and secondary passages of said inner tubular member; a check valve at the lower end of said primary passage of said inner tubular member; an inlet valve; and walls forming passage means connecting said pumping cylinder with said inlet valve and said check valve.

ing down within said casing and connecting to the upper end of said primary passage of said inner tubular member; a check valve for controlling the flow through the lower end of said primary passage; an inlet valve; and walls forming passage means connecting said passages of said lower partition wall with said inlet valve and said check valve.

In testimony that we claim the foregoing as our invention we have signed our names.

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9. A fluid operated pump of the character described, including: an outer shell adapted to be secured to the lower end of a casing; an annular pumping plunger in said shell having a plurality of annular heads projecting inwardly therefrom, there being annular spaces between said heads; an inner tubular member extending through said plunger, said inner tubular member having stationary annular pistons projecting into the spaces between said heads of said plunger so as to form pumping pressure chambers and retracting pressure chambers, there being a pumping cylinder formed below the lowermost of said heads of said plunger, said inner tubular member having a primary passage communicating with said retracting pressure chambers and a secondary passage communicating with said pumping pressure chambers; an inner fluid pipe extending down through said casing and connecting to said primary passage; walls connecting said secondary passage to the interior space of said casing around said inner fluid pipe; a check valve at the lower end of said primary passage of said inner tubular member; an inlet valve; and walls forming passage means connecting said pumping cylinder with said inlet valve and said check valve.

10. A fluid operated pump of the character described, including: an outer shell adapted to be secured to the lower end of a casing; an annular pumping plunger in said shell having a plurality of annular heads projecting inwardly therefrom, there being annular spaces between said heads; an inner tubular member extending through said plunger, said inner tubular member having stationary annular pistons projecting into the spaces between said heads of said plunger so as to form pumping pressure chambers and retracting pressure chambers, there being a pumping cylinder formed below the lowermost of said heads of said plunger, said inner tubular member having a primary passage communicating with said retracting pressure chambers and a secondary passage communicating with said pumping pressure chambers; upper and lower partition walls supporting said inner tubular member within said shell, there being passages in said upper partition wall connecting the interior of said casing with said secondary passage, and there being passages in said lower partition wall leading from said pumping cylinder; an inner fluid pipe extend-

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