

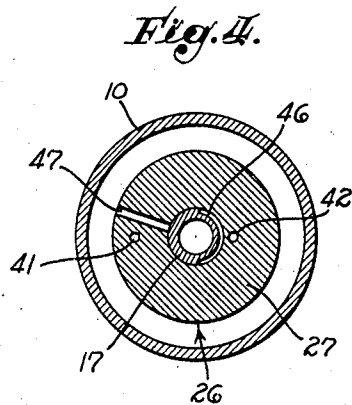
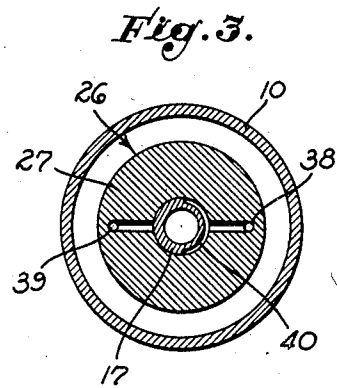
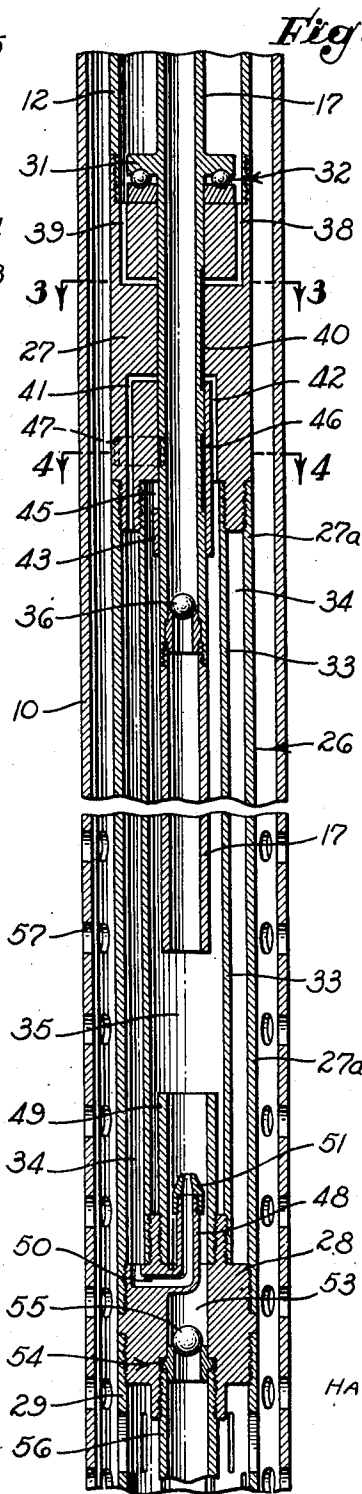
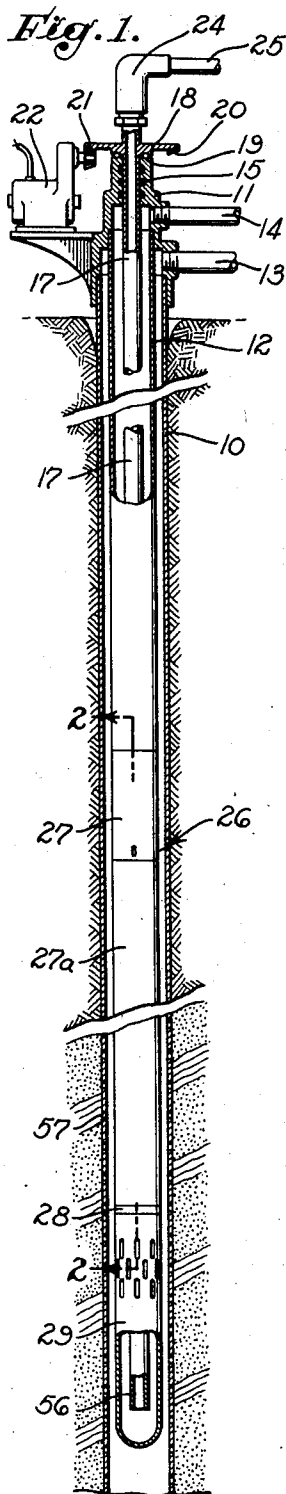
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GAS LIFT PUMP

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GAS LIFT PUMP

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7 Claims. (Cl. 103—231)

My invention relates to the pumping art and, more particularly, to a fluid operated pumping device.

The invention has particular utility in pumping from oil wells and will be described in connection with such use. It will be understood, however, that the invention is susceptible of other uses and I do not intend to be limited to the particular embodiment and use of the invention described.

In the art it is old and well known to provide a displacement pump in which oil to be pumped is intermittently admitted to a displacement chamber from which the oil is raised into a production tubing by the application of gas pressure applied thereto. My invention is an improvement on such displacement pumps, having many novel features as pointed out hereinafter.

It is a primary object of my invention to provide such a displacement pump in which the gas pressure applied to the oil in the displacement chamber is prevented from acting directly on the oil in the well, thus preventing back pressure on the oil producing formation of the well. This is an important feature of the invention, as such back pressure on the formation tends to reduce, and sometimes entirely stops, the flow of oil from the producing well formation into the well, particularly where the natural formation pressure is relatively low. I prefer to accomplish this by at all times maintaining the oil to be pumped and the gas with which the pumping is effected in a closed operating system separated by suitable valve means from the oil in the well.

A further object of my invention is to provide such a displacement pump in which the oil in the well is alternately introduced into the displacement chamber by the jetting action of a gas jet and alternately removed from the chamber by the application of the gas under pressure to the body of oil in the chamber to displace the same therefrom.

Another object of the invention is to provide such a displacement pump to which gas under pressure is conveyed through an outer tubing and from which the production flow is conveyed through an inner concentric tubing.

Still another object of my invention is to provide such a displacement pump in which novel means is provided to alternately direct gas under pressure to the jet and to the displacement chamber, the valve means being operated by

rotation of one of the strings of tubing, and preferably by rotation of the production tubing.

Other objects and advantages will be apparent from the following specification and the drawing, which is for the purpose of illustration only, and in which:

Fig. 1 is an assembly view, showing the invention disposed in a well.

Fig. 2 is a longitudinal sectional view of the invention.

Fig. 3 is a cross-sectional view taken on the line 3—3 of Fig. 2.

Fig. 4 is a cross-sectional view taken on the line 4—4 of Fig. 2.

Referring to the drawing, Fig. 1 shows a well casing 10 set in a well, the upper end of the well casing being provided with a casing head 11. The casing head 11 supports an outer gas tubing 12 and is provided with an exhaust pipe 13 communicating with the space between the casing 10 and the gas tubing 12. The casing head 11 is also provided with a gas supply pipe 14 which communicates with the upper end of the gas tubing 12.

The upper end of the casing head 11 is provided with suitable packing 15 through which extends an inner production tubing 17 which extends downwardly within the gas tubing 12. The upper end of the production tubing 17 is provided with a supporting head 18 supported for rotation on the upper end of the casing head 11 by suitable bearings 19. A gear 20 is formed on the supporting head 18 and engages a driving gear 21 which is operatively connected to a power source 22 which is preferably an electric motor connected through suitable gear reduction means to the driving gear 21 so as to be adapted to rotate the driving gear at relatively low speed. The upper end of the production tubing 17 extends into and is suitably secured in a suitable swivel 24, of any type well known in the art, which in turn is connected to a production pipe 25.

Connected to the lower end of the gas tubing 12 is the pump means 26 of my invention, the same being shown in detail in Fig. 2. The pump means 26 includes an upper head 27 which is suitably threaded to the lower end of the gas tubing 12 and to the upper end of an outer pump shell 27a. The lower end of the outer pump shell 27a is suitably threaded to a lower head 28 to which in turn is suitably threaded a perforated bull plug 29 which, however, may be dispensed with if desired.

The production tubing 17 is provided adjacent its lower end, but above the upper head 27, with an annular flange 31 which forms the upper race of a thrust bearing 32 supported on the upper end of the upper head 27, the thrust bearing serving to support the production tubing 17 rotatably upon the upper head 27. Also threadedly secured to the lower end of the upper head 27 is the upper end of an inner shell 33 which extends downwardly within the outer shell 27a, forming an annular space 34 therebetween, and being threadedly secured at its lower end to the upper end of the lower head 28. The interior of the inner shell 33 forms a displacement chamber 35, into which extends the lower end of the production tubing 17, in which is provided an upwardly opening check valve 36.

Formed in the upper head 27 are gas inlet ports 38 and 39 which are diametrically disposed and which are adapted to alternatively communicate between the lower end of the gas tubing 12 and a semicircular annular channel 40 formed in the outer surface of the production tubing 17. Also formed in the upper head 27 is a first passage 41 communicating with the upper end of the annular space 34 between the inner and outer shells 33 and 27a, respectively, and adapted to communicate with the annular channel 40 formed in the production tubing 17. Also formed in the upper head 27 is a second passage 42 which communicates with the upper end of the displacement chamber 35 and is adapted to communicate with the annular channel 40. The lower end of the upper head 27 is provided with a tubular projection 43 having a port 45 therein which is adapted to register with a lower annular channel 46 formed on the production tubing 17 below the annular channel 40. Substantially vertically disposed above the port 45 is an exhaust port 47 which communicates with the space between the pump means 26 and the casing 10.

The lower head 28 is provided with an internal nipple 48 which extends upwardly within a sleeve 49 suitably secured to the lower head 28 and projecting upwardly into the displacement chamber 35. The nipple 48 is provided with an internal passage 50 which communicates with the annular space 34, the inner end of the nipple being provided with a suitable jet or nozzle 51 which is pointed upwardly toward the displacement chamber 35. The lower head 28 is provided with an inlet 53 in which is provided an inlet valve means 54 which includes an upwardly opening check valve element 55. The inlet valve means 54 is held in place by a skeeter bill 56 which extends downwardly into the perforated bull plug 29, the bull plug and the skeeter bill forming what is known in the art as a "poor man's gas anchor," which, if desired, may be omitted.

In operation, the bull plug 29 is submerged in the fluid in the well, which flows into the casing 10 through perforations 57 provided at the lower end thereof, and opens the check valve 55 of the inlet valve means 54, and flows upwardly through the inlet 53 and the sleeve 49 into the displacement chamber 35. The production tubing 17 is slowly rotated by means of the power source 22 operating through the gears 21 and 20. During such rotation, when the parts are in the positions shown in the drawing, gas under relatively high pressure is conveyed downwardly through the gas tubing 12 from the gas supply pipe 14 which is suitably connected to a suitable source of gas (not shown), and this gas enters

the upper head 27 through the gas inlet port 38 and passes therethrough, through the segmental channel 40, and the second passage 42 into the upper end of the displacement chamber 35. At this time, the lower annular channel 46 is out of registry with the port 45, and the gas admitted to the displacement chamber from the second passage 42 exerts a downward pressure on the top of any well fluid trapped in the displacement chamber 35, forcing the same upwardly into the lower end of the production tubing 17 and past the check valve 36 therein, by which such fluid is trapped in the production tubing, until the level of well fluid in the displacement chamber drops below the lower end of the production tubing. Upon continued rotation of the production tubing 17, the annular channel 40 passes out of registry with the gas inlet port 38 and registers with the gas inlet port 39. At substantially the same time, the lower annular channel 46 registers with the exhaust port 47, thus opening to exhaust pressure the upper end of the displacement chamber 35 through the port 45, the lower annular channel 46, and the exhaust port 47. Gas under pressure then flows through the gas inlet port 39, the upper annular channel 40, and the first passage 41 into the space 34. This gas under pressure then passes downwardly through the annular space 34, the internal passage 50 in the nipple 48, and is discharged upwardly by the jet 51 with a jetting action toward the displacement chamber 35. Since there is still well fluid in the lower end of the displacement chamber 35 up to a level just below the lower end of the production tubing 17, this jetting action of the jet 51 draws additional well fluid through the check valve 55 and the inlet 53 upwardly through the sleeve 49 into the displacement chamber 35 so as to tend to fill the same with well fluid from the well. Since the upper end of the displacement chamber 35 is open to well pressure through the exhaust port 47, the displacement chamber 35 continues to fill with well fluid until such time as it is either filled therewith or the production tubing has rotated to a point where the exhaust port 47 is again closed and the parts are substantially in the positions shown in the drawing, at which time the displacement cycle recommences. Thus, well fluid is alternatively drawn into the displacement chamber 35 by the jetting action of the jet 51 and is then displaced from the displacement chamber by the action of gas under high pressure exerted on the top of the column of fluid in the displacement chamber, the displaced fluid flowing upwardly through the production tubing 17.

Although I have shown and described a preferred embodiment of my invention, it will be understood that certain parts and elements of my device may be replaced by other parts and elements having similar functions without departing from the spirit of my invention, and therefore I do not intend to be limited to the specific embodiment disclosed but desire to be afforded the full scope of the following claims.

I claim as my invention:

1. In a well pump, the combination of: a pump body provided with a chamber therein and having an inlet, an outlet, a pressure intake port, and a pressure exhaust port; inlet valve means in said inlet adapted to permit a flow of liquid through said inlet into said chamber but preventing a reverse flow thereof; jet means in said inlet and

directed toward said chamber; a gas passage communicating with said jet means; and main valve means adapted to connect alternatively said pressure intake port with either said chamber or said gas passage, said main valve means also connecting said chamber with said pressure exhaust port when said pressure intake port is connected to said gas passage.

2. In a well pump, the combination of: a pump body provided with a chamber therein and having an inlet, an outlet, a pressure intake port, and a pressure exhaust port; inlet valve means in said inlet adapted to permit a flow of liquid through said inlet into said chamber but preventing a reverse flow thereof; jet means in said inlet directed toward said chamber; a gas passage communicating with said jet means; main valve means adapted in response to rotation to connect alternatively said pressure intake port with either said chamber or said gas passage, said main valve means also connecting said chamber with said pressure exhaust port when said pressure intake port is connected to said gas passage; and means for rotating said valve means.

3. In a well pump, the combination of: a pump body provided with a chamber therein and having an inlet, an outlet, a pressure intake port, and a pressure exhaust port; inlet valve means in said inlet adapted to permit a flow of liquid through said inlet into said chamber but preventing a reverse flow thereof; jet means in said inlet directed toward said chamber; a gas passage communicating with said jet means; a first tubing connected to said pump body and communicating with said pressure intake port for supplying gas under pressure thereto; a second tubing within said first tubing and connected to said pump body and communicating with said outlet for receiving a production flow therefrom; and main valve means operatively connected to said second tubing and adapted to connect alternatively said pressure intake port with either said chamber or said gas passage, said main valve means also connecting said chamber with said pressure exhaust port when said pressure intake port is connected to said gas passage, said main valve means operating in response to rotation of said second tubing.

4. In a well pump, the combination of: an outer cylindrical shell; an upper head secured to one end of said outer shell; a lower head secured to the other end of said outer shell; an inner shell within and spaced from said outer shell and secured to said heads, the interior of said inner shell forming a displacement chamber; an inlet port in said lower head communicating between the lower end of said lower head and said displacement chamber; check valve means in said inlet port permitting a flow of well fluid through said inlet port into said displacement chamber but preventing a reverse flow therethrough; jet means in said inlet port means and communicating with said space between said shells for directing a jet of gas along said inlet port toward said displacement chamber; and valve means in said upper head, including a gas inlet port, a first passage communicating between said gas inlet port and the space between said shells, a second passage communicating with the upper end of said displacement chamber, and a third passage communicating between the upper end of said displacement chamber and the exterior of said upper head, and including a rotatable valve member adapted to alternatively connect said gas inlet port with either said first passage or said second

passage and to open said third passage when said gas inlet port is connected to said first passage.

5. In a well pump, the combination of: an outer cylindrical shell; an upper head secured to one end of said outer shell; a lower head secured to the other end of said outer shell; an inner shell within and spaced from said outer shell to form a space therebetween and secured to said heads, the interior of said inner shell forming a displacement chamber; an inlet port in said lower head communicating between the lower end of said lower head and said displacement chamber; check valve means in said inlet port permitting a flow of well fluid through said inlet port into said displacement chamber but preventing a reverse flow therethrough; fluid passage means communicating between said space and the lower end of said chamber; jet means in the line of said fluid passage means; and valve means in said upper head, including a gas inlet port, a first passage communicating between said gas inlet port and said space, a second passage communicating with the upper end of said chamber, and a third passage communicating between the upper end of said chamber and the exterior of said upper head, and including a rotatable valve member adapted to alternatively connect said gas inlet port with either said first passage or said second passage and to open said third passage when said gas inlet port is connected to said first passage.

6. In a well pump, the combination of: an outer cylindrical shell; an upper head secured to one end of said outer shell; a lower head secured to the other end of said outer shell; an inner shell within and spaced from said outer shell to form a space therebetween and secured to said heads, the interior of said inner shell forming a displacement chamber; an inlet port in said lower head communicating between the lower end of said lower head and said displacement chamber; check valve means in said inlet port permitting a flow of well fluid through said inlet port into said displacement chamber but preventing a reverse flow therethrough; fluid passage means communicating between said space and the lower end of said chamber; jet means in the line of said fluid passage means; valve means in said upper head, including a gas inlet port, a first passage communicating between said gas inlet port and said space, a second passage communicating with the upper end of said chamber, and a third passage communicating between the upper end of said chamber and the exterior of said upper head, and including a rotatable valve member adapted to alternatively connect said gas inlet port with either said first passage or said second passage and to open said third passage when said gas inlet port is connected to said first passage; and a rotatable tubing having its lower end operatively attached to said valve means.

7. In a well pump, the combination of: an outer cylindrical shell; an upper head secured to one end of said outer shell; a lower head secured to the other end of said outer shell; an inner shell within and spaced from said outer shell to form a space therebetween and secured to said heads, the interior of said inner shell forming a displacement chamber; an inlet port in said lower head communicating between the lower end of said lower head and said displacement chamber; check valve means in said inlet port permitting a flow of well fluid through said

inlet port into said displacement chamber but preventing a reverse flow therethrough; fluid passage means communicating between said space and the lower end of said chamber; jet means in the line of said fluid passage means; valve means in said upper head, including a gas inlet port, a first passage communicating between said gas inlet port and said space, a second passage communicating with the upper end of said chamber, and a third passage communicating between the upper end of said chamber and the exterior of said upper head, and including a rotatable

5 valve member adapted to alternatively connect said gas inlet port with either said first passage or said second passage and to open said third passage when said gas inlet port is connected to said first passage; a rotatable tubing having its lower end operatively attached to said valve means; and anti-friction bearing means disposed between said rotatable tubing and said upper head and adapted to support the weight of said rotatable tubing. 10

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