Jan. 5, 1943. C. J. COBERLY 2,307,451

HYDRAULIC PUMP WITH MECHANICALLY ACTUATED INTAKE VALVE

Filed Aug. 2, 1940 2 Sheets-Sheet 1

Fig. 1

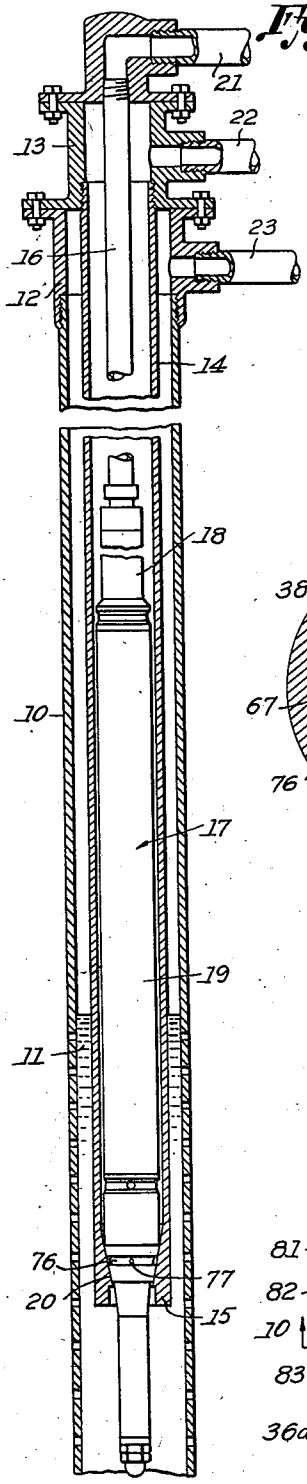


Fig. 5

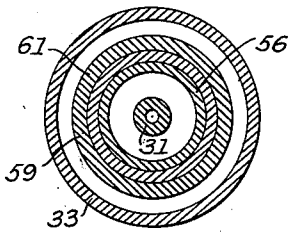


Fig. 6

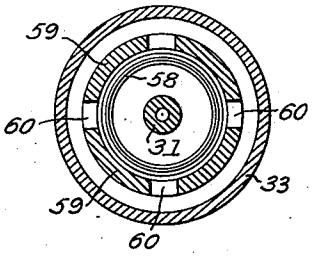


Fig. 7

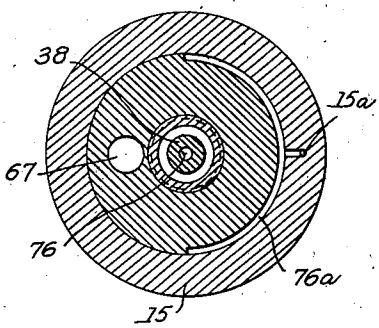


Fig. 8

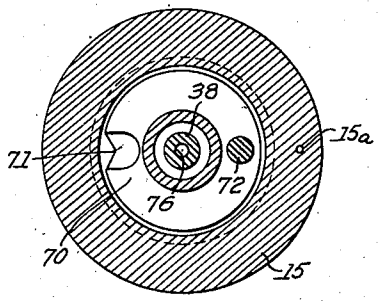


Fig. 9

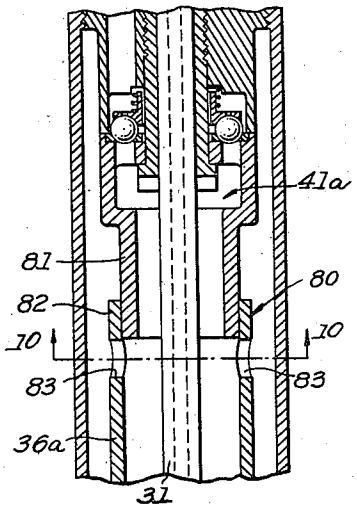
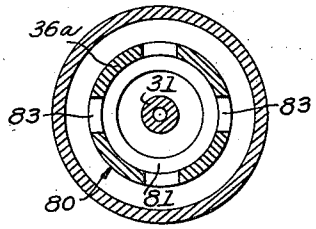


Fig. 10

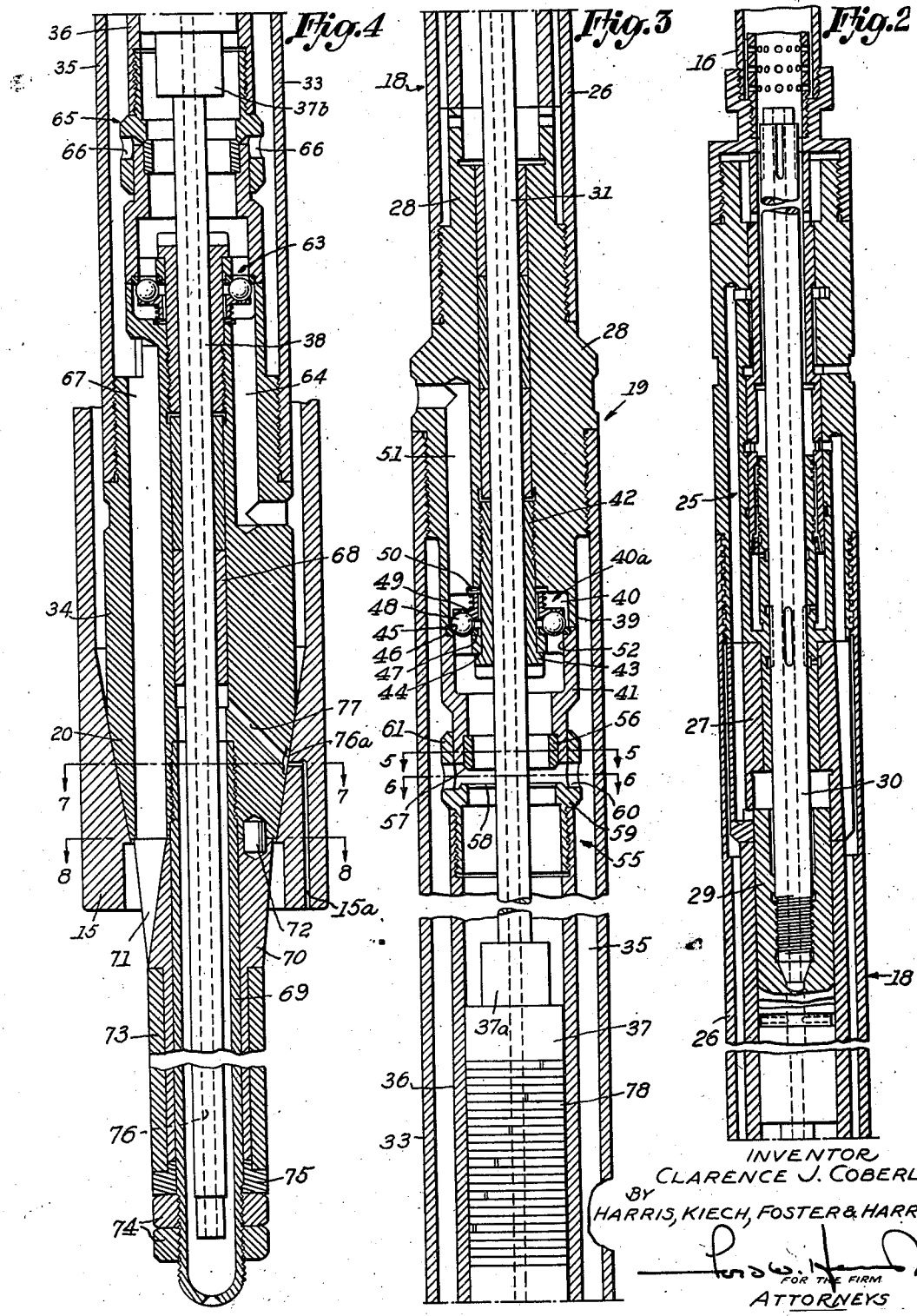


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UNITED STATES PATENT OFFICE

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HYDRAULIC PUMP WITH MECHANICALLY ACTUATED INTAKE VALVE

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Application August 2, 1940, Serial No. 350,011

7 Claims. (Cl. 103—163)

My invention relates to the pump art, and more particularly to a fluid operated pumping device adapted to be used in wells.

Although my invention is capable of many uses, it is of particular utility in connection with a fluid operated pump for use in oil wells, and, consequently, for the purpose of illustration will be described in connection therewith, although it is to be understood that I do not intend to be limited to such use of the invention.

This invention is an improvement over the construction shown and claimed in my Patent No. 2,081,222, issued on May 25, 1937, to which reference is hereby made.

In the hydraulic pump art it is standard practice to provide a fluid operated pump having a fluid operated motor operatively connected to a pumping unit adapted to pump fluid from a well to the surface of the ground. Such a device is shown and described in my Patent No. 2,134,174, issued October 25, 1938, and since the fluid operated motor of such device is not a part of the present invention, it is not described in detail herein, reference being made to said earlier patent for the construction thereof.

In such prior art devices as shown in my said Patent No. 2,134,174, it is standard practice to provide a pump cylinder having a cylinder liner rigidly held therein, by shrinking or otherwise, within which a pump piston is moved to pump fluid from the well through suitable intake and discharge valves provided at each end of the pump cylinder. Such valves, as shown in my said Patent No. 2,081,222, are ordinarily formed of a number of parts which are expensive to manufacture and inconvenient to assemble. It is therefore a primary object of the present invention to provide an intake valve construction for such a pump which is relatively cheap to manufacture, easy to assemble, and yet positive in operation. I prefer to accomplish this by providing a movable cylinder liner in the pump cylinder adapted to actuate mechanically by its movement the intake valves of a pump cylinder, movement of the cylinder liner being accomplished by movement of the pump piston.

By mechanically operating the intake valves of my device, I am able to provide intake valves having ports of large area, thus adapting a pump equipped with my invention to handle fluids of high viscosity so as to readily permit the pump cylinder to fill with the well fluid, an advantage not normally enjoyed by pumps having intake valves of the suction type as shown in my said Patent No. 2,081,222, in which the area of the ports is limited by the general space limitations existing in oil well pumps and with which it is impractical to pump fluids of high viscosity. A further advantage of my improved type intake valves is that their operation is positive because it is mechanical, thus preventing sticking which frequently occurs in the suction valves of the prior art when a viscous fluid is pumped.

It is also standard practice in the hydraulic pumping art, where a hydraulic pump unit is actuated by operating fluid conveyed to the pump unit under pressure through power tubing, to provide a special tubing bleeder in the line of the power tubing adjacent the pump unit which may be opened from the surface of the ground when desired to permit fluid in the power tubing to drain into the well. Such tubing bleeders are normally used when the pump unit is to be pulled to prevent what is known in the oil industry as a "wet job," such a tubing bleeder being illustrated in my Patent No. 2,053,602, issued September 8, 1936. Such prior art tubing bleeders are expensive to make and install, and, since they must be installed in the line of the power tubing above the pump, are never effective to drain the tubing completely. It is therefore a further important object of my present invention to provide a fluid operated pump unit in which a simple and practical power tubing bleeder is built into the pump unit so that when the pump unit is raised from its pumping position in a well, substantially all of the fluid in the power tubing may be drained therefrom into the well.

I have discovered that in operating a fluid operated pump in a well it is frequently desirable or necessary to treat the well fluid in the well prior to conveying it to the pump so as to render it suitable for pumping by such a fluid operated pump. Such treatment of the well fluid may be to cure a variety of defects in the characteristics of the well fluid. For example, in new oil wells it frequently occurs that the well oil carries a relatively high percentage by volume of sand, or other solid foreign material, which also sometimes occurs in wells which have been producing for some time. If the well oil contains a substantial amount of such sand or other foreign materials, they settle out in the pumping equipment, clogging the pump valves, the pump cylinder, and frequently the tubing conveying the pumped oil to the surface of the ground. This condition makes it impossible or impractical to operate a fluid operated pump in the well, because even if the foreign materials pass through the pump fairly well, clogging of the pumping equipment parts is so

rapid that frequent cleaning jobs on the pumping equipment are required, which is uneconomical and impractical in commercial operations. I have discovered that where oil to be pumped from a well contains high quantities of such foreign materials such as would render it impossible to pump it with standard pumping equipment, the percentage by volume of such foreign materials in the oil can be maintained below a predetermined maximum by diluting the well oil with clean oil during operation of the pumping equipment, which is a further object of my present invention. I prefer to accomplish this by diverting a portion of the clean oil normally used to operate the fluid operated pump directly into the well oil in the well to dilute the same to reduce the percentage of foreign materials by volume to a point at which the same will pass through the pumping equipment without clogging the same.

Another difficulty occurs in deep well pumping when the well fluid, such as oil, is of high viscosity, in that a very viscous well fluid also tends to clog and gum the moving parts of the pumping equipment, and is difficult to handle therein, even with a fluid operated pump having a valve designed as illustrated and described herein. Accordingly, it is still another object of my invention to reduce the viscosity of well fluid to be pumped from a well before the same is conveyed to the pump. I prefer to accomplish this by diluting the well fluid in the well with a thinner during operation of the pumping equipment, such as, for example, kerosene or other thin hydrocarbon where an oil well is to be pumped which contains highly viscous oil. In my preferred embodiment, such a thinner is added directly to the operating fluid normally used to operate a fluid operated pump, a portion thereof being diverted and mixed with the well oil during pumping.

Still another difficulty in pumping well oil from wells is that the well oil is of such a nature as to produce a high head of foam on the top of the column of well oil, thus causing a pump inserted therein to pump substantial quantities of gas. This is inefficient and otherwise undesirable, sometimes causing gas locks in the pumping equipment. Therefore, it is another object of my invention to treat well fluid in a well during pumping of the same with a de-foaming agent, such as, for example, kerosene, so as to break up the gas oil emulsion of such a foam. I prefer to accomplish this by conveying the de-foaming agent downwardly with the operating fluid normally used to operate a fluid operated pump, and to divert and discharge a part of such operating fluid directly into the well oil so as to reduce the foam therein.

Further objects and advantages of my invention will be evident from the specification and the drawings, which are for the purpose of illustration only and in which:

Fig. 1 is a diagrammatic utility view, partly in section, of my invention disposed in a well.

Fig. 2 is a vertical sectional view of the motor and main valve construction of my device.

Fig. 3 is a vertical sectional view of my device, continued downwardly from the bottom of Fig. 1.

Fig. 4 is a vertical sectional view of my device, continued downwardly from the bottom of Fig. 2.

Fig. 5 is a cross-sectional view taken on the line 5—5 of Fig. 3.

Fig. 6 is a cross-sectional view taken on the line 6—6 of Fig. 3.

Fig. 7 is a cross-sectional view taken on the line 7—7 of Fig. 4.

Fig. 8 is a cross-sectional view taken on the line 8—8 of Fig. 4.

Fig. 9 is a vertical sectional view of an alternative form of pump intake valve.

Fig. 10 is a cross-sectional view taken on the line 10—10 of Fig. 9.

Referring to the drawings, Fig. 1 shows a casing 10 set in a well, the lower end of which is filled with well fluid as indicated at 11, the upper end of the casing having a casing head 12 connected thereto on which is rigidly positioned a tubing head 13. The casing head 12 and the tubing head 13 may be of any type well known in the art.

Suspended from the tubing head 13 is a production tubing 14 provided at its lower end with a conical seat member 15, and also suspended from the tubing head is a power tubing 16 on the lower end of which is a fluid operated pump unit 17 which includes a motor unit and a pump unit, generally designated as 18 and 19 respectively. The conical seat member is provided with a port 15a for a purpose to be described hereinafter. The lower end of the pump unit 19 is provided with a tapered seat surface 20 adapted to seat in the conical seat member 15, making a fluid-tight joint therewith. Suitably connected to the tubing head 13 is a supply pipe 21 communicating between the power tubing 16 and a source of supply of operating fluid under pressure (not shown), and also connected to the tubing head is a production pipe 22 communicating between the production tubing 14 and a point of discharge or storage (not shown). The casing head 12 is provided with a vent pipe 23 communicating with the interior of the casing 10 through which gas may be taken off from the top of the casing.

Referring to Figs. 2 and 3, I show the motor unit 18 and valve mechanism 25 therefor, the specific construction and operation of which are not a part of the present invention, being fully illustrated and described in my earlier Patent No. 2,134,174, to which reference has been made. The main parts of the motor unit construction, however, are a motor cylinder 26 closed at its upper end by a head 27 and closed at its lower end by a central head 28, and having a motor piston 29 adapted to be actuated therein by operating fluid under pressure delivered through the power tubing 16 and through the valve mechanism 25 alternately to opposite ends of the motor cylinder. The motor piston 29 is provided with an upper piston rod 30 which is connected to the motor piston and extends upwardly through the upper head 27 and into the path of the operating fluid delivered through the power tubing 16. Also connected to the motor piston 29 is an intermediate piston rod 31 which passes downwardly through the lower head 28 of the motor cylinder 26.

The pump unit 19 generally comprises a pump cylinder 33 threaded at its upper end to the central head 28 and threaded at its lower end to a lower head 34, there being a cylinder liner 36 provided in the pump cylinder 33 so as to be slidable relative thereto, the liner being supported as described hereinafter so as to provide a fluid space 35 therearound. A pump piston 37 is provided in the cylinder liner 36, being connected to the lower end of the intermediate piston rod 31, and has connected to its lower end a lower piston rod 38 which extends downwardly

through the lower head 34. The pump piston 37 is provided with piston rings 78 held in suitable annular piston ring grooves formed in the outer surface of the pump piston, which operate to form a sliding fluid-tight fit between the pump piston and the interior of the cylinder liner 36. The piston rings 78 are adjusted to create more friction between the pump piston 37 and the cylinder liner 36 than exists between the cylinder liner and the inner walls of the pump cylinder 33, for a purpose to be described later, but it will be apparent that the use of the piston rings is preferable only, and that any other suitable means may be used to provide friction between the liner and the pump piston without departing from the spirit of my invention.

The lower end of the central head 28 is provided with a reduced diameter 39 and has formed therein an upper discharge valve means 40*a*, including an annular discharge valve chamber 40, there being an upper valve cage 41 abutting against the lower end of the central head 28 so as to close the valve chamber 40, being held in fluid-tight relation with the central head by means of a sleeve 42 threaded into the central head 28 and having a flange 43 engaging an annular shoulder 44 formed on the valve cage 41. A plurality of ball valve seats 45 are formed in a valve seat ring 46 set in a recess 47 in the valve cage 41, each of which is adapted to seat a ball valve element 48, all of the ball valve elements normally being held in seated position by an upper ring 49 held in yielding engagement therewith by a compression spring 50. Formed in the central head 28 and communicating between the upper portion of the valve chamber 40 and the exterior of the central head is an upper discharge passage 51. Formed in the upper portion of the valve cage 41 are passages 52, each of which communicates between the valve seats 45 and the interior of the valve cage.

Cooperating with the lower end of the upper valve cage 41 is an upper poppet valve device 55, which includes an annular seat ring 56 rigidly set into the lower interior of the valve cage 41 and provided with an outwardly directed beveled seat 57 adapted to cooperate with an internally beveled seat 58 formed on a valve member 59 threaded to the upper end of the cylinder liner 36, and having upper intake ports 60 therein, formed in a sleeve portion 61 telescoping over the lower outer end of the valve cage 41 and forming a sliding fluid-tight fit therewith and supporting the upper end of the liner in the pump cylinder 33. The upper intake ports 60 communicate at all times with the upper end of the fluid space 35.

The lower head 34 is provided with a lower discharge valve means 63 similar in construction to the upper discharge valve means 40*a* but inverted in position, which is adapted to discharge pumped fluid through a lower discharge passage 64. Threaded on the lower end of the cylinder liner 36 is a lower poppet valve device 65, similar in construction to the upper poppet valve device 55 but inverted in position, and having lower intake ports 66. Also formed in the lower head 34 is an intake passage 67 communicating around the lower discharge valve means 63 and the lower poppet valve device 65 with the fluid space 35 around the cylinder liner 36. As will be noted, the pump piston 37 is provided with upper and lower tubular heads 37*a* and 37*b*, respectively, which enter the valve cages of the upper and lower poppet valve devices 55 and 65, respectively, at opposite ends of the pump piston stroke to reduce the clearance volume of the piston rods 31 and 38 at such times, so as to render the pumping device more efficient if the pumped fluid contains relatively high percentages of gas.

As will be noted, the lower piston rod 38 extends downwardly through the lower head 34 and is provided with suitable packing 68 therearound, and projects downwardly into a closure tube 69 threaded into the lower end of the lower head 34. Abutting against the lower end of the lower head 34 is a spacer element 70 having an inlet groove 71 formed therein which is adapted to be aligned with the intake passage 67 by means of a dowel pin 72 projecting into suitable registering openings in both the lower head and spacer element. Engaging the lower end of the spacer element 70 is a guard sleeve 73 concentric with and spaced from the closure tube 69 to protect the same, and which is adapted to be rigidly positioned relative to the spacer element by lock nuts 74 threaded on the lower end of the closure tube 69 and engaging an end ring 75 which in turn engages the guard sleeve.

Through the upper piston rod 30, the motor piston 29, the intermediate piston rod 31, the pump piston 37, and the lower piston rod 38, is a longitudinal passage 76 communicating at its upper end with the interior of the power tubing 16 and communicating at its lower end with the interior of the closure tube 69. Formed in the lower head 34 is a bleeder port 77 which communicates between the interior of the closure tube 69 and a semicircular groove 76*a* formed in the exterior of the lower head at the approximate center of the tapered seat surface 20 thereon.

In operation, operating fluid under relatively high pressure is conveyed downwardly through the power tubing 16 to the motor unit 18 through the valve mechanism 25 to reciprocate the motor piston 29 in the motor cylinder 26, as described in my said Patent No. 2,134,174. Reciprocation of the motor piston 29 causes a corresponding reciprocation of the pump piston 37 in the pump cylinder 33. The parts of the device are so designed that when the upper poppet valve device 55 is in its open position as shown in Fig. 3, the lower poppet valve device 65 will be in its closed position as shown in Fig. 4. When in such position, well fluid may flow from the well through the inlet grooves 71 and the intake passage 67 into and upwardly through the fluid space 35 of the pump unit 19, and may flow therefrom through the upper intake ports 60 of the upper poppet valve device 55 into the upper end of the cylinder liner 36 above the pump piston 37. When the parts are in such position, fluid below the pump piston 37 may not flow out through the lower poppet valve device 65, since the same is closed, but flows downwardly through the lower discharge valve means 63 to discharge from the pump unit through the lower discharge passage 64. With the pump piston 37 in the position shown in Fig. 4, it is just completing its downstroke. When it starts its upstroke, friction created between the pump piston and the cylinder liner 36 by the packing rings 78 on the pump piston will cause the cylinder liner to move upwardly with the pump piston until the valve member 59 of the upper poppet valve device 55 seats on the beveled seat 57 of the annular seat ring 56, at which time the upper poppet valve device will be closed and the lower poppet valve device will be open. As soon as the valve member 59 engages the annular seat ring 56, upward movement of the cylinder liner 36 will be stopped,

and during the remainder of the upward stroke of the pump piston 37, the pump piston will move relative to the cylinder liner. Upon reversal of the direction of movement of the pump piston 37, the cylinder liner 36 will then move downwardly with the pump piston by reason of the friction created therebetween by the packing rings 78 to open the upper poppet valve device 55 and close the lower poppet valve device 65. As will be understood, the upper and lower poppet valve devices 55 and 65 comprise inlet valve means for the pump unit 19. By using this type of inlet valve construction, it is possible to make the area of the inlet ports as large as may be desired, so as to enable a hydraulic pump of my present construction to be used satisfactorily in pumping fluids having high viscosity, which is a particular advantage of my invention.

During normal operation, the fluid operated pump unit 17 is seated in the conical seat member 15 of the production tubing 14, so that the groove 76a is out of registry with the port 15a so that the seat effectively closes the outer end of the bleeder port 77. When the power tubing 16 is pulled from the well, to repair the fluid operated pump unit 17, or for other reasons, it is desirable to permit the operating fluid therein to drain therefrom so as to prevent the operating fluid from flooding the area around the casing head 12 as the tubing joints are broken, known in the industry as a "wet job." This is accomplished in my present construction by the bleeder port 77, which is open to the well as soon as the fluid operated pump unit 17 is raised from the conical seat member 15, thus permitting the operating fluid in the power tubing 16 to drain therefrom through the longitudinal passage 76 of the piston rod, the closure tube 69, and the bleeder port 77, the fluid then passing downwardly through the conical seat member at the lower end of the production tubing 14. Obviously, as soon as the fluid operated pump unit 17 is raised from the conical seat member 15, all well fluid in the production tubing 14 will also be permitted to drain downwardly through the conical seat member 15 and back into the well so that the production tubing may also be pulled free from the oil which would otherwise be therein. By providing this bleeder construction at the lower end of the fluid operated pump unit, substantially all of the oil in both the production tubing 14 and the power tubing 16 may be drained therefrom, which is a distinct advantage over the bleeder devices of the prior art. By incorporating my bleeder construction in my fluid operated pump unit, I also obviate the necessity of providing a separate bleeder device above the fluid operated pump unit in the line of the production and power tubing, which would otherwise be necessary, thus materially decreasing the cost of such installation and simplifying the assembly thereof.

In the event that my invention is intended to be used in a well in which the well fluid has characteristics normally detrimental to the operation of the pump, such as, for example, unduly high foreign matter content or viscosity, or an undesirable foam or emulsion condition, all as pointed out hereinabove, I provide means whereby the well fluid may be treated to render it suitable for pumping during the normal operation of my fluid operated pump unit 17 and prior to the time when the well fluid passes into the inlet of the pump unit through the groove 71. This is accomplished by relative rotation of the production tubing 14 and the power tubing 16 so as to cause the groove 76a to register with the port 15a, thus permitting a small portion of the operating fluid to discharge outwardly through the bleeder port 77 and the port 15a directly into the fluid in the well. This discharge of operating fluid is preferably continued as long as necessary during the operation of the fluid operated pump unit 17. Due to the relatively small cross-sectional area of the port 15a, only a small proportion of the operating fluid may be discharged therethrough, although, obviously, the size of the port 15a may be varied as desired, depending upon the pressure of the operating fluid and the amount of flow desired through the port 15a. Since the operating fluid is normally clean oil, or clean fluid of the same type as that to be pumped, if it is desired to merely reduce the percentage by volume of foreign material in the pumped well fluid, a portion of the operating fluid may be diverted directly through the bleeder port 77 and the port 15a to dilute the well fluid in the well, and thus reduce the percentage by volume of foreign material therein. If other types of treatment of the well fluid are necessary, a treating substance may be added to the operating fluid at its source (not shown), as is well known in the art, and the treating substance may thus be discharged with the diverted operating fluid directly through the bleeder port 77 and the port 15a into the well fluid in the well during operation of the fluid operated pump 17. Thus, if the well fluid naturally has such a high viscosity as to prevent proper operation of the fluid operated pump 17, a treating agent comprising a thinner, such as, for example, light oil, may be used as the operating fluid or may be added to the operating fluid, which, when mixed with the well fluid, causes a material reduction of the viscosity of the well fluid before the same enters the pump unit through the groove 71. Again, if the well fluid in the well is comprised largely of a foam, emulsion, or gas-liquid mixture containing large quantities of gas, a defoaming or de-emulsifying agent may be added to the operating fluid at its source, so that as a portion of the operating fluid is discharged into the well fluid through the port 15a, the defoaming or de-emulsifying agent will act on the foam or emulsion comprising the well fluid to break the same, thus permitting liquid substantially free of gas to enter the pump unit through the groove 71. It is to be noted that in practicing all of these methods of treating the well fluid, the treatment may be carried on continuously during the operation of the fluid operated pump unit 17, which is an important feature of my invention. Obviously, if at any time during operation of the fluid operated pump unit 17 it is desired to discontinue the treatment of the well fluid in the well, relative rotation of the production tubing 14 and the power tubing 16 may be used to move the port 15a out of registry with the groove 76a, thus sealing closed the port 15a.

Figs. 9 and 10 show an alternative form of pump intake valve construction comprising an upper slide valve device 80 adapted to be substituted for the upper poppet valve device 55 of Fig. 3. This embodiment also contemplates the substitution of a lower slide valve device (not shown) for the lower poppet valve device 65 of Fig. 4, but as the lower slide valve device is of the same construction as the upper slide valve device 80, but inverted in position, only the upper slide valve device will be described in detail.

The upper slide valve device 80 includes a valve

cage 41a, of the same general construction as the upper valve cage 41, but having a depending sleeve portion 81 of smaller diameter than the diameter of the lower portion of the upper valve cage 41, the sleeve portion 81 being of such a diameter that it telescopes into the upper end 82 of the liner 36a, forming a fluid-tight sliding fit therewith. Provided in the upper end 82 of the liner 36a are intake ports 83 adapted to be disposed below the lower end of the sleeve portion 81 when the liner 36a is in its lower position, and adapted to be closed by the sleeve portion 81 when the liner is moved upwardly to its upper position. The liner 36a is moved between upper and lower positions, as described hereinabove in connection with the operation of the liner 36, and, as will be appreciated, when the liner 36a is in its lower position, as shown in Figs. 9 and 10, the upper slide valve device 80 will be open to permit well fluid to flow into the upper end of the liner through the intake ports 83, and at the same time the lower slide valve device (not shown) will be closed, and when the upper slide valve device is closed, by upward movement of the liner 36a, the lower slide valve device will be opened. The construction of the upper slide valve device 80 is somewhat simpler than the construction of the upper poppet valve device 55, requiring less parts, but the operation is substantially the same.

Although I have shown and described a preferred embodiment of my invention, it will be understood that I do not intend to be limited thereby but intend to be afforded the full protection of the following claims.

I claim as my invention:

1. In a pump for use in a well, the combination of: a pump cylinder having heads closing each end thereof; a pump piston in said cylinder; an upper piston rod connected to said pump piston and extending upwardly through said upper head; means for reciprocating said upper piston rod to reciprocate said piston; a lower piston rod connected to said piston and extending downwardly through said lower head and therebelow; a relatively thin sleeve, closed at the bottom and surrounding said lower piston rod projecting below said lower head; and a relatively heavy sleeve rigidly secured relative to said lower head and surrounding said thin sleeve.

2. In a device of the character described, the combination of: a pump cylinder; a cylinder liner in said pump cylinder and adapted to move axially therein, there being a longitudinal fluid passage between said cylinder and said liner; a pump piston slidably disposed in said cylinder liner; a sleeve member rigidly positioned relative to said pump cylinder and telescoping into said cylinder liner, said cylinder liner having port means adapted to be closed by said sleeve member when said liner is in an upper position and open when said liner is in a lower position, said port means when open communicating between said passage and the interior of said liner; and frictional means between said piston and said liner for moving said liner between said upper and lower positions in response to movement of said pump piston to alternately open and close said port means.

3. In a well pump, the combination of: an upper head member having an upper discharge passage communicating between the lower end of said head member and the exterior thereof; a pump cylinder having its upper end secured to the lower end of said upper head member; a lower head member secured to the lower end of said pump cylinder and having a lower discharge passage communicating between the upper end of said lower head member and the exterior thereof, and having an inlet passage extending longitudinally therethrough; outwardly opening valve means in each of said discharge passages; an axially movable cylinder liner in said pump cylinder and spaced therefrom to provide an inlet space therebetween communicating with said inlet passage, said liner being axially movable from a first position in which said space communicates with the interior of the upper end of said liner to a second position in which said space communicates with the interior of the lower end of said liner; a pump piston in and frictionally engaging said liner; and means for reciprocating said pump piston, said liner moving between said positions in response to axial movement of said pump piston and by reason of said frictional engagement between said liner and said piston.

4. In a well pump, the combination of: an upper head member having an upper discharge passage communicating between the lower end of said head member and the exterior thereof; a pump cylinder having its upper end secured to the lower end of said upper head member; a lower head member secured to the lower end of said pump cylinder and having a lower discharge passage communicating between the upper end of said lower head member and the exterior thereof, and having an inlet passage extending longitudinally therethrough; outwardly opening valve means in each of said discharge passages; an upper tubular valve member extending downwardly from said upper head member; a lower tubular valve member extending upwardly from said lower head member; an axially movable cylinder liner in said pump cylinder and spaced therefrom to provide an inlet space therebetween communicating with said inlet passage, said liner being axially movable from an upper position in which it telescopes over said upper valve member to a lower position in which it telescopes over said lower valve member; a pump piston in and frictionally engaging said liner; and means for reciprocating said pump piston, said liner moving between said positions in response to axial movement of said pump piston and by reason of said frictional engagement between said liner and said piston.

5. In a well pump, the combination of: an upper head member having an upper discharge passage communicating between the lower end of said head member and the exterior thereof; a pump cylinder having its upper end secured to the lower end of said upper head member; a lower head member secured to the lower end of said pump cylinder and having a lower discharge passage communicating between the upper end of said lower head member and the exterior thereof, and having an inlet passage extending longitudinally therethrough; outwardly opening valve means in each of said discharge passages; an axially movable cylinder liner in said pump cylinder and spaced therefrom to provide an inlet space therebetween communicating with said inlet passage, said liner being axially movable from a first position in which said space communicates with the interior of the upper end of said liner to a second position in which said space communicates with the interior of the lower end of said liner; a pump piston in and frictionally engaging said liner; an upper piston rod secured to said pump piston and extending upwardly

through said upper head member; and a lower piston rod secured to said piston and extending downwardly through said lower head member, said liner moving between said positions in response to axial movement of said pump piston by means of said frictional engagement between said liner and said piston.

6. In a well pump, the combination of: an upper head member having an upper discharge passage communicating between the lower end of said head member and the exterior thereof; a pump cylinder having its upper end secured to the lower end of said upper head member; a lower head member secured to the lower end of said pump cylinder and having a lower discharge passage communicating between the upper end of said lower head member and the exterior thereof, and having an inlet passage extending longitudinally therethrough; outwardly opening valve means in each of said discharge passages; an upper tubular valve member extending downwardly from said upper head member; an upper annular valve seat carried by said upper tubular member; a lower tubular valve member extending upwardly from said lower head member; a lower annular valve seat carried by said lower tubular member; an axially movable cylinder liner in said pump cylinder and spaced therefrom to provide an inlet space therebetween communicating with said inlet passage, said liner being axially movable from an upper position in which it telescopes over said upper valve member to a lower position in which it telescopes over said lower valve member, said liner having an annular valve member at each end thereof, said valve members being adapted to alternately engage said valve seats in seating relation; a pump piston in and frictionally engaging said liner; and means for reciprocating said pump piston, said liner moving between said positions in response to axial movement of said pump piston and by reason of said frictional engagement between said liner and said piston.

7. In a well pump, the combination of: a pump cylinder; an upper head closing the upper end of said cylinder; a lower head closing the lower end of said cylinder, said lower head having a longitudinal fluid passage therein; a pump piston in said cylinder; an upper piston rod connected to said pump piston and extending upwardly through said upper head; means for reciprocating said upper piston rod to reciprocate said piston; a lower piston rod connected to said piston and extending downwardly through said lower head and therebelow; sleeve means adapted to enclose the lower end of said lower piston rod and adapted to be secured to said lower head, said sleeve means having a fluid port therein adapted to communicate with said longitudinal passage; and means for insuring alignment of said port and passage when said sleeve means is connected to said lower head.

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