

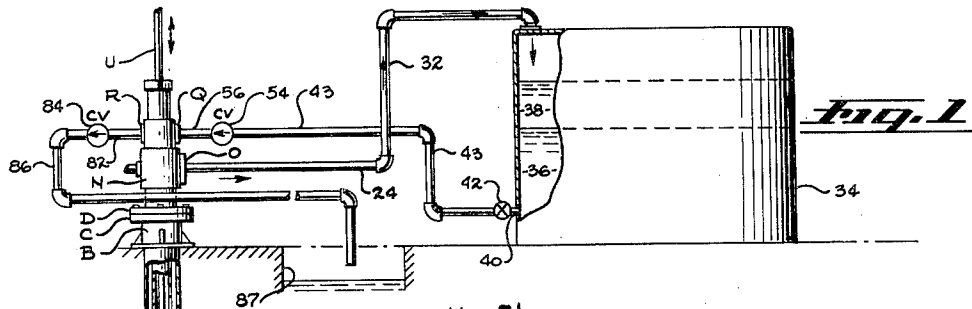
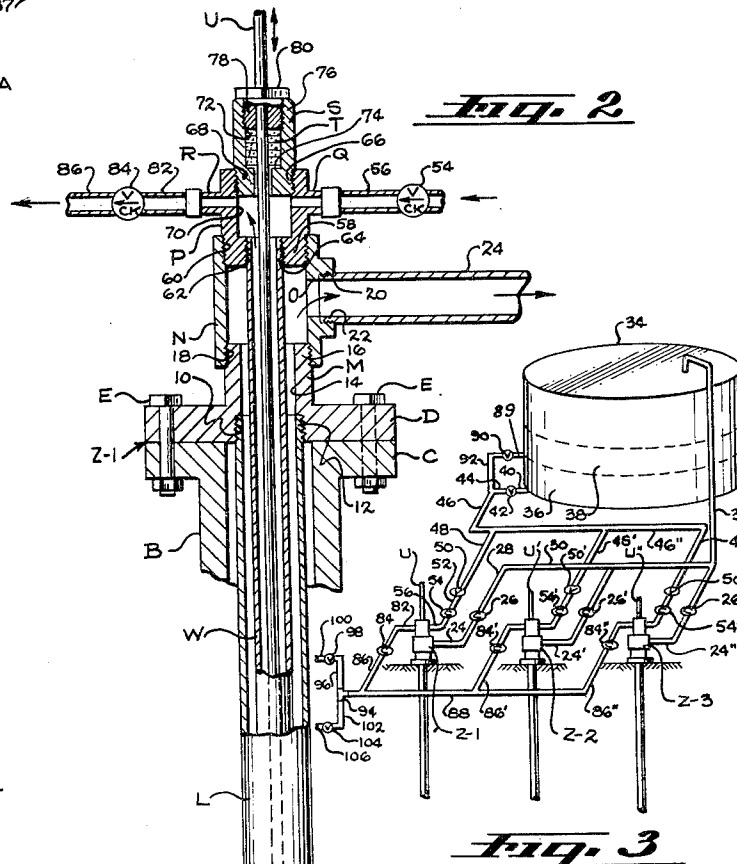
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OIL WELL PUMPING UNIT AND METHOD OF USING SAME

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The present invention relates generally to the field of oil well pumping equipment, and more particularly to an improved oil well pumping unit that is not only adapted to pump well fluid to a storage or settling tank, but concurrently pump either oil or waste water from the settling tank to a desired location as well.

In many oil fields the fluid produced from a well contains a high percentage of water in the form of an oil-water emulsion. Such fluid is customarily pumped to a settling tank, where the emulsion gradually stratifies to form a lower water phase and upper oil phase. The water phase is a waste product that must be periodically pumped to a disposal area, normally a considerable distance from the settling tank. Upon occasion, particularly when a well is producing fluid with a high water content, the settling tank may overflow due to human error or neglect in failing to pump the waste water therefrom. Such overflow is highly undesirable, for the first portion of the overflow that is lost is the oil.

A major object of the present invention is to provide a pumping unit that not only discharges well fluid to a settling tank, but can concurrently pump either oil therefrom to a desired location, or waste water from the settling tank to a disposal area.

Another object of the present invention is to supply an improved pumping unit that minimizes the possibility of overflow from a settling tank due to the concurrent withdrawal by the pumping unit of waste water from the tank as it discharges well fluid thereinto.

Yet another object of the invention is to simplify the equipment necessary to pump well fluid into a settling tank, and to selectively remove oil and waste water therefrom.

A still further object of the invention is to supply an improved pumping unit that is of extremely simple mechanical structure, easy to install and use, inexpensive to produce, requires a minimum of maintenance attention, and minimizes the power costs to pump well fluid into a settling tank and to selectively pump waste water or oil therefrom to a desired location.

These and other objects and advantages of the invention will become apparent from the following description of a preferred form thereof, and the method of using same as shown in the accompanying drawing in which:

FIGURE 1 is a combined side elevational and vertical cross sectional view of the improved pumping unit in combination with a settling tank and the associated piping;

FIGURE 2 is a vertical cross-sectional view of the upper portion of the pumping unit; and

FIGURE 3 is a diagrammatic view showing the manner in which a number of associated wells may be interconnected to concurrently discharge well fluid into a settling tank and selectively discharge either oil or waste water from the tank to desired locations.

Referring now to FIGURES 1 and 2 for the general arrangement of one of the improved pumping units, it will be seen that the oil well A on which it is installed includes a casing B that terminates on the upper end thereof in a first flange C. A second flange D is held in abutting contact with first flange C by bolts E that extend there-through. Only the upper extremity of casing B is shown as it plays no part in the invention.

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A conventional reciprocating oil well pump F is disposed at a desired location in the well bore G, best seen in FIGURE 1. The lower portion only of well bore G is shown. Pump F communicates with a tubing string H that extends upwardly therefrom.

Tubing string H at the upper end thereof is connected to an upwardly and outwardly tapered swage J that has a threaded straight-walled portion (not shown) that is engaged by an interior threaded coupling K. Coupling K is threadedly connected to the lower end of a tubing string extension L which is of substantially larger interior transverse cross section than that of tubing string H. Tubing string extension L as shown in FIGURE 2 is connected to, and supported by, second flange D.

Second flange D has a threaded boss M extending upwardly therefrom that is connected to a standard pumping T N. The T N has a well fluid discharge O projecting therefrom. A bushing P is threaded in the upper end of pumping T N. Bushing P, as can be seen in FIGURE 2, is provided with a liquid inlet Q and liquid outlet R.

A tubular stuffing box S is threaded into the upper end of bushing P. Stuffing box S, as is conventional with such devices, has packing T disposed therein that is in fluid sealing engagement with a polished rod U extending downwardly therethrough to a piston V. Piston V is slidably and sealingly mounted inside an elongate tubular barrel W. Piston V supports a sucker rod X that extends downwardly therefrom through tubing extension L and tubing string H to a plunger Y slidably mounted within the confines of pump F. The components above described comprise one of the improved pump units Z shown in FIGURES 1 and 2. A number of the pump units Z may be connected together as shown in FIGURE 3. These pump units are identical, but for ease in describing their combined operation, the units are further identified by the notations Z-1, Z-2 and Z-3 respectively. Details of the units Z-1 are shown in both FIGURES 2 and 3.

Referring now to FIGURE 2 for the detailed structure of the invention, it will be seen that the second flange D is preferably formed with a first vertically extending tapped bore 10 that is engaged by an upper threaded end 12 of the liner extension L. Bore 10 is coaxially aligned with a second bore 14 that extends longitudinally through the boss M. The upper exterior end of the boss M has threads 16 formed thereon that engage the lower tapped end 18 of the T N. Well fluid outlet O formed in the T N is formed with threads 20 that engage the threaded end 22 of a pipe 24.

Pipe 24, as may be seen in FIGURE 3, is preferably connected to a check valve 26 which in turn is connected to a lateral 28. The lateral 28 is in communication with a header 30. The header 30 is connected to a riser 32 through which the well fluid is discharged into the confines of a settling tank 34 as shown in FIGURE 3. The well fluid after being discharged into settling tank 34 stratifies and separates into a lower body of waste water 36 and an upper oil body 38 shown in FIGURE 3. A waste water outlet 40 is connected to the bottom of tank 34 and extends to a valve 42. A lateral 44 is connected to valve 42 and extends to a header 46 as best seen in FIGURE 3. The header 46 is connected by a lateral 48 to a gate valve 50. A pipe 52 extends from gate valve 50 to a check valve 54. Check valve 54 is connected by a pipe 56 to the inlet Q on T N as shown in FIGURE 2.

Bushing P, also shown in FIGURE 2, is formed with a lower threaded end 58 that engages the upper tapped end 60 of the T N. The bushing P has a lower longitudinally extending tapped bore 62 formed therein that

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threadedly engages the upper threaded end 64 of barrel W. An upper tapped bore 66 formed in bushing P is engaged by the lower threaded end 68 of the stuffing box S. Stuffing box S includes a downwardly disposed, longitudinally extending first bore 70 that is slidably engaged by the polished rod U. A second longitudinally extending bore 72 is formed in the stuffing box S that is of substantially greater cross section than the bore 70, and forms a ring-shaped seat 74 at the junction therewith. The second bore 72 is formed with threads 76, which threads are engaged by a threaded plug 78 that has an externally disposed head 80. The head 80 permits the plug 78 to be turned relative to the stuffing box S to cause the plug 78 to move downwardly therein and compress the packing P to force same into fluid sealing engagement with the polished rod U. The liquid outlet R of unit Z-1 as shown in FIGURES 2 and 3 is connected to a pipe 82 that extends to a check valve 84. The discharge outlet of check valve 84 is connected to a pipe 86. If the invention is to be used for disposing of waste water 36 only from tank 34, the pipe 86 will be extended to a disposal area 87 as shown in FIGURE 1. However, if the invention is to be used to pump both waste water 36 and oil 38 from tank 34, the pipe 86 will be connected to a header 88 as shown in FIGURE 3.

At times it may be desirable to have the units Z-1, Z-2 and Z-3 either individually or multiples thereof pump oil 38 from the tank 34 as well as waste water. For the purpose of pumping oil 38 from tank 34 an oil outlet 89 is connected to the interior of the tank and extends to a gate valve 90. The gate valve 90 is connected by a pipe 92 to the header 46. When waste water 36 is being withdrawn from tank 34, the valve 90 is placed in the closed position and the valve 42 in the open position. Likewise, when it is desired to withdraw oil 38 from the tank 34, the valve 42 is placed in the closed position and the valve 90 in the open position.

Header 88, as best seen in FIGURE 3, extends to a T 94 which has a pipe 96 extending therefrom to a gate valve 98. Valve 98 has a pipe 100 connected thereto that extends to a location (not shown) where it is desired to pump oil 38 from the tank 34. The T 94 is also connected to a pipe 102 that extends to a gate valve 104. Valve 104 has a pipe 106 extending therefrom through which waste water 36 is pumped from the tank 34 to the desired disposal location 87.

The pump units Z-1, Z-2 and Z-3 as previously mentioned are identical, and hence only the operation of the unit Z-1 shown in FIGURE 2 will be explained. The polished rod U as it reciprocates upwardly and downwardly in the unit by power means (not shown) reciprocates the piston V therewith, which piston is slidably and sealingly mounted within the confines of the barrel W. On the downstroke of the piston V inside the barrel W, the pressure inside the upper portion of the barrel is lowered to the extent that either waste water 36 or oil 38 from tank 34 will flow therein through the check valve 54 when the gate valve 50 is placed in the open position. The waste water 38, or oil 36 as the case may be, enters the confines of the bushing P and flows downwardly into the barrel W as the piston V moves downwardly therein.

On the upstroke of the piston V, the check valve 54 automatically assumes a closed position and the check valve 84, as the pressure on the waste water or oil in barrel W increases, opens to permit discharge of the waste water or oil from the confines of the barrel W through the outlet R best seen in FIGURE 2. The check valve 84 automatically closes on the downstroke of the piston V as the pressure inside the barrel W drops as previously described. The waste water 36 or oil 38 after being forced past the check valve 84 enters the pipe 86 and proceeds to the header 88 to flow to the T 94. At the T 94 the fluid flowing in the header 88 can be caused to flow through either the pipe 96 or pipe 102. In the situation where the unit Z-1 is pumping waste water 36 from

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the tank 34, the valve 98 is closed and the valve 104 is opened to permit the waste water to enter the pipe 106 and flow therethrough to the disposal area 87. However, if the liquid being pumped is oil, the valve 104 is closed, the valve 98 is opened, and the oil is then discharged through the pipe 100 to a desired destination (not shown).

Each of the units Z-1, Z-2 and Z-3 shown in FIGURE 3 is of identical construction. Accordingly, corresponding components of the units Z-2 and Z-3 and the piping connecting same to tank 34 are identified by the same numerals used in conjunction with the unit Z-1, but with a prime being added thereto in the case of unit Z-2, and double primes being added in the case of unit Z-3. The number of units Z-1, Z-2 or Z-3 that will be used in disposing of waste water 36 from the tank 34 will depend largely on the percentage of water in the fluid being pumped into the tank through the riser 32. If the well fluid has but a small percentage of water in it, then the operation of the unit Z-1 would suffice to dispose of the waste water by the individual operation thereof. When it is desired to have only the unit Z-1 operate, the gate valves 50' and 50'' (FIGURE 3) are placed in the closed position. The check valves 84' and 84'' prevent the flow of waste water into the unit Z-2 and Z-3 from the header 88. Should the operation of the unit Z-1 not be sufficient to dispose of the waste water 36 as rapidly as desired from the tank 34, the gate valve 50' or 50'' may be placed in the open position to permit either the unit Z-2 or Z-3 to operate to increase the rate of withdrawal of waste water 36 from the tank 34. The maximum rate of withdrawal of waste water from tank 34 is, of course, achieved by opening all three gate valves 50, 50' and 50''. The rate at which oil may be withdrawn from the tank 34 is variable, in the same manner as the rate at which waste water is withdrawn from the tank as previously described.

The construction of the piston V is susceptible of a number of designs, but from a standpoint of convenience it has been found desirable to define same by an elongate hollow body 110 that is closed at both ends. A threaded nipple 112 extends upwardly from the upper end of the body 110 to threadedly engage a coupling 114 that is connected to the lower threaded ends 116 of the polished rod U. A second nipple 118 projects downwardly from the lower end of the body 110 to threadedly engage a second coupling 120 that is removably connected to the upper end of the sucker rod X. The use and operation of the invention has previously been described in detail and need not be repeated.

The invention as shown in FIGURE 1 is a single pumping unit that is so connected to tank 34 that only waste water 36 can be withdrawn therefrom. Therefore, instead of the valve 42 being connected to a pipe 44 as shown in FIGURE 3, the valve is connected to a pipe 43 that continues directly to check valve 54. The pipe 86 as previously mentioned in the unit Z-1 as shown in FIGURE 1 extends directly to disposal area 87, instead of being connected to header 88 as shown in FIGURE 3.

Although the invention herein shown and described and the method of using same have been found to provide the advantages and attain the objects hereinbefore mentioned, it is to be understood that the invention herein shown and described is merely a presently preferred embodiment of the invention and is not to be limited to the details of construction herein shown and described, other than as defined in the appended claims.

We claim:

1. In an oil well pumping unit that includes a power operated upwardly and downwardly movable polished rod, a stuffing box in which said polished rod is slidably and sealingly disposed, a reciprocating pump, a sucker rod extending downwardly from said polished rod to said pump and a tubing string of larger internal cross section than the transverse cross section of said sucker rod extending upwardly from said pump to a predeter-

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mined distance from said stuffing box and surrounding said sucker rod, the combination of:

- (a) a tubing string extension of larger interior transverse cross section than the exterior transverse cross section of said tubing string that extends upwardly from the top of said tubing string to a fixed position relative to said stuffing box;
- (b) a tubular barrel disposed in the upper portion of said tubing extension which barrel and extension cooperatively define an annulus-shaped space therebetween;
- (c) first confined space-defining means disposed above the upper extremity of said tubing string extension and in communication with said annulus-shaped space;
- (d) well fluid discharge means in communication with said first confined space-defining means;
- (e) a piston connected to said polished rod and slidably and sealingly disposed in said barrel;
- (f) second confined space-defining means of variable volume that includes said piston and at least a portion of said barrel;
- (g) a liquid inlet and a liquid outlet in communication with said second confined space-defining means; and
- (h) first check valve means on said inlet that opens to admit liquid into said second confined space-defining means on the downstroke of said piston, and closes on the upstroke of said piston to cause said liquid in said second confined space to discharge

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therefrom through said liquid outlet when said well fluid is discharged by said rod-actuated pump from said well fluid discharge means.

2. An oil well pumping unit as defined in claim 1 wherein a second check valve means is provided on said liquid outlet that opens only on the upstroke of said piston to permit liquid in said second confined space-defining means to discharge therefrom.

3. An oil well pumping unit as defined in claim 1 in addition that includes a tank, a pipe extending from said well fluid discharge means to said tank to permit said liquid when containing both water and oil to be discharged into said tank to separate into a lower first phase of waste water and an upper second phase of oil; valve means connected to the interior of said tank to permit either said waste water phase or said oil phase therein to be selectively withdrawn from said tank; and piping connecting said valve means to said inlet to permit either said oil or said waste water to flow into said second confined space to be discharged therefrom through said liquid outlet on the upstroke of said piston.

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