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METHOD AND MEANS TO PUMP OIL WITH FLUIDS

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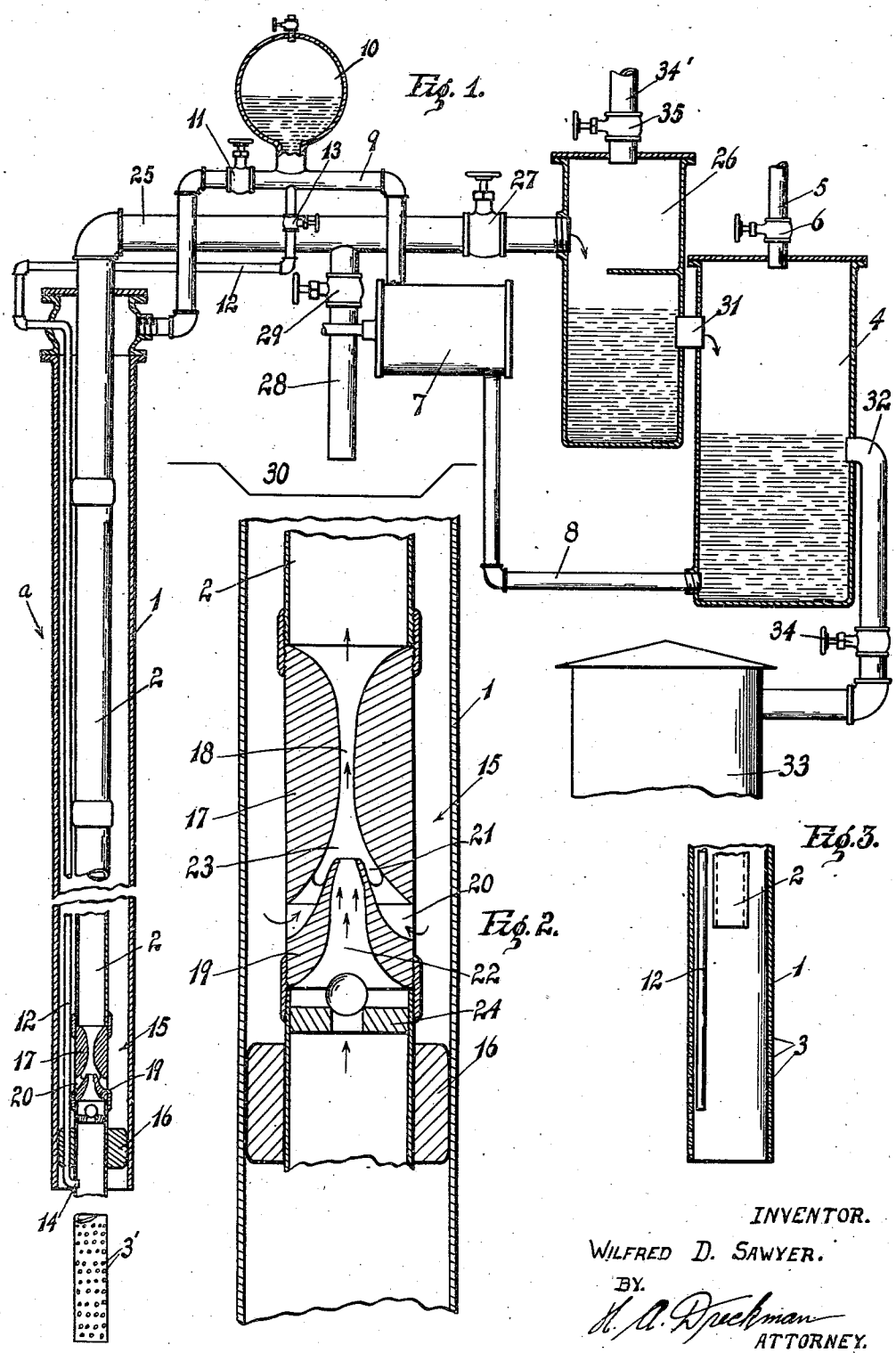


Fig. 1.

Fig. 2.

Fig. 3.

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METHOD AND MEANS TO PUMP OIL WITH FLUIDS

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The object of my invention is to provide a novel method for pumping, washing, swabbing, diluting and circulating a fluid in a well, and each of these operations may be performed simultaneously or separately.

Another object is to provide a novel fluid circulating system in an oil well by means of which the well may be either pumped, washed or swabbed as desired.

Another object is to provide a novel fluid circulating system in an oil well whereby any desired fluid or mixture of fluids in passing thru an ejector device will cause any mixture of oil, water, gas and solid matter in suspension in the well to be carried upwardly with the fluid and out of the well.

A further object of my invention is to provide an ejector of improved design having a positive suction of large value and which may be controlled to vary the suction to perform any of the operations stated in the prime object.

A feature of my invention is simplicity and ease in operation.

Other objects, advantages and features of invention may appear from the accompanying drawing, the subjoined detailed description and the appended claims.

In the accompanying drawing I have illustrated the preferred form of my invention, but it may also be embodied in other forms, and in this application I desire to cover my invention in whatever form it may be embodied within the scope of my claims.

In the drawing

Figure 1 is a diagrammatic view of my apparatus in operative position in a well.

Figure 2, is a longitudinal sectional view of the ejector device.

Figure 3, is a fragmentary sectional view of a modified form of casing and flow pipe arrangement.

Referring more particularly to the drawings:

In an oil well "*a*" there is provided the usual casing 1 with perforations 3 at the bottom of the casing to permit the entrance of oil. A flow pipe 2 is positioned in said casing with its lower end at any desired depth in the well below the fluid level and its upper end extending out of the top of the said casing. In order not to limit myself to any one type of well, it is understood that in case the above mentioned casing does not have perforations at its lower end, but is open ended, the flow pipe will be provided with a closed end except for perforations 3′ such that the oil in the casing must enter the flow pipe thru the perforations. In all subsequent descriptions it is to be understood that the perforations may be in either of the two above mentioned positions.

The ejector device 15 comprises a body 17 having a central impulse passage 18 therein, said passage being so curved that the kinetic energy of the fluid passing therethru will be transformed to potential energy. A nozzle 19 extends into the lower end of the passage 18, and a plurality of circumferentially placed ports 20 are arranged between the nozzle 19 and body 17, thru which the fluid under pressure enters as will be further described. The ports 20 extend to a ring jet 21 formed between the end of the nozzle 19 and the body 17. A suction passage 22 extends thru the nozzle 19 in alinement with the passage 18. The lower end of the passage 18 above the nozzle 19 comprises the mixture cone 23. The body 17 and the nozzle 19 may be integrally cast and suitably coupled to the flow pipe 2. A check valve 24 is mounted below the ejector device 15 within the flow pipe 2. The jet 21 is so shaped as to give high velocity to the jet fluid and directs the incoming fluid without loss of velocity into impulse passage 18 and forms a suction cone in the center of the jet above the nozzle 19. The cross sectional area of the passage 18 is approximately the same as that of the ring jet 21, it being of sufficient size to keep up the velocity of the jet, and the passage 18 is so curved as to transform the kinetic energy of the fluid passing therethru to potential energy. It will be evident that the induced fluid enters a suction cone formed within the jetting fluid and this arrangement prevents the nozzle from wearing due to the abrasive action of the solids in the incoming fluid.

A packer 16 of well known design is set at any desired depth in the casing below the

fluid level in the well and the flow pipe extends thru said packer to any suitable depth in the well.

I will first describe the washing or cleaning of the perforations 3 in the washing of the well. A reservoir 4 of sufficient capacity is supplied with fluid thru a pipe 5 leading from a fluid source (not shown). The fluid may be suitable substance such as water, oil, distillate, etc., and a valve 6 in the pipe 5 controls the flow therethru.

A pump 7 of well known design is connected to the reservoir 4 thru a pipe 8, and a discharge pipe 9 extends from the pump to the top of the casing 1. A pressure dome 10 opens into the pipe 9 and a valve 11 between the pressure dome and casing controls the flow thru said pipe.

A flushing pipe 12 controlled by a valve 13 therein extends from the pipe 9 at a point between the pump 7 and dome 10 to the casing 1, thence down the casing adjacent the flow pipe 2 to a point 14 adjacent the perforations 3 where it discharges inside whichever element carries the perforations, i. e., casing 1 or flow pipe 2.

To start the washing operation, the valves 11, 27 and 29 are closed and valve 13 opened. Operation of the pump 7 will force fluid from the reservoir 4 into pipe 9, thence to pipe 12, thence down to point 14 inside the element carrying the perforations, thru the perforations 3 and into the oil sand thus cleansing the perforations and washing the oil bearing formation.

To withdraw the cleansing fluid the mixture of oil, water, etc., as well as the solid matter therein, from the sands the valve 13 is closed, and valves 11 and 29 are opened. Operation of the pump 7 will now draw the fluid from the reservoir 4 and force it into the pipe 9 to the casing 1. The fluid flows into the casing, thru the ports 20 and fills the casing and flow pipe 2 for the entire length thereof. The packer 16 and valve 24 prevent the fluid from flowing into the oil bearing sand thru the perforations 3. A pipe 25 extends from the top of the flow pipe 2 to a sediment trap 26, and a valve 27 is provided in said pipe. A pipe 28 having a valve 29 therein is connected to pipe 25, and extends to a sump 30. The dome 10 is higher than the pipe 25, therefore there is a natural flow from the dome thru the casing 1 and flow pipe 2 to the trap 26 or sump 30. To greatly accelerate this flow, the pump operates under any required pressure so that the fluid passes thru ports 20 and into passage 18 at a high rate of speed. This creates a reduced pressure at 23 and the oil, water, sand, etc., is drawn thru the perforations 3, valve 24, suction passage 22 and joins and mixes with the fluid at 23 to pass out of the flow pipe 2. By increasing or decreasing the pressure of the fluid coming from the pump, the suction at 23 may be varied to either wash or swab the well, and the rate of pumping out the contents of the well governed accordingly, that is, to create such a suction within the bottom of the casing as is required to pull thru the perforations the sediment that is tending to clog up said perforations or tending to retard free flow of oil from the sands thru the perforations 3 into the casing. During washing or swabbing, the valve 27 is closed and valve 29 opened so as to deposit sand and sediment in the sump. A swabbing operation is accomplished in the same manner as that of withdrawing the cleansing fluid after the washing operation as above described except that for the swabbing operation the valves 11 and 29 are suddenly opened, the valve 13 immediately closed and without any pause in the operation of the pump, the pump is made to deliver the maximum fluid pressure and the maximum suction produced at 23. The above mentioned sudden opening of valves relieves the pressure in the flow pipe 2 which in turn causes a sudden surge of fluid from the well into the flow pipe and this flow, with the above mentioned maximum suction produced, causes a very rapid pumping out of the well and a complete withdrawal of all matter dislodged during washing. The great suction tends to create a vacuum or total relief of fluid pressure in the bottom of the casing which draws thru the perforations the sediment that is tending to clog up said perforations or tending to retard free flow of oil from the sands into the casing. During the operations of washing or swabbing, the valve 27 is closed and valve 29 opened so as to deposit sand and sediment into the sump.

An accumulation of sediment in the casing itself may be flushed out without washing into the sands by adjusting the openings of both valves 11 and 13 such that some of the fluid being forced by the pump into the pipe 9 shall be by-passed into the pipe 12 which extends down the casing thru the packer 16 to a point adjacent the perforations 3, said point of termination of the flushing pipe 12, as shown in Figure 3, to be at any desired distance from the end of the flow pipe 2 and independent of any definite or absolute relationship to the flow pipe 2. Thus above mentioned by-passed fluid is forced into the accumulation of sediment in the bottom of the casing thereby diluting and agitating the sediment mixture and causing it to circulate up the casing more freely under the suction of the ejector device which is operating at the same time. In case the accumulation or deposit of sediment or matter in the bottom of the well should be difficult to break up and agitate, it may nevertheless be flushed out without washing into the sand by closing the valve 11 and opening the valve 13 so that the whole pressure of the pump shall be

exerted to force a discharge of fluid from the flushing pipe into the above mentioned deposit in the bottom of the well and having the valve 29 open so that the pressure created within the deposit may be relieved up thru the flow pipe 2. As soon as deposit is broken up, valve 11 may be opened and the two valves 11 and 13 adjusted as above mentioned to give circulation of the mixture under the suction of the ejector device.

To start the pumping operation of the well, as soon as oil begins to appear in the sump discharge at the end of the above described washing or circulating operation, valve 29 is closed and valve 27 opened whereupon the oil drops into the sediment trap 26. A pipe 31 connects the trap 26 and reservoir 4 so that the oil returns to said reservoir.

The oil fluid mixture in excess of that required for operation of the ejector in the well is drawn from the reservoir 4 thru a pipe 32 to a storage tank 33. A valve 34 controls the flow thru pipe 32 and the oil is preferably drawn by gravity from the reservoir to the storage tank.

The gas which passes from the well is withdrawn thru a pipe 34′ in the trap 26, and a valve 35 controls the opening in said pipe.

The pressure of the fluid delivered by the pump may be varied by varying the speed of the pump and thus the suction created by the ejector device varied to suit the particular well in which the apparatus may be placed.

With my method, a well may be pumped, washed or swabbed by the simple adjustment of valves at the surface of the ground, and the apparatus requires very little attention because the pump is the only moving element. The operation of my method and apparatus will be apparent from the foregoing description.

I do not wish to limit myself to fluids as a means for pumping, washing or swabbing, but gas may be also used to advantage when used with my apparatus.

While I have described my invention as applied to oil wells, it may obviously be applied to any deep well such as water or gas.

I claim:

1. In a well including a casing, a flow pipe, pumping means in said flow pipe, a packer around said flow pipe below said pumping means, a supply pipe connected to the top of said casing, means for forcing fluid under pressure through said supply pipe into the casing, a flushing pipe connected to said supply pipe and extending through said packer to a point adjacent the bottom of the well, a valve in each of said flushing pipes and supply pipes, said flushing pipe being adapted to agitate and flush sediment from the bottom of the well and circulate it to said pump means while said pumping means is in operation.

2. The method of swabbing a well having a casing, a flow pipe, an ejector device, a packer below said ejector device, a flushing pipe extending below the packer, said method comprises forcing a fluid through the flushing pipe and upwardly in the flow pipe, then suddenly ceasing the flow through the flushing pipe and rapidly circulating the fluid through the ejector device, thus causing a rapid flow of the contents out of the well to swab the same.

3. The method of swabbing a well which has a casing, a flow pipe, an ejector device, a packer below the ejector device, a flushing pipe extending below the packer, which comprises forcing a fluid through the flushing pipe, and out of the casing, then suddenly ceasing the flow through the flushing pipe and rapidly circulating the fluid through the ejector thus causing a rapid flow out of the well to swab the same.

In testimony whereof I affix my signature.

WILFRED D. SAWYER.