April 6, 1954 C. P. HOWE 2,674,198

METHOD OF PUMPING OIL UNDER PRESSURE WITHOUT THE LOSS OF GAS

Filed Dec. 7, 1951 5 Sheets-Sheet 1

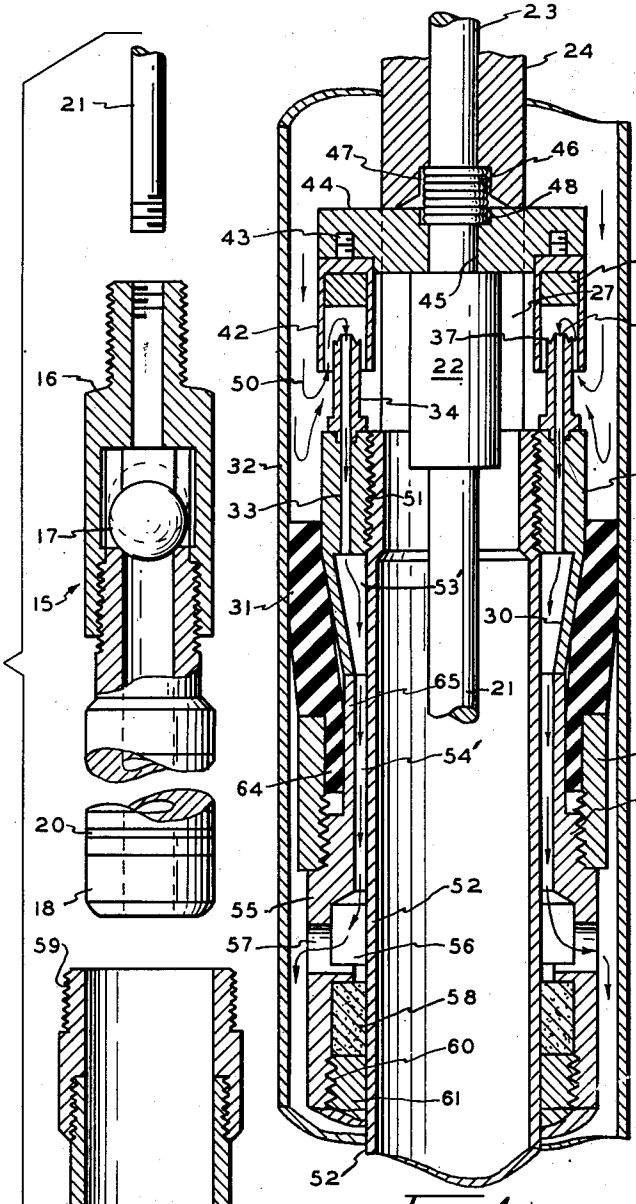


FIG. 11

FIG. 1

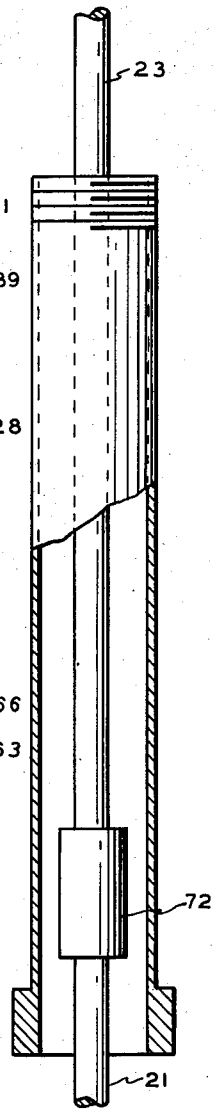


FIG. 10

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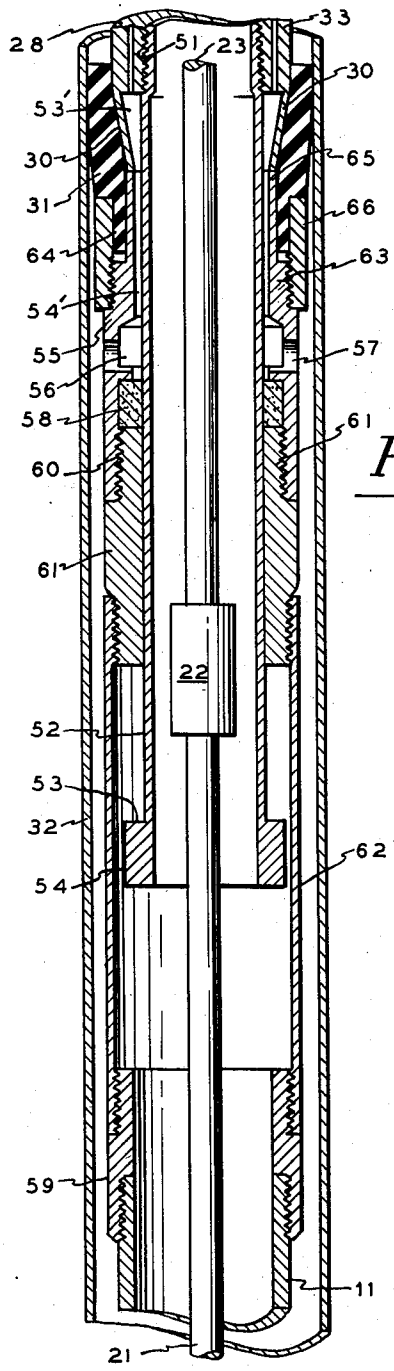


FIG. 2

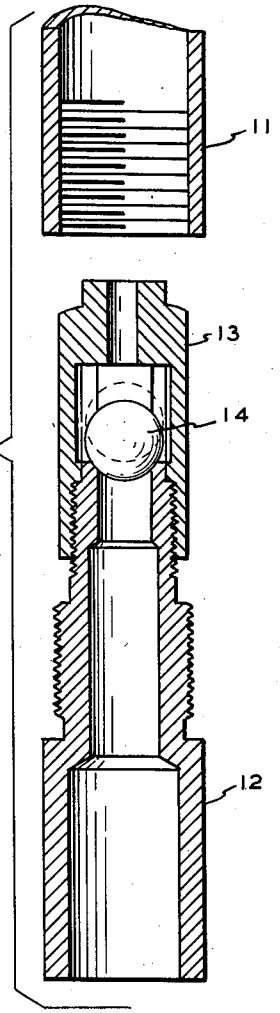


FIG. 12

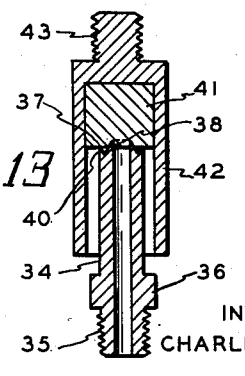


FIG. 13

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METHOD OF PUMPING OIL UNDER PRESSURE WITHOUT THE LOSS OF GAS

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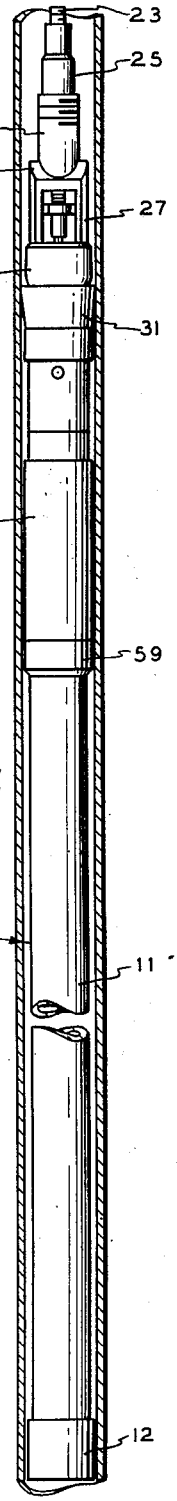


FIG. 4

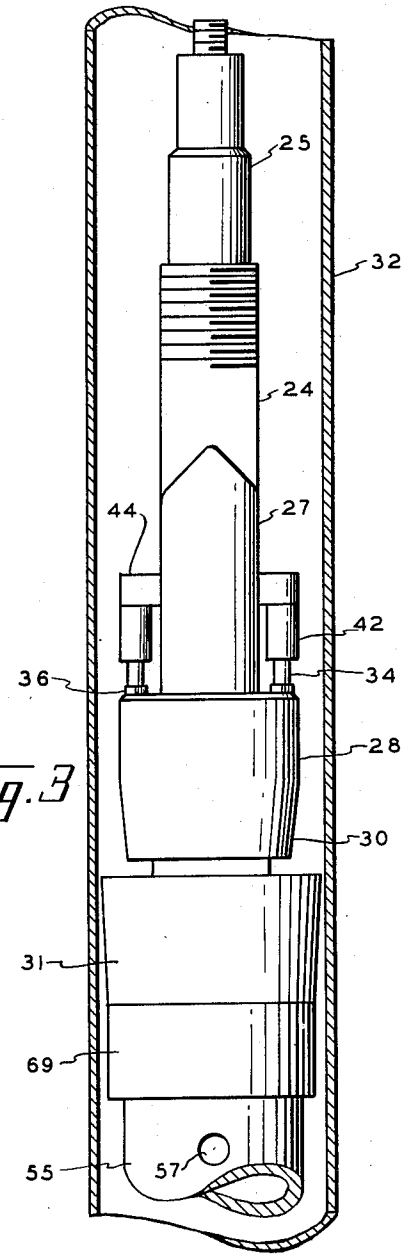


FIG. 3

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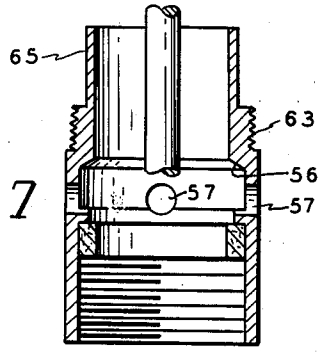


Fig. 7

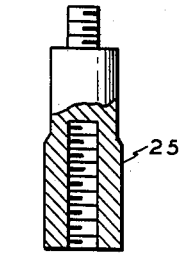


Fig. 14

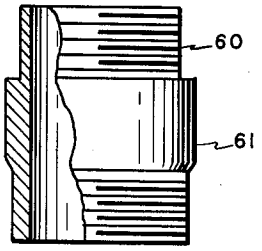


Fig. 8

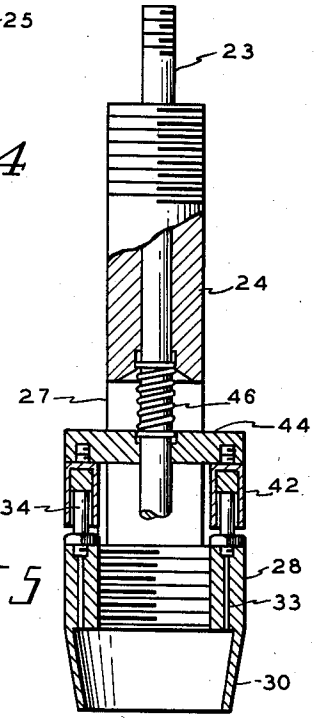


Fig. 5

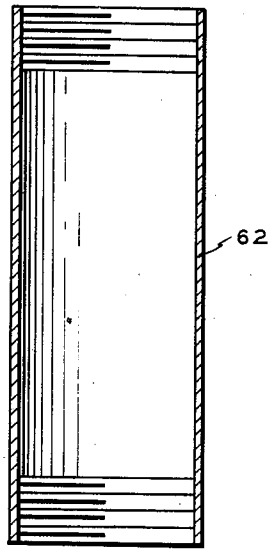


Fig. 9

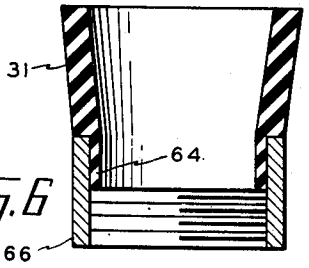


Fig. 6

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METHOD OF PUMPING OIL UNDER PRESSURE WITHOUT THE LOSS OF GAS

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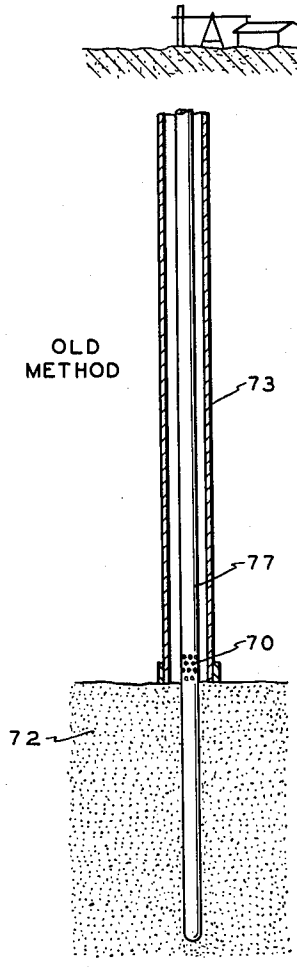


Fig. 15

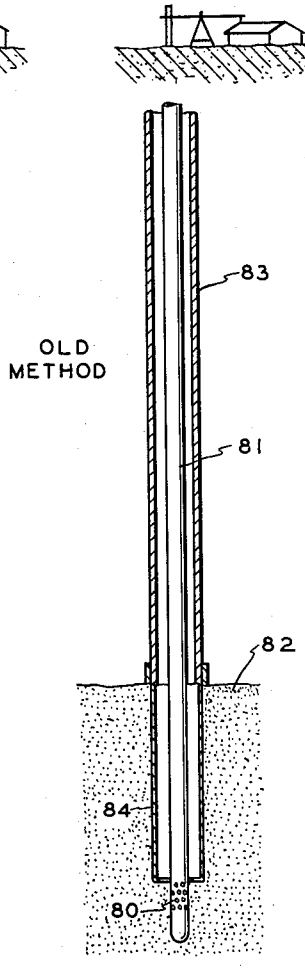


Fig. 16

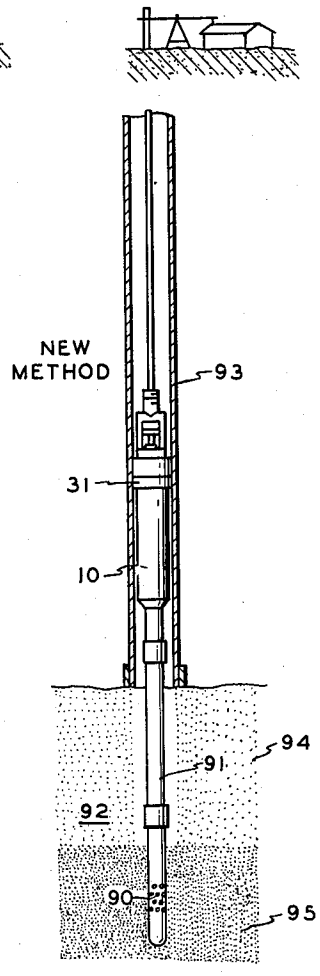


Fig. 17

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Patented Apr. 6, 1954

2,674,198

UNITED STATES PATENT OFFICE

2,674,198

METHOD OF PUMPING OIL UNDER PRESSURE WITHOUT THE LOSS OF GAS

Charles P. Howe, Albion, Ill.

Application December 7, 1951, Serial No. 260,372

2 Claims. (Cl. 103—204)

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This invention relates to a casing pump drain valve and a method of pumping oil under pressure without the loss of gas and has for an object to provide a method of providing the maximum oil production from an oil well by producing oil from the well without permitting the gas pressure in the well to escape, and to provide an improved casing pump having a drain valve which will permit the entrapped sands and solids above the pump head to be washed back and drained through the pump head before the casing pump is pulled for repair or replacement.

A further object of this invention is to provide a drain valve in a casing pump unit which has means for not only automatically releasing the hydrostatic pressure upon the unit before raising the unit from its operating position, but also causes any entrapped sands or solids above the pump head to be washed downwardly from above the pump head through the drain opening to below the same so that the pumping unit may be easily pulled with the regular pulley equipment and without likelihood of breaks occurring by pulling the pump for inspection, repairs or replacement. Although drain valves for oil well casing pumps are old as shown in the patent to D. B. Howe, 2,062,058 of November 24, 1936, and such previous drain valves will permit the hydrostatic pressure above the pump head to drain downwardly through the pump head, such previous type of drain valves do not necessarily cause the sands or solids entrapped above the pump head to be necessarily washed downwardly therethrough, and with such previous drain valves, it is possible that there may be still so great a load of sands or solids left above the pump head after the oil has drained downwardly therethrough that it may be impossible to remove the pumping unit as necessary. With this invention, however, the drain valve insures that any sands or solids will be washed downwardly through the pump head thus relieving the pumping unit from any load of either hydrostatic pressure of oil or of weight of sands or solids, thus leaving the pumping unit free to be readily removed in the usual manner.

The pumping head and drain valve of this invention is also particularly intended in connection with the improved method of pumping oil under pressure without the loss of gas of this invention.

A further object of this invention is to prevent the loss of gas pressure while pumping oil under pressure, and involves removing the oil from the oil sand without allowing the gas pressure to simultaneously escape therefrom or as in some methods of pumping to escape before the oil is even pumped. A particular feature of this invention is that it prevents air from reaching the

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oil sand, thereby preventing air from causing paraffin to clog up the sand and thus diminish the oil production.

A further object of this invention is to produce oil from an oil sand by the "seltzer bottle" method that is, by keeping the oil pressure trapped at the top of the oil sand and taking off the oil from the bottom or below the oil sand so that the trapped oil pressure tends to drive the oil toward the bottom of the sand and into the producing tube, whereby a maximum of oil is produced without loss of oil pressure.

With the foregoing and other objects in view, this invention comprises the combination, construction and arrangement of parts hereinafter set forth, claimed and disclosed in the accompanying drawings, wherein:

Fig. 1 is a longitudinal sectional view through an oil well casing pump and drain valves of this invention showing the drain valves in operating position.

Fig. 2 is a longitudinal sectional view through the working barrel assembly and pump head.

Fig. 3 is a plan view of the pump head and drain valves, in the position of being pulled from the casing.

Fig. 4 is a plan view of the pumping unit in operative position.

Fig. 5 is a sectional view through the pump head and drain valves.

Fig. 6 is a sectional view of the pump head packer.

Fig. 7 is a sectional view of the drain sleeve.

Fig. 8 is a sectional partly elevational view of the drain sleeve support or packing gland.

Fig. 9 is a sectional view through the assembly barrel.

Fig. 10 is a partly broken view of the assembly nipple showing the pump rod extending therethrough.

Fig. 11 is an exploded sectional and partly fragmentary view of the travelling valve.

Fig. 12 is an exploded sectional view of the standing valve.

Fig. 13 is a sectional view through one of the drain valves.

Fig. 14 is a partly sectional view of the upper pump rod coupling.

Fig. 15 shows one old method of pumping oil.

Fig. 16 shows another old method of pumping oil.

Fig. 17 shows the new method of pumping oil of this invention.

There is shown at 10 the pumping unit of this invention. This pumping unit 10 includes a valve barrel 11 to the bottom of which is threaded a standing valve 12 including a valve cage 13 and valve ball 14 for permitting oil to travel upwardly

therethrough but preventing it from travelling downwardly.

Reciprocably operable within the valve barrel 11 above the standing valve 12 is the travelling valve 15 consisting of the cage 16, the ball valve 17, hollow pump piston 18 and pump packings 20. This travelling valve is reciprocated within the valve barrel 11 by means of the lower pump rod 21 which is secured by a left hand thread to a pump rod coupling 22 to the pump rod 23.

The upper pump rod 23 extends through a guide sleeve 24 where it is secured by means of the upper pump rod coupling 25 to a sucker rod extending to the top of the well. The guide sleeve 24, which is hollow to permit the upper pump rod 23 to reciprocate therethrough, is integrally supported on the yoke 26 which in turn is an integral part of the yoke legs 27 extending integrally up from the pumping head 28. This pumping head 28 is a substantially cylindrical member provided with an integral depending cone-shaped skirt 30 arranged when in pumping position to extend into and compress a packing 31 against the sides of the well casing 32 to provide a leak proof seal therewith. Extending vertically through the pump head 28 are a pair of drain openings 33 leading to the inside of the skirt 30. Threaded into the top of the pump head 28 in communication with the drain openings 33 is a drain valve tube 34 having its lower end suitably threaded at 35 and provided adjacent the threads 35 with an integral hex 36 for receiving a wrench. The top end of tube 34 terminates in a pair of concentric spaced apart sharpened lips 37 and 38, the inner lip 38 extending slightly beyond the outer lip 37 and connected thereto by a valley 40.

Cooperating with the valve lips 37 and 38 for sealing or opening the drain openings 33 extending through the tube 34 is a valve seat 41 of soft metal such as babbitt or lead or the like mounted within an inverted cup 42 having an integrally formed threaded boss 43 for supporting it at one end of a floating bridge 44. The floating bridge 44 with a valve seat cup 42 at each end is provided with a central aperture 45 through which the upper pump rod 23 extends, and is located between the yoke arms 27, being yieldably urged downwardly so as to press the valve seats 41 against the valve lips 37 and 38 by means of a coil spring 46 biased between a recess 47 in the bottom of the guide sleeve 24 and another recess 48 in the top of the bridge 44 counterbored from the pump rod opening 45.

As will be apparent from Fig. 1, when the sucker rod is raised upwardly beyond the normal pumping stroke, it will cause the lower pump rod coupling 22 to abut the bottom of floating bridge 44 and raise it against the coil spring 47 until it abuts the bottom of the guide sleeve 24 and yoke 26, thus raising the valve cups 42 upward and removing the valve seat 41 from contact with the valve lips 37 and 38. As shown in Fig. 1, the cups 42 come to rest with the valve tubes 34 still extending about half way into the cups, hence, any fluid flowing down from above the pumping head unit must swirl about as shown by arrows 50 in order to pass into the inverted cup 42 and reach the opening through the drain tube 34 to the drain openings 33.

Threaded to the inside of the pumping head 28 is the upper threaded end 51 of the assembly nipple 52 whose lower end is provided with a shoulder 53 and enlarged portion 54. The outer surface of nipple 52 cooperating with the inner surface of skirt 30 forms a drain passage 53' therebetween as shown in Fig. 1 leading from the pump head drain openings 33 to a lower drain passage 54' formed between the outside of assembly nipple 52 and the inside of a drain sleeve 55 leading to an internal annular recess 56 and to drain openings 57 to the outside of drain sleeve 55. A packing 58 in the bottom of drain sleeve 55 seals against the outside of assembly nipple 52. The packing 58 is held in position by the upper threaded end 60 of an assembly coupling 61 whose lower end is threaded into the upper end of the assembly sleeve 62, the lower end of assembly sleeve 62 being in turned threaded by a coupling 59 on the upper end of barrel valve 11.

The drain sleeve 55 has a threaded counterbore 63 for securing it in the bottom of the packing sleeve 66, the packing 31, preferably of neoprene rubber or the like having a portion 64 extending therewithin and bonded thereto as by vulcanization or the like. The drain sleeve 55 has an upwardly extending portion 65 above the threaded counterbore 63 and arranged to abut the bottom edge of skirt 30 so as to connect drain passageways 53 and 54 together as shown in Fig. 1 when the pump head skirt is fully depressed within the packing 31 as in normal operation of the pump.

When the pumping unit is being lowered into the well or is being raised therefrom, it will be supported on the sucker rod and upper pump rod 23 holding the coupling 22 against the bottom of floating bridge 44 and thus against the bottom of the yoke guide sleeve 24 and yoke 26. The pump barrel assembly will be supported in turn by shoulder 53 of assembly nipple 52 abutting the bottom end of assembly coupling 61. In this position, the skirt 30 is disengaged from the outside of packing 31 as shown in Fig. 3 and the maximum external diameter of packing 31 is less than the internal diameter of casing 32, thus permitting the pumping unit to pass freely up and down within the casing 32. When being placed in the well, the bottom ends of the working barrel 12 or any suitable extension tube thereon will hit against the bottom of the well, thus preventing further descent of the pumping unit. The weight of the assembly nipple 52 and attached spots and the pumping head will cause the skirt 30 of pumping head 28 to enter within and expand the packing 31 tightly against the inside of casing 32 while simultaneously the spring 46 urges floating bridge 44 downwardly and thus seals the valve seat 41 against the tube lips 37 and 38. The pump is now ready to be operated, as the sucker rod drops down further to the normal pumping position, in which position, the travelling valve 15 may be reciprocated up and down by means of the lower pumping rod 21 with its coupling 22 remaining well below the floating bridge 44 on which the valve cups 42 are supported. After an extended period of pumping, it may be necessary to remove the pumping unit for inspection, repair or replacement. To do so, the sucker rod is raised upwardly beyond its normal zone of operation until coupling 22 comes into contact with the bottom of floating bridge 44 and raises against the coil spring 46 to abut the bottom of guide sleeve 24 and yoke 26. Should the pump sand up and the travelling rod 15 freeze or stick so that it will not travel either way, the sucker rod may be rotated in the direction to unthread the left hand thread between the bottom of coupling 22 and the top of

lower pumping rod 21, thus freeing coupling 22 for upward movement. This opens the drain valves 42 from the drain valve tube 34 without having to do any work against the hydrostatic pressure of the column of oil and entrained sands or solids therewithin, while the pumping head skirt 30 still remains within packing 31 compressed against the inside of casing 32. The column of oil immediately starts to drain down through the drain openings 33 and passageways 53', 54', recess 56 and drain openings 57 to below the packing 31 to the bottom of the well.

As the oil drains downwardly, it is forced to reverse its direction in order to enter under the cups 42 to reach the opening through tube 34, thus causing a swirling motion in the bottom of the oil column thoroughly washing out any entrapped sand through the opening so that by the time the column of oil has drained from above to below, every bit of sand will have been washed therethrough, leaving the pumping unit free of both the weight of the oil column and of the weight of any sand that might otherwise be left thereabove. The sucker rod is then pulled somewhat additionally, thereby pulling the skirt 30 out of the packing 31 and allowing it to contract to the condition shown in Fig. 3 whereupon the pumping unit may be pulled easily from the well by means of the sucker rod for replacement or repair, the column of oil that has drained therebelow thus serving to seal the bottom of the well.

This pumping unit 10, with its drain valves as thus described is used in applicant's new method for pumping oil from an oil sand without loss of gas pressure therein. In order to understand the new method of this invention, two old methods will first be referred to.

In Fig. 15, the screen 70 in the pumping tube 71 is located above the oil sands 72 at the bottom of the well casing 73. With this method, the oil sands 72 is covered with fluid and no air can get to the oil sands to paraffin and gum it up. However, in order to get the oil it is necessary to release the gas pressure so that the oil will rise above the formation. As the gas pressure escapes, less and less oil can reach the screen 70 so that finally there is no pressure left to bring any oil to the screen 70, and most of the oil in the oil sands 72 is still left therein and not available to the pump and in order to recover this further oil it is necessary to repressure or water drive the oil to the screen 70 which is quite expensive.

In Fig. 16, the screen 80 in the pump tube 81 is extended into the oil sands 82 which is thus uncovered to the casing 83. As a result of this, air reaches the oil sands to paraffin and gum it up as at 84 and the pressure is soon exhausted and production drops even through there is a great deal of oil still left in the oil sands 82 most of which is not recoverable as a result of this process.

In applicant's new method as shown in Fig. 17, the screen 90 in the pump tube 91 is located substantially at or below the bottom of the oil sands 92, the well casing 93 extending to the oil sands with the pumping unit 10 sealed within the casing 93 as by the packing 31 as above described. With this method, no gas can escape past the pumping unit 10 while in operation, and no air can get down past the pumping unit 10 to reach the oil sands 92. As a result, gas pressure will be retained within the oil sands 92 and the oil in the oil sands 92 will enter the pump tube 91 through the screen 90 at the bottom thereof, gas pressure retained in the oil sands 92 intending to collect at the top thereof as shown at 94 will drive the oil downwardly as at 95 to the screen 90.

This method of operation prevents any loss of the gas pressure 94 and makes it possible to collect substantially all the oil 95 in the oil sands 92 being in effect a "seltzer bottle" method of removing the oil 95 from the oil sands 92 without any loss of the gas pressure 94, and utilizing the gas pressure 94 to drive the oil 95 in oil sands 92 into the pumping tube 91.

While the device has been shown and the structure described in detail, it is obvious that this invention is not to be considered as being limited to the exact form disclosed, and that changes in detail and construction may be made therein within the scope of what is claimed, without departing from the spirit of this invention.

Having thus set forth and disclosed the nature of this invention, what is claimed is:

1. The method of producing oil from an oil sand in a deep well comprising extending a casing to the top of the oil sand, extending a tube perforated solely adjacent its bottom through the casing to adjacent the bottom of the oil sand, the tube having a pump including a barrel connected therethrough that is subject to the accumulation of sand above the pump during the pumping operation, sealing the pump barrel to the bottom of the casing to prevent access of air to the oil sand and escape of gas pressure from the oil sand, operating a pump piston in the pump barrel to remove oil from the perforated tube as it accumulates therein from the oil sand utilizing the well casing to conduct oil from the pump to the surface, and periodically draining oil from above the pump therethrough.

2. The method of producing oil from an oil sand in a deep well comprising extending a casing to the top of the oil sand, extending a tube perforated at its bottom through the casing to adjacent the bottom of the oil sand, the tube having a pump including a barrel connected therethrough that is subject to the accumulation of sand above the pump during the pumping operation, sealing the pump barrel to the bottom of the casing to prevent access of air to the oil sand and escape of gas pressure from the oil sand, operating a pump piston in the pump barrel to remove oil from the perforated tube as it accumulates therein from the oil sand utilizing the well casing to conduct the oil from the pump to the surface, and periodically draining oil above the pump therethrough and subjecting it to a reverse swirling motion to thereby agitate the accumulated sand and thus wash it down through the pump to free the pump for removal from the well.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
276,116	Williamson	Apr. 17, 1883
1,190,267	Dunn	July 11, 1916
1,295,243	Waitz	Feb. 25, 1919
1,523,286	Railsback	Jan. 13, 1925
2,062,058	Howe	Nov. 24, 1936
2,074,912	Hutto	Mar. 23, 1937
2,111,173	Cox	Mar. 15, 1938
2,172,101	Howard	Sept. 5, 1939
2,181,099	Pyle	Nov. 21, 1939
2,281,801	Reynolds et al.	May 5, 1942
2,363,644	Collins	Nov. 28, 1944
2,451,168	Lauman	Oct. 12, 1948
2,652,000	Woolsey	Sept. 15, 1953