Oct. 6, 1936. C. J. COBERLY 2,056,418

METHOD AND APPARATUS FOR INSTALLING PUMPS IN WELLS

Filed Aug. 18, 1934 2 Sheets-Sheet 1

Fig. 1.

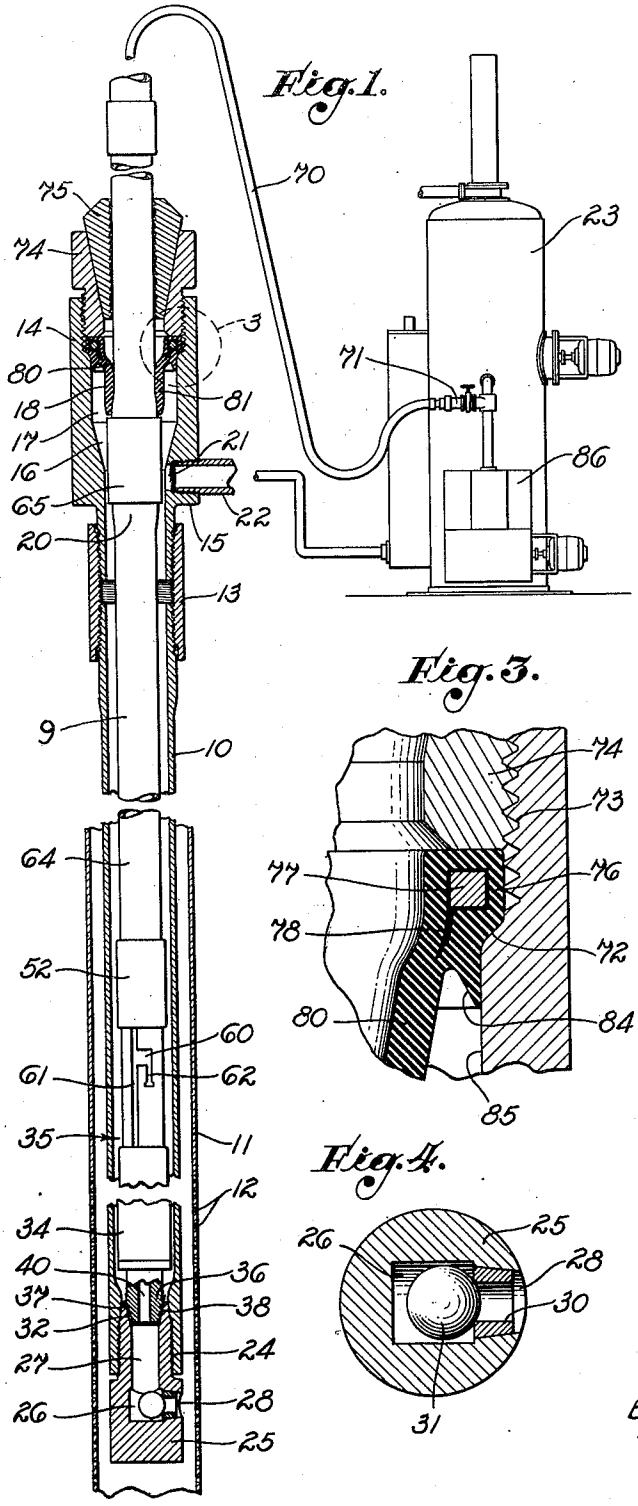


Fig. 2.

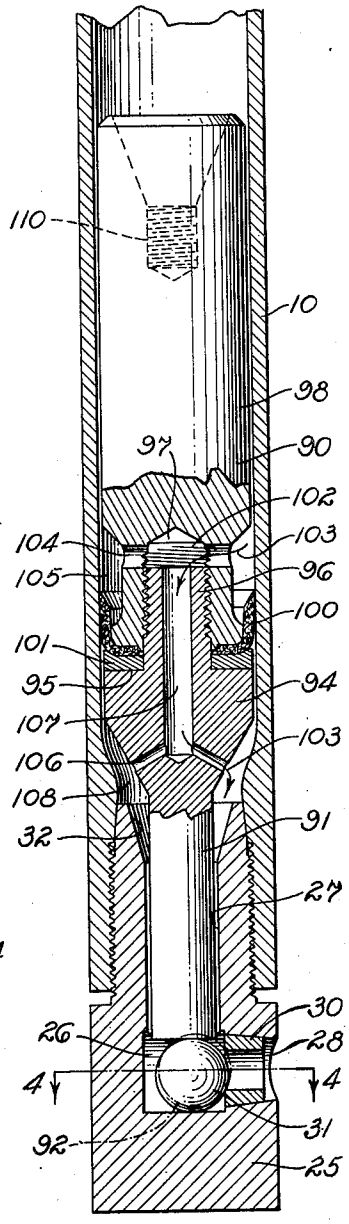


Fig. 3.

Fig. 4.

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Fig. 5.

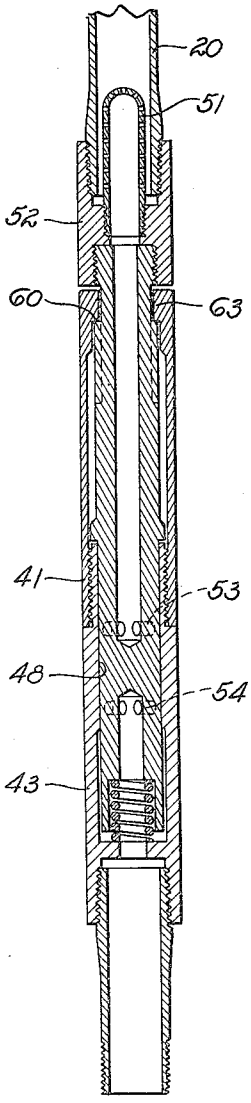


Fig. 6.

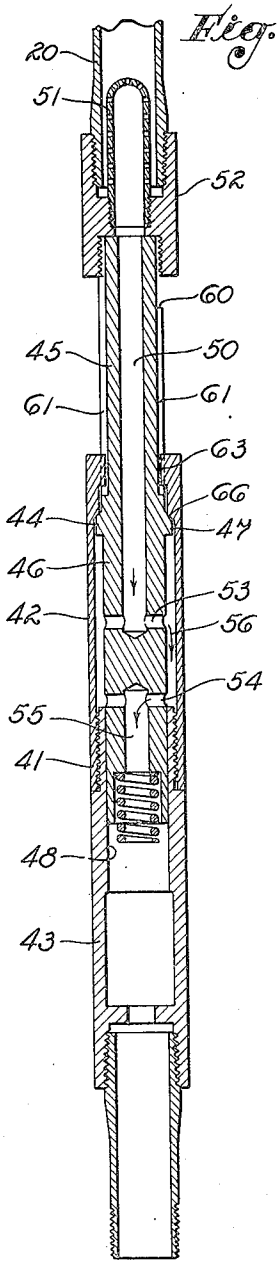
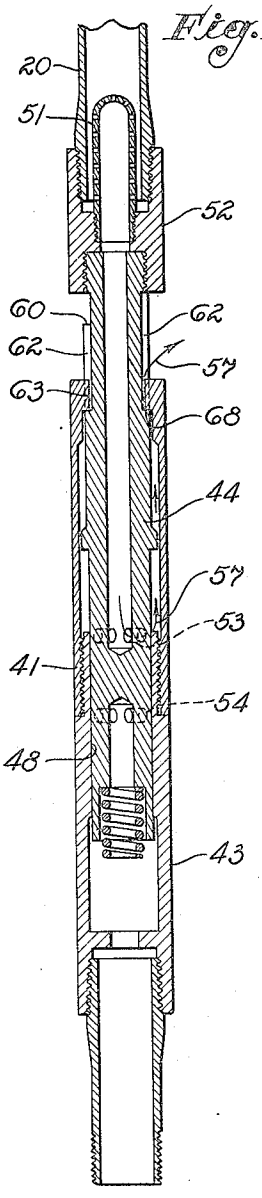


Fig. 7.



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Patented Oct. 6, 1936 2,056,418

UNITED STATES PATENT OFFICE

2,056,418

METHOD AND APPARATUS FOR INSTALLING PUMPS IN WELLS

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Application August 18, 1934, Serial No. 740,452

12 Claims. (Cl. 103—46)

My invention relates to a method and means for pumping wells, and relates in particular to a method and apparatus having particular utility in the pumping of oil wells. Although the invention may be employed with various types of well pumping equipment, the original conception thereof is in connection with the pumping of oil from wells by the use of fluid operated pumps in which the actual oil pump is operated by a fluid such as clean oil forced under pressure down to the motor of the pump through a pressure pipe which extends from the surface of the well to the pumping mechanism situated in the oil producing zone. This form of pumping mechanism ordinarily includes a fluid motor which is generally of reciprocating type, and a piston pump to which the motor is connected. Delivery of the operating fluid, or clean oil under pressure, to the motor is controlled by valves situated at the motor, and the exhaust fluid after its power has been expended in operating the motor is discharged into the production pipe or oil tube which also carries the pumped oil from the well to the surface of the ground. Such a pumping mechanism is lowered into the well at the lower end of the pressure piping through which the clean operating oil is to be delivered to the motor of the pump. When the pump is lowered into the oil in the well, the external pressure operating against the pumping mechanism will cause the motor to work in reverse direction, and oil from the well will be permitted to pass inwardly through the motor mechanism into the clean oil delivery tube. This oil from the well is generally dirty; in other words, it carries more or less sand or grit, and consequently such abrasive substances are carried into the working parts of the motor with a harmful effect thereon.

Important objects of my invention are to provide a method and apparatus whereby a pump may be lowered into a position for operation in a well without possibility of dirty oil entering operating parts thereof which might be injured by such entry of dirty oil, and to prevent loss of the quantity of oil contained in the production tube when the pumping mechanism is pulled from the well.

In conjunction with the foregoing, it is also an object of the invention to provide a method and means whereby the body of oil existing in the production pipe during the operation of the pumping mechanism may be retained therein when the pump is pulled from the well for the purpose of repair. The invention contemplates the provision of means for placing and maintaining within the pressure fluid tube, to the lower end of which the pumping mechanism is attached, a body of clean oil, the static head of which will resist the entry of dirty oil into the pump, and the provision of means for receiving and filtering the oil which is displaced from the production tube as the result of the lowering of the pump into the well.

A further object of the invention is to provide a production tube having a check valve at the lower end thereof so that when the pump is pulled, the oil content of the production tube will not drain back into the well, and having a seal at the upper end of the production tube for preventing the displacement of oil from the production tube onto the derrick floor as the result of, and during the time of, the relowering of the pumping mechanism and the pressure tube into the oil production tube which contains oil left therein from the preceding pumping operation and clean oil which is bled from the pressure piping during the pulling of the pump.

It is a further object of the invention to provide a method of handling a pumping mechanism of the above character in a well, wherein the oil contained in the pressure piping leading to the pumping mechanism is drained into the production tube as the pumping mechanism is drawn, and wherein the lower end of the pressure pump is closed during the relowering of the pumping mechanism into the production tube so that oil from the production tube cannot enter the same, and the oil from the production tube is displaced through suitable piping at the upper end of the production tube to be subsequently filtered and fed into the pressure piping as the pumping mechanism is lowered toward the oil production zone of the well.

A further object of the invention is to provide an oil production tube having an inlet check valve at the lower end thereof and means for opening this check valve when it is desired to pull the oil tube from the well, thereby providing a means for draining the production tube at such time and preventing what is known as a "wet job".

A further object of the invention is to provide a simple form of release for the inlet check valve of the oil production tube, which may operate within the production tube and which is so formed that it will positively hold the check valve in open position against the forces which operate to close such valve due to the draining of oil therefrom.

Further objects and advantages of the inven-

tion will be made evident throughout the following part of the specification.

Referring to the drawings, which are for illustrative purposes only;

Fig. 1 is a vertically sectioned view showing a preferred form of apparatus for the practice of the invention.

Fig. 2 is an enlarged fragmentary sectional view of the lower end of the production tube and the bleeder valve releasing means.

Fig. 3 is an enlarged fragmentary section of the area defined by the dotted circle 3 of Fig. 1.

Fig. 4 is a cross-section on a plane represented by the line 4—4 of Fig. 2.

Fig. 5 is a slightly enlarged vertical section through the control valve mechanism disposed between the lower end of the pressure piping and the pumping mechanism, the parts thereof being in position for lowering the pumping mechanism into the well.

Fig. 6 is a view similar to Fig. 5 but showing the parts of the control valve mechanism in the positions they assume during the pumping of the well.

Fig. 7 is a view similar to Fig. 5, showing the parts of the control valve mechanism in position for bleeding the clean oil from the pressure piping.

In Fig. 1 of the drawings I show an oil production tube 10 which may be extended down into a well into the oil producing zone of such well. When so positioned, the oil tube generally has its lower end positioned within a screen pipe 11 having screen openings 12 through which the oil enters from the oil bearing formation. The production tube 10 is hung in the well and may have its upper end connected by a collar 13 with a head 14. The head 14 has an opening 16 axially therethrough which is enlarged toward its upper end to provide a chamber 17 in which a sealing member 18 operates to prevent escape of oil upwardly around a string of pressure piping 20 which is lowered therethrough into the oil production tube 10. For the escape of oil from the upper end of the production tube, the head 14 thereof is provided with an outlet opening 21 to which transfer piping 22 is connected, this transfer piping extending to a suitable means for disposal of the oil and in the preferred practice of the invention being connected to a filter 23 of the character shown in my copending application entitled "Filtering device", Serial No. 654,431, filed January 31, 1933 now Patent No. 2,046,770, July 7, 1936.

The lower end of the oil production tube 10 is provided with threads 24 for the connection of a valve body 25 having a chamber 26 in the lower portion thereof which connects through a vertical passage 27 with the interior of the production tube 10 and which connects through a lateral opening 28 with the body of oil contained in the oil producing zone of the well. The opening 28 is constricted in outward direction and receives a valve seat 30 which is tapered to correspond to the opening 28 and is inserted through the vertical passage 27. In the chamber 26 is a valve closure means in the form of a ball 31 which is forced into engagement with the valve seat 30 by force or pressure derived from the oil which tends to escape through the valve seat and the opening 28. This ball 31 permits oil to enter the chamber 26 and the passage 27 but prevents escape of oil therefrom except when held in open position as shown in Fig. 2 by means which will be hereinafter described.

The upper end of the body 25 has a conical seat 32 adapted to receive the inlet end of a pumping means 9 which is lowered into the production tube 10. The preferred embodiment of the pumping means 9 disclosed includes the previously set forth pressure piping 20 and a fluid operated pump 34 which is connected to the lower end of the pressure piping 20 by means of a control valve mechanism 35, such as shown in the copending application of C. J. Coberly et al., entitled "Bleeder for deep well pumps", Serial No. 720,414, filed April 13, 1934, and which is shown in section in Figs. 5, 6, and 7 of the present application. The lower end of the pump 34 has a conical projection 36 adapted to rest in the seat 32 of the valve body 25 so as to provide a seal between the vertical passage 27 of the valve body 25 and the interior of the oil production tube 10. The tapered projection or plug 36 has external annular grooves 37 therein so as to produce intervening ribs 38 which engage the seat 32. In the operation of the pumping device clean oil under pressure is pumped down through the pressure piping 20 to operate the pump 34, and the pump 34 draws oil from the well through an opening 40 in the extension 36, this oil being delivered by the pump 34 into the production tube 10 where it passes upwardly together with the clean oil which discharges from the motor element of the pump 34.

As shown in Figs. 5, 6, and 7, the control valve mechanism 35 includes a shell 41 comprising an upper member 42 and a lower member 43 which connects to the upper end or motor end of the pump 34. Slidable within the shell 41 is an inner tubular member 44 which is divided into upper and lower sections 45 and 46 by an annular rib or collar 47. The lower section 46 of the member 44 is slidable within the bore 48 of the lower tubular member 43. The inner member 44 has a bore 50 which connects to the interior of the pressure piping 20 through a screen member 51 which projects upwardly from a collar 52 employed to connect the member 44 to the piping 20. Extending radially from the lower end of the passage 50 are ports or passages 53 through which communication is made, when the parts 41 and 44 are in extended relation as shown in Fig. 6, with ports 54 connected through a lower vertical passage 55 of the member 44 with the bore 48 of the shell 41. Accordingly, when the parts 41 and 44 are in extended relation, fluid under pressure from the piping 20 may pass as indicated by arrows 56 through the control valve device to the pump 34. When the parts 41 and 44 are in collapsed relation, as shown in Fig. 5, both the ports 53 and 54 are within the bore 48, and consequently the communication between the pressure piping 20 and the pump 34 is closed off. When the parts 41 and 44 are in intermediate position, as shown in Fig. 7, the lower ports 54 are within the bore 48 so as to be closed against passage of fluid therethrough; but, the ports 53 are above the upper end of the section 43 of the shell 41 so that the clean oil from the pressure piping may drain to the exterior as indicated by arrows 57.

As shown in Figs. 1 and 5, a pair of upwardly faced shoulders 60 are formed in the upper end of the member 44, and as shown in Figs. 1 and 6 and 1 and 7, long and short slots 61 and 62 respectively extend downwardly from opposite sides of the shoulders 60. Projecting inwardly

at the upper end of the member 42 are blocks or lugs 63 adapted to rest upon the shoulders 60, as shown in Fig. 5, and to project into the grooves or channels 61 and 62, as shown in Figs. 6 and 7. As shown in Fig. 5, it is possible to move the parts 41 and 44 into collapsed relation and to relatively turn the same so that the lugs 63 will rest upon the shoulders 60 prior to the lowering of the pump into the well and so that during the lowering of the pump into the well, the ports 53 and 54 will be closed.

As the piping 20 is assembled from separate lengths of piping or tubing 64 connected together by collars 65, clean oil or other clean fluid is placed in the piping 20 to exert a static head of fluid therein to resist entry of fluid from the exterior by leakage and to weight the piping 20 so that it will readily descend through the oil in the production tube. As the piping 20 is lowered, additional quantities of clean oil are fed thereinto from a source of supply which is preferably the filter 23 which is connected through the piping 22 with the upper end of the production tube 10. When the pump 34 reaches its position of operation and the extension 36 engages the seat, the control valve mechanism 35 may be adjusted to bring its parts 41 and 44 into the positions in which they are shown in Fig. 6, this being accomplished by rotating the piping 20 so that the long slots 61 will move into alignment with the lugs 63, whereupon the piping 20 may be raised so as to bring the collar 47 into engagement with a sealing shoulder 66 formed within the upper section 42 of the shell 41 just below the lugs 63. Then fluid under pressure may be pumped downwardly through the piping 20 to pass as indicated by the arrows 56 through the ports 53 and 54 into the bore 48 which connects with the upper end of the pump 34, thereby operating the pump entirely with clean oil and causing the pump to pump dirty oil from the well upwardly through the production tube 10 to the discharge piping 22 which connects with the filter 23 and with an oil reservoir, not shown.

When it becomes necessary to withdraw the pump from the well for the purpose of repair, the piping 20 is first lowered to bring the part 44 into the position in which it is shown in Fig. 5, whereupon the piping 20 is rotated so as to bring the short grooves 62 into alignment with the lugs 63. The piping 20 is then lifted, and the member 44 moves upwardly until shoulders 68 formed at the lower ends of the grooves 62, as shown in Fig. 7, come into engagement with the lugs 63. Continued upward movement of the piping 20 then lifts the pump from the well, and at the same time the clean oil from the pressure piping 20 is permitted to bleed out through the ports 53 and the interior of the upper section 42, as shown by the arrows 57 in Fig. 7. When the piping 20 and the pump 34 are withdrawn from the production tube 10, such tube 10 is left nearly full of oil which is held therein by the check valve 31, by reason of the fact that the pressure fluid in the piping 20 is added to the production oil in the production tube 10.

When the pump is again lowered into the production tube 10, the piping 20 will displace the oil in the production tube 10 upwardly. In the practice of my invention, this upwardly displaced oil is forced outwardly through the piping 22 and into the filter 23 by reason of the fact that the upper portion of the chamber 17 of the head 14 is sealed by the member 18. Accordingly, in the practice of my invention a quantity of clean oil is placed in the lower end of the tubing 20 as it is started down into the production tube 10, and thereafter clean oil, for continuing to fill the piping 20 as the length thereof is increased, is taken from the filter 23 to which oil from the production tube 10 is supplied through the discharge piping 22 as the result of the displacement of oil in the tube 10 by the piping 20 as it is lowered. Therefore, a hose 70 may be connected to the outlet pipe 71 of the filter 23 through which the desired quantities of clean oil may be delivered into the upper end of the piping 20, as required.

The sealing member 18 is so designed that the piping 20 may pass therethrough and so that such sealing member will pass over the collars 65 as the piping 20 moves downwardly. As shown in Figs. 1 and 3, the upper portion of the head 14 is counterbored to provide a shoulder 72 and is provided with internal threads 73 for receiving the lower end of an annular tapered socket member 74 which receives wedges 75 adapted to engage the piping 20, as shown in Fig. 1. The sealing member 18 is molded from rubber or rubber composition and includes an upper reinforced ring portion 76 which is held between the shoulder 72 of the head 14 and the lower end of the socket member 74. The ring portion 76 of the sealing member 18 is reinforced by a metal ring 77 having a suitable fabric 78 folded therearound to tie the ring to the rubber from which the sealing member 18 is formed. The sealing member 18 further includes a conical wall 80 which converges downwardly from the ring portion 76, and a cylindrical wall portion 81 at the lower end of the conical wall portion 80. The wall portion 81 is of such diameter that it will grip the surface of the piping 20 but will let the piping 20 slide therethrough. Pressure of oil in the chamber 17 of the head 14 forces the sealing member tightly against the piping 20 so that a seal is accomplished which will prevent leakage of oil upwardly between the surface of the piping 20 and the sealing member 18. On the lower part of the ring portion 76 a downwardly projecting annular lip 84 is formed in a position to engage the inner surface 85 of the head 14. Fluid pressure in the chamber 17 forces the lip 84 outwardly against the surface 85 so as to produce an effective seal supplementary to the seal accomplished by the holding of the ring portion 76 against the shoulder 72 by the socket 74. After the piping 20 has been lowered to provide the proper position of operation for the pump 34, the upper end of such piping 20 may be connected to the force pump 86 of the filter device 23 in the manner described in my copending application hereinbefore referred to, Serial No. 654,431, filed January 31, 1933, and entitled "Filtering device" now Patent No. 2,046,770, July 7, 1936.

My invention provides a means for moving the ball 31 into open relation to the seat 30 when it is desired to drain the production tube 10 so as to permit a dry job in pulling the production tube. Such means comprises a member 90, Fig. 2, adapted to be dropped into the production tube 10 and having a stem 91 extending downwardly therefrom to pass through the vertical passage 27 of the body 25 and to strike the ball 31 and displace it downwardly from the position indicated by dotted lines 92 into the position in which it is shown in full lines in Fig. 2. The stem 91 has a head 94 at the upper end thereof formed with an upwardly faced shoulder 95 and a threaded pin 96 adapted to enter a threaded

opening 97 of a body 98 of cylindrical form of sufficient weight to cause the member 90 to pass downwardly through the body of oil in the production tube 10.

So that the stem 91 will be held forcibly down against the ball 31 to hold it in open relation against the hydraulic force operating to move the same into closed position relative to the seat 30, I provide hydraulic means in connection with the member 90 consisting of a cup washer or sealing member 100 which is held against a dished ring 101 carried by the shoulder 95 of the head 94. When the valve ball 31 is displaced, as above described, the cup washer is expanded so as to make sealing engagement with the wall of the tube 10 and fluid pressure operating downwardly against the body 98 and against the cup washer 100 forces the member 90 downwardly with great pressure, and the draining fluid passes through a by-pass 102 as indicated by arrows 103. Such by-pass 102 comprises radial holes 104 connecting the space 105, above the washer 100, with the opening 97 of the body 98, and diagonal passages or flow restricting orifices 106 which are connected with the opening 97 through a vertical opening 107 in the head 94, and lead to the space 108 within the tube 10 lying below the washer 100. The orifices 106 are of smaller area than the opening now existing between the ball 31 and the seat 30 so as to restrict drainage of oil from the upper part of the production tube 10 and to consequently lower the pressure in the space below the plane of the cup washer 100 whereby sufficient differential hydraulic pressure is maintained downwardly against the valve opening device 90 to hold the ball 31 positively in open position. Should it be desired to remove the opening device 90 from the position shown in Fig. 2, without removing the production pipe 10 from the well, I provide an internally threaded socket 110 at the upper end thereof which may be engaged by a suitably threaded bar or string of rods.

Although I have herein shown and described my invention in simple and practical form, it is recognized that certain parts or elements thereof are representative of other parts, elements, or mechanisms which may be used in substantially the same manner to accomplish substantially the same results; therefore, it is to be understood that the invention is not to be limited to the details disclosed herein but is to be accorded the full scope of the following claims.

I claim as my invention:

1. A method of installing in an oil-filled production tube a pumping means comprising a string of pressure piping having a fluid operated pumping mechanism at the lower end thereof, comprising: closing the lower portion of said pumping means; lowering said pumping means into said production tube so as to displace oil therefrom; and feeding the displaced oil into said pumping means as the same is moved downwardly in said production tube.

2. A method of installing in an oil-filled production tube a pumping means comprising a string of pressure piping having a fluid operated pumping mechanism at the lower end thereof, comprising: closing the lower portion of said pumping means; lowering said pumping means into said production tube so as to displace oil therefrom; passing oil which has been displaced from said production tube through a filter; and feeding the oil from the filter into said pumping means.

3. A method of installing in an oil-filled production tube a pumping means comprising a string of pressure piping having a fluid operated pumping mechanism at the lower end thereof, comprising: moving said pumping means downwardly into said production tube; sealing around said pumping means at a point near the upper end of said production tube as such pumping means is moved downwardly; diverting from the upper end of said production tube the oil displaced in said production tube by said pumping means; passing a portion of the diverted oil through a filter; and then feeding the same into said pumping means.

4. A method of initiating in an oil-filled production tube the operation of a pumping means comprising a string of pressure piping having a fluid operated pumping mechanism at the lower end thereof, comprising: closing the lower portion of said pumping means; lowering said pumping means into said production tube so as to displace oil therefrom; feeding the displaced oil into said pumping means; opening the lower portion of said pumping means; and forcing an operating fluid under pressure through said pressure piping for the operation of said pumping means.

5. A method of installing in an oil-filled production tube a pumping means comprising a string of pressure piping having a fluid operated pumping mechanism at the lower end thereof, comprising: closing the lower end of said pressure piping; lowering said pumping means into said production tube so as to displace oil therefrom; and feeding the displaced oil into the upper end of said pressure piping.

6. A method of installing in an oil-filled production tube a pumping means comprising a string of pressure piping having a fluid operated pumping mechanism at the lower end thereof, comprising: closing the lower end of said pressure piping; lowering said pumping means into said production tube so as to displace oil therefrom; passing oil which has been displaced from said production tube through a filter; and feeding clean oil from the filter into the upper end of said pressure piping.

7. A method of initiating in an oil-filled production tube the operation of a pumping means comprising a string of pressure piping having a fluid operated pumping mechanism at the lower end thereof, comprising: closing the lower end of said pressure piping; lowering said pumping means into said production tube so as to displace oil therefrom; feeding the displaced oil into the upper end of said pressure piping; opening the lower portion of said pumping means; and forcing an operating fluid under pressure through said pressure piping for the operation of said pumping means.

8. A method of installing in an oil-filled production tube a pumping means comprising a string of pressure piping having a fluid operated pumping mechanism at the lower end thereof, comprising: closing the lower portion of said pumping means; placing a quantity of clean fluid in said pumping means; lowering said pumping means into said production tube so as to displace oil therefrom; and feeding the displaced oil into said pumping means.

9. A method of initiating in an oil-filled production tube the operation of a pumping means comprising a string of pressure piping having a fluid operated pumping mechanism at the lower end thereof, comprising: closing the lower end of said pressure piping; placing a quantity of clean

liquid in said pressure piping; lowering said pumping means into said production tube so as to displace oil therefrom; feeding the displaced oil into the upper end of said pressure piping; opening the lower portion of said pumping means; and forcing an operating fluid under pressure through said pressure piping for the operation of said pumping means.

10. A method of installing in a well a pumping means comprising pressure fluid piping and a fluid actuated pump connected to the lower end thereof, comprising: closing the lower portion of said pumping means; lowering said pumping means into the well; and feeding a clean liquid into the upper end of said pumping means as it is lowered into the well.

11. Producing equipment for a well, for use with fluid operated pumping means having pressure fluid piping with a fluid operated pump secured to the lower end thereof, comprising: a production tube having an inlet check valve at its lower end; a sealing means at its upper end adapted to permit passage of said pumping means; discharge piping leading from the upper portion of said production tube below said sealing means; a filter connected to said discharge piping; and means for delivering filtered fluid from said filter into said pressure fluid piping of said pumping means.

12. Producing equipment for a well, for use with fluid operated pumping means having pressure fluid piping with a fluid operated pump secured to the lower end thereof, comprising: a production tube having an inlet check valve at its lower end; a sealing means at its upper end adapted to permit passage of said pumping means; and discharge piping leading from the upper portion of said production tube below said sealing means.

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