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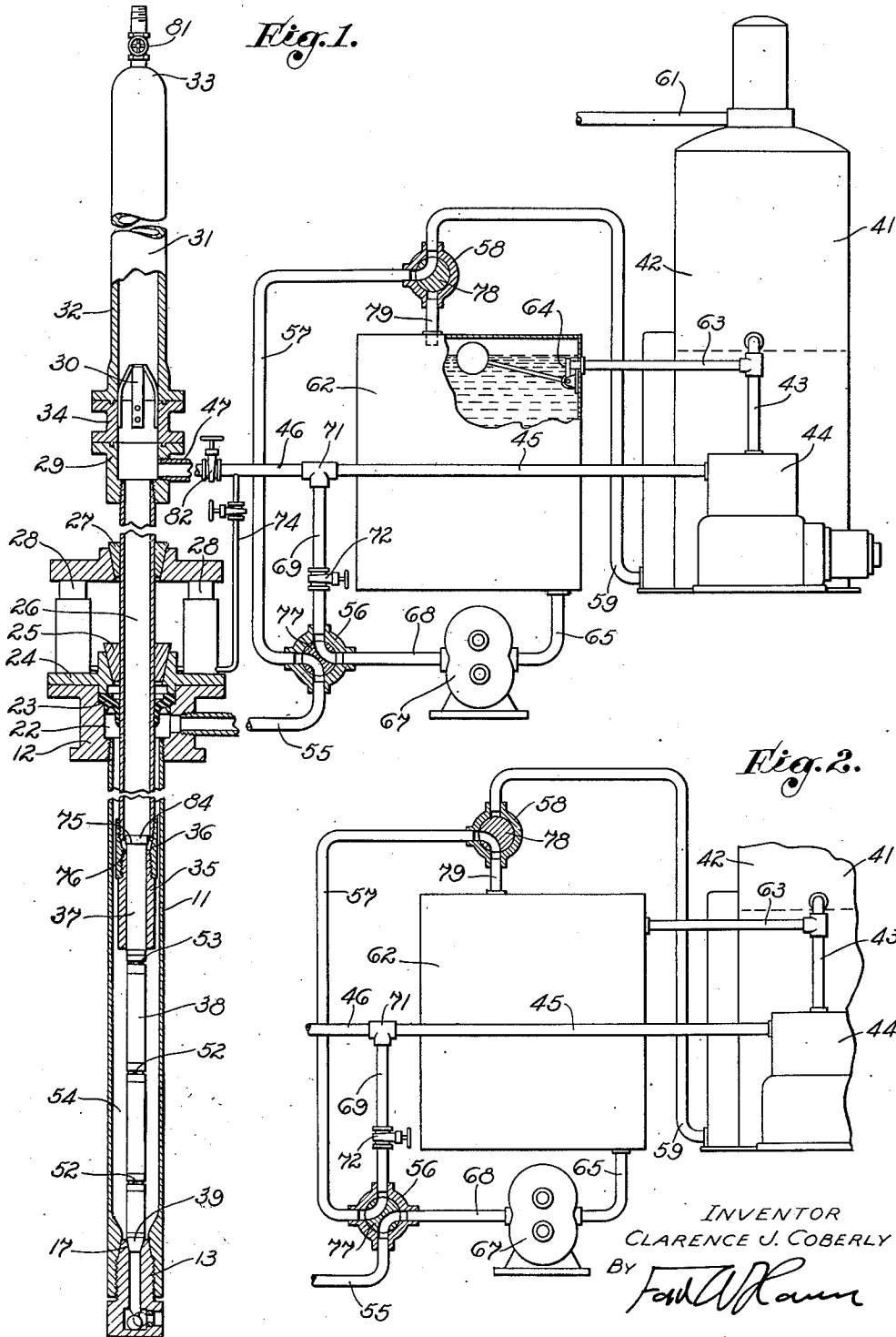
C. J. COBERLY

2,230,830

DEEP WELL PUMP AND METHOD OF INSTALLING AND REMOVING THE SAME

Filed March 5, 1935

3 Sheets-Sheet 1



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Fig. 3.

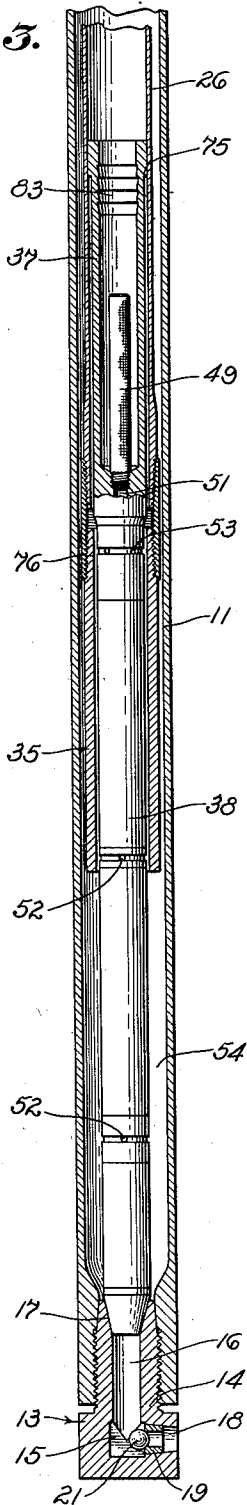
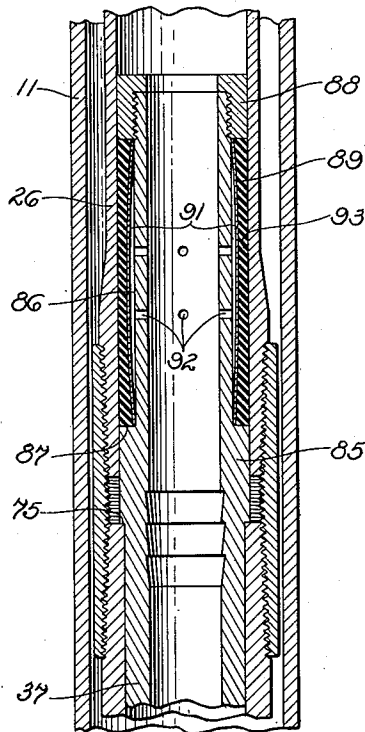


Fig. 4.



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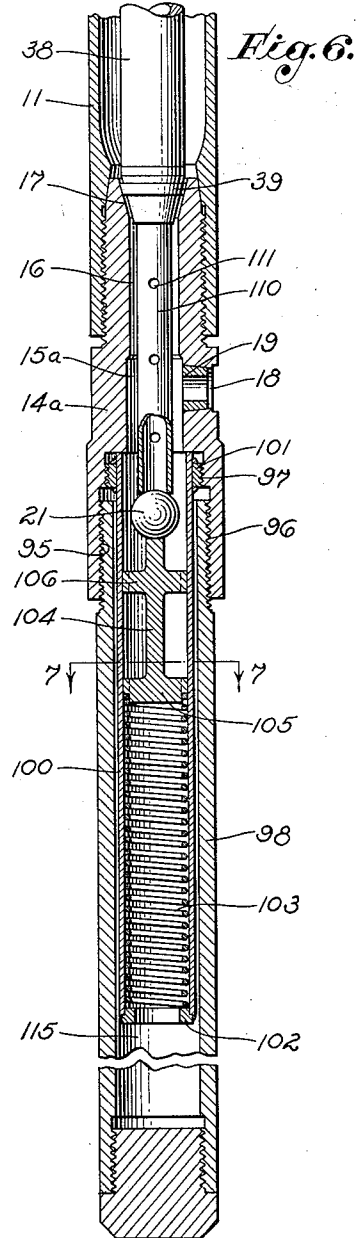
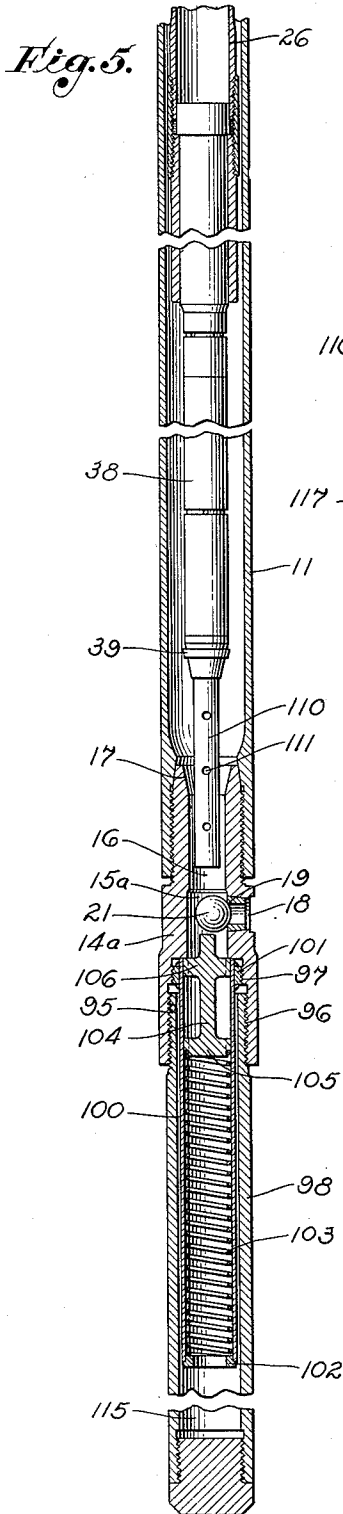
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3 Sheets-Sheet 3



UNITED STATES PATENT OFFICE

2,230,830

DEEP WELL PUMP AND METHOD OF INSTALLING AND REMOVING THE SAME

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Application March 5, 1935, Serial No. 9,412

24 Claims. (Cl. 103—46)

My invention relates to pumps of the character used for pumping oil from deep wells and relates in particular to pumps which are operated by fluid under pressure which is forced downwardly through suitable piping to a fluid motor unit forming part of the pump.

Although the invention is of especial utility with fluid operated pumps, it may be in many instances profitably employed with other types of pumps. Fluid operated deep well pumps are now used where it is desired to avoid sucker rods and the attendant losses and inefficiency. A type of fluid operated pump now in use employs an outer tube which is adapted to receive oil from the well and an inner tube having a pump connected to the lower end thereof and extended down into the well to such position that the intake of the pump will receive oil from the well. The pump is operated by clean fluid, such as oil, which is pumped downwardly through the inner tube to the pump unit. A pump of this character has been known to operate for a long period of time, but regardless of the high efficiency of the pump, such pump is subject to wear of its operating parts and must be removed as occasion demands. The known construction of such pumps, that is, with the pump secured to the lower end of the inner tube, requires the removal of the entire inner tube from the well in order to bring the pump to the surface. This requires considerable time and labor. For example, to pull a pump from a six thousand foot well requires a crew of four or five men and approximately four hours of time, and, in addition to this, the use of heavy equipment and considerable power.

It is an object of my present invention to provide a pumping equipment in which the pump constitutes a separate unit adapted to be lowered to the lower end of a tube in a well and to be removed from such tube by the action of an upward flow of fluid through the tube. With the invention in use, instead of four or five hours being required for pulling the pump, it may be pumped from the well in approximately one-half hour, the result being that a worn pump may be removed from a well and replaced by another in a period of one and one-half hours or less. The invention avoids the necessity of assembling a crew of men when it becomes necessary to pull the pump and also avoids the transporting of pulling equipment.

It is an object of the invention to provide a pumping equipment including means for pumping a clean fluid under high pressure and rela-

tively low velocity to a pump unit in a well for the purpose of operating such pump unit, and having means for reversing the flow of fluid and conducting the same at lower pressure and relatively high velocity in a manner to remove the pump unit from the well by the action of such reversed flow of fluid.

It is a further object of the invention to provide a means at the upper end of the well for receiving and holding the pump after it has been raised by fluid, such receiver being detachable from the upper end of the well structure so that the pump may be readily removed therefrom after the fluid has been turned off.

It is a further object of the invention to provide a means for properly sealing the pump in operative position, together with means which may be operated from the upper end of the well to free or release such seal so that the action of the reversed fluid pressure may readily carry the pump to the upper end of the well structure.

It is an object of the invention to provide a pumping equipment consisting of an outer tube extended down into a well, this outer tube having a pump receiving shoe or seat at the lower end thereof, an inner tube extending down through the outer tube to a point near the lower end of the outer tube, and a pump adapted to be inserted in the upper end of the inner tube and then caused to move to the lower end thereof and to project through the lower end of the inner tube into engagement with the seat carried at the lower end of the outer tube, together with means for providing a seal between the lower end of the inner tube and the pump so that the fluid delivered under high pressure through the inner tube will not leak from the lower end thereof into the outer tube but must pass through the power unit of the pump which has its fluid inlet communicating with the inner tube.

A further object of the invention is to provide means for raising and lowering the inner tube so as to first lift the pump from engagement with the seat at the lower end of the outer tube, thereby freeing the pump at this point, and, second, to move the sealing means of the inner tube downwardly relative to the upper end of the pump so as to free or break this seal, after which the fluid may be reversed and the pump forced upwardly through the inner tube.

A further object of the invention is to provide a pump unit adapted to be moved through a tube in a well by fluid under pressure, this pump having an expansible sealing or packing means

thereon for producing a desired sealing engagement with the wall of the tubular member.

A further object of the invention is to provide a means for the disposal of sediment which may accumulate at the lower end of the tubing, and further to provide a means for preventing the accumulation of sediment from holding the pump off its seat.

A further object of the invention is to provide an inlet check valve at the lower end of an oil tube, and a pump adapted to be lowered into the oil tube, this pump having means for positively opening the inlet check valve.

It is a further object of the invention to provide a means of the character set forth in the preceding paragraph which will open the inlet check valve before the pump reaches its position of operation.

Further objects and advantages of the invention 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 partly sectioned schematic view showing a preferred embodiment of my invention.

Fig. 2 is a portion of Fig. 1 showing the valves thereof set for removal of the pump from the well.

Fig. 3 is an enlarged, vertically sectioned view showing the lower end of the inner tube lowered with relation to the sealing means at the upper end of the pump.

Fig. 4 is an enlarged fragmentary section showing an expansible sealing means at the upper end of the pump.

Fig. 5 is a sectional view showing an alternative form of my invention.

Fig. 6 is a view drawn to slightly enlarged scale showing the pump of Fig. 5 seated.

Fig. 7 is a cross sectional view taken on a plane indicated by the line 7-7 of Fig. 6.

In the drawings I show an outer tube 11 which is secured to and projects downwardly from a head 12 into a well to the oil producing zone. The lower end of this outer tube 11 is provided with an inlet check valve 13 which, as shown in Fig. 3, comprises a body 14 having a chamber 15 from which a vertical passage 16 extends upwardly to a conical seat 17. From the chamber 15 a lateral passage 18 extends to the exterior of the valve body 14. This lateral passage 18 has an inwardly faced valve seat 19 therein adapted to be engaged by a closure member 21 consisting preferably of a metal ball. The head 12 has an upwardly faced recess 22 therein in which an expansible rubber packing member 23 is clamped by means of a cover plate 24 adapted to carry slips 25 for holding an inner tube 26 which projects downwardly through the packing 23 and through the outer tube 11 to a point near the lower end thereof. The packing member 23 is of the character disclosed in my copending application, Serial No. 740,452, filed August 18, 1934, entitled "Method and apparatus for installing pumps in wells," patented October 6, 1936, No. 2,056,418. The upper portion of the inner tube 26 projects through slips 27 carried by hydraulic jacks 28 mounted on the cover plate 24 of the head 12. Threaded upon the upper end of the inner tube 26 is a cup-like fitting 29 to which a pump receiver or catcher 31 is secured. This receiver 31 consists of a tubular member 32 having the upper end 33 thereof closed and having a removable sleeve 34 secured to the lower end

thereof. In the sleeve 34 spring fingers 30 are secured, these spring fingers having the upper ends thereof sloping inwardly and projecting toward the interior of the tube 32.

At the lower end of the inner tube 26 a sealing member 35 is secured, this sealing member consisting of a steel sleeve which is connected to the lower end of the inner tube 26 by means of a threaded coupling 36. The inner surface of the sleeve 35 is accurately ground to fit the external surface of a sealing member 37 which is secured to the upper end of a pump unit 38 which projects downwardly through the lower end of the inner tube 26 and is seated at 39 in the conical seat 17 carried at the lower end of the outer tube 11. As clearly shown in Fig. 3, the external diameter of the sealing member 37 is slightly greater than the diameter of the main body of the pump 38 so that the body of the pump will pass readily through the bore of the sleeve 35 into operative position, as shown in Fig. 1.

In proximity to the upper end of the well I provide means for supplying clean fluid under pressure to the interior of the inner tube. As shown in Fig. 1, I may use a filter device 41 of the character disclosed in my copending application, Serial No. 654,430, filed January 31, 1933, entitled "Method and equipment for pumping oil," patented July 7, 1936, #2,046,769. This filter 41 has an upper receptacle 42 for clean oil, from which clean oil flows through a pipe 43 to a high pressure pump 44 which connects through piping 45 and 46 with a nipple 47 projecting from the fitting 29 at the upper end of the inner tube 26. Accordingly, clean liquid, such as filtered oil, is pumped down through the inner tube 26 to the pump unit 38, this clean oil passing through the tubular sealing member 37 of the pump and then through a strainer 49 into the fluid inlet passage 51 of the pump 38. This pump has therein a fluid operated motor and a pumping piston of the type disclosed in my copending application, Serial No. 720,057, filed April 11, 1934, entitled "Liquid operated motor."

The operation of the pump causes oil to be drawn in through the inlet check valve 13 into the lower end of the pump and to be discharged through openings 52 into the space 54 within the outer tube 11 exterior of the exposed portion of the pump. The discharge or exhaust fluid from the motor element of the pump is discharged through openings 53 into the space 54. From this space 54 the mixture of exhaust fluid and pumped fluid passes upwardly within the outer tube 11 around the outside of the inner tube 26 to the chamber 22 in the head 12, from which the fluid passes outwardly through piping 55 to a 4-way valve 56 which directs such fluid through piping 57 to a 3-way valve 58. This discharge fluid is then directed by the 3-way valve 58 into a discharge line 59 which leads into the lower end of the filter 41. A portion of the oil directed into the filter 41 is filtered and delivered into the clean oil chamber 42, and the remainder of the discharge oil passes from the filter through piping 61 to suitable means for disposal, such as storage tanks.

In the form of the invention shown a reserve fluid tank 62 is placed in a position convenient to the filter, and a clean oil delivery pipe 63 is connected into the clean oil discharge pipe 43 of the filter 41. Through the pipe 63 a small flow of clean oil passes into the tank 62, and this tank is gradually filled. When the desired level

thereof is produced in the tank 62, a float valve 64 operates and cuts off further delivery of oil into the tank 62. Connected to the bottom of the tank 62 is a pipe 65 which leads to a pump 67, which pump in turn connects through piping 68 with the 4-way valve 56. The 4-way valve 56 also has a pipe 69 leading therefrom to a fitting 71 which connects the piping 45 with the piping 46. During the normal operation of the pump a valve 72 in the pipe 69 is kept closed so that the pressure fluid delivered by the pressure pump 44 will not pass through the pump 67 into the tank 62.

When it is desired to remove the pump 38 from the well, the following procedure may be pursued. First, high pressure fluid, which may be obtained from the pump 44, may be delivered through piping 74 into the hydraulic jacks 28, causing the slips 27 to be raised so as to lift the inner tube 26 so that a shoulder 75 at the upper end of the cylindrical sealing member 37 of the pump 38 will engage the upper end 76 of the sleeve 35, whereby to raise the pump 38 from engagement with the seat 17, which will allow the ball 21 to move into engagement with the seat 19 and allow the fluid pressures to balance above and below the seat 17. In this manner the tendency for the lower end of the pump 38 to bind in the seat 17 due to a long period of engagement between the pump and the seat is offset, and these parts are mechanically and positively freed. Also, due to engagement between the closely fitting ground surfaces of the parts 35 and 37, there may be a tendency for these parts to bind in a manner to resist upward movement of the pump 38. Therefore, after the pump is lifted, as hereinabove described, the inner tube 26 is again lowered, first to cause the pump 38 to rest in the seat 17, and then to move the sleeve 35 downwardly from its position surrounding the sealing member 37 to a position below such sealing member 37, as shown in Fig. 3. The plug 77 of the 4-way valve 56 is then turned through an angle of 90° into the position in which it is shown in Fig. 2, and the plug 78 of the 3-way valve 58 is rotated from the position in which it is shown in Fig. 1 to a position as shown in Fig. 2 in which the piping 57 will be connected with a pipe 79 leading into the clean oil reserve tank 62. The pump 67 may be then operated to deliver oil from the reserve fluid tank 62 through the piping 65 into the upper end of the outer tube 11, causing an upward pressure to be exerted against the downwardly presented cross-sectional area of the pump 38 to cause the same to move upwardly through the inner tube 26. As the pump 38 moves upwardly, clean oil will be discharged from the upper end thereof through the piping 47, 46, and 69 to the 4-way valve 56, which will in turn deliver the oil through the piping 57, the 3-way valve 58, and the pipe 79 into the upper end of the tank 62.

When the pump approaches near to the upper end of the tube 26, the plug 78 of the 3-way valve 58 is swung back into the position shown in Fig. 1 so that as dirty oil from the bottom of the well starts to discharge through the piping 47, such dirty oil will be diverted through the piping 59 into the filter 41, thereby preventing contamination of the supply of clean oil maintained in the tank 62. The upwardly moving oil will carry the pump from the upper end of the inner tube 26 into the pump receiver 31, and the pump may be caused to move upwardly beyond the catcher 75 represented by the fingers 30 by opening a valve

81 connected with the upper end of the receiver 31 and closing a valve 82 in the piping 46. When the pump is received by the receiver 31, oil may be drained from the interior of the receiver 31 down to a point below the fitting 29, whereupon the sleeve 34 of the receiver 31 may be disconnected from the fitting 29, and the receiver 31 moved from the position in which it is shown in Fig. 1 to the floor of the derrick, where the sleeve 34 may be removed, carrying therewith the fingers 30 so that the pump may be withdrawn from the interior of the receiver 31.

The pump may be then repaired, as, for instance, by the replacement of worn parts thereof, and this pump or a new pump of the same character may be inserted in the upper end of the inner tube 26, whereupon the receiver 31 may be replaced on the fitting 29, after which clean oil from the tank 62 may be delivered by the pump 67 through the 4-way valve 56, with the plug 77 thereof in the position in which it is shown in Fig. 1, and through piping 69 and 46 into the upper end of the inner tube 26, causing a downward flow of fluid through the inner tube 26 to carry the pump down to the operating position thereof shown in Fig. 1.

The pump 67 is of greater volume than the pump 44 and is of relatively lower pressure. The pump 67 accordingly is shown as being of rotary type, and by the use thereof the circulation of fluid, for the purpose of lifting the pump 38 through the tube 26 or forcing the pump down through the tube 26 to operating position, is of much higher velocity than the fluid delivered under high pressure by the pump 44, in order that a relatively fast travel of the pump through the inner tube 26 may be obtained and whereby the removal and replacement of the pump may be accomplished in a minimum of time.

For use in emergency I have, as shown in Fig. 3, provided annular notches 83 within the upper end of the sealing member 37 of the pump 38, adapted to be engaged by a spear lowered by means of a sand line through the inner tube. This form and practice of my invention in themselves constitute a marked simplification in the pumping of wells by means of fluid operated pumps, since it is possible to remove the pump without necessity of removing the fluid pressure line to which it is connected. With the structure shown in Fig. 1, the pump 38 may be lowered through the inner tube 26 to operating position. Then, when it is desired to remove the pump, a sand line with a spear on the end thereof may be lowered and the pump engaged and then pulled from the well in a relatively short time and without the necessity of breaking down joints of tubing as in the common form of fluid operated pump, or the uncoupling and handling of sucker rods as in the commonly used sucker rod pumps.

Where the invention is employed with means for pumping the pump unit through the inner tube 26, it is necessary that a relatively close fit be maintained between the pump and the wall of the inner tube 26 so that leakage of fluid past the pump will be maintained at a minimum. In Figs. 1 and 3 I show as a means for sealing between the pump and the inner tube 26 a collar 84 formed on the upper end of the member 37, the lower portion of this collar forming the shoulder 75. The collar 84 is of such external diameter that it will just pass through the tube 26 without binding.

In Fig. 4 I show a form of sealing means which is of expansible and yieldable character so that it

will make a positive wiping engagement with the inner face of the tube 26. As shown, the upper end 85 of the member 37 is extended above the shoulder 75. On this portion 85 an annular recess 86 is formed between an upwardly facing shoulder 87 and a ring 88 which is threaded onto the upper end of the extension 85 of the member 37. In the annular recess 86 a rubber packer consisting of a rubber cylinder 89 is placed. A number of outwardly bowed spring fingers 91 may be placed under the rubber packer 89 to force the same outwardly, and in the bottom wall of the recess 86 holes 92 are formed for the admission of fluid under pressure to the recess, this fluid causing the rubber packer 89 to expand and bear tightly against the inner surface 93 of the inner tube 26. When the pump equipped with this packing means is hydraulically moved through the inner tube 26, the pressure of fluid within the member 37 expands the packer 89 to produce an effective seal with the wall of the tube whereby maximum efficiency may be maintained in the application of fluid to move the pump 38 through the tube 26. Although this seal may be used in the placing and removal of the pump, it may be also advantageously employed merely in the pumping of the pump down to its operative position and then sealing around the pump during the operation thereof to prevent loss of pressure fluid, the removal of the pump thereafter being accomplished by a mechanical lifting means such as the sand line and spear hereinbefore mentioned.

In Figs. 5 and 6 I show a valve body 14a secured to the lower end of the outer tube 11. Instead of being closed at its lower end, the valve body 14a has a downwardly faced axial opening 95 equipped with internal threads 96 and 97. A hollow member 98 is screwed into the threads 96 of the body 14a and forms an extension to the chamber 15a of the valve body 14a. In the upper part of the member 98 I place a guide sleeve 100 which has an externally threaded collar 101 on the upper end thereof to engage the internal threads 97 of the body 14a, and which has a collar 102 in the lower end thereof for supporting a compression spring 103 adapted to resiliently hold a valve supporting member 104 in raised position.

The valve supporting member 104 comprises an axial bar having spiders 105 and 106 formed thereon for sliding engagement with the inner surface of the guide member 100. The upper end of the member 104, when it is in raised position as shown in Fig. 5, provides a rest for holding the valve ball 21 in a position for engagement with the valve seat 19 carried in the lateral opening 18 of the body 14a. When this form of inlet valve structure is employed in the practice of my invention, the pump unit 38 is provided with a means for displacing the valve ball 21 from engagement with the valve seat 19, such means being shown in the form of a tube 110 which extends downwardly from the lower end part 39 and is provided with radial openings 111.

More or less sediment may accumulate in the lower end of the tube 11, on the valve seat 17, and in the passage 16 of the body 14a. Also, more or less sediment may be wiped down from the walls of the inner tube 26 when the pump is moved downwardly therethrough. This latter form of my invention shown in Figs. 5 and 6 provides a means for disposing of the sediment, which will be readily understood from the following description.

The stem or tube 110 which projects downwardly from the pump unit 38 is of such length that it will engage the valve ball 21 before the member 39 of the pump unit 38 engages the seat 17. Accordingly, the valve ball 21 will be forced downwardly, and likewise the supporting member 104 will be moved downwardly, against the action of the spring 103 within the upper end of the guide member 100. After the movement of the valve ball 21 from closed relation to the valve seat 19, and before engagement of the member 39 with the seat 17, oil may flow downwardly and outwardly from the interior of the tube 11 across the face of the seat 17, downwardly through the passage 16, and outwardly through the lateral opening 18, thereby washing out sediment and thereby cleaning the valve seat 17 so that the member 39 may form a fluid-tight closure therewith. It will be perceived that by raising and lowering the inner tube 26, the pump 38 may be intermittently lifted from the seat 17 and returned to engagement therewith so as to insure a proper seating of the part 39 with the seat 17.

In removing the pump unit 38 from the well, the joint between the member 37 at the upper end thereof and the sleeve 35 at the lower end of the tube 26 may be broken by lowering the tube 26 in the manner shown in Fig. 3. Then, by raising the inner tube 26, the pump unit 38 may be lifted to such height that the valve ball 21 may engage the seat 19, thereby closing the lower end of the production tube 11 against leakage of oil therefrom. Pressure may then be applied to the oil in the outer tube 11 in the manner described relative to Fig. 2, and the pump unit 38 may be thereby pumped upwardly through the inner tube 26 to the top of the well.

The member 98 provides a sediment chamber 115 for holding such sediment as may pass downwardly by the valve ball 21 and through the openings 116 formed between the arms 117 of the spiders 105 and 106. This sediment passes down through the spring 103 and out through the collar 102 into the sediment chamber 115. By use of the equipment described it is possible to not only assure a proper seating of the pump unit 38 in the seat 17, but to also assure a proper operation of the inlet check valve structure.

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. Pumping equipment of the character described, including: an outer tube set in a well, said outer tube extending downwardly from the surface of the ground to a point in said well; an inner tube extending within said outer tube; a pump of a size to be lowered through said inner tube to the lower end thereof, said pump having discharge port means communicating with the interior of said outer tube, said pump being adapted to pump well fluid through said port and through said outer tube to the surface of the ground; means for connecting the intake of said pump with the fluid in the well through the lower portion of said outer tube; and means for sealing between said pump and the lower portion of said inner tube.

2. Pumping equipment of the character described, including: an outer tube set in a well; an inner tube extending within said outer tube; a pump of a size to be lowered through said inner tube to the lower end thereof; means for connecting the intake of said pump with the fluid in the well through the lower portion of said outer tube; means for sealing between said pump and the lower portion of said inner tube; and means for producing a flow of fluid downwardly through said outer tube and upwardly through said inner tube to pump said pump upwardly through said inner tube to the ground level.

3. Pumping equipment of the character described, including: an outer tube set in a well; an inner tube extending within said outer tube; a pump of a size to be lowered through said inner tube to the lower end thereof; means for connecting the intake of said pump with the fluid in the well through the lower portion of said outer tube; means for sealing between said pump and the lower portion of said inner tube; means for producing a flow of fluid downwardly through said outer tube and upwardly through said inner tube to pump said pump upwardly through said inner tube to the ground level; and means at the upper end of said inner tube to hold said pump after it has been raised by said flow of fluid.

4. Pumping equipment of the character described, including: an outer tube set in a well; an inner tube extending within said outer tube; a pump of a size to be lowered through said inner tube to the lower end thereof; means for connecting the intake of said pump with the fluid in the well through the lower portion of said outer tube; means for sealing between said pump and the lower portion of said inner tube; means for producing a flow of fluid downwardly through said outer tube and upwardly through said inner tube to pump said pump upwardly through said inner tube to the ground level; and a detachable receiver at the upper end of said inner tube for receiving said pump, said receiver having means for holding said pump therein.

5. Pumping equipment of the character described, including: a first tube and a second tube extended within a well, the lower ends of said tubes communicating with each other; a pump adapted to be lowered through the first of said tubes to the lower end thereof; means for connecting the intake of said pump to the fluid in the well; and means for forcing fluid down through said second tube and into said first tube so as to force said pump upwardly through said first tube.

6. Pumping equipment of the character described, including: a first tube and a second tube extended within a well, the lower ends of said tubes communicating with each other; a pump adapted to be lowered through the first of said tubes to the lower end thereof; means for connecting the intake of said pump to the fluid in the well; means for forcing fluid down through said second tube and into said first tube so as to force said pump upwardly through said first tube; and a catcher at the upper end of said first tube for receiving and holding said pump.

7. Pumping equipment of the character described, including: a first tube and a second tube extended within a well; a fluid operated pump adapted to be lowered through the first of said tubes to the lower end thereof, said pump having a discharge opening communicating with said second tube; means for connecting the intake of said pump to the fluid in the well; means for

forcing fluid down through said first tube to operate said pump; and means for reversing the flow of fluid so that it will flow down through said second tube and up through said first tube to carry said pump to the upper end of said first tube.

8. Pumping equipment of the character described, including: a first tube and a second tube extended within a well; a pump adapted to be lowered through the first of said tubes to the lower end thereof, said pump having a discharge opening communicating with said second tube; means for connecting the intake of said pump to the fluid in the well; means for operating said pump; and means for producing a flow of fluid downwardly through said second tube and up through said first tube to carry said pump to the upper end of said first tube.

9. A fluid operated pump unit for use at the lower end of a tube set in a well and having an internal ground sleeve at the lower end thereof, including: a fluid motor; a force pump connected thereto; a body structure supporting said motor and said force pump in operating relation, said body structure being of a diameter to pass through said tube from the upper to the lower end thereof; and means forming an externally ground cylindrical surface on said body to fit said ground sleeve.

10. Pumping equipment of the character described, including: an outer tube set in a well, said outer tube extending downwardly from the surface of the ground to a point in said well; an inner tube extending within said outer tube; a pump of a size to be lowered through said inner tube to the lower end thereof, said pump having discharge port means communicating with the interior of said outer tube, said pump being adapted to pump well fluid through said port and through said outer tube to the surface of the ground; means for connecting the intake of said pump with the fluid in the well through the lower portion of said outer tube; means for sealing between said pump and the lower portion of said inner tube; and means for moving said inner tube relative to said outer tube.

11. Pumping equipment of the character described, including: an outer tube set in a well; an inner tube extending within said outer tube; a pump of a size to be lowered through said inner tube to the lower end thereof; a seat carried in the lower end of said outer tube for receiving the lower end of said pump; an inlet valve below said seat through which fluid may pass into said pump; and means to open said valve before said pump reaches said seat so that the outflow of fluid from said outer tube will remove sediment.

12. Pumping equipment of the character described, including: an outer tube set in a well; an inner tube extending within said outer tube; a pump of a size to be lowered through said inner tube to the lower end thereof; a seat carried in the lower end of said outer tube for receiving the lower end of said pump; an inlet valve below said seat through which fluid may pass into said pump; and a part extending from said pump down through said seat to open said valve before said pump reaches said seat so that the outflow of fluid from said outer tube will remove sediment.

13. Pumping equipment of the character described, including: a first tube and a second tube extended within a well, the lower ends of said tubes communicating with each other; a fluid

operated pump adapted to be lowered through the first of said tubes to the lower end thereof; means for connecting the intake of said pump to the fluid in the well; means for forcing a flow of fluid down through said first tube to operate said pump; means forming a supply of fluid near the upper end of said well; and a pump for taking fluid from said supply means and forcing the same down through said second tube and into said first tube so as to force said pump up through said first tube.

14. Pumping equipment of the character described, including: a first tube and a second tube extended within a well, the lower ends of said tubes communicating with each other; a fluid operated pump adapted to be lowered through the first of said tubes to the lower end thereof; means for connecting the intake of said pump to the fluid in the well; means for forcing a flow of fluid down through said first tube to operate said pump; means forming a supply of fluid near the upper end of said well; a pump for taking fluid from said supply means and forcing the same down through said second tube and into said first tube so as to force said pump up through said first tube; and means for delivering fluid from the upper end of said first tube into said supply means as said pump moves upwardly through said first tube.

15. Pumping equipment of the character described, including: a first tube and a second tube extended within a well, the lower ends of said tubes communicating with each other; a fluid operated pump adapted to be lowered through the first of said tubes to the lower end thereof and to be so positioned that the discharge from said pump will pass into the lower end of said second tube; means for connecting the intake of said pump to the fluid in the well; a pressure pump connected through piping with the upper end of said first tube; a container for fluid disposed near the upper end of said well; a circulating pump having its inlet connected to said container; and a four-way valve having two opposing ports connected respectively to said piping from said pressure pump and the upper end of said second tube, and two opposing ports connected respectively to said container and the outlet of said circulating pump.

16. Well pumping equipment of the character described, comprising: an outer tube with an opening at its lower end which extends below the fluid level of the well; an inner tube which extends within said outer tube to a point slightly above the bottom of said outer tube and having an opening at its lower end communicating with said outer tube; and a fluid operated pump which may be lowered into operating position through said inner tube wherein it projects from the lower end of said inner tube and forms a closure for both of said tubes.

17. Well pumping equipment, comprising: a pair of tubes extending within a well; means providing communication between the lower ends of said tubes so that fluid forced down through one of said tubes may rise through the other of said tubes; a fluid operated pump insertable within one of said tubes; and fluid means for inserting said pump in, and operable through said communication means for removing said pump from, said one of said tubes.

18. In a well pumping device, the combination of: tubing adapted to extend into the well; a pump structure adapted to pass through said tubing and when set in a stationary position

therein and suitably actuated is adapted to pump fluid from said well; means on said pump structure adapted to engage the inner wall of said tubing in such a manner as to prevent a free flow of liquid through the space between said pump structure and said tubing during the passage of said pump structure through said tubing; limiting means adapted to prevent the pump structure from passing entirely out of the bottom of said tubing; a pipe extending downwardly in said well and so connected to said tubing as to apply fluid pressure to said pump structure in such a manner as to tend to force said pump structure upwardly in said tubing; and means by which fluid pressure may be exerted on the bottom of said pump structure through said pipe in such a manner as to force said pump structure upwardly in said tubing.

19. Pumping equipment of the character described, including: a tube adapted to be extended into a well; a pump of a size to pass through said tube from the upper to the lower end thereof, said pump having a sealing portion thereon; means for forcing fluid into the upper end of said tube to move said pump by fluid pressure from the upper to the lower end thereof and into operating position; means at the lower end of said tube for forming a seal between said tube and said sealing portion of said pump; means for moving said tube relative to said pump so as to break said seal between said tube and said pump; and means for moving said pump from operating position at the lower end of said tube to the upper end of said tube.

20. Pumping equipment of the character described, including: an outer tube extending into a well; an inner tube within said outer tube and extending into said well, said inner tube having a sealing portion adjacent the lower end thereof; a pump of a size to be passed through said inner tube and into sealing relation with said sealing portion of said tube, said pump having a seal adapted to engage said sealing portion; means for connecting the intake of said pump with fluid in said well through said outer tube; means for moving said inner tube relative to said pump so as to disengage said sealing portion of said inner tube from said seal; and means for moving said pump through said inner tube to the upper end thereof.

21. Pumping equipment of the character described, including: an outer tube extending into a well, said outer tube having an inlet adjacent its lower end communicating with fluid in said well, said outer tube having a seat adjacent its lower end; an inner tube within said outer tube, said inner tube having a sealing portion adjacent the lower end thereof; a pump of a size to be passed through said inner tube into engagement with said seat and into sealing relation with said sealing portion of said inner tube, said pump having its intake connected to said inlet; means for moving said pump relative to said seat, said means being adapted to move said inner tube relative to said pump so as to disengage said sealing portion of said inner tube from said pump; and means for moving said pump through said inner tube to the upper end thereof.

22. A method of removing from a well a pump positioned at the lower end of an inner tube, the pump being seated in a seat provided by an outer tube, the inner tube and pump being provided with means for forming a seal therebetween, including the steps of: moving said pump relative to said seat so as to break the seating

connection therebetween; moving said inner tube relative to said pump so as to break the seal therebetween; and moving said pump through said inner tube to the upper end thereof.

5 23. A method of removing from a well a pump positioned at the lower end of an inner tube, the pump being seated in a seat provided by an outer tube, the inner tube and pump being provided with means for forming a seal therebetween, including the steps of: raising said pump
10 relative to said seat so as to break the seating connection therebetween; lowering said pump relative to said seat until said pump rests on said seat; lowering said inner tube relative to said
15 pump so as to break the sealing connection therebetween; and raising said pump through said inner tube to the upper end thereof.

20 24. In a well pumping device, the combination of: a first tube extending downwardly in the well; a check valve closing the bottom of said first tube in such a manner that fluid may flow into said tube from the well, but all flow of fluid

from said tube to said well is prevented; a second tube extending downwardly in said well, said second tube being placed inside said first tube, the lower end of said second tube being in communication with said first tube above said check valve; 5 a pump structure of such size that it can pass readily through said second tube and having a discharge opening communicating with said first tube so that when set in a stationary position in said tubing and suitably actuated it pumps fluid 10 upwardly in said first tube; means carried on said pump structure for engaging the inner wall of said second tube in such a manner as to prevent the free flow of fluid through the space between said pump structure and said second 15 tube; and means for forcing fluid downwardly through said first tube so that said fluid exerts an upward pressure on said pump structure tending to force said pump structure upwardly in said second tube. 20

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