March 18, 1930. T. A. BEECHER 1,750,951

APPARATUS FOR FLOWING OIL WELLS

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Fig. 1

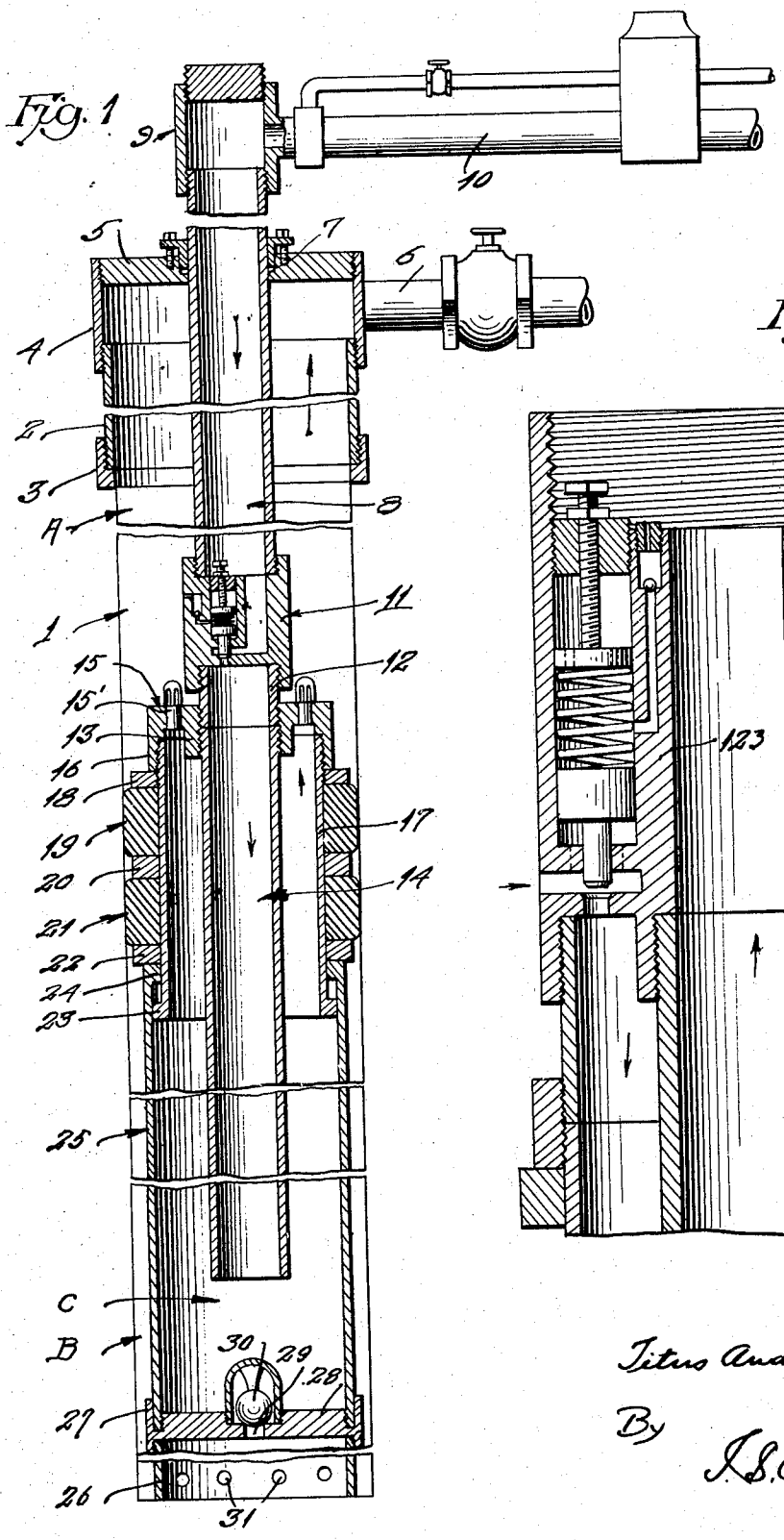


Fig. 6

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APPARATUS FOR FLOWING OIL WELLS

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Fig. 5

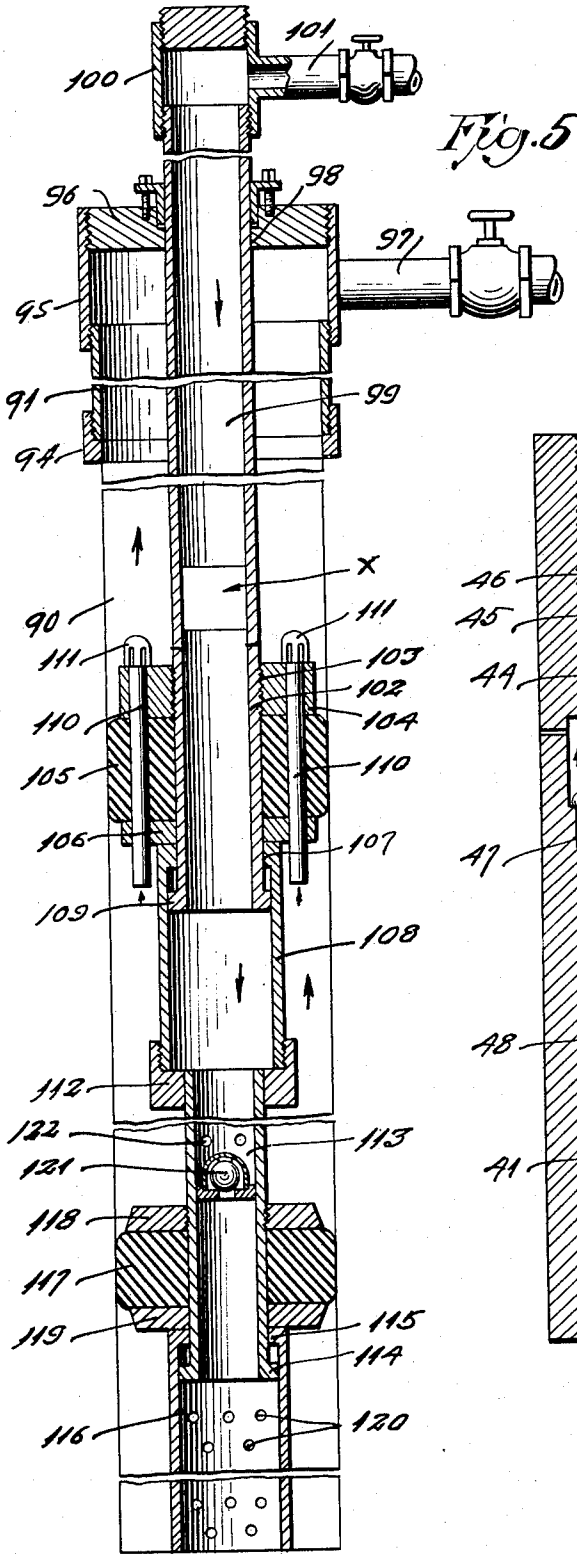
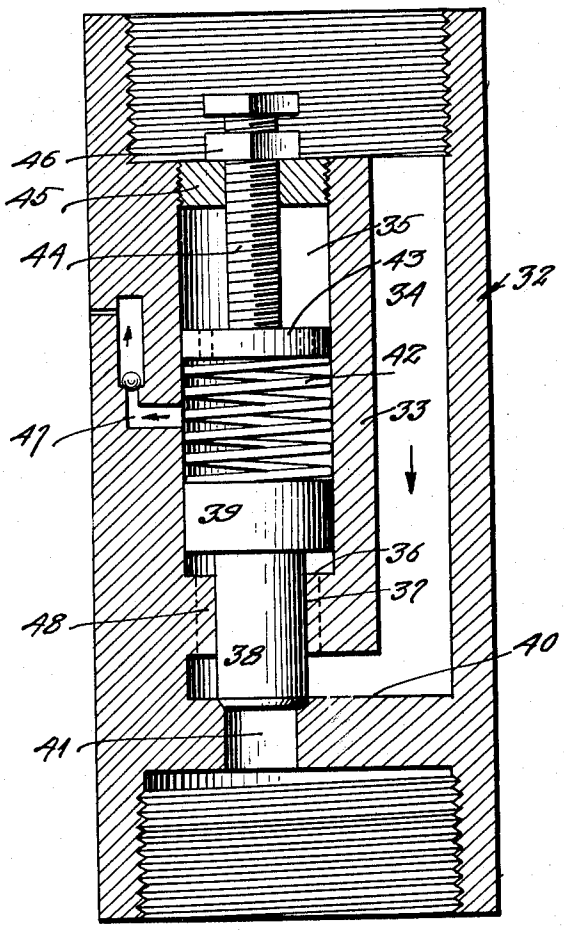


Fig. 2.



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Fig. 3

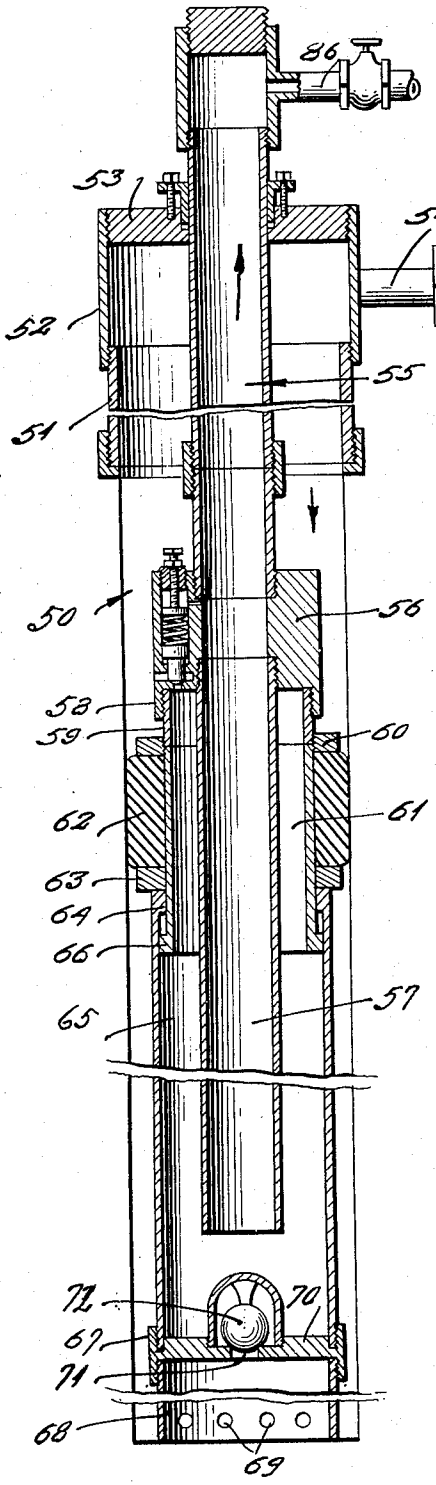
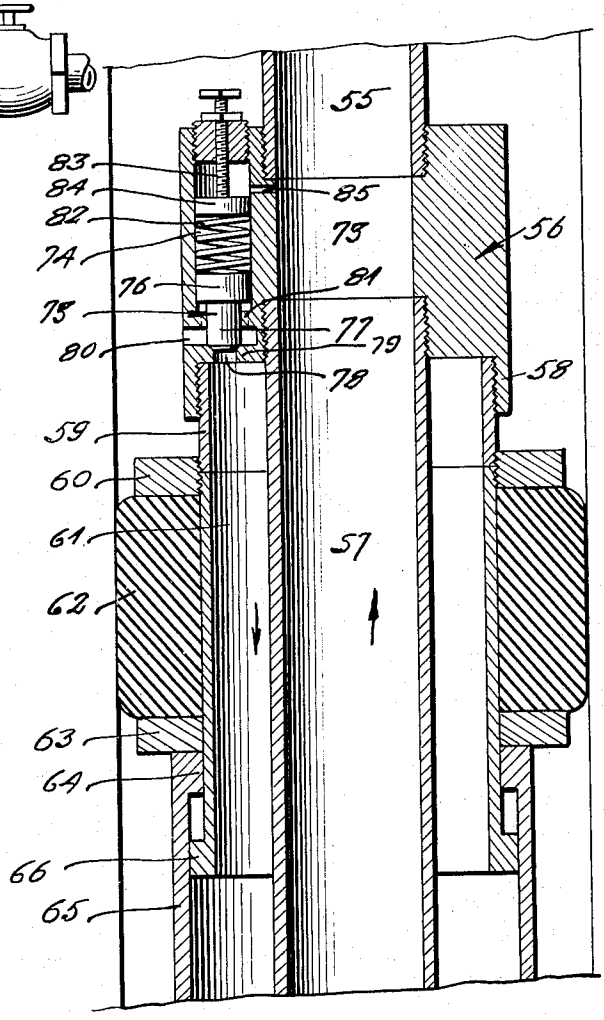


Fig. 4



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UNITED STATES PATENT OFFICE

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APPARATUS FOR FLOWING OIL WELLS

Application filed April 8, 1927. Serial No. 182,021.

My invention relates to improvements in the apparatus for controlling the flow of wells, especially oil and gas, and is more particularly adapted to utilize in a most efficient manner the natural gas contained within a well or fluid pressure which may be admitted thereinto.

It is the principal object of the present invention to provide an apparatus in which is employed substantially three compartments, two of which are adapted to contain oil, while the other receives therein either the natural gas or fluid pressure admitted thereinto.

Another object in the invention is to provide means for flowing a liquid from a well in which the liquid will be allowed to collect therein and pass into a compartment from which it is removed by the natural gas or fluid pressure, and during its removal from the compartment additional liquid may be permitted to again collect in the well.

Still another object of the invention is to provide a packer which separates the interior of a well into separate compartments for the reception of fluid pressure and liquid which may collect in the well and to prevent the pressure from acting upon the liquid only at certain periods.

Still another object of the invention is to provide an apparatus of the class set forth having therein a pressure control valve so positioned with respect to the other parts of the apparatus that liquid engagement therewith is prevented, except in the initial insertion of the apparatus into a well or when a well is flowing an excessive amount of liquid.

Another object of the present invention is to provide an apparatus of the class described having therein a valve which controls the passage of fluid pressure for engagement with the liquid therebelow, thus elevating the liquid upwardly from a well.

Another object of the invention is to provide a valve so positioned with respect to the various other elements of the apparatus above described that the admission of fluid pressure upon a liquid may be controlled, and this fluid pressure being directed downwardly upon the liquid contained within the well.

Another object of the present invention resides in providing a valve so constructed that its movement from a closed to an open position is controlled solely by fluid pressure within the well.

Still another object of the invention is to provide a valve having its movable element so constructed that its movement from a closed to an open position is controlled by the fluid pressure within a well and above the packer together with fluid pressure which enters the well below the packer. This last said fluid pressure may include the pressure exerted by the oil.

Another object of the present invention resides in providing a valve having a movable part which when opened moves within a chamber, the chamber having means for permitting the escape of compressed air or liquid therefrom during the opening movement of the valve.

Another object of the present invention is to provide an apparatus of the class described including a pair of spaced packers for dividing the well bore into a number of compartments, one packer being positioned adjacent the bottom of the well, and within the producing sands, or thereabove if desired, while the other packer may be positioned at any desired point throughout the remaining portion of the well and above the first packer.

Still another object of the present invention is to provide an apparatus of the class described in which the flow of liquid from the well is periodic and this movement of the liquid being controlled by a valve which opens upon the accumulation of a certain pressure thereagainst.

Another object of the invention is to provide means for dividing a well bore into a plurality of compartments and this means serving to separate the pressure from the liquid.

With the above and other objects in view, the invention consists in the several successive steps comprising my improved method, which will be hereinafter more fully described and set forth in the appended claims.

In the accompanying drawings:—

Figure 1 is a vertical sectional view taken

through a well illustrating my improved apparatus positioned therein.

Figure 2 is an enlarged detail view, in section, illustrating the form of a valve which is used with the structure illustrated in Figures 1 and 5.

Figure 3 illustrates a modified form of an apparatus of substantially the same structure as illustrated in Figure 1 having therein a valve more specificially shown in Figure 4.

Figure 4 is a detailed view, in section, illustrating more clearly the valve used in connection with the apparatus illustrated in Figure 3, and which if desired may be used in connection with the passages through the packer illustrated in Figure 5, all which will be more specificially pointed out hereinafter.

Figure 5 is a further modified form of my invention showing an apparatus of substantially the same arrangement, but wherein I employ two packers for dividing the well into several compartments, and

Figure 6 is a modified form of the valve illustrated in Figure 2.

Referring to the accompanying drawings in detail, wherein like reference characters denote corresponding parts throughout the several views, the numeral 1 indicates the bore of an oil well, the same passing through various productive and non-productive formations.

The well 1 has positioned therein a cylindrical casing 2 which may project downwardly to any desired depth and having at its lower end a casing shoe or the like 3 which supports the casing within the well bore. The upper end of the casing 2 is exteriorly threaded and receives thereon a pipe section 4, the upper end of which is closed by a header 5. The pipe section 4 has in connection therewith a valve controlled passage 6 through which oil, after it is elevated from the well, may flow.

The header 5 is provided with a central bore 7 through which passes a sectional pipe 8 extending downwardly to any desired depth within the bore of the well 1. The upper end of the pipe 8 is closed by a header 9 which has in communication therewith a valve controlled inlet 10 through which fluid under pressure may be admitted.

The lower end of the pipe 8 has connected thereto a valve body 11 to the lower portion of which is connected a pipe section or nipple 12, the latter having connected thereto, by a flanged ring 13, a second pipe section 14 which projects downward to approximately the bottom of the well.

The flanged ring 13 includes a horizontally disposed flange 15 and a depending flange 16, the latter being interiorly threaded and receiving therein a pipe section 17 upon the exterior of which is positioned a packer which I will hereinafter describe, while the flange 15 has positioned therein a plurality of liquid passages 15'.

The pipe 17 has adjacent its connection with the depending flange 16 a threaded portion which receives thereon a ring 18 and abutting this ring, and slidable upon the pipe 17, is a packer 19 formed of yielding material. Positioned below the packer 19 is a second ring 20 which is likewise slidable upon the pipe section 17 and which spaces from the packer 19 a second packer 21, the latter being supported by a ring 22 slidable upon the pipe 17.

To expand the packers 19 and 21 during the positioning of the device within a well bore, I have provided the pipe 17 at its lower end with a horizontally arranged flange 23 which is adapted to abut against a similar flange 24 carried at the upper end of a pipe 25 and within which the pipe 17 is adapted to move to limit its upward movement. Thus it will be seen that downward movement of the pipe section 17 within the pipe 25 will compress the packers 19 and 21 and cause the same to engage the inner wall of a well bore, thus preventing the passage of liquid or fluid pressure thereabout.

The lower end of the pipe section 25 is connected to a second pipe section 26 by a collar 27 having formed integral therewith a diaphragm 28, the central portion of which is provided with an opening 29 closed by a check valve 30, the pipe section 26 having formed therein a plurality of openings 31 through which liquid may freely pass.

The valve shown in combination with this structure and illustrated generally by the reference numeral 11 is more specifically defined in Figure 2 and includes a pipe section 32 having formed integral therewith a valve body 33 around which is a vertical passage 34.

The valve body 33 has formed therein a vertical bore 35, the lower end of which is closed by a wall 36 and which has centrally thereof an opening 37 through which the reduced portion 38 of a valve member 39 may pass. The lower portion of the reduced section of the valve 38 is adapted to seat upon a diaphragm 40, formed integral with the pipe section 32, and closing an opening 41 formed therein. To normally hold the valve 39 in a closed position I have positioned within the valve chamber 35 a coil spring 42, one end of which rests upon the upper face of the valve 39, while the other abuts a perforated disc 43 carried by a threaded stem 44, adjustable within a plug 45 closing the upper end of the vertical bore 35. The stem 44 carries at its upper end a suitable thumb engaging portion and a lock nut 46 which is adapted to hold the screw 44 in any desired position.

To relieve the compression, and any liquid or pressure, which may seep past the valve 39, I have provided a check valve controlled passage 47 which passes outwardly

from the bore 35 and into the escaping oil and pressure.

Surrounding the opening 37 formed in the closed end of the bore 35, and through which the reduced portion 38 of the valve passes, is a plurality of passages 48 through which fluid pressure may pass and engage the enlarged portion of the valve 39.

In the operation of the structure hereinbefore described, particularly that structure set forth in Figures 1 and 2, it will be assumed that the apparatus is being positioned within a well having therein a quantity of oil and as the apparatus illustrated in Figure 1 is lowered within a well the pipe section 26 will first abut the well bottom and as its downward movement is thus prevented, a further downward movement of the pipe 8, and the pipe 17 connected thereto, causes the latter to move downwardly within the pipe section 25, thus compressing the packers 19 and 21 and causing the same to engage the wall of the well bore. The apparatus is now in position for the withdrawal of oil within the well and assuming that the valve 39 is closed, oil will pass upwardly within the pipe 14. thus compressing between its upper face and the closed valve natural gas pressure or the like that may be confined within the pipe 14, oil will at the same time pass upwardly within the pipes 25 and 17 and through passages 15′ formed in the horizontal flange 15 and to a height such as indicated by the arrow A. It is, of course, to be understood that the height of the liquid within the pipe 14 and within the well bore varies under numerous conditions, but it is the purpose here to point out that the oil within the pipe 14 does not at any time assume a height equal to that in the well bore.

After this condition has taken place fluid pressure is admitted through the inlet 10 and downwardly of the pipe 8 into the passage 34 sourrounding the valve body. The pressure then passes upwardly through the passages 48 surrounding the reduced portion 38 of the valve, and as it moves upwardly through these passages it is caused to engage the larger portion 39 of the valve. The engagement of this fluid pressure with the larger portion 39 of the valve together with the engagement of what pressure has been compressed within the pipe 14 upon the reduced end 38, moves the valve upwardly against the tension of the spring 42, thus permitting the free flow of pressure through the opening 41. In the event that any liquid or fluid pressure has passed beyond the valve 39 and within the bore 35, the upward movement of the valve forces this pressure and liquid outwardly through the check controlled passage 47.

As the oil and pressure pass downwardly through the pipe 14, they will force the oil therein downwardly and then upwardly through the pipe sections 25 and 17 and through the passages 15′ to the upper portion of the well bore, from whence it escapes through the valve controlled passage 6. During the movement of the oil from the pipe 14 and upon the initial admittance of fluid pressure therein, the valve 30 will be closed, thus preventing an outlet for the oil contained thereabove only through the passages 15′. During the removal of the oil from above the valve 30, additional oil is permitted to collect within the bottom of the well, indicated by the letter B and immediately upon the escape of the oil and pressure above the valve 30, the valve 30 will open and admit into the compartment C, oil that has collected in the compartment B, whereupon the operation is repeated.

In Figure 3 wherein I have indicated a modified form of my invention, in which it will be noted that the flow of the liquid and fluid pressure is reversed and in which practically the same elements as described in Figure 1 are employed, with the exception of a valve which operates directly opposite to that disclosed in Figure 2 and which is more spcifically illustrated in Figure 4.

In referring to Figure 3 the well bore 50 has positioned therein the usual casing 51 upon which is positioned a pipe section 52, the upper end of which is closed by a header 53. The pipe section 52 has connected therewith a valve controlled inlet 54, through which fluid under pressure may be admitted for the elevation of oil from the bottom of the well.

The header 53 has passing downwardly thereof a flow pipe 55 which is composed of a plurality of pipe sections, one of which 56 includes a valve illustrated in Figure 4 and which will be hereinafter more fully described.

Connected to the valve section 56 is a downwardly projecting pipe 57 which extends approximately the entire length of the well. The valve section 56 is further provided with a depending flange 58 to which is connected a nipple 59, the latter having connected to its lower end, by a ring 60, a pipe section 61 upon which is slidable a packer 62 of the class hereinbefore described. Also slidable upon the pipe section 61 is a ring 63 which rests upon a flange 64 of a pipe section 65 within which the section 61 is movable. To prevent the withdrawal of the pipe section 61 from the section 65, the former has formed at its lower end a horizontal flange 66 which engages the flange 64 and limits the upward movement of the pipe 61 within the pipe 65.

The lower end of the pipe section 65 has connected thereto, by a collar 67, a section 68 which is provided with a plurality of openings 69 through which liquid may pass. The collar 67 is also provided with a dia-

phragm 70, the central portion of which has an opening 71, closed by a check valve 72.

Upon referring to Figure 4 wherein I have indicated more specifically the structure of the valve used in connection with the apparatus disclosed in Figure 3, it will be observed that the valve body 56 has formed centrally thereof an opening 73 which aligns with the interior of the pipe sections 55 and 57. The body 56 is provided with a vertical bore 74 in which is movable a valve 75 similar in structure to that disclosed in Figure 2 and which includes an enlarged portion 76 and a reduced portion 77, the reduced portion closing an opening 78 formed within a horizontal wall 79. Communicating with the opening 78, is a passage 80 through which fluid pressure may enter. Also surrounding the reduced portion 77 of the valve is a plurality of openings 81 through which the fluid pressure may pass and engage the enlarged portion 76 of the valve. This valve also includes a spring 82 which is adapted to hold the valve upon its seat and the spring being adjusted by the means illustrated generally by the numeral 83, this means including a perforated disc 84 through which fluid or liquid that has passed beyond the valve may pass and escape through an opening 85 into the oil as it moves from the bottom of the well.

In the operation of this structure, the apparatus is positioned within a well as hereinbefore pointed out, and what oil there is within the well will pass upwardly through the valve 72 into the pipes 65 and 61 and assume such a height in the latter as determined by the natural gas and air pressure compressed between the closed valve and the upper face of the oil, while the oil within the pipe 57 may assume such a height as depends upon the quantity of oil within the well. After the parts have assumed their proper positions, fluid pressure is admitted through the inlet 54 and passes downwardly until it engages the enlarged portion 76 of the valve, and this pressure together with that pressure which is bearing upon the smaller end 77 of the valve will move the valve upwardly from its seat, thus permitting the passage of fluid pressure through the opening 78, after which it is directed downwardly upon the oil confined within the pipe 61′ and 65 and around the pipe 57 therein. The pressure thus exerted upon the oil first tends to close the valve 72, preventing the escape of oil through the opening 71 and the pressure bearing upon the oil moves the same upwardly through the flow pipe, composed of the sections 57 and 55, to a discharge opening 86 connected therewith. When the valve 72 closes the opening 71 additional liquid may enter into the lower end of the well and collect therein until all oil above the outlet pipe has been removed and the pressure upon the valve 72 relieved, after which the valve will open and permit the passage of oil from the bottom of the well to the interior of the pipe 65, whereupon the cycle of operation repeats itself.

In Figure 5 wherein I have illustrated a further modified form of the invention, the well bore 90 has positioned therein a cylindrical casing 91 which may project downwardly to any desired depth and having at its lower end a casing shoe or the like 94 which supports the casing within the well bore. The upper end of the casing 91 is exteriorly threaded and receives thereon a pipe section 95, the upper end of which is closed by a header 96. The pipe section 95 has in connection therewith a valve controlled passage 97 through which oil, after it is elevated from the well, may flow.

The header 96 is provided with a central bore 98 through which passes a sectional pipe 99 which extends downwardly to any desired depth within the bore of the well 90. The upper end of the pipe 99 is closed by a header 100 which has in communication therewith a valve controlled inlet 101 through which fluid under pressure may be admitted.

The lower end of the pipe 99 carries a section 102, exteriorly threaded, as indicated at 103, to receive thereon a ring 104, and abutting this ring 104 and slidable upon the pipe section 102 is a packer 105 supported by a sliding ring 106 which rests upon a flanged end 107 of a pipe section 108, the flanged end 107 engaging a similar flange 109 formed upon the lower end of the pipe section 102. Thus it will be seen that downward movement of the pipe section 102 will compress the packer 105 and force the same outwardly against the bore of the well, thus preventing the passage of either fluid under pressure or liquid thereabout.

In the form illustrated in Figure 5, it is intended to permit the flow of liquid, and possibly pressure, upwardly through the packer and to do this the packer 105 is provided with a plurality of vertically extending passages 110 formed by pipe sections connected in any desired manner to the ring 104, the pipe sections 110 thus forming passages for liquid or pressure and at the same time forming guides for the vertical movement of the packer 105 and the ring 106. As illustrated in the drawings I have shown the upper end of the pipes 110 as having thereabout cages 111, the purpose of which being to form a protector for the upper ends of the passages.

The lower end of the pipe section 108 is threaded and receives thereon a collar 112 to which is attached, centrally thereof, a smaller pipe 113 which projects downwardly to approximately the bottom of the well. The lower end of the pipe section 113 is provided with a horizontal flange 114 which is adapted to engage with a similar flange 115

formed integral with a pipe section 116 and upon which a packer 117 rests.

As in the former packer 105, the packer 117 is formed of any suitable material and is adapted to engage a stationary ring 118 carried by the pipe section 113 and supported by a ring 119 slidable upon the said pipe section and resting upon the flange 115 of the pipe 116. Thus it will be seen, as above pointed out, that when the pipe section 116 engages the bottom of a well bore the continued downward movement of the pipe 99 will cause the packer 117 to expand and engage the wall of the well. It is, of course, to be understood that when positioning the apparatus herebefore set forth the packer 117 will first engage the wall of the well, after which the engagement of the packer 105 therewith will take place.

The foregoing constitutes the structure of the apparatus disclosed in Figure 5 and when the same is positioned within a well bore having therein oil, the oil is adapted to first pass into the lower pipe section 116 through perforations 120 formed therein, upwardly through the pipe 113 and through a check valve 121 formed therein and after passing beyond the check valve the liquid will flow outwardly of the pipe 113, through perforations 122 formed therein and into the compartment formed between the packers 105 and 117. It is, of course, to be understood that in the event sufficient liquid is within the well bore, it will assume a certain height within the lower portion of the pipes 99 and 108 and will pass upwardly through the passages 110 formed in the packer 105.

Assuming that the structure illustrated in Figure 5 is positioned within a well bore and it is desired to remove the liquid therefrom, fluid pressure is admitted into the pipe 99, through the valve controlled passage 101, and as the fluid pressure passes downwardly through the pipe, it will bear upon the oil therein forcing the same downwardly, closing the valve 121, thus causing the liquid to pass outwardly through the perforations 122 and upwardly through the passages 110 in the packer 105 and then to the discharge passage 97.

In the structure which has just been described, it will be noted that I have eliminated the use of such valves as are illustrated in Figures 2, 4 and 6, as it is to be understood that the valve may be dispensed with if desired, but if such a valve is used it may be placed at any point within the pipe 99, but preferably at a point indicated by the letter X in Figure 5.

In the event a valve is used within the pipe 99, as illustrated broadly in Figure 5, the valve being normally closed, the liquid will, upon its entrance into the pipe 102 compress any gas or air pressure that may lie between the valve and its upper portion. From this point on the operation is the same as that hereinbefore set forth.

Furthermore, from the foregoing it will be apparent that in all forms I have divided a well bore into three compartments, one of which initially receives therein the liquid as it enters the well bore, the second of said compartments receiving the liquid from the former and its entry being controlled by a suitable valve, while the third has therein fluid pressure used in elevating the liquid from the second compartment. While the liquid is being removed from the second compartment, its entry valve is closed and liquid collects within the first, but after the liquid has been removed from the second compartment and the pressure upon the inlet valve relieved, it will open and permit the liquid to pass from the first compartment into the second, at which time the cycle of operation is repeated.

The fluid pressure is admitted into the second compartment by a special valve which is controlled solely by the fluid pressures and not by the oil and fluid pressure, as disclosed in my other application filed December 24th 1926 and bearing Serial No. 156,866. By this structure I am enabled to provide a valve that will function more evenly under all conditions than has been done heretofore, the reason being due to the fact that oil does not at any time engage the valve and deposit thereon, or in any of its parts, sand, salt water, paraffine or the like.

It is, of course, to be understood, as hereinbefore pointed out, that oil may possibly engage the valve during the initial placement of the apparatus in a well and in wells wherein the quantity of oil contained therein is excessive, but this engagement of oil with the valve does not continue to such a length of time as would tend to deteriorate or prevent the valve from operating properly.

In Figure 6 of the drawings I have illustrated substantially the same type of valve illustrated in Figure 4 and used with the structure disclosed in Figure 3, but wherein it will be observed that the body 123 of the valve is positioned within the pipe section 124, thus giving an obstructed surface to the exterior of the flow pipe, the valve body being positioned within the line of flow and thus permitting the use of smaller pipe so as to operate in wells of smaller diameter.

From the foregoing, it is thought that the construction, operation and many advantages of the herein described invention will be apparent to those skilled in the art without further description, and it will be understood that various changes in the size, shape, proportion and minor details of construction may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

Having thus fully described my invention,

what I claim as new, and desire to secure by Letters Patent, is:—

1. In a liquid elevating apparatus, the combination of a flow pipe and a fluid pressure pipe, a packer for supporting one of said pipes within the bore of a well and dividing the same into separate liquid and fluid pressure compartments, said liquid compartment having connected thereto the flow pipe, means included within the packer for positioning the same within the well bore and dividing the other of said compartments into separate chambers, the latter receiving therein oil, and a fluid pressure operated valve for controlling the entrance of fluid pressure from the pressure compartment into one of said chambers for removing the liquid upwardly therefrom through the flow pipe.

2. In a liquid elevating apparatus, the combination of a flow pipe and a fluid pressure pipe, a packer for supporting one of said pipes within the bore of a well and dividing the same into liquid and fluid pressure compartments, said liquid compartment having connected thereto the flow pipe, means included within the packer for positioning the same within the well bore and dividing one of said compartments into separate chambers, the latter receiving therein oil, a valve connecting one chamber with the other, and a fluid pressure operated valve for controlling the entrance of fluid pressure from the pressure compartment into one of said chambers for removing the liquid therefrom and closing the valve communicating with the other of said chambers.

3. In a liquid elevating apparatus, the combination of a flow pipe and a fluid pressure pipe, a packer for supporting one of said pipes within the bore of a well and dividing the same into liquid and fluid pressure compartments, the former having connected thereto the flow pipe, a valve positioned above said packer and operated by fluid pressure for permitting the entrance of fluid pressure from one compartment into the other for removing the oil therefrom, and said valve having a relief port through which leakage into its chamber may escape with the oil and pressure.

4. In a liquid elevating apparatus, the combination of a flow pipe and a fluid pressure pipe, a packer for supporting one of said pipes within the bore of a well and dividing the same into separate compartments, one of which receives therein oil and a valve positioned above said packer and operated by fluid pressure for permitting the entrance of fluid pressure from one compartment into the other for removing the oil therefrom.

In testimony whereof I affix my signature.

TITUS ANDREW BEECHER.