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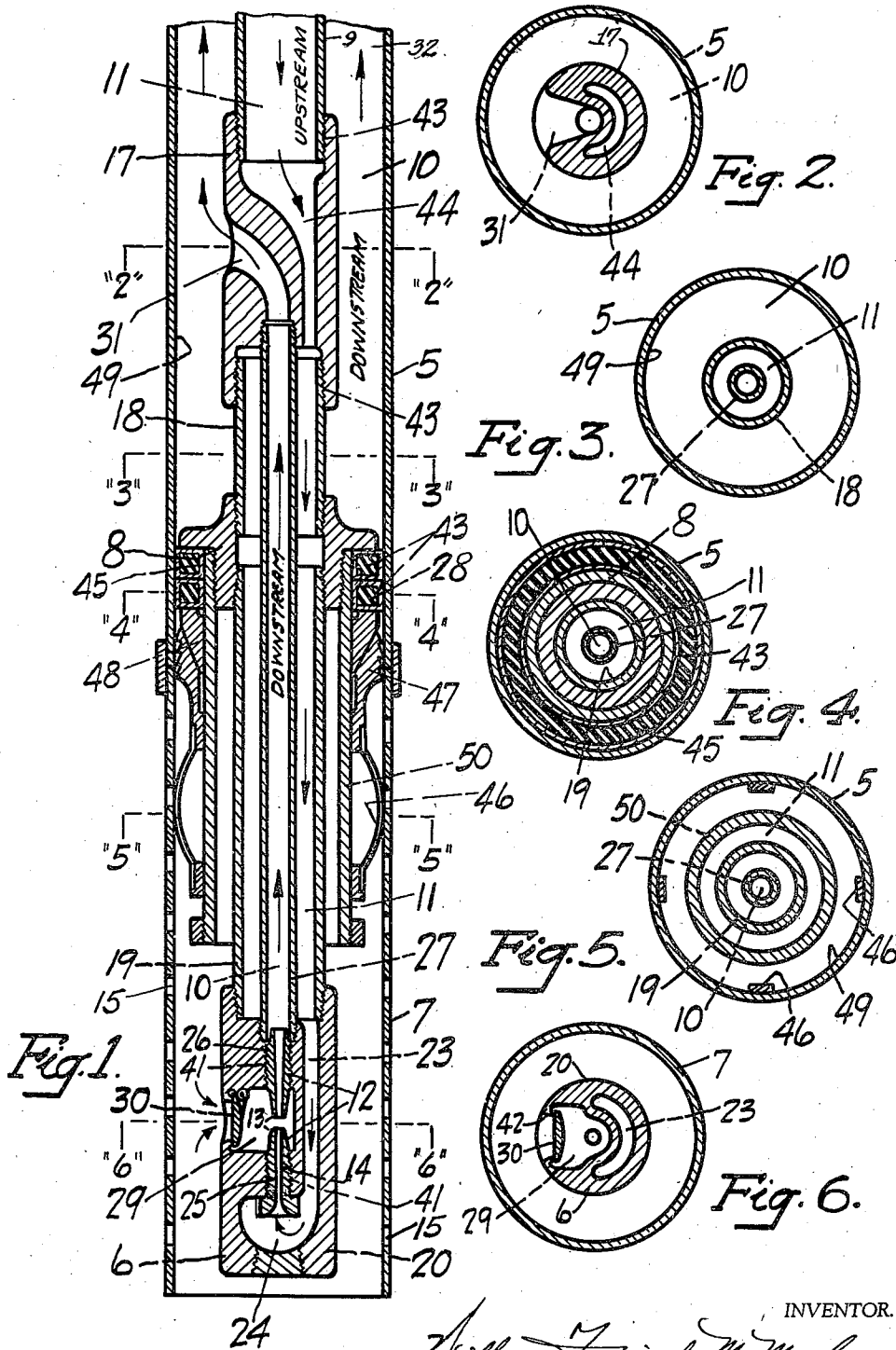
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2,291,911

APPARATUS FOR RAISING OIL AND GAS FROM OIL WELLS

Filed March 7, 1939

2 Sheets-Sheet 1



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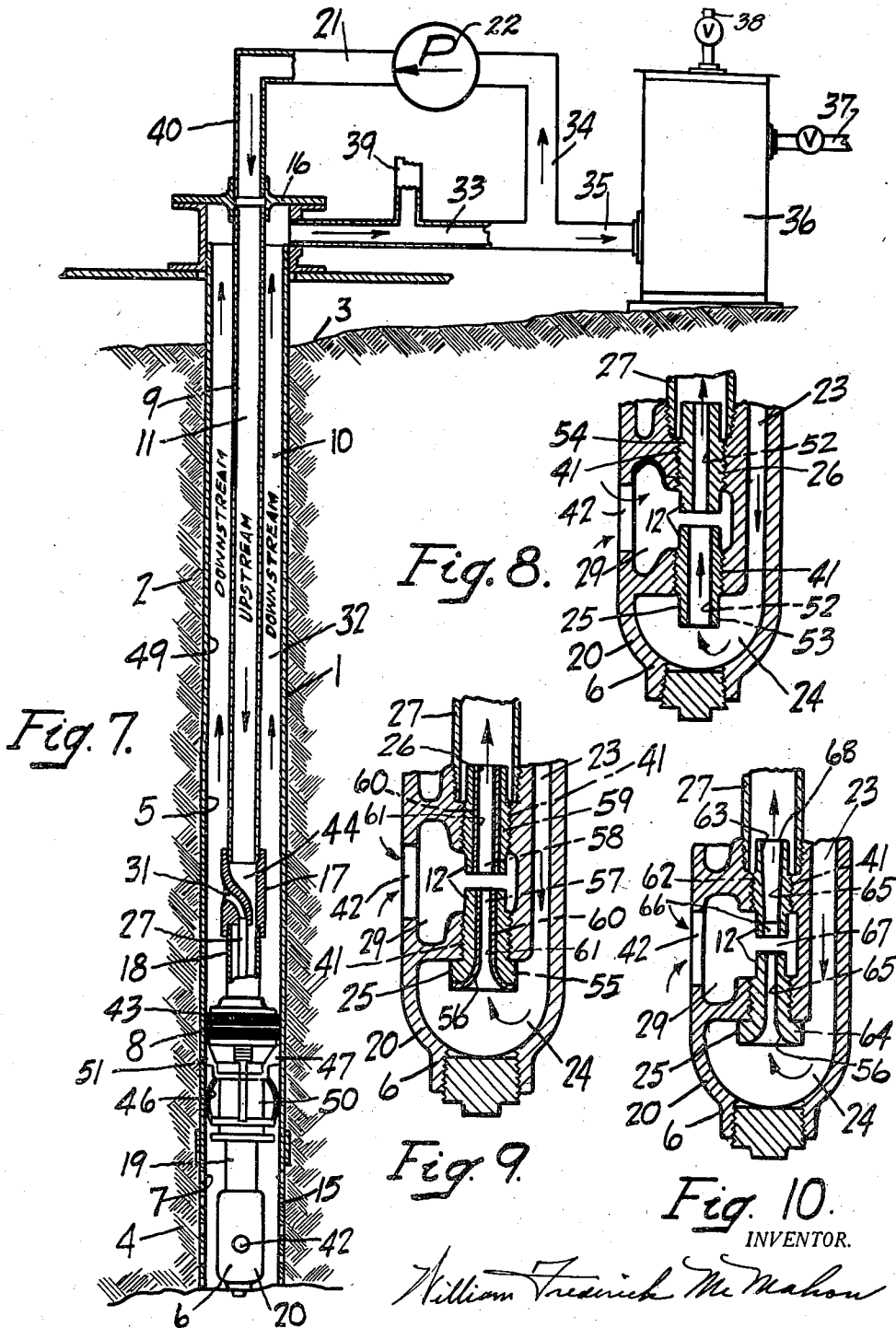
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UNITED STATES PATENT OFFICE

2,291,911

APPARATUS FOR RAISING OIL AND GAS
FROM OIL WELLS

William Frederick McMahon, Riverside, Calif.

Application March 7, 1939, Serial No. 260,273

11 Claims. (Cl. 103-260)

This invention relates to an oil well pumping apparatus for raising fluids from deposits in the earth, in which a fluid operated pump, having no moving parts in the oil well, is employed.

It is an object of my invention to provide a pumping apparatus which will operate with efficiency and economy in raising fluids from deposits in the earth.

It is an object of my invention to provide a pumping apparatus, for oil wells, in which a single string of tubing secured to a conventional packer adapted to seal off the usual oil well casing creates a vacuum in the oil well casing and in the oil well deposits.

It is a further object of my invention to utilize the conventional oil well casing and a single string of tubing, concentrically located within said casing, comprising of a packer and a simple means adapted to reverse the flow of the motivating fluid, in the vicinity of the oil deposits in the oil well, so that entrained fluids from the oil deposits are conveyed in a downstream manner directly into the said casing and whereby the energy of all gas so entrained and conveyed, expands to about atmospheric pressure in the said casing above the downstream portion of a single entraining means.

It is another object of my invention to provide a mode of operation whereby a motivating fluid adapted to entrain fluids from oil deposits will simultaneously and/or dynamically create a higher or lighter A. P. I. gravity than the A. P. I. gravity of the oil in the deposits and will do so automatically during the entraining operation.

It is an object of my invention to provide a pumping means, in which a liquid is used as a motivating means, in which it is advantageous to use fluid that has been emulsified in the oil deposits as the motivating fluid.

It is an object of my invention to provide a pumping means having a minimum number of parts and/or conduits. It is noted that the conventional tubing heretofore used for the conventional rod plunger pumps is used for one conduit while the other conduit used is the conventional oil well casing primarily used to prevent earth from caving into the bore hole in the earth and to shut off the water sands. It should also be noted that I use but a single entraining unit in a pump body secured to the said tubing and not secured to the said casing.

Heretofore if one were to convey his motivating fluid in the usual one string of tubing provided in an oil well in which the conventional oil well casing was sealed off by a packer secured to the

said tubing, he would have to reverse the total volume of motivating fluid together with the volume of entrained fluid in an additional chamber connected with said tubing or in the event he did not reverse the both said volumes in a similar chamber he did reverse one of the volumes in a chamber secured directly to a conduit that would have to be considered the same as the said casing and to resort to such an example would be impractical as it would be impossible to withdraw the oil well casing to remove the said chamber and/or entraining means without destroying the oil well. However, in my invention I use the conventional tubing and conventional oil well casing as the two conduits to convey the upstream volume of fluid and the downstream volume of fluid respectively, and only reverse the motivating or upstream volume of fluid in a chamber not secured to the conventional oil well casing or an equivalent of said casing. It is further noted that I do not subject the volume of the entrained fluids to said reversing action in said chamber and by this method of operation I also eliminate an emulsifying action where entrained gas is involved.

It is a feature of my present invention to provide a mode of operation of flowing an oil well. The said mode of operation comprises means to entrap all the natural gas by use of a packer set to a casing and to compel said gas to pass through a single orifice, in a fluid operated pump, and to intermingle therein with natural oil at a high velocity and thus reduce the oil-gas ratio of the flowing well. At times when the oil well ceases to flow the said single orifice will utilize a hydro-dynamic action of an upward directed current of fluid to actuate the fluid operated pump, when the pressure of the entrapped gas decreases, until such time as the pressure of the entrapped gas rises to flow the oil again.

In my fluid operated pump, when the velocity of fluid through a single entraining means due to the upstream column of fluid in the tubing, is equal to or is greater than that velocity due to a static head of the downstream column of fluid, this hydrodynamic action of the motivating current of fluid will continuously entrain and lift a natural fluid from the oil well. It is noted that my single entraining means is provided to pump a natural fluid from the oil deposits to the surface of the earth by circulating a liquid under pressure independent of utilizing the natural gas pressure in the oil deposits.

My present invention has for its object to pro-

vide an oil well pumping apparatus and mode of operation that may also be utilized to efficiently flow an oil well, without resorting to any modification of the pumping apparatus or method of operation, by merely utilizing the gas or rock pressure in the oil deposits or formation in cooperation with my method of operation and apparatus set forth. With the direction of the flow of gas from the oil deposits, as provided in my invention, coupled with the novel entraining means and the relationship of the conduits and packer, less gas from the oil deposits is required to lift a given amount of oil, and thus the oil-gas ratio is reduced. Also, the dissolved gases and volatile hydro-carbons from the oil deposits, will be introduced to assist very materially in pumping the oil well, supplying energy up to a high percent of that required to lift the oil.

It is an object of my invention to provide a pumping apparatus that will not have to resort to a filtering of its motivating fluid, thus making a further economical operating cost.

In oil fields where paraffin wax deposition gives trouble, the motivating fluid may be slightly heated to offset the cooling effect of expanding gases and eliminate the trouble. Also, in view of there being no moving parts in the oil well, the increased velocity of the fluids will tend to sweep the tubing and/or casing clean.

It should be clearly noted that heretofore, in pumps of this character, no one solely reversed the volume of motivating fluid in such an equivalent chamber without using two or more strings of tubing located within the conventional oil well tubing. Or, if one did solely reverse the volume of motivating fluid in such an equivalent chamber, then in that event, without my disclosure, such a chamber must be considered directly secured to a conduit the equivalent of said conventional oil well casing. To secure such a chamber to the oil well casing would not be practical because the conventional oil well casing is provided to permit drilling operations and/or operations incidental to drilling operations, such as cementing off water sands and preventing earth from caving into the bored hole in the earth, etc. If such a chamber were secured to the conventional oil well casing and a single string of tubing used within the said casing, then in that event the said chamber could not ever be removed without destroying the oil well.

It is accordantly well recognized that the usual standard oil well casings placed in oil wells are only adapted for safe working pressures equal to a pressure set-up by a column of fluid extending from the surface of the earth to the oil deposits in the earth. In apparatus of this kind, the motivating fluid has, in many cases, a pressure which is the total of the surface pump pressure plus the pressure induced by a static head of a column of fluid extending from the surface of the earth to the deposits in the earth. In many oil wells where water is encountered, the said oil well casing is subjected to corrosion which makes the said casing unfit to hold excessive or additional hydrostatic pressures. Therefore it obviously is more practical to convey the motivating fluid in a string of tubing located within the oil well casing instead of in the oil well casing itself. It should be noted at this time that the pressure of the motivating fluid, in my invention, assumes a pressure equal to a static head of a column of fluid extending from the surface of the earth to the pumping apparatus in the vicinity of the oil deposits when

the motivating fluid reaches the said oil well casing which may be opened to the atmosphere if desired.

5 An object of my present invention is to provide a preferred apparatus and mode of operation for pumping an oil well as more clearly shown in the figures of the drawings hereto appended.

10 With these and other objects in view, the invention resides and consists in the construction and novel combination and arrangement of parts hereinafter more fully described, illustrated in the accompanying drawings, and pointed out in the claims hereto appended, it being understood that various changes in the form, proportion, design, size and details of construction may be resorted to by those skilled in the art without departure from the spirit or intent of this invention.

20 Similar characters of reference denote like or corresponding parts throughout the several figures of the accompanying drawings forming a part of this specification, and upon which;

25 Fig. 1 is an enlarged longitudinal sectional view through my pumping apparatus, of that portion thereof, located in the vicinity of the oil deposits.

Fig. 2 is a cross section on a plane represented by the line 2—2 of Fig. 1.

30 Fig. 3 is a cross section on a plane represented by line 3—3 of Fig. 1.

Fig. 4 is a cross section on a plane represented by the line 4—4 of Fig. 1.

35 Fig. 5 is a cross section on a plane represented by the line 5—5 of Fig. 1.

Fig. 6 is a cross section on a plane represented by the line 6—6 of Fig. 1.

40 Fig. 7 is a longitudinal elevation, part of which is in sectional elevation, showing a preferred complete assembly.

Fig. 8 is an enlarged sectional elevation, showing one form of construction of the entraining means in which the area of the upstream orifice is larger than the area of the downstream orifice.

45 Fig. 9 is an enlarged sectional elevation, showing another form of the construction of the entraining means and showing in particular, a tungsten-carbide lined throat.

50 Fig. 10 is an enlarged sectional elevation, showing another form of the construction of the entraining means and showing in particular, the upstream orifice area smaller than the downstream orifice area.

55 Referring to the characters of reference marked upon the drawings, 1 indicates a bored hole in the earth 2. This bored hole 1 extends from the surface of the earth 3 to the oil deposits 4. The usual oil well casing 5 is shown and is conventionally provided to prevent the earth 2 from caving into the bored hole 1. Attached and secured to casing 5 is a perforated liner 7 which is perforated to permit oil and/or gas from the deposits 4 to enter into said casing 5 and/or perforated liner 7.

60 Oil or the like rises to some harmonious fluid level in liner 7 and/or casing 5 in accordance with the amount of rock pressure or gas pressure contained in the oil deposits 4. By use of a packer 8, in my pumping method or apparatus, I utilize casing 5 as one of my conduits to convey the downstream column of fluid.

70 The other conduit and/or upstream column of fluid is conveyed in a single string of tubing 9 located concentrically within the casing 5.

75 A conventional packer 8 is secured to tubing 9

and is provided to seal off the casing 5 relative to said tubing 9. This packer 8 serves to set up an annular chamber 32 formed within casing 5 adapted to hold the downstream column of fluid 10. Packer 8 also serves to prevent the downstream column of fluid 10 from passing out of the annular chamber 32 into the oil deposits 4.

Tubing 9, which will be, in my average physical embodiment, a 2" or 2½" or 3" external upset tubing, is located concentrically within casing 5 and extends from a casing head 16 to a reversing means 17. Tubing 9 has threaded engagement with both the said casing head 16 and reversing means 17. Reversing means 17 is secured to the packer 8 by means of a short piece of tubing 18. If desired, the reversing means can be directly connected with the packer 8 or made part of the packer 8 and the tubing 18 thus eliminated. Another length of tubing 19 serves to secure and connect the packer 8 with the pump body 20 of the oil well pump 6. In practice, the tubing 9, 18 and 19 will be of the same size. The casing head portion 40 of tubing 9, extends from said casing head 16 to a discharge outlet 21 of a surface pressure pump 22. So by referring to Fig. 7 of the drawings, it will be noted that tubing 9, reversing means 17, tubing 18, packer 8, tubing 19 and pump body 20 are all connected together and serve to form a continuous conduit for the upstream column of fluid 11 and/or the volume of fluid discharged from the surface pressure pump 22 and conveyed therethrough to the oil well pump 6.

Oil well pump 6 is, in a preferred construction, a casting 20 comprising a threaded means in its upper portion for connection with tubing 19 and packer 8. It contains a lower enclosed chamber 24 having connection with an upper inlet chamber 29 which contains a check valve 30. Longitudinal cored passageways 23 serve to convey fluid discharged through tubing 19 from the upper portion of the pump body 20 to the lower enclosed chamber 24. In central alinement with the body 20 and located on both sides of the upper inlet chamber 29 are threads 41 provided for threaded engagement for the respective upstream and downstream portions 25 and 26 of the entraining means 12. Entraining means 12 has communication with the fluids in the oil deposits through a passageway 42 enclosed by the check valve 30. Secured to the upper portion of the pump body 20 and for communication with the downstream portion 26 of the entraining means 12 is a length of macaroni-tubing 27. In the lower enclosed chamber 24, the upstream volume of motivating fluid 11 is reversed one hundred eighty degrees (180 degrees) or the like and is discharged through the entraining means 12 into the macaroni-tubing 27. The downstream portion 26 of the entraining means 12 and the macaroni-tubing 27 serve as the place of the source of the downstream column or volume of fluid 10. Check valve 30 will be open at all times the pumping system is entraining fluid from the deposits 4. It plays no part in the operation of the system and is only used to hold the fluid in the system when the system is not in operation.

Oil well pump 6 entrains oil and/or gas from the oil deposits 4, through passageway 42 into the downstream portion 26 of the entraining means 12, when the velocity of the upstream column of fluid 11 passing through the entraining means 12 is equal to or its greater than that velocity caused by the static head of the column of downstream fluid 10. It is noted that the velocity of fluid

through the entraining means 12 will be such as to decrease the pressure against the side walls 14 of the constricted or contracted portion 13, of the entraining means 12, to such extent that fluids will be entrained from deposits 4 to intermingle with the motivating fluid delivered through the downstream portion 26 of the entraining means 12. In my present invention, the velocity of all gas flowing into the downstream portion 26 of the entraining means 12 will create a uniform mixing of oil and gas at high velocity and thereby reduce the tendency of the oil well to surge or head. Also it follows that the whole energy of the entrained gas above the downstream portion 26 is expanded to atmospheric pressure and thereby less gas is required to lift a given amount of oil, thus the oil-gas ratio is reduced. By referring to Fig. 7 of the drawings there will be noted the relationship of packer 8 to the oil well pump 6 and the direction of flow of entrained fluids into casing 5 by means of reversing means 17. This said relationship not only creates a vacuum in the deposits 4 but induces all gas from the deposits 4 to flow through the downstream portion 26 of the entraining means 12, thus the dissolved gases and volatile hydro-carbons from the oil deposits 4 will be so introduced into the system as to assist very materially in lifting the oil or pumping the oil well, supplying energy up to a high percent of that required to lift the oil.

The downstream volume or column of fluid 10 comprises the total volume of the entrained fluids and motivating fluid.

From macaroni-tubing 27, the downstream fluid 10 is discharged through passageway 31, in the reversing means 17, into the casing 5, or to be more exact, into the annular chamber 32 formed by the casing 5.

As before stated the reversing means 17 can be made part of the packer 8. It is in this preferred construction an elongated casing 17 containing threads 43 on its both ends for threaded engagement with tubing 9 and tubing 18. It serves to connect tubing 9 and tubing 18 together and in alinement with each other. Reversing means 17 contains a cored passageway 44 extending from its upper end portion to its lower end portion, and passageway 44 serves to form the passageway for the upstream volume of fluid 11. Another cored passageway 31, in reversing means 17, serves to convey the volume of the downstream fluid 10 from macaroni-tubing 27 into the annular chamber 32 or casing 5. Macaroni-tubing 27 has direct communication with passageway 31 by its threaded engagement with reversing means 17. While I have preferred making this reversing means 17 a casing with cored passageways, it is obvious that the reversing means 17 may be made of a piece of shafting or the like and the passageways drilled to suit.

As one of the important features of my improvement, it should be noted that the total volume or column of the upstream motivating fluid 11 only is reversed in the lower chamber 24 of the pump body 20 and all the entrained fluids from the deposits 4 are conveyed directly into the casing 5 without being subjected to said reversing action in lower chamber 24 of the pump body 20. This results in eliminating an emulsifying factor where the entrained fluids consist of oil, water and gas and it also results in conveying the said entrained fluids in the direction of least resistance, which in turn facilitates the flowing of oil wells almost devoid of gas energy. If more than one entraining means 12 were

used it would not be possible to utilize low gas pressure to flow the well because in the average oil well, past the natural flowing stage, there is not sufficient gas energy to do effective work with more than one entraining means 12, in co-operation with a packer 8.

From annular chamber 32, in casing 5, the downstream volume or column of fluid 10 is discharged through conduit 32, connected with casing head 16, to the suction conduit 34 of the pressure pump 22 and also to tank 36 by means of conduit 35. A conduit 39, connected with conduit 33, serves to draw off entrained gas to a gas trap, not illustrated, before the said gas reaches tank 36. Tank 36 is adapted to store the volume of oil and/or water entrained from the deposits 4 and, if desired, to hold a suction head for the pump 22. The said volume of entrained fluids is in excess of the volume of fluid necessary to fill the complete system. Tank 36 is provided with a draw-off conduit 37 and vent 38. Various conventional heating means may be applied to tank 36, if desired to heat the motivating fluid. Because of the fact that my pumping apparatus has no moving parts in the oil well, heating is not necessary in the average case and may only be necessary in some extreme paraffin wax deposition cases.

Pressure pump 22 may be any kind of a pump adapted to create a pressure on a fluid and it is operated by energy derived from some external source.

Packer 8 is recommended to set and reset without sticking to the casing 5 or blank portion 51 above the perforations 15 in liner 7. It is shown with two packing rings 43 made of graphited cord and fabric 28 with a rubber insert 45. Several rings 43 may be used if desired. In the average case, the packer 8, with the well pump 6, tubing 19, tubing 18, reversing means 17, and tubing 9, is lowered into the well 1 until a desired depth is reached. A preferred depth is the location just above the perforated casing or liner 7. The spring reins 46 create friction against the wall of the casing 5 through which the packer 8 is lowered. Connected to the spring reins 46 is a conventional releasing lock and slips 47 which may be set by turning the tubing 9 to the right about one quarter of a turn. This operation will release the slips 47 from their original set position after which the weight of the tubing 9 above the packer 8 will cause the slips 47 to expand upward and outward on the cone 48 until they engage the wall 49 of the casing 5. Packer tube 50 plays no part in the operation of my pumping system and only serves as a guide for slip reins 46. Packer 8 also permits the entraining means 12 to be replaced quickly by merely withdrawing the tubing 9 from the oil well, together with said packer 8. By use of packer 8, I am enabled to form two columns of fluid with one string of tubing within the conventional oil well casing 5. An important feature of the relationship of pump 6 to packer 8 by means of tubing 19 is disclosed in the fact that, in many oil wells, the perforated liner or casing 7 may be from one hundred feet (100') to several hundred feet in length, and as packer 8 must be located in a blank portion 51 above all perforations 15, therefore, in the event the fluid level of oil in the deposits 4 should only rise, in the lower end portion of the said perforated casing 7, for a short distance, then I am permitted to locate the pump 6 into such fluid from the deposits 4.

By referring to Fig. 8 it will be noted that I

have provided a modified entraining means 12. The upstream portion 53 is formed with a re-entrant orifice having a larger area than the opposite downstream reentrant orifice 54. In many cases in which the entraining means 12 is deeply submerged in fluid, the motivating fluid flowing under a high velocity will jump or flow clear of the side walls 52 of the said upstream 53 and will enter the opposite downstream re-entrant orifice most efficiently to do work. Both orifices 53 and 54 are adapted to be replaced and have threaded engagement 41 with the pump body 20 of pump 6. Heretofore the upstream portion of all entraining means had a smaller area than the downstream portion. While I have found it advantageous to make the side walls 52 straight in cases where the orifices 53 and 54 are of short length, it is obvious that in cases of large lengths the side walls 52 may be slightly tapered without departing from the feature of the respective areas as disclosed. Also the side walls 52 may be lined with tungsten-carbide or the like material.

In Fig. 9 of the drawings I have shown the entraining means 12 comprising an upstream orifice 55 having a well rounded entry 56. In this type of orifice 55 there is little or no contraction, the issuing stream being the same size as the opening 57. Therefore the area of the upstream opening 57 will be slightly less than the area of the opposite opening 58 of the downstream orifice 59. Tungsten-carbide or the like material 60 lines the side walls 61. Both said orifices 55 and 59 are adapted to be entirely replaced and have threaded engagement 41 with the pump body 20 of pump 6. The side walls 61 are made straight. This well rounded entry 56 prevents the issuing stream from becoming "broomy" at high heads or velocities.

In Fig. 10 of the drawings, I have shown a slightly modified entraining means 12, using a well rounded entry 56 similar to that shown in the upstream portion 55 of Fig. 9 of the drawings. The downstream portion 62 shows a reentrant orifice flared at its exit 68. This upstream orifice 64 and downstream orifice 62 are likewise adapted to be entirely replaced by means of threaded engagement 41 with the pump body 20 of pump 6. The side walls 65 may also be entirely lined with tungsten-carbide or the like material. In some cases it is advantageous to have the downstream orifice 62 flared at 63 as shown, because when the whole orifice 62 flows full, the pressure in the throat portion 66 is less than the pressure at the exit 68. A gap 67, between the upstream portion and downstream portion of the entraining means 12, is from five sixteenths of an inch wide to one half of an inch or more wide, in practice. Gap 67 has communication with the fluids in the deposits 4.

In cooperation with the novel entraining means 12, above recited it is possible to use emulsified oil as motivating fluid without having to filter it. This results in a lower operating cost. It has been found that in some oil fields where the A. P. I. gravity of the oil, in the formation 4, was for example, 28 degrees, that after using my mode of operation disclosed, the final gravity of the oil raised and in storage was several degrees higher due to the liquefying of the entrained gases by the application of high pressure on the motivating liquid during the pumping cycle of operation. While I do not desire to be limited to any particular surface equipment, outside of the surface pressure pump 22, to store or vent the

system on the surface of the earth, suitable valves, vents etc., consistent with good piping practice, will be applied or used where necessary.

I claim as my invention:

1. In an oil well having a conventional oil well casing and liner; pumping apparatus of the character described, comprising; a fluid operated pump comprising a single split Venturi-tube, an enclosed chamber and constructed to hydro-dynamically entrain and lift natural fluids through the split portion of the said Venturi-tube; a pressure pump; a packer adapted to be set within said casing above the perforations in the liner; a tubing secured to said packer and connected with said pressure pump and said fluid operated pump for conveying motivating fluid under pressure from said pressure pump through said tubing and said packer, upstream, to said fluid operated pump; an annular channel formed by the setting of the said packer to the said casing above the perforations in the liner, for conveying fluid, downstream, from the said fluid operated pump; means for reversing the motivating fluid one hundred eighty degrees or the like in said enclosed chamber of the fluid operated pump; means connected with the said fluid operated pump for conveying the entrained natural fluids and motivating fluid therefrom, downstream, into the said annular channel whereby, the entrained natural fluids are not received or subjected to the said reversing action of the motivating fluid, in the said enclosed chamber of the fluid operated pump; and means for withdrawing the said fluid operated pump from the oil well without having to withdraw the said casing or liner.

2. In an oil well having a conventional oil well casing and liner; pumping apparatus of the character described, comprising; a fluid operated pump comprising a single split Venturi-tube, an enclosed chamber and constructed to hydro-dynamically entrain and lift a natural fluid through the split portion of the said Venturi-tube; a pressure pump; a packer adapted to be set and reset within said casing above the perforations in the liner; a tubing secured to said packer and connected with said pressure pump and said fluid operated pump for conveying motivating fluid under pressure from said pressure pump through said tubing and said packer, upstream, to said fluid operated pump; means for reversing the motivating fluid one hundred eighty degrees or the like in said enclosed chamber in said fluid operated pump; means connected with said fluid operated pump for conveying the natural fluid and motivating fluid therefrom, downstream, without receiving or subjecting the natural fluid to said reversing action of the motivating fluid, in the said enclosed chamber; an annular chamber for conveying the natural fluid and motivating fluid, downstream, to the surface of the earth and communicating with said means; said annular chamber formed within the said casing by lowering the said tubing, said means, said packer and said fluid operated pump, as a unit, into the said casing and setting the said packer within said casing above the perforations in the liner.

3. In an oil well having a conventional oil well casing and perforated liner connected with the lower end portion of said casing; a fluid operated pump containing a single split Venturi-tube, an enclosed chamber and constructed to entrain and lift a natural fluid through the split portion of the said Venturi-tube; a pressure pump; a packer adapted to be set and reset to said casing above the perforations in the liner;

a tubing secured to said packer and connected with said pressure pump and said fluid operated pump for conveying motivating fluid under pressure from said pressure pump through said tubing and said packer, upstream, to said fluid operated pump; means for reversing the motivating fluid one hundred eighty degrees or the like in said enclosed chamber in said fluid operated pump; means connected with said tubing and fluid operated pump for conveying the natural fluid and motivating fluid therefrom, downstream, without subjecting the natural fluid to the said reversing action of the motivating fluid or receiving the said natural fluid in the said enclosed chamber; an annular chamber communicating with the said means for conveying the natural fluid and motivating fluid, downstream, therefrom; said annular chamber formed within the said casing by lowering the said tubing, said means, said packer and said fluid operated pump, as a unit, into the said casing and setting the said packer within said casing above the perforations in the liner; whereby, after the said packer is set in the said casing, vacuum is created in the said perforated liner; and means whereby the said fluid operated pump can be withdrawn from the said casing without having to withdraw the said perforated liner.

4. In an oil well having a conventional oil well casing and liner; pumping apparatus of the character described, comprising; a fluid operated pump comprising a single split Venturi-tube and constructed to pump a natural fluid through the split portion of the said Venturi-tube; a pressure pump; a tubing connected with said pressure pump and said fluid operated pump for conveying motivating fluid from said pressure pump, upstream, to said fluid operated pump; means connected to said tubing and said fluid operated pump, and adapted to be set to said casing above the perforations in the liner and withdrawn from said casing, for conveying the motivating fluid and natural fluid from the said fluid operated pump, downstream, into said oil well casing and for creating vacuum in the oil well by relieving the weight of the downstream fluid in the said oil well casing by converting the said weight into velocity at the place where the split portion of the said split Venturi-tube communicates with the natural fluid.

5. In an oil well having a conventional oil well casing and liner; pumping apparatus of the character described, comprising; a fluid operated pump comprising a single split Venturi-tube constructed to pump a natural fluid through the split portion of the said Venturi-tube; a pressure pump; a tubing connected with said pressure pump and said fluid operated pump for conveying motivating fluid from said pressure pump, upstream, to said fluid operated pump; means connected to said tubing and said fluid operated pump, and adapted to be set and reset within said casing above the perforations in the liner, for conveying the motivating fluid and natural fluid from the said fluid operated pump, downstream, into the said oil well casing and for assisting to flow the oil well by confining the gas in the oil well, below the said means, to flow in the direction of least resistance, through the said split portion of the said Venturi-tube and said means, directly downstream into the said oil well casing, and means for withdrawing the fluid operated pump from the oil well casing without having to withdraw the said liner.

6. In an oil well having a conventional oil well

casing and liner; pumping apparatus of the character described, comprising; a fluid operated pump comprising a single split Venturi-tube constructed to pump a natural fluid through the split portion of the said Venturi-tube by utilizing an emulsified fluid as a motivating medium; a pressure pump; a tubing connected with said pressure pump and said fluid operated pump for conveying the emulsified motivating fluid from said pressure pump, upstream, to said fluid operated pump; means connected to said tubing and said fluid operated pump, and adapted to be set and reset within said oil well casing above the perforations in the liner, for conveying the emulsified motivating fluid and natural fluid from the said fluid operated pump, downstream, into said oil well casing whereby, the said motivating fluid does not have to be filtered, during the pumping operation and means for withdrawing the fluid operated pump from the oil well without having to withdraw the said casing or liner.

7. In an oil well having a conventional oil well casing or liner; pumping apparatus of the character described, comprising; a fluid operated pump comprising a single split Venturi-tube constructed to pump a natural fluid through the split portion of the said Venturi-tube; a pressure pump; a tubing connected with said pressure pump and said fluid operated pump for conveying motivating fluid from said pressure pump, upstream, to said fluid operated pump; means connected to said tubing and said fluid operated pump, and adapted to be set and reset within said casing above the the perforations in the liner, for conveying the motivating fluid and natural fluid from the said fluid operated pump, downstream, into the said casing and to permit the withdrawal of the said fluid operated pump without having to withdraw the said liner.

8. In an oil well having a conventional oil well casing and liner; pumping apparatus of the character described, comprising; a fluid operated pump comprising a split Venturi-tube having two members, an upstream member and a downstream member, the upstream member of which is formed a reentrant orifice having a larger area than the opposite downstream reentrant orifice member, being arranged to pump a natural fluid through the split portion of the Venturi-tube; a pressure pump; a tubing connected with said pressure pump and said fluid operated pump for conveying motivating fluid from said pressure pump, upstream, to the upstream member of the entraining means in the said fluid operated pump; means connected to said tubing and said fluid operated pump, and adapted to be set within said casing above the perforations in the liner, for conveying the motivating fluid and natural fluid from the downstream member of the entraining means, in said fluid operated pump, into the said casing and means for withdrawing the fluid operated pump from the oil well casing without having to withdraw the said liner.

9. In an oil well having a conventional oil well casing and liner; pumping apparatus of the character described, comprising; a fluid operated pump comprising a single split Venturi-tube having two opposed members spaced apart, an upstream member and a downstream member, the upstream member of which is formed a cylindrical orifice having a well rounded entry, the opposite downstream member of which is formed a reentrant orifice, both members being arranged to entrain a natural fluid through the parting

space between them; a pressure pump; a tubing connected with said pressure pump and said fluid operated pump for conveying motivating fluid from said pressure pump, upstream, to the upstream member of the entraining means in the said fluid operated pump; means connected to said tubing and said fluid operated pump, and adapted to be set within said casing above the perforations in the liner, for conveying the motivating fluid and natural fluid from the downstream member of the entraining means, in said fluid operated pump, into the said casing and adapted for withdrawing the fluid operated pump from the oil well casing without having to withdraw the said liner.

10. In an oil well having a conventional oil well casing and liner; pumping apparatus of the character described, comprising; a fluid operated pump comprising a single split Venturi-tube having two removable members, an upstream member and a downstream member spaced apart, the upstream member of which is formed a cylindrical orifice with a well rounded entry having its side walls lined with tungsten-carbide or the like, the opposite downstream member of which is formed a cylindrical reentrant orifice having its side walls lined with tungsten-carbide or the like, both said members of the entraining means having communication with oil deposits and are arranged to entrain a natural fluid through the space between them; a pressure pump; a tubing connected with said pressure pump and said fluid operated pump, for conveying motivating fluid from said pressure pump, upstream, in an upwardly directed current to the upstream member of the said entraining means in the said fluid operated pump; means connected to said tubing and said fluid operated pump, and adapted to be set and reset within said casing above the perforations in the liner, for conveying the motivating fluid and natural fluid from the downstream member of the said fluid operated pump entraining means, into the said casing and to the surface of the earth and adapted for withdrawing the fluid operated pump from the oil well casing without having to withdraw the said liner.

11. In an oil well having a conventional oil well casing and perforated liner; pumping apparatus of the character described, comprising; a fluid operated pump comprising a single split Venturi-tube having two opposed and adjustable members spaced apart, an upstream member and a downstream member, both said members of the said split Venturi-tube having communication with a natural fluid through the space between them and are arranged to pump the said natural fluid; a pressure pump; a tubing connected with said pressure pump and said fluid operated pump for conveying motivating fluid from said pressure pump, upstream, in an upwardly directed current to the said upstream member of the said entraining means in the said fluid operated pump; means connected to said tubing and said fluid operated pump and arranged to be set and reset within said oil well casing above the perforations in the liner, for conveying the motivating fluid and natural fluid from the said downstream member of the said entraining means of the said fluid operated pump, downstream, into the said oil well casing; said means arranged to permit the withdrawal of the said fluid operated pump without having to withdraw the said perforated liner.

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