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WELL PUMPING DEVICE

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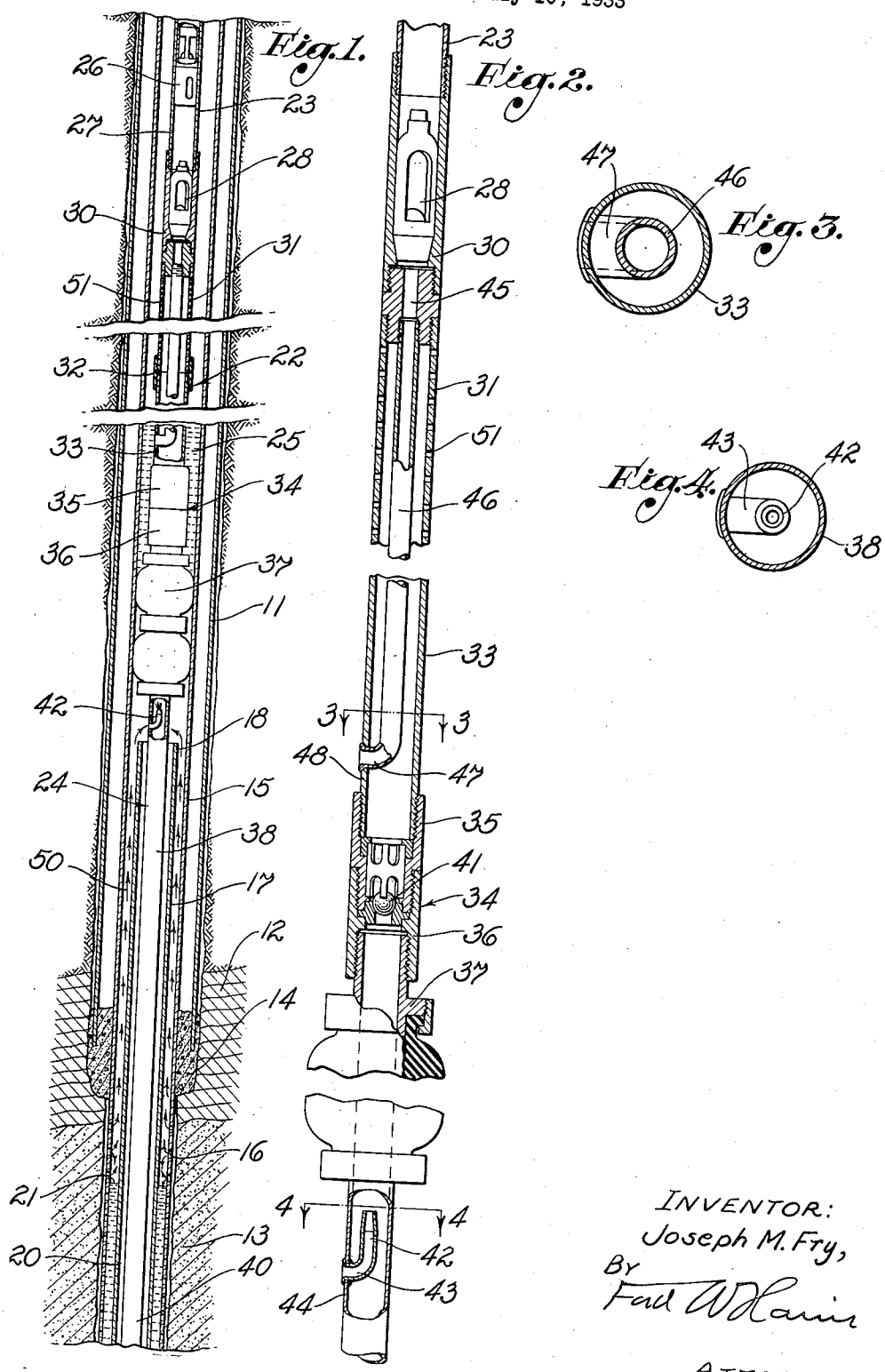

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WELL PUMPING DEVICE

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8 Claims. (Cl. 103—5)

My invention relates to a device for pumping wells, and relates particularly to a pumping device for use in relatively deep oil wells.

Conditions encountered in or developing in the drilling of a deep oil well generally make it necessary to install several casings, one within the other, with the result that the final pipe or casing installed in the well is of extremely small diameter, and it often occurs that in order to penetrate the oil bearing formation, it is necessary to use a pipe which is too small to receive a pump. Under these conditions, unless there is sufficient pressure in the formation to force the oil up through this small pipe into a part of the well structure which is of sufficient size to accommodate a pump, production of oil from the well is impossible. My invention provides a means whereby a well of this character may be pumped by reason of incorporating with the mechanical pumping unit a means having the ability to raise the oil through the final small-diameter pipe or lining into the larger portion of the well structure in which the pump may be placed, the pump being then operative to lift the oil from this higher point within the well to the surface of the ground.

It is an object of my invention to provide a pumping device including a mechanically operated pump having an oil lifting tube of relatively small diameter extending downwardly from the lower end thereof, this oil lifting tube being adapted to extend down from the mechanical pump into a pipe or liner in the lower end of the well structure, which pipe is too small to receive the pump. The oil lifting tube has means therein employing gas from the oil producing formation of the well to lift the oil from the smaller pipe or liner into the zone in the well structure in which the mechanical pump is located.

It is a further object of the invention to provide a device of this general character which may be used in any well, regardless of the size of the casings or liners, to lift the oil from the producing strata to a higher level within the well by use of gas from the formation, and to then pump the oil mechanically from this higher level to the surface of the ground, thereby materially reducing the cost of pumping the well.

A further object of the invention is to provide a device of the above character which is relatively cheap and of simple construction, and which may be readily installed in a well, where it will thereafter operate to produce the valuable results hereinbefore and hereinafter set forth.

Further objects and advantages of the invention will be made evident throughout the following part of the specification.

Referring to the drawing, which is for illustrative purposes only,

Fig. 1 is a vertically sectioned view showing the lower end of a well with a preferred form of my invention therein.

Fig. 2 is an enlarged vertically sectioned view showing the interior construction of the oil lifting tube forming a part of the invention.

Fig. 3 is an enlarged cross sectional view on a plane represented by the line 3—3 of Fig. 2.

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

Although the invention may be used in any well which is producing a required and relatively small amount of gas, I have shown in the drawing a well structure with which my device is of particular value, since it provides a means for pumping a well which could not otherwise be pumped. In Fig. 1, I show a casing 11 extending down into the cap rock formation 12 above an oil bearing formation 13. At 14 it is indicated that the casing string 11 is cemented off, and through the body of cement an inner casing string or pipe 15 has been carried into the oil bearing formation 13. The casing string 15 is shown as being of sufficient size to receive a pump of minimum diameter, but owing to the large size of the perforations 16 in the part of the piping 15 which is in the oil bearing formation, the entrance of sand into the lower end of the string 15 makes the practical operation of the pump therein impossible. Accordingly, to control the sand, a properly perforated liner or screen 17 is placed in the lower end of the pipe 15. This liner 17, however, is of a diameter too small to receive the pump, and unless the formation pressure is such that the oil level will be raised within the pipe 15 a material distance above the upper end of the liner 17, a pump cannot be installed in the well in a position to engage and pump the oil.

In Fig. 1 of the drawing a body of oil 20 is shown having its upper level 21 below the upper end 18 of the screen or liner 17. To pump oil from the well, I have provided a pumping device 22 including a mechanically operated pump 23 which is too large, although it is of minimum diameter, to be lowered into the liner 17, but which pump 23 is equipped with a lifting means 24 adapted to lift oil from the oil body 20 into the interior of the pipe 15 above the top of the liner 17, so as to produce at such raised position in the well a body of oil 25 in engagement with the inlet end of the pump 23 so that the operation of the pump

may be then used to lift the oil to the top of the well.

In the simple form of the invention shown, the pump 23 includes a plunger 26 operating within a barrel 27 which has a standing valve 28 at its lower end fitting 30. Extending downwardly from the fitting 30 is a perforated tube 31 constituting the upper end of the lifting means 24 and which connects by means of a sleeve 32 with an imperforate tube section 33. By means of a coupling 34, comprising upper and lower parts 35 and 36, the tube section 33 is connected to a packing device 37 having a vertical passage therethrough and from which a slender tube 38 downwardly extends. The tube 38 is made of such length that when the packing means 37 is disposed so as to seal the pipe 15 above the upper end 18 of the liner 17, the lower part 40 thereof will extend well down into the body of oil 20 around and within the lower part of the well structure.

The oil lifting means 24 has a check valve 41 intermediate the ends thereof, preferably located between the relatively large tube section 33 and the slender tube 38. This check valve 41 may be conveniently mounted within the coupling 34, as shown in Fig. 2. Within the upper part of the tube 38 and below the packing means 37, a gas injector is placed, this injector consisting of at least one injector nozzle 42 having the lower end 43 thereof bent laterally so as to communicate through the wall 44 of the tube 38 with the exterior of the tube 38. Extending downwardly from the inlet opening 45 of the pump 23, is a small-diameter oil inlet tube 46 having its lower end 47 bent laterally so as to communicate through the side wall 48 of the tube section 33 with the space in the pipe 15 above the packing means 37.

The operation of the device is as follows. Gas from the oil producing formation, trapped below the packing means 37, causes a pressure on the body of oil 20 so that some of this oil may be forced up a distance within the tube 38. Gas under pressure will at the same time pass, as indicated by arrows 50, through the injector nozzle 42 and will be discharged upwardly within the tube 38, causing in the tube 38 a gas-lift effect which will carry oil up through the tube section 33 and discharge the oil through the perforations 51 of the tubular member 31 into the interior of the pipe 15 at some distance above the packing means 37 and at a distance above the inlet end 47 of the oil inlet tube 46 which connects to the inlet passage 45 of the pump 23. The oil, separating from the gas as it leaves the perforations 51, drops into the space within the pipe 15 above the external sealing means 37 of the oil lifting means 24 and forms around the tube section 33 a body of oil submerging the inlet end 47 of the inlet tube 46. The pump 23 may be now operated to pump oil from the body 25 through the inlet tube 46 to the top of the well. Although I have shown the injector nozzle 42 situated close to the upper end of the slender pipe 38 and adjacent the lower end of the packing means 37, the position of this injector nozzle 42 may be changed in accordance with conditions of operation encountered in individual wells in order that it may produce an efficient gas lifting effect on the oil which enters the lower end of the slender tube 38.

It will be noted that in the use of my invention a reduction of pumping costs is obtained for the reason that the pump is not placed at the bottom of the well and for the reason that the oil produced by the well is lifted some distance within the well, without power costs, by the gas operated lifting means 24, and although my invention is of especial utility under such conditions as set forth hereinabove and as shown in the drawing, it may be advantageously used in wells where some gas is produced, but which gas is not sufficient to carry the oil by gas-lift operation very high within the well, it being recognized that whatever gas-lift is obtained constitutes a saving in the cost of pumping the well. The invention provides a simple and efficient means for forming an oil chamber at an intermediate point within a well, into which oil is delivered by gas-lift operation from the bottom of the well and from which the oil may be then pumped mechanically to the surface of the ground near it. As an illustration of the use of my invention, it may be cited that in a well having a six inch oil string extending into an oil formation at a level 6300 feet from the ground surface, a three inch liner was placed. Above this liner at a depth of 5400 feet the mechanical pump element of my device was secured, and the gas-lift element of the device was extended down through the liner to the body of oil. The saving of pumping power in this instance, in addition to other savings, was approximately fourteen per cent.

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

I claim as my invention:

1. A pumping device of the character described, for use in a well having a liner too small to receive a pump, including: a pump adapted to be lowered into the well, said pump having an inlet structure; a lift tube associated with said pump, said lift tube having an outlet adjacent its upper end, and having its lower portion of smaller diameter than said pump so as to project downwardly within said liner; gas injector means in said lift tube for leading gas from the well into said lift tube to carry liquid through said lift tube and said outlet; and external sealing means on said pumping device for forming in said well a chamber in which the liquid discharged from said lift tube may collect in engagement with the inlet structure of said pump.

2. A pumping device of the character described, for use in a well having a liner too small to receive a pump, including: a pump adapted to be lowered into the well, said pump having an inlet structure; a lift tube associated with said pump, said lift tube having an outlet near its upper end, and the lower portion of said lift tube being of smaller diameter than said pump so as to extend downwardly within said liner; gas injector means for said lift tube below the outlet for leading gas from the well into said lift tube to carry liquid upwardly through said lift tube and out through said outlet; and packing means on the upper portion of said lift tube below the outlet, said packing means being adapted for sealing engagement with the wall of the well so as to form in said well a chamber in which the liquid discharged from said outlet may collect in engagement with the inlet structure of said pump.

3. A pumping device of the character described, for use in a well having a liner too small to receive

a pump, including: a pump adapted to be lowered into the well, said pump having an inlet structure; a lift tube associated with said pump, said lift tube having an outlet near its upper end and above the inlet opening of said inlet structure of said pump, and having its lower portion of smaller diameter than said pump so as to project downwardly within said liner; gas injector means in said lift tube for leading gas from the well into said lift tube to carry liquid upwardly through said lift tube and out through said outlet; and external sealing means on said pumping device for forming in said well a chamber in which the liquid discharged from said lift tube may collect in engagement with the inlet structure of said pump.

4. A pumping device of the character described, for use in a well having a liner too small to receive a pump, including: a pump adapted to be lowered into the well, said pump having an inlet structure; a lift tube extending downwardly from said pump, said lift tube having an outlet above the inlet opening of said inlet structure of said pump, the lower portion of said lift tube being of smaller diameter than said pump so as to extend downwardly within said liner; gas injector means for said lift tube for leading gas from the well into said lift tube to carry liquid upwardly through said lift tube and out through said outlet; and packing means on said lift tube, said packing means being adapted for sealing engagement with the wall of the well so as to form in said well a chamber in which the liquid discharged from said outlet may collect in engagement with the inlet structure of said pump.

5. A pumping device for a well, including: a pump adapted to be lowered into the well, said pump having an inlet opening near its lower end; a lift tube associated with said pump, said lift tube having an outlet near its upper end; an inlet tube extending downwardly from said inlet opening of said pump within said lift tube and having its lower end connecting with the exterior of said lift tube through the wall thereof below said outlet of said lift tube; gas injector means in said lift tube below said outlet for leading gas from the well into said lift tube to carry liquid upwardly through said lift tube and out through said outlet; and external sealing means on said lift tube for forming in said well a chamber in which the liquid discharged from said outlet of said lift tube may collect in engagement with the inlet of said pump.

6. A pumping device for a well having a liner pipe too small to receive a pump, including: a pump adapted to be lowered into the well, said pump having an inlet opening near its lower end; a lift tube extending downwardly from said pump, said lift tube having an outlet near its upper end, the lower portion of said lift tube being of a diameter to extend down within said liner pipe to engage the liquid therein; an inlet tube extending downwardly from said inlet opening of said pump and having its lower end below said outlet of said lift tube; gas injector means in said lift tube below said outlet for leading gas from the well into said lift tube to carry liquid upwardly through said lift tube and out through said outlet; and external sealing means on said lift tube below the lower end of said inlet tube for forming in said well a chamber in which the liquid discharged from said outlet of said lift tube may collect in engagement with the inlet of said pump.

7. A pumping device for a well having a liner pipe too small to receive a pump, including: a pump adapted to be lowered into the well, said pump having an inlet opening; a lift tube associated with said pump, said lift tube having an outlet near its upper end, the lower portion of said lift tube being of a diameter to extend down within said liner pipe to engage the liquid therein; an inlet tube extending from said inlet opening of said pump within said lift tube and having its lower end connecting with the exterior of said lift tube through the wall thereof below said outlet of said lift tube; gas injector means in said lift tube for leading gas from the well into said lift tube to carry liquid upwardly through said lift tube and out through said outlet; and external sealing means on said lift tube for forming in said well a chamber in which the liquid discharged from said outlet of said lift tube may collect in engagement with the inlet of said pump.

8. A pumping device of the character described, for use in a well having a liner too small to receive a pump, including: a pump having an inlet structure; a lift tube extending downwardly from said pump through said liner, said lift tube having an outlet adjacent its upper end; gas injector means in said lift tube below said outlet for leading gas from the well into said lift tube to carry liquid upwardly and out through said outlet; and packing means on said lift tube adapted for sealing engagement with the wall of the well so as to form in said well a chamber in which the liquid discharged from said outlet may collect, whereby said liquid may be drawn through said inlet structure by said pump to the top of the well.

JOSEPH M. FRY.

CERTIFICATE OF CORRECTION.

Patent No. 1,959,621. **May 22, 1934.**

JOSEPH M. FRY.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, lines 139 and 143, claim 2, strike out the words "below the outlet"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 19th day of June, A. D. 1934.

Bryan M. Battey

(Seal) **Acting Commissioner of Patents.**