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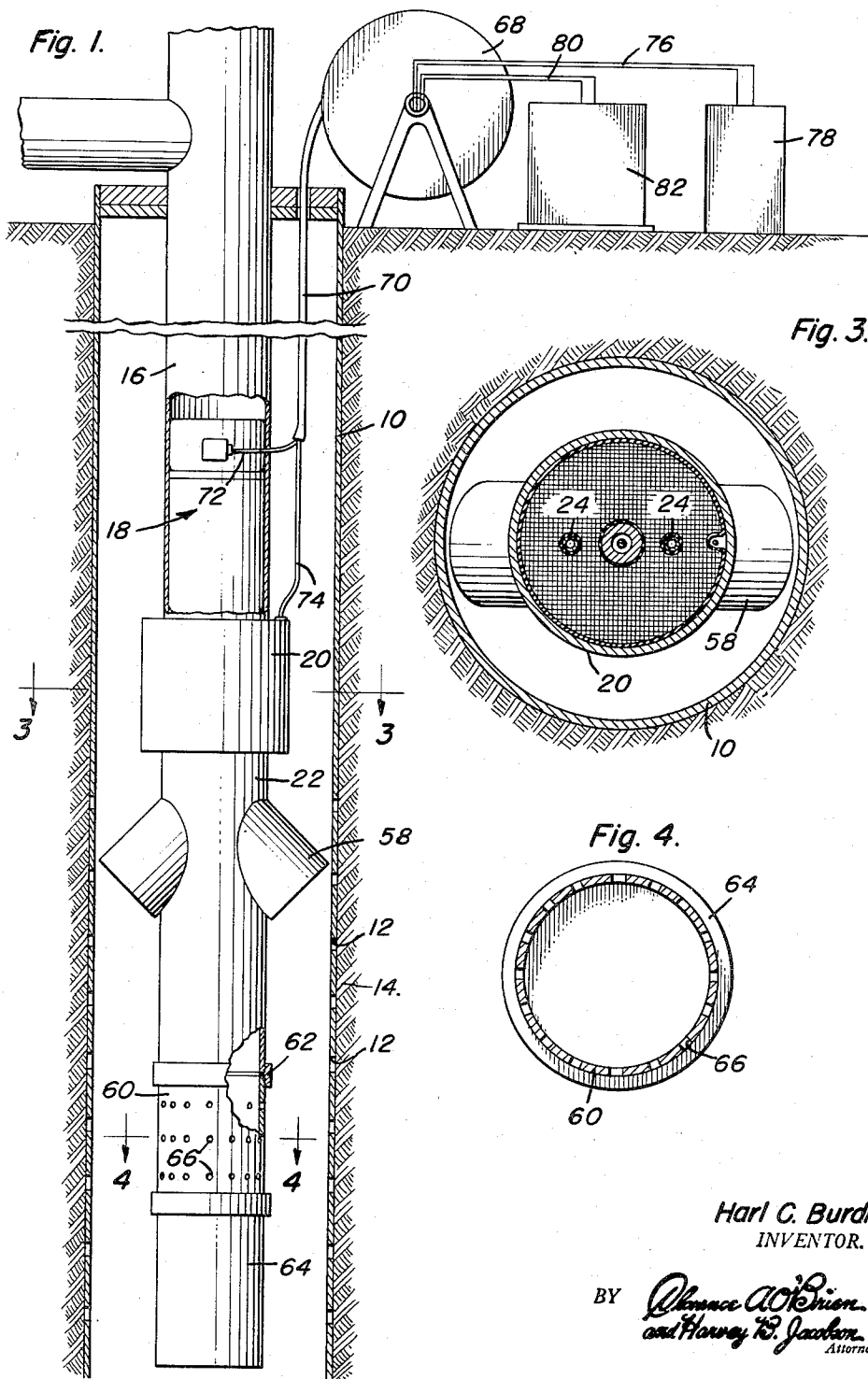
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ULTRASONIC ATTACHMENT FOR OIL PUMPS

Filed Jan. 26, 1951

2 Sheets-Sheet 1



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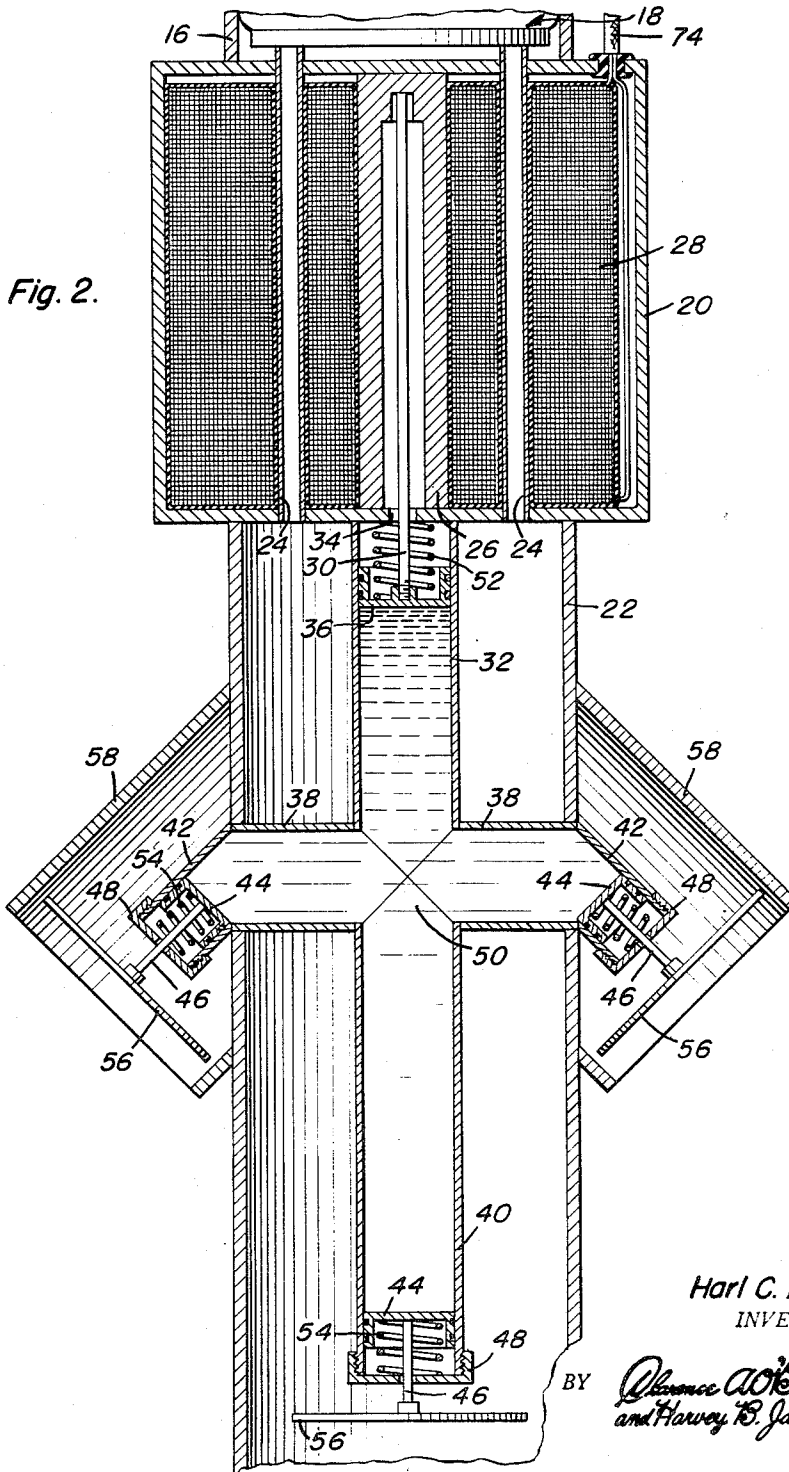
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ULTRASONIC ATTACHMENT FOR OIL PUMPS

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16 Claims. (Cl. 103—204)

The present invention relates to new and useful improvements in oil well pumping apparatus, and particularly pertains to means for preventing and removing accumulations of paraffin on the oil bearing formations, as well as on the casing, tubing, and related oil well structure.

The primary objects of this invention are to prolong the life of oil well pumps by settling out oil sand particles and the like from the oil being pumped before the passage thereof through the pump, and to remove as well as to prevent accumulations of paraffin on the well structure at the bottom of the hole and on the oil bearing formations.

Another important object of this invention is to remove and to prevent paraffin accumulations while the well is being pumped.

A meritorious feature of the present invention resides in the provision of an ultrasonic generator that is carried by the oil well pumping tubing below the oil well pump, so that the generator may produce ultrasonic waves in the fluid before the same enters the intake of the pump.

Another important feature of the present invention resides in the provision of means operated by the ultrasonic wave generator for directing ultrasonic waves outwardly against the face of the oil bearing formations.

Still another meritorious feature of the present invention resides in the provision of means whereby a plurality of ultrasonic wave producing diaphragms may be actuated by a single ultrasonic wave generator.

A final important feature of the present invention to be specifically enumerated herein resides in the provision of fluid passage means through the housing for admitting fluid into the intake of the pump, and the provision of a section of tubing in the housing in communication with such passage means, in which tubing is positioned a wave producing diaphragm for subjecting oil about to enter the pump to ultrasonic vibrations so as to induce the settling of sand or the like therefrom.

These, together with various ancillary objects and features of the invention which will become apparent as the following description proceeds, are attained by the present invention, a preferred embodiment of which has been illustrated by way of example only, in the accompanying drawings, wherein:

Figure 1 is a broken vertical sectional view of an oil well, with pumping structure incorporating the present invention shown installed therein in side elevation, portions of the pumping structure being broken away and shown in section;

Figure 2 is a central vertical sectional view of the ultrasonic generator and the means for applying the waves produced thereby;

Figure 3 is a horizontal sectional view, this view being taken upon the plane of the section line 3—3 of Figure 1; and

Figure 4 is a horizontal sectional view taken upon the plane of the section line 4—4 of Figure 1.

Reference is now made more specifically to the accompanying drawings, wherein like numerals designate similar parts throughout the various views, and in which the reference numeral 10 designates conventional well casing provided with perforations 12 adjacent the level of the oil producing formations 14 surrounding the casing 10.

Oil pumping tubing 16 extends downwardly in the well casing 10 from the ground surface and is provided with an electrical bottom hole pump therein, which is designated generally at 18, such pump 18 being of the bot-

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tom intake type for pumping fluid upwardly through the tubing 16. The pump 18 may be of any one of numerous conventional pumps of this type on the open market.

The construction thus far described is conventional, and merely sets forth the environment of use of the present invention. The present invention comprises a housing 20 secured to the lower end of the tubing 16, and from which housing 20 depends pump tubing 22. Fluid communication is afforded between the tubing 22 and the lower end of the tubing 16 below the pump 18 by means of tubular conduits 24 extending through the housing 20, the arrangement being such that the tubing 22 is in communication with the intake of the pump 18 through the conduits 24.

Centrally secured within the housing 20 is a hollow core 26 of ferro-magnetic material, such as silicon steel, and a magnetizing coil 28 is disposed within the housing 20 surrounding the hollow core 26. An elongated rod 30 of magnetostrictive material, such as nickel, is disposed within the hollow core 26, and is secured at its upper end to the hollow core 26. It will be understood as thus far described that varying the magnetic field strength of the coil 28 will produce variations in the length of the rod 30 by magnetostriction, and that the frequency of the elongation and contraction of the rod 30 will be equal to the frequency of the electric current flowing in the coil 28. In the present invention, the movement of the lower end of the rod 30 is utilized to produce ultrasonic waves in the tubing 22 and in the annular space 30 between the tubing 22 and the casing 10.

In the present invention, this purpose is accomplished by the provision of a hydraulic conduit 32 within the tubing 22, which conduit 32 is secured at its upper end by any suitable means to the underside of the housing 20. The lower end of the rod 30 projects downwardly from the housing 20 through a suitable opening 34 therein, and is received in the upper end of the conduit 32. A piston 36 is slidably fitted in the upper end of the conduit 32 and is suitably secured to the lower or free end of the rod 30, so that variations in the length of the rod 30 will cause the piston 36 to reciprocate in the upper end of the conduit 32.

The conduit 32 is branched to form lateral branches 38 which project outwardly through the tubing 22 and a central vertical branch 40 concentric with the tubing 22. The outer portions 42 of the branches 38 are disposed outside the tubing 22 and are directed downwardly and outwardly from the tubing 22 as clearly shown in the drawings. Pistons 44 are slidably fitted in the portions 42 and the lower end of the branch 40, and piston rods 46 are secured to the pistons 44 to slidably project through caps 48 threaded on the ends of the portions 42 and the lower end of the branch 40. It will thus be seen that the conduit 32 and the branches 38 and 40 thereof may be filled with a liquid 50 and such liquid will be confined therein by the pistons 36 and 44. A coiled compression spring 52 embraces the rod 30 and is seated between the housing 20 and the piston 36 to urge the piston 36 toward the liquid 50. In a similar manner, coiled compression springs 54 embrace the piston rods 46 and are seated between the pistons 44 and the caps 48 to urge the pistons 44 toward the liquid 50.

As thus far described, it will be seen that upon downward movement of the piston 36, the fluid 50 is acted upon so as to urge each of the pistons 44 outwardly against the action of the springs 54. It will be equally apparent that upon contraction of the rod 30 and the consequent upward movement of the piston 36, the pistons 44 will move inwardly under the action of the springs 54, the arrangement being generally such that the piston rods 46 will be moved with a frequency corresponding to that of the rod 30.

The free end of each of the piston rods 46 are provided with enlarged disks or diaphragms 56. It will be understood that the diaphragms 56 will vibrate with the same frequency as the current applied to the magnetizing coil 28, and that if such frequency is in the ultrasonic ranges, the diaphragms 56 will produce ultrasonic waves in the fluid surrounding the same. The diaphragm 56 disposed in the tubing 22 will produce waves moving in the verti-

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cal direction so that oil passing upwardly through the tubing 22 to the pump 18 will be subjected to waves of the frequency of vibration of the diaphragm, so that sand or similar particles may be caused to settle downwardly in the rising stream of oil in the tubing 22.

In a similar manner, the diaphragms 56 disposed externally of the tubing 22 will produce waves moving downwardly and radially outward from the tubing 22 toward the casing 10 and the faces of the oil bearing formations 14. It is one of the primary advantages of the present invention that the radially outwardly directed waves will strike the casing 10 in the vicinity of the perforations 12 so as to remove and prevent the accumulation of paraffin in the perforations 12, and that such waves will be transmitted through the perforations and the casing 10 to the oil bearing formations to prevent the deposition of paraffin deposits in the pores of the formations.

In order to prevent damage to the diaphragms 56 carried externally of the tubing 22 upon lowering the same into the casing 10, downwardly inclined tubular housings 58 are provided on the outside of the tubing 22 to partially enclose the diaphragms as shown in the drawings.

In the preferred construction, a tubular section 60 is detachably coupled to the lower end of the tubing 22 as at 62, and a closed mud anchor 64 is detachably carried at the lower end of the tubular section 60. The tubular section 60 is provided with a plurality of perforations 66 therein through which oil from the annular space between the tubing 22 and the casing 10 enters the tubing 22.

Mounted adjacent the top of the well is a reel 68 upon which is wound a suitable oil and water-proof electrical conduit 70, the free end of which conduit 70 extends down into the well in the annular space between the tubing 16 and the casing 10. Pairs of electrical leads 72 and 74 are carried within the conduit 70, and are respectively connected to the terminal posts, not shown, of the electric pump 18 and the magnetizing coil 28.

The inner ends of the leads 72 that are disposed on the reel 68 are electrically connected by means, not shown, to a pair of electrical conductors 76 that are, in turn, connected to a switch control stand 78 for the pump 18. Likewise, the inner ends of the leads 74 that are disposed upon the reel 68 are electrically connected by means, not shown, to a pair of electrical conductors 80 that are, in turn, electrically connected to a source of high frequency electrical energy 82 for operation of the magnetizing coil 28.

From the foregoing, the construction and operation of the device will be readily understood and further explanation is believed to be unnecessary.

However, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the appended claims.

Having described the invention, what is claimed as new is:

1. In apparatus for producing oil wells, the combination of a pump, tubing connected to the intake of the pump and depending therefrom, and means forming an ultrasonic wave generator comprising a part of said tubing for producing ultrasonic waves in a fluid medium passing upwardly through the tubing.

2. In apparatus for producing oil wells, the combination of a pump, tubing connected to the intake of the pump and depending therefrom, and means forming an ultrasonic wave generator comprising a part of said tubing for producing ultrasonic waves in a fluid medium passing upwardly through the tubing and also for producing ultrasonic waves in a fluid medium surrounding the tubing.

3. In apparatus for producing oil wells, a pump, tubing connected to the intake of the pump and extending downwardly therefrom, a diaphragm movably connected in the tubing, and means within said tubing for generating a high frequency vibration and imparting the same to the diaphragm.

4. In an oil well, pumping tubing and a pump disposed in the tubing adjacent its lower end for pumping fluid upwardly through the tubing, and an ultrasonic generator having a housing rigidly mounted in said tubing below said pump and in the fluid being pumped.

5. In apparatus for producing oil wells, a pump having

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an intake, a housing disposed below the pump and having fluid passage means therethrough in communication with said intake, an elongated vertically disposed rod of magnetostrictive material, the upper end of the rod being secured within the housing, a magnetizing coil in the housing and surrounding the rod, a diaphragm disposed below the housing and in said fluid passage means, and means operatively connecting the lower end of the rod to the diaphragm.

6. An apparatus for oil well pumping apparatus comprising a housing, an elongated rod of magnetostrictive material, a magnetizing coil in the housing surrounding the rod, one end of the rod being fixed in the housing with the other end projecting outwardly therefrom, a diaphragm, means operatively connecting the other end of the rod to the diaphragm comprising a hydraulic conduit, a pair of pistons movably fitted in the conduit, one of the pistons being connected to said other end of the rod and the other piston being connected to the diaphragm, said conduit being adapted to contain a liquid between the pistons.

7. An attachment for oil well pumping apparatus comprising a housing, an elongated rod of magnetostrictive material, a magnetizing coil in the housing surrounding the rod, one end of the rod being fixed in the housing with the other end projecting outwardly therefrom, a diaphragm, means operatively connecting the other end of the rod to the diaphragm comprising a hydraulic conduit, a pair of pistons movably fitted in the conduit, one of the pistons being connected to said other end of the rod and the other piston being connected to the diaphragm, said conduit being adapted to contain a liquid between the pistons, a pumping tubing adapted to communicate with the intake of a pump, said diaphragm being disposed transversely in the tubing and being movable longitudinally of the tubing.

8. The combination of claim 7 including means communicating with said tubing for passing fluid through said housing.

9. The combination of claim 7 including means communicating with said tubing for passing fluid through said housing and through said coil.

10. An attachment for oil well pumping apparatus comprising a housing, an elongated rod of magnetostrictive material, a magnetizing coil in the housing surrounding the rod, one end of the rod being fixed in the housing with the other end projecting outwardly therefrom, a diaphragm, means operatively connecting the other end of the rod to the diaphragm comprising a hydraulic conduit, a pair of pistons movably fitted in the conduit, one of the pistons being connected to the other end of the rod and the other piston being connected to the diaphragm, said conduit being adapted to contain a liquid between the pistons, a pumping tubing carried by the housing and adapted to communicate with the intake of a pump, said diaphragm being disposed on the outside of the tubing and being movable towards and away from the tubing.

11. The combination of claim 10 including means communicating with said tubing for passing fluid through said housing and through said coil.

12. The combination of claim 11 including means communicating with said tubing for passing fluid through said housing and through said coil.

13. An attachment for oil well pumping apparatus comprising a housing, an elongated rod of magnetostrictive material, a magnetizing coil in the housing surrounding the rod, one end of the rod being fixed in the housing with the other end projecting outwardly therefrom, a tubing carried by and depending from the housing, a pair of diaphragms, one of the diaphragms being disposed in the tubing and the other diaphragm being disposed on the outside thereof, means operatively connecting the other end of the rod to the diaphragms, said last means comprising a branched hydraulic conduit, pistons movably fitted in the conduit and connected to the rod and the diaphragms.

14. The combination of claim 13, wherein said other diaphragm is movable towards and away from the tubing, and a tubular housing carried by the tubing partially enclosing said other diaphragm.

15. The combination of claim 13 including means communicating with said tubing for passing fluid through said housing.

16. The combination of claim 15 including means com-

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municating with said tubing for passing fluid through said housing and through said coil.

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