Feb. 27, 1945. C. S. NATION 2,370,413

DEEP WELL PUMP

Filed April 1, 1944 2 Sheets-Sheet 1

Fig. 1.

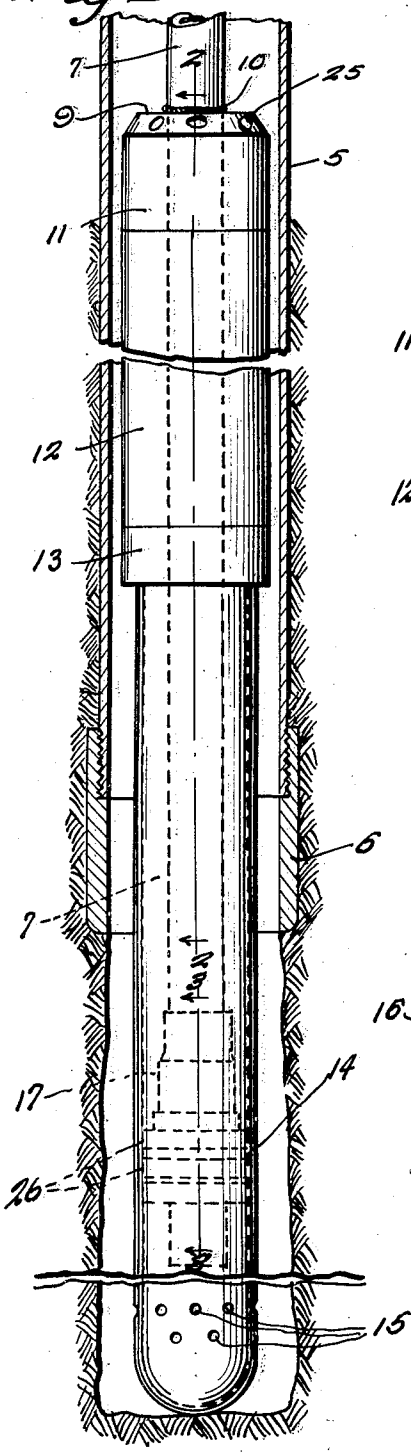
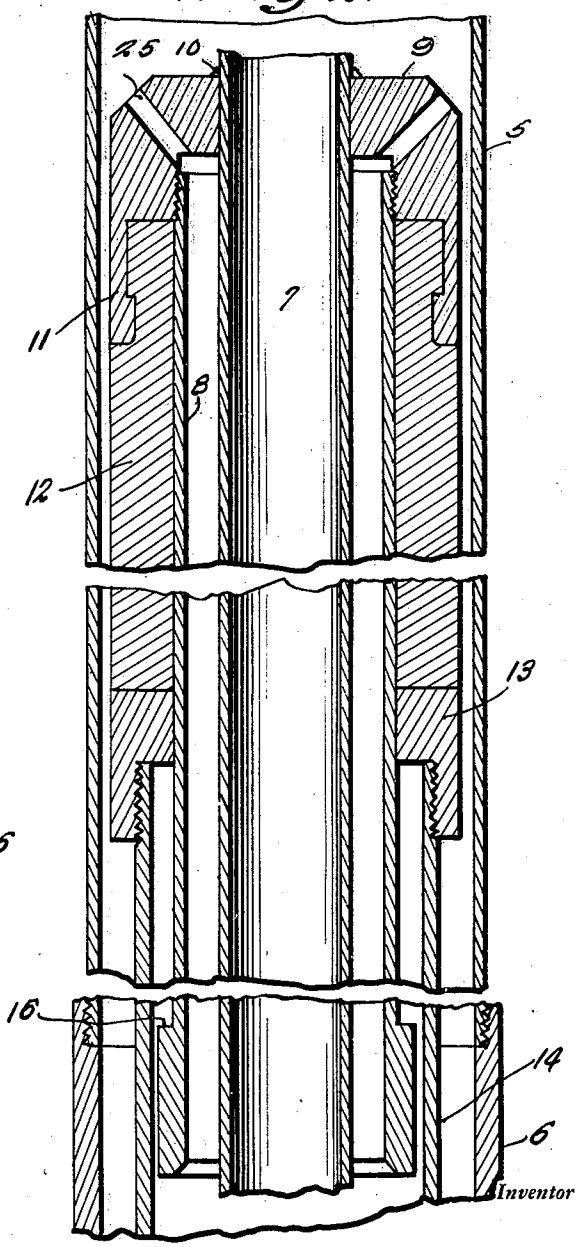


Fig. 2.



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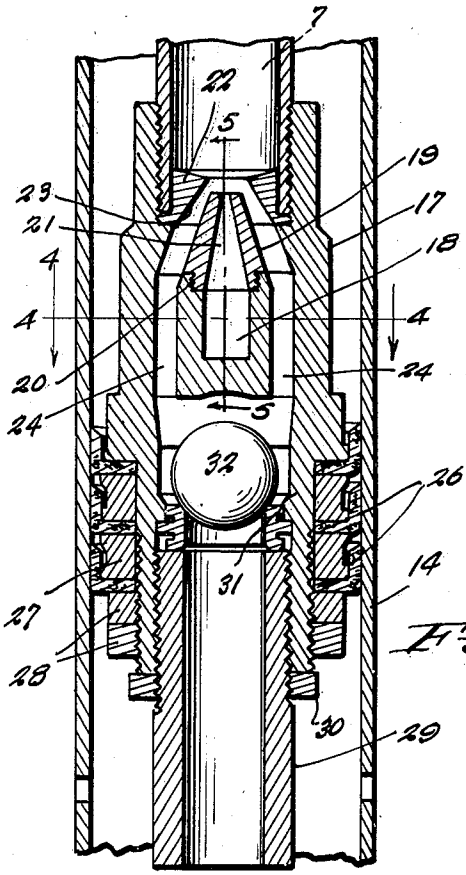


Fig. 3.

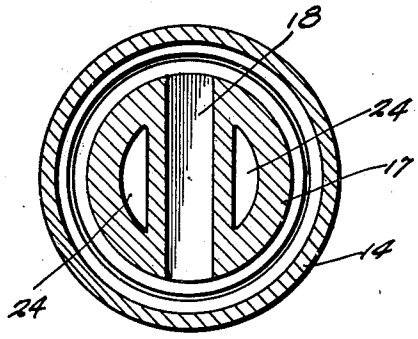


Fig. 4

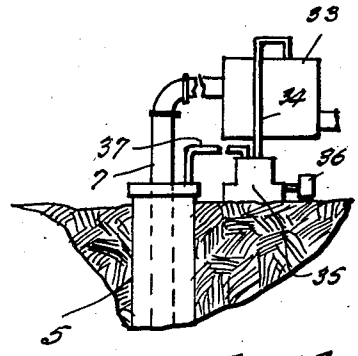


Fig. 6.

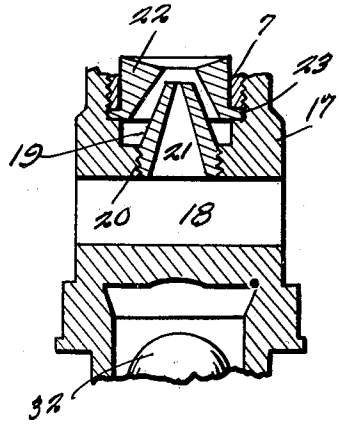


Fig. 5.

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DEEP WELL PUMP

Charles S. Nation, Marion, Ill.

Application April 1, 1944, Serial No. 529,121

3 Claims. (Cl. 103—260)

This invention relates to improvements in deep well pumps of the kind commonly used in oil wells, and the primary object of the present invention is to provide a deep well pump of the ejector type, wherein gas under pressure is pumped into the well between the well casing and the tubing and finally discharged through a jet nozzle in an upward direction into the well tubing for drawing the oil upwardly and forcing it through the tubing to the surface.

An important object of the present invention is to provide a deep well pump of the above type which is comparatively simple in construction and highly efficient in operation, and by means of which the many difficulties and objections of a mechanical pump operated from the surface are overcome.

Another object of the present invention is to provide an ejector pump for deep wells which may be readily lowered into the well or pulled therefrom, and wherein lowering of the pump into the well conditions it for use by automatically expanding the packer into engagement with the well casing subsequent to contact of the bottom strainer section of the pump with the bottom of the well.

Other objects and advantages of the invention will become apparent from the following description when considered in connection with the accompanying drawings, and the invention consists in the novel form, combination and arrangement of parts hereinafter more fully described, shown in the drawings and claimed.

In the drawings, wherein like reference characters indicate corresponding parts throughout the several views:

Figure 1 is a fragmentary view partly broken away, partly in vertical section, and partly in elevation, showing a deep well pump embodying the present invention operatively positioned within a well casing.

Figure 2 is an enlarged fragmentary vertical section taken on the plane of line 2—2 of Figure 1, and partly broken away.

Figure 3 is a fragmentary vertical section, taken on the plane of line 3—3 of Figure 1.

Figure 4 is a horizontal section taken on line 4—4 of Figure 3.

Figure 5 is a fragmentary vertical section through the ejector proper, taken on the plane of line 5—5 of Figure 3.

Figure 6 is a somewhat diagrammatic view illustrating the manner of operating the present pump when used in an oil well.

Referring in detail to the drawings, 5 indicates a well casing having the usual shoe 6 on the lower end thereof, which shoe is located a suitable distance above the bottom of the well in the usual way. Extending down into the well from the surface and within the casing 5 is the usual tubing 7 which is equipped near its lower end with a packer including a sleeve 8 disposed in spaced concentric relation to the tubing 7 and threaded into the upper collar 9 of the packer which is fitted on the tubing 7 and welded to the latter, as at 10. The collar 9 has a depending annular flange 11 which is undercut to retainingly receive the upper end of the packer tube 12 which consists of a flexible elastic member fitted on the sleeve 8. Slidable on the sleeve 8 and arranged to abut the lower end of the packer tube 12 is the lower packer collar 13 into which is threaded the upper end of a strainer section 14 whose lower portion is provided with the usual side perforations 15 to admit the oil therein. The lower end of packer sleeve 8 is enlarged, as at 16, so as to abut the lower collar 13 and limit upward movement of the sleeve 8, collar 9 and tube 12 relative to said collar 13. It will be apparent that when the tubing 7 is lifted, it will elevate the parts 9, 8 and 12 until the enlarged lower end of sleeve 8 engages the collar 13 and causes the latter and the strainer section 14 to also be elevated. Thus, the structure may be pulled as a unit from the well in a convenient manner because this operation causes collapsing of the packer tube 12 out of engagement with the well casing 5. On the other hand, when the tubing 7 and parts carried thereby are lowered, the bottom end of strainer section 14 will engage the bottom of the well and cause upward movement of the lower packer collar 13 to ultimately compress and expand the packer tube 12 outwardly into engagement with the casing 5, thereby sealing the space between the casing 5 and tubing 7 adjacent the lower end of the latter, so that oil may not flow upwardly between the casing 5 and tubing 7 above the packer.

As indicated by dotted lines in Figure 1 and shown more clearly in Figures 2 and 3, the tubing 7 projects below the packer but terminates some distance above the bottom of the strainer section 14. Threaded onto the lower end of tubing 7 is the casing 17 of an ejector. This ejector casing is formed with a transverse passage 18 therethrough that communicates at its ends with the space between the strainer section 14 and the lower end of tubing 7. The passage 18 is open at the top at a point intermediate its ends so as to communicate with a jet nozzle 19 that is detachably threaded in place, as at 20, to facilitate

its renewal. This jet nozzle projects upwardly and has a passage therethrough that tapers smaller in an upward direction, as indicated at 21. Also, the nozzle 19 projects at its upper end into the central upwardly tapering passage of a bushing 22 that is fitted in the lower end of tubing 7 and is clamped in place between the lower end of said tubing 7 and an internal shoulder provided in the ejector casing 17, as at 23. It will be further noted that the casing 17 is provided with longitudinal passages 24 at opposite sides of the transverse passage 18 so as to afford communication between the open upper and lower ends of casing 17. Thus, gas under pressure escaping from the nozzle 19 will flow upwardly at a very rapid speed and then quickly expand, producing a suction in the passages 24 and drawing the oil upwardly to the tubing 7 and then forcing the oil through said tubing to the surface. This gas, which is pumped into the casing 5 between the latter and the tubing 7, passes through passages 25 in the upper packer collar 9 into the space between the tubing 7 and packer sleeve 8, so that it may ultimately pass into the transverse passage 18. In passing downwardly into the well, the compressed gas is cooled, and when it escapes from the nozzle 19, the sudden expansion causes further cooling so that any oil entrained in the gas will be liquified and precipitated so as to combine with the oil being pumped from the well.

As shown more clearly in Figure 3, the ejector casing 17 is provided with a series of packing cups 26 on the exterior thereof below the passage 18, and these packing cups tightly engage the inner surface of the strainer section 14 so as to prevent the gas from passing downwardly between the parts 14 and 17 to any material distance below the passage 18. Accordingly, this gas must pass from the space between tubing 7 and strainer section 14 into the passage 18 for ultimate discharge through nozzle 19 upwardly into tubing 7. The packing cups 26 are preferably spaced by means of rings 27 fitted on the lower end portion of casing 17 between said packing cups, and the assembly is maintained in place upon casing 17 by suitable securing and jamb nuts, as at 28. A suitable inlet pipe of relatively short length may be threaded into the lower end of casing 17, as indicated at 29, and secured in place by a jamb nut 30 threaded thereon and against the lower end of casing 17. This inlet pipe 29 of casing 17 secures a removable valve seat 31 in place within the casing 17 below the passage 18, and cooperating with seat 31 is a gravity-seated ball check valve 32. When the oil is drawn upwardly and forced into the tubing 7, the ball 32 will be elevated to permit the passage of the oil, but when the supply of gas under pressure is discontinued, the ball valve 32 will automatically seat so as to prevent oil from flowing downwardly from the tubing 7 after it has been elevated above the valve 32.

In using the present pump in connection with oil wells which afford a considerable supply of gas, such gas may be utilized as the pumping medium. Such utilization of gas may be accomplished by passing the oil through a separator 33, as shown in Figure 6, and conducting the separated gas by means of pipe 34 to a pump 35 operated by a motor 36, the pump forcing the compressed gas through pipe 37 into the space between the well casing 5 and tubing 7 near the surface of the well.

It will be readily apparent that a pump of the present kind may be operated a great deal more economically and efficiently than mechanical pumps operated from the surface. It will also be seen that operation of the pump causes liquefaction of gasoline entrained in the gas utilized to lift the oil from the well. There is only one working part consisting of the check valve 32, so that continued operation without the need of replacing parts is made possible. The abrasive action of any sand forced through the bushing 22 may be partly overcome by making such bushing of special wear-resisting material. While I have shown and described one manner of installing the ejector in the construction of a well pump, it is noted that other methods of installation are possible, and their use will depend upon the particular conditions met with in the operation of a well. A decided advantage of the present invention is the complete absence of working parts such as traveling valves, sucker rods and the like.

What I claim is:

1. A pump for a deep well having a casing therein, comprising a tubing extended into the well, a packer on the tubing above the lower end of the latter and engageable with the casing, a strainer section suspended from the lower end of the packer and movable upwardly for expanding the latter into engagement with the casing, said packer being in spaced surrounding relation to the tubing and having gas-admission passages through the upper end thereof for permitting passage of gas under pressure from the space between the casing and the tubing to the space between the tubing and the packer, an ejector including a casing attached to the lower end of the tubing and having a downwardly seating check valve in the lower portion thereof, said ejector casing being free of the strainer section, said ejector casing having a transverse passage therethrough communicating at its ends with the space between the packer and the tubing and being open at the top intermediate the ends of the same, an ejector nozzle communicating with the top opening and projecting upwardly toward the tubing, passages at opposite sides of said transverse passage affording communication between the upper and lower ends of the ejector casing, and packing means carried by the ejector casing below said transverse passage and engaging the inner surface of the strainer section.

2. In a deep well pump, a tubing, a packer including an upper collar fixed to the tubing above the lower end of the latter and having gas-admission passages therethrough, a packer sleeve rigidly attached at its upper end to said upper collar and disposed in spaced surrounding relation to the tubing, said passages communicating with the space between said packer sleeve and said tubing, a packer tube attached to and depending from the upper packer collar and fitted on said packer sleeve, a lower packer collar slidable on said packer sleeve and arranged to abut the lower end of said packer tube, a strainer section attached at its upper end to said lower packer collar and surrounding and depending below the tubing so that lowering of the latter after contact of the strainer section with the bottom of the well will cause upward movement of the lower packer collar and expansion of the packer tube outwardly for engagement with a well casing, an ejector attached to the lower end of the tubing and including a casing provided with an inlet and having a jet nozzle

projecting upwardly toward the tubing so as to discharge into the lower end of the latter, and packing means carried by said ejector casing below said inlet and engaging the inner surface of the strainer section.

3. In a deep well pump, a tubing, a packer including an upper collar fixed to the tubing above the lower end of the latter and having gas-admission passages therethrough, a packer sleeve rigidly attached at its upper end to said upper collar and disposed in spaced surrounding relation to the tubing, said passages communicating with the space between said packer sleeve and said tubing, a packer tube attached to and depending from the upper packer collar and fitted on said packer sleeve, a lower packer collar slidable on said packer sleeve and arranged to abut the lower end of said packer tube, a strainer section attached at its upper end to said lower packer collar and surrounding and depending below the tubing so that lowering of the latter after contact of the strainer section with the bottom of the well will cause upper movement of the lower packer collar and expansion of the packer tube outwardly for engagement with a well casing, an ejector attached to the lower end of the tubing and including a jet nozzle projecting upwardly toward the tubing so as to discharge into the lower end of the latter, said ejector including a casing and packing cups on said ejector casing engaging the inner surface of the strainer section, said ejector casing having a transverse passage communicating at its ends with the space between the tubing and the strainer section above said packing cups and opening into said jet nozzle.

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