Nov. 26, 1935. J. M. HEWGLEY 2,021,997

FLUID OPERATED LIFT FOR OIL WELLS

Filed Jan. 6, 1934 2 Sheets-Sheet 1

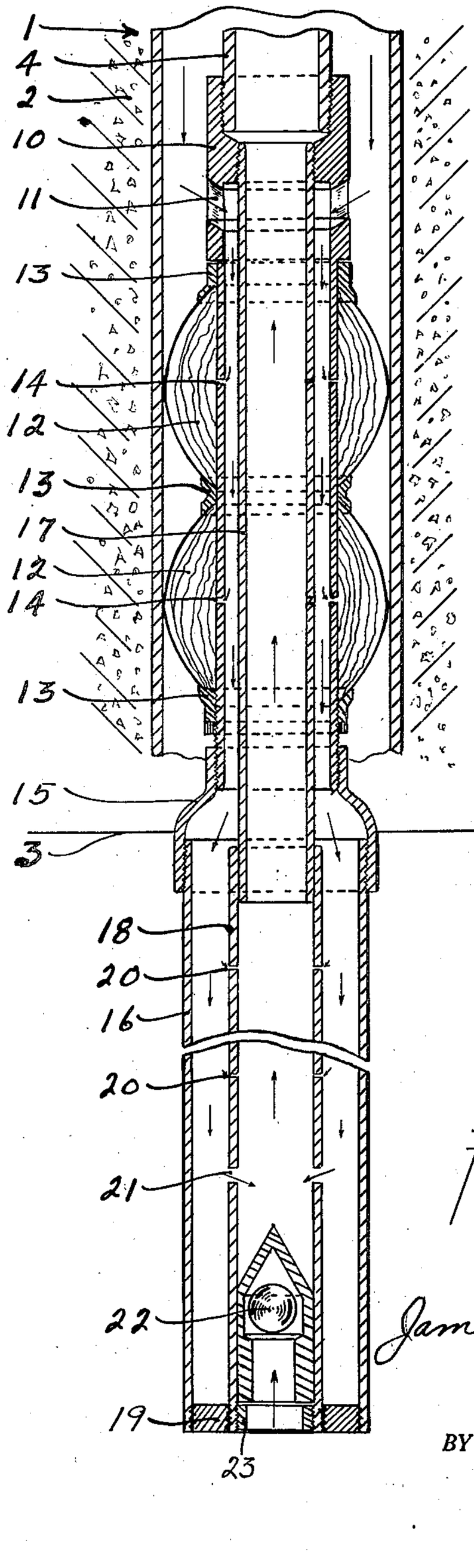

FIG. 1.

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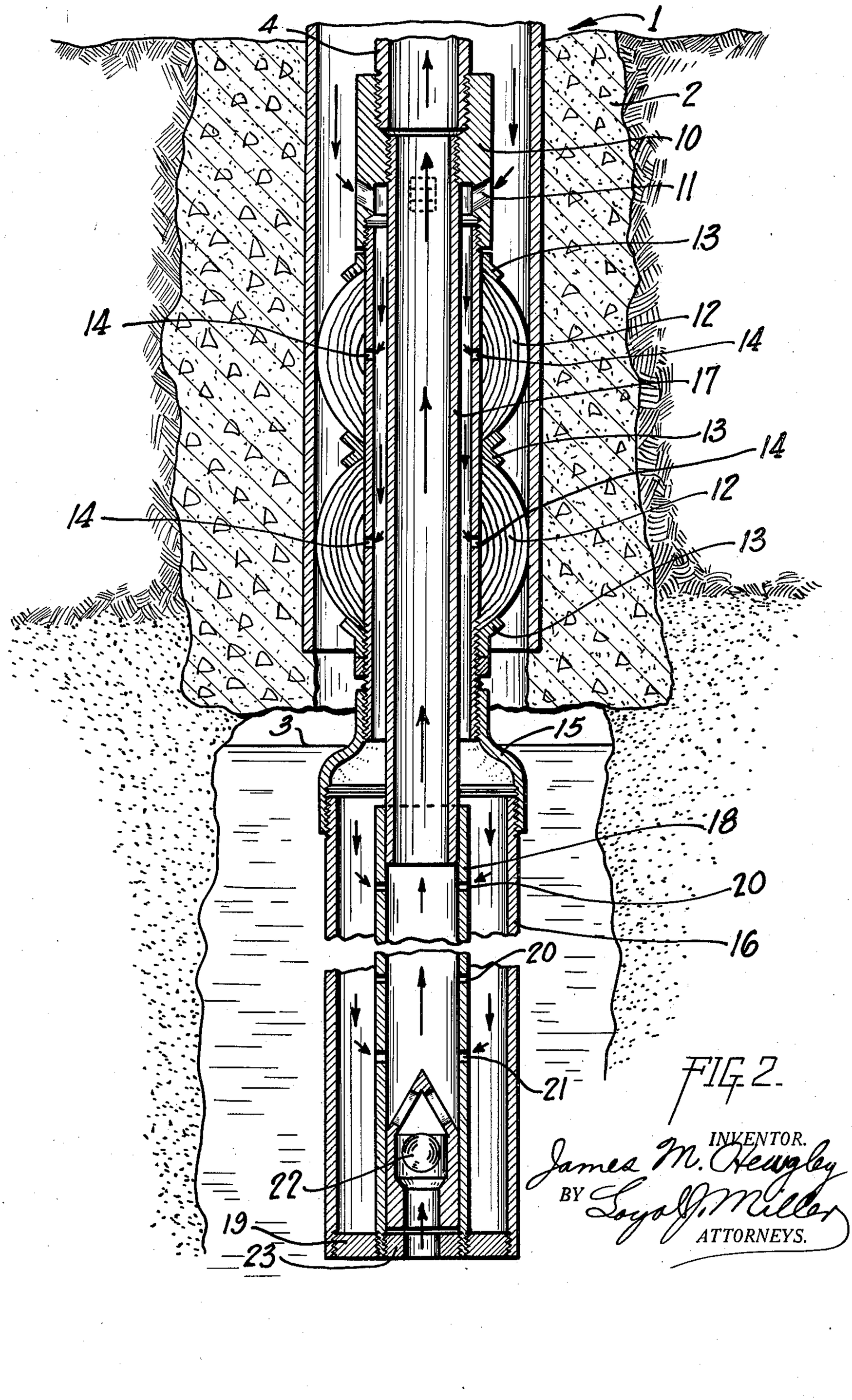

FIG. 2.

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FLUID OPERATED LIFT FOR OIL WELLS

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14 Claims. (Cl. 103—232)

My invention relates to means for lifting or flowing oil in oil wells.

The prime object of my invention is to provide a device whereby a fluid under pressure, such as air, steam, or gas, may be introduced into a well beneath the normal liquid level, and when so introduced, will lift the liquid in the well without causing a back pressure upon the oil bearing stratum.

Other objects of the invention are to provide a device of this class which is new, novel, practical and of utility; which will utilize the rock or gas pressure normally present in a well, as well as the pressure mechanically injected into the well; which may be lowered into the well upon the end of a string of usual production tubing to a point beneath the normal liquid level in the well, and when in operative position will utilize the injected pressure as a means for packing off between the tubing and the well walls; which will have few moving parts to become worn or to get out of order; which will be simple to install; and, which will be efficient in accomplishing all the purposes for which it is intended.

In some oil fields now under production, the oil bearing stratum occurs as deep as sixty-five hundred feet or more. When these wells fail to produce from the natural rock or gas pressure, considerable difficulty is encountered in pumping or otherwise raising the oil to the earth's surface. The usual traveling barrel pump has proven inadequate for pumping at such depths, and the introduction of a fluid, such as air or gas under pressure, has been resorted to in order to lift the oil.

When such fluid under pressure is used as a lifting medium, the pressure at which the air or gas is introduced into the well must of course be considerably greater than the natural pressure in the well and in the oil bearing stratum; consequently a back pressure is exerted in the oil sand, and eventually the well is "killed" because the continual back pressure causes the natural fissures in the sand to become clogged by the oil residue, and consequently the flow of oil through the sand to the well is impaired or completely stopped.

My device is designed to overcome this difficulty and to lengthen the life of the well.

With these and other objects in view as will more fully appear, my invention consists in the construction, novel features, and combination of parts hereinafter more fully described, pointed out in the claims hereto appended, and illustrated in the accompanying drawings, of which,

Fig. 1 is an elevational sectional view of the device shown in operative position in a well; and,

Fig. 2 is a similar view detailing a form of installation.

Like characters of reference designate like parts throughout the figures.

It is understood that various changes in the form, proportion, size, shape, weight and other details of construction, within the scope of my invention may be resorted to without departing from the spirit or broad principle of my invention and without sacrificing any of the advantages thereof; and it is also understood that the drawings are to be interpreted as being illustrative and not restrictive.

A description of one practical embodiment of the invention follows:

The reference numeral 1 indicates a portion of the lower section of usual casing held by cement 2 in a well, and 3 indicates the imaginary natural level of the oil standing in the well. This level, however, is not at all fixed, and may be several feet or even several hundred feet above the operative position of the device. The oil level may in some instances occur several feet above the bottom section of casing 1 and in others may be below the casing, but in any event it is necessary to the operation of the device that its lower end be submerged. The reference numeral 4 indicates the lower section of a usual string of production tubing. The string extends upwardly to the earth's surface for the conveying of oil thereto.

The device consists substantially of a tubular upper body section 10 threadedly connected at its upper end to the lower end of the tubing 4, and having inlet openings 11 for air or gas slightly below its upper end. Rigidly attached to the exterior of section 10 at a point below the openings 11 are a desired plurality (two being shown) of resilient annular packers or envelopes 12 which are hermetically sealed to the section 10 by suitable bands 13. The section 10 is plurally perforated as indicated at 14 to form communication between the interior of the section and the interiors of the packers. To the lower end of the section 10 is attached by a nipple 15 a lower tubular body section 16.

Axially disposed within the body sections 10 and 16 in spaced relation thereto is a pair of tubes 17 and 18 which have a telescoping engagement at their junction point. The upper tube 17 is connected at its upper end to the upper end of the body section 10 at a point above the inlet openings 11, and communicates with the interior

of the production tubing 4. The lower tube 18 is held in place at its lower end by threaded engagement with an annular member 19 which closes the space between the body section 16 and the tube 18. The lower tube is provided with a plurality of minute through-perforations 20 and below these perforations its lower portion is provided with larger through-perforations 21.

A usual ball check valve 22 of the drop type is seated in the lower end of the tube 18 upon a threaded ring 23 and permits ingress of a fluid into the tube through its lower end but prevents escape of the fluid therefrom in a downward direction. The valve is of a type permitting its withdrawal upwardly through the tube 4 when it is desired to remove the device from the well. This is advisable in order to eliminate the necessity of bodily lifting the column of oil with the tubing.

Operation

In operation, the device will be lowered into the well to a point at which the lower body section 16 is submerged in the oil. The inlet openings 11 may be above the oil level, but in most instances the oil level will be a considerable distance above the device. The oil will raise the valve 22 and seek its normal level in the tube 18. A suitable fluid under pressure will be delivered into the casing 1 and around the production tubing 4 at the earth's surface, and the fluid or the oil will enter the inlet openings 11 and travel downwardly in the body sections 10 and 16 exteriorly of the tubes 17 and 18. The space within the body section 16 and around the tube 18 will have filled with oil due to the perforations 20 and 21. In this event a pressure will be built up in the body section 10 and the fluid or the oil will be forced through the perforations 14 into the packers 12 which will be inflated and which will seal between the casing 1 and the exterior of the section 10.

After the packers have been inflated the continuance of the fluid pressure will force any oil above the device or within the body section 16 around the tube 18 to pass through the perforations 20 and 21. This pressure will also seat the valve 22. As the fluid pressure continues, the fluid or oil will simultaneously pass through the perforations 20 and 21 and will lift any oil present in the tubes 17 or 18 or in the tubing 4 thereabove. It will be understood, of course, that in manufacture the section 16 and the tube 18 will be constructed of a considerable length, for instance, possibly one hundred feet, and consequently considerable oil will be contained in the tube 18. It will also be understood that intermediate its ends the production tubing 4 will be equipped with suitable check valves to prevent any oil once raised, from returning to the bottom of the well. The pressure will be continued until the oil originally within the device and any oil in the tubing thereabove is raised to the earth's surface. The fluid pressure will then be discontinued for a sufficient period of time to permit the oil to again seek its normal level either in the device or in the tubing thereabove, after which the operation will be repeated intermittently.

The minute perforations 20 act as jets to agitate and more or less aerate the oil to increase its buoyancy. It is contemplated to provide similar perforations at desired points intermediate the ends of the tubing 4 for a similar purpose.

The intermittent introduction of the fluid under pressure may be controlled mechanically upon the earth's surface.

From the foregoing description it may be seen that the present device permits the use of a fluid under pressure for lifting the oil, and at the same time, at no time during its operation is the pressure of the fluid permitted to act upon the oil bearing stratum.

Obviously, the invention is susceptible of embodiment in forms other than that which is illustrated in the accompanying drawings, and described herein, and applicable for uses and purposes other than as detailed, and I therefore consider as my own all such modifications and adaptations and other uses of the form of the device herein described as fairly fall within the scope of my invention.

Having thus described my invention, what is claimed and desired to be secured by Letters Patent, is:

1. In a device of the class described, the combination with a string of production tubing, of means for introducing a fluid under pressure into the lower portion of the tubing, means for causing the fluid to exert an upward pressure in the tubing, and means operated by pressure of the fluid for packing between the tubing and the walls of a well.

2. In a device of the class described, a tube adapted to be attached to and to form a continuation of a section of production tubing, a tubular body surrounding the tube concentrically and sealed thereto at both ends, said body having through perforations in its upper portion for admitting a fluid thereinto around the tube, the lower end portion of said tube having a plurality of minute through perforations for admitting the fluid, and for causing the fluid to be injected into the tube in streams sufficiently small and at sufficient velocity to thoroughly agitate any liquid in the tubing, and a check valve in the free end of the tube below the perforations for admitting a well liquid upwardly into the tube and preventing its escape downwardly from the tube.

3. Organization as described in claim 2, and means exterior of the tubular body and below its perforations for packing between the body and the walls of a well.

4. Organization as described in claim 2, in which the tubular body is provided with a plurality of through perforations other than the first mentioned perforations, and in which an inflatable packing means is hermetically attached around the body over the last mentioned perforations, said packer adapted to be inflated by the fluid for packing between the body and the walls of a well.

5. In a device of the class described, a tubular head adapted to be connected at its upper end to the lower end of a string of production tubing, said head having an inlet below the tubing, a depending tube carried by the head in communication with the production tubing, said tube having a plurality of perforations in its lower portion, a check valve in the tube below the perforations, a tubular body carried by the head surrounding the tube concentrically and sealed at its lower end to the tube below said perforations, and an inflatable packer hermetically sealed around the body below said inlet, said body having perforations communicating from its interior with the interior of the packer, whereby a fluid introduced under pressure within the body and around the tube may be admitted into the packer for causing its inflation.

6. In a device of the class described, a tubular head adapted to be connected at its upper end to the lower end of a string of production tubing, said head having an inlet below the tubing, a depending tube carried by the head in communication with the production tubing, said tube having a plurality of perforations in its lower portion, a check valve in the tube below the perforations, a tubular body carried by the head surrounding the tube concentrically and sealed at its lower end to the tube below said perforations, and means carried by the body and operated by fluid pressure therein for packing between the body and the walls of a well.

7. In a device of the class described, a tube adapted to be attached to and to form a continuation of a section of production tubing, said tube having a plurally perforated free end portion, a check valve in the free end of the tube, a tubular body surrounding the tube concentrically and sealed to the tube at both ends, said body having through perforations in its upper portion for admitting a fluid thereinto around the tube, an inflatable packing means hermetically attached around the body, said body having through perforations communicating with the interior of said packing means whereby the packing means may be inflated by pressure of the fluid.

8. In a device of the class described, a first tubular perforated member having a valve in its lower end portion, a jacket sealed around the member and having a wall passage above the perforation, said jacket adapted to receive fluid under pressure, and an inflatable member sealed around the jacket and in communication therewith.

9. In a device of the class described, the combination with a well casing set with its lower end above a producing stratum, a tubular head adapted to be connected at its upper end to the lower end of a string of production tubing, said head having an inlet below the tubing, a depending tube carried by the head in communication with the production tubing, said tube having a plurality of perforations in its lower portion, a check valve in the tube below the perforations, and a tubular body carried by the head surrounding the tube concentrically and sealed at its lower end to the tube at a point below said perforations, and means for packing between the body and the casing, said check valve and the lower ends of said tube and said body, being located below the casing and within the producing stratum.

10. In a device of the class described, a tubular head adapted to be connected at its upper end to the lower end of a string of production tubing, said head having an inlet below the tubing, a depending tube carried by the head in communication with the production tubing, said tube having a plurality of perforations in its lower portion, a check valve in the tube below the perforations, a tubular body carried by the head surrounding the tube concentrically and sealed at its lower end to the tube at a point below said perforations, and means above the valve for packing between the tubular body and the casing of a well, said perforations and said check valve being located below the lower end of said casing.

11. In a fluid operated lift for oil wells, the combination with a string of production tubing, of two tubular elements having different diameters and both concentrically connected one within the other to the lower end of the production tubing, the inner element having at its upper end communication with the tubing and having communication at its lower end portion with the interior of the outer element, the outer element having an inlet at its upper end portion for permitting ingress of a fluid, a check valve in the inner element below its point of communication with the outer element, means for sealing between the two elements at a point below their point of communication, and means for sealing between the outer element and the casing of a well, said check valve and the lower ends of said elements being located below the lower end of the casing and within a producing stratum of the earth.

12. In a device of the class described, the combination with a well casing having its lower end terminating above the bottom of a well, of: a tube within the casing, extending therebelow, and having a perforated portion below the casing; a jacket around the tubing, sealed thereto at a point above the bottom of the casing, and also sealed thereto at a point below its perforated portion, said jacket having fluid inlets in its upper portion; a check valve in the tubing below its perforated portion; and, means above the bottom of the casing and below the inlets for sealing between the jacket and the casing.

13. In a device of the class described, the combination with a well casing having its lower end positioned above the bottom of the well and above the normal liquid level in the well, of: a tube within the casing, extending therebelow into the well liquid and having a perforated portion below said liquid level; a jacket around the tubing, sealed thereto at points above the bottom of the casing and below said perforated portion, said jacket having a fluid inlet above the bottom of said casing; a check-valve in the tubing below its perforated portion; and, means above the bottom of the casing and below the jacket's inlet for sealing between the jacket and the casing.

14. In a device of the class described, the combination with a well casing having its lower end terminating above the bottom of a well, of: a tube within the casing, extending therebelow, and having an opening for fluid below the casing; a jacket around the tubing, sealed thereto at a point above the bottom of the casing, and also sealed thereto at a point below said opening, said jacket having a fluid inlet in its upper portion; a downwardly closing valve below said opening for controlling ingress of a well fluid to said tubing; and, means above the bottom of the casing and below said inlet for sealing between the jacket and the casing.

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