May 6, 1930. O. MORGAN ET AL 1,757,381

FLUID ELEVATOR

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Fig. 1.

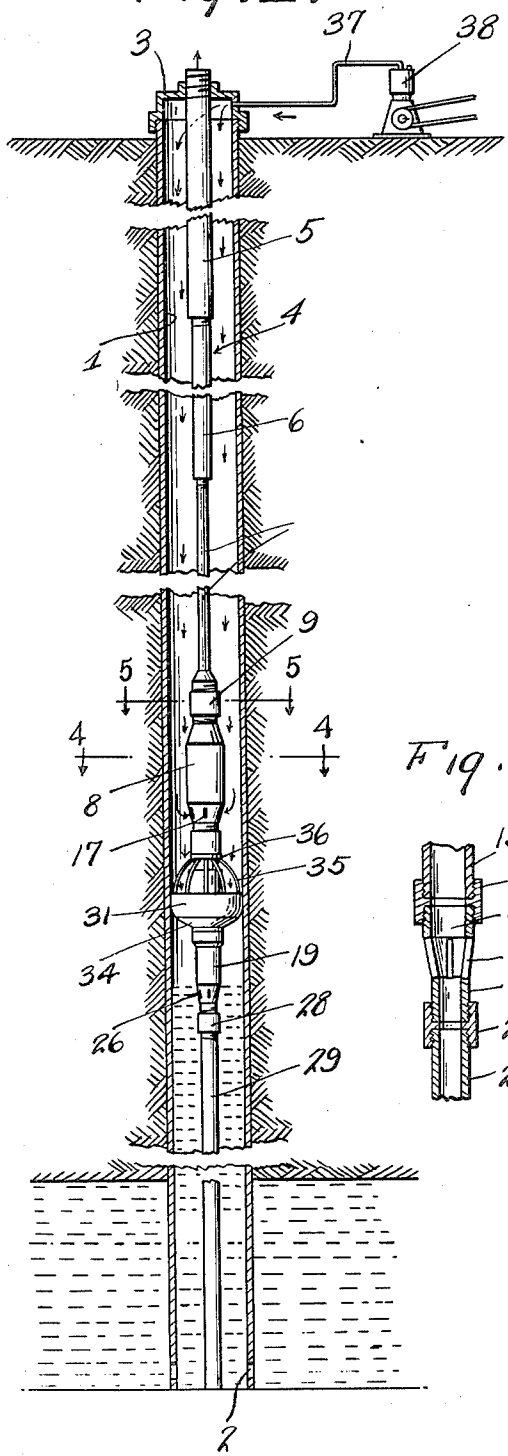


Fig. 4.

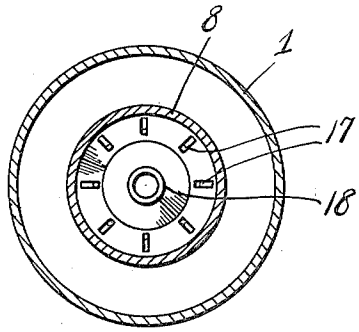
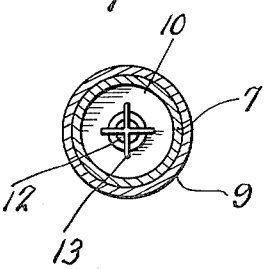


Fig. 6.

Fig. 5.



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Fig. 2.

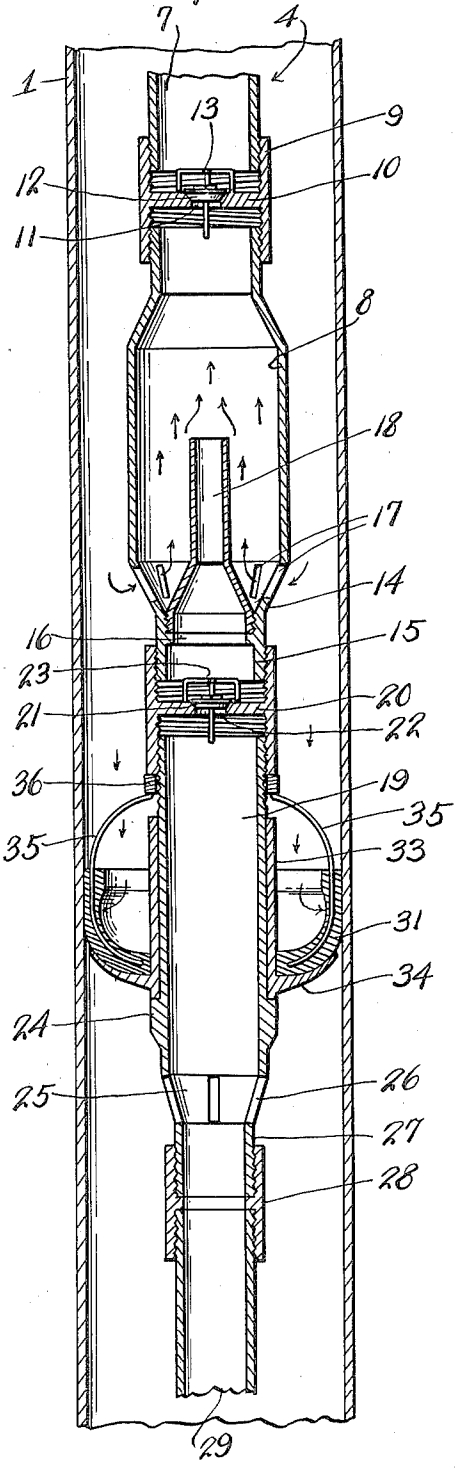
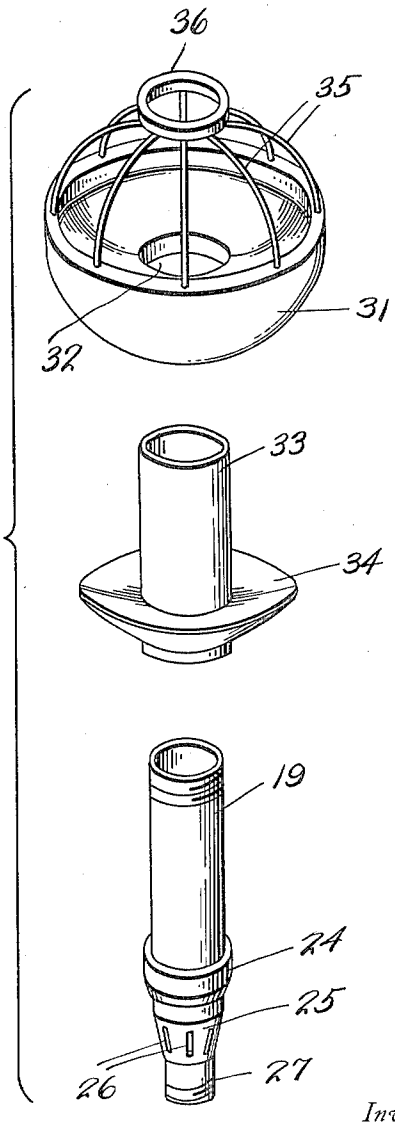


Fig. 3.



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UNITED STATES PATENT OFFICE

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FLUID ELEVATOR

Application filed January 14, 1928. Serial No. 246,777.

The present invention relates to improvements in fluid elevators for use in conjunction with oil wells and has reference more particularly to that class of fluid elevators known as "aerated columns."

One of the important objects of the present invention is to provide a fluid elevator wherein an expansible packer unit is associated with the eduction tube, the same being adapted to be expanded by the action of the lifting fluid that is forced downwardly in the well casing or tubing so that a liquid seal is formed whereby to prevent any possibility of the lifting fluid coming in contact with the liquid within the lower portion of the well casing and disturbing the sand.

Another important object of the invention is to provide a fluid elevator of the above mentioned character which is simple in construction, inexpensive, strong and durable and further well adapted to the purposes for which it is designed.

Other objects and advantages of the invention will become apparent from the following description when taken in connection with the accompanying drawings.

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

Figure 1 is a sectional view of an oil well casing showing the eduction pipe in elevation and showing the expansible packer in tight engagement with the inner wall of the well casing.

Figure 2 is an enlarged fragmentary sectional view of the well casing showing a portion of the eduction pipe or tube in section, and also disclosing more clearly the manner in which the expansible packer is forced outwardly against the inner wall of the well casing to provide a liquid seal.

Figure 3 is a group perspective view of the expansible packer and the bowed steel spring wires associated therewith; the ring to which the converging ends of the wires are secured; and also the supporting unit for the packer and the adjacent portion of the eduction pipe or tube, the parts being disassembled.

Figure 4 is a transverse section taken substantially on the line 4—4 of Figure 1 looking in the direction of the arrows.

Figure 5 is a similar section taken approximately on the line 5—5 of Figure 1 looking in the direction of the arrows, and

Figure 6 is a fragmentary sectional view showing a modification of the liquid inlet portion of the eduction pipe.

In the drawings wherein for the purpose of illustration is shown the preferred embodiment of our invention, the numeral 1 designates the usual casing that extends downwardly into the well in the manner well known in the art, and which is provided at its lower end with the liquid inlet openings 2. The upper end of this casing is open and secured thereon is the head 3 that is located above the surface of the ground.

An eduction pipe or tube that is designated generally by the numeral 4 is arranged centrally within the casing 1 and the same includes a plurality of sections that are connected together by suitable couplings and the like. The upper section 5 extends through the head 3 to provide a liquid outlet above the surface of the ground. The lower end of the uppermost section 5 is secured on the upper end of the adjacent pipe section 6 and this section is in turn secured at its lower end to the upper end of the pipe section 7.

The pipe section 8 constitutes what we term as a vacuum chamber and the upper end of this particular pipe section is externally threaded as is also the lower end of the next adjacent section 7. A coupling 9 affords a means for connecting the adjacent ends of these pipe sections together and this coupling structure is clearly shown in Figure 2 of the drawings. The coupling is provided with a central partition 10 that is formed in its center with an opening 11, and the upper edge of the opening is beveled to form a seat for the vertically movable valve 12 that normally rests on the seat by the action of gravity whereby to close the opening. A cage 13 is arranged on the upper face of the partition 10 around the opening 11 for the valve as also clearly illustrated in Figure 2 and the cage will prevent the displacement of

the valve and further limit the upward movement thereof.

The lower portion of the vacuum chamber 8 is reduced as illustrated at 14 and a neck 15 extends downwardly from the reduced portion 14 as more clearly shown in Figure 2. An annular shoulder 16 is formed in the neck portion 15. The reduced portion 14 is formed with a series of fluid passages 17, the purpose of which will be hereinafter more fully described.

A Venturi tube 18 is arranged vertically within the lower portion of the vacuum chamber 8, the lower end of this tube being enlarged and being externally threaded at its lower extremity for threaded engagement within the upper portion of the neck 15 and for rest upon the shoulder 16 as is clearly illustrated in Figure 2. The upper end of this Venturi tube terminates at the central portion of the vacuum chamber 8 and is of such diameter as to be spaced a considerable distance from the sides of the chamber.

The eduction pipe or tube 4 further includes the provision of the pipe section 19 that is threaded at its upper end and a coupling 20 similar to the coupling 9 affords a means for connecting the lower end of the vacuum chamber 8 with the upper end of the next lower pipe section 19. A central partition 21 is formed in the pipe coupling 19 and this partition is also provided with a central opening, the upper edge of which is beveled to form a valve seat and cooperating with this opening and valve seat is the vertically movable valve 22 which is similar to the valve 12 heretofore described.

A cage 23 is arranged on the upper face of the partition 21 for cooperation with the valve 22 as disclosed in Figure 2.

The pipe section 19 is formed adjacent its lower end with the external annular shoulder or flange 24 and the upper face thereof is ground for a purpose to be presently apparent.

The portion of the pipe section 19 directly below this flange or shoulder is tapered as illustrated at 25 with reference more particularly to Figures 2 and 3 of the drawings. This tapered portion is formed with a series of spaced liquid inlet slots 26 that are similar to the slots 17 formed in the tapered or reduced portion 14 of the vacuum chamber 8. An externally threaded neck 27 extends from the lower end of the tapered portion 25.

A coupling 28 provides a means for connecting the lower end of the pipe section 19 with the lowermost pipe section 29 and the lower end of the lowermost pipe section 29 is adapted to rest on the bottom of the well. This pipe section 29 provides an anchor and further serves to hold up a part of the weight of the eduction pipe 4.

The salient part of the present invention relates to an improved packer construction and in the present instance, the packer comprises a cup shaped member 31 that is formed preferably of rubber. The bottom of the rubber cup-shaped packer is provided with an opening 32 whereby the same may fit over a sleeve 33 that is slidably fitted over the pipe section 19 and the lower edge of this sleeve is ground for engagement with the ground upper edge of the shoulder 24 whereby to form a ground seat and a liquid proof joint. An annular flange or collar 34 is formed on the lower end portion of the sleeve 33 and the upper face of this shoulder or flange is slightly curved upwardly to conform to the contour of the bottom of the expansible packer member 31 and this is clearly shown in Figure 2.

The rubber packer 31 is of a suitable thickness but it will be observed that the upper edge portion of the cup shaped packer is of slightly greater thickness than the remaining portion of said member, and this is also clearly illustrated in Figure 2 of the drawings.

A series of bowed steel spring wires 35 have their lower end portions extending downwardly into the upper edge portion of the rubber cup shaped packer and the lower end portions of these wires extend downwardly along the sides of the body of the packer and along the bottom portion so as to be securely embedded in the packer.

The upper ends of the steel spring wires 35 gradually converge and are secured to a ring 36 that is freely slidable over the upper portion of the pipe section 19 and is further adapted for slidable movement between the lower end of the coupling 20 and the upper end of the sleeve 33.

The spring wires 35 normally have a tendency to hold the expansible packer 31 in a contracted position and obviously by increasing the distance between the upper end of the sleeve 33 and the coupling 20, the tension on the spring wires may be regulated to effect an upward movement of the upper converging end portions of the wires and thereby to further contract the rubber packer.

A compressed air or gas pipe 37 extends into the side of the head 3 provided for the upper end of the well casing 1 and a compressor designated generally by the numeral 38 and of any well known construction is associated with the pipe 37 as clearly illustrated in Figure 1.

Normally, the rubber packer 31 is contracted and is not in tight engagement with the inner wall of the casing and thereby will not interfere with the placing of the eduction pipe or tube within the well casing. When the parts are arranged as shown in Figure 1, it will be observed that the air or gas under pressure that enters the top of the casing will move downwardly in the casing around the

upper portion of the eduction pipe. The valves 12 and 22 are normally closed and manifestly the air or gas under pressure will pass upwardly through the passages 17 into the chamber 8 and create a vacuum within the chamber whereby to unseat the valve 22 and at the same time force the valve 12 upwardly out of engagement with its seat. This section will result in a vacuum being created in the lower portion of the eduction pipe whereby to lift the oil or other liquid upwardly through the various pipe sections of the eduction pipe and the oil will flow outwardly through the upper end of the eduction pipe.

Simultaneously with the fluid that is under pressure, creating a suction in the eduction pipe to raise the liquid upwardly in the pipe, a certain amount of the fluid under pressure will travel downwardly below the vacuum chamber and will enter the cup shaped packer 31 and will cause the packer to expand whereby the outer side of the cup shaped packer will be brought into tighter engagement with the inner wall of the well casing 1 and thus provide a perfect liquid seal so that the oil or other liquid in the lower portion of the casing cannot be subjected to agitation by coming in contact with the liquid under pressure that is employed for lifting the liquid. The liquid will enter the eduction pipe through the inlet passages 26 that are located below the packer unit.

It is of course understood that when the eduction pipe is lowered into the well, the liquid of its own accord will raise upwardly by its own volume and gas pressure. The liquid enters through the passages 26 and passes upwardly through the tube 18 then a portion of the liquid flows downwardly in the chamber 8 and passes out through the openings 17, thence downwardly until the same comes in contact with the expansible packer which fits close enough against the casing of the well to hold it in position until the packer becomes more firmly seated by the action of the compressed air or gas. The liquid continues to seek a higher level in the casing.

When the compressed air or gas comes in contact with the liquid it causes the latter to travel downwardly under pressure between the casing and the eduction pipe, then upwardly through the passages 17 into the vacuum chamber 8 and then upwardly through the upper portion of the eduction pipe and out of the well. At the same time, while traveling upward through the vacuum chamber a vacuum is created thereby drawing the liquid through the passages 26.

In Figure 6 there is shown a modification of the liquid inlet portion of the eduction pipe. A swage nipple 30 is detachably secured at its upper end to the lower end of the pipe section 19′ through the medium of the coupling 30′. The intermediate portion of the nipple is formed with liquid inlet passages 26′, and the lower reduced end 27′ is secured to the upper end of the next adjacent pipe section 29′ by means of the coupling 28′.

It will thus be seen from the foregoing description, that we have provided a fluid elevator which will at all times be positive and efficient in its operation and by providing a packing structure such as above described, there will be no possibility of the lifting fluid coming in contact with the liquid in the lower portion of the said well casing.

It is of course to be understood that when the fluid under pressure is cut off to the casing 1, so that the same will not act on the rubber packer and force the same outwardly, the bowed steel spring wires that have been placed under tension by the action of the fluid under pressure coming in contact with the rubber packer will return the packer to its contracted position and thereby permit the eduction pipe to be readily and easily removed from the well casing.

While we have shown the preferred embodiment of our invention, it is to be understood that various changes in the size, shape and arrangement of parts may be resorted to without departing from the spirit of the invention and the scope of the appended claims.

Having thus described the invention, what we claim as new and desire to secure by Letters Patent is:—

1. In a fluid elevator, a casing, a liquid eduction pipe arranged therein having liquid openings in the lower portion thereof, and passages to permit a fluid under pressure to enter the pipe and lift the liquid upwardly therethrough, a packer surrounding the eduction pipe at a point below the fluid inlet passage, said packer being normally contracted and out of tight engagement with the casing, said packer being expanded and forced outwardly against the casing to provide a liquid seal by the action of the lifting fluid under pressure acting on the packer.

2. In a packer, an eduction pipe, a sleeve surrounding said pipe, a shoulder formed on the lower end portion of said sleeve, a flange formed on the eduction pipe for engagement with the lower end of the sleeve, an expansible cup-shaped member for resting upon said shoulder, said sleeve extending upwardly through the bottom of the cup-shaped member, a series of bowed spring elements having their lower ends extending downwardly into the upper edge portion of the cup-shaped member, the lower edge portions of the spring element extending downwardly along the sides of the body of the cup-shaped member and along the bottom thereof, said spring elements gradually converging toward their upper ends, and a ring to which the upper ends

of the spring elements are connected, said ring being slidable on the eduction pipe, the spring elements normally holding the cup-shaped member in a contracted position.

In testimony whereof we affix our signatures.

OLIVER MORGAN
HOWARD W. STRAIT.