

Nov. 17, 1931.

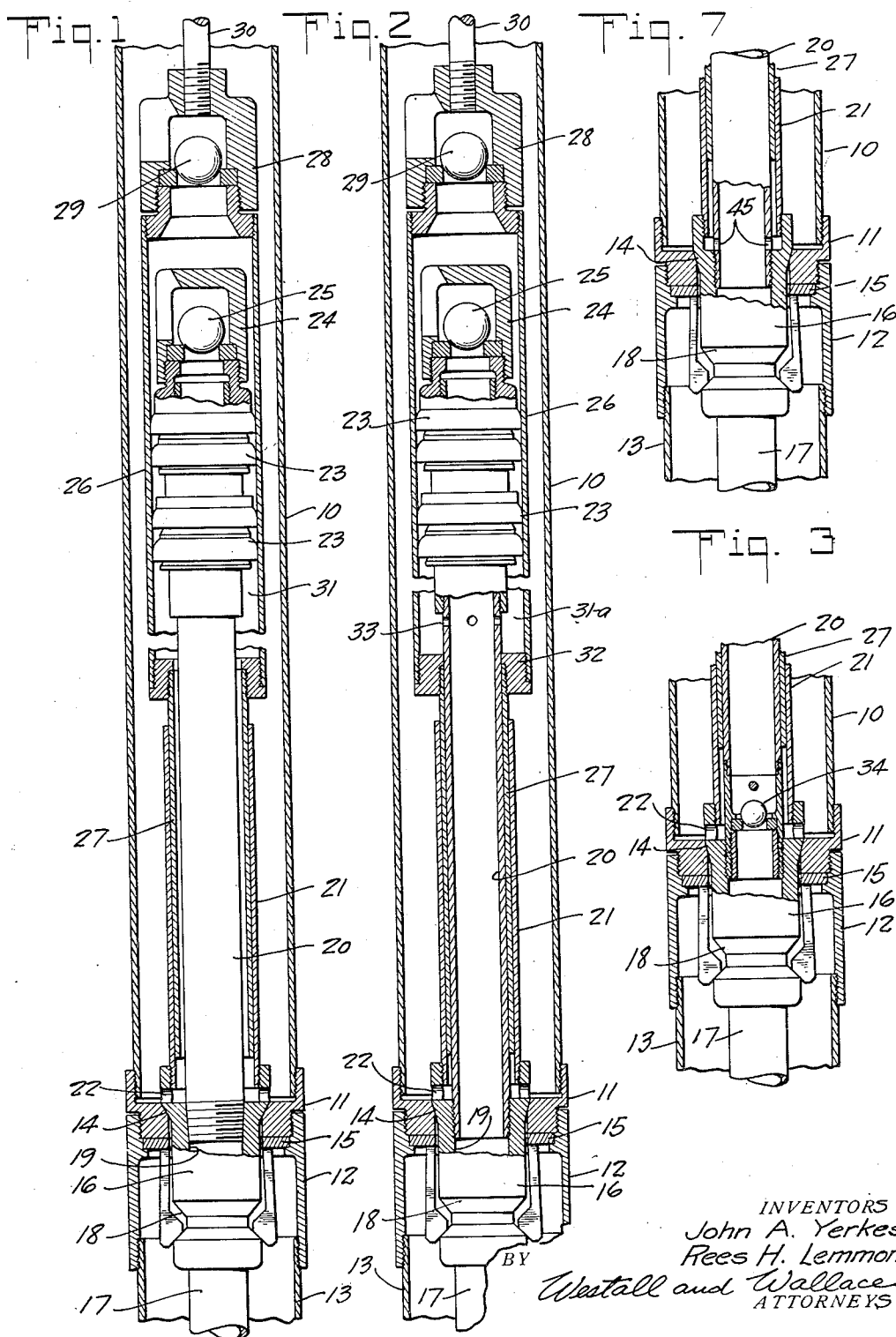
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TRAVELING TUBE PUMP

Filed Jan. 28, 1930

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2 Sheets-Sheet 2

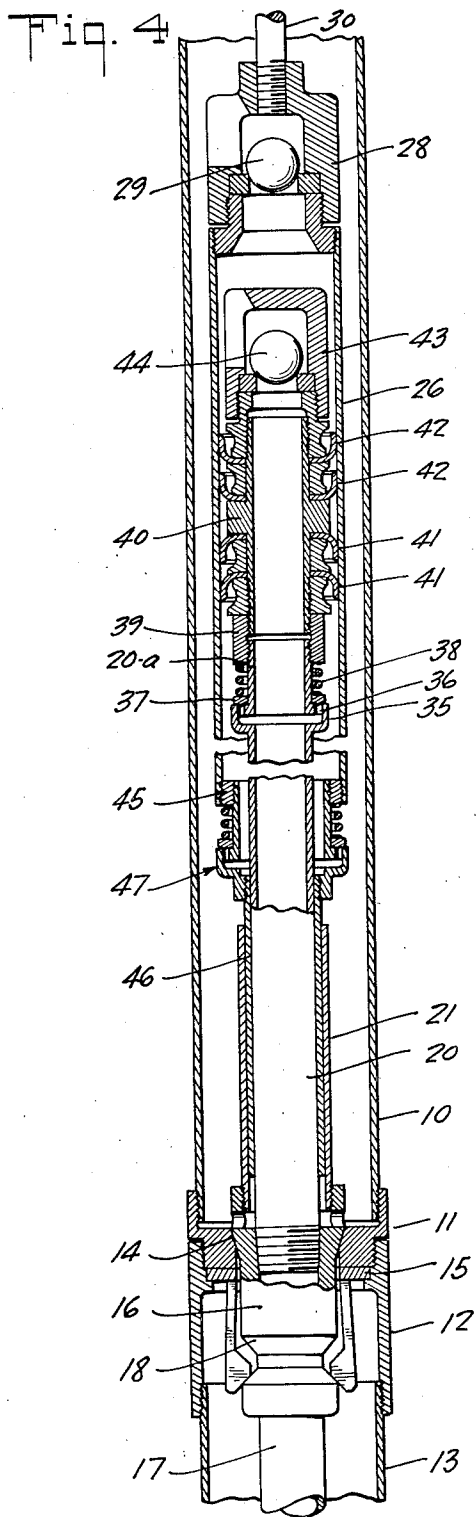


Fig. 5

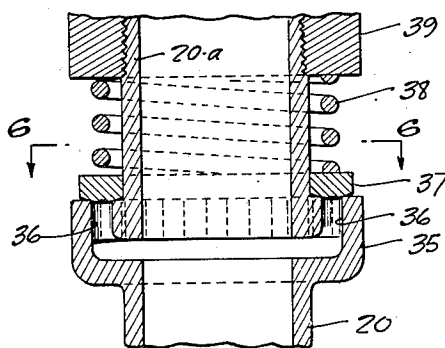
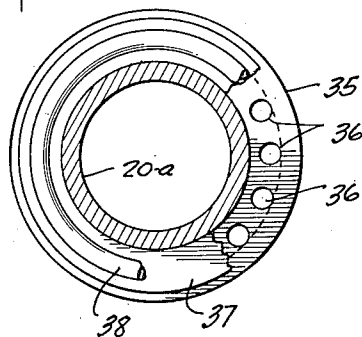


Fig. 6



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TRAVELING TUBE PUMP

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This invention relates to a deep well pump having a relatively stationary piston and a reciprocating working barrel nested over the piston. The invention pertains broadly to features of construction whereby any or all of the following features are attained; a fluid seal packing for one side of the working barrel; the creation of a surging zone for liquid at the lower end of the pump and within the space surrounding the pump barrel to prevent settling of sand and sediment therein; provision of a pump of the traveling barrel type wherein the working space is unrestricted; and the provision of a double acting traveling barrel type of pump. Another specific object of this invention is to provide a traveling tube pump in which solid particles such as sand or sediment are prevented from settling out of the liquid in the well tubing and from lodging between the well tubing and the pump thereby obviating the usual difficulties encountered by such pump, such as ultimately results in shortening the pump stroke. Inserted pumps employing our present invention are prevented from sticking in the well tube as a result of the sand and sediment packing around the pump. A further specific object of this invention is to provide greater strength and simplicity as well as inexpensive construction. A still further object of this invention is to provide a deep well pump having nested tubular stand pipes, one of which is provided with a working piston, a working barrel surrounding the piston and forming therewith a working space, said working barrel coacting with the stand pipes to cause surging of liquid back and forth in the space between the pump and well tube, the surging in said space being substantially coextensive therewith.

These objects are accomplished by means of the embodiments of our invention illustrated in the accompanying drawings, in which:—

Fig. 1 is an axial section through a well tube showing one form of pump inserted therein, portions of the pump being shown in elevation; Fig. 2 is an axial section through another form of pump and well tubing; Fig. 3 is a section through the lower end of a pump

of the type shown in Fig. 2, but including another valve; Fig. 4 is a longitudinal section through a fragment of well tubing showing a double acting pump embodying our invention; Fig. 5 is a section on an enlarged scale showing a detail of the piston annular valve; Fig. 6 is a section as seen on the line 6—6 of Fig. 5; and Fig. 7 shows in section the lower end of a pump of the general type of Fig. 2 exclusive of the surging parts.

Referring more particularly to Fig. 1, the usual well tubing is marked 10. The section of well tubing is that near the bottom of the well and carries at its lower end a shoe 11, to which is attached a collar 12. A gas anchor pipe marked 13 is threadedly attached to collar 12. The shoe 11 has a tapered bore 14 to receive an extension, later described.

Clamped between the shoe 11 and collar 12 is a resilient anchoring member 15 including spring fingers which depend below the shoe 11 and into the collar.

The pump proper comprises an anchoring extension 16 also serving as a seat for the pump and coacting with the tapered bore 14. A tail pipe 17 for the intake of liquid is attached to the anchoring extension. In extension 16 is a bevelled annular recess 18 serving for the mounds on the fingers to engage therewith and hold the anchoring extension in place. A bore 19 is formed in the extension and is threaded to receive an inner stand pipe 20. The upper end of the extension is enlarged in diameter and threaded to receive an outer stand pipe 21. Below the lower end of stand pipe 21 and in the wall of the anchoring extension are lateral ports 22 which serve for communication of the space between the stand pipes 20 and 21 with the space between the well tube 10 and the pump.

A piston body is secured to the upper end of the inner stand pipe 20 and mounted thereon are plunger cups 23 secured in any suitable manner as by lock nuts and followers. Secured to the upper end of the piston by a suitable lock bushing is a valve cage 24 housing a ball valve 25.

Reciprocatingly mounted over the piston

is a working barrel 26 having a skirt tube extension 27 which closely and slidably engages the inner wall outer standing tube 21 to form a seal therewith which when filled with liquid is a capillary seal. It will be obvious that the reciprocation of the skirt tube within the outer standing tube will cause surging of liquid through the ports 22. The traveling tube is provided at the top with a valve cage 28 housing a ball valve 29 to which sucker rod string 30 is attached.

It will be understood, that in actual practice, the tubing 10, shoe 11, resilient anchoring device 15, collar 12 and the anchor pipe 13 are assembled and lowered into the well hole in position. Thereupon the assembled pump elements as a unit are secured to the sucker rod string 30 and lowered into the well tubing until the anchoring extension 16 seats in the shoe 11 and is securely locked in position by the resilient anchoring device 15, but in such a manner that an upward pull upon the sucker rod string will cause the spring fingers on the anchoring device to release the pump assembly. With the pump inserted in position in the well tubing, it is now ready for operation. The sucker rod string 30 is reciprocated as usual which causes the traveling tube 26 or working barrel to reciprocate over the piston. On the up-stroke of the pump, liquid is drawn through the tail pipe 17 up through the standing tube 20 through the piston and past the valve 25. It enters the pump working space, being elevated by the upward movement of the working barrel 26. The valve 29 in cage 28 will have remained seated upon the up-stroke of the pump. On the down-stroke of the pump, the ball valve 25 seats and the ball valve 29 lifts to permit discharge of the fluid into the well tubing 10.

The pumping action just described is the usual action common to this type of pump. However, the working barrel causes an additional and novel action. In Fig. 1, the working barrel is shown near the bottom of the down-stroke. On the following up-stroke, the liquid which is contained in the annular space between the standing tube 20 and 21 is forced downwardly through the annular space between the standing tubes. The annular space just referred to constitutes a play chamber for liquid contained therein, and the play chamber is contracted and expanded with reciprocation of the working barrel. Contraction of the play chamber causes liquid to be forced therefrom out through the holes 22 about the pump unit. On the following down-stroke, it is obvious that liquid will be drawn into the play chamber through the holes 22. It will be seen that the skirt tube 27 fitting closely against the outer standing tube 21 acts as a seal. The space 31 is alternately contracted and expanded with reciprocation of the traveling tube. Thus, a surging

device in the nature of a simple auxiliary pump is provided which alternately draws in and discharges liquid through the holes 22 at the bottom of the space around the pump and close to the shoe 11.

Under operating conditions, the liquid contained in the tubing generally carried quantities of sediment and sand in varying amounts. The largest portion of this sand or sediment is usually carried out with the liquid due to the velocity of the liquid moving upwardly. Some sand and sediment, however, will settle out of the liquid and tend to lodge in the annular space between the well tubing and the working barrel. It will often, if permitted, settle around the anchoring extension 16 at the pump seat or shoe, rendering it difficult and often impossible to remove the pump by pulling upon the sucker rods and requiring pulling of the tubing string 10, causing an expensive and laborious job. So long as the working barrel 26, in the ordinary type of such traveling tube pump, is kept in motion, it is unlikely that sand or sediment will clog the space between the tubing 10 and the traveling tube due to the agitation. Likewise, fluid above the valve cage 29 moving upwardly tends to prevent settling of sand and sediment. However, some sand usually finds its way down to the lowermost portion of the tubing and tends to build up at this point, often to such an extent that the traveling tube "pounds" or strikes the sand packed at the bottom of the space. This is highly detrimental to the operation of the pump, as it is necessary to respace the traveling tube to prevent it from striking the packed sand or sediment in this space. In many cases, this must be repeatedly done and often involves shortening the stroke to avoid "pounding". This shortening decreases the capacity of the pump. Such "pounding" also tends to tamp the sand, "freezing" the inserted assembly and making removal thereof practically impossible without pulling the well tubing. Furthermore, there is danger of causing parting of the tubing string when it is attempted to pull the pump. Heretofore, numerous attempts have been made to avoid the above described conditions, but with the devices heretofore used, sufficient surge of the fluid in the space around the pump is not obtained to adequately agitate the fluid. In the structure just described, the turbulence is coextensive with the space and the surge is inaugurated at the extreme lower point, where it is most effective.

It may be desirable to closely fit the skirt tube between the standing tubes and this is shown particularly in Fig. 2. Like parts are marked with the same reference numerals. However, in this construction, fluid would be trapped between the cups of the plunger and the bushing marked 32. To relieve the chamber formed below the plunger and above

the bushing, ports 33 are provided serving for communication of the chamber 31—*a* with the bore of standing tube 20. There is danger in the construction just described that the plunger cup will not engage the inner wall of the working barrel with sufficient tightness, as the ports 32 will so restrict the discharge of the fluid from the chamber below the plunger as to hold sufficient pressure against the cups. In this instance an additional ball and seat marked 34 in Fig. 3 may be used to prevent back flow of the liquid. It will be noted that chamber 31—*a* is sealed by the tubes 20, 27 and 21 to provide a capillary seal.

Referring particularly to Figs. 4, 5 and 6, the well tubing is shown as before and parts corresponding to those shown in Figs. 1 and 2 marked with like reference characters. Anchoring extension 16 is provided with standing tubes 20 and 21. The upper end of standing tube 21 is provided with an annular ledge 35 having ports 36 communicating with the bore. The tube 20 is extended upwardly as marked by 20—*a*. A ring valve 37 is provided to control ports 36 and is held on its seat by a compression spring 38 seating at the upper end against a collar 39. A piston body 40 is secured by the collar to the standing tube. Mounted on the body are cups 41 and 42 held in place by suitable followers and nuts. Cups 41 are directed downwardly and cups 42 upwardly. A valve cage 43 housing a ball valve 44 is secured to the upper end of the piston.

The traveling tube 26 is provided at its upper end with a valve in like manner to the forms heretofore described. At the lower end a bushing 45 connects a skirt tube 46 to the traveling tube. A valve structure similar to that in the standing tube is denoted generally by 47.

In the structure shown in Figs. 4, 5, and 6, the pump is double acting. Liquid is drawn from standing tube 20 past valve 37 on the downstroke and discharged through valve 47 into the well tubing on the upstroke. At the same time, the skirt tube 46 reciprocating in the space between standing tubes 20 and 21 causes surging of liquid back and forth through ports 22.

Referring to Fig. 7 the parts corresponding to those shown in Fig. 2 are marked with like reference numerals. It will be noted that surge ports 22 in extension 16 are omitted. To relieve the space between standing tubes 20 and 21, ports 45 are provided in tube 20 opening to the bore.

It will be noted that in the forms of pump shown in Figs. 2, 3, 4 and 7 that a fluid seal is provided between the traveling tube or its skirt and the standing tubes. This seals the space below the piston against back pressure from the liquid in the tubing. A simple sliding tube structure is provided which effects surging of liquid at the lower end of

the pump to keep sand or sediment laden liquid in agitation and prevent settling of sand. In all of the forms of pump shown the traveling barrel and piston are enlarged as compared with the skirt of the traveling barrel and the associated standing tube structure. Full advantage is taken of the allowable working space, there being no constrictions of parts. In the type of pump shown in Fig. 4, advantage is taken of the added pumping effect of the lower side of the piston and its barrel. It will be understood that by the word "piston" as used herein and in the appended claims, we intend to include broadly a displacement member mounted within a barrel and in operative reciprocating relation thereto.

What we claim is:—

1. In a well pump, the combination of nested tubular stand pipes, one of said stand pipes being provided with a piston, said stand pipes being spaced from one another to provide an annular space therebetween, openings at the base of the outer stand pipe placing said annular space in communication with the space surrounding said stand pipes, a working barrel surrounding said piston and forming therewith a working pump space, said working barrel telescopically forming a sliding fit throughout its length with the outer stand pipe to cause play of liquid contained in said annular space and surging of such liquid back and forth through said openings.

2. In combination with a well tube, an inserted pump, retaining means at the lower end of said pump to hold said pump in said well tube and enable withdrawal by upward axial pull; said pump comprising the combination of a tubular stand pipe provided with a piston at its upper end, a second stand pipe disposed about and spaced from said first mentioned stand pipe to provide an annular space, a working barrel surrounding said piston and forming therewith a working pump space, said working barrel having its lower end telescopically forming a sliding fit throughout its length with both of said stand pipes and providing a contractible and expandible chamber, and passages at the base of the outer stand pipe and above said retaining means at the lower end of the stand pipes connecting said chamber with the flow space for the liquid being elevated.

3. In a double acting well pump, the combination of a tubular stand pipe, a second stand pipe disposed about and spaced from said first mentioned stand pipe to provide an annular space, openings at the base of the outer stand pipe placing said annular space in communication with the flow space for the liquid being elevated, one of said stand pipes being provided with a piston having a valve control, a working barrel surrounding said piston and forming therewith working pump

spaces above and below said piston, said working barrel telescopically forming a sliding fit throughout its length with both of said stand pipes to form a fluid seal, a valve controlled inlet placing the stand pipe carrying said piston in communication with the working spaces below said piston, and a valve controlled outlet placing the working space below said piston in communication with the space exterior to said pump.

4. In combination with a well tube, an inserted double acting pump, retaining means at the lower end of said pump to hold said pump in said well tube and enable withdrawal by upward axial pull; said pump comprising the combination of a tubular stand pipe provided at its upper end with a piston having a valve control, a second stand pipe disposed about and spaced from said first mentioned stand pipe to provide an annular space, a working barrel surrounding said piston and forming therewith a working pump space, said working barrel having its lower end telescopically forming a sliding fit throughout its length with both of said stand pipes and providing a contractible and expandible chamber, and passages at the base of the outer stand pipe connecting said chamber with the flow space for the liquid being elevated above said retaining means, a valve controlled inlet placing the stand pipe carrying said piston in communication with the working spaces below said piston, and a valve controlled outlet placing the working space below said piston in communication with the space exterior to said pump.

In witness that we claim the foregoing we have hereunto subscribed our names this 26th day of December, 1929.

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