Jan. 18, 1927. 1,614,865

C. S. BODEN

CIRCULATING PLUNGER PUMP

Filed June 12, 1925 2 Sheets-Sheet 1

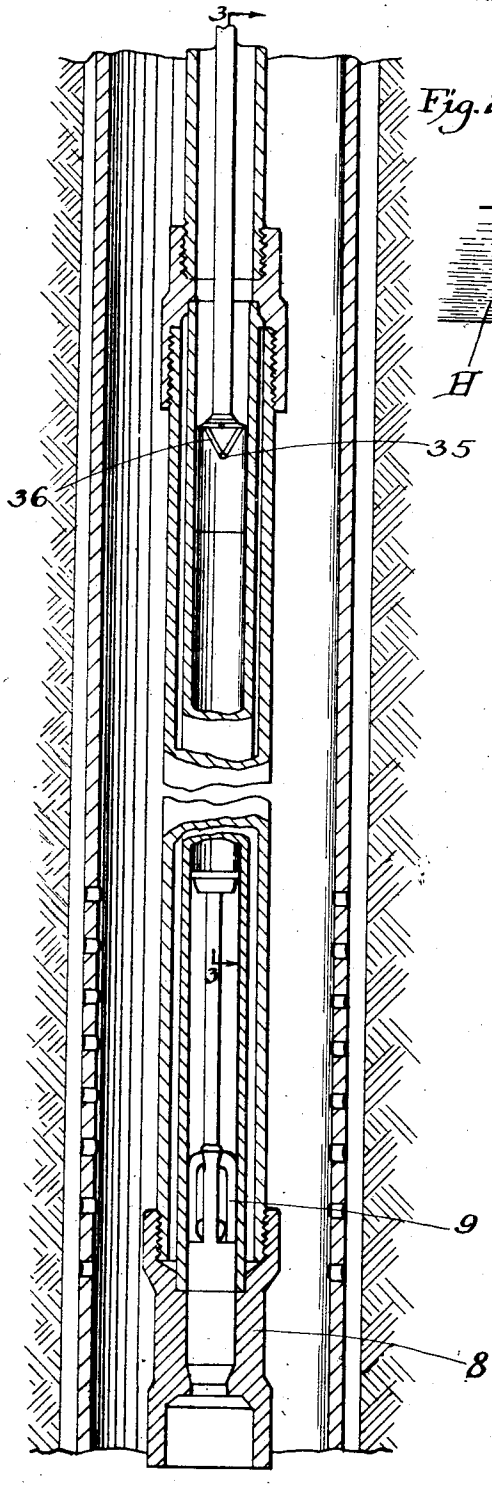


Fig. 2

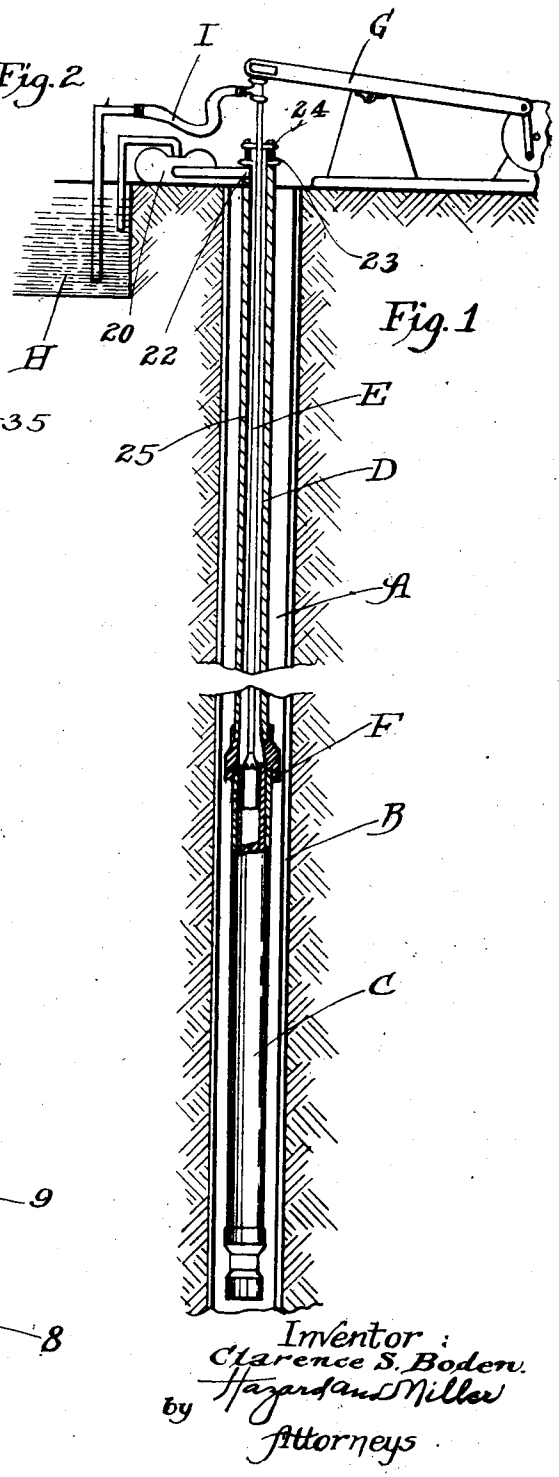


Fig. 1

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Fig. 3

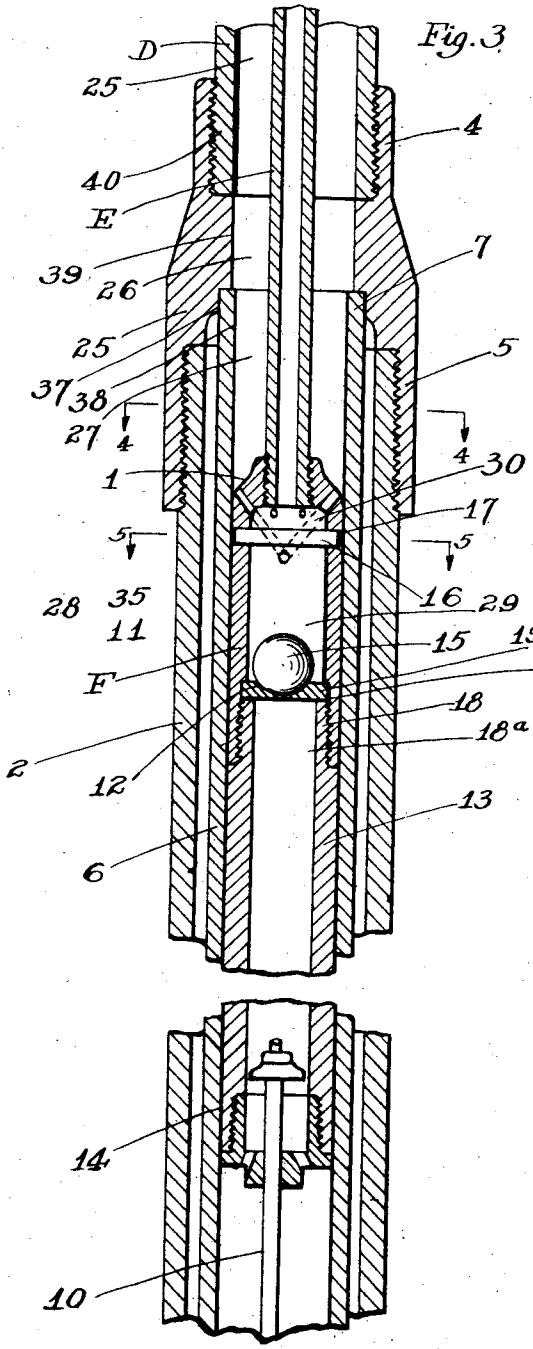


Fig. 4

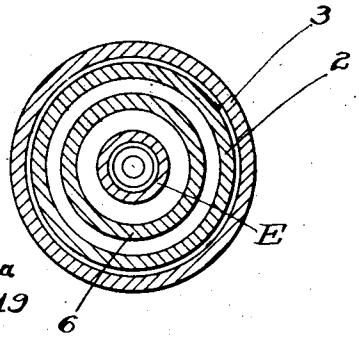
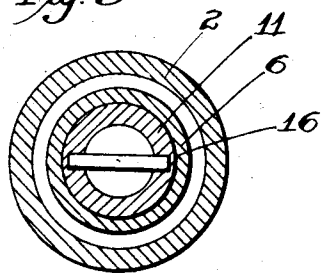


Fig. 5



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UNITED STATES PATENT OFFICE.

CLARENCE S. BODEN, OF LOS ANGELES, CALIFORNIA.

CIRCULATING PLUNGER PUMP.

Application filed June 12, 1925. Serial No. 36,622.

My invention relates to circulating plunger pumps, preferably for oil wells in which the oil is thick with sand.

The object is to agitate the well oil in and above the pump so that the sand carried thereby will not be allowed to clog.

The broad aspects of my invention include a method or process of pumping oil in which a stream of clear oil under high pressure is forced into the body of well oil. I preferably use a pressure in the clear oil higher than that due to the hydrostatic head of the well oil.

The specific embodiment of my invention and the mechanism therefor comprises the usual oil pump tubing and any suitable type of plunger pump. A so-called macaroni tube conveys the oil from the plunger pump to the top of the well.

I provide a pump for forcing clear oil down the pump tubing in a body surrounding the macaroni tube and through apertures in the pump into the stream of well oil. This clear oil being under considerable pressure dislodges any sand clogging the pump, thins out the well oil and its sand mixture and enables the combined mixture to be carried to the surface through the small macaroni tube without clogging it. When clear oil is forced down to a position below the plunger of a pump it interferes with the oil production, as in such case the pump acts on the clear oil without lifting the well oil. I force the clear oil into the plunger above the valve so that the whole of the pumping action is utilized on the well oil. The chamber above the valve is the place usually clogged with sand and it is here that the clear oil is forced into the plunger and up through the macaroni tube.

My invention will be more readily understood by the accompanying drawings, in which:—

Figure 1 is a diagrammatic view of an oil well with a plunger pump and my circulating system connected with the well.

Fig. 2 is a section of the well showing the working barrel of the plunger pump partly in section and the pump in side elevation.

Fig. 3 is a section of Fig. 2 on a line 3—3 enlarged.

Fig. 4 is a cross section of Fig. 3 on the line 4—4.

Fig. 5 is a cross section of Fig. 3 on the line 5—5.

Referring first to Figure 1, A represents an oil well having usual well casing B, in which is inserted the plunger pump C supported by the pump tubing D. In this latter a macaroni tube E reciprocates and operates the pump plunger F. The pump is actuated by the usual walking beam G and the oil is conveyed to a sump H through the usual flexible pipe I.

Referring more particularly to the details as shown in the remaining figures, the macaroni tube E is connected to the plunger F by a screw threaded connection 1. The pump tubing D is connected to the working barrel 2 of the plunger pump C by means of a coupling 3 having a screw threaded connection 4 to the pump tubing and a screw threaded connection 5 to the working barrel. A usual liner 6 is secured to the coupling 3 in the usual manner, as indicated at 7. The working barrel carries a seat 8 for the standing valve 9 in the usual manner. I have shown the standing valve connected to my plunger pump by what is known in the trade as the garbutt rod 10. My pump plunger F is an elongated shell 11 secured to the macaroni tube by the screw threads 1 as above mentioned, and has a valve seat 12 preferably secured at the joint of the pump shell 11 and the tube 13 to engage the butterfly 14 of the garbutt rod 10. I preferably use a ball 15 to engage the valve seat 12. This is prevented from lifting and closing the lower end of the macaroni tube by a pin 16 extending across the shell 11 and secured in position by apertures 17.

The connection I have shown between the shell 11 and the tube 13 is by means of internal threads 18 on the shell and external threads 18^a on the tube. The top of the tube 19 forms an abutment with the valve seat which fits into an annular recess 19^a turned in the lower end of the shell 11.

In order to feed clear oil through the pump tubing I provide a pump 20 taking clear oil from the surface of the sump, as indicated at 21, and leading it into the space between the macaroni tube E and the pump tubing D, as indicated at 22. It is necessary to use a closure 23 for the top of the pump tubing with a stuffing box 24, to allow the macaroni tube E to reciprocate without undue leakage of clear oil. The clear oil is conveyed down the annular space 25 between the macaroni tube E and the pump

tubing D through the annular space 26 at the coupling 3 into the annular space 27 between the macaroni tube E and the pump liner 6.

A series of apertures 28 lead from this annular space into the pump chamber 29. I preferably incline these apertures inward so that the jets of clear oil will be injected into the well oil in a cone, as indicated at 30.

The operation of my circulating plunger pump is as follows:

The walking beam G reciprocates the macaroni tube E and pump plunger F with the working valve C in the usual manner. This lifts the oil through the standing valve 9 into the pump chamber 29 in the usual manner. In order to facilitate the suction I preferably, in starting the pump, force clear oil by means of the pump 20 through the annular spaces 25, 26 and 27 and through the apertures 28 into the pump chamber 29. A certain amount of this oil will seep around the ball valve and fill up the bottom of the pump, thereby priming it in wells which are difficult to pump.

In wells which flow with clear oil, or oil which is not liable to clog, the pumping is carried on in the usual way, except that I provide a small flow of clear oil which has at the pump substantially the same hydrostatic head as the well oil which is being elevated. Therefore, there is very little clear oil mixing with the well oil in the chamber 29. I merely provide sufficient flow through the apertures 28 to prevent the well oil, in the pumping operation, from flowing upwardly through the apertures 28 into the annular space 27.

In pumping an oil which is thick with sand and liable to clog the plunger pump, I force the clear oil downward with considerable pressure so that the hydrostatic head of the oil in the annular spaces 25, 26 and 27 is much greater than that of the oil in the macaroni tube E. This high pressure forces jets of oil through the apertures 28 at a high velocity and therefore agitates the thick well, oil, prevents clogging of the sand in the pump chamber 29 and thoroughly mixes the well oil, clear oil and sand so that the sand is more easily lifted through the macaroni tube to the sump.

On the upward stroke of the pump plunger F the oil in the annular space 27, on account of the inertia of the body of oil above, is forced through the apertures 28. This flow of oil being in a downward direction in the chamber 29 and more or less along the sides of the chamber, displaces the well oil and causes the flow of well oil upward through the macaroni tube E in addition to the oil which is directly lifted in the macaroni tube. The amount of oil which would be thus displaced depends upon the size of the apertures. These jets also act to positively seat the ball 15 on the valve seat 12. On the downward stroke of the pump plunger F there is no danger of the well oil passing out of the apertures 28, as there is sufficient head in the annular spaces 25, 26 and 27 to force a small flow of oil into the pump chamber 29. If, on account of clogging of the macaroni tube with sand, an excessive pressure is built up in the chamber 29 and forces the well oil through the apertures 28 into the passage 27, it would do no harm, as the small amount of well oil will immediately be mixed with a very large body of clear oil in which the sand would readily be held in suspension.

The clear oil in the annular space 27 being under considerable hydrostatic head, and the additional pressure caused by the pump 20, will force a flow of lubricating oil between the shell 11 and the tube 13 and the liner 6, within which these reciprocate, thus a lubrication of clear oil is maintained between the working parts of the plunger pump, preventing the sand in the well oil from clogging and wearing both the plunger pump and the liner. With my construction and mode of operation the liners will last materially longer than at present, as will also the pump plungers.

From the above it will be seen that I have a new method or process of pumping sand and oil in which clear oil is forced into the body of the well oil being elevated, agitates this well oil, prevents the sand from clogging the pumps and so thoroughly mixes the clear oil, well oil and sand that the latter is carried in suspension through the small bore macaroni tube without clogging.

In addition to the apertures 28 in the top of the plunger, I may also use lateral apertures 35 in the side of the plunger through the shell 11 positioned above the valve 15. These lateral apertures will function with a loose fitting plunger in which the oil passes around the shell 11 and the liner 6, or grooves 36 may be cut in the outside of the shell to feed the oil more freely to these lateral apertures 35.

The preferred way of operation, however, is to lift the plunger F at each stroke so that the top of the shell 11 and the lateral apertures 35 will be lifted above the upper edge 37 of the liner 6. The inner bore 38 of the liner is of less diameter than the inner bore 39 of the coupling 3 and preferably of less bore than the inner bore 40 of the pump tubing D. This leaves a slight annular space between the outer periphery of the shell 11 and the bore 39 of the coupling so that a full stream of clear oil will be forced down this annular space through the lateral apertures 35 into the chamber 29 above the valve.

This construction with the lateral apertures may be utilized to function by giving

an increased flow of clear oil at the top of the stroke or I may use the lateral apertures only. I prefer to form the apertures 28 and 35 having screw threads so that plugs may be inserted to close any one or more of the apertures as desired. The plugs in the lateral apertures 35 would of course need to be counter-sunk so as not to come in contact with the liner 6. With all the apertures 28 plugged, the pump may be operated to have the flow of clear oil forced through the lateral apertures 35 at the top of each stroke and thereby give an intermittent flow of oil at the moment when the sand is most apt to clog in the chamber above the valve.

I may, instead of using a coupling of larger bore than the working barrel liner. construct the liner with a larger bore at the upper end than at the lower end so that on the upstroke the apertures 35 will come into the portion of enlarged diameter, but the main portion of the plunger still having a close bearing on the lower portion of the working barrel.

I accomplish this with a very simple apparatus, inexpensive to construct and to maintain in efficient operation. However, my process and the appliances necessary therefor can be considerably modified without departing from the spirit of my invention.

Various changes may be made without departing from the spirit of the invention as claimed.

I claim:

1. In a plunger pump for wells, a pump working barrel, a pump plunger reciprocating therein, a small bore tube connected from the upper end of the plunger to the top of the well and forming with the pump working barrel an annular passage, a valve seat in the plunger, a valve seated thereon, means to limit the upward movement of the valve, apertures through the plunger above the means limiting the upward movement of the valve from the passage to the interior of the plunger, and means to convey clear oil from the top of the well to the annular passage.

2. In a plunger pump for wells, a pump working barrel, a pump plunger reciprocating therein, a small bore tube connected from the upper end of the plunger to the top of the well and forming with the pump working barrel an annular passage, a valve seat in the plunger, a valve seated therein, means to limit the upward movement of the valve, apertures through the plunger from the passage to the interior of the plunger above the means limiting the upward movement of the valve, apertures through the plunger below the means for limiting the upward movement of the valve, there being grooves on the outside of the pump plunger leading to said latter apertures, and means to convey clear oil from the top of the well to the annular passage.

3. In a plunger pump, a plunger having a shell, a valve therein, a chamber above the valve, apertures through the shell to the chamber, a small bore tube leading upward from the shell, the apertures being through the top of the shell adjacent the small bore tube and through the lateral wall of the shell.

4. In a plunger pump, a plunger having a shell, a valve therein, a chamber above the valve, apertures through the shell to the chamber, a small bore tube leading upward from the shell, and having the apertures through the lateral wall of the shell.

In testimony whereof I have signed my name to this specification.

C. S. BODEN.