March 15, 1927. 1,620,934

A. O. ZINN

DOUBLE ACTION OIL WELL PUMP

Filed Dec. 3, 1923 2 Sheets-Sheet 1

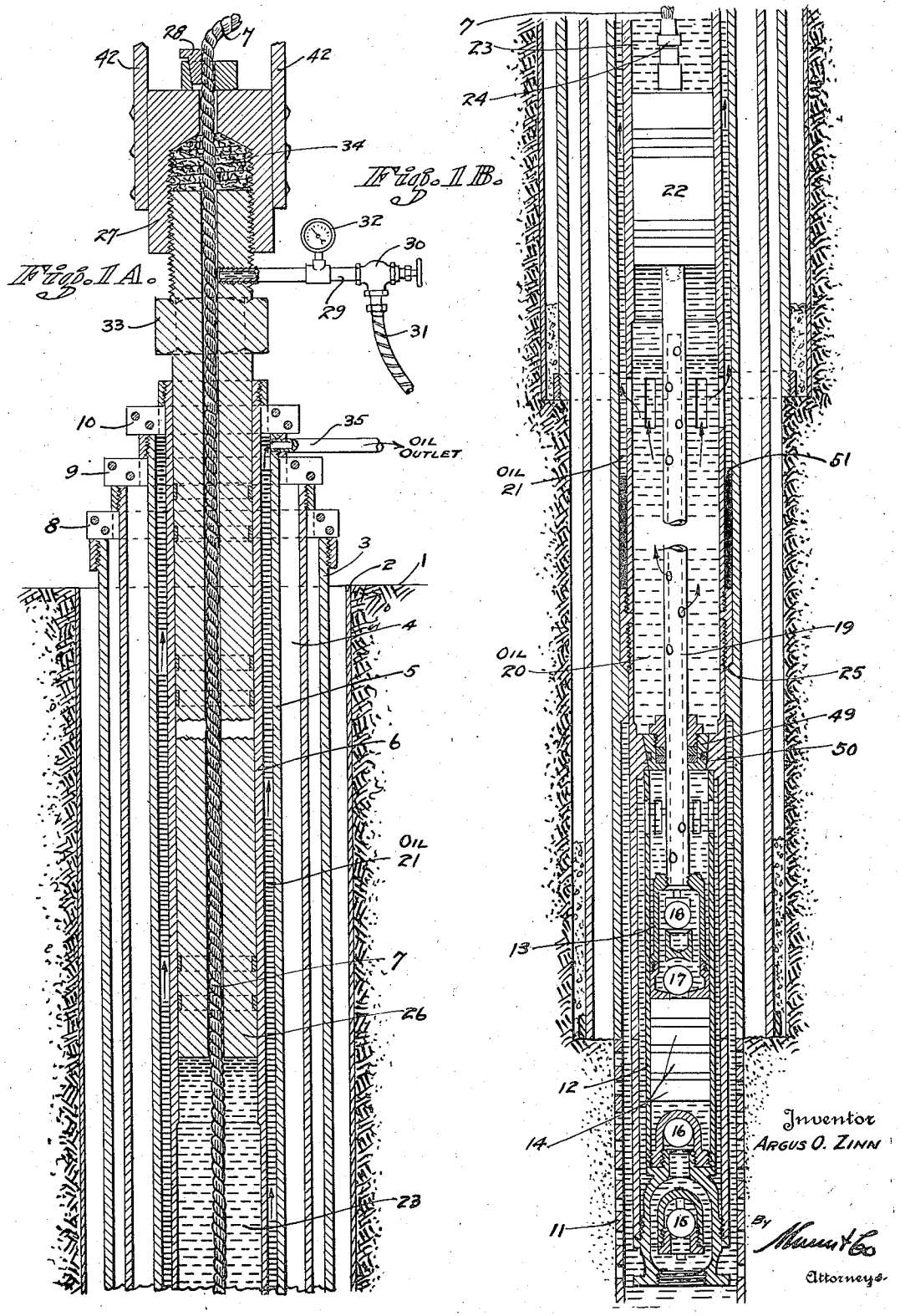


Fig. II A.

Fig. II B.

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Fig. 2.

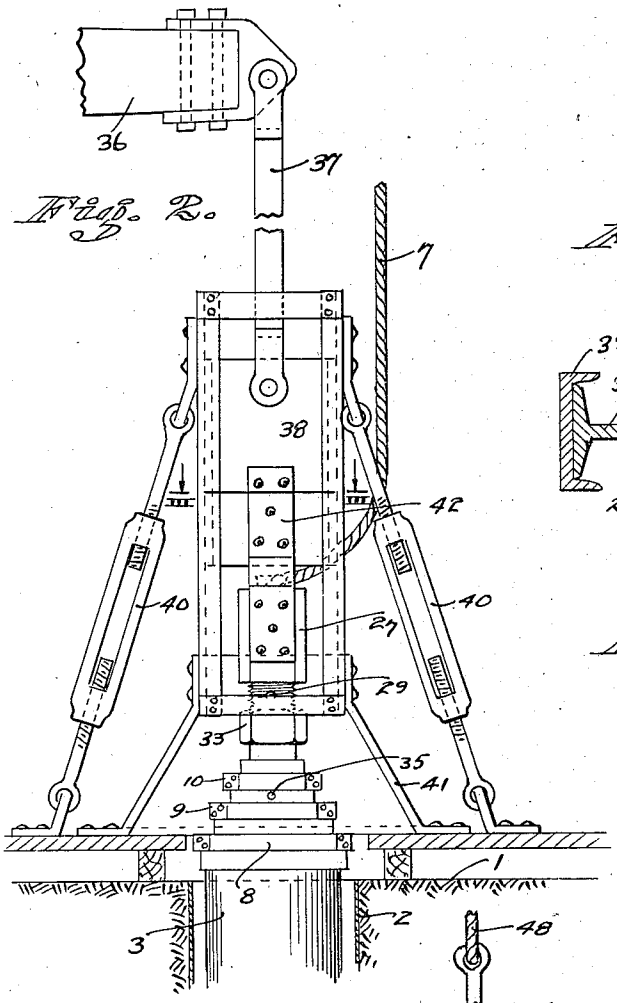


Fig. 3.

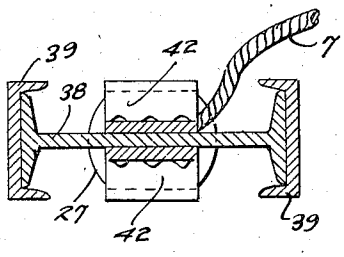


Fig. 5.

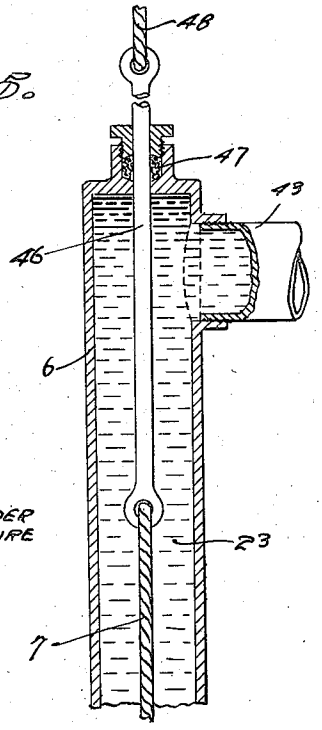
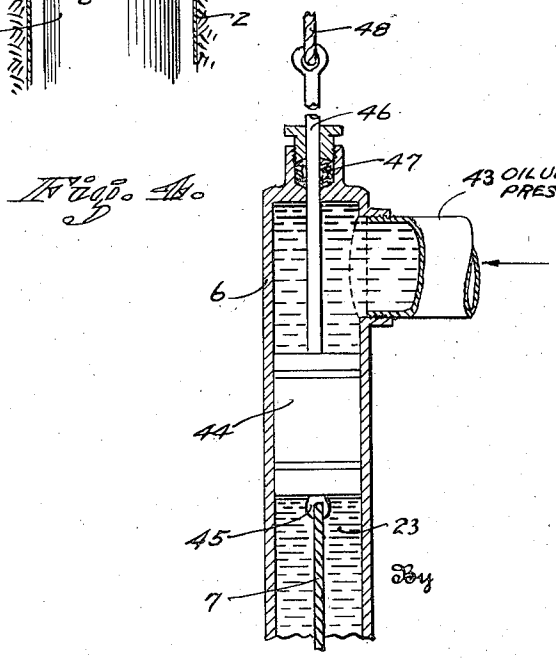


Fig. 4.



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UNITED STATES PATENT OFFICE

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DOUBLE-ACTION OIL-WELL PUMP.

Application filed December 3, 1923. Serial No. 678,285.

This invention relates to the pumping of oil from oil wells and particularly to means of increasing the pumping efficiency especially in case of the deeper wells.

The principal objects of my invention are to provide pumping means for oil wells which will also be positive in the return or downward stroke as well as the upward stroke, thus overcoming the great loss of time through the slow descent of the plunger as at present which necessitates the use of single acting pumps, and thereby provide for the proper operation of a double acting pump plunger at the bottom of the well.

The pumping of oil wells is generally accomplished with a single acting plunger at the bottom of the well pulled upward on the power stroke by a "sucker" rod, and allowed to fall by gravity on the return stroke, though a wire cable is sometimes used in place of the rod. A gravity return stroke is used as the rod is loose in the pipe and not adapted for pushing upon to force the plunger downward. This is easily understood when we consider the great depth of an oil well, in the California oil fields the wells being frequently drilled to a depth of over five thousand feet, and in such wells a pump rod becomes in proportion to its great length only a loose wire in a pipe adapted for a pulling strain only.

Also, since in the deeper wells, such solid rods may part of their own weight, the use of cable for pumping is resorted to, and of course this precludes any pushing down upon it in order to secure a double acting effect.

The loss of time through the gravity return stroke is very great, often consuming several minutes. This is due principally to the friction of the working parts and the sluggishness of the oil passing through the check valves in the pump to permit descent of the plunger.

I overcome the aforesaid loss of time in pumping with single acting pumps, and make possible the use of double acting pumps by providing definite means for forcing the plunger downward through the agency of a confined liquid, preferably oil, surrounding the pumping cable or rod, and which confined liquid transmits the pressure for the return stroke.

In carrying out my invention the double or reverse application of power may be made by means of a rigid reciprocating member attached to a rocker beam at the upper end of the rod or cable and the confined liquid column, or the cable may be pulled upward in the usual manner and auxiliary means used to force the liquid column downward, such auxiliary means being, if desired, the push of a pressure cylinder—either mechanically applied to a plunger piston at the upper end of the confined liquid column, or by a liquid admitted under pressure to the confining chamber to act directly upon the pressure transmitting liquid within.

My invention may be carried out by the apparatus shown in the accompanying drawings and in which:

Figures 1^A and 1^B are respectively, the lower and upper ends of an oil well drawn in vertical section showing respectively, the pumping elements in the lower end and the arrangement of the plunger actuating elements at the upper end;

Figure 2 is an extension view of the upper end of Figure 1^A showing a means of applying power to the actuating elements; and

Figure 3 is an enlarged cross section of Figure 2 taken along the line 3—3 thereof;

Figures 4 and 5 are diagrams illustrating optional methods of pushing the confined oil column downward by the application of other oil under pressure, either to the upper plunger (Figure 4) or directly to the confined liquid (Figure 5).

In further detail the figures show at (1) the ground surface, (2) the outer or conductor casing, (3) the water string of casing, (4) the liner string, (5) the oil string, (6) the tubing, (7) the pumping cable or rod, as the case may be, within the tubing.

The various casings and tubing are supported in the usual way by casing clamps (8), (9) and (10) surmounted by a collar screwed to the particular casing which it supports, and the water and liner strings of casing being cemented off below in the usual manner is firm in the hole.

At the lower end of the oil string is the screen section (11) and at the lower end of the tubing is the pump cylinder (12).

Within the cylinder is a pump plunger

(13) here shown as a double acting one, though it is evident without illustration that a single acting plunger may be used instead.

The plunger (13) consists of several parts including a piston of cup washers or rings (14), ball check valves (15), (16), (17) and (18) and a hollow rod (19) through which the oil (20) is pumped upon both the up and down strokes of the pump, and passes through suitable ports in the cylinder and the hollow rod and tubing for ejection from the well through the space between the oil string and the tubing, as indicated at (21).

At the lower end of the cylinder the inlet ball valves (15) and (16) serve the opposite strokes and at the upper end of the rod (19) extending from the compound plunger is a piston (22) by which it is forced downward for the return stroke through means of the confined oil column (23) within the tubing, and above the piston (22) is a connection (24) for the pump rod or cable for pulling the plunger on the upward stroke.

The compound pump plunger shown may assume any one of a variety of forms, either single or double acting, and the arrangement of the various valves and ports modified to suit. But since such structure is well known to those versed in the art and forms no part of the invented improvements no detailed description of its action is thought necessary.

The tubing is positioned within the oil string by resting on a tapered seat (25) and above that is a standard "packer" (51) sealing the lower end of the space between the tubing and the oil string.

The plunger rod (19) works through a removable head (49) having a tapered seat (50) against an internal portion of the tubing. The head is held to the seat by superior fluid pressure on its upper surface, yet provides means enabling the plunger to be pulled for repairs.

At the upper end of the well is a piston plunger (26) slidable within the tubing or a cylinder barrel communicating with it, and through which piston the rod or cable (7) usually extends as shown in Figure 1A. On top of the piston (26) is a stuffing box member (27) to seal off the cable and the inner-tube space, and above the member (27) is a suitable cable clamp (28) to prevent the cable from falling.

Within the tubing, surrounding the cable is a liquid (23) preferably oil, and kept under sufficient pressure to tension the cable beyond that to which it is subjected to in pumping the well.

The pressure is maintained by injecting liquid through a pipe (29) having a valve (30) and a flexible metal tube (31) leading to any suitable source of liquid pressure such as a pump, not shown.

A gage (32) on the pipe gives an indication of the inner tube pressure at the upper end of the column, and of course if there are no leaks in the line will record a steady pressure, but should it drop the pressure is occasionally restored by injecting more oil, or if desired the tube (31) may be kept open to a supply of oil at a fixed pressure.

In case a rod is used in place of the cable (7) it may be secured to the lower end of the piston (26) instead of passing through, but a cable is better passed through as shown to provide for its adjustment, or for pumping the upward stroke if desired as in ordinary pumping with single acting pump.

At the upper end of the piston (26) is a nut portion (33) serving as a grip for adjusting the stuffing box (34) or for suspending the confined oil column by resting the nut on the upper end of the tubing.

The pumping is effected by moving the piston (26) up and down by means of any suitable mechanism, and whereby the confined liquid column (23) is pushed downward to actuate the pump in a downward direction and the cable is pulled upward to actuate the pump in the upward direction, and of course also to raise the confined oil column (23) for the next downward stroke.

The oil being pumped from the well is forced upward between the tubing and the oil string as indicated at (21) and finds an outlet in a pipe through the upper clamp (10) or flange below it as indicated at (35).

A simple way to apply the alternate push and pull to the column and cable is to hook it up to the walking beam of a standard drilling and pumping rig as indicated in Figure 2 and wherein (36) is the end of the beam, (37) a link connected to a slide or cross head (38) slidable in a pair of channel guides (39) suitably braced at (40) and (41).

The cross head (38) is connected by suitable straps (42) to the member (27) so that it will be forced in both directions upon operation of the beam. Other means might be used for applying a downward push to the liquid column instead of the beam, two such methods being indicated in Figures 4 and 5; in Figure 4 the pressure being applied by means of a liquid from a pump or other suitable source through the pipe (43) to the upper end of a piston (44). The piston (44) is secured to the cable at (45) and has a rod (46) passing through a stuffing box (47), and adapted for pulling on the upward stroke by a cable (48).

In Figure 5 the arrangement is similar except that the piston (44) is omitted so that the forcing down liquid from pipe (43) acts directly against the confined liquid in the tubing (6).

Having thus described my invention it will be seen that it provides for the positive movement in the direction to the plunger of an oil well pump through the agency of a

confined column of liquid combined with a tension member, and that it may be realized by several modifications without departing from the spirit of the invention, any of which coming within the scope of the invention are intended to be embraced in the appended claims.

I claim:

1. In a deep well reciprocating pump, a confined column of liquid of substantially constant length for transmitting an operative impulse in one direction, and a tension device for transmitting an impulse in the opposite direction extending entirely through the confined column.

2. In a deep well reciprocating pump, means for applying a reciprocatory power thereto comprising a tension member, and a confined column of liquid of substantially constant length surrounding the tension member, both adapted for combined or unitary longitudinal reciprocatory movement.

3. In an oil well, a reciprocatory plunger pump at the lower part of the well, a tension member extending down the well from the upper end thereof and secured to the pump plunger for raising the same, a confined column of liquid of substantially constant length above the plunger adapted for forcing it down, and means at the top of the well for alternately applying power for lifting the plunger by the tension member and for forcing it downward by the confined column of liquid.

4. In an oil well, a reciprocatory plunger pump at the lower part of the well, a tension member extending down the well from the upper end thereof and secured to the pump plunger for raising the same, a confined column of liquid of substantially constant length above the plunger adapted for forcing it down, means at the top of the well for alternately applying power for lifting the plunger by the tension member and for forcing it downward by the confined column of liquid, and means for maintaining a pressure on the confined column of liquid.

5. In an oil well, a tube extending down the well with a reciprocatory pump plunger in the lower end thereof, a tension member extending down the tube secured to the plunger for lifting same, a slidable plunger at the upper end of the tube secured to the tension member, and a liquid filling the tube space between the two plungers.

6. In an oil well, a tube extending down the well with a reciprocatory pump plunger in the lower end thereof, a tension member extending down the tube secured to the plunger for lifting same, a slidable plunger at the upper end of the tube secured to the tension member, and a liquid filling the tube space between the two plungers confined under pressure to tension the member.

7. In an oil well, a tube extending down the well with a reciprocatory pump plunger in the lower end thereof, a tension member extending down the tube secured to the plunger for lifting same, a slidable plunger at the upper end of the tube secured to the tension member, and a liquid filling the tube space between the two plungers confined under pressure to tension the member and means for reciprocating the upper plunger.

8. In an oil well, a plunger pump therein, a member extending down into the well and secured to the plunger of the pump for lifting same, a tube extending down into the well surrounding the member and in which the plunger is operable, means in the upper end of the tube for sealing the member and tube, and a liquid under pressure within the tube to tension the member.

9. In an oil well, a plunger pump therein, a tension member extending down into the well and secured to the plunger for lifting same, a tube surrounding the tension member and having an extension in which the plunger operates, and means at the upper end of the tube sealing the tension member to confine the space within the tube between the plunger and the upper end of the tube, said means being slidable in the upper end of the tube.

10. In an oil well, a plunger pump therein, a tension member extending down into the well and secured to the plunger for lifting same, a tube surrounding the tension member and having an extension in which the plunger operates, and means at the upper end of the tube sealing the tension member to confine the space within the tube between the plunger and the upper end of the tube, said means being slidable in the upper end of the tube, and a liquid under pressure filling the space within the tube.

11. In an oil well, a plunger pump therein, a tension member extending down into the well and secured to the plunger for lifting same, a tube surrounding the tension member and having an extension in which the plunger operates, and means at the upper end of the tube sealing the tension member to confine the space within the tube between the plunger and the upper end of the tube, said means being slidable in the upper end of the tube, and a liquid under pressure filling the space within the tube, and means for maintaining the pressure on said liquid.

12. In an oil well, a plunger pump therein, a tension member extending down into the well and secured to the plunger for lifting same, a tube surrounding the tension member and having an extension in which the plunger operates, and means at the upper end of the tube sealing the tension member to confine the space within the tube be-

tween the plunger and the upper end of the tube, said means being slidable in the upper end of the tube, and a liquid under pressure filling the space within the tube, and means above the well connected to the tube space for indicating the pressure of the liquid at the upper end of the column.

13. In an oil well, a pump therein having a reciprocatory plunger mechanism, a confined column of liquid above the pump for forcing the plunger downward, and a device secured to the plunger mechanism for pulling the plunger and the confined column of liquid upward and bodily raising the same to a higher elevation.

14. In an oil well, a pump therein having a reciprocatory mechanism, means for transmitting reciprocatory motion thereto comprising a pipe from the pump to the upper part of the well having spaced plungers slidable therein, a tension resisting device extending through the pipe connecting the plungers and a liquid filling the pipe space between the plungers whereby the movement of one plunger in either direction causes a corresponding movement of the other plunger.

15. In an oil well, a pump therein having a reciprocatory plunger mechanism, a device extending into the well secured to the mechanism, a confined column of liquid surrounding the device extending from the mechanism to the upper part of the well, means at the top of the well for forcing the liquid downward to correspondingly move the mechanism and means at the top of the well for pulling the device upward to lift the mechanism and the confined column of liquid bodily to a higher elevation.

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