Feb. 25, 1936. C. C. BROWN ET AL 2,032,000

MEANS FOR RAISING FLUID FROM DEEP OIL AND WATER WELLS

Filed Sept. 15, 1933 2 Sheets-Sheet 1

Fig. 1.

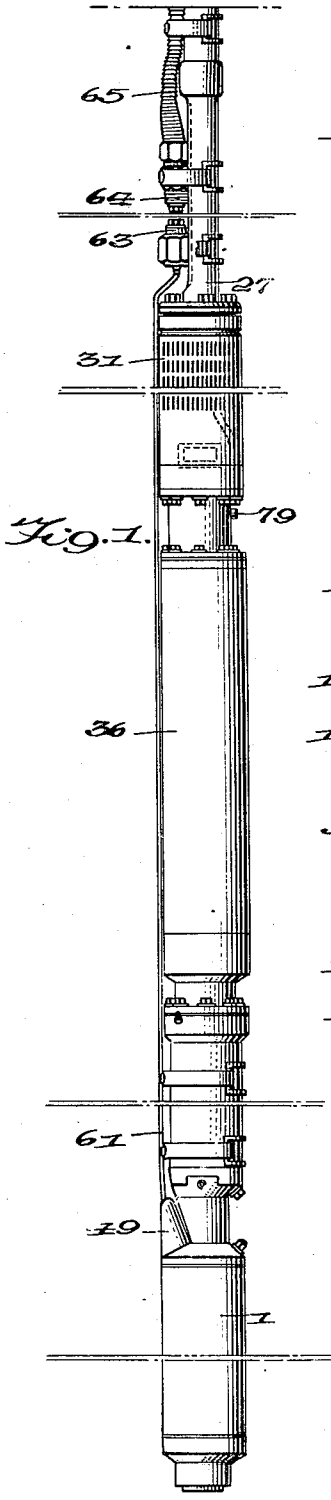


Fig. 2.

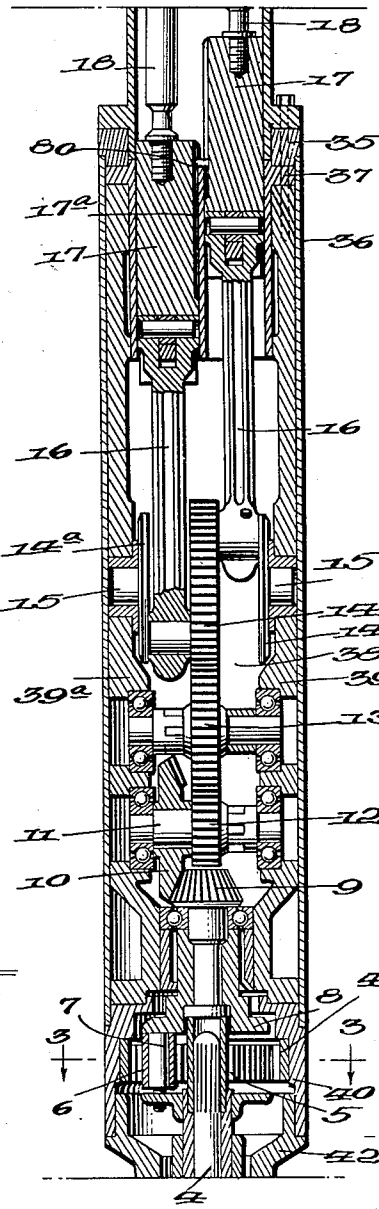


Fig. 3.

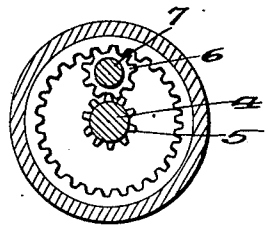
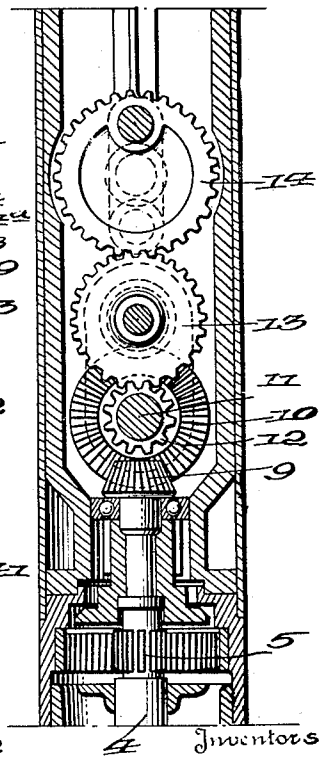


Fig. 4.



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Filed Sept. 15, 1933 2 Sheets-Sheet 2

Fig. 5.

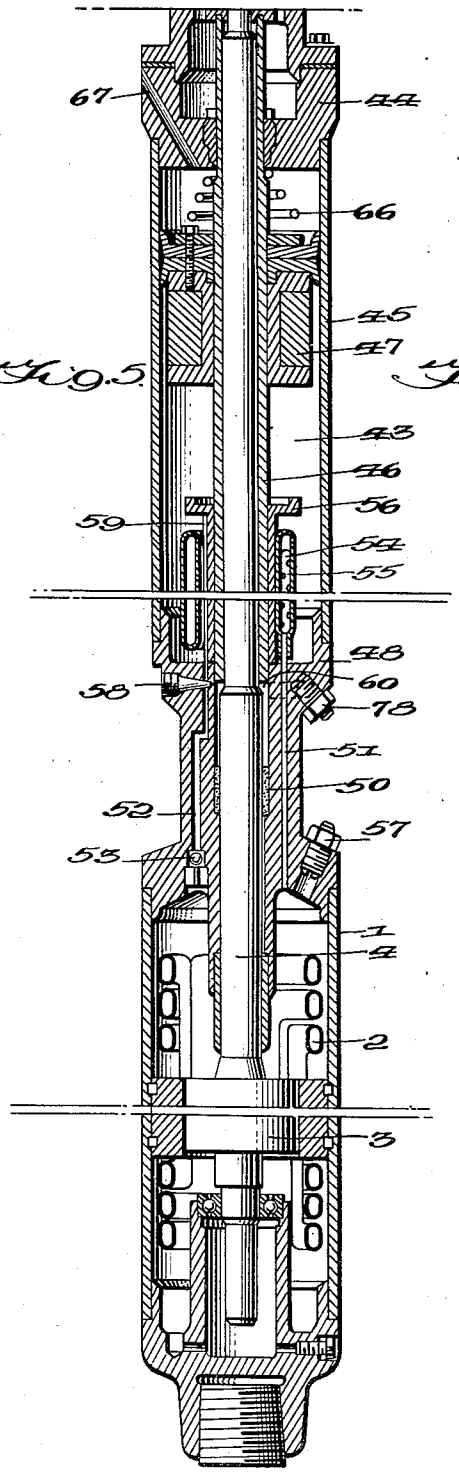
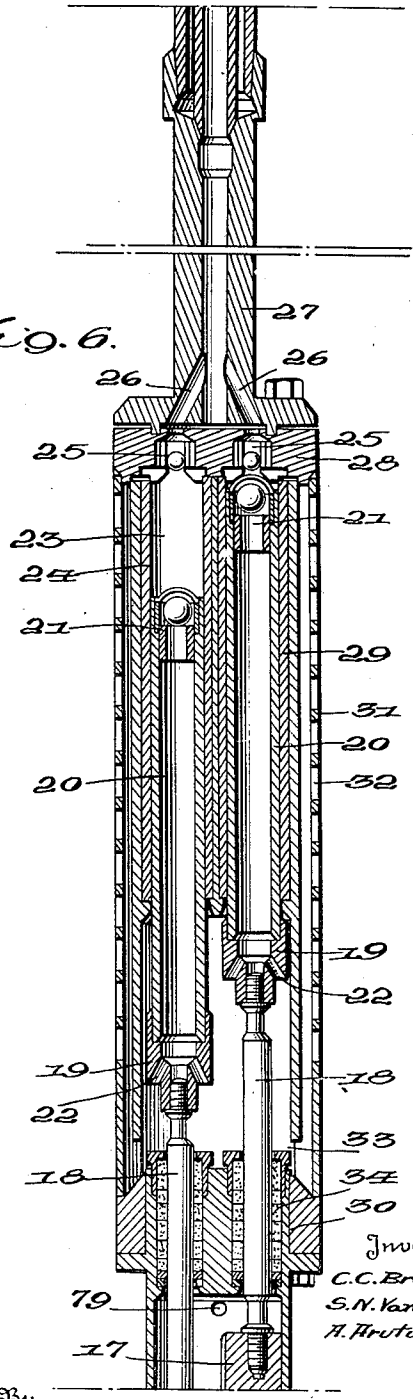


Fig. 6.



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MEANS FOR RAISING FLUID FROM DEEP OIL AND WATER WELLS

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4 Claims. (Cl. 103—46)

Our invention consists in new and useful improvements in mechanism for raising fluid from deep oil and water wells and has for its primary object to provide a novel combination of a pump, submergible electric motor, transmission and lubricating and protecting unit, so constructed and arranged that the entire assembly may be lowered into the well as a single unit.

Another object of our invention is to provide an efficient means for transforming the rotary motion of the vertical shaft of an electric motor into reciprocating motion of the pump stems.

A further object of our invention resides in a novel lubricating unit for insuring the proper lubrication of the working parts of the pump and for facilitating the protection of the electric motor and transmission during submersion.

Still another object of our invention is to provide, in a device of this character, means whereby different sizes of plungers or pistons and liners may be used and whereby the changing from one size to another may be accomplished conveniently in the field.

A still further object is to provide in a vertical duplex pump for oil wells, an arrangement whereby, for a given well size, plungers of a maximum diameter may be employed. In other words, larger plungers may be used than the size normally prescribed by the center distance between the pump stems.

Still another object is to provide an arrangement of cross heads and stationary guides whereby, when it is necessary to unscrew an old plunger and replace it with a new one, the cross heads are prevented from rotating by the stationary guides.

With the above and other objects in view, which will appear as the description proceeds, our invention consists in the novel features herein set forth, illustrated in the accompanying drawings and more particularly pointed out in the appended claims.

Referring to the drawings in which numerals of like character designate similar parts throughout the several views:

Fig. 1 is a view in side elevation showing the complete assembly of our invention.

Fig. 2 is an enlarged sectional view of the transmission unit.

Fig. 3 is a transverse sectional view taken on line 3—3 of Fig. 2.

Fig. 4 is a transverse sectional view of the gearing mechanism taken at right angles to Fig. 2.

Fig. 5 is an enlarged sectional view of the motor and protecting unit showing at its upper end the point of connection with the transmission unit, and

Fig. 6 is an enlarged sectional view of the pump unit showing at its lower end the point of connection with the transmission unit.

In the drawings, 1 represents the housing of an electrical submergible motor comprising a stator 2 and a rotor 3. A motor shaft 4 extends vertically upwardly and is splined at its upper end to operatively carry a spur gear 5 (Figs. 2 and 3) which through the medium of planetary gears 6 on pins 7 of a spider 8, rotates a bevel pinion 9, the latter in turn operatively engaging a bevel gear 10 carried on the transverse shaft or axle 11. A gear 12 carried by the axle 11 meshes with an intermediate gear 13 and through it transmits power to a toothed crank shaft gear 14 supported on bearings 15.

The crank shaft gear 14 is formed with disc-like sides 14a as shown in Fig. 2, and is preferably machined out of a solid sphere-like forging, the gear, sides and bearings 15 being integral. This gear is operatively connected by means of connecting rods 16 to cross heads 17 which support the lower extremities of pump stems 18, the latter being connected at their upper ends to hollow plungers 20 by means of suitable adapters 19 as shown in Fig. 6. It will be noted that the distance between the centers of the pump stems 18 is greater than the distance between the centers of the cross heads 17. This arrangement permits the combination in a unit of a given outside diameter, the maximum strength of crank mechanism with plungers of a maximum diameter, a feature of great importance in handling large volumes of fluid.

Each plunger 20 is equipped with a valve 21, preferably of the ball type, at its upper end and is open to communication with intake passageways 22 in the respective adapters 19. The plungers 20 are reciprocably mounted in a liner 24 in cylinder block 29, which is enclosed in a cylindrical screen-like casing 31. The casing 31 is perforated as at 32 throughout the greater portion of its area and is closed at its upper extremity by a discharge valve plate 28 connected in any suitable manner to a discharge connection 27, the latter being provided with valves 25 and discharge passageways 26 which converge in communication with a central discharge conduit. The lower extremity of the casing 31 is closed by a packing housing 30 having stuffing boxes 34 through which the valve stems 18 reciprocate.

The cylinder block 29 is provided with intake ports 33 at its lower extremity, said ports being

located below the perforations 32 in the screen or casing 31, whereby a gas separating action is effected on the fluid entering the screen 31.

The packing housing 30 extends downwardly from the pump unit and is connected by any suitable means to the upper end of the jacket 36 which encloses the gear transmission mechanism heretofore described, said jacket having welded at its upper end a ring 35 and cross head guide piece 37 in which the cross heads 17 operate. The cross head pieces 17 are provided with grooves 17a adapted to engage a stationary key piece 80 in the guide 37, whereby the pump stems 18 may be screwed and unscrewed in the cross heads without effecting any torque on the parts below the cross heads.

The whole transmission mechanism 38 (Fig. 2) is tightly enclosed in the jacket 36 with the cross head guide piece 37, crank shaft gear 14 with its bearings 15 and the other associated gears, assembled in a supporting frame made up of two semicircular sections 39 and 39a which extend longitudinally in the jacket 36. These semicircular sections 39 and 39a are assembled in the form of a cylinder and are secured at their lower ends to a member 40 which houses a stationary internal gear 41 with which the planetary gears 6 are adapted to cooperate.

A member 42 is suitably connected to the member 40 and is in turn connected to the upper part 44 of a lubricating reservoir 43. The lubricating reservoir 43 comprises a housing 45 connected to member 44 and has a longitudinally extending central tube 46 which operatively supports a relatively heavy piston 47, the lower extremity of the housing 45 being connected to a bottom piece 48 which also serves as the upper end of the motor unit. The member 48 is provided with a terminal outlet 49 (Fig. 1) and has a stuffing box 50 which surrounds the motor shaft 4, protecting oil passageways 51 and 52 extending longitudinally through member 48 from the oil reservoir to the motor casing, the latter passageway being provided with a relief valve 53 as shown in Fig. 5.

Inside of the lubricating reservoir 43 and in the lower portion thereof is located a breathing member 54 which is preferably in the form of a collapsible tube of suitable resilient material, said tube being in communication on its inner side with the oil in the motor housing, through conduit 55 and passageway 51. The outside of the tube 54 is exposed to the lubricant in reservoir 43 and is therefore subjected to the pressure of the heavy piston 47, said piston being prevented from coming in direct contact with member 54 by a suitable stop plate 56. It will be noted that while we have shown and described the breathing member 54 as being in the form of a resilient tube, we may employ different embodiments such for example as pistons, bellows or the like suitably arranged for effecting this same function.

A plugged or valved opening 57 in the upper part of the motor housing serves as an oil charging inlet for the motor. A valve 58 is located in the passageway 52 to control communication through a pipe or tube 59 between the lubricant reservoir 43 and the motor chamber. The reservoir 43 is also in communication through pipe 59 and valve 58, with a recess 60 in the top piece 48 of the motor housing, said recess opening to the exterior through a check valve 78 by means of which lubricating oil is forced into the assembly.

Before this unit is set into operation, a cable conduit 61 (Fig. 1) is connected to the terminal outlet 49 and the motor is filled with transformer oil through valve 57. Valve 58 is opened by unscrewing it to its outermost position, opening communication through tube 59, between the lubricant reservoir and recess 60. Lubricating oil is then forced through valve 78 into recess 60 from whence it travels upwardly into the clearance between shaft 4 and the central tube 56, filling the entire space surrounded by housing 45. This filling is continued until oil appears at the air outlet 79 at the upper end of the transmission, which is then closed by a suitable plug. After closing the outlet 79 the forcing of lubricant is continued until piston 47 has been raised by the pressure of the fluid to its uppermost position, compressing the spring 66 in the upper portion of the chamber 45 and further forcing of oil becomes difficult. It will be noted that the space in chamber 45 above the piston 47 is nominally in communication with the exterior by means of a passageway 67 located in the member 44 forming the top of the lubricating unit.

An electrical cable 65 (Fig. 1) is attached with its part 64 hermetically sealed in connection with the end 63 of conduit 61 and the whole unit is lowered into the well suspended from the discharge tubing and submerged in the liquid to be pumped.

When the motor is started and the pump set into operation, the expansion of the motor oil causes the breathing element 54 in the oil reservoir 43 to expand, and when the motor is stopped and oil cools, the breathing element 54 contracts therewith. With this arrangement it will be seen that at all times the pressure in the motor chamber and in the transmission chamber is higher than the pressure of the fluid in which the unit is submerged, as the weight of the heavy piston 47, supplemented by the submergence pressure on its upper side through openings 67, acts on the oil in reservoir 43 which in turn, through breathing member 54, controls the pressure in the motor chamber.

It will be readily apparent to those skilled in the art that lubricant under pressure is necessary for the prolonged operation of the power-head mechanism. It is also necessary that the pressure on the inside of the unit be higher than the submergence pressure to prevent access of endangering corrosive well fluid to such parts of the mechanism as the motor, gears and bearings, etc., through the clearance around the stems 18 or through loose joints or the like.

With our improved combination of elements wherein the same piston is employed for maintaining both the lubricant and the insulating oil under the same pressure but in separate compartments and wherein the lubricating chamber houses the breathing element for the motor, we have provided a compact and efficient structure for insuring not only the proper lubrication of the working parts of a duplex pump mechanism, but the protection of such mechanism from the deleterious effect which would otherwise result from the access of submergence fluid.

Furthermore, this arrangement permits the efficient and convenient use of a high speed vertical electric motor located below the pump for producing a reciprocating motion of the pump stems.

Also the particular arrangement of hollow plungers 20 carrying the travelling valves 21 per-

mits the construction of a pump chamber with a minimum dead space between the travelling valves 21 and standing valves 25. In other words, it allows the handling of gaseous liquids under a high compression ratio comparable to that of high pressure gas compressors.

From the foregoing it is believed that this invention may be readily understood by those skilled in the art without further description, it being borne in mind that numerous changes may be made in the details disclosed, without departing from the spirit of the invention as set forth in the following claims.

We claim:

1. In combination, a submergible electrically driven reciprocating pump unit for oil wells, an oil filled motor unit below said pump unit, an oil filled transmission unit between said pump and motor units, means for operatively connecting said transmission unit to said pump and motor units, a separate oil filled lubricating unit interposed between said motor unit and transmission unit for supplying lubricant to said motor and transmission units, means for securing said units together in axial alignment, and means for creating a pressure in said lubricating unit greater than the submergence pressure.

2. In combination, a submergible electrically driven reciprocating pump unit for oil wells, an oil filled motor unit below said pump unit, an oil filled transmission unit between said pump and motor units, means for operatively connecting said transmission unit to said pump and motor units, a separate oil filled lubricating unit interposed between said motor unit and transmission unit for supplying lubricant to said motor and transmission units, means for securing said units together in axial alignment, means for creating a pressure in said lubricating unit greater than the submergence pressure, and a breather member arranged in said lubricating unit in communication with said motor unit and responsive to the pressure in said lubricating unit.

3. In combination, a submergible electrically driven reciprocating pump unit for oil wells, an oil filled motor unit below said pump unit, an oil filled transmission unit between said pump and motor units, means for operatively connecting said transmission unit to said pump and motor units, a separate oil filled lubricating unit comprising a cylindrical chamber interposed between said motor and transmission units for supplying lubricant to said motor and transmission units, a weighted piston in said chamber, means for placing the area of said chamber above said piston in communication with the exterior of said chamber, whereby the weight of said piston supplemented by the submergence pressure, creates a pressure in said lubricating unit greater than the submergence pressure, and means for securing said units together in axial alignment.

4. The combination as claimed in claim 3 including a breather member arranged in said lubricating chamber in communication with said motor unit and responsive to the pressure in said lubricating unit.

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