Nov. 30, 1937. F. W. KENNEDY 2,100,560

DEEP WELL PUMP

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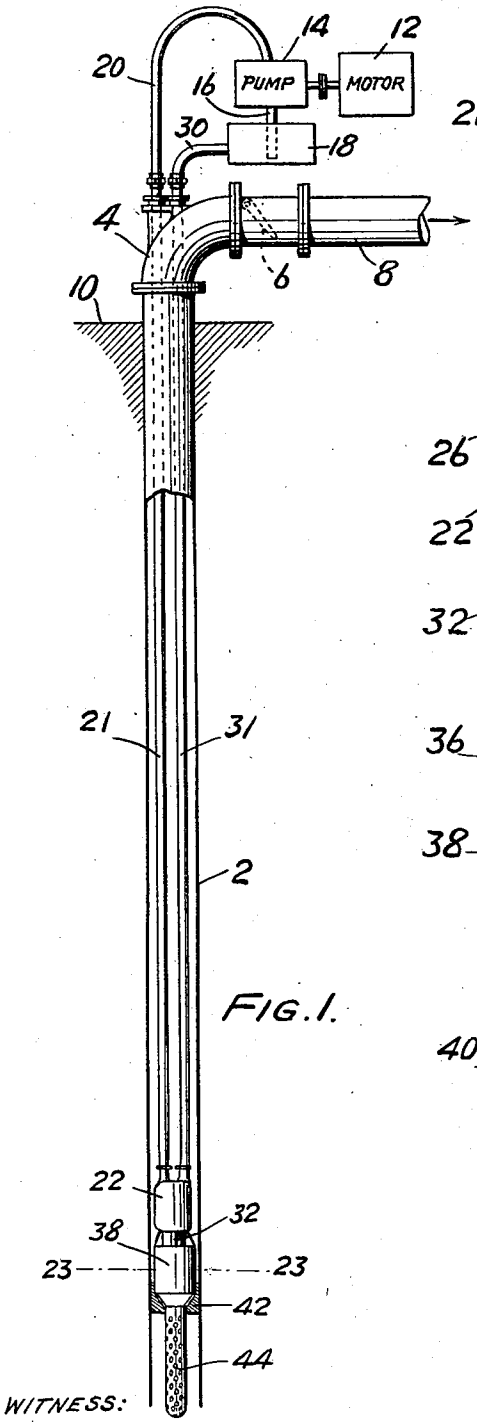

FIG. 1.

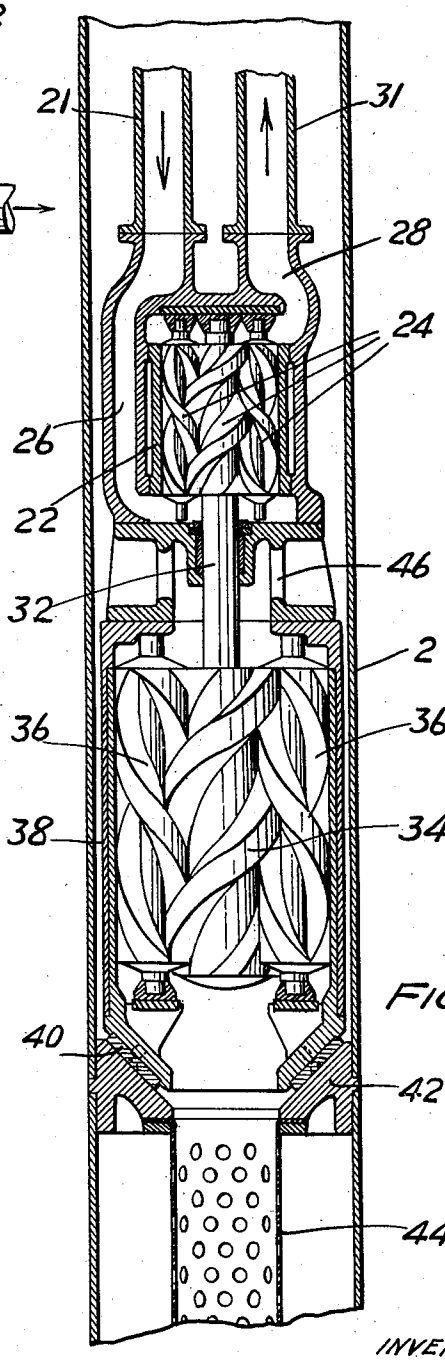

FIG. 2.

WITNESS:

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DEEP WELL PUMP

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1 Claim. (Cl. 103—118)

This invention relates to an improvement in deep well pumps and more particularly to such pumps in which the pump is of a screw type.

This application is in part a continuation of my prior application Ser. No. 640,600, filed November 1, 1932, now abandoned.

Heretofore it has been customary in various types of deep well pumping systems to provide a pump unit positioned at or near the bottom of a well and to drive the pump by means of a motor positioned outside the well through the medium of a line shaft. Such systems are generally disadvantageous, more especially in connection with wells of substantial depth, since the provision of a long line shaft presents various problems and is objectionable.

In accordance with the present invention, there is provided a deep well pump of such character as to eliminate the necessity for the use of a line shaft and at the same time, one which will be efficient and economical in operation; also one in which the pump unit may be readily introduced into and removed from a well for inspection and repair.

More particularly, in accordance with this invention, there is provided a combined pump and motor unit, the motor being adapted to be driven by hydraulic power transmitted from without the well and the unit as a whole being adapted to be readily positioned within the well in combination with a well casing and to be readily removed for inspection and repair without the necessity for disturbing the casing or other parts.

The combined pump and motor unit in accordance with this invention may, under certain aspects thereof, comprise any suitable type of positive displacement hydraulic pump and motor, but desirably the pump and motor will be of the screw type and for maximum efficiency the motor, and desirably also the pump, will be of the type described in United States Letters Patent No. 1,698,802, dated January 15, 1929, to C. O. J. Montelius, to which more detailed reference will be made hereinafter.

The hydraulic motor included in the pump-motor unit may be driven from any source of hydraulic power as, for example, a suitable pump which, for maximum efficiency, may be desirably of the type described in the Montelius patent above referred to. The transmission of power to the motor is through a suitable pipe desirably extending within the well casing. If the same liquid is used for driving the motor as is being lifted by the pump from the well then the discharge from the motor may mingle with and rise out of the well with the discharge from the pump. The liquid that is pumped out of the ground may be water, which often contains a certain amount of sand, or it may be crude oil, which also may contain sand. When any positive displacement pump is used, any abrasive material such as sand will tend to cause scoring, particularly if the clearances are close. The pump ordinarily works on a smaller pressure differential than does the motor and the sand is therefore not quite so objectionable in the pump, particularly since the clearances may be made somewhat larger and nevertheless a substantially satisfactory efficiency attained. On the other hand, it is not desirable that any such abrasive material should enter a positive displacement motor, for example, of the type shown in the Montelius patent, particularly since the clearances of such motor should be maintained at a minimum to obtain a maximum efficiency and a maximum amount of work for a given amount of driving liquid.

Accordingly, in the preferred embodiment of the invention specifically disclosed herein, a separate fluid, such as oil, is used for driving the motor so that no wear will take place in this part of the equipment due to the presence of foreign abrasive materials. Furthermore, the efficiency of a motor is considerably higher when supplied with a lubricating oil than it would be when supplied with water or crude oil that have practically no lubricating value at all.

The pump and motor in accordance with the invention are preferably arranged within a casing on a single shaft in such manner that end thrust will be balanced, and the casing is arranged for cooperation with the well casing so that water may be pumped out of the well through the well casing without the provision of any special discharge piping, and at the same time so that the pump-motor unit may be readily introduced into and removed from the well.

Detailed objects of the invention will be apparent from the following description read in conjunction with the accompanying drawing, in which:

Fig. 1 is a side view, partly broken away, of a deep well pump system in combination with a well casing in accordance with the invention; and

Fig. 2 is a sectional view of a pump-motor unit embodying the invention, this unit being shown in combination with a well casing.

Referring more particularly to Fig. 1, there is indicated at 2 a well casing provided at its upper end with an elbow 4 which is connected through a check valve 6 to a pipe line 8 leading to any

point to which it is desired to deliver the water or oil as, for example, a reservoir or tank. The elbow 4 in the structure shown is above the ground level, which is indicated at 10.

Mounted adjacent the upper end of the casing 2 is a motor 12 which may be of any suitable type, as a steam turbine, internal combustion engine, electric motor, or the like, which is connected to drive a pump 14, which may be of any suitable type, for example, a plunger pump, a centrifugal pump, or a screw pump of the Montelius or other type. This pump receives the driving liquid through an inlet pipe 16 from a suitable reservoir or storage tank 18 and discharges through a pipe 20 connected to a pipe 21 within the well casing by means of a suitable union. The pipe 21 passes through a suitable stuffing box in the elbow 4 and is connected at its lower end to a pump motor unit as indicated in Fig. 2, the pump of this unit being below the water level, which is indicated by the line 23—23.

The hydraulic motor is indicated generally by the numeral 22 and comprises a housing forming a receptacle for a plurality of screws 24 of the Montelius type. This type of motor is preferred because of its high efficiency and the fact that it is of positive displacement type so that a maximum amount of work may be obtained from a given quantity of driving liquid handled. The inlet to this motor is indicated at 26, the liquid entering below the screws which are provided with thrust bearings at their upper ends and being discharged into the passage 28 which communicates with a pipe 31 paralleling the pipe 21 and extending through a suitable stuffing box in the elbow 4 above which it is connected by a suitable union with a pipe 30 delivering the discharge into the supply reservoir 18.

The shaft 32 which carries the power screw of the motor supports the central screw 34 cooperating with a plurality of idler screws 36 constituting the members of the pump 38, these screws being received within a suitable housing and being provided with thrust bearings as indicated. While the motor and pump are shown as of the triple screw type, it will be clear that they may be satisfactorily of any of the types described in the said Montelius patent, all of which have substantially the same characteristics of high efficiency and positive displacement. Other types of screw pumps may be used but are not so satisfactory because of low efficiency.

The casing of the pump 38 is tapered as indicated and provided with a suitable seat 40 contacting with the tapered inner surface of an annular partition wall 42 fixed in the casing. A central opening of this is joined to a strainer, indicated at 44, which prevents any large foreign objects from entering the pump. The pump, as indicated in Fig. 1, is at least partially submerged so that it will pick up the liquid, priming itself, and discharge through the openings 46 into the upper portion of the well casing by which it is delivered to the surface.

By the use of the arrangement which is disclosed, it will be noted that the driving fluid for the motor 22 is kept separate from the liquid handled by the pump 38. In case the motor is to be driven by the liquid which is removed from the well, then a certain portion of this liquid may be by-passed to the pump 14 and delivered to the motor 22. In this case, of course, there is no necessity for preventing mingling of the driving liquid and the liquid which is pumped so that the pipe 31 and its connections may be dispensed with.

If the liquid handled by the pump 38 is to be used for driving the motor 22, then it is taken from the delivery side of the check valve 6 by the pump 14.

The motor and pump, as pointed out above, are desirably of the type described in the Montelius patent and comprise a plurality of screws within housings, the screws being of opposite pitch and the helicoidal surfaces of each thread of at least one screw being both substantially concave and those of each thread of at least one cooperating screw being both substantially convex so that the screws will fit to each other along an uninterrupted contact line defined by parts of the outside edges of the said helicoidal surfaces and by the lines generating the outside perimeters of the threads and by those generating the inside surfaces of the screw grooves. In the case of a triple screw pump, the central screw has convex threads and the outer screws concave ones. For a more complete description of such pumps or motors, reference may be made to the said Montelius patent. The pitches of the component screws of the motor and the pump are preferably such that both will operate without gearing and with minimum loss. Furthermore, the design is preferably such that the idler screws do little, if any, work.

In operation, the motor 12 drives the pump 14, supplying liquid under pressure to the motor 22, which in turn drives the pump 38, having a considerably greater capacity per revolution. The seal formed between the motor-pump casing and the shoulder 42 in the well casing will be maintained tight by the weight of the motor-pump unit and by the weight of the columns of water in the well casing and will prevent flow back of the column of water into the supply.

As more specifically illustrative of the operation, for example, without consideration of losses due to friction, etc., if the pump 14 delivers to the motor 22, 100 g. p. m. against 1,000 feet head, the pump 38 within the well will deliver upwards of 1000 g. p. m. against 100 feet head.

If and when it is desirable to inspect the motor 22 and/or pump 38, both as a unit may be readily withdrawn from the well after disconnecting elbow 4 and pipes 20 and 30 by merely withdrawing the pipes 21 and 31 with the unit attached. It will be noted that the gasket 40 is desirably secured to the tapered surface of the casing 38 so that it may readily be replaced on withdrawal of the unit.

The check valve 6 is provided to prevent the return of liquid which is pumped into the well when the motor 22 is not operating, since under such conditions it could pass downwardly through the pump 38 driving it as a motor and possibly causing trouble due to reversal of flow through the pump 14. The check valve prevents this action. The check valve is also important if the liquid pumped from the well is in part used for driving the motor 22. In such case, as noted above, the liquid for the pump 14 should be drawn from the discharge side of the check valve 6. Under such conditions, of course, in starting up, liquid would have to be supplied from an outside source to the pump 14.

What I claim and desire to protect by Letters Patent is:

In combination with a well casing, a well pump unit including a hydraulic motor, a pump mounted in a housing adjacent the motor, and driving

connections between the motor and pump; a conduit arranged within the casing to lead liquid from the surface to drive the motor; and another conduit arranged within the casing to return the motor driving liquid to the surface separately from the liquid being pumped; said casing being provided with a seat engageable by a portion of said housing below the pump, whereby, when the unit is in operative position, communication, except through the pump, is cut off between the portions of the casing above and below said seat.

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