Sept. 3, 1946. D. H. MILLARD 2,406,959

ROTARY PUMP

Filed Aug. 21, 1944 2 Sheets-Sheet 1

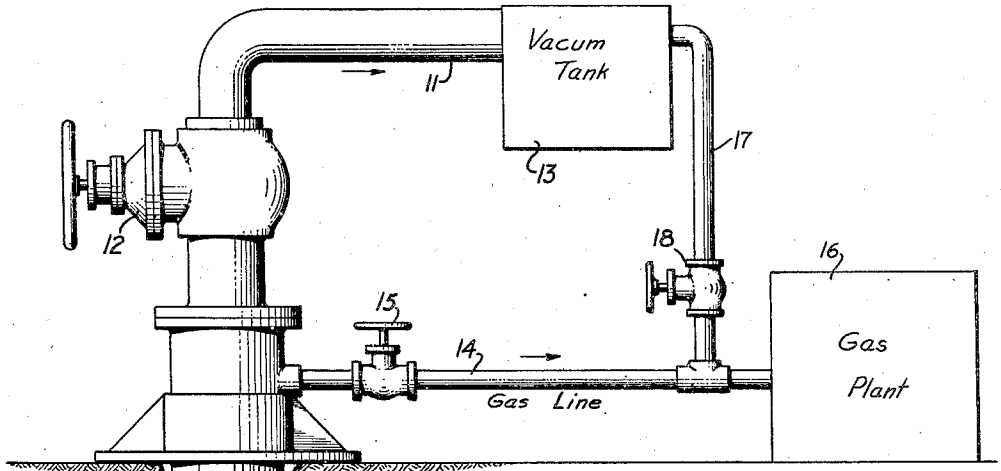


Fig. 1

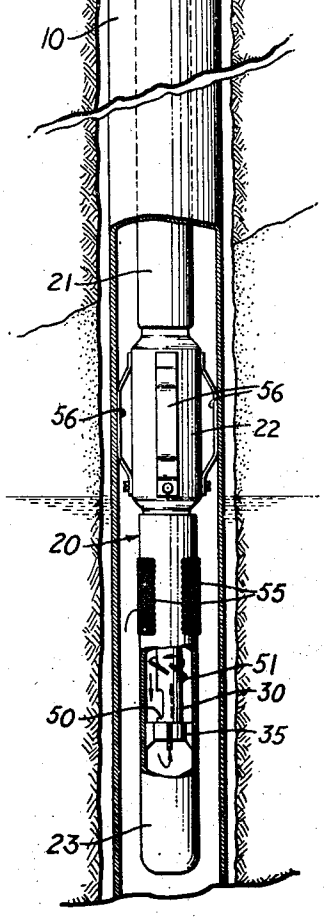
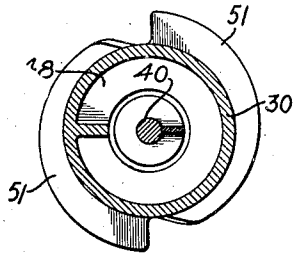


Fig. 5



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Fig. 2

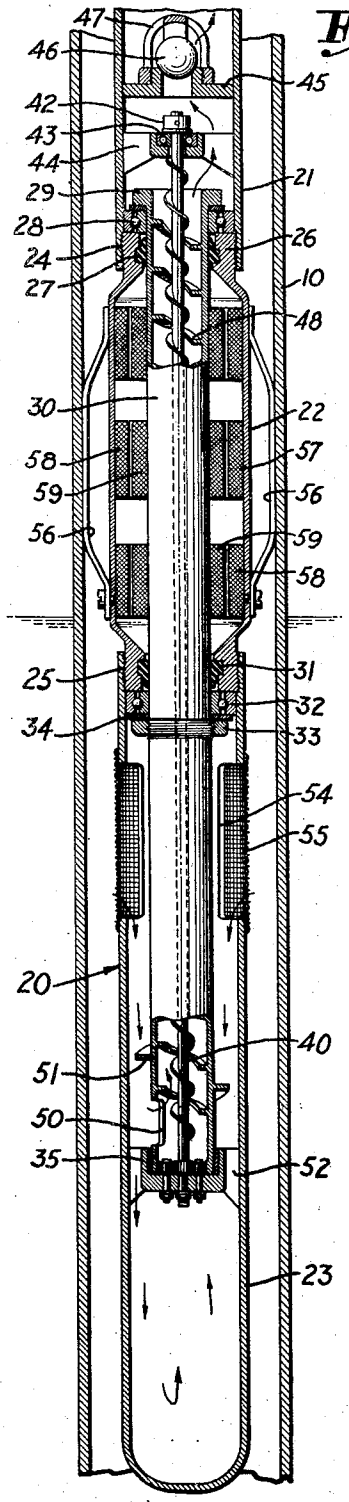


Fig. 3

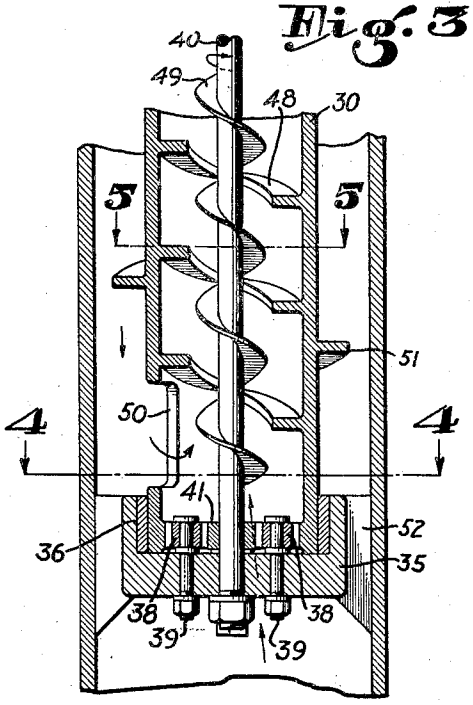
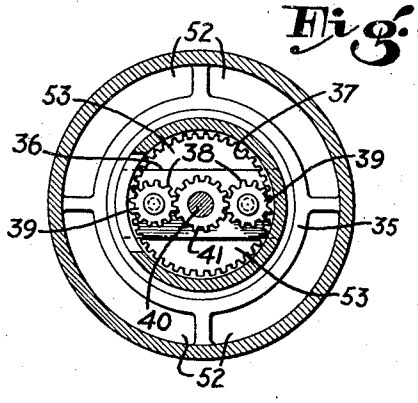


Fig. 4



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UNITED STATES PATENT OFFICE

2,406,959

ROTARY PUMP

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Application August 21, 1944, Serial No. 550,426

6 Claims. (Cl. 103—87)

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This invention relates to pumping machinery and more especially to a rodless pump particularly adapted for use in deep wells or horizontal pipe lines of considerable length.

An object of the invention is to provide a novel, self-contained rodless pump structure adapted for operation in deep water wells or other deep wells such as are commonly used in the oil well industry, or for use on ships or other similar applications.

Another object of the invention is to provide a novel rodless pump, as described, wherein a plurality of pumps may be employed in the same pipe or casing, whereby increased load operations may be effected.

An additional object is to provide a rodless pump of the screw impeller type wherein efficiency is increased, due to a minimized turbulence of the pumped liquid.

Another object of the invention is to provide a self-contained rodless pump which can be secured on the slips of a conventional oil well line and provides electric motor driving means powered from wires extending through the pipe or casing.

Another object is to provide a novel pump for deep wells or long pipe lines having a minimum of rotating or moving parts wherein is provided a motor, the rotary fields of which are secured to one of the rotating pump members.

An additional object is to provide a rotary rodless pump incorporating a tubular impeller of the screw blade type having an internal screw blade which produces a substantially uniform and non-turbulent column of liquid to be pumped.

Other objects and advantages will be made apparent from a further consideration of the description and drawings.

In the drawings:

Figure 1 is an elevation view partly in section showing a well pipe and the pump of my invention therein.

Figure 2 is an enlarged elevation view in section of the pump.

Figure 3 is an enlarged fragmentary view in section showing the lower portion of the pump shown in Figure 2.

Figure 4 is a sectional view taken along the line 4—4 of Figure 3.

Figure 5 is a sectional view taken along the line 5—5 of Figure 3.

Referring more particularly to the drawings, I show a stand of pipe 10, such as an oil well casing, extending into the ground, pipe 10 being connected to a vacuum line 11 through a valve 12 and connected to a vacuum tank 13. A gas line 14 is connected to pipe 10 below valve 12 and provided with a control valve 15 and connected to a suitable gas plant 16. A pipe 17 connects vacuum tank 13 with pipe 14 through a valve 18.

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My invention comprises, in essence, a pump 20 adapted for positioning in pipe 10 and consists of tubular portions 21, 22 and 23 which are detachably interconnected, as by threaded portions 24 and 25. Tubular portion 22 has an annular shoulder 26 which is recessed to provide a mounting for a ring packing 27, and the shoulder supports a thrust bearing 28 which rotatably carries the flanged end 29 of a rotary tubular impeller member 30 which extends downwardly through tubular portions 22 and 23. Tubular portion 20 is provided with a ring packing 31 at the reduced lower end thereof, and a guide bearing 32 is positioned between the end of tubular portion 20 and a collar 33 threaded secured on impeller 30, a packing ring 34 being provided between bearing 32 and collar 33.

A web member 35 is provided and suitably secured or formed integrally within tubular member 23 and has an upwardly opening recess 36 into which extends the lower end of impeller 30. Impeller 30 is provided with a ring gear 37 immediately within the lower end opening thereof, which gear meshes with a pair of pinions 38, suitable bearing pins 39 for which are secured in a portion of web 35 which extends diametrically thereacross.

A rotary impeller member 40 extends through impeller 30 and is provided with a gear 41 suitably secured thereto which meshes with pinions 38. Web 35 provides a bearing aperture for the shaft of impeller 40. A thrust collar 42 is suitably secured to the upper end of impeller shaft 40 and is carried by a bearing 43 suitably housed in a web member 44 secured within or formed integrally within tubular member 21.

A flange 45 is secured within tubular member 21 above impeller 40 and has a central opening and valve seat for a ball valve 46 which is restrained within a cage or retainer 47 on flange 45 having suitable fluid discharge openings.

Impeller 30 is provided with an internal spiral blade 48 and impeller 40 is provided with an external spiral blade 49, the said spirals being right-handed and left-handed respectively. Impeller 30 is provided with one or more ports 50 near the lower end thereof and is also provided with an external spiral blade 51 which comprises a few turns adjacent the lower end thereof. Web 35 provides a plurality of passages 52 for the

passage of fluid upwardly therethrough. The diametrically extending bar portion of web **35** provides passages **53** for fluid to enter impeller **30** which fluid may also enter through ports **50** and passages **52**.

Tubular member **23** has a plurality of side openings **54** suitably covered by screens **55** which permit fluid to enter the tubular member which member is closed at the bottom thereof, as shown in Figure 2. Tubular member **22** may, if desired, have a plurality of anchor spring members **56** secured thereon, which springs serve to center the pump within pipe or well casing **10** and also serve to prevent any tendency of the pump casing to turn due to reaction from the motor. A motor **57** is provided within member **22** and comprises stationary fields **58** secured to tubular member **22** and rotary or armature fields **59** secured to impeller **30**. Suitable power wires for motor **57** (not shown), are provided and extend upwardly through pipe **10** to a suitable source of power. If desired a pressure actuated switch for controlling the operation of motor **57** may be provided, such that the pump will start and stop when the pressure of the fluid varies between selected limits.

From this detailed description of the invention the hereinabove stated objects and advantages should be obvious and the operation of the invention should be apparent. In normal operation the pump will be lowered in a well to a position, as shown in Figures 1 and 3, wherein the inlet openings **54** are somewhat below the liquid level indicated. The liquid flows into tubular member **23** through openings **54** and, upon operation of the motor, the impellers **30** and **40** rotate in opposite directions and spiral blades **51** on the outside of impeller **30** draw the liquid downwardly, some of which enters impeller **30** through ports **50**, and the remainder is drawn downwardly through passages **52** and upwardly into the impeller through passages **53**. The liquid thereafter rises in and through impeller member **30** in a substantially solid column without appreciable turbulence, due to the opposite direction of rotation of impellers **30** and **40**. The liquid is lifted through web member **44** and check valve **45—46** and is lifted through the tubular hanger structure and through pipes **11** or **14** to the gas plant **16**.

Although I have shown my invention applied to a vertical well or pipe line, it should be clear that the pump will operate at an angle from the vertical, or even horizontally, and is adapted for use in horizontal systems, such as cross country pipe lines wherein pressure boosters of the type comprising this invention may be employed at desired intervals. The operation of the motor means, which in the present case is shown and described as an electric motor, may however comprise a turbine, such as a gas turbine, which would operate from the gas derived from the oil well in which it might be situated, or any rotary type of power means may be employed if desired. The operation of the motor may be made automatic by the use of a conventional pressure actuated switch which starts and stops the pump whenever the operating head varies between predetermined limits.

The invention, as shown and described, discloses the pump secured to and discharging into a pipe within the well casing. However, the pump may be supported from a cable and, by being provided with suitable packing means, discharge directly into the well casing above the pump. The pump is adaptable to numerous other specific forms of structure and can be used whenever

pumps generally are used, such as water wells, oil wells, long pipe lines, storage tanks, ships and the like.

Due to its high efficiency, the pump may be advantageously used where small amounts of liquid are to be supplied continuously or over long periods of time. Furthermore, two or more pumps may be operated in a stand or pipe section, or two or more impeller units may be driven from a single motor.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. In hydraulic pumping, a pump comprising a housing, a rotatable tubular impeller member in said housing having an inlet opening and a gear adjacent an end thereof, motor means in said housing for said impeller, a web member forming an idler gear bearing bracket, an idler gear mounted on said bracket, a rotatable complementary impeller member within said tubular impeller member and having a driving gear engageable with said idler gear, said bearing bracket having a fluid passage registering with said tubular impeller member inlet opening, said tubular impeller member having an internal spiral blade, and an external spiral blade adapted to direct fluid toward said inlet opening.

2. In hydraulic pumping, a rodless pump comprising a tubular housing having an open end and a closed end, a tubular impeller member rotatably mounted in said housing and having a discharge opening adjacent the open end of said housing, a guide bearing and gear bracket member for said impeller member within said housing adjacent the closed end thereof, said impeller member having an open end an an internal gear, adjacent said bearing member, an idler gear mounted on said bearing bracket member, a complementary impeller member rotatably mounted in said tubular impeller member and gear connected thereto for rotation in the opposite direction, an inlet opening in said housing adjacent said tubular impeller member, said bearing bracket having a passage for fluid inlet to said tubular impeller member and a passage for fluid external to said tubular impeller member to a portion of said housing beyond the end of said tubular impeller member for inlet to said tubular impeller member.

3. In hydraulic pumping a pump comprising a tubular housing adapted for insertion into a well hole, said housing having a closed bottom, a web adjacent the closed bottom and spaced therefrom, a lateral inlet opening above the web and a passage through the web, a tubular impeller member having a rotating bearing in said web, helical blades respectively on the outside and inside of said tubular member disposed in opposite directions and adapted on rotation of the tubular member in a pre-determined direction to pass fluid respectively into the lower portion of the housing and from the interior of the housing to the interior of the member.

4. In hydraulic pumping a pump comprising a tubular housing adapted for insertion into a well hole, said housing having a closed bottom, a web adjacent the closed bottom and spaced therefrom, a lateral inlet opening above the web and a passage through the web, helical blades respectively on the outside and inside of the tubular member disposed in opposite directions and adapted on rotation of the tubular member in a pre-determined direction to pass fluid respectively into the lower portion of the housing and from the interior of the housing to the interior of

the member, and a complementary impeller member within the tubular member rotatably journaled in the web and having a driving gear connection with the tubular member.

5. In hydraulic pumping a pump comprising a tubular housing adapted for insertion into a well hole, said housing having a closed bottom, a web adjacent the closed bottom and spaced therefrom, a lateral inlet opening above the web and a passage through the web, a tubular impeller member having a rotating bearing in said web, helical blades respectively on the outside and inside of the tubular member disposed in opposite directions and adapted on rotation of the tubular member in a pre-determined direction to pass fluid respectively into the lower portion of the housing and from the interior of the housing to the interior of the member, and a motor between

the housing and the tubular member for rotating the tubular member together with the impeller member.

6. In hydraulic pumping a pump comprising a tubular housing adapted for insertion in a well hole, said housing having a closed bottom, a web adjacent the closed bottom and spaced therefrom, a lateral inlet opening above the web and a passage through the web, a tubular impeller member having a rotating bearing in said web, a helical blade on the inside wall of the tubular member adapted on rotation in a pre-determined direction to draw fluid from the lateral inlet opening to the interior of the tubular impeller member, and an impeller member rotatably mounted within the tubular member having a driving gear connection with the tubular member.

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