July 23, 1935. J. A. WINTROATH 2,009,008

ROTARY IMPELLER TYPE WELL PUMP

Filed July 18, 1932

Fig 1.

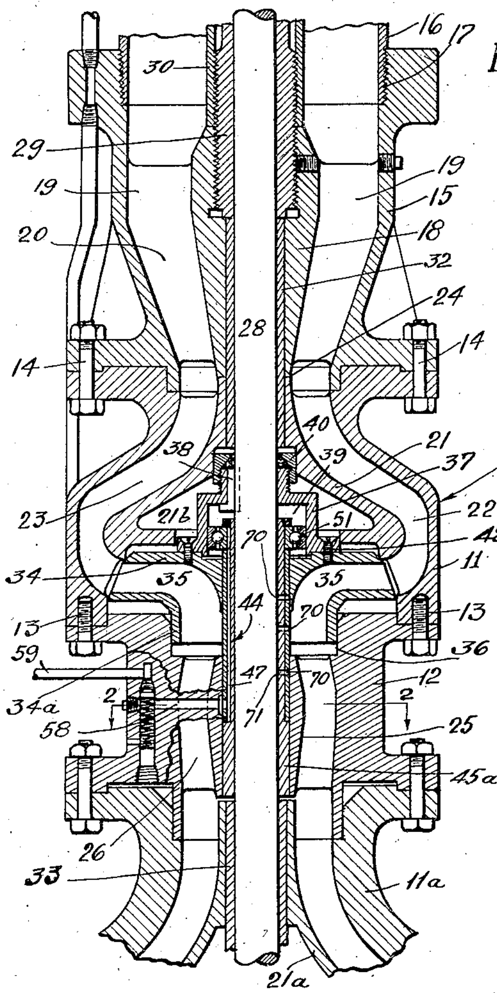


Fig. 3.

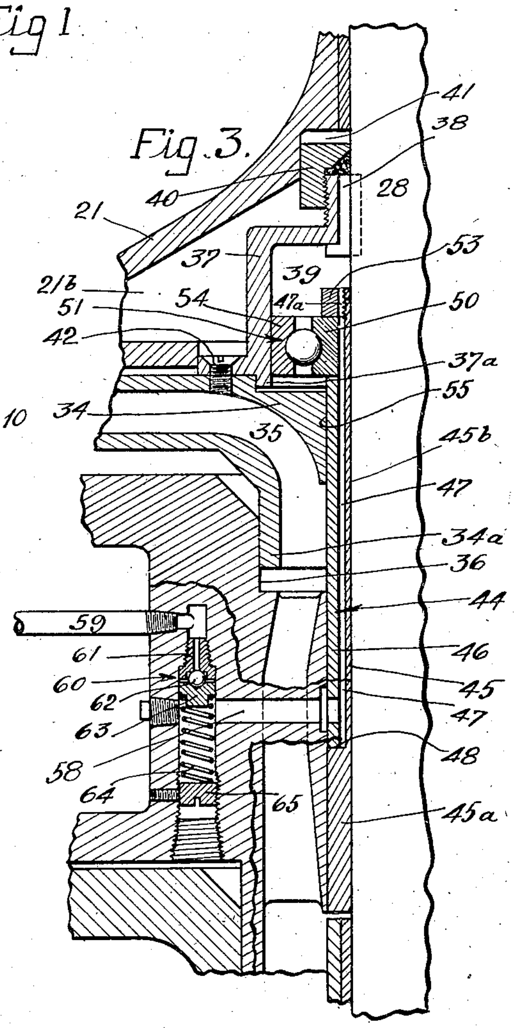
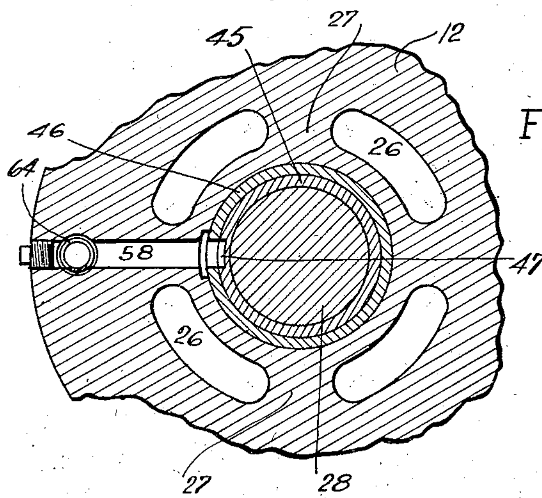


Fig. 2.



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ROTARY IMPELLER TYPE WELL PUMP

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4 Claims. (Cl. 103—102)

This invention has reference to rotary impeller type well pumps, and deals in the majority of its aspects with an improved bearing arrangement for the impellers, the invention having as a particular object the provision of proper and efficient lubrication for the bearing.

In pumps of the present type, the submersed pumping unit comprises a series of impellers carried on a rotary pump shaft, the impeller being contained within a series of impeller bowls. Well liquid is taken upwardly through an arrangement of passages within the impeller bowls and discharged upwardly into an eduction column extending to the ground surface, by the pumping action of the rotating impellers. The impeller carrying shaft is journaled within radial bearings at suitable longitudinal intervals within the impeller bowl assembly; and where the pump is used for pumping water from wells, although the pump is by no means limited to this use as it operates equally well for pumping oil, it is of primary importance that the bearings be so designed as to withstand long usage without serious wear, and to this ultimate end that proper provision be made for lubricating the bearings.

It is a primary object of the invention to provide an improved type of impeller bearing and to incorporate in the bearing structure, means whereby ample lubrication of the bearing at all times will be insured. It is believed that the invention will be most readily and fully understood, without the necessity for further preliminary generalization, from the following detailed description of a typical and preferred embodiment of the invention. It is to be understood however that the scope of the invention is in no way to be regarded as limited to the particular form shown herein, since the invention is capable of departure and variations from the specific form selected for purposes of description, without departure from the spirit of the invention as expressed in the appended claims.

Throughout the description to follow, reference is had to the accompanying drawing, in which:

Fig. 1 is a fragmentary sectional view showing the upper end portion of a submersible rotary impeller type pump embodying the invention;

Fig. 2 is an enlarged fragmentary section on line 2—2 of Fig. 1;

Fig. 3 is an enlargement of a fragmentary portion of Fig. 1 showing the impeller bearing construction and the arrangement of the lubricant supplying passages.

In Fig. 1, I have shown only a fragmentary portion of a complete impeller pump unit, but this partial showing will suffice for the purpose of describing the invention since this general type of pump unit is well known to those familiar with the art and will require no detailed showing herein beyond an illustration of the bearing construction and arrangement as applied to one of the impellers. It will be understood that a complete pump unit includes a series of these impellers, and that my improved bearing construction may be applied to any one or all of the impellers in a complete unit.

Referring first to Fig. 1, the impeller housing or bowl assembly, generally indicated at 10, is shown to comprise a series of bowl units each consisting of upper and lower sections 11 and 12 joined together by means of screws 13, the joint between the sections being fluid tight. The upper section 11 of the illustrated top bowl assembly is attached by bolts 14 to an adaptor head 15, into the upper end of which is screwed the eduction pipe 16 as at 17. During operations, the pump unit is submersed within the well liquid, and the latter is taken upwardly through the bowl assembly and discharged by the pumping action of the impellers into the eduction column within pipe 16 extending to the ground surface.

The adaptor head section 15 has cast integrally therewith a central shaft bearing support 18 carried by radial ribs 19 which are also integral parts of the head. Ribs 19 are arranged at spaced intervals about the central bearing support 18, providing fluid passages at 20 through which the well liquid is discharged from the upper pump bowl section 11 into the eduction pipe 16.

The outer shell of the upper bowl section 11 is cast integrally with a hollow core 21, the latter being supported by ribs 22 spaced apart around the hollow core to form fluid passages 23. When the joint between the head 15 and the impeller bowl 11 is taken up, the lower ends of the bearing support 18 of the head and the upper end of core 21 are in substantial engagement as indicated at 24. The lower bowl section 12 also has a central bearing support 25 and fluid passages 26 separated by ribs 27, see Fig. 2.

A motor driven shaft 28 extends centrally and longitudinally through the bowl assembly as illustrated. According to the construction shown herein, the shaft 28 is adapted to be driven by a motor, not shown, located at the ground surface, the shaft being shown to be journaled within a sleeve 29 threaded into the upper end of bearing support 18 of the head 15 and projecting upwardly a short distance within a pipe 30 screwed onto the upper threaded portion of the sleeve. Pipe 30 extends to the ground surface, and serves the usual purpose of the shaft enclosing pipe in an extensible line shaft pump, namely, to support shaft bearings at suitable vertical intervals, pipe 30 ordinarily containing a lubricant for the bearings. It may be mentioned that while I have shown the pump illustrated herein to be of the extensible line shaft type, the invention is equally adaptable to pumps in which the shaft driving motor is incorporated in the pumping unit submersed within the well, as for example, the type of pump shown in my copending application Ser. No. 517,481, filed Feb. 21, 1931 on Submersible motor driven pump.

A bearing line 32 is inserted within and in overlapping relation with portion 18 of the head 15, and the upper end of the hollow core 21 of the upper bowl section 11. A similar bearing liner 33 extends within the hollow core of the upper section 11a of the bowl assembly below. In the event the impeller below the single top impeller illustrated is not equipped with the bearing construction comprising the subject matter of the invention, liner 33 may extend down through the core 21a of the lower bowl section, but otherwise a liner will terminate at the upper end of the core chamber to accommodate the bearing parts hereinafter described.

An impeller 34, attached to the shaft 28 as described, is positioned in close proximity to the lower end of core 21, the impeller having a plurality of radial fluid passages 35 and the lower skirt portion 34a of the impeller having a running or substantially sliding fit within counterbore 36 in the upper end of lower bowl section 12. In my copending application filed Oct. 26, 1931, entitled Submersible impeller type pumps, Ser. No. 571,016, I show certain improvements in the impeller construction and its arrangement relative to adjacent parts of the bowl, for the purpose of preventing abrasive wear on the impeller, which improvements may be incorporated in the pump shown herein. These improvements, however, are foreign to the present invention and need not be shown or described herein.

An inverted lubricant forming chamber cup 37 is placed within the hollow interior 21b of core 21, cup 37 being non-rotatably secured to the shaft by means of key 38. The entry of well liquid into the upper end of the lubricant chamber 39 within cup 37 is prevented by means of a packing gland, generally indicated at 40, accommodated within counterbore 41. The lower flanged end of cup 37 is secured to the impeller 34 by screws 42, the joint between the cup and impeller being fluid tight. As will appear, the impeller is rotatably driven from the shaft 28 through its connection therewith by way of cup 37.

A shaft surrounding sleeve assembly, generally indicated at 44, extends upwardly from the lower end of the central portion 25 of bowl section 12, through the impeller 34 into the lubricant chamber 39. The sleeve assembly 44 is so formed as to perform the dual function of journaling the shaft throughout the length of the sleeve, and also to provide a passage through which lubricant may be delivered upwardly between the impeller and the shaft into chamber 39. Although the sleeve 44 may be formed in any suitable manner to provide a passage for taking lubricant into chamber 39, I have shown a typical and preferred sleeve assembly construction to comprise inner and outer concentric sleeves 45 and 46 having therebetween a lubricant passage 47 formed by longitudinally grooving the surface of one of the sleeves. As shown in Fig. 3, the inner sleeve 45 has an enlarged diameter portion 45a at its lower end, and an upper reduced diameter portion 45b over which is slipped the outer sleeve 46, the combined thickness of sleeve 46 and the upper portion 45b of the inner sleeve being the same as the lower portion 45a of the latter. The lower end of sleeve 46 abuts against shoulder 48 at the upper end of section 45a of the inner sleeve.

Sleeve 46 may be made substantially integral with the inner sleeve 45 by first heating and thereby expanding sleeve 46, and allowing it to cool and contract around the inner sleeve. The sleeve assembly consisting of inner and outer sleeves 45 and 46 may be made substantially integral with the interior portion 25 of the lower bowl section 12, by expanding the sleeve assembly within the bore thereof, or by any other suitable means of attachment. Sleeve 46 projects above the top surface of the impeller and into the lubricant chamber 39, the upper end of the sleeve having a ring 50 serving as one of the race rings for the bearing 51 which journals the inverted cup 37, and therefore the impeller, on the sleeve assembly. Sleeve 46 and ring 50 are locked against longitudinal movement on the inner sleeve by a nut 53 threaded on the upper end of the inner sleeve projecting above flange 50, the nut being set against ring 50. The outer race ring 54 of the bearing 51 is fitted to the inner wall of the inverted cup 37.

The bore of impeller 34 has a running fit with the outside of sleeve 46, the fit between these parts being so close that while some lubricant may leak from chamber 39 downwardly between the impeller and the outer sleeve, such leakage will be comparatively slight. Lateral support is given the vertical wall of cup 37 in addition to the attachment of the lower flanged end of the cup with the impeller, by projecting the lower end 37a of the cup into a counterbore in the upper end of the impeller, the projecting end 37a of the cup having a snug fit within the bore.

As previously explained, the impeller is driven by the shaft 28 through its connection therewith by way of the cup-shaped member 37. During the pumping operations, the impeller takes suction at its lower end through passages 26 and 23, the well liquid being forced by the pumping action of the impeller upwardly through passages 23 and 20 into the eduction column in pipe 16.

Lubricant passage 47 in the sleeve assembly 44 is formed by a longitudinal groove in the outer surface of inner sleeve 45, as shown in Fig. 2. A number of circumferentially spaced grooves 47a may be formed within the interior of nut 53, one of the grooves 47a being brought into register with passage 47 as indicated in Fig. 3. The lower end of lubricant passage 47 communicates with a transverse bore 58 in one of the ribs 27 in the lower impeller bowl section 12. Lubricant is supplied to the bearing chamber 39 through passages 47 and 58, by way of a conduit 59 extending to the ground surface, a reverse flow of lubricant from bore 58 into the conduit being prevented by a suitable check valve, generally indicated at 60. The check valve comprises an apertured plug 61, the aperture of which is closed against counter flow therethrough by ball check valve 62 supported on bushing 63. The check valve is seated under the influence of spring 64, the lower end of which seats against a plug 65 screw threaded into the lower end of the check valve bore, plug

65 being adjustable to vary the tension of the spring.

As previously mentioned, packing gland 40 seals the lubricant chamber 39 against the entry of well liquid at its upper end, and consequently the only ways in which the well liquid may have access to the bearing chamber would be by upward leakage between sleeve 45 and the shaft, or between the impeller 34 and outer sleeve 46. In order to prevent such leakage, the lubricant is supplied to the bearing chamber under sufficient pressure to counterbalance the well liquid pressure in tending to leak into the chamber, and in fact the lubricant in bearing chamber may be maintained under such pressure that a slight amount of leakage of the lubricant may occur between sleeve 45 and the shaft, and between the impeller and sleeve 46. The clearances between the parts however, and the pressure under which the lubricant is maintained, will ordinarily be such that the quantity of lubricant lost through leakage will be but little and of no consequence.

A plurality of holes 70 and 71 may be drilled through sleeves 46 and 45, these openings serving as means to balance the pressure existing between sleeve 45 and the shaft, and between the wall of the impeller bore 55 and sleeve 46. Due to the velocity of the water entering the impeller, there would be a slight pressure reduction in the space between the impeller hub and sleeve 46, tending to set up circulation between sleeve 45 and the shaft and between the impeller hub and the sleeve 46. Pressure equalization and elimination of this circulating tendency is accomplished by the series of holes 70, 71, so arranged as not to interfere with groove 47.

In view of the foregoing it will be seen that ample supply of lubricant, free from well liquid, will be maintained in the bearing chamber at all times. And it will be further noted that even though the supply of lubricant should be temporarily cut off, no loss of lubricant from the bearing chamber would occur in that substantially balanced pressures would be communicated to bearing chamber through the medium of well liquid tending to leak upwardly between the impeller and sleeve 46, and between the shaft and the inner sleeve 45. That the pressures so communicated to the bearing chamber would be substantially balanced is evidenced by the fact that the clearances through which such leakage occurs, both terminate at the lower suction end of impeller 34 and above the impeller below, the well liquid in the interval therebetween being under substantially uniform pressure. In view of the capability of this construction to maintain the lubricant in the bearing chamber for substantial periods of time in the absence of additional supply lubricant, it is to be understood that in its broader aspects the invention is not regarded as limited to the provision for supplying lubricant from the ground surface, although the provision of such lubricant supply connection will be generally preferred.

I claim:

1. In a well pump, the combination comprising, a vertically extending rotatable shaft, a tubular member secured to said shaft and spaced therefrom to form a lubricant containing chamber, an impeller having its upper end joined to the lower end of said tubular member at points spaced from the outside of the shaft passing opening of the impeller, a rotatively stationary sleeve between said impeller and the shaft and projecting above the upper end of the impeller, a bearing confined between said sleeve and said tubular member, and means for delivering lubricant to said chamber through a longitudinal passage in said sleeve and from a point below said impeller.

2. In a well pump having an impeller bowl with fluid passages extending therethrough, a vertically extending rotatable shaft within said bowl, and an impeller in said bowl and joined to said shaft; a non-rotatable sleeve secured to said bowl and extending between said impeller and the shaft to a point above the impeller, a wall attached to said impeller and shaft at points respectively below and above the upper end of said sleeve and forming a chamber, and packing between said wall and the shaft preventing entry of well liquid to said chamber.

3. In a well pump having an impeller bowl with fluid passages extending therethrough, a vertically extending rotatable shaft within said bowl, and an impeller in said bowl and joined to said shaft, a non-rotatable sleeve secured to said bowl below said impeller and projecting upwardly between said impeller and the shaft to a point above the impeller, a wall attached to said impeller and shaft at points respectively below and above the upper end of said sleeve and forming a chamber, and packing between said wall and the shaft preventing entry of well liquid to said chamber.

4. In a well pump having an impeller bowl with fluid passages extending therethrough, a vertically extending rotatable shaft within said bowl, and an impeller in said bowl and joined to said shaft; a non-rotatable sleeve secured to said bowl below said impeller and projecting upwardly between said impeller and the shaft, walls forming a lubricant chamber above the upper end of said impeller, a bearing between said walls and said sleeve, there being a lubricant passage extending within said sleeve from below said impeller to said lubricant chamber, and packing between said walls and the shaft preventing the entry of well liquid to said chamber.

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