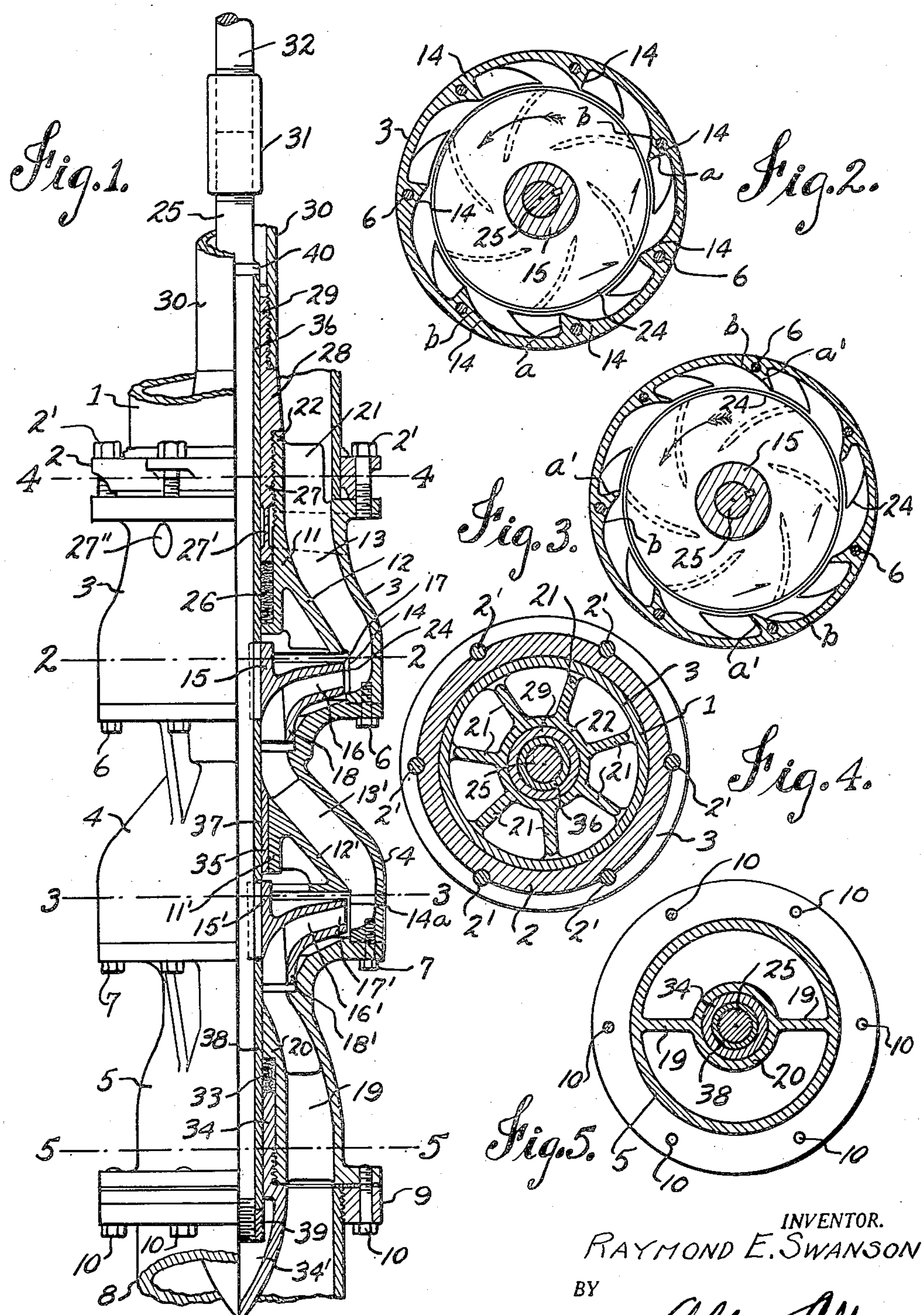
Oct. 9, 1934. R. E. SWANSON 1,976,200

DEEP WELL TURBINE PUMP

Filed April 14, 1931



INVENTOR.

RAYMOND E. SWANSON

BY

Allen & Allen

ATTORNEYS

Patented Oct. 9, 1934 1,976,200

UNITED STATES PATENT OFFICE

1,976,200

DEEP-WELL TURBINE PUMP

Raymond E. Swanson, Lawrenceburg, Ind., assignor to A. D. Cook, Inc., Lawrenceburg, Ind., a corporation of Indiana

Application April 14, 1931, Serial No. 530,001

4 Claims. (Cl. 103—102)

My invention relates to deep-well turbine pumps, especially of multi-stage construction, such as disclosed in my copending application, Serial No. 452,427, filed May 14, 1930, of which this application is a continuation in part.

Its objects are to increase the durability of such pumps, to simplify and reduce the labor and cost of their construction, and to increase their efficiency, especially by affording a more direct streamline flow throughout the intake, vane, and bowl passages. Other objects will appear in the course of the following description:

I accomplish the above objects by a device illustrated, for example, in the accompanying drawing, in which:

Figure 1 is a view showing half of the pump in side elevation and the other half in vertical cross section on a plane through the center line of the pump.

Figure 2 is a horizontal cross section on the plane of the line 2—2 of Figure 1.

Figure 3 is a similar cross section illustrating modification of the shape of the bowl vanes.

Figure 4 is a similar section on the plane of the line 4—4 of Figure 1.

Figure 5 is a similar cross section on the plane of the line 5—5 of Figure 1.

In Figure 1 is shown the lower end portion of the casing 1 understood to lead from the pump to the upper ground level. This casing has an end collar 2, and the top bowl 3 has a flange by which cap screws 2′ attach the top of the bowl 3 to the casing 1. The next lower bowl 4 is attached to the bottom of the upper bowl 3, and the inlet case 5 is attached to the bottom of the lower bowl 4 by screws 6 and 7 respectively, peculiar details of which connection will later be described. At the bottom is shown the upper end part of the suction tube 8 having on its end part a collar 9, and the bottom of the inlet case 5 has a flange by means of which cap screws 10 connect the inlet case 5 and suction tube 8 together.

The upper bowl 3 has the central hub 11 surrounded by the downwardly flaring skirt 12 in its bottom part; this hub and skirt being connected to the inner walls of the bowl 3 by radial ribs 13. The lower part of the bowl 3 extends below the skirt 12, and downward continuations of the ribs 13 form the bowl vanes 14 extending inward not quite to the periphery of the skirt 12 and leaving a space below the hub 11 and skirt 12 for the impeller 15. This impeller 15 comprises a hub in its upper part and upwardly and outwardly curving upper and lower walls in its lower part forming the upwardly and outwardly curving discharge passage 16 which is continuously annular near the shaft axis, but has the impeller vanes 17 at intervals around its outer zone. The lower part 18 of the impeller-containing entrance to the discharge space 16 extends considerably below the lower ends of the hub 15 and the bowl 3.

The construction of the lower bowl 4 answers in general to that just described for the upper bowl 3, having the ribs 13′ terminating below in the vanes 14′; the ribs 13′ connecting the outer wall of the bowl with the central skirt 12′ and hub 11′; while the hub 15′ carries the structure forming the discharge space 16′ which has the vanes 17′. The top of the bowl 4 has an annular recess in which fits the downward extension 18 of the impeller that is in bowl 3 above. The bowl vane or rib 13′ terminates considerably below the bottom of this recess. In like manner the lower part 18′ of the lower impeller hub fits in a recess in the top of the inlet casing 5, and ribs 19 extend in from the inner walls of the inlet casing 5 to the central hub 20.

So far as described, this pump structure resembles broadly various prior pump structures; but several details thereof now will be described which I believe to be decided improvements over any prior pump structures known to me, especially in respect of practical manufacture, installation, operation and maintenance, from a commercial point of view.

One of these is the extension of the rib or vane part 13 upward past the top of the upper bowl 3, forming a support 21, separate from the interior of the casing 1 but joining the upward extension 22 of the central hub 11 of the bowl 3. A further improvement is in the cross section of the bowl vanes 14 and 14′, which as shown in Figure 2 is not a mere inward radial extension symmetrical to a central radial line. The side *a* which is presented in direction opposite to that of rotation of the impeller, which may be termed the front side, is substantially on the radial line. The opposite side *b*, past which the discharge flows from the impeller, and which may be termed the rear side of the vane, is curved on a large radius from the inner edge of the vane far around, almost half way to the next vane. In the modification of Figure 3 the rear side *b* has this ample curvature, and the front side *a′* inclines forward in its outward extent from a radial line through its inner edge, this inclined rear side having an ample fillet with the outer wall of the bowl. This later example is even more desirable from a working view point than the example of Figure 2; but is somewhat more difficult of practical construction. The advantage of either example is the avoidance of eddy currents at the rear side *b* of the vane, this avoidance being due to the large radius and therefore allowing a more smooth and even passage of the discharge from the impeller into the bowl passage up along the ribs 13 or 13′. Another advantage permitted by the enlargement of cross section of the bowl vane 13 or 13′ incident to the above construction, is the admittance of the cap screws 6 and 7 upward through the top flanges, respectively, of the lower bowl 4 and the inlet casing 5 into the upper and lower bowls 3 and 4, for securing the bowls 3 and 4 together and the bowl 4 to the inlet casing 5.

Another improvement in detail which is disclosed and claimed in my copending application above mentioned, is the spacing of the edges 14 and 14′ of the vanes of the bowls 3 and 4, respectively, out from the peripheries 24 of the impellers. This not only eliminates the need of machining the bowl vane edges 14 and 14*a*, usually also necessitating chipping and hand work for attaining the narrow cutting edges of the bowl vanes as in such prior devices as I am aware of, but also permitting these edges of the bowl vanes to retain the hard crust or scale incident to the casting of the bowl 3 or 4. Since the friction of the discharge from the impellers at the edges of the bowl vanes 14 and 14′ is considerable, having a considerable erosive effect, this maintenance of the hardness of these parts greatly conduces to the durability of the pump. Due to the novel heavier construction of these bowl vanes as above described, it is possible to cast them with edges sharp enough to coact properly with the impellers without machining, facilitating attainment of the above results.

The main pump shaft 25 extends down through the upper bowl hub 11 and has the impellers fixed on it by means of their hubs 15 and 15′, and the lower end part of this shaft extends down through the bearing hub 20 of the inlet casing 5. The central hub 11 of the upper bowl 3 has an annular space around the shaft 25 containing packing 26, which is forced together by the lower end part of the gland coupling 27 which has the annular recess 27′ leading to the bypass 27″, and is screwed down into the top extension 22 of the bowl hub 11, having a thick middle portion 28 overlapping the upper end of the extension 22, and having extending up from this part 28 an upper threaded extension 29 around which is screwed the lower end of the oil tube 30. The shaft 25 connects by a coupling 31 with the connecting shaft 32, which, together with the oil tube 30, will be understood to extend to the upper ground level; the oil tube 30 serving to admit lubricant to the bearing 29.

At the bottom, screwed up into the bottom hub 20 and compressing packing 33 is a member 34 which enlarges below the hub 20 into a hollow downwardly pointed grease chamber 34′. Where the shaft passes through the central hub 11′ of the lower bowl 4, this hub has a bushing 35.

Thus, the example shown discloses the pump shaft 25 as having an upper bearing in the parts 27, 28 and 29, a middle bearing at 35 and a lower bearing in the member 34.

Another one of my improvements, which is fully disclosed and claimed in my copending application to which I have referred above, consists in surrounding this shaft 25 with covering tubes. As here shown, there is an upper covering tube 36 extending entirely from above the upper extension 29 of the gland coupling 28 down into close contact with the upper end of the hub 15 of the upper impeller; a middle cover 37 with its upper end in close contact with the lower end of the hub 15 of the upper impeller down through the bushing 35 into close contact with the top of the hub 15′ of the lower impeller; and the lower cover 38 in close contact with the lower end of the lower impeller hub 15′ and extending down entirely through the lower bearing into the interior of the grease chamber 34′, where the lower end part of the main shaft 25 being threaded, a nut 39 is screwed up onto the shaft against the lower end of the lower cover 38, clamping the entire assemblage of covers 38, 37 and 36 and impeller hubs 15 and 15′ closely together in coaction with an annular flange 40 fixed on the main shaft 25 shortly above the upper bearing extension 29 within the oil tube 30; this flange preferably being welded onto the shaft 25 so that it is substantially integral therewith. This comparatively thin and light covering of tubes 38, 37 and 36, thus may be of material well adapted to resist corrosion by the chemical contents of water being pumped, for instance bronze, and as it covers the main shaft 25 in all areas which might in its absence be exposed to contact with the water, the shaft 25 itself may be of steel, which is not only less expensive but may be much stronger and therefore of less diameter than a shaft required to be of metal having greater resistance to corrosion.

By the novel construction of the upper bearing, including the packing 26 in the downwardly extending hub 11 of the inner skirt 12 of the bowl 13, and substantially maintaining this diameter of this hub 11 above the skirt up to the connection with the oil tube 30, it will be seen that I have provided a very direct or streamline path for the travel of the liquid after the last pumping stage thereof and for entrance to the discharge casing 1. A similar improvement in operation is attained by the construction of the lower bearing, with the packing 33 contained in a hub or cap of the inlet casing, minimized in diameter, with the reduced part of the grease chamber 34 fitting up in and holding the packing 23 in the cap 20, affording a very direct or streamline path of the liquid from the suction tube 8 to the interior passage 16′ of the first-stage impeller. I am thus enabled to attain at the inlet and outlet ends of the pump, substantially the same direct streamline effect attained in the passages 13 and 13′ from one impeller to the other. These improvements, together with the improvements affording the smooth travel of the liquid from the impeller into the spaces between the bowl vanes result in a marked increase in efficiency of the pump as I have found in practice.

While the example shown is a two stage pump, it will be understood that the omission or addition of bowls, impellers, and their associated parts, for a greater or less number of stages of centrifugal action will readily be made by those skilled in the art, upon the basis of the disclosure herein.

I have somewhat specifically illustrated and described my invention but it will be understood that modifications may occur in practice which will not depart from the scope and spirit of my invention, and therefore I am not limited to such precise disclosure but what I desire to claim and secure by Letters Patent, is:

1. In a pump, in combination with an upright shaft, an impeller on said shaft, an enclosure for said impeller comprising means coactive with

said impeller, an upper bearing comprising a member with a reduced upper end part and a reduced lower end part, a lubricating tube around said shaft, fitting around said upper end part of said member, said enclosure comprising an inner concentric skirt element above said impeller, with an upper hollow extension receiving said lower end part of said member inside said extension, and packing confined in said hollow extension by the received lower end part of said member.

2. In a pump, in combination with an upright shaft, an impeller on said shaft, an enclosure for said impeller comprising means coactive with said impeller, an upper bearing comprising a member with a reduced upper end part and a reduced lower end part, a lubricating tube around said shaft, fitting around said upper end part of said member, said enclosure comprising an inner concentric skirt element above said impeller, with an upper hollow extension receiving said lower end part of said member inside said extension, and packing confined in said hollow extension by the received lower end part of said member, and a covering having a substantially liquid-tight fit around said shaft, extending continuously from said impeller up through said bearing into said lubricating tube.

3. In a pump, in combination with an impeller having peripheral outlets with edges, and an enclosure having vanes extending inward toward and coacting with said impeller outlet edges, each with its side presented in the direction of rotation of said impeller gradually inclined from near its inner edge out to the wall of said enclosure, and its opposite side confined substantially within a radial plane through said inner edge, affording enlargement of the thickness of said enclosure wall at intervals therearound, an adjacent enclosure, and means entering respective ones of said enlargements, securing said enclosures together.

4. In a pump, a rotary impeller having peripheral outlet edges, an enclosure for said impeller having its walls continuously closed radially opposite said edges, with helical vanes extending in from and continuous with said walls toward said outlet edges and subject to erosion by the discharge from said impeller, each vane having its side presented in the direction of rotation of said impeller gradually inclined from near its inner edge out to the wall of said enclosure and having its opposite side confined substantially within a radial plane through said inner edge, and being a continuous mass between said sides and said wall, the inward extension of said vanes relative to the outward extension of said impeller outlet edges being such that a substantial space is left between the inner edges of the vanes and the impeller outlet edges, said walls and said vanes being an integral ferrous casting, whereby inherent hardness of the surfaces of said vane edges is acquired incident to the casting process and said vane edges being left unmachined with their inherent hardness, maintained and, due to the mass of each vane, the vanes being cast with sufficiently sharp edges with such inherent hardness.

RAYMOND E. SWANSON.