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J. J. BRADLEY

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SUBMERGED CENTRIFUGAL PUMP

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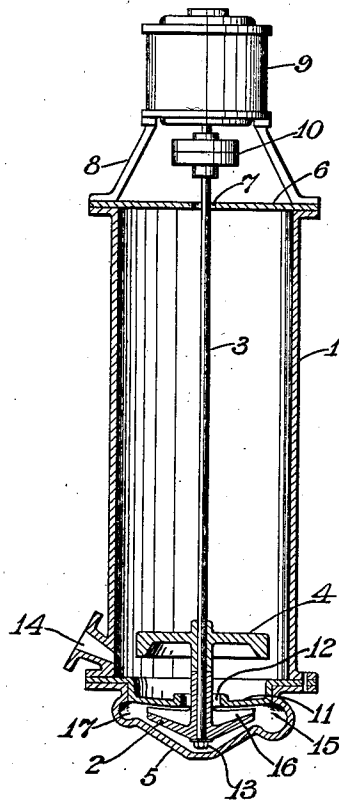


Fig. 1

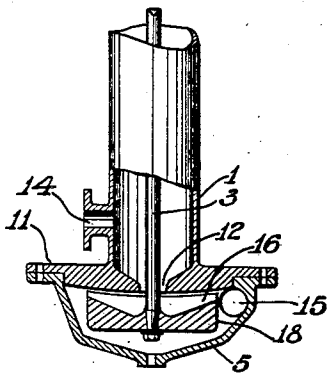


Fig. 2

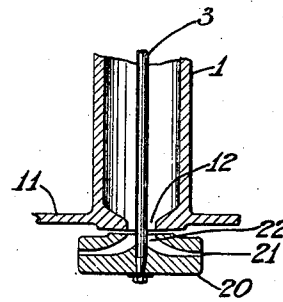


Fig. 3

John J. Bradley INVENTOR.

BY *George Johnson*
ATTORNEY.

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SUBMERGED CENTRIFUGAL PUMP

John J. Bradley, Cranford, N. J., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware

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2 Claims. (Cl. 103—103)

This invention relates to pumps for pumping corrosive liquids and more particularly to submerged centrifugal pumps having a gyro mechanically stabilized floating impeller.

5 Pumping corrosive liquids, such as hot concentrated sulfuric acid, is attended by many difficulties, due to the severe corrosive action to which the various parts of the pumping mechanism are subjected. In particular, submerged centrifugal pumps have the disadvantage that 10 submerged bearings, bushings, packing glands and like fittings are subject to severe corrosion. The fact that these fittings are submerged also complicates lubrication.

15 This invention has as an object a provision of submerged centrifugal pumps which are particularly adapted to pumping corrosive liquids. A further object resides in the elimination of local corrosive action such as would occur in bearings, packing glands and like fittings. A 20 further object is the elimination of the need for lubricating any of the submerged parts. A further object resides in the provision of pumps which are insensitive to temperature variations. Other ob- 25 jects will appear hereinafter.

These objects are accomplished by the following invention which is characterized principally by a floating impeller. By "floating" I 30 mean that free movement of the impeller is in no manner inhibited or restrained by bearings, bushings and like fittings. By the use of a suitable balance wheel the floating impeller is gyro mechanically stabilized against oscillations due 35 to dynamic and hydraulic unbalance. In this manner submerged bearings, bushings, packing glands and like fittings and their attendant disadvantages are eliminated.

40 In the drawing:

Figure 1 is a sectional elevation;

Figure 2 is a sectional elevation of a modified form; and

45 Figure 3 is a partial section similar to Figure 2 showing a modified form of the impeller.

As shown in Figure 1, my improved apparatus consists generally of a casing 1, an impeller 2, an impeller shaft 3, a balance wheel 4, and an 50 impeller housing 5.

55 The casing 1 is of such height as to project above the level of the liquid in which the pump is submerged, and is provided with a cover plate 6 having an aperture 7 through which the shaft 3 freely projects. Mounted on the casing 1 by suitable supports 8 is a motor 9 which is con-

nected to the impeller shaft 3 by the universal joint 10.

The impeller housing 5 includes a vortex plate 11 provided with a large central opening 12 through which the impeller shaft projects freely. This opening serves as the suction vortex 5 of the impeller housing.

The impeller 2 is rigidly connected to the end of the impeller shaft 3, as illustrated at 13, and is free to move about the universal joint 10 as a pivot. Its movement is, in this manner, constrained to the surface of a geometrical sphere. In order to admit of movement as described without upsetting the clearance between the im- 10 peller 2 and the vortex plate 11, adjacent surfaces of the vortex plate 11 and the impeller 2 are machined on radii concentric with the universal joint 10. The clearance so provided may be adjusted by raising or lowering the impeller shaft 3. For this purpose the universal joint 10 may 20 be of a design capable of vertical adjustment.

The balance wheel 4 is provided for the purpose of dampening oscillations of the impeller due to dynamic and hydraulic unbalance. It is mounted on the impeller shaft 3 within the casing 1 as close to the impeller as is practical without undue restriction of the suction vortex 12. In this manner the impeller, tho free to move 25 as above described, is confined, for practical purposes, as effectually as if bearings were provided. Oscillations of appreciable magnitude occur only during starting and stopping.

The effective pumping mechanism resides in the impeller housing 5 and the impeller 2, inlet and outlet being provided as shown at 14 and 15 35 respectively. The impeller 2 is provided with vanes 16 of conventional design and the impeller housing is shaped in a conventional manner to provide an annular chamber 17 gradually increasing in capacity toward the outlet 15.

Figure 2 illustrates a modified form of my invention. It differs from the form shown in Figure 1 principally in that a fly-wheel and the 40 impeller have been combined as a single unit as shown at 18. By this construction the gyro mechanism is located at a point where its inertia exerts the greatest mechanical advantage. In addition, the casing 1 is of smaller diameter, a construction made possible by the transposition of the gyro mechanism. It may be observed 50 further that the vortex plate 11 has been constructed as an integral part of the casing 1 and that a drain 19 is also provided at the base of the impeller housing 5.

Figure 3 shows a modified form of my inven- 55

tion, showing a closed type impeller. The construction is otherwise the same as that shown in Figure 2. This form of impeller as shown at 20 is constructed with radiating internal passages 21 communicating at 22 with the suction vortex 11. It differs from the usual closed type impeller by its increased mass which provides the inertia required to stabilize the impeller. When the closed type of impeller is used with the form of invention illustrated in Figure 1 its mass may, of course, be considerably reduced.

The impeller housing and the impeller may be of any suitable design, the essential features residing in the absence of any bearings, bushings and like fittings, in the provision of a gyro mechanical stabilizer, and in the machining of the opposed surfaces of the vortex plate and the impeller on radii concentric with the universal joint.

The clearance between the impeller and the vortex plate may be varied by vertically adjusting the impeller shaft at the universal joint. Suitable universal joints are known in the art. The clearance may also be varied by vertically adjusting the prime mover. In this manner, notwithstanding wear and corrosion, my pump may be maintained at high efficiency by a very simple adjustment.

The universal joint 10 may be of any suitable construction, either of the flexible or mechanical type. Furthermore the use of a universal joint is not an essential feature of my invention, as flexible shafting is available which will perform satisfactorily without a universal connection.

Although I show but a single suction vortex, two may be employed if desired. Such a construction would not only provide increased capacity but also tend to neutralize vertical thrust due to hydraulic unbalance. Even where a second suction vortex is not provided it may be found expeditious to use vanes on the under side of the impeller to neutralize vertical thrust. These and such other modifications as come within the scope of those skilled in the art are to be considered within the scope of my invention.

My invention is particularly advantageous in that there are no submerged bearings and like fittings which would be subject to intense local corrosion such as would result from localized electrolytic effects or increased erosion due to

sliding contact in a highly corrosive medium, and which would necessitate involved means for submerged lubrication. In addition, my invention is particularly advantageous in that it may be easily adjusted to compensate for wear. Thus long life and high efficiency are assured.

It may also be pointed out that my new and improved pump is not dependent upon extremely close clearance, hence high temperatures or even fluctuating temperatures will not effect materially the operation of the pump.

I claim:

1. A submerged centrifugal pump comprising a rotatable shaft, a universal connection, a vortex plate, and a floating impeller characterized in that said impeller and shaft are assembled as a rotatable unit and suspended from said universal connection whereby said impeller is constrained to movement on the surface of a geometrical sphere having as its center said universal connection and further characterized in that said vortex plate has a central inlet opening surrounded by a surface which is adjacent to the suction side of said impeller and is developed on a spherical surface concentric with said geometrical sphere whereby the clearance between the vortex plate and the impeller remains constant irrespective of the relative lateral displacement of the vortex plate and impeller.

2. A submerged centrifugal pump comprising a vertical shaft of a length greater than the submergence of the pump, a rotary impeller carried thereby and normal thereto, a vortex plate normal to said shaft having a central inlet opening surrounded by a surface which is adjacent to the suction side of said impeller, means adapted to rotate said shaft and thereby impart rotation to said impeller, and a universal connection between said means and said shaft whereby said impeller is constrained to move on the surface of a geometrical sphere having as its center said universal connection, said impeller and vortex plate being characterized in that adjacent surfaces thereof are developed on spherical surfaces concentric with said geometrical sphere whereby the clearance between said impeller and said vortex plate remains constant irrespective of relative lateral movement.

JOHN J. BRADLEY.