Sept. 11, 1934. H. E. BROUGHTON ET AL 1,972,865

CENTRIFUGAL PUMP

Filed June 15, 1931

Fig. 1.

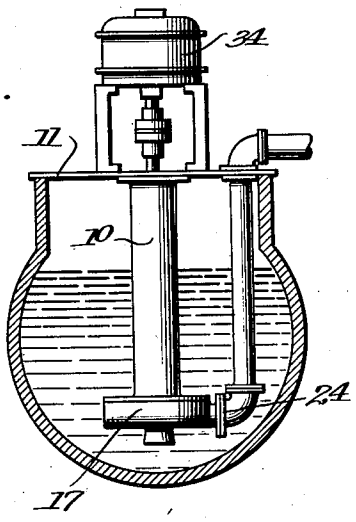


Fig. 2.

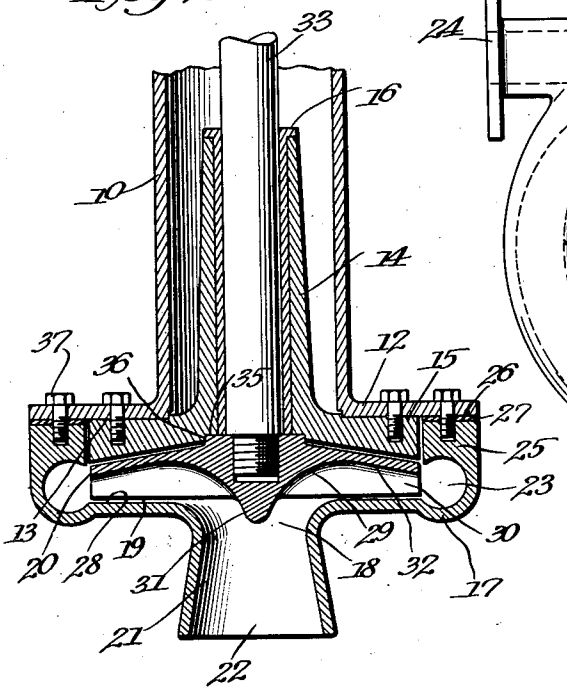
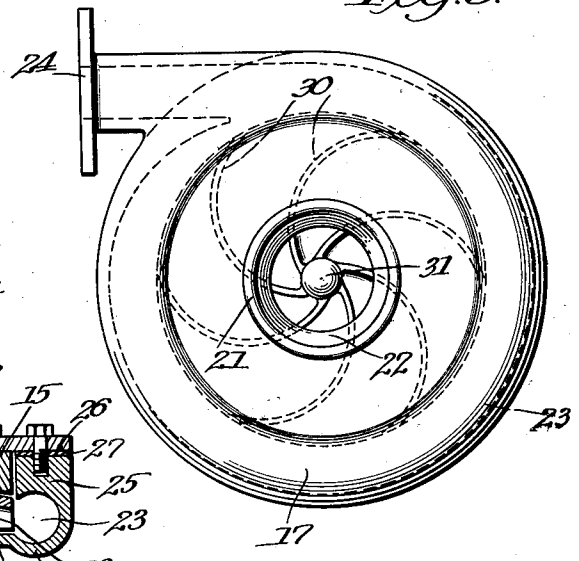


Fig. 3.



Inventors

H. E. Broughton.
W. F. Lamoreaux.

By

Cushman Bryant & Berkley. Attorneys

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CENTRIFUGAL PUMP

Harold E. Broughton and William F. Lamoreaux, Isabella, Tenn.

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5 Claims. (Cl. 103—103)

Our invention relates to improvements in centrifugal pumps, and more particularly to centrifugal pumps designed to handle liquids which possess densities and/or viscosities greater than that of water.

It is a primary object of the present invention to provide a centrifugal pump casing assembly which is extremely simple, compact, and efficient, and which may be easily taken down or assembled.

It is a further object to provide a centrifugal pump in which the sectional area of the passage for the liquid travelling through the pump decreases in a predetermined proportion to the increase in the velocity imparted to the liquid by a centrifugal impeller during its flow through the pump.

It is a further object of the invention to provide an open-sided impeller having a desirable relation between curved surfaces and vanes so that a pump is produced which is unusually efficient with liquids of high viscosity and/or density.

A further object is to provide, with such an impeller, a casing of peculiar form which has parts cooperating with the impeller in a novel way to produce new results.

Another object of the invention is to counteract end thrust which results from the weight of the parts and from suction during the operation of the pump. This object is accomplished by curved surfaces on the impeller, as will be pointed out below.

In carrying out our invention, we provide a casing assembly for a centrifugal pump, said assemby comprising three principal elements, which may be simply bolted together. Each of the parts is constructed of peculiar form in order to attain the objects of our invention.

In the accompanying drawing, an illustrative embodiment of the invention is shown, in which:

Figure 1 is a vertical elevation of a pump embodying our invention, the pump being submerged in a tank, and the tank being shown in section.

Figure 2 is a vertical sectional view of our improved centrifugal pump.

Figure 3 is a bottom plan view.

It is to be understood that the apparatus shown in the accompanying drawing is an illustrative embodiment only of our invention, and that the invention is not to be limited to the specific construction shown, but is to be given a scope equal to that defined by the accompanying claims.

In the device of the drawing, we have shown a pump casing assembly comprising a supporting section 10 having a cylindrical body and secured at its upper end to a stand 11. At the lower end of the cylindrical body of the supporting section 10, we provide a radially extending flange 12 which has an outer face 13 normal to the axis of the cylindrical portion.

The casing assembly further comprises a bearing section or member 14 having a substantially cylindrical sleeve disposed in the interior of the cylindrical portion of the supporting section 10, and it also has an outwardly extending radial flange 15 which may be secured to and carried by the flange 12 of the supporting section. The sleeve of the bearing member may conveniently be provided with a replaceable bushing 16, which is shown as extending the full length thereof.

A volute section, represented generally by reference character 17, constitutes the third principal element or section of our casing assembly. This section has certain desirable characteristics which will now be described.

A central inlet opening 18 communicates directly with an interior substantially cylindrical impeller chamber 19 in which the impeller 20, described in detail below, is mounted for rotation. The central inlet opening 18 communicates with an inlet conduit 21, which is of frusto-conical shape and flares outwardly, having an enlarged opening 22. A discharge chamber 23 is disposed in the peripheral portion of the volute section 17, and this chamber may be in substantially the form of a volute, or any other conventional discharge chamber used with centrifugal pumps may be employed. The discharge chamber communicates with a discharge passage 24 in a conventional manner. Above the discharge chamber we provide a thickened wall 25 to our volute section, and on the upper surface thereof a plane annular attaching surface 26 is located. As is clearly shown in the drawing, this surface 26 is bolted to the outer portion of flange 12 on supporting section 10. An appropriate gasket 27 should be interposed between the surface 26 and flange 12 to prevent leakage of fluid along this joint.

Another important feature of the volute section resides in the fact that the impeller chamber thereof is provided with a substantially plane interior surface 28 normal to the axis of the pump and extending from the inlet opening 18 outwardly to the discharge chamber 23.

The impeller of our invention is entirely open on one side and closed on the other side by a backing member 29. This backing member, or body portion of the impeller, has on its front face a plurality of vanes or blades 30 which may be radial with respect to the impeller or may

be curved rearwardly in accordance with well known centrifugal pump practice, as shown in dotted lines in Figure 3. The blades 30 project from the front face of the impeller body, as aforesaid, and their front edges terminate in a plane which is normal to the plane of the axis of the pump. The curved front surface of the backing member 29 projects centrally in a substantially conical point 31, which point preferably extends through, projects beyond, and intersects the plane of the front edges of the impeller blades. It will be noted that the plane of these edges is adjacent the plane of the interior surface 28 of the casing 17 and is parallel thereto. The front surface of the impeller curves from the point 31 away from the plane surface 28 throughout the central portion of the impeller and then, approximately at point 32, commences to curve toward said plane and continues to do so throughout the remaining peripheral portion of the impeller.

The impeller described above is shown in the drawing as being secured to an axial driving shaft 33 connected to a suitable electric motor 34. The rear face of the impeller is provided with a shoulder 35 which extends across the end of bushing 16 and has a thrust fit with an annular depression 36 in bearing member 14.

It will be seen that this construction of the impeller with respect to the casing in which it rotates provides a passage for the liquid being pumped, which passage gradually decreases in sectional area from the inlet to the outlet, and in a predetermined proportion to the increase in the velocity of the liquid being worked on by the impeller. We find that this decrease in sectional area greatly increases the efficiency of the pump.

The combination of the contracting inlet throat 21 centrally disposed with respect to the conically pointed portion 31 of the lower section of the impeller ensures that the vortex produced in the incoming liquid is maintained exactly centrally to and with the revolving impeller. Consequently, the vortex is prevented from oscillating about the axis of the pump, and since the entire path of the liquid into and through the impeller is stream-lined and of suitably decreasing area, the efficiency of the pump is greatly improved.

The curvature of the impeller surface is so proportioned as to develop the desired velocity of liquid flow with respect to the peripheral speed of the impeller vanes. Furthermore, the centrifugal flow of the liquid against the curved front surface of the impeller exerts an upward lift thereupon more than sufficient to balance the downward thrust due to the weight of the impeller and shaft, and consequently there is maintained a constant contact between the shoulder 35 and the bearing member at point 36, thereby preventing any vertical movement of these parts. This upward thrust causes the floating impeller to rotate in a fixed horizontal plane and prevents end play during the operation of the device.

From a manufacturing point of view, the pump casing assembly shown in the accompanying drawing and described above, presents many advantages. The meeting surfaces of the various parts are all exposed during the manufacturing process, and consequently may be conveniently and accurately machined on standard lathes so that an accurate fit between the various parts may readily be accomplished. The three-part assembly of the casing is extremely simple and may be taken down or assembled for installation, removal or repair with ease by merely removing the bolts 37.

It will be seen by one skilled in the art that all of the objects of our invention are accomplished by a device made in accordance with the description given above when considered with the accompanying drawing, and that an exceeding novel, simple, and efficient centrifugal pump is provided.

We claim:

1. In a centrifugal pump, a casing having a central inlet opening and an outwardly projecting inlet conduit adjacent said opening, said conduit being frusto-conical in form and having its smaller end adjacent said opening in said casing, said casing having a peripheral discharge chamber and a plane interior surface extending radially from said opening to said discharge chamber, said pump having an open-sided impeller in said casing coaxial with said inlet opening and having its open side facing said plane interior surface of said casing and a plurality of rearwardly curved blades projecting from the open side and extending continuously from substantially the center of the impeller to the periphery thereof, said front surface of said impeller being curved from a substantially conical point adjacent the inner ends of said blades away from said plane surface throughout a central portion of said impeller, said front surface being curved to incline toward said plane surface throughout a peripheral portion of said impeller as said surface approaches said peripheral discharge chamber.

2. An open-sided impeller for use with a centrifugal pump having a fixed axis on which said impeller rotates, said pump having an axial inlet and a peripheral discharge, said impeller comprising a backing member having a curved front surface facing said inlet and a plurality of rearwardly curved blades projecting from said curved surface and each extending from a point substantially adjacent the axis of the pump to the periphery thereof, the front edges of said blades being disposed to lie in a plane normal to the axis of said pump substantially throughout their lengths, said curved front surface of said impeller being disposed to intersect said normal plane adjacent the axis of said pump and at the inner ends of said blades and to form a substantially conical point projecting through said normal plane of said blade edges.

3. A casing assembly for a centrifugal pump having an impeller and an axial driving shaft, said assembly comprising a substantially cylindrical supporting section having means adjacent one end for attachment to a stand and having a radial outwardly extending flange at the other end, a bearing section having an elongated bearing sleeve for said driving shaft and extending into the cylindrical portion of the supporting section in spaced relation thereto, and an outwardly extending flange secured to the radial flange on the supporting section and constituting a backing member for the impeller and defining one wall of an impeller chamber, and a volute section secured to the first mentioned flange in concentric relation to the bearing section flange and defining another wall of said impeller chamber.

4. A casing assembly for a centrifugal pump having an impeller and an axial driving shaft, said assembly comprising a substantially cylindrical supporting section having means adjacent one end for attachment to a stand and having a radial outwardly extending flange at the other

end, a bearing section having an elongated bearing sleeve for said driving shaft and extending into the cylindrical portion of the supporting section in spaced relation thereto and an outwardly extending flange secured in face to face relation to the radial flange on the supporting section and constituting a backing member for the impeller and defining one wall of an impeller chamber, said flange on said bearing section having a diameter substantially equal to the diameter of said impeller, and a volute section secured to the first-mentioned flange in concentric relation to the bearing section flange and defining another wall of said impeller chamber.

5. A three part casing assembly for a centrifugal pump having an impeller and an axial driving shaft, the three parts of said assembly serving to define an impeller chamber and a discharge chamber and comprising a substantially cylindrical supporting section having a radial outwardly extending flange at one end, a bearing section for said shaft having an elongated bearing sleeve extending into the cylindrical supporting section in spaced relation thereto and having an outwardly extending radial flange of gradually increasing cross-sectional thickness toward its periphery secured in face to face relation to the radial flange on the supporting section, said bearing section flange constituting a backing member for the impeller and having a surface constituting a frusto-conical wall for said impeller chamber behind the impeller, and a volute flange in concentric relation to the bearing section flange and having surfaces defining another wall of said impeller chamber and the walls of said discharge chamber.

HAROLD E. BROUGHTON.
WILLIAM F. LAMOREAUX.