Dec. 16, 1941. R. P. EMERICK 2,266,180

IMPELLER FOR CENTRIFUGAL PUMPS

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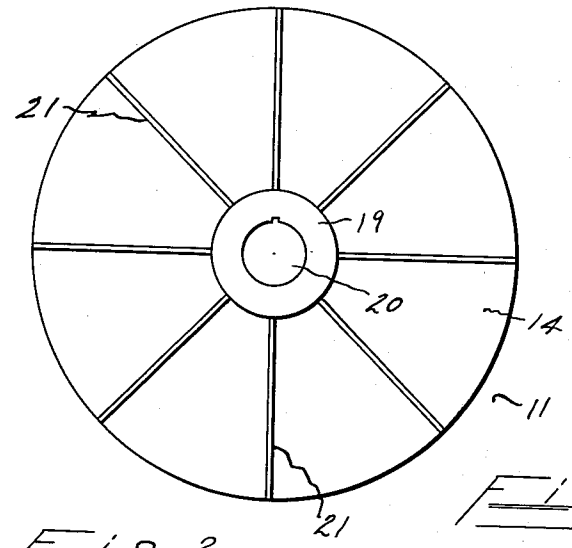


Fig. 2

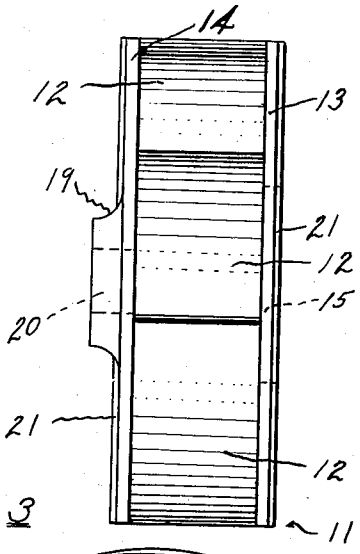


Fig. 3

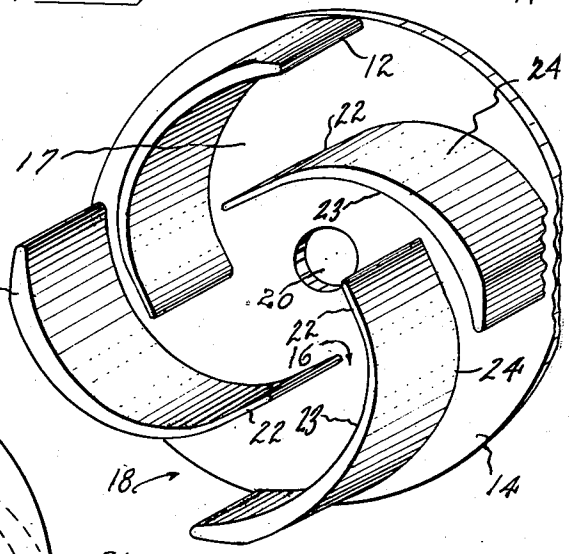


Fig. 4

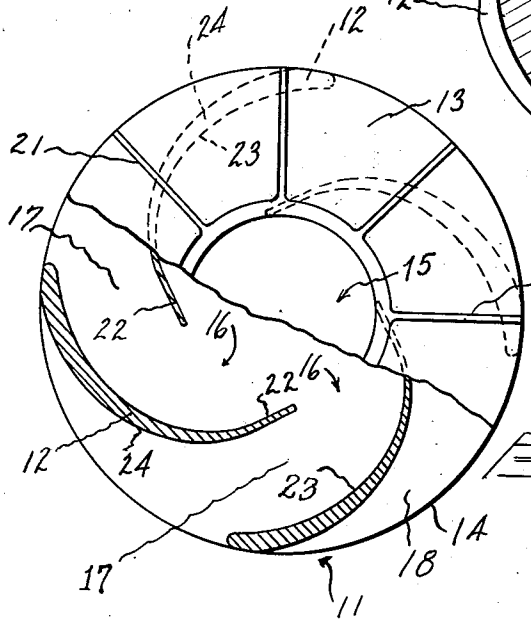


Fig. 1

INVENTOR.

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IMPELLER FOR CENTRIFUGAL PUMPS

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5 Claims. (Cl. 103—115)

My invention relates to impellers for centrifugal pumps, and more particularly, to the shape and curvature of the radially disposed vanes which form a part thereof.

The invention hereinafter disclosed is specially applicable to the large centrifugal pumps used in dredging operations, i. e. the pumping of conglomerate mixtures with water of sand, clay, gravel or rock, and the pumping of oil or water.

Heretofore centrifugal pumps have been accompanied in operation with "hammering or slugging" with resulting loss of power and efficiency. Hammering is caused by the sudden release of vacuum areas produced by velocity changes in a pumped aggregate at different points along the radially and circumferentially spaced fluid passages of an impeller.

The velocity of flow of pumped material at different points within the fluid passages is directly dependent upon the initial velocity, the shape and curvature of the vanes defining said fluid passages, and upon centrifugal force.

If the velocity of a pumped material is greater at the point of discharge of the fluid conducting channels than at the intake end thereof or at other points along the same, an irregularity of flow develops which intermittently produces the aforesaid low pressure or vacuum areas.

Another cause of hammering is the sudden piling up of pumped aggregate within the fluid passages caused by temporary reduced velocity at the discharge end of the vanes. With the conventional circular curvature of the vanes an excessive frictional force is developed. This force, which is due to the sudden changes in direction of the circular vanes, operates against the flow of any pumped mixture. It is this force which causes a decrease in velocity of a pumped aggregate. When the initial velocity is not maintained, the suction pressure at the intake end of the fluid conducting passages is irregular. It is also these irregularities which produce variations in fluid velocity throughout the fluid channels of the impeller; and consequently with such irregularities of flow producing intermittent low pressure areas, "hammering" is to be expected.

It is the object of my invention to eliminate the hammering or slugging which very often accompanies the operation of centrifugal pumps, specially when pumping conglomerate mixtures with water of sand, clay, gravel or rock.

It is the object of my invention to thereby produce a regular and continuous flow of such mixtures thus accomplishing greater efficiency.

It is the further object of my invention to cut down power costs.

The objects of my invention are accomplished by the novel impeller hereinafter described which is so designed as to overcome the existing difficulties of operation of centrifugal pumps hereinbefore described.

For a better understanding of my invention, reference should now be had to the following more specific description and drawing of which:

Figure 1 is a front elevational view of an impeller, partially in section.

Figure 2 is a rear elevational view of the same.

Figure 3 is a side elevational view thereof.

Figure 4 is a partial isometric view of the impeller blades and shroud.

Referring to the drawing, the impeller 11, which forms the important part of a centrifugal pump, is cast in one piece of some hard abrasion resisting material.

A plurality of vanes 12 are radially and circumferentially disposed about the axis of the impeller.

The shrouds or discs 13 and 14, forming part of the impeller, support the blades or vanes 12, and are integral therewith.

The opening 15 in the impeller shell provides intake means through which fluids are drawn. This opening extends through the impeller shell to the shroud 14 conducting pumped fluids through the openings 16 to the fluid conducting channels 17 defined by the vanes or blades 12.

The impeller 11 is provided with circumferentially spaced discharge orifices 18 on the periphery thereof through which the pumped medium is discharged, entering the casing, (not shown) within which said impeller is rotatably mounted, to be discharged through an outlet therein tangential to said casing.

The flanged portion 19 forming a part of the shroud 14 is provided with an opening 20 within which would be secured the actuating means for the impeller.

A plurality of ribs 21 axially disposed upon the shrouds 13 and 14 form a part thereof and are designed to prevent the return of any pumped material in the casing which might seek the low pressure area at the inlet opening of the impeller on the outside of the shroud 13. These ribs act as vanes on a small scale throwing out any escaping pumped medium by centrifugal force.

The blades or vanes 12 which define the fluid passages of the impeller, in order to withstand

the additional forces, increase in thickness towards the periphery thereof.

The profile of the vane which forms a part of my invention consists of straight line portions 22 and curved portions 23 and 24. These vanes defining the fluid passages start at the periphery of the intake opening 15 and extend laterally through the impeller shell, and are retained by the shrouds 13 and 14. These vanes also extend radially from the said intake channel to the periphery of the shrouds which form an integral part of the said impeller.

Were the vanes to radially extend from the central axis in a straight line normal to the intake opening, the velocity of flow would so vary at different points along the fluid channel due to the increasing radii that the flow would necessarily be irregular producing the "hammering" effect heretofore mentioned.

In the conventional impeller, the vanes start at the central portion and continue to the periphery at a substantially constant radius. It is this sudden change of direction of a regular curve which produces the frictional forces heretofore stated.

The straight line portions 22 nearest the suction end of the vanes 12 are designed to produce a higher initial velocity to the pumped substance than would be produced if the vanes started with a curve.

In my preferred embodiment the straight line portion comprises 25% of the radial distance from the intake opening 16 to the outer surface of the impeller. However, it is contemplated as within the scope of my invention, depending upon the nature of the substance to be pumped, that said straight line portions comprise from 1% to 75% of the aforesaid radial distance.

In my preferable embodiment the said straight line portion extends at a 63° angle from the radial lines passing through the center of the imaginary circle defined by the interior end points of the vanes. These radial lines also pass through said end points. However, it is contemplated as within the scope hereof depending upon the nature of the substance to be pumped, that said angle be varied from zero to 90° from the aforesaid radial line.

It is to be understood that the measurement of the above acute angle is based upon a radial line which is defined as follows:

The interior end points of the radially spaced surfaces define the loci of a circle. The radial line referred to passes through the center of said circle and through any one of the above said points defining said circle. Thus the straight line portion of the vane is constructed at an acute angle, preferably 63° from the above described radial line.

The conventional circular vane is replaced in my invention with vane curvatures 23 and 24 defined by the curves of increasing radii.

The curvature of my preferable embodiment is essentially as disclosed in the drawing, Figure 1; however, the exact rate of change in curvature shown depends upon the material sought to be pumped. In other words, the principle of my invention is applicable to curves defined by arcs of increasing radii within the limits of a straight line and the arc of a perfect circle.

My theory is that by supplementing the regular curved vane of impellers with a vane defined by arcs of increasing radii, the initial velocity obtained by the pumped medium is maintained so as to guarantee a continuous and regular flow for centrifugal pumps. This, of course, facilitates the exit of a pumped medium eliminating the aforesaid "hammering" characteristic of the conventional centrifugal pump, depending, in degree, upon the amount of concentration in the pumped conglomerate.

This result is accomplished by diminishing the frictional forces which naturally act upon a flowing fluid where there are sudden changes in direction as would be the case where the vanes are shaped in the conventional circular form. With this frictional resistance reduced to a minimum, the pumped medium is permitted to maintain its initial velocity. When this is accomplished "hammering" and plugging up of the pump is eliminated.

It has been this hammering and plugging up of centrifugal heavy duty pumps of the conventional type which eventually causes their destruction.

By maintaining the initial velocity of any pumped medium, I am able to guarantee uniform vacuum pressure in centrifugal pumps.

Thus by the novel shape and curvature of the vane, I am able to obtain a smooth, continuous, and uninterrupted flow of pumped medium. Consequently, I have produced an impeller for centrifugal pumps with a new efficiency approximately 38% greater than the usual 35% to 45% efficiency of this type of pump.

The impeller disclosed herein is comprised of four vanes as my preferable embodiment. However, I do not limit the theory of my invention to this number, it being contemplated that any convenient number greater than one vane may be used.

Now having fully described my invention herein, reference will be had to the claims which follow for determining the scope hereof.

I claim:

1. A closed impeller for a centrifugal pump comprising a plurality of vanes defined by a plurality of separate substantially spirally spaced surfaces, and by supporting members integral therewith, one thereof having an opening for receiving a power source, and the other having an axial fluid inlet opening, the latter communicating with a central inlet recess, the inlet openings between said vanes communicating with said inlet recess, the surfaces defining each vane consisting of a straight line portion for a substantially short part of its length, the same being disposed at an acute angle with respect to a radial line passing through the center of the circle defined by the interior ends of said surfaces, at the points where the vanes communicate with the central recess, the outer portion of said surfaces being generated by arcs of increasing radii, whereby the cross sectional areas of the vanes progressively increase out to the periphery of the impeller.

2. A closed impeller for a centrifugal pump comprising a plurality of vanes defined by a plurality of separate radially spaced surfaces, and by supporting members integral therewith, one thereof having an opening for receiving a power source, and the other having an axial fluid inlet opening, the latter communicating with a central inlet recess, the inlet openings between said vanes communicating with said inlet recess, the surfaces defining each vane consisting of a straight line portion for a substantially short part of its length, the same being disposed at an acute angle with respect to a radial line passing through the center of the circle defined by the

interior ends of said surfaces, at the points where the vanes communicate with the central recess, the outer portions of said surfaces being irregularly curved.

3. A closed impeller for a centrifugal pump comprising a plurality of fluid conducting passages defined by a plurality of separate angularly disposed radial surfaces, and by shrouds integral therewith, there being a central inlet opening in one of said shrouds, communicating with an axial recess bounded by the said shrouds, the surfaces defining each vane consisting of a substantially short straight line portion adjacent the axial recess, the same being disposed at an acute angle with respect to a radial line passing through the center of the circle defined by the interior end points of said surfaces, at the points where the vanes communicate with the central recess, and a trailing curved portion defined by arcs of increasing radii.

4. An impeller for a centrifugal pump comprising a plurality of vanes defined by a plurality of radially and spirally spaced surfaces, and by supporting members joined thereto, one thereof having an opening for receiving a power source, and the other having a fluid inlet opening, the latter communicating with an inlet recess, the inlet openings between said vanes communicating with said inlet recess, the surfaces defining each vane consisting of a straight line portion for a substantially short part of its length, the same being disposed at an acute angle with respect to a radial line passing through the center of the circle defined by the interior end points of said surfaces, and also passing through one of said end points, the outer portion of said surfaces being generated by arcs of increasing radii.

5. An impeller for a centrifugal pump comprising a plurality of vanes defined by a plurality of radially spaced surfaces, and by supporting members joined thereto, one thereof having an opening for receiving a power source, and the other having a fluid inlet opening, the latter communicating with an inlet recess, the inlet openings of said vanes communicating with said inlet recess, the surfaces defining each vane consisting of a substantially straight line portion for a substantially short part of its length, the same being disposed at an acute angle with respect to a radial line passing through the center of the circle defined by the interior end points of said surfaces, and also passing through one of said end points, the outer portion of said surfaces being generated by arcs of increasing radii.

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