June 14, 1955 H. T. HOLZWARTH 2,710,580

VANED ROTOR

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Fig. 1

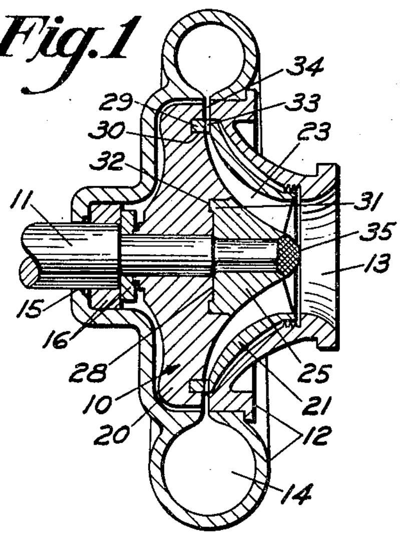


Fig. 2

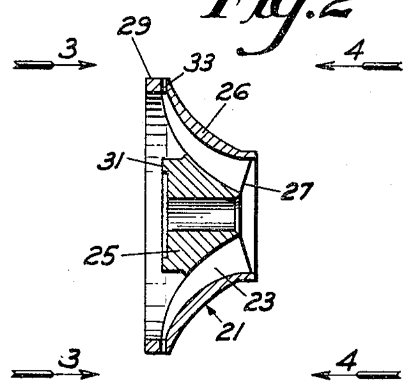


Fig. 3

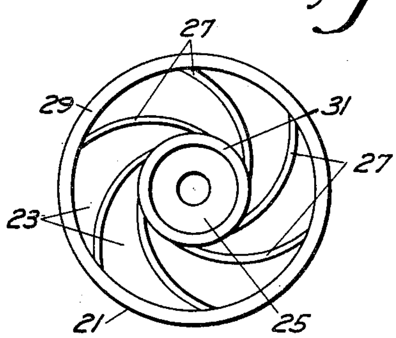
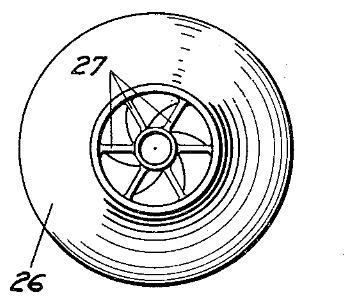


Fig. 4



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VANED ROTOR

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3 Claims. (Cl. 103—115)

The present invention relates to vaned rotors, such as centrifugal pump impellers or turbine wheels.

Vaned rotors, such as centrifugal pump impellers, designed for large pressure heads and small capacity, require a narrow passage width in an axial direction at the discharge end of the impeller. For a shrouded impeller of this general type, the narrow passage width between the shroud and the impeller disc at the discharge region in combination with a small discharge angle, makes the casting of such an impeller integrally with the shroud extremely difficult, if not impossible. If the casting of such an impeller is possible, machining thereof becomes extremely difficult.

One object of the present invention is to provide a vaned rotor of the general type referred to, constructed to permit it to be easily and inexpensively manufactured.

Various other objects of the invention will be apparent from the following particular description, and from an inspection of the accompanying drawings, in which:

Fig. 1 is an axial section of a centrifugal pump embodying the present invention;

Fig. 2 is an axial sectional view of the impeller;

Fig. 3 is an end view of the impeller taken in the direction of the arrows 3—3 of Fig. 2; and

Fig. 4 is an opposite end view of the impeller taken in the direction of the arrows 4—4 of Fig. 2.

Referring to the drawings, the vaned rotor unit of the present invention is shown in the form of a centrifugal pump comprising a vaned impeller **10** secured to a shaft **11**, and mounted in a casing **12**. The casing **12** defines an axial inlet opening or eye **13** at one end and a volute discharge chamber **14** at its outer periphery. The shaft **11** passes through an opening **15** in the other end of the pump casing **12**, and is shown sealed at this opening by means of a suitable sealing device **16**, as for instance, a nose seal ring.

The impeller **10** comprises two concentric nested sections **20** and **21** separately formed and constituting the holding disc and the vane disc respectively. Sections **20** and **21** may each be formed by a casting operation, however, if section **20** is highly stressed in use, then it is preferred to form section **20** by a forging or by a machining operation. The holding disc **20** is designed to withstand the centrifugal forces exerted by its own mass, and also part of the centrifugal forces exerted by the mass of the vane disc **21**, and since it does not participate in the transmission of torque from the shaft **11** to the vanes, it does not require special keying or splining with respect to said shaft. The holding disc **20** is concavely contoured at its inner face to define in conjunction with the hub **25** of the vane disc **21**, one of the continuous confining guide walls of the vane flow passages **23**.

The vane disc **21** which has to transmit the whole torque of the shaft **11** to the vanes, comprises the sturdy hub **25** designed for splined connection to the shaft **11**, a shroud plate **26** curvedly contoured at its inner face to define the opposite confining guide wall of the vane flow passages **23**, and a series of relatively thin walled vanes **27** integral with said hub and said shroud plate, and extending therebetween. The hub **25**, which has its inner face concavely curved and in continuity with the inner curved face of the holding disc **21**, is set snugly in a recess **28** of the holding disc **20**.

At its outer periphery, the shroud plate **26** has a cylindrical ring or flange **29**, which fits snugly in an annular groove **30** in the holding disc **20**. The hub **25** is similarly provided at its outer periphery with a cylindrical ring or flange **31**, extending with a snug fit in an annular groove **32** of the holding disc **20** at the outer periphery of the cavity **28**.

The flange or ring **29** is provided with a series of discharge openings **33** extending between the vanes **27**, and arranged in axial alignment and in communication with a narrow discharge passage **34** defined between the inner face of the holding disc **20** and the opposed inner face of the casing **12**. This discharge passage **34** leads into the discharge volute chamber **14**.

The hub **25** is retained on the shaft **11** by means of a head **35** welded or otherwise secured to the end of said shaft, and seated against the corresponding end of said hub.

The vanes **27** extend from the entrance end of the hub **25** to the flange **29**, and the outer diameter of said hub is sufficiently smaller than the outer diameter of said vanes to expose and render readily accessible a substantial portion of the rear side of the vane passages **23** radially outwardly beyond said hub, before the two impeller discs **20** and **21** are put together. The vanes **27** are shown of the usual substantially spiral shape, with their entrance sections almost substantially radial of the axis of the shaft **11**, and their discharge sections curved and approaching tangentiality with respect to the flange **29**. The width of the vanes **27** in a line perpendicular to the meridian direction decreases progressively from the entrance end thereof to the discharge end where the vane width is small, so that the impeller will afford a large pressure head and a small volume flow.

The casting and machining of the vane disc **21** is possible, since the flow vane passages **23** are exposed and easily accessible for hand fitting or machining operations radially outwardly beyond the hub **25**. The entrance end of the disc **21** is of greater radial or axial width compared to the discharge end, and is therefore not so difficult to manipulate or to handle for fitting or machining operations. The almost radial direction of the vanes **27** at their entrance end and the axial shortness of the hub **25**, are both helpful for cleaning, finishing and smoothing the walls of the flow passages **23**. Since the annular flow passage **34** on the outlet side of the impeller discharge openings **33** is designed with two flat parallel walls perpendicular to the axis of the impeller, it is possible even in cases of extremely narrow passage width in axial direction at the discharge section of the impeller, to machine and hand fit these openings **33** by removing the material from the ring **28** between the vanes **27**. The curving of the vanes **27** towards tangentiality with the flange **29** at their discharge ends makes the connection between said vanes and said flange sufficiently rigid to permit the use of vanes of the usual wall thickness.

No positive connection is shown between the holding disc **20** and the shaft **11** or the vane disc **21**. Nevertheless, there is enough frictional binding action between the holding disc **20** and the shaft **11** or the vane disc **21** to cause said holding disc to rotate with said vane. If desired, the flange **29** may be press-fitted into the groove **30**, the hub **25** press-fitted into the recess **28** and/or the flange **31** press-fitted into the groove **32** to assure binding driving action between the two impeller discs **20** and **21**.

Although the construction of the present invention is shown as applied to a centrifugal pump impeller, it must be understood that as far as certain aspects of the invention are concerned, it is also suitable for an expander type of turbine wheel or runner.

As many changes can be made in the above apparatus, and many apparently widely different embodiments of this invention can be made without departing from the scope of the claims, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A rotor for a centrifugal pump or turbine comprising a holding disc having an annular recess on its inner face, and a vane disc separately formed from said holding disc and mounted in axially opposed relationship with respect thereto for rotation therewith, said vane disc comprising a shroud plate with an annular flange extending into said recess with a snug fit, and a series of vanes integral with said plate and extending to said holding disc, said flange having discharge openings extending therethrough between said vanes.

2. A rotor for a centrifugal pump or turbine comprising a holding disc having an annular recess on its inner face, and a vane disc separately formed from said holding disc and mounted in axially opposed relationship with respect thereto for rotation in unison therewith, said vane disc comprising a shroud plate, a hub, an annular flange projecting from the inner face of said shroud plate into said recess, and a series of substantially spiral vanes integral with said plate and said hub and extending therebetween from the entrance end of said shroud plate to said flange, said flange having discharge openings extending therethrough between said vanes, said vanes progressively decreasing in meridian width from their entrance to their discharge end, said hub having an outer diameter substantially smaller than the outer diameter of said vanes, whereby substantial portions of said vanes extend radially outwardly beyond said hub, the surfaces of said vanes between said plate and said hub being accessible for finishing to close tolerances during manufacture.

3. A rotor for a centrifugal pump or turbine comprising a holding disc having an opening to receive a shaft, an annular groove in its inner face near its outer periphery, and an annular recess in the center of its inner face around said shaft opening, and a vane disc separately formed from said holding disc and mounted in axially opposed relationship with respect thereto for rotation in unison, said vane disc comprising a shroud plate having an annular flange which extends into said groove and contoured on its inner face to define one confining wall of the vaned flow passages, and a hub set into said recess, said holding disc and said hub having their inner faces contoured in continuous relationship to define conjointly the opposite confining wall of said passages, and a series of substantially spiral vanes integral with said plate and said hub and extending therebetween from the entrance end of said shroud plate to said flange, said flange having discharge openings extending therethrough between the vanes, said vanes progressively decreasing in meridian width from their entrance end to their discharge end, said hub having an outer diameter substantially smaller than the outer diameter of said vanes, whereby substantial portions of said vanes extend outwardly beyond said hub, the surfaces defining said vaned flow passages being accessible for finishing to close tolerances during manufacture.

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