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CENTRIFUGAL IMPELLERS

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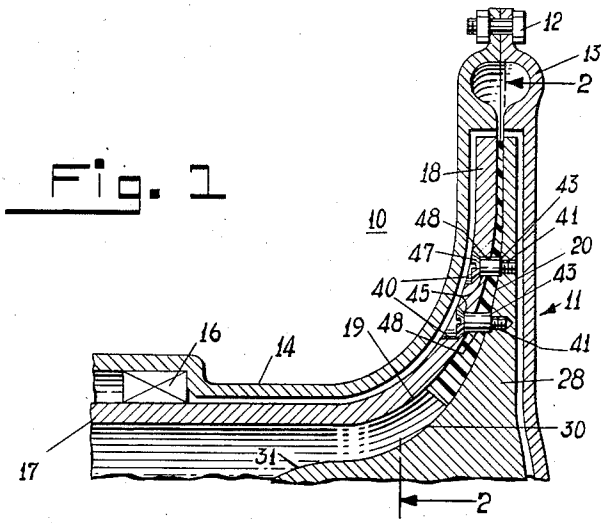


Fig. 1

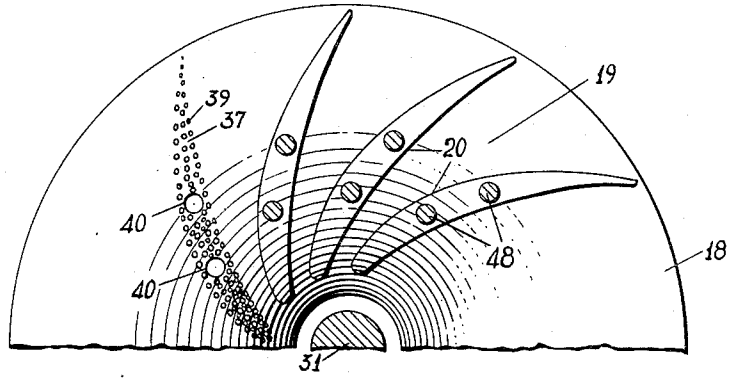


Fig. 2

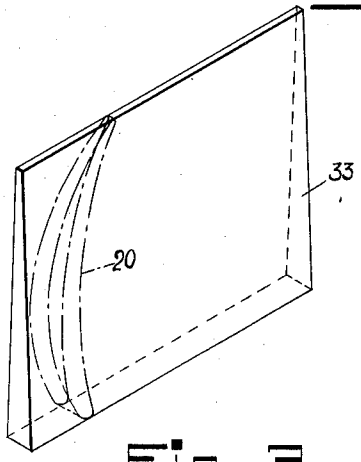


Fig. 3

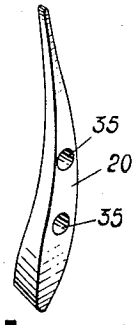


Fig. 4

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CENTRIFUGAL IMPELLERS

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5 Claims. (Cl. 103—115)

This invention relates to centrifugal impellers of the character employed in pumps, injectors and the like.

When centrifugal impellers, whether used in pumps or as injectors, and the like, are designed to handle low fluid flows at large pressure heads and at low speeds of rotation, the width of the discharge gap and the mean height of the impeller vanes becomes quite small. By reason of these considerations the efficiency of such impellers is inherently low. However, if such impellers are designed and manufactured in the conventional ways they are as costly and as troublesome to make as the impellers of inherently high efficiencies.

I have found that these inherently low efficiency impellers can be made more simply and cheaply than heretofore without materially lowering their efficiency.

It is the principal object of this invention to provide a centrifugal impeller, characterized by its narrow discharge gap and the low mean height of its vanes, of simple and rugged construction which can be simply and easily manufactured at low cost and whose efficiency compares favorably with the conventional impellers of this type.

It is also a principal object of this invention to provide a centrifugal impeller whose disc, vanes, and shroud are made separately by simple operations and subsequently assembled and formed into an operating unit by screws or similar fastening means, said vanes being formed from stock of wedge cross-section and being of a material sufficiently deformable when pressed by said disc and shroud, through said fastening means, to assume the contour of the fluid passageway, said fastening means being such as to accurately space said shroud from said disc.

It is a further important object of this invention to provide a centrifugal impeller whose vanes are formed separately from the disc and shroud thereof, said vanes being formed from stock of wedge cross-section by a simple operation and being of a synthetic deformable plastic material.

The further objects, features and advantages of the invention will be apparent from a consideration of the following detailed description of a present preferred embodiment thereof taken with the accompanying drawings, in which:

Fig. 1 is a cross-sectional view of a centrifugal pump provided with the novel impeller of the invention;

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1 showing the impeller disc with some of the vanes in position thereon;

Fig. 3 is an isometric view of a block of the material out of which the vanes are formed; and

Fig. 4 is an isometric view of one of the vanes.

The novel impeller of the invention is applicable generally to centrifugal pumps, injectors and the like. However, the novel impeller is particularly adapted for use in those cases where cost rather than efficiency is the primary consideration as well as in those cases where,

by reason of the conditions of operation, high efficiencies are inherently unobtainable. In the latter cases the novel impeller while it may not provide efficiencies higher than those obtainable by conventional impellers will provide efficiencies of the same order as those of conventional impellers.

The pump **10** is an example of the latter case and has been designed to handle low fluid flows at large pressure heads and at low speed of rotation of the impeller.

The pump **10** includes a two part casing **11** held together by a circular series of bolts **12**. The peripheral portions of the halves of the casing **10** are shaped to provide the outlet scroll **13** of the usual sort. The casing **10** includes an extension **14** which carries the bearing **16** for the impeller shaft **17** which may be driven by any of the usual means, not shown. For convenience the shaft **17** is made hollow so that it also serves as the pump inlet means.

The shaft **17** carries integral therewith the impeller disc **18**, which alternatively may be separately formed and united in any preferred manner to the hollow shaft **17**. The disc **18** may be formed by a casting or a forging operation, as preferred, and the fluid passageway defining face **19** thereof finished by a simple machining and/or grinding operation. It is to be noted that since the vanes **20** are not integral with the disc **18** and do not extend from the face **19**, said face is an uninterrupted surface of revolution generated by the rotation of a line about the axis of the shaft **17** as a center and may be machined or ground as by rotating it in a lathe against a tool or grinding wheel. The shroud disc **28** may also be formed by a casting or forging operation, as preferred, and the fluid passageway defining face **30** thereof finished by a simple machining and/or grinding operation. It is again to be noted that the vanes **20** are not integral with the shroud **28** and do not extend from the face **30**, hence said face is also an uninterrupted surface of revolution generated by the rotation of a line about the axis of the shaft **17** as a center and may be machined or ground as by rotating it against a tool or a grinding wheel. The shroud **28** includes a central portion **31** that extends into the hollow of the shaft **17**. The vanes **20**, as best shown in Figs. 2 and 3, approximate an airfoil in shape and curve from their wider inlet ends to their narrower outlet ends so that said outlet ends are at a considerable angle to the radius of the impeller and with the impeller disc **18** and the shroud disc **28** define a series of like shaped passageways for the fluid handled.

It is to be noted that in accordance with the design conditions imposed the mean height of the impeller vanes **20** is quite small and the change in height of the vanes **20** is gradual and approximates a straight line function. Thus, the vanes **20**, if made of a material that is sufficiently deformable, may be formed as flat wedge elements of proper taper and shaped to the proper contour by pressing them, in their final location, between the disc **14** and the shroud **28**. The vanes **20** may be made of deformable metal such as aluminum and lead, and their alloys, or they may be made of synthetic plastic material. At present it is preferred to form the vane **20** of synthetic plastic material as such material is readily available with corrosion resistance properties superior to those of the common metals and is easy to form and shape.

The vanes **20** may conveniently be formed from stock of the proper taper, as for instance the wedge block **33** of plastic material, by a simple operation such as sawing, punch pressing, etc., which does not require hand finishing. The holes **35** may be formed in the vanes **20** separately or as part of the punching operation when

said operation is employed. When the vanes **20** are formed of plastic material they are made of somewhat greater height than the design height and the areas **37** of the face **19** and/or the face **30**, ultimately covered by the vanes **20**, provided with shallow holes **39**, or shallow grooves, or are checkered, so as to receive material of the vanes **20** to lock them to the disc **18** and/or the shroud **28**.

The disc **18** is provided with a pair of counter-sunk holes **40** while the shroud **28** is provided with a pair of tapped holes **41** for each vane **20** employed. Each pair of disc holes **40** is adapted to register with a pair of vane holes **35** and a pair of shroud holes **41** when the impeller **11** is assembled. Each hole **41** is countersunk to provide a flat bearing surface **43** accurately located relative to the portion of the surface **30** around it. Each shoulder **45** is also accurately located relative to the portion of the surface **19** around its hole **40** and provides a bearing surface accurately located relative to the portion of the surface **19** around its hole **40**. Each set of aligned holes **40**, **35** and **41** is adapted to receive a screw **47** which includes a straight shank portion **48**.

The length of the shank **48** of the inner series of screws **47** is longer than that of the outer series of screws **47**. The shanks **48** of the screws **47** of each of said series are accurately cut to length, the shank lengths chosen being such that when the screws **47** are driven home in their respective holes **41** and the shoulders formed at the end of the shanks **48** adjacent the threaded portions of the screw **47** are snug on the horizontal bearing surfaces **43**, while the opposite ends of the shanks **48** are in line with the bearing surface of the shoulders **45**; the disc **18** and the shroud will be accurately spaced from each other and the vanes **20** will all be brought to the designed height throughout their lengths. To facilitate this operation the disc **14** and the shroud **28** may be heated to render the plastic vanes **20** sufficiently plastic to readily deform. If the vanes **20** are of metal then only a minimum thinning thereof can be anticipated so that they must initially closely approximate their design height.

I claim:

1. A centrifugal impeller comprising a rotatable shaft, a disc member extending from said shaft and rotatable therewith, a shroud member spaced from said disc member and centered to rotate therewith, said members presenting opposed flow path defining surfaces, said defining surfaces each being a surface of revolution generated by the rotation of a line about the axis of said shaft as a center, a plurality of vanes dividing the space between said defining surfaces into a plurality of like flow passageways, said vanes each having a plurality of spaced holes therethrough, said members each having a plurality of holes therein, each of the disc holes and each of the shroud holes being aligned with a respective one of said vane holes, one hole of each aligned pair of disc holes and shroud holes being tapped with one end thereof opening at its respective one of said defining surfaces, material around said one end being removed to provide a bearing surface predeterminately positioned relative to its surrounding defining surface, the other hole of each aligned pair of disc holes and shroud holes being stepped, the bore of said stepped hole of smaller diameter opening at its respective one of said defining surfaces and extending into its one of said members a predetermined distance, the bore of larger diameter meeting said bore of smaller diameter and opening at the outer surface of its one of said members, a plurality of connecting members adapted to enter the aligned holes of said shroud member, said disc member and said vanes, said members each including a tool engaging head portion of a diameter to fit into said bore of larger diameter, a shank portion of predetermined length adapted to fit in said smaller bore and the hole in the respective vane and terminating in a shoulder adapted to bear on said bearing surface,

and a threaded portion of reduced diameter extending from said shoulder and adapted to be screwed into said tapped hole whereby when said connecting members are screwed into said tapped holes as required to seat said shoulders on said bearing surfaces and said head portions on the ends of said large diameter bores, said defining surfaces are predeterminately spaced throughout.

2. In the method of forming a centrifugal impeller including a rotatable shaft, a disc rotatable with said shaft, and a shroud spaced from said disc by vanes formed of a material more easily deformable than the materials of said disc and said shroud, said shroud adapted to be connected to said disc for unitary rotation, said disc and shroud presenting spaced opposed flow path defining surfaces each generated by the rotation of a line about the axis of said shaft as a center, the steps comprising positioning a plurality of separately formed substantially flat, stiff flow path defining vanes between said disc and said shroud, distributing said vanes to divide the space between said disc and said shroud into a plurality of like flow passageways, connecting said shroud and said vanes to said disc and exerting pressure on said vanes through said disc and said shroud to deform said vanes to the contour of said defining surfaces covered by said vanes.

3. In the method of forming a centrifugal impeller including a rotatable shaft, a disc rotatable with said shaft, and a shroud spaced from said disc by vanes formed of a material more easily deformable than the materials of said disc and said shroud, said shroud adapted to be connected to said disc for unitary rotation, said disc and shroud presenting spaced opposed flow path defining surfaces each generated by the rotation of a line about the axis of said shaft as a center, the steps comprising positioning a plurality of separately formed substantially flat, stiff flow path defining vanes of greater mean height than the ultimately desired mean spacing between said disc and said shroud between said disc and said shroud, distributing said vanes to divide the space between said disc and said shroud into a plurality of like flow passageways, passing connecting members through said disc, said vanes and said shroud, applying pressure on said disc and said shroud through said connecting members to move said disc and said shroud toward each other and simultaneously deforming said vanes by the pressure exerted thereon by said disc and said shroud to reduce the mean height of said vanes, and continuing said pressure application until said disc and said shroud attain a predetermined spacing and the mean height of said vanes is reduced to a predetermined ultimate mean height.

4. In the method of forming a centrifugal impeller including a rotatable shaft, a disc extending from said shaft, and a shroud spaced from said disc by vanes formed of a non-metallic plastic material more easily deformable than the materials of said disc and said shroud, said shroud centered to rotate with said disc, said shroud and said disc presenting opposed flow path defining surfaces each generated by the rotation of a curved line about the axis of said shaft as a center, the steps comprising positioning a plurality of separately formed, flat stiff flow path defining vanes of wedge cross section between said disc and said shroud, distributing said vanes to divide the space between said disc and said shroud into a plurality of like flow passageways, securing said disc, said shroud and said vanes together as a unit and during said securing step applying sufficient pressure on said vanes through said disc and said shroud to deform said vanes to the curved contour of said defining surfaces covered by said vanes.

5. The method set forth in claim 4 wherein prior to the positioning of said vanes between said disc and said shroud, the portions of said disc and said shroud ultimately covered by said vanes are removed to provide shallow

voids, and wherein during the pressure applying step sufficient pressure is applied to force material of said vanes into said voids.

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