

## IMPELLER WHEEL

### TECHNICAL FIELD

The invention concerns a pump impeller and more precisely a pump impeller  
 5 for centrifugal-or half axial pumps for pumping of fluids containing  
 pollutants.

### BACKGROUND OF THE INVENTION

In literature there are lot of types of pumps and pump impellers for this  
 10 purpose described, all however having certain disadvantages. Above all, this  
 concerns problems with wear, clogging and low efficiency.

Sewage water contains a lot of different types of pollutants, the amount and  
 structure of which depend on the season and type of area from which the  
 15 water emanates. In cities plastic material, hygiene articles, textile etc are  
 common, while industrial areas may produce wearing particles. Experience  
 shows that the worst problems are rags and the like which stick to the  
 leading edges of the vanes and become wound around the impeller hub. Such  
 incidents cause frequent service intervals and a reduced efficiency.

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In agriculture and pulp industry different kinds of special pumps are used,  
 which should manage straw, grass, leaves and other types of organic  
 material. For this purpose the leading edges of the vanes are swept  
 backwards in order to cause the pollutants to be fed outwards to the  
 25 periphery instead of getting stuck to the edges.

Different types of disintegration means are often used for cutting the material  
 and making the flow more easily. Examples are shown in SE-435 952, SE-  
 375 831 and US-A 4 347 035.

In literature the designs of the pump impellers are described very generally, especially as regards the sweep of the leading edges of open impeller wheels. Attempts to define the sweep of the leading edges for an open impeller wheel are described in e.g. EP 0916851 and EP 0916852.

During pumping where high lifting heights are required, for example in mines, closed pump impellers are often used, i.e. such with two cover discs, an upper and a lower as well as intermediate vanes, because these types of impellers reduce the axial load on the pump in comparison to the open type impellers. On the other hand, closed impellers have a lesser lead-through, which means higher risk for clogging.

EP 0395604 discloses an impeller wheel, which is arranged with one or several vanes that are attached to cover discs on each side forming a so called closed impeller wheel. The leading edges of the vanes are placed generally in a plane perpendicular to the axis of rotation of the impeller, at the inlet opening in one of the cover discs.

Regarding closed impeller wheels they are generally designed with leading edges placed in the central inlet such that they are rather straight as seen in the flow direction. It has been found that during use, and in particular when the liquid contains rather large quantities of abrasive pollution, there is considerable wear on the leading edges of the vanes. There is further a risk that pollutants such as rags, plastic bags and other elongated objects get stuck on the leading edges, thereby requiring cleaning of the pump.

#### BRIEF DESCRIPTION OF THE INVENTION

Embodiments of the present invention seek to remedy the above mentioned problems and in particular in connection with closed impeller wheels.

These problems may be solved according to a main aspect of the invention by what is characterized in claim 1. Preferable embodiments of the invention form the dependent claims.

According to an aspect of the invention, there is provided an impeller wheel of a centrifugal or half axial type to be used in a pump for pumping liquids, wherein the impeller is arranged with one or several vanes, that the vanes are attached to cover discs on each side, forming a so called closed impeller wheel, that the leading edges of the vanes are placed generally in a plane perpendicular to the axis of rotation of the impeller, at the inlet opening in one of the cover discs, **characterized** in that the leading edges of the vanes are swept backwards at the inlet opening in one of the cover discs of the impeller in relation to the direction of rotation.

According to embodiments of the invention, the leading edges may co-operate with cutting means arranged in a central inlet opening of the pump.

Preferably the leading edges protrude somewhat out of the inlet opening, and that the cutting means constitute at least one narrowing section of the gap between the central inlet opening of the pump and the leading ledges of the impeller, whereby, when the leading edges sweep past these sections during operation, a cutting action may be obtained there between.

By designing the leading edges of the vanes strongly backswept it has been found that the wear on these edges are reduced drastically. The design also reduces the risk of material getting stuck on the edges. Rather such material are fed towards the periphery.

The material that however tends to get stuck on the edges at the inlet opening of the impeller will be cut by the cutting means. In a preferred

embodiment the leading edge of the vanes co-operate with two narrowing parts of the inlet opening of the pump housing.

For a good performance regarding the pump function and transportation of material towards the periphery, the sweep angle  $\alpha$  should be in the region 40 - 60° and the sweeping of the leading edges may generally follow the curvature of a logarithmic spiral.

In all an impeller wheel with improved performance and wear resistance is obtained, leading to long operation cycles between maintenance and service.

These and other aspects of and advantages with the present invention will become apparent from the following detailed description and from the drawings.

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#### BRIEF DESCRIPTION OF THE DRAWINGS

In the following detailed description of the invention, reference will be made to the drawings, of which

20 Fig. 1 is an axial cross-section through a pump according to the invention,

Fig. 2a is a perspective view from above of an impeller wheel comprising the present invention,

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Fig. 2b is a view corresponding to Fig. 2a from below,

Fig. 3 is a view from below of the impeller wheel of Fig. 2, and

Fig. 4 is a bottom plate to be mounted in a pump and co-operating with the impeller wheel according to Fig. 1.

#### DETAILED DESCRIPTION OF THE INVENTION

5 Fig. 1 shows an impeller wheel of the closed type mounted in a pump comprising a drive shaft 10 connected to an electrical motor (not shown) for driving the pump. To the lower end of the shaft a pump impeller 12 is mounted, comprising upper 14 and lower 16 cover discs, vanes 18 and back vanes 19. The above mentioned components are mounted in a pump housing 10 20, having a bottom wall 22, an inlet 24 and an outlet 26. The pump impeller 12 is mounted such in the pump housing that there is a gap 28 between the peripheral surface of the lower cover disc 16 and an inner side wall of the pump housing 20, a space 29 between the lower disc and the bottom wall as well as a gap 30 between a lower surface of the lower cover disc 16 and an 15 upper surface of the bottom wall 22.

According to the principles for a centrifugal pump, the liquid is sucked in axially through the inlet 24 and leaves the pump through the outlet 26 according to flow arrows A, B and C.

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According to the present invention the vanes 18 are designed such that the leading edges 40 are swept strongly backwards at the inlet opening 42 of the impeller wheel, in relation to the direction of rotation R. The sweep angle could be increased from the hub and outwards. The sweep of the leading 25 edges could be defined by a logarithmic spiral where the sweep angle  $\alpha$  is  $\pi/2 - \beta$ , where  $\beta$  is the angle of the logarithmic spiral. Preferably the sweep angle should be in the region  $40 - 60^\circ$ .

At the inlet opening of the impeller the leading edges are placed generally in a plane perpendicular to the axis of rotation 10 of the impeller. The advantage with this design is to make sure that pollutants slide towards the periphery instead of getting stuck on the edges. It has further been shown that the wear on the leading edges are reduced when they have this configuration instead of the conventional design.

Further, the leading edges protrude somewhat out of the central opening of the impeller, Fig. 1. The edge parts 44 of the vanes protruding above the bottom surface of the lower cover disc 16 can be arranged to co-operate with the edge part 46 of the stationary inlet 24 of the housing arranged in a bottom plate 22. The circular inlet is thus arranged with two oppositely arranged straight parts 50 whereby the gap between the vanes and the edge part of the inlet becomes very small. Elongated pollution such as rags, plastic bags and the like that have been stuck on the leading edges of the vanes will be cut here.

In total the design of the leading edges being swept and protruding somewhat, and co-operating with the opening of the bottom plate, greatly reduces the risk of pollutants getting stuck and reduces the wear on the leading edges.

It is to be understood that the embodiment described above and shown in the drawings is to be regarded as a non-limiting example of the invention and that it may be modified within the scope of the patent claims.

## PATENT CLAIMS

1. An impeller wheel of a centrifugal or half axial type to be used in a pump for pumping liquids, wherein the impeller is arranged with one or several vanes, that the vanes are attached to cover discs on each side, forming a so called closed impeller wheel, that the leading edges of the vanes are placed generally in a plane perpendicular to the axis of rotation of the impeller, at the inlet opening in one of the cover discs, **characterized** in that the leading edges of the vanes are swept backwards at the inlet opening in one of the cover discs of the impeller in relation to the direction of rotation.
2. Impeller wheel according to claim 1, wherein the leading edges protrude somewhat out of the inlet opening, arranged and capable of co-operating with cutting means arranged in a central inlet opening of the pump.
3. Impeller wheel according to claim 2, wherein the cutting means constitute at least one narrowing section of the gap between the central inlet opening of the pump and the leading ledges of the impeller.
4. Impeller wheel according to any of the preceding claims, wherein the leading edges are swept generally corresponding to a logarithmic spiral.
5. Impeller wheel according to claim 4, wherein a sweep angle of the leading edges is  $\Pi/2 - \beta$ , where  $\beta$  is the angle of the logarithmic spiral.

6. Impeller wheel according to any of the preceding claims, wherein the sweep angle of the leading edges are in the region 40 - 60°.
7. Pump comprising an impeller wheel according to any of the claims 1 - 3.