Feb. 15, 1966 C. B. GROSSKOPF 3,234,887

IMPELLER, PARTICULARLY WITH ONE OR MORE CHANNELS

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Fig.2

Fig.1

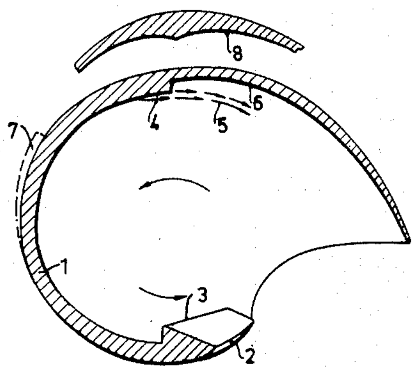

Fig.3

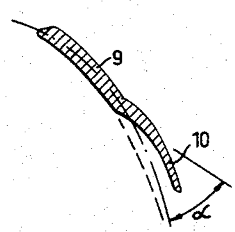

Fig.4

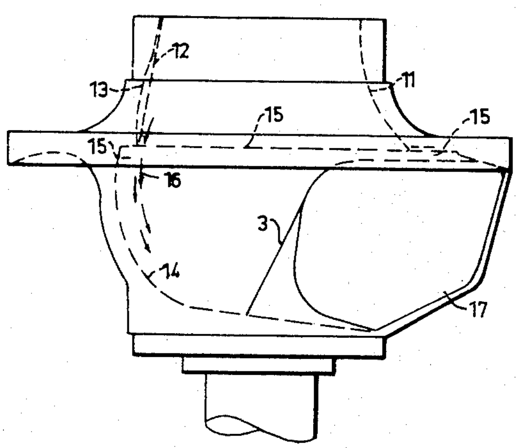

Fig.5

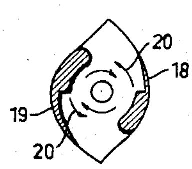

Fig.6

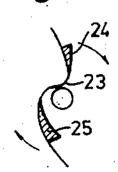

Fig.7

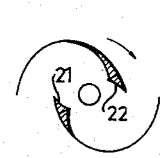

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Fig. 8

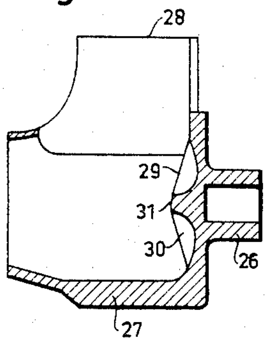


Fig. 9

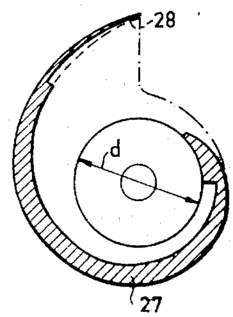


Fig. 10

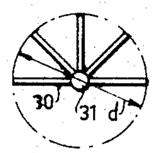


Fig. 11

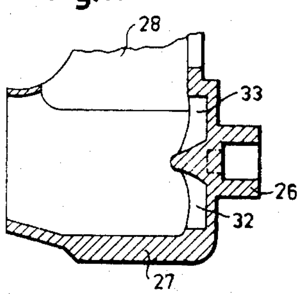


Fig. 12

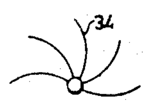


Fig. 13

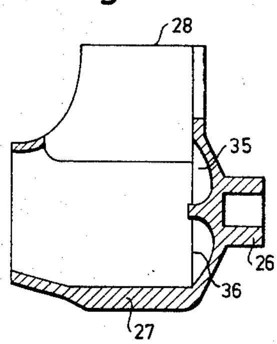
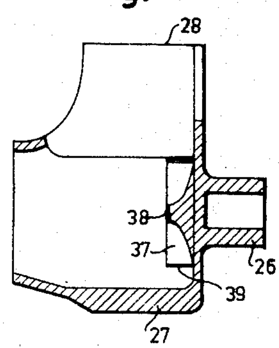


Fig. 14



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IMPELLER, PARTICULARLY WITH ONE OR MORE CHANNELS

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8 Claims. (Cl. 103—115)

Impellers with not more than two blades for pumping composite mediums such as sludgy waste water, drippy mediums carrying solid particles or the like are known. A disadvantage with such impellers is, that they very quickly wear out when abrasive compositions are pumped and that they are not suitable for pumping media containing gaseous occlusions or similar substances.

The present invention has among its objects to avoid such inconveniences and it broadly provides that the blades of the impeller, which are curved convexly helically and which extend over a substantial part of the periphery angle of the impeller, preferably at their inside, are provided with disengagement-forcing steps; furthermore, that the surfaces of the blades in connection with said steps are arranged in such a way, that an extension of the blade surface just before each step in the flow-through direction is divergent in relation to the blade surface just after the step, the solid particles in the medium being thus prevented from striking the blade surface after the steps. Said steps may be arranged either substantially in the axial flow-through direction or arranged perpendicularly to said axial flow-through direction. It is also possible to bend out the out-flow edge of each blade in a diffusor like manner so as to form a disengagement-forcing step.

If several steps are arranged in the flow-through direction it may also be suitable to arrange them diametrically with respect to each other and it is also possible to carry out the different steps between the in- and outflow of the impeller with different heights. According to the invention one may also make said steps exchangeable and also carry them out in a plastic material.

In order to further improve the possibility to keep the solid particles suspended in the carrying liquid, which is for instance also a problem in the food industry, according to the invention there is further provided a whirl-creating element within the spacing of the one-bladed impeller, such as for instance a vortex impeller with substantially radial or curved blades. Said element thus creates a whirl in the impeller space, which makes it easier to keep the solid particles suspended in the carrying liquid, thus enabling them to pass through the one-blade impeller space in a free flow together with the carrying liquid.

The vortex creating element is preferably arranged at the pressure side or bearing side of the impeller and may be provided in a recess of the bearing wall, whereby the borders of the recess will form a limitation at the periphery of the vortex generating impeller.

It is suitable to execute the vortex generating element as an exchangeable impeller positioned on an inner axis rotatably mounted in the hollow axis of the one-blade impeller. Further the vortex generating element too may be composed of elastic material.

The invention will now be described more in detail with reference to the accompanying drawings in which:

FIG. 1 is a sectional view of a one-channel impeller with a step-shaped disengagement-forcing inflow edge and a step-shaped profile particularly the inside of the blade, the two means forcing disengagement being positioned approximately radially opposite each other;

FIG. 2 is a fragmentary sectional view of a flow threshold;

FIG. 3 is a fragmentary sectional view of a blade outflow edge which is expanded with the purpose of causing disengagement;

FIG. 4 is an elevational view of a one-channel impeller in accordance with the invention having disengagement forcing steps at right angles to the system axis;

FIGS. 5 and 7 are fragmentary sectional views of two-channel impellers, which are by way of example provided with blades opposite each other;

FIG. 6 is a fragmentary sectional view of an S-shaped blade and disengagement-forcing means on the pressure side of said blade and on the sub-pressure side, respectively;

FIG. 8 is a sectional view of a one-channel impeller and a one-blade impeller, respectively, having a substantially smooth or flat interior spacing limitation on the pressure side and the bearing side, respectively, the blade sections of the vortex generator being retracted somewhat behind the plane of the wall;

FIG. 9 is a sectional view of a blade in a one-channel impeller with axial disengagement-forcing profiles in the blade mantle;

FIG. 10 is a fragmentary schematic view of a vortex generator having straight radial blades;

FIG. 11 is a fragmentary sectional view of the vortex generator positioned in a recess in the wall of the pressure side and bearing side, respectively, of a one-channel impeller, wherein said blades can be curved;

FIG. 12 is a schematic view of a one-channel impeller with curved blades;

FIG. 13 is a sectional view, similar to FIG. 11, but showing a modication wherein a one-channel impeller with a vortex generator is provided behind the wall plane and with the circumferential surfaces of the vortex generator wall passing successively into the interior blade surfaces of the one-channel impeller; and

FIG. 14 is a sectional view of a further modified vortex generator in front of the wall plane of the pressure side and the bearing side, respectively, and having its circumferential outflow edges bounded by headband-resembling damming means or the like, which are fixed in position or rotatable.

In the figures the designation **1** refers to a blade which is helically curved outwards and provided with an inflow edge **2** and a disengagement-forcing step **3** as an example situated opposite the step **4** serving for disengagement, the outflow direction **5** of which diverges with respect to the adjacent blade surface **6**. As an example the designation **7** refers to a disengagement-forcing step on the outside of the blade. The designation **8** refers to a profile in the form of a flow threshold.

FIGURE 3 shows a blade **9** provided with an outflow edge **10**, which is bent or curved outwards an angle α for the purpose of causing disengagement.

In FIGURE 4 the designations **11**, **12** and **13** refer to the axial or inclined inflow surfaces of a one-channel impeller. Together with the remainder of the blade surface **14** these surfaces form the disengagement-forcing steps **15** lying at right angles to the flow-through direction, the outflow direction of said steps being designated **16**. The blade outflow edge which is curved outwardly is designated **17**. The designations **18** and **19** (FIGURE 5) refer to the blades in a two-channel impeller having diametrically opposed steps wherein the outflow directions are designated **20** and are divergent with respect to the surfaces of the adjacent blade portions. The designations **21** and **22** refer to the blades of a two-channel impeller having profiled blade inflow edges which are positioned adjacent each other mounthpiecelike. An S-shaped blade **23** (FIGURE 6) is provided with disengagement-forcing means **24** on the pressure side and corresponding means **25** on the suction side. In FIGURE 8 the impeller hub is designated **26**, the single blade in a one-channel impeller is designated **27**, and **28** is the outflow edge of said blade. The designation **29** refers to a vortex generator with impeller blades **30** and a radial guard plate **31** at the impeller hub. The designation **32** refers to a vortex generator provided with damming surfaces **33** and positioned in a recess. The vortex generator blades **34**, FIGURE 12, are as an example shown having curved shape. The designation **35** refers to a vortex generator situated in the impeller wheel on the pressure side and substantially behind the impeller plane **36**. A vortex generator freely positioned in the impeller spacing is designated **37**, **38** is its radial guard plate and **39** is a circumferential boundary ring. The diameters of the inflow connection of the pump housing to the one-channel impeller and the cylindrical inflow portion of a one-channel impeller, respectively, are designated *d*.

The figures in the accompanying drawings are intended only to illustrate examples of the invention, which can be applied in many other embodiments and combinations than those shown above, thereby making it possible to provide other shapes and types of impellers for centrifugal pumps, above all for pumping compositions containing slimy and sludgy material, abrasive particles etc.

I claim:

1. In a one-blade-impeller for pumping composite media comprising an impeller blade which is curved convexly helically and which extends over a substantial part of the periphery angle of the impeller and which further at its inside is provided with disengagement-forcing steps having a surface just before each step which, if extended in the flow-through direction, would be divergent with respect to the blade surface just after said step, the arrangement of a vortex generating element lying within the impeller blade spacing, said vortex generating element being shaped as an impeller with substantially radially positioned blades and being furthermore positioned on the impeller wall situated on the bearing side of the impeller.

2. In a one-blade-impeller for pumping composite media comprising an impeller blade which is curved convexly helically and which extends over a substantial part of the periphery angle of the impeller and which further at its inside is provided with disengagement-forcing steps having a surface just before each step which, if extended in the flow-through direction, would be divergent with respect to the blade surface just after said step, the arrangement of a vortex generating element lying within the impeller blade spacing, said vortex generating element being shaped as an impeller with substantially radially positioned blades, said vortex generating element being arranged in a recess in the bearing side wall of the impeller, the borders of said recess forming a limitation at the periphery of the vortex generating element.

3. In a one-blade-impeller for pumping composite media comprising an impeller blade which is curved convexly helically and which extends over a substantial part of the periphery angle of the impeller and which further at its inside is provided with disengagement-forcing steps having a surface just before each step which, if extended in the flow-through direction, would be divergent with respect to the blade surface just after said step, the arrangement of a vortex generating element lying within the impeller blade spacing, said vortex generating element being shaped as an impeller with substantially radially positioned blades, said vortex generating element comprising an exchangeable impeller which is positioned on an inner axis rotatably mounted in a hollow driving axis of the one-blade impeller.

4. In a one-blade-impeller for pumping composite media comprising an impeller blade which is curved convexly helically and which extends over a substantial part of the periphery angle of the impeller and which further at its inside is provided with disengagement-forcing steps having a surface just before each step which, if extended in the flow-through direction, would be divergent with respect to the blade surface just after said step, the arrangement of a vortex generating element lying within the impeller blade spacing, said vortex generating element being shaped as an impeller with substantially radially positioned blades, said vortex generating element being composed of an exchangeable impeller comprising elastic material.

5. A one-blade impeller for pumping composite media, comprising an impeller blade which is curved convexly helically and which extends over a substantial part of the periphery angle of the impeller, said impeller blade being provided with disengagement-forcing steps, the blade surface in connection with said steps being arranged in such a way, that an extension of the blade surface just before a step in the flow-through direction is divergent with respect to the blade surface just after said step, the solid particles in the medium thereby being restrained from striking the blade surface after the steps.

6. An impeller according to claim **5**, in which the disengagement-forcing steps are arranged substantially in the axial direction of the impeller.

7. An impeller according to claim **5**, in which the out-flow-edge of the blade is bent out in a diffusor-like manner, so as to form a disengagement-forcing-step.

8. An impeller according to claim **5**, in which the disengagement-forcing steps between the inflow and outflow have different step heights.

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