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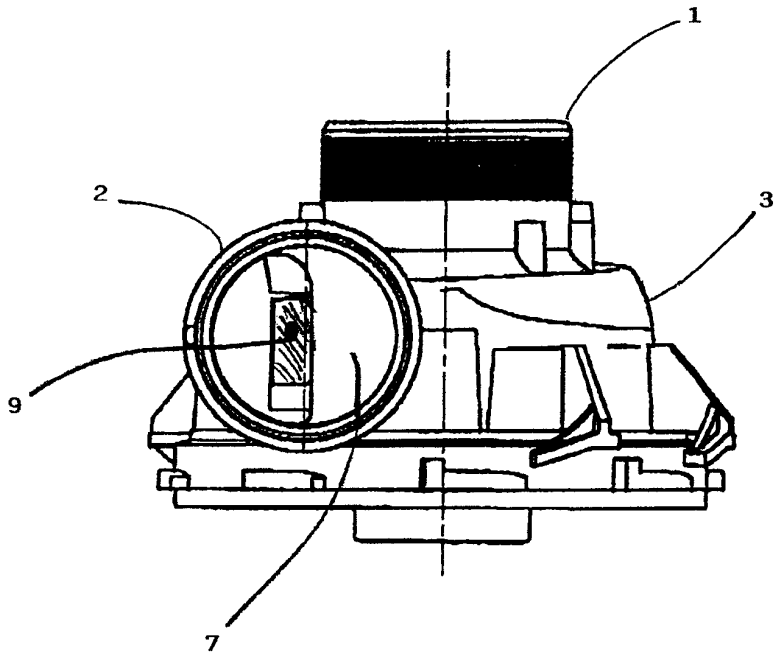
(54) **Improvement in a hydraulic centrifugal turbine pump**

(57) Centrifugal turbine pump comprising an intake conduit, a delivery conduit, a pumping chamber, an impeller housed in the pumping chamber and provided with a plurality of vanes, wherein said delivery conduit comprises a transition region extending from the inflow section to the discharge or outflow section thereof, wherein the cross-section area of said delivery conduit increases along such transition region in a gradual, continuous manner.

The curve that represents the cross-section area of said transition region does not show any cusp point. In addition, the portion of the pumping chamber that houses the impeller is formed integrally, i.e. as a single-piece, unitary construction with said delivery conduit and the related transition region.

FIG. 7



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Description

[0001] The present invention relates to an improved kind of centrifugal turbine pump, preferably of the type generally used in connection with electrical home appliances, such as clothes washing machines, dishwashers, and the like, and provided therefore with such design and operating specifications as generally required in view of such applications.

[0002] Since pumps of the above-cited kind are generally used in appliances and machines that are required to be very competitive as far as both costs and energy efficiency are concerned, a considerable, constant effort is most obviously being made in industry by manufacturing and design engineers in an attempt to continuously improve the overall operating and construction characteristics of such pumps.

[0003] Centrifugal turbine pumps of the type covered by the present invention are generally mass-produced on a vast industrial scale so that, owing to reasons pertaining to substantially manufacturing costs and space requirements, i.e. compact size, there is no possibility for all typical measures and provisions of both a design and technical nature to be taken and implemented in these pumps as they are on the contrary usually taken and implemented in pumps for industrial and professional applications in general, in which there are involved much higher flow rates and power ratings, actually.

[0004] Therefore, the efforts of manufacturing and design engineers are in this case particularly focussing on the possibility of providing impellers and pumping chambers that are effective in bringing in sensible improvements in the overall efficiency, so as to achieve a natural reduction in the size and the power rating of the motor used to drive said impeller.

[0005] What is obtained in this way, actually, is therefore a twofold advantage in terms of an improved water-handling, i.e. hydraulic efficiency and a resulting reduction in the size - and therefore the costs - of the motor used to drive the pump.

[0006] Anyway, a reduction in the size of the pumping chamber and, in general, also in the cross-section are of the delivery or discharge conduit connected thereto, gives rise to a drawback that is particularly felt as such in the home appliance industry where these pumps are used; in fact, with reference to Figure 1, which is a copy of Figure 10 appended to the patent publication WO 2005/108976, and to Figure 2, which is a copy of Figure 4 appended to the US patent publication no. 5,049,134, these can be noticed to be planar sectional views - orthogonally to the axis of the impeller - of a pumping chamber according to the prior art. It can be noticed that the diameter D of the delivery conduit 2 does neither narrow nor widen at the outlet from the pumping chamber 3, since said delivery conduit 2 is directly connected to the machine-side use conduit 4, which - as just roughly schematized in the above-cited Figures - is connected to said delivery conduit 2 of the pump immediately downstream therefrom, and has the same diameter D as said delivery conduit 2, actually.

[0007] The above-cited drawback derives from the fact that, if the size of the pumping chamber 3 is reduced, then the diameter of the delivery or discharge conduit of the pump has of course to be reduced, as well. However, since the diameter of the utilization conduit 4 will remain unvaried due to imperative constraints set by such conduit having to mechanically interface with the appliance parts using the liquid delivered by it, it quite obviously ensues that the pumping chamber 3 has to join up into the delivery conduit 2 in the way as this is schematically illustrated in Figure 3, in which there can be noticed that the diameter D1 of the delivery conduit shall join up into the diameter D2 of the contiguous utilization conduit 4 attached thereto in a very quick manner.

[0008] Such situation causes a chamber 22 to come practically into existence where said two conduits join into each other, the shape and position of this chamber being such as to give rise to a vortex, i.e. whirling flow conditions.

[0009] As is largely known in the art, vortices are the cause of losses in hydraulic efficiency that, in pumps of a general type as the ones covered by the present invention, may be quite sensible.

[0010] In view of reducing this problem, an option may of course lie in providing an appropriately shaped and contoured joint configuration with a gradually increasing cross-section area, so as to avoid forming chambers in which vortices can develop and become established.

[0011] Generally, however, such kind of joint just cannot be implemented with the appliance-side utilization conduits, whose design specifications are already defined and set in view of the afore-cited mechanical-interface constraints.

[0012] It would therefore be desirable, and it is the main object of the present invention, actually, to provide a kind of centrifugal water turbine pump that is effective in doing away with the two above-indicated drawback of prior-art pumps of the same kind, so as to ensure a high water-handling, i.e. hydraulic efficiency, jointly with a pumping chamber that, apart from having a reduced size, is adapted to eliminate the afore-cited mechanical-interface constraints set by the pump having to be coupled mechanically to the appliance parts using the liquid delivered by the pump, and is further adapted to prevent vortices, or whirling flow conditions, from being generated downstream from the pumping chamber.

[0013] According to the present invention, these aims are reached in a centrifugal turbine pump incorporating the features as defined and recited in the appended claims.

[0014] Features and advantages of the present invention will anyway be more readily understood from the description that is given below by way of non-limiting example with reference to the accompanying drawings, in which, further to Figures 1, 2 and 3 already mentioned and described hereinbefore:

- Figure 4 is an outer perspective view of a turbine pump according to the present invention;

- Figure 5 shows a projection, along to the plane lying orthogonally to the axis of the impeller, of the same impeller, the pumping chamber and the delivery conduit, according to a first embodiment of the present invention;

- Figures 6A to 6E are respective cross-sectional views of the delivery conduit, as taken orthogonally thereto and arranged at regular intervals from each other;

- Figure 7 is a further outer perspective view of the pump according to the present invention, as viewed from a point situated on the axis of the delivery conduit thereof.

With reference to Figures 4 and 5, a centrifugal turbine pump according to the present invention comprises an intake conduit 1, a delivery or discharge conduit 2, a pumping chamber 3, an impeller 4 housed in said pumping chamber in a manner that is largely known as such in the art, and a plurality of vanes 5 applied to said impeller along the circumference thereof.

[0015] Between the inflow section S1 and the outflow section S2 of the delivery conduit 2 there is formed a transition region 6 that is physically part of said delivery conduit.

[0016] According to the present invention, the area of said inflow section S1 is made significantly smaller than the area of said outflow section S2.

[0017] With particular reference to Figure 5, said delivery conduit is provided so that it widens gradually out in its cross-section to develop into such shape that a projection thereof on a plane lying orthogonally to the axis of the impeller would trace out a P-shaped contour featuring two concavities C1, C2, the first one C1 of which faces the exterior of the conduit with a vertex V1, whereas the second one C2, with a vertex V2, is facing the interior of the same conduit.

[0018] These two mutually opposing concavities are therefore divided from each other by a point of inflection F.

[0019] In a preferred embodiment of the delivery conduit, the face 7 of the inner surface portion of said P-shaped contour that faces the pumping chamber 3 is given a substantially planar shape, so that the projection thereof on a plane lying orthogonally to the axis C of said delivery conduit 2 appears as a segment 7.

[0020] In fact, if properly and accurately designed, such feature will generally enable the length of the delivery conduit to be reduced, however without introducing any risk of small vortices being likely to be brought about by the shortness of the delivery conduit.

[0021] It can therefore be most readily appreciated that any possibility is substantially prevented for vortices to be created in the so-called "dead" zone, i.e. in the zone along which the delivery conduit extends alongside the outer side of the pumping chamber.

[0022] Therefore, the actual advantage of the present invention lies in providing a centrifugal turbine pump, the delivery or discharge conduit of which features such inflow section as to be able to make as best as possible a use of and take as best as possible an advantage from the characteristics of the pumping chamber, the impeller, and the operating parameters thereof, and such outflow section as to fully comply with the mechanical-interface constraints and requirements set by the appliance in which the pump is due to be installed and operate.

[0023] Figures 6A through to 6E are respective cross-sectional views of the delivery conduit, as viewed along the respective section planes extending parallel to each other and orthogonally to said axis C, from Pa to Pe in Figure 5. As it can be noticed in these Figures, the available free passage area 9 of the delivery conduit, as identified by the non-hatched sectors, increases in a gradual manner from a Figure to the next one, corresponding exactly to the gradual increase in the cross-section area of the same conduit.

[0024] Furthermore, and referring again to the same Figures 6A through to 6E, the side 7 that widens out inside the delivery conduit keeps in all cases having a substantially planar contour, so as to be able to couple in a natural manner with the shape of the inflow section S1 of the delivery conduit.

[0025] With particular reference to Figure 7, it is moreover particularly advantageous for the pump body, which includes the pumping chamber 3 and the delivery conduit 2, to be entirely provided as a single-piece unitary construction, so as to also include said transition region of said delivery conduit having a gradually increasing cross-section area.

[0026] The advantage deriving from such solution lies in the fact that, in this way, the possibility is given for a pump body to be provided, which most advantageously combines compact-size and high-efficiency characteristics, while complying with the requirements set by the mechanical-interface design constraints described hereinbefore, this being a result that can be obtained by providing said transition region within the delivery conduit itself as a single-piece unitary construction therewith.

Claims

1. Centrifugal turbine pump comprising:

- an intake conduit (1),
- a delivery conduit (2),
- a pumping chamber (3),
- an impeller (4) housed in said pumping chamber,
- a plurality of vanes (5) arranged on and at-

tached to said impeller,

characterized in that said delivery conduit (2) comprises a transition region extending from the inflow section (S1) to the discharge or outflow section (S2) thereof, and **in that** the cross-section area of said delivery conduit increases along such transition region in a gradual, continuous manner.

2. Centrifugal turbine pump according to claim 1, **characterized in that** the contour (P) of the curve (C) traced by the projection, on a plane extending orthogonally to the axis of rotation of said impeller, of the side of said transition region (6) lying closer to the axis (X) of said impeller, comprises a point of inflection (F).

3. Centrifugal turbine pump according to any of the preceding claims, **characterized in that** the side (7) of said transition region lying closer to the axis (X) of said impeller has a substantially planar configuration.

4. Centrifugal turbine pump according to any of the preceding claims, **characterized in that** the portion of the pumping chamber (3) that houses said impeller is provided integrally, i.e. as a single-piece unitary construction with said delivery conduit (2).

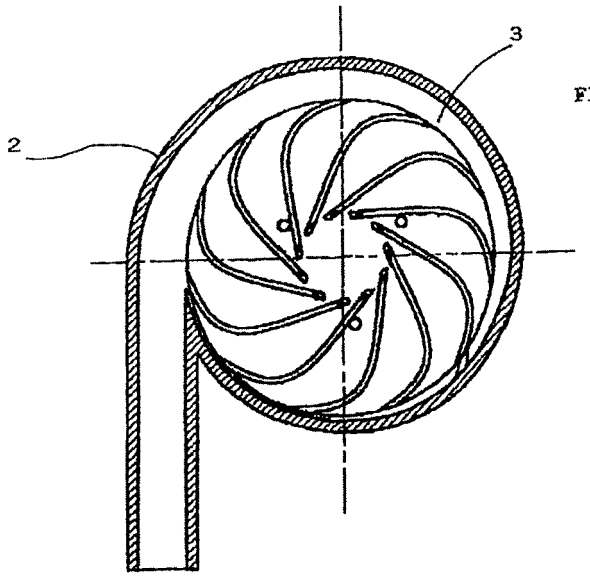


FIG. 1

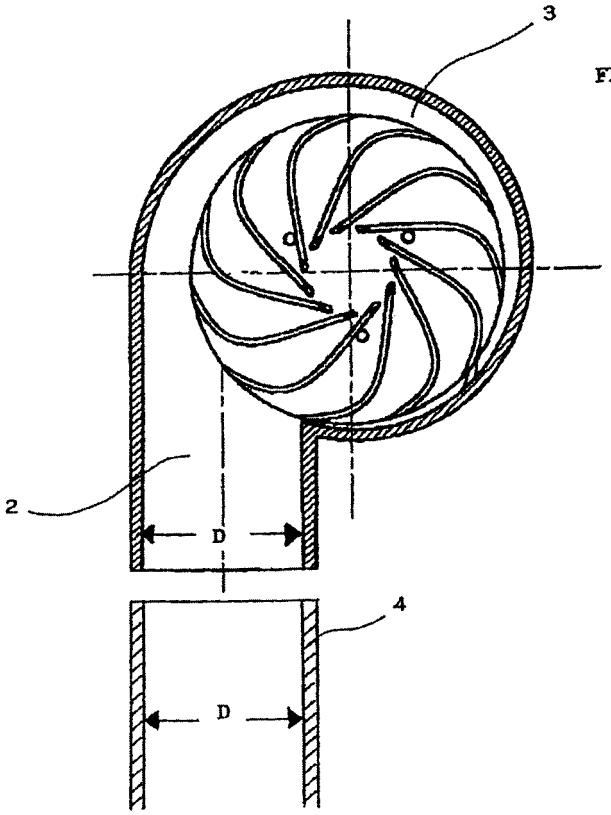


FIG. 2

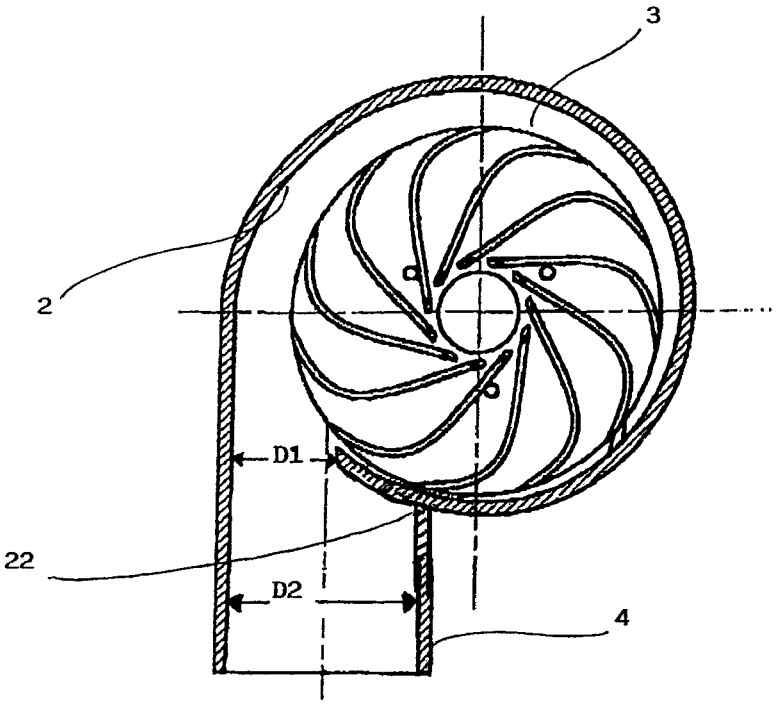


FIG. 3

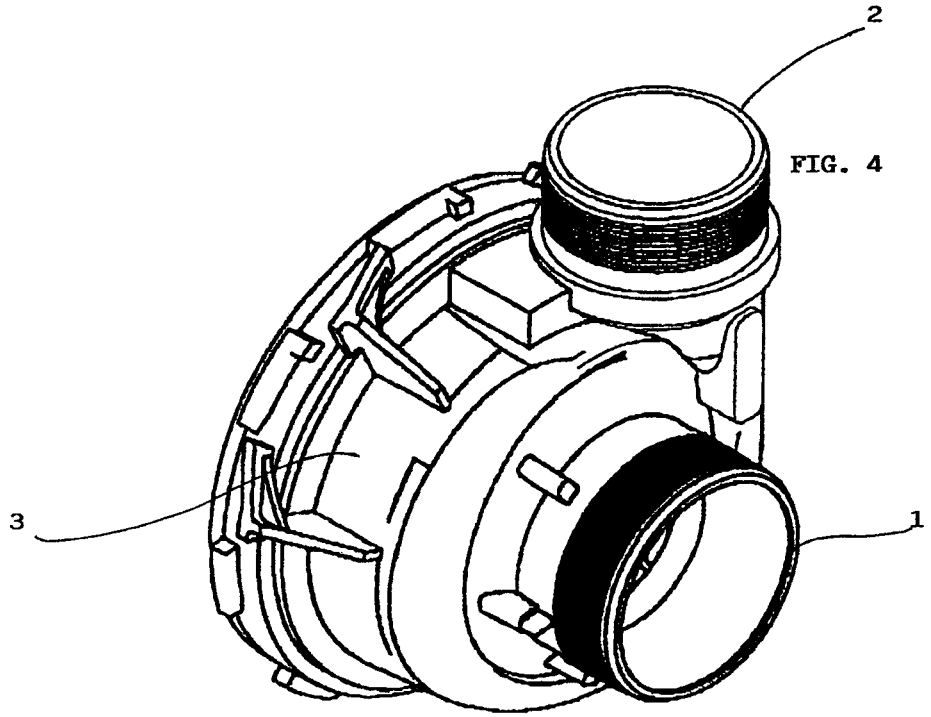


FIG. 4

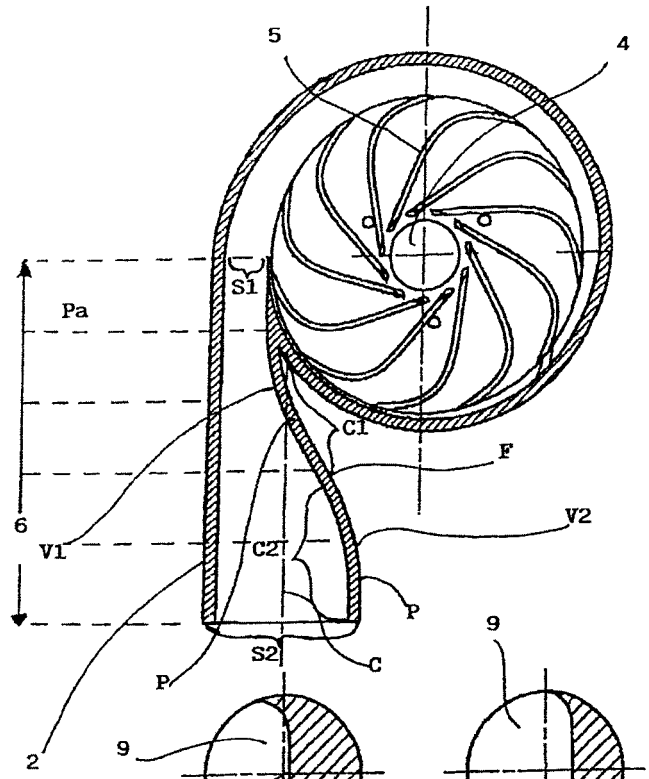


FIG. 5

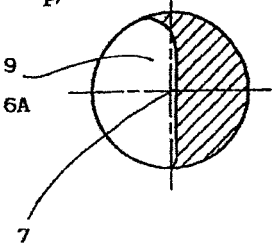


FIG. 6A

FIG. 6B

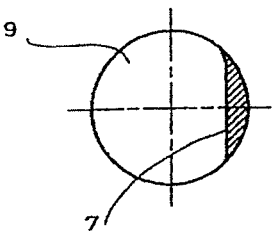


FIG. 6C

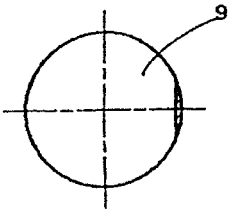


FIG. 6D

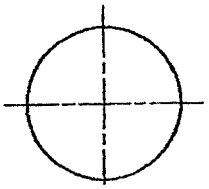
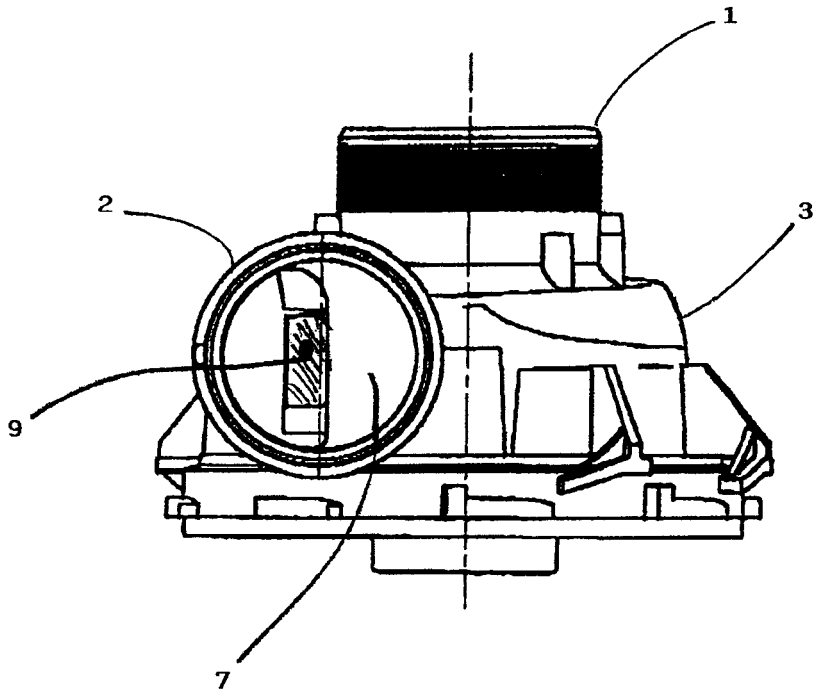


FIG. 6E

FIG. 7



REFERENCES CITED IN THE DESCRIPTION

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- US 5049134 A **[0006]**