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## Impeller pump

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### 5    Technical field

The present invention relates to an impeller pump having an improved geometry of the inlet and outlet openings.

### Technical background

10    Impeller pumps use an impeller wheel having a plurality of elastic impeller blades (also known as impeller vanes), which rotates in a pump housing. The diameter of the impeller wheel, i.e. the length of the impeller blades, is selected here such that the free end of the impeller blades bears against the inner wall of the pump housing in every position of the impeller wheel. Between the outlet opening and the inlet opening of the pump housing, the distance of the inner wall from the axis of rotation of the impeller wheel decreases. As a result, the impeller blades are bent (to a greater  
15    extent) during the movement from the outlet opening to the inlet opening than during the movement from the inlet opening to the outlet opening. As a result, the volume that is delivered from the outlet opening to the inlet opening during a rotation of the impeller wheel is less than the volume that is delivered from the inlet opening to the outlet opening during a rotation of the impeller wheel. This results in the medium to be pumped being delivered from the inlet opening to the outlet opening.

20    Impeller pumps are particularly suitable for delivering liquids contaminated with suspended solids and fibres – for example containing food waste. A further advantage is that impeller pumps are self-priming on account of the sealing off of the impeller blades from the pump housing.

Since, in order to ensure this sealing off, the impeller blades bear firmly against the inner wall of the pump housing, they are subject to wear. This is exacerbated by the fact that, when they sweep over  
25    the inlet opening and the outlet opening, the impeller blades are pushed into these openings, and particularly against the edges thereof, on account of their elasticity and also on account of centrifugal forces.

From the prior art, it is previously known to provide the inlet and/or outlet opening with a grating or “comb” in order to reduce this impact on the impeller blades. However, in the case of liquids containing suspended solids, in particular when the latter contain fibrous constituents, this results in the possibility of the contaminants getting caught on the grating bars, thereby reducing the delivery capacity of the pump. Furthermore, there are hygienic concerns in this case, when the contaminants are located in the pump housing for a relatively long time.

Furthermore, EP 2 646 691 B1 discloses an impeller pump in which the inlet or the outlet is configured in an elliptical manner. As a result, although the depth to which the impeller blades are pushed in can be reduced, on account of the elliptical shape of the inlet or outlet, only some of the impeller blades come into contact with the edge of the ellipse in each case, and so the impeller blades wear down to a greater extent there and thus unevenly, with the possible consequence of leaks.

### Summary

Proceeding from the known prior art, it is an example of the present disclosure to design an impeller pump such that the abovementioned drawbacks of the prior art are resolved.

This example is achieved by an impeller pump according to independent Claim 1. Preferred examples are specified in the dependent claims, the figures and the description.

In one aspect, the present disclosure refers to an impeller pump comprising, a housing comprising, an inlet comprising an opening consisting of one inner inlet opening at which the inlet transitions into an interior of the housing, and an outlet comprising an opening consisting of one inner outlet opening at which the outlet transitions into the interior of the housing, and an impeller wheel disposed in the interior of the housing, rotatable about an axis of rotation, and comprising a plurality of elastic impeller blades, wherein a cross section of at least one of the inner inlet opening or of the inner outlet opening when viewed from the interior of the housing along an axis defined by the at least one of the inlet or the outlet is in a shape of a polygon comprising a plurality of straight line segments, a longitudinal extent that is oriented perpendicular to the axis of rotation, and a width of the cross section that is oriented parallel to the axis of rotation, wherein widths of the cross section vary along at least a part of the longitudinal extent.

Accordingly, an impeller pump having a housing, which has an inlet and an outlet, and having an impeller wheel, which is accommodated in the housing interior, with a plurality of elastic impeller blades is proposed. According to the disclosure, the cross section of the inlet and/or of the outlet on the side facing the housing interior is substantially in the shape of a polygon.

The inlet and the outlet have an inner inlet opening and an inner outlet opening, respectively, at which they transition in each case into the housing interior, in which the impeller wheel with the plurality of elastic impeller blades (made for example of rubber) is located.

5 The term “*cross section*” should be understood herein as meaning that in particular the inlet or the outlet is viewed from the interior of the housing along an axis defined by the inlet or outlet. This means for example that an inlet which is provided by a pipe having a circular cross section has a circular cross section even when the actual shape of the inlet opening in the housing is no longer circular when it is developed onto a plane of the pump housing.

Since the inlet and the outlet are openings, the polygon is usually a closed polygon.

Since the cross section of the inlet and/or of the outlet on the side facing the housing interior is substantially in the shape of a polygon, when an impeller blade moves over the inlet or outlet, even sweeping of the impeller blade over the edges of the inlet or the outlet can be achieved. In other words, the contact point between the impeller blade and the respective edge of the inlet or outlet is shifted substantially evenly, such that more even wearing down of the impeller blades occurs and thus a longer lifetime of the individual impeller blades and thus a longer service life of the impeller wheel is achieved.

The polygon can preferably have a number of from 3 to 17 corners.

The shape of the cross section of the inlet and of the outlet can be the same or different.

In a further preferred example, the polygon has a longitudinal extent and a transverse extent, wherein the ratio of the length of the transverse extent to the length of the longitudinal extent is less than or equal to 1:2, preferably about 1:3 or about 1:4. As a result, with the same inlet or outlet cross-sectional area, the width of the inlet or outlet opening is correspondingly smaller, and so it is also the case that only a correspondingly narrower section of the impeller blades does not come into contact with the housing wall during the movement over the inlet or outlet opening. As a result, the impact on the impeller blades by deformation decreases correspondingly, when the latter are moved over the inlet or outlet opening.

The term "*longitudinal extent*" should be understood herein as meaning the maximum length of the cross section and the orientation thereof. The term "*transverse extent*" describes a maximum width, oriented differently from the orientation of the longitudinal extent, of the cross section.

Preferably, the shape of the inlet or outlet is configured such that the longitudinal extent and the transverse extent are formed substantially perpendicularly to one another.

In order to achieve even wearing down of the impeller blades during the movement of the impeller blades over the inlet or outlet opening, and in order to achieve uniform flow conditions in the regions between the impeller blades and in the inlet and/or outlet, in a further preferred example, the polygon is configured in a symmetrical manner with respect to the longitudinal extent and/or is configured in a symmetrical manner with respect to the transverse extent.

In a further preferred example, the ratio of the length of the transverse extent of the polygon to the width of the impeller blades is less than 1:1, preferably less than or equal to 1:2, more preferably about 1:3 or about 1:4. In this way, it is possible to ensure that a sufficiently large part of the impeller blades is always in contact with the housing wall on sweeping over the inlet or outlet

opening. As a result, deformation of the impeller blade as a result of the passing into the inlet or outlet opening is limited. In addition, good sealing off between the housing wall and the little-deformed impeller blade is always ensured. The polygon is in this case preferably oriented such that the longitudinal extent extends in the direction of movement of the impeller blades.

- 5 In a particularly preferred example, the polygon has at least one rounded corner, wherein preferably all the corners of the polygon are rounded. This results in more uniform flow conditions during pump operation.

In a further example, the cross section of the inlet and/or of the outlet on the side facing away from the housing interior is substantially in the shape of a circle or the shape of a polygon, preferably of a  
10 rectangle, particularly preferably of a square. This makes it possible to attach the impeller pump described here to conventional pipelines or fit it into special arrangements.

Preferably, the area of the associated cross section on the side facing the housing interior and the area of the associated cross section on the side facing away from the housing interior differ substantially by less than 10%, and they are preferably substantially the same size. This allows a  
15 uniform inlet into the pump or outlet out of the pump, since the medium to be delivered cannot back up at a constriction, or turbulence cannot develop on account of a large increase in cross section.

Alternatively, the area of the associated cross section on the side facing the housing interior and the area of the associated cross section on the side facing away from the housing interior can differ, preferably by 15% - 75%, particularly preferably by 30% - 60% and very particularly preferably by  
20 about 50%. In this way, a cross section with a particularly small or short transverse extent can be employed, such that the impeller blades are correspondingly deformed and worn only a little.

The abovementioned example is also achieved by an impeller pump according to the additional examples. Preferred examples are specified in the dependent claims, the description and the figures.

- 25 In another aspect, the present disclosure refers to an impeller pump comprising, a housing comprising, an inlet comprising an opening consisting of one inner inlet opening at which the inlet transitions into an interior of the housing, and an outlet comprising an opening consisting of one inner outlet opening at which the outlet transitions into the interior of the housing, and an impeller wheel disposed in the interior of the housing, rotatable about an axis of rotation, and comprising a  
30 plurality of elastic impeller blades, wherein a cross section of at least one of the inner inlet opening or of the inner outlet opening on a side facing the interior of the housing has a longitudinal extent

and a transverse extent, a length of the longitudinal extent is greater than a length of the transverse extent, and the longitudinal extent of the cross section encloses an angle with the axis of rotation.

Accordingly, an impeller pump having a housing, which has an inlet and an outlet, and having an impeller wheel, which is accommodated in the housing interior and rotatable about an axis of rotation, with a plurality of elastic impeller blades is proposed. The cross section of the inlet and/or of the outlet on the side facing the housing interior has a longitudinal extent and a transverse extent, wherein the length of the longitudinal extent is greater than the length of the transverse extent. According to the disclosure, the longitudinal extent encloses an angle with the axis of rotation.

Since the longitudinal extent encloses an angle with the axis of rotation, more even wearing down of the individual impeller blades is achieved. The impeller blade does not, as in conventional impeller pumps, come into contact symmetrically with the edge of the inlet or outlet opening in each case at the same points of the impeller blades before and after sweeping over the middle of the inlet or outlet opening. Rather, the blade sweeps over the inlet or outlet opening in a substantially uniform progression from one side of the impeller blade to the other side of the impeller blade.

In other words, the contact point of the impeller blade shifts on moving past the inlet or outlet opening in the transverse direction to the direction of movement of the impeller blades. At the same time, the maximum width with which the individual impeller blades do not come into contact with the housing wall in each case is still relatively small on account of the greater longitudinal extent compared to the transverse extent, and so still only little deformation of the impeller blades and reduced passing of the impeller blade into the inlet or outlet opening occurs.

The term “*angle*” should be understood here as being the angle which forms when the cross section between the longitudinal extent – or possibly the elongation thereof – and the axis of rotation is seen in plan view. In other words, in order to determine the angle, the axis of rotation of the impeller wheel should be projected onto a plane defined by the cross section. The angle corresponds then to the angular dimension between the longitudinal extent and the projection of the axis of rotation.

The orientation of the longitudinal extent may be different for the inlet and the outlet, but may also have the same orientation.

Preferably, in this case, the angle is greater than  $0^\circ$  and less than  $90^\circ$ , preferably greater than or equal to  $15^\circ$  and less than or equal to  $75^\circ$ , particularly preferably greater than or equal to  $30^\circ$  and less than or equal to  $60^\circ$  and very particularly preferably about  $5^\circ$ ,  $10^\circ$ ,  $15^\circ$ ,  $20^\circ$ ,  $25^\circ$ ,  $30^\circ$ ,  $35^\circ$ ,  $40^\circ$  or  $45^\circ$ .

In a further example, the cross section is substantially in the shape of an ellipse or polygon.

In order to further adapt the flow conditions during pumping, in a preferred example, the polygon has at least one rounded corner, wherein preferably all the corners are rounded. If the polygon is in the shape of an elongated rectangle, the radii of the roundings in this case correspond preferably to half the width of the rectangle, and therefore they are then selected such that an oblong hole is formed.

In a particularly advantageous preferred example, the ratio of the length of the transverse extent to the width of the impeller blades is less than 1:1, preferably less than or equal to 1:2, more preferably about 1:3 or about 1:4.

In order to keep the deformation of the impeller blades as the impeller blades move over the inlet or outlet opening low, the ratio of the length of the transverse extent to the length of the longitudinal extent is, according to a preferred example, less than or equal to 1:2, preferably less than or equal to 1:3 or about 1:4.

In a further preferred example, the ratio of the width of the impeller blades to a cross-sectional width parallel to the width of the impeller blades is greater than or equal to 3:2, preferably greater than or equal to 2:1. As a result, the deformation of the impeller blades on moving over the inlet or outlet opening can still be kept low.

In a further preferred example, the cross section of the inlet and/or of the outlet on the side facing away from the housing interior is substantially in the shape of a circle or the shape of a polygon, preferably of a rectangle, particularly preferably of a square, wherein preferably the area of the cross section on the side facing the housing interior and the area of the associated cross section on the side facing away from the housing interior differ substantially by less than 10%, and are preferably substantially the same size. Alternatively, the area of the associated cross section on the side facing the housing interior and the area of the associated cross section on the side facing away from the housing interior can differ, preferably by 15% - 75%, particularly preferably by 30% - 60% and very particularly preferably by about 50%. As a result, the abovementioned advantages are achieved.

In a further preferred example of the abovementioned impeller pumps, at least one edge of the inlet and/or of the outlet has a chamfer or is rounded at the transition to the housing interior, wherein preferably all the edges of the inlet and/or of the outlet have a chamfer or are rounded at the transition to the housing interior. As a result, the pressure which is applied to the impeller blade by the edge on account of the deformation and the pressure force of the impeller blade is reduced. This also results in smooth pressure-point progress on the impeller blade. It is also possible here for at least one edge to be rounded and for at least one other edge to have a chamfer.

In a further example of the abovementioned impeller pumps, the transition of the inner wall of the housing from a region with a maximum diameter to a region with a reduced diameter coincides substantially with the transverse extent of the cross section of the inlet or outlet opening. In this case, this transition does not take place abruptly, but the distance of the housing inner wall from the axis of rotation of the impeller wheel decreases continuously from the maximum distance, at which

the impeller blades are not bent or are bent to the least extent, to the minimum distance, at which the impeller blades are bent to the greatest extent.

#### Brief description of the figures

Preferred further embodiments are explained in more detail by the following description of the figures, in which:

- Figure 1           schematically shows a sectional view of an impeller pump;
- Figure 2           schematically shows an impeller wheel;
- Figure 3           schematically shows a perspective side view of a housing of an impeller pump;
- Figure 4           schematically shows a further embodiment of an impeller pump;
- 10   Figure 5        schematically shows a further embodiment of an impeller pump with a cross section in the shape of a polygon with six corners;
- Figure 6           schematically shows a further embodiment of an impeller pump, the longitudinal extent of the inlet-opening cross section of which encloses an angle with the axis of rotation of the impeller wheel on a plane defined by the cross section;
- 15   Figure 7        shows the impeller pump from Figure 6 in a schematic perspective side view;
- Figure 8           shows a schematic side view of an impeller pump in a further embodiment;
- Figures 9-22       schematically show different polygonal embodiments of cross sections of the inlet or outlet; and
- Figures 23-25     schematically show different embodiments of cross sections, the longitudinal extent of which encloses an angle with the axis of rotation of the impeller wheel.
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#### Detailed description of preferred exemplary embodiments

Preferred exemplary embodiments are described in the following text with reference to the figures. Here, identical, similar or identically acting elements are provided with identical reference signs in the different figures, and a repeated description of these elements is to some extent dispensed with in order to avoid redundancies.

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The operating principle of an impeller pump is readily visible from the illustration according to Figure 1. The housing 1 of the impeller pump has an inlet 2 and an outlet 3. Mounted in the interior of the housing 1 so as to be rotatable about an axis of rotation D in the direction of the arrow is an impeller wheel 4. The impeller wheel 4 has a plurality of impeller blades 5, the blade ends 6 of which bear  
 5 against the inner wall 7 of the housing 1. The interior of the housing 1 is not formed in a rotationally symmetrical manner about the axis of rotation D, but is shaped such that the impeller blades 5 are not deformed or are deformed only slightly on moving from the inlet opening 8 to the outlet opening 9, while they are bent counter to the direction of rotation of the impeller wheel 4 on moving from the outlet opening 9 to the inlet opening 8. As a result, the volume between two impeller blades 5 is  
 10 greater on moving from the inlet opening 8 to the outlet opening 9 than the volume on moving from the outlet opening 9 to the inlet opening 8, with the result that the medium to be pumped is delivered from the inlet opening 8 to the outlet opening.

Figure 2 illustrates an impeller wheel 4, the impeller blades 5 of which are reinforced at their ends 6 by a wire 10 in order to minimize the deformation of the blade end 6 on sweeping over the inlet  
 15 opening 8 and the outlet opening 9.

Figure 3 shows a perspective side view of the housing of an impeller pump. The housing 1 of the impeller pump is assembled from two parts 1a, 1b, which are axially symmetrical to one another with respect to the axis R, along a dividing plane 11. Protrusions 12 on one housing part 1b, which engage in corresponding recesses 13 in the other housing part 1a and thus make it easier to  
 20 assemble the two housing parts 1a, 1b, in this case ensure a slight deviation of the contact faces between the two parts 1a, 1b from the dividing plane. The two housing parts 1a, 1b are held together by a plurality of screw connections 14. Between the two housing parts 1a, 1b, sealing elements can be provided, which can also take on the function of the protrusions 12 and recesses 13, when for example a sealing element engages in a groove formed in both housing parts.

25 The inlet opening 8 and the outlet opening (not shown) each have a cross section in the shape of a diamond-shaped polygon in this embodiment. As can also be seen from Figure 3, the interior of the housing 1 of the impeller pump consists of a region in which the distance between the inner wall 7 and the axis of rotation D of the impeller wheel 4 is at a maximum, specifically when the impeller blades 5 move from the inlet opening 8 to the outlet opening 9. Furthermore, there is a region in  
 30 which this distance is reduced, when the impeller blades 5 move from the outlet opening 9 to the inlet opening 8, in order to achieve deformation of the impeller blades 5.

The continuous transition from the region with the maximum distance to the region with the minimum distance starts at the level of the maximum transverse extent of the diamond of the inlet

opening 8 or of the outlet opening 9, that is to say approximately in the middle of the inlet opening 8 or of the outlet opening 9. The housing 1 shown in Figure 3 is illustrated without a side wall. Such a side wall can be produced separately from the two housing parts 1a, 1b and be connected to the corresponding housing part 1a for example by means of screwing or adhesive bonding. However,  
 5 the housing part can also be produced with a side wall from the outset.

Clamping screws 15 at the inlet 2 and at the outlet 3 can be used to connect connection pipes to the inlet 2 or outlet 3 of the housing 1.

In Figure 3 the elongate and narrow shape of the inlet opening 8 can also be seen, which has the result that the impeller blades 5 of the impeller wheel 4 (not illustrated in Figure 3) are not pushed  
 10 so greatly outwards and deformed by the occurring centrifugal forces on account of the rotation of the impeller wheel 4 and the elastic restoring forces on account of the deformation of the impeller blades 5, as in the case of impeller pumps in which the inlet opening extends over the entire width – or virtually the entire width – of the impeller blades and thus also of the housing interior. The outlet opening 9, which cannot be seen in Figure 3, is preferably formed identically to the inlet opening 8.

15 Although the shape of the inlet opening 8 in Figure 3 appears to be irregular on account of the irregular curvature of the inner wall 7, the cross section of the inlet opening 8, i.e. the view of the inlet opening 8 from the housing interior along the axis Z defined by the inlet, is in the shape of a regular diamond. This can be readily seen in Figure 4, which shows a section through an impeller pump along a plane E perpendicular to the axis Z defined by the inlet.

20 Figure 4 shows an embodiment of the impeller pump in which the housing 1 is connected to a drive unit 16 which drives the impeller wheel 4 (not illustrated). In this illustration, the diamond shape of the cross section of the inlet opening 8 can be readily seen. The longitudinal extent L of the polygon, which extends in the dividing plane 11 between the two housing parts 1a, 1b, is approximately three times as long as the transverse extent Q in this embodiment. The length of the  
 25 transverse extent Q is about a third of the width of the inner wall 7 of the housing, i.e. approximately a third of the width of the impeller blades 5.

The embodiment of the impeller pump that is shown in Figure 5 corresponds substantially to the one in Figure 4, wherein the shape of the cross section is a polygon with six corners. The longitudinal extent L of the polygon, which extends in the dividing plane 11 between the two housing  
 30 parts 1a, 1b, is approximately three times as long as the transverse extent Q in this embodiment. Compared to the cross section in Figure 4, the cross section in Figure 5 has a larger cross-sectional area, such that, under identical pressure conditions during pump operation, a greater volumetric flow can be delivered.

Figure 6 shows a further embodiment of an impeller pump, the structure of which corresponds substantially to that of the impeller pumps shown in Figures 3 to 5. The impeller pump shown in Figure 6 also has an inlet which has, on the side facing the housing interior, a cross section with a longitudinal extent L and a transverse extent Q, wherein the longitudinal extent L encloses an angle  $\alpha$  with the axis of rotation D of the impeller wheel (not shown). In the present case, the angle  $\alpha$  is 60°.

The cross section of the inlet opening 8 in Figure 6 is in the shape of an ellipse.

However, alternatively, the angle  $\alpha$  can also have other values, for example 5°, 10°, 15°, 20°, 25°, 30°, 35°, 40°, 45°, 50°, 55°, 60°, 65°, 70°, 75°, 80°, or 85°, and be arranged in a positive and a negative direction of rotation.

Preferably, the longitudinal extent L of the inlet opening 8 and the longitudinal extent of the outlet opening 9 are arranged in a parallel manner. Alternatively, the two longitudinal extents can also be oriented in different manners.

Figure 7 shows the impeller pump from Figure 6 in a schematic perspective side view. It is readily apparent here that, on moving along the inlet opening 8, an impeller blade comes into contact with the edges of the inlet opening 8 initially in the region of its one end. As the impeller blades continue to move, the contact points between the impeller blade and the edges of the inlet opening 8 move along the impeller blade into the region of the other end of the impeller blade. Therefore, after moving over the inlet opening 8, the impeller blade has come into contact with the edges of the inlet opening 8 substantially across its entire width, wherein the contact points have moved continuously. Since, as can be gathered from the detail in Figure 23, the cross-sectional width b of the cross section parallel to the width of the impeller blade is only insignificantly wider than the transverse extent Q on account of the narrow, elongate form of the cross section, deformation of the impeller blade on moving over the inlet opening is limited to a minimum. Therefore, the impeller blade undergoes even and only slight wear substantially over its entire width, thereby allowing a long service life of the impeller wheel used.

Figure 8 shows a schematic sectional view of an impeller pump in a further embodiment. The longitudinal extent L forms an angle  $\alpha$  of 45° with the axis of rotation D in this case.

In the embodiments of the impeller pump that are illustrated in the figures, the inlet 2 and the outlet 3 are in the shape of a circle at their outer ends facing away from the housing interior, in order for it to be possible to connect normal, round connection pipes easily to the inlet 2 and the outlet 3.

In this regard, it is readily apparent from Figure 8 that the area of the circle of the outer inlet opening 17 and the cross section of the inner inlet opening 8 are approximately the same size, in order to allow uniform transport of the medium to be pumped.

In the embodiment shown in Figure 8, the circular cross section at the outer end, facing away from the housing interior, transitions to the elliptical cross section of the inlet opening 8 gradually, and thus without abrupt changes in the cross-sectional profile along the axis Z.

Figures 9 to 25 schematically depict different embodiments of the cross section for the inlet and/or the outlet with their respective longitudinal extents L and their respective transverse extents Q.

The cross section schematically illustrated in Figure 9 is a polygon in the shape of an elongated rectangle, such that an inlet with the shape of a rectangular oblong hole is formed.

The cross section schematically illustrated in Figure 10 is a polygon in the shape of a regular diamond. The transverse extent Q and the longitudinal extent L therefore intersect in each case at their central points.

The cross section schematically illustrated in Figure 11 is a polygon in the shape of a diamond, in which the transverse extent Q divides the longitudinal extent L in a ratio of 2:1.

The cross section schematically illustrated in Figure 12 is a polygon in the shape of a hexagon.

The cross section schematically illustrated in Figure 13 is a polygon in the shape of a further hexagon.

The cross section schematically illustrated in Figure 14 corresponds to the one in Figure 9, wherein the corners of the cross section are rounded so as to produce a rounded oblong hole. The radii of the roundings are selected in this case such that semicircular ends are formed.

The cross section schematically illustrated in Figure 15 is in the shape of an ellipse. This is created in this case by rounding the corners of the polygon in Figure 10.

The cross section schematically illustrated in Figure 16 corresponds to the one in Figure 11, wherein the corners are rounded such that the cross section has an "egg-shaped" shape.

The cross section schematically illustrated in Figure 17 corresponds to the one in Figure 12, wherein the corners located at the two ends as seen in the longitudinal extent L are rounded.

The cross section schematically illustrated in Figure 18 corresponds to the one in Figure 13, wherein the corners located at the two ends as seen in the longitudinal extent L are rounded, such that a single rounding has been produced at each of the corners.

5 The cross section schematically illustrated in Figure 19 is a quadrilateral polygon, in which the longitudinal extent L coincides with the longest edge of the polygon.

The cross section schematically illustrated in Figure 20 is an octagonal polygon, the transverse extent Q of which is constant as seen along the longitudinal extent L.

10 The cross section schematically illustrated in Figure 21 corresponds to the one in Figure 20, wherein the edges which have a component in the longitudinal extent L have different curvatures, such that a polygon with four corners has been produced, wherein an edge curved in an S shape has been formed from in each case three edges of the cross section in Figure 20.

In the cross sections shown in Figures 9 to 21, the longitudinal extent L and the transverse extent Q are each oriented perpendicularly to one another.

15 As a rule, the longitudinal extent in these embodiments is arranged perpendicularly to the axis of rotation D. In the cross sections shown in Figures 9 to 21, the transverse extent Q extends accordingly parallel to the axis of rotation D of the impeller wheel. Alternatively, the longitudinal extent L and axis of rotation D can also enclose an angle.

The cross section schematically illustrated in Figure 22 is a quadrilateral polygon in which the longitudinal extent L and the transverse extent Q are oriented at an angle other than  $90^\circ$ .

20 Figures 23 to 25 depict schematically illustrated cross sections of the inlet opening or of the outlet opening, in which the longitudinal extent L encloses an angle  $\alpha$  with the axis of rotation D.

25 The cross section schematically shown in Figure 23 is in the shape of an ellipse. Therefore, the longitudinal extent L coincides with the major axis of the ellipse and the transverse extent Q coincides with the minor axis of the ellipse. The angle  $\alpha$  is about  $60^\circ$  in the present case. The reference sign b indicates the cross-sectional width parallel to the width of the impeller blades, and thus perpendicular to the axis of rotation D. This cross-sectional width b corresponds to that part of the impeller blade that does not come into contact with the housing wall during a movement along the opening. On account of the elliptical shape of the cross section, the cross-sectional width b varies depending on the position of the impeller blade at the opening defining the cross section.

The cross section schematically shown in Figure 24 is in the shape of a diamond. The angle  $\alpha$  is about  $45^\circ$  in the present case. As a result of the specific configuration of the cross section, the transverse extent Q and the maximum cross-sectional width b, oriented thereto at an angle of accordingly likewise  $45^\circ$ , have more or less the same vector length.

- 5 The cross section schematically illustrated in Figure 25 corresponds to the one in Figure 23, wherein the angle  $\alpha$  is about  $45^\circ$  in the present case.

Where applicable, all the individual features which are illustrated in the exemplary embodiments can be combined and/or exchanged for one another, without departing from the scope of the invention.

List of reference signs

|    |          |                       |
|----|----------|-----------------------|
|    | 1        | Housing               |
|    | 1a, 1b   | Housing parts         |
|    | 2        | Inlet                 |
| 5  | 3        | Outlet                |
|    | 4        | Impeller wheel        |
|    | 5        | Impeller blade        |
|    | 6        | Blade end             |
|    | 7        | Inner wall            |
| 10 | 8        | Inner inlet opening   |
|    | 9        | Inner outlet opening  |
|    | 10       | Wire reinforcement    |
|    | 11       | Dividing plane        |
|    | 12       | Protrusion            |
| 15 | 13       | Recess                |
|    | 14       | Screw connection      |
|    | 15       | Clamping screw        |
|    | 16       | Drive unit            |
|    | 17       | Outer inlet opening   |
| 20 | 18       | Outer outlet opening  |
|    | L        | Longitudinal extent   |
|    | Q        | Transverse extent     |
|    | b        | Cross-sectional width |
| 25 | D        | Axis of rotation      |
|    | R        | Axis                  |
|    | Z        | Axis                  |
|    | $\alpha$ | Angle                 |

## Claims

1. An impeller pump comprising:

a housing comprising:

5 an inlet comprising an opening consisting of one inner inlet opening at which the inlet transitions into an interior of the housing, and

an outlet comprising an opening consisting of one inner outlet opening at which the outlet transitions into the interior of the housing; and

10 an impeller wheel disposed in the interior of the housing, rotatable about an axis of rotation, and comprising a plurality of elastic impeller blades,

wherein a cross section of at least one of the inner inlet opening or of the inner outlet opening when viewed from the interior of the housing along an axis defined by the at least one of the inlet or the outlet is in a shape of a polygon comprising a plurality of straight line segments, a longitudinal extent that is oriented perpendicular to the axis of rotation, and a width of the cross section that is oriented parallel to the axis of rotation, wherein widths of the cross section vary along  
15 at least a part of the longitudinal extent.

2. The impeller pump of claim 1, wherein the polygon further comprises a transverse extent, and a ratio of a length of the transverse extent to a length of the longitudinal extent is less than or equal to  
20 1:2.

3. The impeller pump of claim 2, wherein the ratio of the length of the transverse extent to the length of the longitudinal extent is 1:3 or 1:4.

25 4. The impeller pump of claim 2, wherein the polygon is symmetrical with respect to at least one of the longitudinal extent or the transverse extent.

5. The impeller pump of claim 2, wherein a ratio of the length of the transverse extent to a width of the impeller blades is less than 1:1.  
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6. The impeller pump of claim 5, wherein the ratio of the length of the transverse extent to the width of the impeller blades is 1:3 or 1:4.

7. The impeller pump of claim 1, wherein the polygon has at least one rounded corner.  
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8. The impeller pump of claim 1, wherein a cross section of at least one of the inner inlet opening or of the inner outlet opening on a side facing away from the interior of the housing is in a shape of a circle or the shape of a polygon.

9. The impeller pump of claim 8, wherein at least one of the cross section of the inner inlet opening or of the inner outlet opening on the side facing away from the interior of the housing is in a shape of a square.

10. An impeller pump comprising:

a housing comprising:

an inlet comprising an opening consisting of one inner inlet opening at which the inlet transitions into an interior of the housing, and

an outlet comprising an opening consisting of one inner outlet opening at which the outlet transitions into the interior of the housing; and

an impeller wheel disposed in the interior of the housing, rotatable about an axis of rotation, and comprising a plurality of elastic impeller blades,

wherein a cross section of at least one of the inner inlet opening or of the inner outlet opening on a side facing the interior of the housing has a longitudinal extent and a transverse extent, a length of the longitudinal extent is greater than a length of the transverse extent, and the longitudinal extent of the cross section encloses an angle with the axis of rotation.

11. The impeller pump of claim 10, wherein the angle is greater than  $0^\circ$  and less than  $90^\circ$ .

12. The impeller pump of claim 11, wherein the angle is greater than or equal to  $30^\circ$  and less than or equal to  $60^\circ$ .

13. The impeller pump of claim 10, wherein the cross section of at least one of the inner inlet opening or of the inner outlet opening is in a shape of an ellipse or a polygon.

14. The impeller pump of claim 13, wherein the polygon comprises at least one rounded corner.

15. The impeller pump of claim 10, wherein a ratio of the length of the transverse extent to a width of the impeller blades is less than 1:1.

16. The impeller pump of claim 15, wherein the ratio of the length of the transverse extent to the width of the impeller blades is less than or equal to 1:2.

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17. The impeller pump of claim 10, wherein a ratio of a width of the impeller blades to a cross-sectional width of the cross section of at least one of the inner inlet opening or of the inner outlet opening parallel to the width of the impeller blades is greater than or equal to 3:2.

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18. The impeller pump of claim 10, wherein a cross section of at least one of the inner inlet opening or of the inner outlet opening on a side facing away from the interior of the housing is in a shape of a circle or a shape of a polygon.

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19. The impeller pump of claim 18, wherein the polygon comprises a rectangle.

20. The impeller pump of claim 10, wherein at least one edge of at least one of the inner inlet opening or of the inner outlet opening comprises a chamfer or is rounded at a transition to the interior of the housing.

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