

Description

Title of Invention: PUMP IMPELLER

Technical Field

[0001]

The present invention relates to a pump impeller.

Background Art

[0002]

Conventionally, an impeller used for a submersible pump is known.

[0003]

For example, Patent Literature 1 discloses an art related to an impeller which suppresses deformation of a vane part made of rubber or a resin by a pressure applied from a fluid during rotation of the impeller. Specifically, the impeller is constituted by embedding a reinforcing part made of metal inside of a plate-shaped part and the vane part.

Citation List

Patent Literature

[0004]

Patent Literature 1: Patent Publication JP-A-2017-210937

Summary of Invention

Technical Problem

[0005]

However, even in the case of the impeller disclosed in Patent Literature 1, during rotation of the impeller, abrasion of the impeller (the vane part in particular) by contaminants such as sand contained in a fluid that collides against the impeller is unavoidable.

[0006]

For example, when the vane part of the impeller is worn to such a degree that an original function cannot be exerted, there is a concern that the performance of the pump might be deteriorated, and it is desired that the pump impeller is inspected or replaced before such a situation occurs.

[0007]

Thus, an object of the present invention is to provide a pump impeller capable of easily grasping a degree of abrasion of a pump impeller.

Solution to Problem

[0008]

A pump impeller according to an aspect of the present invention is a pump impeller for use in a submersible pump, the pump impeller formed at least by a primary member and a secondary member constituted so as to cover the primary member, in which the primary member includes a plate-shaped part in a substantially disk shape and a vane part formed on one surface side of the plate-shaped part so as to correspond to a blade of the pump impeller, and the primary member and the secondary member are constituted by different resin materials.

[0009]

In the above-described aspect, in the blade of the pump impeller, at least a part of the vane part formed by the primary member and at least a part formed by the

secondary member so as to cover the vane part may be constituted in different colors.

[0010]

In the above-described aspect, in the blade of the pump impeller, at least a part formed by the secondary member so as to cover the vane part may be constituted to be transparent.

[0011]

In the above-described aspect, with respect to the vane part, at least a part of the vane part may include an indicator part having a first height.

[0012]

In the above-described aspect, the secondary member may be constituted so as to cover a side wall part on a rotating direction side of the pump impeller and a side wall part on a side opposite to the rotating direction with substantially the same thickness with respect to the indicator part.

[0013]

In the above-described aspect, the secondary member may be constituted so as to cover the side wall part on the rotating direction side of the pump impeller with the thickness larger than that on the side wall part on the side opposite to the rotating direction with respect to the indicator part.

[0014]

In the above-described aspect, the secondary member may be constituted so as to cover a distal end part of the indicator part with the thickness larger than that on the one surface side of the plate-shaped part.

[0015]

In the above-described aspect, the vane part may include a rib part having a second height smaller than the first height in the vane part.

[0016]

In the above-described aspect, the primary member may be a resin material, and the secondary member may be a resin material softer than the primary member.

Advantageous Effect of Invention

[0017]

According to the present invention, a pump impeller which can easily grasp a degree of abrasion of the impeller can be provided.

Brief Description of Drawings

[0018]

[Figure 1] Figure 1 is a perspective view illustrating an appearance of a pump impeller 10 according to an Embodiment of the present invention.

[Figure 2] Figure 2 is a perspective view illustrating an appearance of a primary member 100 constituting the pump impeller 10 according to the Embodiment of the present invention.

[Figure 3] Figure 3 is a perspective view illustrating a state in which the primary member 100 is disposed inside of the pump impeller 10 according to the Embodiment of the present invention.

[Figure 4] Figure 4 is an enlarged view of an E part illustrated in Figure 3 for explaining more specifically a state in which the vane part 120 (the indicator part

121) in the primary member 100 is disposed inside of the blade 12 in the pump impeller 10 according to the Embodiment of the present invention.

[Figure 5] Figure 5 is a view showing another specific example in which the vane part 120 (indicator part 121) in the primary member 100 is disposed inside of the blade 12 in the pump impeller 10 according to the Embodiment of the present invention.

[Figure 6] Figure 6 is a view showing another specific example in which the vane part 120 (indicator part 121) in the primary member 100 is disposed inside of the blade 12 in the pump impeller 10 according to the Embodiment of the present invention.

[Figure 7] Figure 7 is a perspective view illustrating an appearance of a primary member 200 constituting the pump impeller 10 according to the Embodiment of the present invention.

[Figure 8] Figure 8 is a perspective view illustrating an appearance of a primary member 300 constituting the pump impeller 10 according to the Embodiment of the present invention.

[Figure 9] Figure 9 is an enlarged view illustrating details of a vane part 320 in the primary member 300 shown in Figure 8.

[Figure 10] Figure 10 is a perspective view illustrating an appearance of a primary member 400 constituting the pump impeller 10 according to the Embodiment of the present invention.

Description of Embodiments

[0019]

Hereinafter, preferred Embodiments of the present invention will be specifically described with reference to the accompanying drawings. It is to be noted that the Embodiment described below is merely a specific example for carrying

out the present invention, and the present invention is not to be interpreted in a limited manner. In addition, in order to facilitate understanding of the description, the same components in each of the drawings are given the same reference numerals as much as possible, and redundant description will be omitted in some cases.

[0020]

<One Embodiment>

[Outline of Pump Impeller]

Figure 1 is a perspective view illustrating an appearance of a pump impeller 10 according to an Embodiment of the present invention. As shown in Figure 1, a pump impeller 10 includes a main plate (disk part) 11 and eight blades 12 on one surface side of the main plate 11 and is used for a submersible pump. On the main plate 11, a bearing part 13 having a through hole in which a rotating shaft for rotating the pump impeller 10 is installed is formed.

[0021]

The pump impeller 10 is formed at least by a primary member and a secondary member constituted to cover the primary member, and it can be checked from the appearance of the pump impeller 10 that a part of the primary member is exposed.

[0022]

In the pump impeller 10, an exposed part 14 where the primary member is exposed is present in each of spaces between eight blades 12. That is, in the main plate (disk portion) 11 of the pump impeller 10, on one surface side on which the eight blades 12 are disposed, the exposed part 14 of the primary member which is

not covered by the secondary member is present in each of the spaces between the eight blades 12.

[0023]

In addition, on the other surface side of the main plate (disk part) 11, at a position corresponding to the exposed part 14 of the primary member on the one surface side, there is an exposed part of the primary member which is not covered by the secondary member is present similarly to the exposed part 14.

[0024]

In a bearing part 13 in the pump impeller 10, in a through hole in which a rotating shaft is disposed, an inner wall surface with which the rotating shaft is brought into contact is not covered by the secondary member, but the primary member is exposed. That is, when the rotating shaft is disposed in the through hole in the bearing part 13, the rotating shaft is brought into contact with the primary member.

[0025]

[Configuration of Primary Member in Pump Impeller]

Figure 2 is a perspective view showing an external appearance of a primary member 100 constituting the pump impeller 10 according to the Embodiment of the present invention. As illustrated in Figure 2, the primary member 100 includes a plate-shaped part 110, eight vane parts 120, a bearing part 130, a plurality of protruding parts 140, and a plurality of through holes 150, and is disposed inside of the pump impeller 10 as a core material.

[0026]

The plate-shaped part 110 has a substantially disk shape, and is mainly disposed inside of the main plate (disk part) 11 of the pump impeller 10.

[0027]

The eight vane parts 120 are formed on one surface side of the plate-shaped part 110 so as to be disposed inside correspondingly to the eight blades 12 of the pump impeller 10. It is to be noted that each of the eight vane parts 120 includes an indicator part 121 and a rib part 122.

[0028]

The indicator part 121 is formed, in the vane part 120, on the outer edge side of the plate-shaped part 110 having a substantially disk shape. For example, here, the indicator part 121 is formed, in the vane part 120, in a region of approximately 1/4 to 1/3 from an outer edge of the plate-shaped part 110.

[0029]

The vane part 120 is constituted inside of the blade 12 of the pump impeller 10 by being covered by the secondary member and is configured such that the indicator part 121 of the vane part 120 appears on the surface in accordance with gradual abrasion of the secondary member of the blade 12 due to use of the pump impeller 10. That is, the indicator part 121 has an indicator function for grasping the degree of abrasion of the secondary member of the blade 12. It is to be noted that details of the indicator function will be described later.

[0030]

The rib part 122 is formed in a region other than the indicator part 121 in the vane part 120. The height (second height) of the rib part 122 may be smaller than the height (first height) of the indicator part 121. As a result, even when the

secondary member of the blade 12 is gradually worn, the rib part 122 is less likely to appear on the surface.

[0031]

It is to be noted that, when the indicator part 121 of the vane part 120 is formed so as to satisfy the indicator function, the shape of the eight vane parts 120 (the indicator part 121 and the rib part 122), for example, may be made larger, smaller, thicker, or thinner in consideration of the strength or the like required for the eight blades 12 of the pump impeller 10. In addition, as the shape of the eight vane parts 120 (indicator parts 121 and the rib parts 122), the height protruding from one surface side of the plate-shaped part 110 may be increased or decreased, and moreover, the height may be made different between the center side and the outer edge side of the plate-shaped part 110.

[0032]

In the bearing part 130, a through hole through which the rotating shaft is penetrated is formed at the center of the plate-shaped part 110. The shape of the through hole may be a circular shape or a so-called D-cut shape in which at least a part of the circular shape is made a straight line, for example. In other words, when the shape of the through hole is made in the D-cut shape, the rotating shaft also becomes a D-cut shaft to which the D-cut is applied accordingly.

[0033]

As described above, in the pump impeller 10, in the through hole in which the rotating shaft is disposed, the inner wall with which the rotating shaft is brought into contact is not covered by the secondary member, and the primary member 100 is exposed. That is, when the pump impeller 10 is used, the rotating shaft is rotated,

and a large torque is transmitted to the primary member 100 which is in direct contact with the rotating shaft. At that time, when the shape of the through hole is made the D-cut shape, and the D-cut shaft is used as the rotating shaft, the pump impeller 10 and the rotating shaft can be firmly fastened to each other, occurrence of idling can be suppressed, and abrasion of the bearing part 130 in the primary member 100 can be reduced.

[0034]

The plurality of protruding parts 140 are formed so as to protrude from one surface side and the other surface side of the plate-shaped part 110. For example, on the one surface side of the plate-shaped part 110, the plurality of protruding parts 140 are formed between the eight vane parts 120 two each in the vicinity of the outer edge (outer-side region) of the plate-shaped part 110 and in an intermediate region between the bearing part 130 and the outer edge of the plate-shaped part 110, that is, a total of 16 pieces. And on the other surface side of the plate-shaped part 110, the protruding parts are formed at positions corresponding to the positions of the plurality of protruding parts 140 formed on the one surface side of the plate-shaped part 110.

[0035]

Here, the intermediate region and the outer-side region are, in the plate-shaped part 110, an intermediate region and an outer-side region when a distance from an outer periphery of the bearing part 130 to the outer edge of the plate-shaped part 110 is equally divided into three regions, that is, an inner-side region (bearing part 130 side), an intermediate region, and an outer-side region (outer edge side of the plate-shaped part 110).

[0036]

The sixteen protruding parts 140 are provided to fix (position) the primary member 100 to a mold for molding the pump impeller 10 when the pump impeller 10 is produced. Specifically, the pump impeller 10 is produced by inserting the primary member 100 as a core material of the pump impeller 10 into a mold for molding the pump impeller 10 and then, by filling the secondary member. At this time, the bearing part 130 in the primary member 100 is fitted at a position of the mold corresponding to the rotating shaft, and the sixteen protruding parts 140 in the primary member 100 are brought into contact with the inside of the mold, and the primary member 100 is fixed to the mold.

[0037]

The plurality of through holes 150 are formed so as to penetrate the plate-shaped part 110 from the one surface side to the other surface side. For example, the plurality of through holes 150 are formed between the eight vane parts 120 such that one each on the outer-side region of the plate-shaped part 110 and four pieces in the vicinity of the outer periphery (inner-side region) of the bearing part 130, totaling in 12 pieces.

[0038]

[Indicator Function]

Figure 3 is a perspective view illustrating a state in which the primary member 100 is disposed inside of the pump impeller 10 according to the Embodiment of the present invention. As shown in Figure 3, the primary member 100 is disposed inside of the pump impeller 10 as a core material of the pump impeller 10.

[0039]

The pump impeller 10 is rotated in a rotating direction shown in Figure 3 by rotation of the rotating shaft disposed in the through hole of the bearing part 13.

[0040]

And during rotation of the pump impeller 10, the pump impeller 10 is gradually worn by contaminants such as sand contained in a fluid colliding against the pump impeller 10. That is, as the gradual abrasion of the secondary member constituted so as to cover the primary member 100 progresses, the primary member 100 begins to appear on the surface.

[0041]

When the pump impeller 10 is rotated in the rotating direction shown in Figure 3, a large pressure from the fluid applies to the blade 12 in the pump impeller 10. Particularly, the pressure received from the fluid in a part on the outer edge side of the main plate 11 in the side wall part on the rotating direction side of the blade 12 is considered to be larger than the others, and by collision of the contaminants such as sand contained in the fluid, the abrasion of the part in the secondary member becomes severe.

[0042]

Figure 4 is an enlarged view of an E part shown in Figure 3 for explaining a state more specifically in which the vane part 120 (indicator part 121) in the primary member 100 is disposed inside of the blade 12 in the pump impeller 10 according to the Embodiment of the present invention. As shown in Figure 4, with respect to the blade 12 when seen from the outer edge side of the main plate 11, the indicator part 121 of the primary member 100 is disposed inside thereof.

[0043]

The vane part 120 is disposed Inside the blade 12, and in the vane part 120, the indicator part 121 is disposed on the outer edge side of the plate-shaped part 110 in a substantially disk shape. As described above, when the pump impeller 10 is rotated in the rotating direction, the secondary member of a side wall part 12A on the rotating direction side of the blade 12 is gradually worn, and the indicator part 121 appears on the surface.

[0044]

The primary member 100 and the secondary member are constituted such that they can be visually identified and thus, it is possible to grasp that the secondary member is worn in the side wall part 12A, and the indicator part 121 of the primary member 100 appears on the surface.

[0045]

The primary member 100 and the secondary member may be constituted in different colors, and the primary member 100 may be constituted in black, and the secondary member may be constituted in orange, for example. In addition, the color of each member is not limited to them, but the primary member 100 may be constituted in gray or the like, and the secondary member may be constituted in red or the like.

[0046]

In addition, the secondary member may be constituted to be transparent. By constituting the secondary member to be transparent, the primary member 100 (indicator part 121) disposed inside thereof can be checked and thus, it is possible to grasp an extent to which the primary member 100 (indicator part 121) appears to the surface.

[0047]

It is to be noted that, in the example shown in Figure 4, the indicator part 121 is disposed at a center part of the blade 12. That is, with respect to the indicator part 121, the secondary member is constituted so as to cover the side wall part (pressure surface) on the rotating direction side of the pump impeller 10 and the side wall part (negative pressure surface) on the side opposite to the rotating direction with substantially the same thickness. By disposing the vane part 120 (including the indicator part 121) of the primary member 100 as the core material at the center part of the blade 12, manufacture is easy in the aspects of filling performance, hardening time and the like of the secondary member in a manufacturing process.

[0048]

Figure 5 is a diagram illustrating another specific example in which the vane part 120 (indicator part 121) in the primary member 100 is disposed inside of the blade 12 in the pump impeller 10 according to the Embodiment of the present invention. As shown in Figure 5, with respect to the blade 12 when seen from the outer edge side of the main plate 11, the indicator part 121 of the primary member 100 is disposed inside thereof.

[0049]

In the example shown in Figure 5, the indicator part 121 is disposed closer to the side opposite to the rotating direction of the pump impeller 10 from the center part of the blade 12. That is, with respect to the indicator part 121, the secondary member is constituted to cover the side wall part 12B on the rotating direction side of the pump impeller 10 with a thickness larger than the side wall part on the side opposite to the rotating direction.

[0050]

As described above, by increasing the thickness of the side wall part 12B constituted by the secondary member, as compared with the example shown in Figure 4, the secondary member of the side wall part 12B is gradually worn, and it takes more time until the indicator part 121 appears on the surface. In other words, in accordance with the position of the indicator part 121 disposed inside of the blade 12 (an extent of the thickness of the secondary member covering the indicator part 121), the time till the secondary member is gradually worn, and the indicator part 121 appears on the surface can be adjusted.

[0051]

Here, it is to be noted that the side wall part 12B constituted by the secondary member has a larger thickness, but when the time till the indicator part 121 appears on the surface is to be short, the thickness may be smaller as compared with the example shown in Figure 4.

[0052]

Figure 6 is a diagram illustrating another specific example in which the vane part 120 (indicator part 121) in the primary member 100 is disposed inside of the blade 12 in the pump impeller 10 according to the Embodiment of the present invention. As shown in Figure 6, with respect to the blade 12 when seen from the outer edge side of the main plate 11, the indicator part 121 of the primary member 100 is disposed inside thereof.

[0053]

In the example shown in Figure 6, the indicator part 121 is constituted at a height smaller as compared with the example shown in Figure 4 and Figure 5. That

is, the secondary member is constituted, with respect to the indicator part 121, to cover a distal end part 12C thereof with a thickness larger than that on the one surface side of the plate-shaped part 110.

[0054]

When the pump impeller 10 is rotated, the pressure received from the fluid is applied not only to the side wall part on the rotating direction side of the blade 12 but also largely to the distal end part of the blade 12. In the distal end part, too, the secondary member is gradually worn, and the indicator part 121 appears on the surface.

[0055]

As described above, by increasing the thickness of the distal end part 12C constituted by the secondary member, as compared with the example shown in Figure 4 and Figure 5, it takes more time till the secondary member of the distal end part 12C is gradually worn, and the indicator part 121 appears on the surface. In other words, in accordance with the shape of the indicator part 121 disposed inside of the blade 12 (the degree of the thickness of the secondary member covering the indicator part 121), it is possible to adjust the time until the secondary member is gradually worn, and the indicator part 121 appears on the surface.

[0056]

[Materials of Primary Member and Secondary Member]

As a material for forming the pump impeller 10, in the case of the primary member 100, a hard resin material is preferable as a core material of the pump impeller 10. For example, for the primary member 100, a material having a predetermined bending elastic modulus (8000 MPa or more, for example, in

accordance with a shape or a required performance of the impeller) is used or specifically, it may be a modified PPE (m-PPE, modified polyphenylene ether) resin or may be PPS (polyphenylene sulfide), and they may contain glass fibers, calcium carbonate or the like.

[0057]

For the secondary member, a resin material which is softer than the primary member 100 such as soft ether-based urethane with excellent abrasion resistance / hydrolysis resistance, for example, is preferable.

[0058]

As described above, by generating the primary member 100 by a hard resin material, a degree of freedom of a product shape of the pump impeller 10 is improved, and since a metal material is not used as a core material, mono-material can be realized. As a result, the pump impeller 10 can be provided as a product which facilitates thermal recycling and is environmentally friendly.

[0059]

As described above, the pump impeller 10 according to the Embodiment of the present invention is formed by the primary member 100, which is a hard resin material, and the secondary member formed of ether-based urethane, which is softer than the primary member 100. The primary member 100 includes the plate-shaped part 110 in the substantially disk shape and the eight vane parts 120 formed on the one surface side of the plate-shaped part 110, and the secondary member is constituted so as to cover the primary member 100, and the primary member 100 and the secondary member are constituted such that they can be visually distinguished. As a result, at rotation of the pump impeller 10, the secondary

member is gradually worn by contaminants such as sand contained in the fluid colliding against the pump impeller 10, and the indicator part 121 in the primary member 100 gradually appears on the surface. As a result, the degree of the abrasion of the pump impeller 10 can be easily grasped, and inspection timing and replacement timing thereof can be appropriately grasped.

[0060]

It is to be noted that, in this Embodiment, with respect to the vane part 120 in the primary member 100, as shown in Figure 2, the height of the rib part 122 (second height) is constituted to be smaller than the height of the indicator part 121 (first height), but this is not limiting. For example, by setting the height of the indicator part 121 (first height) the same as the height of the rib part 122 (second height) such that there is no boundary between the indicator part 121 and the rib part 122, and the entire unit including the rib part 122 may be the indicator part 121.

[0061]

In addition, in this Embodiment, the height of the indicator part 121 (first height) and / or the height of the rib part 122 (second height) are set to be constant, but this is not limiting, and it may be such a constitution that it gradually becomes smaller from the outer edge side toward the center side of the plate-shaped part 110 in the substantially disk shape, for example.

[0062]

Furthermore, all or some of the rib parts 122 do not have to be formed so as to protrude on the one surface side of the plate-shaped part 110. For example, as long as a strength required for the eight blades 12 of the pump impeller 10 is

satisfied, a position corresponding to the blade of the pump impeller in the primary member 100 (plate-shaped part 110) may be planar.

[0063]

[Another Specific Example (1) of Primary Member]

In this Embodiment, the indicator part 121 is formed, in the vane part 120, only on the outer edge side of the plate-shaped part 110 in the substantially disk shape, but this is not limiting. Figure 7 is a perspective view illustrating an appearance of a primary member 200 constituting the pump impeller 10 according to the Embodiment of the present invention. As shown in Figure 7, the primary member 200 is, as compared with the primary member 100 shown in Figure 2, different, in eight vane parts 220, in such a point that each of them includes two indicator parts 221A, 221B and a rib part 222.

[0064]

The vane part 220 has the indicator part 221A on the outer edge side of the plate-shaped part 110 in the substantially disk shape in the vane part 120 and in addition, has the indicator part 221B on the center side. Since the indicator part 221B is formed on the center side of the plate-shaped part 110 in the substantially disk shape in the vane part 220, in accordance with the gradual abrasion of the secondary member constituted to cover the indicator part 221B, the indicator part 221B appears on the surface. That is, in the case where the abrasion on the center side of the plate-shaped part 110 in the substantially disk shape in the vane part 220 is severe, the degree of the abrasion can be easily grasped.

[0065]

As described above, the indicator part may be formed not only in the vicinity of the outer-side region (outer edge side of the plate-shaped part 110) but also in the vicinity of the inner-side region (bearing part 130 side) or in the vicinity of the intermediate region in the vane part 120 (220).

[0066]

In addition, as shown in Figure 7, the protruding parts 140 may be formed one each between the eight vane parts 120, totaling in eight pieces. In Figure 2, the protruding parts 140 are formed two each between the eight vane parts 120, which form 16 pieces of the protruding parts 140, but this is not limiting. Since the protruding parts 140 are provided so as to be fixed (positioned) to a mold, it is only necessary that at least three pieces of the protruding parts 140 are formed as long as they can be stably fixed to the mold.

[0067]

On the other hand, in order to stably fix (position) the primary member 100 to a mold in the manufacturing process in accordance with the material and the shape of the primary member 100, the material of the secondary member, and the mold, a large number (exceeding 16 pieces) of the protruding parts 140 may be formed. For example, three or more protruding parts 140 may be formed between the plurality of vane parts 120 formed on the plate-shaped part 110, respectively, or the protruding parts 140 may be formed also on the inner-side region in addition to the intermediate region and the outer-side region.

[0068]

In addition, as a method in which the primary member 100 as the core material of the pump impeller 10 is inserted into and fixed to the mold for molding the

pump impeller 10, if a jig or the like is used, for example, the protruding part 140 as above does not have to be provided,.

[0069]

In addition, as shown in Figure 7, eight pieces of the through holes 150 in total may be formed one each between eight pieces of the vane parts 120. In Figure 2, the through holes 150 are formed one each between the eight vane parts 120 in the outer-side region, and four pieces are formed along the outer periphery of the bearing part 130 in the inner-side region, which means that 12 pieces of the through holes 150 in total are formed, but this is not limiting. Since the through holes 150 are provided in order to ensure close contact between the primary member 100 and the secondary member, as long as appropriate close contact between the primary member 100 and the secondary member can be ensured, the number, the positions, and the sizes thereof may be set as appropriate.

[0070]

As described above, the numbers, the positions, and the sizes of the protruding parts 140 and the through holes 150 may be set as appropriate, and though the secondary member is filled after the primary member 100 is inserted in the mold for molding the pump impeller 10, a large load is applied to the primary member 100 set in the mold at filling of the secondary member and thus, by considering a viewpoint of prevention of deformation of the primary member 100, it is preferable that many protruding parts 140 are formed. In addition, when the secondary member is made to fill, such an effect can be expected that the secondary member flows in with a good balance between the one surface side and the other surface side of the plate-shaped part 110 via the through hole 150.

[0071]

[Another Specific Example (2) of Primary Member]

Figure 8 is a perspective view showing an appearance of a primary member 300 constituting the pump impeller 10 according to the Embodiment of the present invention. As shown in Figure 8, the primary member 300 is different as compared with the primary member 100 shown in Figure 2 in such a point that an indicator part 321 is formed at each of the centers in the eight vane parts 320.

[0072]

With respect to the vane part 320, the indicator part is not formed on the outer edge side of the plate-shaped part 110 in the substantially disk shape in the vane part 320 as shown in Figure 2 and Figure 7, but the indicator part 321 is formed at the center in the vane part 320. For example, in the vane part 320, the indicator part 321 is formed in the vicinity of the intermediate region, a rib part 322A is formed in the vicinity of the outer-side region (outer edge side of the plate-shaped part 110), and a rib part 322B is formed in the vicinity of the inner-side region (bearing part 130 side). As a result, correspondingly to the gradual abrasion of the secondary member constituted so as to cover the indicator part 321, the indicator part 321 appears on the surface. That is, in a case where the abrasion from the center side of the plate-shaped part 110 in the substantially disk shape in the vane part 320 is severe, the degree of the abrasion can be easily grasped.

[0073]

Figure 9 is an enlarged view illustrating details of the vane part 320 in the primary member 300 shown in Figure 8. As shown in Figure 8, the indicator part 321 is formed at the center of the vane part 320.

[0074]

By means of the rotation of the pump impeller, a large pressure from the fluid is applied to the blade 12 in the pump impeller 10. At this time, in accordance with the environment and condition for usage of the pump and the type and the amount of the foreign substance contained in the fluid, a pressure is applied to the blade 12 not only from the side wall part in the rotating direction side of the blade 12 or the part on the outer edge side of the main plate 11 but also from various directions.

[0075]

For example, in the region on the bearing part 130 side of the blade 12, there is such a case that the secondary member (an upper part of the rib part 322B) covering the vane part 320 is gradually worn, and the indicator part 321 appears on the surface. At this time, in the indicator part 321 shown in Figure 9, by means of appearance of a surface 321a opposing the bearing part 130 side to the surface, the degree of abrasion of the pump impeller 10 can be easily grasped, and it may be so constituted that inspection timing and replacement timing thereof are grasped appropriately.

[0076]

[Another Specific Example (3) of Primary Member]

Figure 10 is a perspective view illustrating an appearance of a primary member 400 constituting the pump impeller 10 according to the Embodiment of the present invention. As shown in Figure 10, the primary member 400 is different from the primary member 100 shown in Figure 2 in such a point that an indicator part 421 is formed only on each of the respective outer edge sides thereof in eight vane parts 420.

[0077]

With respect to the vane part 420, as shown in Figure 2, Figure 7, and Figure 8, the indicator part is not formed on the center side (inner side) or the vicinity of the center of the plate-shaped part 110 in the substantially disk shape of the vane part 420, but the indicator part 421 is formed only on the outer edge side of the vane part 320. For example, in the vane part 420, the rib part as shown in Figure 2, Figure 7, and Figure 8 does not have to be provided, or may be provided only to such a degree that the rib part is slightly formed in the periphery of the indicator part 421. As a result, in accordance with the gradual abrasion of the secondary member constituted so as to cover the indicator part 421, the indicator part 421 appears on the surface. In the blade 12, in a case where the abrasion from the center side of the plate-shaped part 110 in the substantially disk shape is severe and in a case where the abrasion on the outer edge side is severe, the degree of the abrasion can be easily grasped. In addition, the constitution is simple.

[0078]

It is to be noted that, in this Embodiment, the explanation was made by citing the pump impeller 10 having eight blades 12 as an example, but this is not limiting, and it may be a pump impeller having less than eight blades or nine blades or more, for example.

[0079]

The Embodiments having been explained above are for facilitating the understanding of the present invention and are not intended to interpret the present invention in a limited manner. The elements included in the Embodiment and the disposition, materials, conditions, shapes, sizes, and the like thereof are not limited

to those exemplified but can be changed as appropriate. In addition, it is possible to partially replace or combine the constitutions shown in different Embodiments.

Reference Signs List

[0080]

- 10 Pump impeller
- 11 Main plate (disk part)
- 12 Blade
- 13 Bearing part
- 14 Exposed part
- 100, 200, 300, 400 Primary member
- 110 Plate-shaped part
- 120, 220, 320, 420 Vane part
- 121, 221A, 221B, 321, 321a, 421 Indicator part
- 122, 222, 322A, 322B Rib part
- 130 Bearing part
- 140 Protruding part
- 150 Through hole
- 12A, 12B Side wall part
- 12C Distal end part

Claims

[Claim 1] A pump impeller for use in a submersible pump, the pump impeller is formed by:

at least a primary member and a secondary member constituted to cover the primary member, wherein

the primary member includes:

a plate-shaped part in a substantially disk shape; and

a vane part formed on one surface side of the plate-shaped part so as to correspond to a blade of the pump impeller; and

the primary member and the secondary member are constituted by different resin materials.

[Claim 2] The pump impeller according to claim 1, wherein

in the blade of the pump impeller, at least a part of the vane part formed by the primary member and at least a part formed by the secondary member so as to cover the vane part are constituted in different colors.

[Claim 3] The pump impeller according to claim 2, wherein

in the blade of the pump impeller, at least a part formed by the secondary member such that the vane part is covered is constituted to be transparent.

[Claim 4] The pump impeller according to claim 1, wherein

the vane part includes an indicator part having a first height at least a part in the vane part.

[Claim 5] The pump impeller according to claim 4, wherein

the secondary member is constituted to cover, with respect to the indicator part, a side wall part on a rotating direction side of the pump impeller and a side wall part on a side opposite to the rotating direction with substantially the same thickness.

[Claim 6] The pump impeller according to claim 4, wherein

the secondary member is constituted to cover, with respect to the indicator part, a side wall part on a rotating direction side of the pump impeller with a thickness larger than a side wall part on a side opposite to the rotating direction.

[Claim 7] The pump impeller according to claim 4, wherein

the secondary member is constituted to cover a distal end part of the indicator part with a thickness larger than the one surface side of the plate-shaped part.

[Claim 8] The pump impeller according to claim 4, wherein

the vane part includes a rib part having a second height smaller than the first height in the vane part.

[Claim 9] The pump impeller according to claim 1, wherein

the secondary member is a resin material which is softer than the primary member.