

Description

Title of Invention: SUBMERSIBLE PUMP

Technical Field

[0001]

The present invention relates to a submersible pump.

Background Art

[0002]

Conventionally, there is a submersible pump used for applications such as spring water discharge at a construction site or the like. The submersible pump pumps up water collecting in a sump (water tank) by driving a motor and discharges it or the like, and in order to prevent clogging of a suction port in a pump main-body by foreign substances during suctioning of water, a strainer covering the suction port is provided.

[0003]

For example, Patent Literature 1 discloses a submersible pump including an opening part where a plurality of holes with the same diameter are drilled with a predetermined disposition on a side surface of the strainer. And the opening part suppresses suctioning of small foreign substances, while preventing clogging of the hole by setting disposition density of the holes in a part on a relatively lower side lower than the disposition density of the holes in a part on a relatively upper side.

Citation List

Patent Literature

[0004]

Summary of Invention

Technical Problem

[0005]

However, in the submersible pump disclosed in Patent Literature 1, water or the like remaining inside of the submersible pump (strainer) after the operation of the submersible pump main-body is stopped is not considered.

[0006]

For example, discharge of water remaining inside of the submersible pump (strainer) by providing a water drain hole in a bottom surface of the strainer can be considered, but if the submersible pump is installed on the ground, there is such a problem that the hole is blocked, and the water cannot be discharged sufficiently.

[0007]

If water remains inside of the submersible pump (strainer), for example, when water is to be suctioned, for example, cement and sludge which was contained in the water when the water is sucked and entered into the submersible pump might be coagulated and adhere and as a result, there is a concern that the water discharge function of the submersible pump might be lowered.

[0008]

Thus, the present invention has an object to provide a submersible pump which reduces water remaining inside of the submersible pump (strainer) after an operation of the submersible pump main-body is stopped.

Solution to Problem

[0009]

A submersible pump according to an aspect of the present invention includes a pump main-body and a strainer disposed so as to cover a suction port of the pump main-body, in which the strainer has an opening part formed by extending from an outer-peripheral side surface of the strainer at least to a part of the bottom surface.

[0010]

In the above-described aspect, the strainer may have an opposing surface opposing the suction port and inclined so as to get closer to the suction port as it goes from an outer peripheral part to a center part.

[0011]

In the above-described aspect, the opening part may be formed by a plurality of slits.

[0012]

In the above-described aspect, the plurality of slits may be formed such that, in the outer-peripheral side surface of the strainer, the widths thereof become larger as they go toward the bottom surface.

[0013]

In the above-described aspect, the plurality of slits may be formed to have a predetermined width on the bottom surface and to extend from the outer peripheral part toward the center part.

[0014]

In the above-described aspect, the plurality of slits may be formed such that lengths of the adjacent slits are different on the bottom surface.

[0015]

In the above-described aspect, in the plurality of slits, one slit formed at a position corresponding to a flow passage formed so as to lead water sucked from the suction port to a discharge port in the pump main-body may be smaller than another slit formed at another position.

[0016]

In the above-described aspect, opening regions of the plurality of slits formed in the outer-peripheral side surface of the strainer may be formed with inclination to a thickness direction such that an inner-peripheral surface becomes larger than an outer-peripheral surface.

[0017]

In the above-described aspect, the strainer may further include a cut-out part provided between two slits, which is a part of the outer-peripheral side surface on the side opposite to the bottom surface being cut out.

Advantageous Effect of Invention

[0018]

According to the present invention, a submersible pump which reduces water remaining inside of the submersible pump (strainer) after the operation of the submersible pump main-body is stopped can be provided.

Brief Description of Drawings

[0019]

[Figure 1] Figure 1 is a schematic diagram illustrating an appearance of a submersible pump 10 according to a First Embodiment of the present invention.

[Figure 2] Figure 2 is a sectional view illustrating an internal structure of the submersible pump 10 according to the First Embodiment of the present invention.

[Figure 3] Figure 3 is a perspective view of a strainer 200 according to the First Embodiment of the present invention when seen from an upper side.

[Figure 4] Figure 4 is a plan view of the strainer 200 according to the First Embodiment of the present invention when seen from a lower side.

[Figure 5] Figure 5 is a perspective view illustrating a detailed constitution of a casing unit 140 according to the First Embodiment of the present invention.

[Figure 6] Figure 6 is a schematic diagram illustrating an appearance of a submersible pump 11 according to a Second Embodiment of the present invention.

[Figure 7] Figure 7 is a perspective view of a strainer 201 according to the Second Embodiment of the present invention when seen from an upper side.

[Figure 8] Figure 8 is a perspective view of the strainer 201 according to the Second Embodiment of the present invention when seen from a lower side.

Description of Embodiments

[0020]

Hereinafter, Preferred Embodiments of the present invention will be explained specifically with reference to the attached drawings. It is to be noted that the Embodiment described below is only a specific example for implementing the present invention and is not to interpret the present invention in a limited manner. In addition, in order to facilitate understanding of the explanation, the same signs are given to the same constituent elements in each of the drawings as much as possible, and duplicated explanation will be omitted in some cases.

[0021]

<First Embodiment>

[Constitution of Submersible Pump]

Figure 1 is a schematic diagram illustrating an appearance of a submersible pump 10 according to a First Embodiment of the present invention. In each of the drawings, an x-axis, a y-axis, and a z-axis might be illustrated in some cases. The x-axis, the y-axis, and the z-axis form right-handed three-dimensional rectangular coordinates. Hereinafter, an arrow direction of the x-axis shall be referred to as an x-axis + side and a direction opposite to the arrow as an x-axis - side in some cases, and the same applies to the other axes. It is to be noted that the z-axis + side and the z-axis - side are called an "upper side" and a "lower side", respectively, in some cases. In addition, the z-axis direction is called an "up-down direction" in some cases. Furthermore, a surface crossing the x-axis, the y-axis, or the z-axis at a right angle, respectively, is called a yz surface, a zx surface or a xy surface in some cases.

[0022]

As shown in Figure 1, the submersible pump 10 includes a pump main-body 100 and a strainer 200 provided on a lower side of the pump main-body 100.

[0023]

Figure 2 is a sectional diagram illustrating an internal structure of the submersible pump 10 according to the First Embodiment of the present invention. As shown in Figure 2, the pump main-body 100 includes a rotation shaft 110, a motor 120, an impeller 130, and a casing unit 140.

[0024]

The pump main-body 100 has a substantially columnar shape. On an upper side and a lower side of the pump main-body 100, a discharge port 170 and a suction port 160 are provided, respectively.

[0025]

The submersible pump 10 is a vertical submersible electric pump with a rotation center axis of the rotation shaft 110 extending along the up-down direction. The rotation shaft 110 has a columnar shape extending in the up-down direction and is rotatably fixed to the pump main-body 100. To an end part on the lower side of the rotation shaft 110, the impeller 130 is fixed. To an upper side of the rotation shaft 110, a rotor of the motor 120 is fixed. By means of an electromagnetic force between a stator and the rotor included in the motor 120, rotation of the rotation shaft 110 is driven. The rotation shaft 110 transmits a rotating force generated by the motor 120 to the impeller 130.

[0026]

The casing unit 140 is provided on the lower side of the motor 120 and forms a pump chamber 150 in which the impeller 130 is accommodated. On the lower side of the rotation shaft 110, a suction port 160 opened in a wall separating the pump chamber 150 from a space on the lower side of the casing unit 140 is provided. Into the pump chamber 150, it is constituted such that water to be discharged is led from a space on the lower side of the casing unit 140 through the suction port 160.

[0027]

When the impeller 130 is rotated by driving the motor 120, the water led to the pump chamber 150 is given a momentum by the impeller 130, moves along the flow

passage FP and is discharged from the discharge port 170. When the water having been led into the pump chamber 150 is discharged, new water flows into the pump chamber 150 through the suction port 160 from the space on the lower side of the casing unit 140. As a result, in the pump main-body 100, a continuous water flow is generated along the flow passage FP provided such that the water having been suctioned from the suction port 160 is led to the discharge port 170 through the pump chamber 150, and the water is discharged by the submersible pump 10.

[0028]

[Constitution of Strainer]

Figure 3 is a perspective view of the strainer 200 according to the First Embodiment of the present invention when seen from the upper side. Figure 4 is a plan view of the strainer 200 according to the First Embodiment of the present invention when seen from the lower side.

[0029]

As shown in Figure 2 to Figure 4, the strainer 200 includes a cylindrical part 210 and a bottom part 220. The bottom part 220 is a disk-shaped member extending along the xy surface crossing the z-axis. The bottom part 220 has an opposing surface 220a on the upper side and a bottom surface 220b on the side opposite to the opposing surface 220a. It is to be noted that the shape of the bottom part 220 is not limited to the disk shape but it is only necessary to be a plate shape.

[0030]

The cylindrical part 210 has a substantially cylindrical shape extending in the up-down direction. It is to be noted that the shape of the cylindrical part 210 is not

limited to the substantially cylindrical shape but it is only necessary to be cylindrical. The cylindrical part 210 includes three high parts 210H and three low parts 210L. The high parts 210H and the low parts 210L are provided alternately along a circumferential direction. By means of the outer circumferential surfaces of the high parts 210H and the outer circumferential surfaces of the low parts 210L, a smooth outer-peripheral side surface 210a over the entire cylindrical part 210 is formed.

[0031]

An end part on the lower side of the high part 210H and an end part on the lower side of the low part 210L are aligned and are connected to an outer-peripheral part 220ae of the bottom surface 220b. On the other hand, an end part on the upper side of the high part 210H is located on the upper side as compared with the end part on the upper side of the low part 210L. When the cylindrical part 210 and the bottom part 220 are connected, the strainer 200 has a cup shape with the upper side opened when seen as a whole.

[0032]

The upper side of the strainer 200 is connected to the lower side of the pump main-body 100. By mounting the submersible pump 10 in a sump such that the bottom surface 220b is brought into contact with the water bottom of the sump, the submersible pump 10 stands by itself with respect to the water bottom in a state in which the strainer 200 and the pump main-body 100 are located on the lower side and the upper side, respectively.

[0033]

The strainer 200 is disposed so as to cover the suction port 160 of the pump main-body 100. In detail, the strainer 200 is connected to the pump main-body 100

such that the opposing surface 220a is opposed to the suction port 160 of the pump main-body 100. The entire shape of the submersible pump 10 is formed by the strainer 200 and the pump main-body 100.

[0034]

The strainer 200 has one or a plurality of opening parts formed by extending from the outer-peripheral side surface 210a at least to a part of the bottom surface 220b. In this Embodiment, the opening part is formed by a plurality of slits 211 (an example of the "opening part") and a plurality of slits 212 (an example of the "opening part"), for example.

[0035]

The plurality of slits 211 are formed in the high part 210H. The plurality of slits 212 are formed in the low part 210L.

[0036]

When discharge of water at the sump is completed and the submersible pump 10 is stopped or when the submersible pump 10 is stopped before discharge of water at the sump is completed, and the submersible pump 10 is brought up from the sump, residual water collected in the pump chamber 150 or the like drips down to the bottom surface 220b through the suction port 160 due to the gravity. By means of such a constitution that the slits 211 and 212 are formed by extending at least to a part of the bottom surface 220b from the outer-peripheral side surface 210a, the residual water dripped to the bottom surface 220b can be discharged rapidly from the slits 211 and 212 to the outside of the submersible pump 10 and thus, retention of the residual water inside of the strainer 200 can be suppressed.

[0037]

In addition, even in the case where the residual water is water containing muddy water or cement, for example, retention of the residual water inside of the strainer 200 can be suppressed and thus, consolidation and adhesion of sludge or cement which entered inside of the strainer 200 can be suppressed, and moreover, lowering of a discharge function of the submersible pump 10 can be suppressed.

[0038]

The opposing surface 220a on the bottom part 220 is opposed to the suction port 160 and is inclined so as to be closer to the suction port 160 as it goes from an outer-peripheral part 220ae toward a center part 220ac (see Figure 2). In other words, the bottom surface 220b is formed so as to be inclined downward from the center part 220ac toward the outer-peripheral part 220ae. In this Embodiment, the approximate center of the opposing surface 220a rises the most to the upper side and it evenly goes downward from the center toward the outer-peripheral part 220ae.

[0039]

By means of the constitution as above, in a case where the residual water collected in the pump chamber 150 or the like drips down to the bottom surface 220b through the suction port 160 due to the gravity, the residual water can be moved to the outer-peripheral part 220ae by a gradient formed on the bottom surface 220b and can be discharged smoothly to the outside of the submersible pump 10 from the slits 211 and 212.

[0040]

The plurality of slits 211 and the plurality of slits 212 are formed so as to have predetermined widths on the bottom surface 220b and to extend from the outer-peripheral part 220ae toward the center part 220ac (see Figure 4).

[0041]

As described above, by setting the widths of the slits 211 and 212 to a predetermined width, which is equal to or smaller than a diameter of a foreign substance whose passage in the pump main-body 100 can be allowed, for example, passage of a foreign substance larger than the above width through the strainer 200 and through the pump main-body 100 can be suppressed. In addition, since it is formed to extend from the outer-peripheral part 220ae toward the center part 220ac, lowering of the discharge efficiency of the residual water can be suppressed.

[0042]

The plurality of slits 211 are formed substantially in parallel on the bottom surface 220b (see Figure 4). In addition, the plurality of slits 212 are formed substantially in parallel on the bottom surface 220b (see Figure 4).

[0043]

The plurality of slits 211 and the plurality of slits 212 are formed such that lengths of adjacent slits are different on the bottom surface 220b (see Figure 4).

[0044]

By means of the constitution as above, since an interval between the two slits 211 and an interval between the two slits 212 can be made substantially constant, such a situation can be suppressed that the slits get closer to each other, become thinner and strengths thereof are lowered. As a result, the strength of the strainer 200 can be ensured.

[0045]

Figure 5 is a perspective view illustrating a detailed constitution of the casing unit 140 according to the First Embodiment of the present invention. As illustrated

in Figure 5, the casing unit 140 includes a pump casing 310, a wear ring 320, and a suction cover 330.

[0046]

The suction cover 330 has a cup shape opened to an upper side, and an opening part functioning as the suction port 160 is formed in the bottom surface. The wear ring 320 is a substantially disk-shaped member extending along the xy surface and is connected to the suction cover 330 on the upper side of the suction cover 330.

[0047]

By connecting the wear ring 320 and the suction cover 330, an internal space surrounded by the wear ring 320 and the suction cover 330 is formed.

[0048]

The pump casing 310 has a cup shape opened to the upper side, and an opening part functioning as the suction port 160 is formed in the bottom surface. The pump casing 310 is accommodated in the above-described internal space. By means of the pump casing 310 and the wear ring 320, the pump chamber 150 is formed. Though not illustrated in Figure 5, in the pump chamber 150, the impeller 130 (see Figure 2) is accommodated.

[0049]

The pump casing 310, the wear ring 320, and the suction cover 330, that is, the casing unit 140 has a columnar shape as a whole. On the outer periphery of the casing unit 140, three convex parts protruding to the radial direction and three concave parts located among the convex parts are formed. Each of the convex

parts is provided between the two high parts 210H and on the upper side of the low part 210L in the strainer 200.

[0050]

On the wear ring 320, three opening parts 320a are formed at positions where the three convex parts are formed, respectively. In the pump casing 310, on the lower side of the opening part 320a, a bag-shaped part extending along the circumferential direction with one end communicating with the pump chamber 150 and the other blocked is formed.

[0051]

A path from the slit 211 or 212 to the pump main-body 100 via the suction port 160, the pump chamber 150, the bag-shaped part, and the opening part 320a is the flow passage FP.

[0052]

In the plurality of slits 211 and the plurality of slits 212, the slit 212 formed at a position corresponding to the flow passage FP is smaller than the slit 211 formed at the other positions.

[0053]

In this Embodiment, the end part on the upper side of the slit 212 located on the lower side of the flow passage FP is located on the side lower than the end part on the upper side of the slit 211 provided on the high part 210H, and a length in the up-down direction of the slit 212 is smaller than the length in the up-down direction of the slit 211.

[0054]

As described above, by means of the constitution that the slit 211 with the longer length in the up-down direction (the opening area is larger) is disposed at a position not interfering with the flow passage FP, the opening area can be ensured to a certain degree as a whole and thus, resistance at suctioning can be suppressed.

[0055]

[Variation of Strainer]

The opening regions of the slits 211 and 212 formed in the outer-peripheral side surface 210a of the strainer 200 are formed so as to be enlarged as they get closer to the inner-peripheral surface. That is, the opening regions of the plurality of slits 211 and 212 are smaller on the outer side than on the inner side.

[0056]

By means of the constitution as above, sticking of a woodchip or the like drifting in the water into the slit can be suppressed. As a result, since prevention of inflow of the water into the inside of the strainer 200 can be suppressed, lowering of the drainage capability of the submersible pump 10 can be suppressed.

[0057]

Alternatively, the plurality of slits 211 and the plurality of slits 212 may be formed such that the widths become larger as they get closer to the bottom surface 220b on the outer-peripheral side surface 210a of the strainer 200.

[0058]

Since the widths of the slits 211 and 212 are larger on the lower sides, the muddy water or cement collected on the bottom surface 220b can be easily discharged from the slits 211 and 212.

[0059]

<Second Embodiment>

The submersible pump 11 according to a Second Embodiment will be explained. In the Second Embodiment and after, description on the matters in common with the First Embodiment is omitted, and only different points will be explained. Particularly, similar effects by the similar constitutions will not be referred to individually for each of the Embodiments.

[0060]

The submersible pump 11 according to the Second Embodiment is different from the submersible pump 10 according to the First Embodiment in a point that, in a strainer, a cut-out part is provided between two slits.

[0061]

Figure 6 is a schematic diagram illustrating an appearance of the submersible pump 11 according to the Second Embodiment of the present invention. Figure 7 is a perspective view when the strainer 201 according to the Second Embodiment of the present invention is seen from the upper side. Figure 8 is a perspective view when the strainer 201 according to the Second Embodiment of the present invention is seen from the lower side.

[0062]

As shown in Figure 6 to Figure 8, the submersible pump 11 includes the strainer 201 instead of the strainer 200 as compared with the submersible pump 10 according to the First Embodiment.

[0063]

In this Embodiment, in the cylindrical part 210 in the strainer 201, three screwing parts 217 are provided along the circumferential direction with a substantially equal interval. Since the screwing part 217 is fixed to the pump main-body 100 by a screw (nut), the strainer 201 is fixed to the pump main-body 100.

[0064]

The strainer 201 has a plurality of slits 213 having such a shape that is long in the up-down direction. In this Embodiment, the strainer 201 has 9 pieces of the slits 213. In detail, in each of intervals between the two screwing parts 217, three pieces of the slits 213 are provided with substantially equal intervals. The slit 213 is formed by extending from the outer-peripheral side surface 210a to a part of the bottom surface 220b.

[0065]

Between two pieces of the slits 213, a cut-out part 216 in which a part of the outer-peripheral side surface 210a and the part on the side opposite to the bottom surface 220b is cut out is provided. In this Embodiment, in each of the intervals between the two screwing parts 217, four pieces of the cut-out parts 216 are provided with a substantially equal interval.

[0066]

Two of the four pieces of cut-out parts 216 are provided between the screwing part 217 and the slit 213. The other two of the four pieces of the cut-out parts 216 are provided between the two slits 213.

[0067]

That is, in each of the intervals between the two screwing parts 217, the cut-out parts 216 and the slits 213 are provided alternately along the circumferential direction of the outer-peripheral side surface 210a.

[0068]

The cylindrical parts 210 extend in a bellows state (an accordion state) along the circumferential direction from the one screwing part 217 toward the other screwing part 217 while alternately forming the cut-out parts 216 and the slits 213. In other words, the cylindrical parts 210 form a zigzag state along the circumferential direction from the one screwing part 217 toward the other screwing part 217 while alternately forming the cut-out parts 216 and the slits 213.

[0069]

For example, when the strainers 200 and 201 are formed of a resin such as vinyl chloride or the like, in a high-temperature season such as summer, the strainers 200 and 201 might be softened in some cases. In the strainer 200 (see Figure 3 to Figure 5), a part of the cylindrical part 210 (hereinafter, referred to as an L-shaped plate part 231 in some cases) located between two pieces of the slits 211 (between two pieces of the slits 212) divides the cylindrical part 210 from the outer-peripheral side surface 210a to the bottom surface 220b and becomes a thin plate shape. In the L-shaped plate part 231, a distal end part which is bent in the L-shape at a connection part between the outer-peripheral side surface 210a and the bottom surface 220b and protrudes toward the outside is formed. For example, in a case where the submersible pump 10 is installed diagonally, when a load is applied to the distal end part, the L-shaped plate part 231 is deformed and will not return to the original in some cases.

[0070]

On the other hand, in the strainer 201, by means of such constitution that the cut-out part 216 is provided between two pieces of the slits 213, and the lower sides of the two plate-shaped parts 232 opposing each other by interposing the cut-out part 216 between them, that is, the lower sides of the cut-out parts 216, are connected, rigidity can be improved and thus, even in the season with a high temperature such as summer, deformation of the strainer 201 can be suppressed.

[0071]

In addition, by means of such constitution that the upper sides of the cut-out parts 216 are not connected, an area of the opening through which water flows can be made larger. As a result, an inflow amount can be increased and thus, lowering of a discharge amount of the submersible pump 10 can be suppressed.

[0072]

It is to be noted that, in this Embodiment, such constitution that the cut-out part 216 is provided between two pieces of the slits 213 is explained, but this is not limiting. It may be so constituted that, between the two slits 213, an opening part is formed in the outer-peripheral side surface 210a such that the bottom surface 220b remains. The opening part is formed by connecting the upper sides of the two plate-shaped parts 232 opposing each other with the cut-out part 216 between them, for example.

[0073]

The Embodiments explained above are for facilitating understanding of the present invention and are not to interpret the present invention in a limited manner. Each element as well as the disposition, materials, conditions, shapes, sizes and the

like thereof provided in the Embodiments are not limited to those exemplified but can be changed as appropriate. In addition, the constitutions illustrated in different Embodiments can be partially replaced or combined.

Reference Signs List

[0074]

- 10, 11 Submersible pump
- 100 Pump main-body
- 110 Rotation shaft
- 120 Motor
- 130 Impeller
- 140 Casing unit
- 150 Pump chamber
- 160 Suction port
- 170 Discharge port
- 200, 201 Strainer
- 210 Cylindrical part
- 210a Outer-peripheral side surface
- 210H High part
- 210L Low part
- 211, 212, 213 Slit
- 216 Cut-out part

217 Screwing part

220 Bottom part

220a Opposing surface

220ac Center part

220ae Outer-peripheral part

220b Bottom surface

231 L-shaped plate part

232 Plate-shaped part

310 Pump casing

320 Wear ring

320a Opening part

330 Suction cover

211a Water surface

FP Flow passage

Claims

[Claim 1] A submersible pump comprising:

a pump main-body; and

a strainer disposed so as to cover a suction port of the pump main-body,

wherein

the strainer has an opening part formed by extending from an outer-peripheral side surface of the strainer at least to a part of a bottom surface.

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

the strainer has an opposing surface opposing the suction port and inclined so as to get closer to the suction port as it goes from an outer peripheral part to a center part.

[Claim 3] The submersible pump according to claim 1, wherein

the opening part is formed by a plurality of slits.

[Claim 4] The submersible pump according to claim 3, wherein

the plurality of slits are formed such that, in the outer-peripheral side surface of the strainer, widths become larger as going toward the bottom surface.

[Claim 5] The submersible pump according to claim 3, wherein

the plurality of slits are formed to have a predetermined width on the bottom surface and to extend from an outer peripheral part toward a center part.

[Claim 6] The submersible pump according to claim 5, wherein

the plurality of slits are formed such that lengths of adjacent slits are different on the bottom surface.

[Claim 7] The submersible pump according to claim 3, wherein

in the plurality of slits, one slit formed at a position corresponding to a flow passage formed so as to lead water sucked from the suction port to a discharge port in the pump main-body is smaller than another slit formed at another position.

[Claim 8] The submersible pump according to claim 3, wherein

opening regions of the plurality of slits formed in the outer-peripheral side surface of the strainer are formed so as to be enlarged as they get closer to an inner-peripheral surface.

[Claim 9] The submersible pump according to claim 3, wherein

the strainer further includes a cut-out part which is provided between the two slits and is a part of the outer-peripheral side surface opposite to the bottom surface is cut out.