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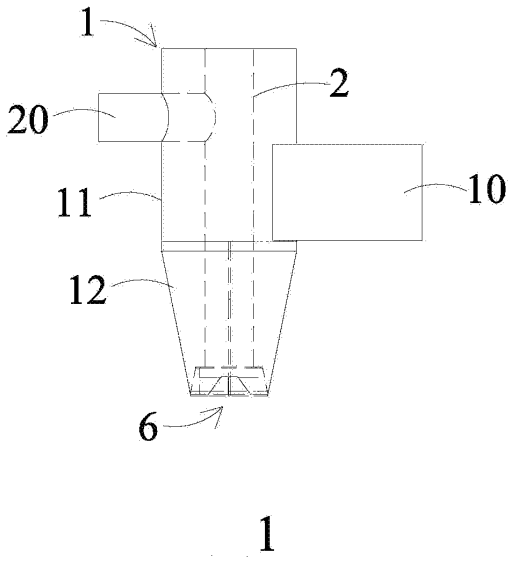
(71) Applicants:
- **Grundfos Holding A/S**
  8850 Bjerringbro (DK)
- **Grundfos (China) Holding Co. Ltd.**
  Beijing 100086 (CN)

(72) Inventors:
- **YANG, Zhiyong**
  Suzhou
  Jiangsu 215000 (CN)
- **QIAO, Cheng**
  Suzhou
  Jiangsu 215000 (CN)
- **CAO, Yanghua**
  Suzhou
  Jiangsu 215028 (CN)
- **XU, Feng**
  Suzhou
  Jiangsu 215000 (CN)
- **SHAO, Teng**
  Suzhou
  Jiangsu 215000 (CN)

(74) Representative: **Patentanwälte Vollmann & Hemmer**
Wallstraße 33a
23560 Lübeck (DE)

(54) PREFABRICATED PUMP STATION UNIT AND WATER DISTRIBUTION UNIT

(57) The invention provides a prefabricated pumping station unit and a water distribution unit. The prefabricated pumping station unit comprises a prefabricated hollow shaped pumping station body, a liquid inlet connected to the pumping station body, and a wellbore mounted in the pump station body. The circumference of the cross section of the upper end portion of the pumping station body is greater than the circumference of the cross section of the lower end portion thereof. In the prefabricated pumping station unit of the present invention, the pumping station body is large in the upper portion and small in the lower portion, when the fluid flows through the liquid inlet to the pumping station body, the fluid gradually gathers toward the center of the pumping station body along the inner wall of the pumping station, and the fluid energy is consumed, and the fluid flow state is uniformly homogenized, so that the fluid flow state entering the suction inlet of the submersible pump is uniform, which creates a good water inlet condition for the submersible pump and improves the stability of the submersible pump operation.



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Description

Technical field

[0001] The present invention generally relates to a pumping station for transporting liquids, and more particularly to a prefabricated pumping station unit and water distribution unit.

Background of the invention

[0002] With the development of urban construction, the amount of municipal rainwater and sewage is increasing, so there are various kinds of sewage treatment equipment, and the pumping station is one of them.

[0003] US Patent Application Publication No. US 20080011372 discloses a prefabricated pumping station unit comprising a floor, an enclosing wall fixed to the floor, and a plurality of submersible pumps mounted inside the enclosing wall. On the enclosing wall there is a liquid inlet and a liquid outlet. The fluid enters the prefabricated pumping station unit from the liquid inlet and flows out through the liquid outlet, due to the power provided by the submersible pump. Due to heavy rain and other reasons, the amount of fluid flowing into the prefabricated pumping station unit is sometimes very large, and the flow speed is very fast. Therefore, the fluid is accompanied by a large amount of energy, and if the energy directly hits the submersible pump, especially the suction inlet of the submersible pump, it will be easy to generate an operating environment that is unfavorable to the submersible pump, for example, a vortex will be generated near the suction inlet, or the air will be brought into the suction inlet, thereby causing cavitation or vibration, resulting in decreasing of the performance of the submersible pump. Aiming at solving this problem, a baffle device is arranged adjacent to the liquid inlet inside the enclosing wall of the prefabricated pumping station unit, and a plurality of liquid discharging ports are arranged at the bottom of the baffle device, and the plurality of liquid distribution ports respectively correspond to the plurality of submersible pumps. The fluid flowing into the enclosing wall from the inlet port is divided into a plurality of sections by the baffle device, and each section flows to the suction inlet of the corresponding submersible pump through the corresponding liquid distribution port, and then is sent out by the submersible pump.

[0004] The technical solution in the U.S. patent application is relatively complicated, although the fluid power can be consumed to a certain extent by the baffle device, the fluid state becomes very uneven after passing through the plurality of liquid distribution ports of the baffle device, there are a large amount of turbulence, therefore, the U.S. patent application has deficiencies in improving fluid flow status.

[0005] The above information disclosed in this background section is only for enhancement of understanding of the background of the invention, and thus it may include information that does not constitute the prior art known to person skilled in the art.

Summary of the invention

[0006] An object of the present invention is to overcome the above-mentioned deficiencies of the prior art and to provide a prefabricated pumping station unit having a good flow-guiding function, and make the flow state of fluid entering the suction inlet of the submersible pump uniform, and create a good water inlet condition for the submersible pump, and improve the stability of the submersible pump operation.

[0007] It is still another object of the present invention to provide a prefabricated pumping station unit that is lightweight and convenient to transport.

[0008] It is still another object of the present invention to provide a prefabricated pumping station unit having a small floor area.

[0009] It is still another object of the present invention to provide a prefabricated pumping station unit that can be installed with a high flow axial or mixed flow pump.

[0010] It is still another object of the present invention to provide a prefabricated pumping station unit that is easy to assemble.

[0011] It is still another object of the present invention to provide a water distribution unit in which the prefabricated pumping station unit of the present invention is installed. To achieve the above object, the present invention uses the following technical solutions:

[0012] According to an aspect of the present invention, the present invention provides a prefabricated pumping station unit, comprising a prefabricated hollow-shaped pumping station body, a liquid inlet and a liquid outlet connected to the pumping station body, and a wellbore arranged inside the pumping station body. Wherein the circumference of the cross section of the upper end portion of the pumping station body is greater than the circumference of the cross section of the lower end portion thereof. In the prefabricated pumping station unit of the present invention, the pumping station body comprises a hollow-shaped pumping station body, and the circumference of the cross section of the upper end portion of the pumping station body is larger than the circumference of the cross section of the lower end portion thereof, that is, the upper part of pumping station is large and the lower part of pumping station small, when the fluid flows into the pumping station body from the liquid inlet, the fluid gradually gathers toward the center of the pumping station body along the inner wall of the pumping station, when the fluid energy is consumed, the fluid flow state is uniformly homogenized, which can effectively avoid or reduce the influence of the fluid flow state of the inlet port on the operation of the submersible pump, and make the fluid flowing into the suction inlet of the submersible pump uniform, and create a good liquid intaking condition for the submersible pump and improve the stability of the submersible pump operation. At the same time, since the

prefabricated pumping station unit of the present invention is a prefabricated structure, the on-site construction period can be greatly reduced, and it is light and convenient to transport, simple in structure and low in cost.

[0013] According to an embodiment of the present invention, the pumping station body includes a first cylindrical portion and a tapered portion connecting to the lower end portion of the first cylindrical portion, the cross-sectional dimension of the tapered portion decreases along a top-to-bottom direction, the liquid inlet is provided in the first cylindrical portion.

[0014] According to an embodiment of the invention, the center line of the first cylindrical portion and the tapered portion coincide.

[0015] According to an embodiment of the invention, the first cylindrical portion is a cylinder, and the tapered portion is a conical cylinder.

[0016] According to an embodiment of the invention, the cone angle of the conical cylinder is in the range of 15° to 50°.

[0017] According to an embodiment of the invention, the bottom edge of the liquid inlet is adjacent to the tapered portion or flush with the top edge of the tapered portion.

[0018] According to an embodiment of the present invention, the prefabricated pumping station unit further comprises a first grill device, the first grill device being mounted in a lower end portion of the first cylindrical portion; or being mounted in a middle or upper portion of the tapered portion; or installed at the end of the liquid inlet.

[0019] According to an embodiment of the invention, the prefabricated pumping station unit further comprises a submersible pump disposed in the wellbore, the submersible pump being an axial flow pump, a mixed flow pump or a cross flow pump.

[0020] According to an embodiment of the present invention, the prefabricated pumping station unit further includes a pump base installed in the pumping station body and located under the wellbore; or the pump base is installed in the wellbore, and the submersible pump is mounted on the pump base.

[0021] According to an embodiment of the present invention, the pump base includes a bottom plate, a flow guiding portion fixed to a central position of the bottom plate, and at least two diverting portions fixed to the bottom plate and the flow guiding portion, the at least two diverting portions are evenly distributed in the circumferential direction of the flow guiding portion.

[0022] According to an embodiment of the present invention, the pump base further includes at least two support portions fixed to the bottom plate, the height of the support portion being higher than the flow guiding portion and the diverting portion, and a flange is fixed on the top of the at least two supporting portions.

[0023] According to an embodiment of the invention, the wellbore is disposed coaxially with the pumping station body in the pumping station body.

[0024] According to an embodiment of the present invention, the pumping station body further includes a second cylindrical portion, and the cross-sectional dimension of said second cylindrical portion is smaller than the first cylindrical portion, the second cylindrical portion being connected to the lower end of the tapered.

[0025] According to an embodiment of the present invention, the first tubular portion and the second tubular portion are both cylindrical, and the tapered portion is a conical cylinder, and the center lines of the three are coincident.

[0026] According to an embodiment of the invention, at least one fixing plate is provided between the wellbore and the tapered portion and/or the second tubular portion.

[0027] According to another aspect of the invention, the present invention provides a water distribution unit, comprising a water tank having a liquid inlet. Wherein the water distribution unit further comprises at least one prefabricated pumping station unit, each of the prefabricated pumping station units including a tapered portion, a wellbore, a submersible pump and a liquid outlet, the tapered portion being fixed to an outer bottom of the water tank, and the cross-sectional dimension of the tapered portion gradually decreases in a direction from top to bottom, the wellbore is disposed in the tapered portion and extends upward into the water tank, the liquid outlet is connected to the wellbore, and extending out of the water tank, and the submersible pump is disposed in the wellbore.

[0028] According to an embodiment of the invention, the prefabricated pumping station unit further includes a second cylindrical portion connecting to the tapered portion.

[0029] According to an embodiment of the invention, the water tank is a prefabricated water tank or a civil structure; and/or the water tank is a tank having a rectangular, circular, or elliptical cross-sectional shape; and/or the water tank is disposed horizontally.

[0030] According to an embodiment of the present invention, the pumping station body includes an outer tubular body and an inner tubular body, the outer tubular body includes a bottom of the outer tubular body and an outer peripheral wall provided at the bottom of the outer tubular body; the inner tubular body includes an inner peripheral wall, and the top end of the inner tubular body is open, the upper end of the inner tubular body penetrates through the bottom of the outer tubular body and is disposed in the outer tubular body, and the remaining portion of the inner tubular body is located outside the outer tubular body, part of the inner tubular body and part of the outer peripheral wall, and the bottom of the outer tubular body together form a circulation space, and the liquid inlet is arranged on the outer peripheral wall.

[0031] According to an embodiment of the present invention, the inner tubular body further includes a bottom of the inner tubular body, the bottom integrally formed at a bottom end portion of the inner peripheral wall or sealingly fixed to a bottom end portion of the inner peripheral

wall.

[0032] According to an embodiment of the invention, the centerlines of the outer tubular body and inner tubular body coincide.

[0033] According to an embodiment of the invention, the inner tubular body and the outer tubular body are both cylindrical, and the inner tubular body has a cross-sectional dimension smaller than a cross-sectional dimension of the outer tubular body.

[0034] According to an embodiment of the invention, the inner tubular body has a conical cylindrical shape with a large diameter end and a small diameter end, and a large diameter end of the inner tubular body is located inside the outer tubular body.

[0035] According to an embodiment of the invention, the portion of the inner tubular body that is located inside the outer tubular body has a cone shape.

[0036] According to an embodiment of the invention, the bottom edge of the liquid inlet is not higher than the top edge of the inner peripheral wall.

[0037] According to an embodiment of the invention, the bottom edge of the liquid inlet is adjacent to or flush with the bottom of the outer tubular body.

[0038] According to an embodiment of the present invention, a portion of the inner peripheral wall located in the outer tubular body is provided with grille holes that communicate the inside of the inner tubular body with the circulation space.

[0039] According to an embodiment of the invention, the grille holes are disposed adjacent to bottom of the outer tubular body.

[0040] According to an embodiment of the present invention, the grille holes are disposed at the positions of the inner peripheral wall away from the inner peripheral wall portion facing the liquid inlet.

[0041] According to an embodiment of the present invention, the prefabricated pumping station unit further includes a grilling device, the grilling device is mounted to the end of the liquid inlet; or the grilling device is mounted to an upper end of the inner peripheral wall of the inner tubular body.

[0042] According to an embodiment of the invention, the inner tubular body comprises a plurality of sub- inner-tubular-bodies connected in series, and/or the outer tubular body comprises a plurality of sub-outer-tubular-body connected in series.

[0043] According to an embodiment of the invention, the wellbore is disposed coaxially with the pumping station body in the pumping station body.

[0044] According to an embodiment of the present invention, the relationship between the height H1 of the portion of the inner tubular body out of the outer tubular body and the diameter D of the wellbore satisfies: H1 = (2 ~ 5) D.

[0045] According to an embodiment of the invention, the prefabricated pumping station unit further includes a submersible pump disposed in the wellbore.

[0046] According to an embodiment of the invention, the submersible pump is an axial flow pump or a mixed flow pump.

[0047] According to an embodiment of the invention, the prefabricated pumping station unit further includes a pump base installed in the pumping station body and located below the wellbore, and the submersible pump is mounted on the pump base.

[0048] According to an embodiment of the present invention, the pump base includes a bottom plate, a flow guiding portion fixed to a central position of the bottom plate, and at least two diverting portions fixed to the bottom plate and the flow guiding portion, the at least two diverting portions are evenly distributed in the circumferential direction of the flow guiding portion.

[0049] According to an embodiment of the present invention, the pump base further includes at least two support portions fixed to the bottom plate, the height of the support portion being higher than the flow guiding portion and the diverting portion, and a flange is fixed onto the top of the at least two supporting portions.

[0050] According to another aspect of the present invention, a water distribution unit includes a water tank having a liquid inlet, the water distribution unit further comprising at least one prefabricated pumping station subunit, each of the prefabricated pumping station subunits including an inner tubular body, a wellbore, and a liquid outlet, the inner tubular body is fixed to a bottom of the water tank, a top end portion of the inner tubular body is open and protrudes into the water tank, the wellbore is disposed on the inner tubular body and extends upwardly out of a top opening of the inner tubular body, the liquid outlet communicates with the wellbore and extends out of the water tank.

[0051] According to an embodiment of the invention, the water distribution unit further includes a submersible pump disposed in the wellbore.

[0052] According to an embodiment of the invention, the water tank is a prefabricated water tank or a civil structure; and/or the water tank is a tank having a rectangular, circular, or elliptical cross-sectional shape; and/or the water tank is disposed horizontally.

[0053] According to an embodiment of the present invention, the wellbore is a split structure including a lower tubular portion and an upper tubular portion connected to the lower tubular portion, wherein the liquid outlet conduit is in communication with the upper tubular portion; the prefabricated pumping station unit further includes at least two fixing plates uniformly disposed in the circumferential direction, and the lower cylindrical portion is fixed to the pumping station body by at least two of the fixing plates. Since the wellbore is a split structure composed of the lower tubular portion and the upper tubular portion connected to each other, firstly, the weight of the separate lower tubular portion or the upper tubular portion is greatly reduced compared to a complete wellbore, and it is convenient for handling, and it is convenient and flexible for the installation operation, it is possible to install the lower tube portion and the upper tube portion sepa-

rately, so that the lower tube body is easily aligned with the pump base, and the liquid outlet conduit of the upper tube portion is easily aligned with the liquid outlet on the pumping station body, so the assembly of present invention prefabricated pumping station unit is very convenient. In addition, in the present invention, the lower tubular portion is fixed to the pumping station body by at least two fixing plates, and the fixing is relatively firm on the one hand, and the fixing plate separates the circulation space between the lower tubular portion and the pumping station body on the other hand to form multi flow channels, which guide liquid to flow along each flow channel, which is beneficial to eliminate turbulence and homogenize the fluid flow state, and the impact of the fluid on the fixed plate can also eliminate a large amount of kinetic energy, and provide a uniform fluid for the suction inlet of the submersible pump, which is beneficial to reduce the vibration and noise of the submersible pump.

[0054] According to an embodiment of the invention, the upper tubular portion is detachably coupled to the lower tubular portion. When maintenance is required, the upper cylinder can be removed to increase the working space in the pumping station; in addition, when replacement is required, it is possible to only replace one of the upper tubular portion and the lower tubular portion, and keep the other that is not damaged, which is conducive to cost savings.

[0055] According to an embodiment of the present invention, the liquid outlet conduit is integrally formed with or fixedly coupled to the upper tubular portion.

[0056] According to an embodiment of the present invention, at least two outer sides of the fixing plate are fixed to the pumping station body, and a bottom end is flush with a bottom end surface of the pumping station body or fixed on a bottom plate of the pumping station body. The lower tubular portion is fixed to the inner side of the at least two of the fixing plates.

[0057] According to an embodiment of the invention, a pump base is disposed below the lower tubular portion and is fixed to an inner side of at least two of the fixing plates.

[0058] According to an embodiment of the present invention, sealing members are provided in the gap between the fixing plate and the pump seat, so that at least two of the fixing plates divide the space between the lower tubular portion and the pumping station body into at least two independent flow channels that are isolated from each other, and the pump base is provided with a water passing hole corresponding to each of the independent flow channels. Since the gap between the fixed plate and the pump seat is sealed by the sealing member, when the fluid passes, the debris such as the rope head, the tape, and the like are prevented from being wound around the pump seat when passing through the gap.

[0059] According to an embodiment of the present invention, the pumping station body further includes a first tubular portion having a larger diameter, a tapered portion connected to the first tubular portion and having a gradually decreasing diameter, and a second tubular portion having a smaller diameter connected to the tapered portion, and the tapered portion is fixed provided auxiliary support member(s).

[0060] According to an embodiment of the invention, a flexible joint is disposed between the liquid outlet and the liquid outlet conduit. The flexible joint not only makes the connection of the liquid outlet conduit of the upper tubular part and the liquid outlet of the pumping station body very convenient, but also reduces the difficulty of alignment of the liquid outlet conduit of the upper tubular part and the liquid outlet of the pumping station body. Even if there is a slight deviation between the two positions, the connection can be achieved.

[0061] The above as well as other objects, features and advantages of the present invention will become more apparent from the description of the preferred embodiments.

DRAWINGS

[0062]

Figure 1	is a schematic perspective structural view of a first embodiment of a prefabricated pumping station unit of the present invention;
Figure 2	is a longitudinal cross-sectional view of Figure 1;
Figure 3	is a plan view of Figure 1;
Figure 4	is a schematic view showing the structure of a first grating device in the prefabricated pumping station unit of Figure 1;
Figure 5	is a schematic structural view of a pump base in a first embodiment of a prefabricated pumping station unit of the present invention;
Figure 6	is a plan view of Figure 5;
Figure 7	is a partial cross-sectional perspective view showing the second embodiment of the prefabricated pumping station unit of the present invention;
Figure 8	is a left side view of Figure 7;
Figure 9	is a plan view of Figure 7;
Figure 10	is a perspective view showing the first embodiment of the water distribution unit of the present invention;
Figure 11	is a front view showing the structure of the

water distribution unit shown in Figure 10;

Figure 12 is a partial cross-sectional structural view showing a third embodiment of the prefabricated pumping station unit of the present invention;

Figure 13 is a right side view of Figure 12;

Figure 14 is a plan view of Figure 12;

Figure 15 is a perspective view showing the structure of the prefabricated pumping station unit of Figure 12, in which only a portion of the outer tubular body and the liquid inlet structure are shown for clarity of the internal structure;

Figure 16 is a partial cross-sectional perspective view showing the fourth embodiment of the prefabricated pumping station unit of the present invention;

Figure 17 is a partial cross-sectional perspective view showing the fifth embodiment of the prefabricated pumping station unit of the present invention;

Figure 18 is a perspective view showing the second embodiment of the water distribution unit of the present invention, in which only a part of the tank structure is shown for clarity of the internal structure;

Figure 19 is a partial cross-sectional front view of Figure 18;

Figure 20 is a top plan view of Figure 18;

Figure 21 is a right-side view of Figure 18;

Figure 22 is a perspective view showing the third embodiment of the water distribution unit of the present invention, in which only a part of the tank structure is shown for clarity of the internal structure;

Figure 23 is a partial cross-sectional front view of Figure 22;

Figure 24 is a schematic view showing the simulated flow state of the water flow in the circulation space of the prefabricated pumping station unit;

Figure 25 is a schematic view showing the simulated flow state of the water flow at the inlet of the submersible pump in the prefabricated pumping station unit of the present invention;

Figure 26A is a perspective exploded view of a sixth embodiment of a prefabricated pumping station unit of the present invention;

Figure 26B is an assembled perspective view of the prefabricated pumping station unit shown in Figure 26A, wherein the top cover is not shown;

Figure 26C is an enlarged view of a portion M of Figure 26B;

Figure 26D is a cross-sectional view taken along line A-A of Figure 26B;

Figure 27A is an exploded perspective view showing the top cover and the pumping station body sealed by a seal ring in the prefabricated pumping station unit shown in Figure 26A;

Figure 27B is an assembled view showing the top cover and the pumping station body sealed by a sealing ring in the prefabricated pumping station unit shown in Figure 26A;

Figure 27C is an enlarged view of a portion P of Figure 27A;

Figure 28A is a perspective structural view showing a gate valve in the prefabricated pumping station unit shown in FIG. 26A;

Figure 28B is a front elevational view showing the gate valve of Figure 28A;

Figure 28C shows a right-side view of Figure 28B;

Figure 28D shows a bottom view of Figure 28B;

Figure 28E shows a top view of Figure 28B;

Figure 29A is a perspective view showing the structure of the basket grille in the prefabricated pumping station unit shown in Figure 26A;

Figure 29B is a front elevational view showing the basket grille shown in Figure 29A;

Figure 29C shows a right side view of Figure 29B;

Figure 29D shows a bottom view of Figure 29B;

Figure 29E shows a top view of Figure 29B.

[0063] Wherein, the main component symbols are as follows: 1, a pumping station body; 10, a liquid inlet; 11, a first tubular portion; 12, a tapered portion; 13, a second tubular portion; 2, a wellbore; 20, a liquid outlet; 3, a submersible pump; 23, a fixed plate; 5', a first grille device; 6, a pump seat; 61, a flow guiding portion; 60, a bottom plate; 62, a flow dividing portion; 63, a support portion; 64, a flange; 641, outer ring; 642, inner ring; 100, water tank; 200, liquid inlet; 300, tapered portion; 400, wellbore; 500, second tubular portion; 14, outer tubular portion; 140, circulation space; 141, a bottom of the outer bottom; 142, outer peripheral wall; 15, inner tubular portion; 151, a bottom of the inner bottom; 152, inner peripheral wall; 1521, grille hole; 23, fixing plate; 5", a second grille device; 6, pump seat; 61 , flow guiding portion; 60, bottom plate; 62, a flow dividing portion; 63, support portion; 600, inner tube; 16, support rod; 19, guide rail; 17, bottom plate; 18, independent flow channel; 19, support rod;2, wellbore; 21, lower tubular portion; 22, upper tubular portion; 25, outlet pipe; 30, flexible joint; 4, top cover; 40, manhole; 41, joint; 5, basket grille; 51, grille inlet; 52, grille outlet; 6, pump base; 65, water passage; 7, rubber seal ring; 71, ring body; 72, convex portion; 8, gate valve; 81, back plate; 82, face plate; 83, gate port; 84, gate; 85, connecting tube ; 86, side wall.

DETAILED DESCRIPTION

[0064] Example embodiments will now be described more comprehensively with reference to the accompanying drawings. However, the example embodiments can be embodied in a variety of forms and should not be construed as being limited to the embodiments set forth herein. It will make the present invention comprehensive and complete, and deliver the conception of the example embodiments to those skilled in the art. The same reference numerals in the drawings denote the same or similar structures, and thus their detailed description will be omitted.

[0065] Specific embodiments of the present invention will be described in detail below. It should be noted that the embodiments described herein are for illustrative purposes only and are not intended to limit the invention.

[0066] The inventive concept of the prefabricated pumping station unit of the invention consists in that, by improving the shape of the pumping station body, for example, the circumference of the cross section of the upper end of the pumping station body is greater than the circumference of the cross section of the lower end thereof, that is to say, the upper portion of the pumping station body is large and the lower portion of pumping station body is small, thereby improving the fluid flow state at the inlet of the submersible pump, so that the fluid flow at the inlet of the submersible pump is stable and uniform, creating a good water inlet condition for the submersible pump, and improving the stability of the submersible pump operation.

Embodiment 1 of a prefabricated pumping station unit

[0067] Referring to FIG. 1, FIG. 2, and FIG. 3, FIG. 1 is a perspective view of a first embodiment of a prefabricated pumping station unit of the present invention, FIG. 2 is a longitudinal cross-sectional view of FIG. 1, and FIG. 3 is a plan view of FIG. 1. As shown in Figures 1, 2 and 3, an embodiment of the prefabricated pumping station unit of the present invention mainly comprises a pumping station body 1 in a hollow shape, a wellbore 2 and a submersible pump 3. A liquid inlet 10 is mounted on the pumping station body 1, and fluid enters the pumping station body 1 through the liquid inlet 10. The wellbore 2 is mounted in the pumping station body 1. Preferably, the wellbore 2 is mounted coaxially with the pumping station body 1 in the pumping station body 1, and the wellbore 2 is provided with a liquid outlet 20. The submersible pump 3 is installed in the lower portion of the wellbore 2, and the submersible pump 3 may be an axial flow pump, but is not limited thereto, and other types of pumps such as a centrifugal pump, a mixed flow pump, or a cross flow pump may be applied to the present invention. Due to the cyclic power of the submersible pump 3, the fluid entering the pumping station body 1 is discharged from the pumping station body 1 through the liquid outlet 20.

[0068] In the first embodiment of the prefabricated pumping station unit, the pumping station body 1 includes a first tubular portion 11 and a tapered portion 12. The first tubular portion 11 may be a cylinder, but the present invention is not limited thereto, and the first tubular portion 11 may also be a cylinder having an elliptical or polygonal cross section, etc., even in order to meet the needs of special occasions, the first tubular portion 11 is also feasible to be designed as a cylindrical shape having an irregular closed annular shape. The cross-sectional dimension of the tapered portion 12 gradually decreases in a direction from top to bottom. The tapered portion 12 may be, for example, a conical cylinder, and the larger diameter end is fixedly coupled to the bottom end portion of the first tubular portion 11, the taper angle a of the conical cylinder is 25°. Of course, the taper angle a is not limited to 25°. The taper angle a can be appropriately adjusted according to factors such as the size of the pump body 1 and the fluid flow rate of the liquid inlet 10, and usually the taper angle a ranges from 15° to 50°, and preferably ranges from 20° to 40°. Similarly, the tapered portion 12 is not limited to the cone, and may be a cone having any other shape in cross section, as long as it is a cone structure in which the cross-sectional dimension is gradually decreasing from the upper end to the lower end, then it can be applied into the present invention.

[0069] As shown in FIG. 1 and FIG. 3, four fixing plates 23 are uniformly arranged between the wellbore 2 and the tapered portion 12 in the circumferential direction, one side of the fixing plate 23 is fixed to the outer wall of

the wellbore 2, and the other side is fixed to the tapered portion 12. thereby fixing the wellbore 2 and the tapered portion 12 together. The number of fixing plates 23 is not limited to four, it could be increased or decreased according to the size of the pumping station body 1 and the overall design of the system. The function of the fixing plate 23 is to fix the wellbore 2 and the tapered portion 12; additionally, the fixing plate 23 has a function of uniformly distributing the fluid, and the fluid in the first tubular portion 1 can be more evenly divided to the tapered portion 12. In addition, the fixing plate 23 can also prevent the fluid rushing into the first tubular portion 11 through the liquid inlet 10 forming vertex during flowing downward, that is, also contribute to the homogenization fluid flow state.

[0070] In the example shown in FIG. 3, the pumping station body 1 is composed of a combination of a cylindrical first tubular portion 11 and a conical tubular tapered portion 12. It should be understood by those skilled in the art that the present invention is not limited thereto, and the pumping station body 1 formed by the first tubular portion 11 of any shape and the tapered portion 12 of any shape can be freely combined and sealed to be applied in this invention. In the example embodiment shown in FIG. 3, the center line of the cylindrical first tubular portion 11 and the conical tubular tapered portion 12 are coincided, and in other embodiments, the center lines of the two may not coincide and have a certain partial deviation, so to adapt to certain special occasions where space is limited.

[0071] The fluid with a certain kinetic energy enters the first tubular portion 11 through the liquid inlet 10, hits on the inner wall of the first tubular portion 11 and the liquid therein or flows along the inner wall of the first tubular portion 11 to dissipate a part of kinetic energy, meanwhile, during the fluid flowing along the inner wall of the first tubular portion 11, the flow state is adjusted to a certain degree to become uniform; then the fluid flows down along the inner wall of the tapered portion 12, since the inner wall of the tapered portion 12 tapers towards the center thereof and is capable to optimize the flow and increase the flow speed, so as to harmonize the fluid flow state to the maximum extent, and when the fluid reaches the bottom of the tapered portion 12, the fluid flow state in the circumferential direction is very uniform and stable, so it creates a smooth, uniform, and stable fluid for the suction inlet of pump 3 at the center.

[0072] In an embodiment, the position of the liquid inlet 10 on the first tubular portion 11 may be as close as possible to the tapered portion 12, for example, the bottom edge of the liquid inlet 10 may be adjacent to the tapered portion 12 or be flush with the top edge of the tapered portion 12, this helps to reduce the potential energy of the fluid as it falls to the bottom of the pumping station body 1.

[0073] In one embodiment, the prefabricated pumping station unit of the present invention further includes a first grille means 5'. As shown in FIG. 1 and FIG. 3, the first grille device 5' can be installed at the end of the liquid inlet 10 (not shown in FIG 1), in particular, detachably mounted at the end of the liquid inlet 10, so that the first grille device 5' can be conveniently took out from the opening of the top end of the first tubular portion 11 for cleaning. As shown in FIG. 4, the first grille device 5' may also be mounted with the middle portion or the upper portion of the tapered portion 12; in addition, the first grille device 5' may be attached to the lower end portion of the first tubular portion 11 or may be installed in the joint position of the tubular portion 11 and the tapered portion 12 and covers the tapered portion 12. In either case, the first grille means 5' can be a horizontal porous disk or a mesh disk. The functions of the first grille device 5' is to filter the flow to stop large pollutants such as branches, braids, cables, etc. in the fluid entering the tapered portion 12, and it also has a certain positive effect to dissipate the fluid energy and to homogenize the fluid flow status.

[0074] As shown in FIG. 1 and FIG. 2, in an embodiment, the prefabricated pumping station unit of the present invention further includes a pump base 6 installed in the pumping station body 1 and located below the wellbore 2, and the submersible pump 3 is mounted on the pump base 6. It should be noted that the present invention does not necessarily include a pump base 6, in some structural designs, the pump base 6 can be omitted, for example, when the weight of the submersible pump 3 is relatively light, the submersible pump 3 can be directly installed onto the constricted portion 12 or the first tubular portion 11, so the pump base 6 can be omitted to save cost. In this embodiment, in addition to the function of supporting the submersible pump 3, the pump base 6 also has a flow guiding function to further homogenize the fluid flow state. The detailed structure of the pump base 6 will be illustrated below.

[0075] Referring to FIG. 5 and FIG. 6, FIG. 5 is a schematic structural view of the pump base 6 in an embodiment of the prefabricated pumping station unit of the present invention; and FIG. 6 is a plan view of FIG 5. As shown in FIGS. 5 and 6, in one embodiment, the pump base 6 includes a bottom plate 60, a flow guiding portion 61, at least two flow dividing portions 62, and at least two support portions 63. The bottom plate 60 may have a circular flat shape, which is fixed in the tapered portion 12 and located directly below the wellbore 2; the flow guiding portion 61 may be a frustum, preferably a truncated cone having a top plane and a bottom plane and a conical surface connecting the top plane and the bottom plane, the bottom plane of the flow guiding portion 61 is fixed to the bottom plate 60, and the top plane faces the suction inlet of the submersible pump 3. The flow dividing portion 62 may be, for example, a flow dividing plate, and the bottom side of the flow dividing plate is fixed to the bottom plate 60, and the other side thereof is fixed to the flow guiding portion 61. In Fig. 6, four flow dividing plates are shown, which are evenly distributed along the circumferential direction of the flow guiding portion 61. Of course, the number of the flow dividing portion 62 is not

limited to four, and may be appropriately increased or decreased according to actual needs. The impeller of the submersible pump 3 tends to cause the fluid to generate a vortex that rotates in a single direction during the rotation, and the function of the flow dividing portion 62 is to block these possible vortices and further uniformize the fluid flow state. When the fluid flows down along the tapered portion 12, it can flow up to the top plane along the conical surface of the flow guiding portion 61, and then flows to the suction inlet of the submersible pump 3.

[0076] The support portion 63 may be a support vertical plate that is fixed to the bottom plate 60. As shown in FIG. 6, it shows four support vertical plates, which respectively correspond to four flow dividing plates. However, the number of support vertical plates in the present invention is not limited to four, and the positional relationship between the support vertical plate and the flow dividing plate is not necessarily one-to-one correspondence, and may be arranged in a staggered manner. The height of the support vertical plate is higher than the flow guiding portion 61 and the flow dividing plates, and a flange 64 is fixed to the top of the four support vertical plates, and the flange 64 comprises an outer ring 641 and an inner ring 642. The bottom end portion of the wellbore 2 may be further fixedly coupled to the outer ring 641 of the flange 64; the pump body of the submersible pump 3 may be fixedly coupled to the inner ring 642 of the flange 64 to prevent the pump body from self-rotating.

[0077] It should be noted that when the submersible pump 3 is light in weight, it can be directly mounted into the wellbore 2, for example, and the pump base 6 can be a component only having a flow guiding function and a vortex prevention function.

[0078] In the first embodiment, the pumping station body 1 includes a first tubular portion 11 and a tapered portion 12, and the tapered portion 12 is located at a lower portion of the pumping station body 1, and the size of the cross-sectional dimension of the tapered portion 12 gradually decreases along top to bottom direction, and when the fluid flows into the first tubular portion 11 though the liquid inlet 10, its energy will be consumed to some extent, the flow state is uniformly homogenized; during the fluid flowing further along the inner wall of the tapered portion 12, the flow state of fluid is sufficiently homogenized and then the fluid reaches the suction inlet of the submersible pump 3, which can effectively avoid or reduce the influence of the uneven fluid flow state near the suction inlet 10 on the operation of the submersible pump 3, so that the flow state of the fluid entering the liquid suction port of the submersible pump 3 is uniform, which creates a good water inlet condition for the submersible pump 3 and improves the stability of the operation of the submersible pump 3. At the same time, because the prefabricated pumping station unit is a prefabricated structure, the on-site construction period can be greatly reduced, and it is light and convenient to transport, simple in structure and low in cost.

Embodiment 2 of a prefabricated pumping station unit (very important embodiments)

[0079] Referring to FIG. 7, FIG. 8, and FIG. 9, FIG. 7 is a perspective structural view of another embodiment of the prefabricated pumping station unit of the present invention, FIG. 8 is a longitudinal cross-sectional view of FIG. 7, and FIG. 8 is a plan view of FIG 7. The main differences between the second embodiment of the prefabricated pumping station unit of the present invention and the first embodiment shown in Figures 1, 2 and 3 are:

[0080] The pumping station body 1 includes a first tubular portion 11, a tapered portion 12, and a second tubular portion 13 that are sealingly connected in order from top to bottom, wherein the second tubular portion 13 has a smaller cross-sectional dimension than the first tubular portion 11. The first tubular portion 11 and the second tubular portion 13 may both be cylindrical or may be other shaped cylinders; the tapered portion 12 may be a conical cylinder or other shaped cylinder. The center lines of the first tubular portion 11, the tapered portion 12, and the second tubular portion 13 may be coaxial or may be shifted from each other.

[0081] A fixing device disposed between the pumping station body 1 and the wellbore 2, for example at least one fixing plate 23, may be separately fixed between the wellbore 2 and the tapered portion 12, or separately fixed between the wellbore 2 and the second tubular portion 13. Or at the same time fixed between the wellbore 2 and the tapered portion 12 and the second tubular portion 13.

[0082] The pump base 6 is disposed directly below the second cylindrical portion 13.

[0083] The other structure of the second embodiment of the prefabricated pumping station unit is substantially the same as that of the first embodiment, and details are not described herein again.

An embodiment of water distribution unit 1

[0084] Referring to FIG. 10 and FIG. 11, FIG. 10 is a perspective view of the first embodiment of the water distribution unit of the present invention. FIG. 11 is a front view showing the structure of the water distribution unit shown in FIG. 10. As shown in FIG. 10 and FIG.11, an embodiment of the water distribution unit of the present invention includes a water tank 100 having a liquid inlet 200 and at least one prefabricated pump station unit. Three prefabricated pump station units are shown in Figs. 10 and 11, and the present invention is not limited thereto, and the number of prefabricated pump station units may be appropriately increased or decreased according to actual conditions.

[0085] The water tank 100 may be a large volume tank that may be rectangular, circular, elliptical or other shape in cross-sectional shape. The water tank 100 can be a prefabricated water tank or a built-in civil structure. The water tank 100 is disposed horizontally, that is, the installed water tank 100 has a height less than its length.

[0086] The prefabricated pump station unit is mounted to the bottom surface of the water tank 100. Each prefabricated pump station unit includes a tapered portion 300, a wellbore 400, a submersible pump, and a liquid outlet (not shown); the tapered portion 300 is fixed to the outer bottom portion of the water tank 100, and the cross-sectional dimension of the tapered portion 300 is gradually reduced along the direction from top to bottom. The wellbore 400 is disposed in the tapered portion 300 and extends upward into the water tank 100. The liquid outlet communicates with the wellbore 400 and extends out of the water tank 100. The submersible pump is disposed in the wellbore 400. In an embodiment, the prefabricated pump station unit further includes a second tubular portion 500 coupled to the tapered portion 300.

[0087] The prefabricated pumping station unit in the water distribution unit of the present invention can be regarded as that at least one of the prefabricated pumping station units of the present invention shares a large first cylinder and shares a liquid inlet, so that the above-said structures of the prefabricated pump station unit of present invention can be used therein, such as a pump base, a first grille device, etc.

[0088] The water distribution unit of the present invention works via a large-capacity water tank and cooperates with a plurality of pumping station units, which can realize the uniform water distribution function quickly and conveniently, and solves the demand for large-flow water distribution; and at the same time, based on the specific structure of the pump station unit of the invention, the fluid flow state at the suction inlet of the submersible pump is uniform, so that the water distribution unit of the invention has small vibration noise, long service life and low maintenance cost.

Embodiment 3 of a prefabricated pump station unit

[0089] Referring to FIG. 12, FIG. 13, FIG. 14 and FIG. 15, FIG. 12 is a partial cross-sectional structural view showing a third embodiment of the prefabricated pump station unit of the present invention; FIGS. 13 and 14 are respectively a right-side view and a top view of FIG. 12; and FIG. 15 shows a schematic perspective view of the prefabricated pump station unit of FIG. 12, with only a portion of the outer tubular potion and the liquid inlet structure shown for clarity of the internal structure.

[0090] As shown in FIG. 12, FIG.13, and FIG.14, the third embodiment of the prefabricated pump station unit of the present invention primarily includes a pumping station body 1 and a wellbore 2, and further includes a submersible pump.

[0091] A liquid inlet 10 is mounted on the pumping station body 1 through which fluid enters the pumping station body 1. The wellbore 2 is mounted in the pumping station body 1. Preferably, the wellbore 2 is mounted coaxially with the pumping station body 1 with a liquid outlet 20 mounted thereon. The submersible pump is installed in the lower portion of the wellbore 2, and the submersible pump may be an axial flow pump, but is not limited thereto, and other types of pumps such as a centrifugal pump or a mixed flow pump may be applied to the present invention. Due to the centrifugal power of the submersible pump, the fluid entering the pumping station body 1 is discharged out through the liquid outlet 20.

[0092] In a third embodiment of the prefabricated pumping station unit, the pumping station body 1 comprises an outer tubular portion 14 and an inner tubular portion 15.

[0093] The outer tubular portion 14 comprises a bottom 141 of the outer tubular portion and an outer peripheral wall 142 disposed on the bottom 141 of the outer tubular portion. The bottom 141 of the outer tubular portion and the outer peripheral wall 142 may be integrally formed, or may be fixedly connected to each other by welding or the like. The outer peripheral wall 142 may be a cylindrical shape, but the invention is not limited thereto, and the outer peripheral wall 142 may also be a cylinder having an elliptical or polygonal cross section, etc., and it is also feasible to design the outer peripheral wall 142 as a cylindrical portion with a cross section of irregular enclosed annular ring to meet the needs of special occasions.

[0094] The inner tubular portion 15 comprises a bottom 151 of inner tubular portion and an inner peripheral wall 152 disposed on the bottom 151 of inner tubular portion. The bottom 151 of inner tubular portion and the inner circumferential wall 152 may be integrally formed, or may be fixedly connected to each other by welding or the like. Likewise, the inner peripheral wall 152 can also be cylindrical or non-cylindrical.

[0095] The top end of the inner tubular portion 15 is open, and the upper end portion of the tubular portion 15 is inserted through the bottom 141 of the outer tubular portion 14 and located in the outer tubular portion 14, and the remaining portion of the inner tubular portion 15 is located outside the outer tubular portion 14. Thus, a part of the inner peripheral wall 152, a part of the outer peripheral wall 142 and the bottom 141 of the outer tubular portion together form a circulation space 140, and the liquid inlet 10 is provided on the outer peripheral wall 142.

[0096] In other embodiments, the inner tubular portion 15 may also include only an inner peripheral wall 152, and does not include a bottom 151 of the inner tubular portion. In this case, when the prefabricated pumping station unit of the present invention is installed in the field, the bottom end portion of the inner peripheral wall 152 can be sealed and fixed to a structure such as a base or a bottom plate, and the fluid can be prevented from leaking from the bottom of the inner tubular portion 15 by the help of the base or the bottom plate.

[0097] As shown in FIG. 12 and FIG. 14, four fixing plates 23 are uniformly disposed between the wellbore 2 and the inner tubular portion 15 in the circumferential direction, one side of the fixing plate 23 is fixed to the outer wall of the wellbore 2, and the other side is fixed to the inner tubular portion 15. Thereby, the wellbore 2 and

the inner cylinder 15 are fixed together. The number of fixing plates 23 is not limited to four, it could increase or decrease appropriately according to the size of the pumping station body 1 and the overall design of the prefabricated pumping station unit. One function of the fixing plate 23 is to fix the wellbore 2 and the inner tubular portion 15; and the fixing plate 23 also has the function of uniformly distributing the fluid, which is capable to distribute the fluid, to distribute evenly the fluid in the outer tubular portion 141 into the inner tubular portion 15; In addition, the fixing plate 23 can also prevent the fluid rushing into the outer tubular portion 14 through the liquid inlet 10 from forming vortex during flowing downward, that is, also contribute to the fluid flow state homogenization.

[0098] In the example embodiment shown in Fig. 14, the pumping station body 1 is composed of a combination of a cylindrical outer cylinder 14 and a cylindrical inner cylinder 15. It will be understood by those skilled in the art that the present invention is not limited thereto, and the pumping station body 1 formed by any combination of the outer tubular portion 14 of any shape and the inner tubular portion 15 of any shape can be freely combined and sealed. In the example embodiment shown in FIG. 14, the center line of the cylindrical outer tubular portion 14 and the conical inner tubular portion 15 coincides. In other embodiments, the center lines of the two may not coincide and have a certain offset. This can be adapted to certain special occasions where space is limited.

[0099] During the fluid with a certain kinetic energy entering the circulation space 140 between the outer tubular portion 14 and the inner tubular portion 15 through the liquid inlet 10, it impinges on the inner peripheral wall 152 of the inner tubular portion 15 to dissipate a part of the kinetic energy, and at the same time, the flow state is optimized to a certain extent to become uniform; then the fluid overflows from the opening at the top end of the inner peripheral wall 152 into the inner tubular portion 15, the fluid kinetic energy is further consumed, and the fluid flow state is further homogenized, and when the fluid reaches the bottom of the inner tubular portion 15 the fluid flow state is very uniform and stable, which provides a smooth, uniform, and stable fluid to the suction intake of the submersible pump at the center.

[0100] In one embodiment, the position of the liquid inlet 10 on the outer tubular portion 14 can be as close as possible to the bottom 141 of outer tubular portion. For example, the bottom edge of the liquid inlet 10 can be adjacent to the bottom 141 of outer tubular portion or flush with the bottom 141 of outer tubular portion, which helps the fluid dissipates energy as it enters the circulation space 140 and impinges on the inner peripheral wall 152 of the inner tubular portion 15.

[0101] In one embodiment, the prefabricated pumping station unit of the present invention further includes a second grille device 5". As shown in FIG. 12 and FIG. 14, the second grille device 5" can be installed at the end of the liquid inlet 10, in particular, detachably mounted at the end of the liquid inlet 10, so that the second grille device 5" can be conveniently took out from the opening at the top end of the outer tubular portion 14 for cleaning. The second grille means 5" may be a plate with multiple through holes or a mesh disk mounted at the opening of the top end of the inner tubular portion 15. The function of the second grille device 5" is to intercept the flow of large pollutants such as branches, braids, cables, etc. in the fluid into the inner tubular portion 15; and it also has a certain positive effect to dissipate the fluid energy and to homogenize the fluid flow state.

[0102] As shown in FIG. 12 and FIG. 15, the second grille means 5" may also be replaced by, in detail, a plurality of grille holes 1521 formed in the inner peripheral wall 152 of the inner tubular portion 15 located in the outer tubular portion 14, these grille holes 1521 communicate with the inside of the inner tubular portion 15 and the circulation space 140. In one embodiment, in the up and down direction along the inner peripheral wall 152, the position of the grille hole 1521 is adjacent to the bottom 141 of the outer tubular portion, so that water accumulation in the circulation space 140 can be avoided; in another embodiment, along the circumferential direction of the inner peripheral wall 152, the grille holes 1521 are disposed at other positions of the inner peripheral wall 152 while avoiding the portion of the inner peripheral wall 152 that the inlet port 10 faces, that is, no grille holes 1521 are arranged in the portion of inner peripheral wall 152 where the liquid inlet faces, so that during the fluid entering the circulation space 140, the impact of the inner peripheral wall 152 on the fluid can be enhanced to consume more energy.

[0103] In the third embodiment, the prefabricated pumping station unit of the present invention further includes a pump base 6, and the structure of the pump base 6 is the same as that of the first embodiment described above, and details are not described herein again.

[0104] In a third embodiment of the prefabricated pumping station unit of the present invention, the pumping station body 1 includes an outer tubular portion 14 and an inner tubular portion 15, and the inner tubular portion 15 extends into the outer tubular portion 14 to form a circulation space 140 therebetween. When the fluid enters the prefabricated pumping station unit through the liquid inlet 10, it does not directly enter the inner tubular portion 15, but enters the circulation space 140, in the process, first, the fluid hits the side wall of the inner tubular portion 15 to consume a part of the energy while the fluid flow state gets uniformly homogenized; then the fluid is again overflowed from the circulation space 140 to the inner tubular portion 15, during which the fluid flow state is further homogenized, so that the prefabricated pumping station unit of the present invention can effectively avoid or reduce the impact on the operation of the submersible pump 3 by the ununiform fluid flow state of the liquid port 10, so that the fluid flow state of the liquid entering the suction inlet of the sub-

mersible pump 3 is uniform, which creates a good water inlet condition for the submersible pump and improves the stability of the submersible pump operation.

[0105] The prefabricated pumping station unit is a prefabricated structure, which can greatly reduce the on-site construction period, and is light and convenient to transport, simple in structure and low in cost.

[0106] Prefabricated pumping station units can be fitted with large flow axial or mixed flow pumps.

[0107] In the prefabricated pumping station unit, the outer tubular portion 14 and the inner tubular portion 15 partially overlap in space, thereby forming a circulation space 140, and during the process of the fluid entering the inner tubular portion 15 via the circulation space 140, the fluid kinetic energy is fully consumed, and the fluid flow state is fully homogenized. Therefore, the use of the prefabricated pump station unit of the present invention eliminates the need to provide a plurality of reservoirs to homogenize the fluid and eliminate energy as in the prior art, thereby effectively saving floor space and being flexible for use in more places.

Embodiment 4 of a prefabricated pumping station unit

[0108] Referring to FIG. 16, FIG. 16 is a perspective view of a fourth embodiment of a prefabricated pumping station unit of the present invention. Referring to FIG. 16, the main differences between the fourth embodiment of the prefabricated pumping station unit of the present invention and the third embodiment shown in FIG. 12 to FIG. 15 are:

[0109] The inner tubular portion 15 has a tapered cylindrical shape, and has an end of a large diameter and an end of small diameter, wherein the end of larger diameter is located in the outer cylinder 14. When the fluid flows down the inner wall of the tapered cylindrical shaped inner tubular portion 15, the fluid flow state is further homogenized.

[0110] The other structure of the fourth embodiment of the prefabricated pumping station unit is substantially the same as that of the third embodiment, and details are not described herein again.

Embodiment 5 of a prefabricated pumping station unit

[0111] Referring to FIG. 17, FIG. 17 is a perspective view showing the third embodiment of the prefabricated pumping station unit of the present invention. Referring to FIG. 17, the main differences between the fourth embodiment of the prefabricated pumping station unit of the present invention and the third embodiment shown in Figures 12 to 15 is:

[0112] The portion of the inner tubular portion 15 outside the outer tubular portion 14 has a cylindrical shape, and the portion of the inner tubular portion 15 located inside the outer tubular portion 14 has a tapered cylindrical shape, and has an end of large diameter and an end of small diameter, wherein the end of large diameter is located inside the outer tubular portion 14. The tapered cylindrical portion of the inner tubular portion 15 further homogenizes the flow states of the fluid.

[0113] The other structure of the fifth embodiment of the prefabricated pumping station unit is basically the same as that of the third embodiment, and details are not described herein again.

Embodiment 2 of a water distribution unit

[0114] Referring to FIG. 18 to FIG. 21, FIG. 18 is a schematic perspective structural view of a second embodiment of a water distribution unit according to the present invention, wherein only a part of the tank structure is shown for clearly showing the internal structure; FIG. 19, FIG. 20 and FIG. 21 are respectively schematic diagrams of the front view, top view and right view of the water distribution unit shown. As shown in Figures 18 to 21, a second embodiment of the water distribution unit of the present invention includes a water tank 100 having a liquid inlet 200 and at least one prefabricated pumping station subunit. The figure shows three prefabricated pumping station subunits, and the invention is not limited thereto, and the number of prefabricated pump station subunits may be appropriately increased or decreased according to actual conditions.

[0115] The water tank 100 may be a large volume tank that may be rectangular, circular, elliptical or other shape in cross-sectional shape. The water tank 100 can be a prefabricated water tank or a built-in civil structure. The water tank 100 is disposed horizontally, that is, the installed water tank 100 has a height less than its length.

[0116] The prefabricated pumping station subunit is mounted to the bottom of the water tank 100. Each prefabricated pump station subunit includes a 600 inner tubular portion 600, a wellbore 400, a submersible pump, and a liquid outlet (not shown); the 600 inner tubular portion 600 is fixed to the bottom of the water tank 100 and extends into the inner water tank 100, and the wellbore 400 is mounted in the inner tubular portion 600 extends upwardly from the inner tubular portion 600, and the liquid outlet communicates with the wellbore 400 and extends out of the water tank 100; the submersible pump is mounted in the wellbore 400. In other embodiments, the water distribution unit may not include a submersible pump, and a submersible pump may be separately assembled on-site.

Embodiment 3 of a water distribution unit

[0117] Referring to FIG. 22 and FIG. 23, FIG. 22 is a perspective view showing a third embodiment of the water distribution unit of the present invention, and FIG. 23 is a partial cross-sectional front view of FIG .22. The main difference between the third embodiment of the water distribution unit of the present invention and the second embodiment is that the water tank 100 has a cylindrical shape.

[0118] The other structure of the third embodiment of the water distribution unit is basically the same as that of the second embodiment, and details are not described herein again.

[0119] The water distribution unit of the present invention can be regarded as that at least one of the prefabricated pump station units of the present invention shares a large outer cylinder (water tank) and shares a liquid inlet, so that the water distribution unit of the present invention can use the aforementioned structure of the prefabricated pumping station unit, such as the pump base, the grille unit, and the like.

[0120] The water distribution unit of the invention, by a plurality of prefabricated pump station subunits working together within a large volume water tank, can realize the uniform water distribution function quickly and conveniently, and satisfy the large flow water distribution requirement; and at the same time, based on the specific structure of the prefabricated pumping station unit according to the present invention, The fluid flow state at the suction inlet of the submersible pump is uniform, so that the water distribution unit of the invention has small vibration noise, long service life and low maintenance cost.

[0121] The prefabricated pumping station unit and the water distribution unit of the invention are not only suitable for the applications of sewage transportation, rainwater transportation, the raw water transportation, such as lake water, river water, surface water and groundwater, but also applicable to other applications requiring fluid transportation.

[0122] According to the present invention, the fluid flow state is significantly improved regardless of whether it is a prefabricated pumping station unit or a water distribution unit. Taking the prefabricated pumping station as an example, as shown in FIG. 25, and with FIG. 12, FIG. 24 is a schematic diagram of the simulated flow state of the water flow in the circulation space of the prefabricated pumping station unit of the present invention, and the water flow enters the circulation space 140 through the liquid inlet 10, then part of the water flow flows into the inner cylinder 15 through the second grille device 5", the second grille device 5" can uniform the inlet water flow rate when the submersible pump 3 is working, and improve the inlet condition of the inlet; other part of fluid overflows into the inner cylinder 15 from the top end of the cylinder 15, and the inner cylinder 15 dissipates the energy of the incoming fluid, and in the case of a high water level, the water can freely overflow into the inner cylinder 15 to avoid affecting the discharging water amount of the submersible pump 3 while dissipating energy, so it is beneficial to reduce the pump pit area and enable the high-flow low-head submersible pump to operate normally.

[0123] As shown in Fig. 25, and with Fig. 12, Fig. 25 is a schematic diagram showing the simulated flow state of the fluid at the inlet of the submersible pump in the prefabricated pumping station unit of the present invention. As can be seen from Fig. 25, in the prefabricated pumping station unit of the present invention, the flow line near the suction port of the submersible pump 3 is relatively uniform, and no obvious water flow vortex is observed.

Embodiment 6 of a prefabricated pump station unit

[0124] In the sixth embodiment of the prefabricated pumping station unit of the present invention, the definitions of the orientations "upper" and "lower": when the prefabricated pumping station unit of the present invention is in normal operation, the direction away from the ground is "upper", and the opposite direction close to the ground.is "lower"; specifically to the prefabricated pumping station unit, referring to Figs. 26A and 26B, one side of the pumping station body 1 on which the top cover 4 is mounted is the upper side, and one side where the pump base 6 is mounted is lower side. In other embodiments, the orientations "upper" and "lower" may be referred to.

[0125] Referring to FIG. 26A and FIG. 26B, FIG. 26A is a perspective exploded view of a sixth embodiment of a prefabricated pumping station unit of the present invention; and FIG. 26B is an assembled perspective view of the prefabricated pumping station unit illustrated in FIG. 26A. As shown in FIG. 26A and FIG. 26B, the prefabricated pumping station unit of the present invention comprises a prefabricated pumping station body 1, a wellbore 2, a liquid inlet 10, a liquid outlet 20, a top cover 4, a pump base 6, a submersible pump 3, a submersible pump 3 can be an axial flow pump, a mixed flow pump or a cross flow pump.

[0126] In the sixth embodiment, the pumping station body 1 comprises a first tubular portion 11, a second tubular portion 13, and a tapered portion 12. The tapered portion 12 is connected between the first tubular portion 11 and the second tubular portion 13. The diameter of the first tubular portion 11 is larger than that of the second tubular portion 13. Further, an auxiliary support member 24 such as a support plate, a reinforcing rib, or the like is fixed to the outside of the tapered portion 12.

[0127] A liquid inlet 10 is provided at a position close to the tapered portion 12 of the first tubular portion 11. The liquid inlet 10 may be integrally formed with the first tubular portion 11, or may be fixed to the first tubular portion 11 by welding or the like. A liquid outlet 20 is provided at an upper end portion of the second tubular portion 13, that is, near the top cover 4. Of course, the liquid outlet 20 is not necessarily provided at the upper end portion of the second tubular portion 13, and is not necessarily provided on the second tubular portion 13. For example, when the length of the second tubular portion 13 is relatively small and the length of the first tubular portion 11 is relatively large, the liquid outlet 20 may be provided on the first tubular portion 11. The liquid outlet 20 may be integrally formed with the second tubular portion 13 or the first tubular portion 11, or may be fixed

thereto by welding or the like.

[0128] The pumping station body 1 of the present invention is not limited to the above specific structure, and other structures such as a straight cylindrical pumping station body and a stepped pumping station body can be applied to the present invention.

[0129] As shown in FIG. 26A, the wellbore 2 is disposed coaxially with the pumping station body 1 in the pumping station body 1. The wellbore 2 is of a split structure, including a lower tubular portion 21 and an upper tubular portion 22 that are connected to each other. In the embodiment, the lower tubular portion 21 and the upper tubular portion 22 are detachably coupled together by bolting or the like. An outlet pipe 25 is connected to the upper tubular portion 22, and the outlet pipe 25 can be integrally formed with or fixed to the upper tubular portion 22. In other embodiments, the outlet pipe 25 may also be in communication with the lower tubular portion 21. The outlet pipe 25 and the liquid outlet 20 are connected by a flexible joint 30.

[0130] Referring to FIG. 26A and FIG. 27A, 27B and 27C, FIG. 27A shows an exploded view of the top cover 4 and the pumping station body 1 sealed by a sealing ring in the prefabricated pumping station unit shown in FIG. 26A; FIG. 27B shows an assembled view of the top cover 4 and the pumping station body 1 sealed by a seal ring in the prefabricated pumping station unit shown in FIG. 26A; FIG. 27C shows an enlarged view of a portion P in FIG. 27A.

[0131] As shown in FIG. 26A, the top cover 4 is covered at the top end opening of the pumping station body 1. A manhole 40 may be arranged on the top cover 4 to facilitate an operator or maintenance personnel to enter the pumping station body 1 through the manhole 40. In some embodiments, the pumping station body 1 is provided with a ladder for a person entering or exiting (not shown) or an operating platform that is convenient for people to work (not shown).

[0132] As shown in FIG. 27A, FIG. 27B and FIG. 27C, the top cover 4 may be in the shape of a disk, and a joint portion 41 is formed by the circumference edge of the top cover 4 bending, and there is a sealing ring between the top cover 4 and the pump station body 1 for sealing them. The sealing ring may be a rubber sealing ring 7, preferably, the rubber sealing ring 7 comprises an annular body 71, and an annular convex portion 72 is provided on the outer side surface of the annular body 71, and the annular convex portion 72 can enhance sealing performance, further preferably, the convex portion 72 of the rubber sealing ring 7 has an inverted tooth shape.

[0133] The joint portion 41 of the top cover 4, the side wall of the pumping station body 1, and the rubber seal ring 7 can be further fixed by bolts (not shown).

[0134] As shown in FIG. 26A, in an embodiment, the prefabricated pumping station unit further includes four fixing plates 23 uniformly mounted in the circumferential direction, and the lower tubular portion 21 is fixed to the pump station body 1 by four fixing plates 23. In detail, the outer sides of the four fixing plates 23 are fixed to the side wall of the pumping station body 1, and the four fixing plates 23 are fixed to the bottom plate 17 of the pumping station body 1 (in the case where the prefabricated pumping station unit has the bottom plate 17), and when the prefabricated pumping station unit has no bottom plate 17, the bottom end of the four fixing plates 23 may be flush with the bottom end surface of the pumping station body 1, or further fixed to a base plate for mounting the prefabricated pumping station unit; and the lower tubular portion 21 is fixed to the inner side of the four fixing plates 23, so that the lower tubular portion 21 is fixed to the pumping station body 1 by the four fixing plates 23. The number of the fixing plates 23 is not limited to four, and may be appropriately increased or decreased depending on the diameter of the prefabricated pumping station unit.

[0135] As shown in FIG. 26A, FIG. 26B, FIG. 26C and FIG. 26D, the pump base 6 is mounted within the pumping station body 1 and below the wellbore 2, and in other embodiments, the pump base 6 can also be mounted within the wellbore 2. In the case where the prefabricated pumping station unit is provided with the fixing plate 23, the pump base 6 can be further fixed to the inner side of the fixing plate 23. Further, a gap between the fixing plate 23 and the pump base 6 is provided with a sealing member such as a sealing strip or a isolation plate made of a material such as fiberglass fiber, etc., so that the fixing plates 23 divides the space between the lower tubular portion 21 and the pumping station body 1 into independent flow channels 18 that are isolated from each other (see FIG. 26D). A water passage 65 (see FIG. 26A) is provided on the pump base 6 corresponding to each of the independent flow channels 18 so that fluid can enter the pump seat 6 through the water passage 65 to reach the suction inlet of the submersible pump 3. The submersible pump 3 can be mounted on the pump base 6, which can be an axial flow pump or a mixed flow pump.

[0136] Referring to FIG. 29A to FIG. 29E, which illustrate various schematic views of the basket grille 5 in a prefabricated pumping station unit. As shown in FIG. 29A to FIG. 29E, an embodiment of the prefabricated pumping station unit of the present invention further includes a basket grille 5 and a gate valve 8 mounted to the basket grille 5. The basket grille 5 is slidably mounted in the pumping station body 1 . For example, the upper part of the pumping station body 1 is fixed with a support rod 16 (see FIGS. 29D and 29E), and two parallel guiding rails 19 are fixed on the support rod 16, and the basket grille 5 is slidably mounted on the guide rails 19. The basket grille 5 can slide along the guide rails 19, and to the upwards direction it can reach the top opening of the prefabricated pumping station unit, and to the downwards direction it can reach the grille support seat (not shown) to facilitate the treatment of the dirt collected by the basket grille 5.

[0137] The basket grille 5 has a box shape or a basket shape, and has a larger size grille inlet 51 and a plurality of smaller liquid discharging grille holes 52. During the

fluid entering from the grill inlet 51 and flowing out of the plurality of grill holes 52, large-sized debris such as stones, branches, and the like in the fluid are intercepted in the basket grille 5.

[0138] Referring to FIG. 28A to FIG. 28E, which show various schematic views of the gate valve 8 in the prefabricated pumping station unit shown in FIG. 26A. As shown in FIGS. 28A to 28E, the gate valve 8 includes a back plate 81, a face plate 82 that is parallel to the back plate 81, a side wall 86, and a shutter 84. A middle portion of the back plate 81 and the panel 82 is provided with a gate port 83. The side wall 86 connects the left side and right side and the bottom side of the back plate 81 and the face plate 82. An opening is formed between the top side of the back plate 81 and the top side of the face plate 82, for the shutter84 being inserted from the opening in-between the back plate 81 and the face plate 82 to block the gate port 83, further, in order to facilitate the insertion and removal of the shutter 84, the bottom end portion of the shutter 84 has a guide angle on both sides.

[0139] In this embodiment, the gate valve 8 further includes a connecting cylinder 85 disposed around the gate port 83, and one end of the connecting cylinder 85 is fixed to the face plate 82, and the other end is fixed to the basket grille 5, and the gate port 83 corresponds to the grill water inlet 51, and the grill water inlet 51 of the basket grille 5 can be opened or closed by inserting or pulling out the shutter 84.

[0140] In other embodiments, the gate valve 8 can also be sealingly connected to the liquid inlet 10 at the same time. For example, the gate valve 8 is connected to the liquid inlet 10 through a flange, a gasket or through a flexible joint, in this case, the gate valve 8 also has an functions of opening or cutting off water. Further, the gate valve 8 may be sealed only to the liquid inlet 10 without being connected to the basket grille 5.

[0141] The prefabricated pumping station unit and the water distribution unit of the invention are not only suitable for the applications of sewage transportation, rainwater transportation, raw water transportation applications, such as lake water, river water, surface water and groundwater, but also applicable to other applications requiring fluid transportation.

[0142] Relative terms such as "upper" or "lower" may be used in the above embodiments to describe the relative relationship of one component of the icon to another component. It will be understood that if the device of the icon is flipped upside down, the component described as "lower" will become the component on the "upper". The terms "a", "an", "the", "said" and "at least" are used to mean the presence of one or more elements/parts. The terms "comprising," "comprising," and "having" are used to mean the meaning of the inclusive and are meant to include additional components and the like in addition to the listed components. Moreover, the terms "first", "second", and the like in the claims are used merely as a reference, not a numerical limitation of the subject.

[0143] It should be understood that the invention is not limited to the details of the structure and arrangement of the components presented herein. The invention is capable of other embodiments and of various embodiments. The foregoing variations and modifications are within the scope of the invention. It is to be understood that the invention disclosed and defined herein extends to all alternative combinations of two or more individual features that are mentioned or apparent in the drawings. All of these different combinations constitute a number of alternative aspects of the invention. The embodiments described herein illustrate the best mode known for carrying out the invention and will enable those skilled in the art to utilize the invention

Claims

1. A prefabricated pumping station unit, comprising a prefabricated hollow-shaped pumping station body (1), a liquid inlet (10) and a liquid outlet (20) connected to the pumping station body (1), and a wellbore (2) mounted in the station body (1), **characterized in that** the circumference of the cross section of the upper end portion of the pumping station body (1) is larger than the circumference of the cross section of the lower end portion thereof.

2. A prefabricated pumping station unit according to claim 1, **characterized in that** the pumping station body (1) comprises a first tubular portion (11) and a tapered portion (12), connecting the lower end portion of the first tubular portion (11), the cross-sectional dimension of the tapered portion (12) gradually decreases in a direction from top to bottom, and the liquid inlet (10) is provided in the first tubular portion (11).

3. A prefabricated pumping station unit according to claim 2, **characterized in that** a center line of said first tubular portion (11) and said tapered portion (12) coincide; said first tubular portion (11) is a cylinder, the tapered portion (12) is a conical cylinder; the cone angle (a) of the conical cylinder ranges from 15° to 50°.

4. A prefabricated pumping station unit according to claim 2, **characterized in that** the bottom edge of the liquid inlet (10) is adjacent to the tapered portion (12) or flush with the top edge of the tapered portion (12).

5. A prefabricated pumping station unit according to claim 2, **characterized in that** said prefabricated pump station unit further comprises a first grille means (5'), said first grille means (5') being mounted in the first tubular portion (11); or installed at the end of the liquid inlet (10).

6. A prefabricated pumping station unit according to claim 2, **characterized in that** the wellbore (2) is arranged coaxially with the pumping station body (1) in the pumping station body (1).

7. A prefabricated pumping station unit according to any one of claims 2 to 6, **characterized in that** the pumping station body (1) further comprises a second tubular portion (13), the cross-sectional dimension of the second tubular portion (13) is smaller than the first tubular portion (11), and the second tubular portion (13) is connected to a lower end portion of the tapered portion (12).

8. A prefabricated pumping station unit according to claim 7, **characterized in that** the first tubular portion (11) and the second tubular portion (13) are both cylinders, and the tapered portion (12) is a conical cylinder, and the centerlines of the three coincide.

9. A prefabricated pumping station unit according to claim 7, **characterized in that** at least one fixing plate (23) is provided between the wellbore (2) and the tapered portion (12) and/or the second tubular portion (13).

10. A prefabricated pumping station unit according to claim 1, **characterized in that** said pumping station body (1) comprises an outer tubular portion (14) and an inner tubular portion (15), said outer tubular portion (14) comprising a bottom (141) of an outer tubular portion, and an outer peripheral wall (142) provided on the bottom (141); the inner tubular portion (15) includes an inner peripheral wall (152), the top end of the inner tubular portion (15) is open, and an upper end portion of the inner tubular portion (15) penetrates in the bottom (141) of the outer tubular portion (14) and located in the outer tubular portion (14), and the remaining portion of the inner tubular portion (15) is located out of the outer tubular portion (14); a part of the inner peripheral wall (152), a part of the outer peripheral wall (142) and the bottom (141) of the outer tubular portion together form a circulation space (140), and the liquid inlet (10) is mounted on the outer peripheral wall (142).

11. A prefabricated pumping station unit according to claim 10, **characterized in that** said inner tubular portion (15) further comprises: a bottom (151) of the inner tubular portion, which is integrally formed at a bottom end portion of said inner peripheral wall (152) or sealingly fixed to a bottom end of the inner peripheral wall (152).

12. A prefabricated pumping station unit according to claim 10, **characterized in that** the center line of the outer tubular portion (14) and the inner tubular portion (15) coincide.

13. A prefabricated pumping station unit according to claim 10, **characterized in that** said inner tubular portion (15) and outer tubular portion (14) are both cylindrical, and said inner tubular portion (15) has a smaller cross-sectional dimension than the cross-sectional dimension of the outer tubular portion (14).

14. A prefabricated pumping station unit according to claim 10, **characterized in that** said inner tubular portion (15) is of a conical cylindrical shape, having a large diameter end and a small diameter end, and the large diameter end of said inner tubular portion (15) is located inside the outer tubular portion (14).

15. A prefabricated pumping station unit according to claim 10, **characterized in that** the portion of the inner tubular portion (15) located in the outer tubular portion (14) is of a conical cylindrical shape.

16. A prefabricated pumping station unit according to claim 10, **characterized in that** a bottom edge of the liquid inlet (10) is not higher than the top edge of the inner peripheral wall (152).

17. A prefabricated pumping station unit according to claim 10, **characterized in that** a bottom edge of the liquid inlet (10) is adjacent to the bottom (141) of the outer tubular portion or flush with the bottom (141) of the outer tubular portion.

18. A prefabricated pumping station unit according to claim 10, **characterized in that** at least one grid hole (1521) is provided in a portion of the inner peripheral wall (152) located in the outer tubular portion (14) to communicate with the inner portion of the inner tubular portion (15) and the circulation space (140).

19. A prefabricated pumping station unit according to claim 10, **characterized in that** said prefabricated pumping station unit further comprises a second grille means (5"), said second grid means (5") being mounted to the end of the liquid inlet (10); or the second grille device (5") is attached to the upper end of the inner peripheral wall (152) of the inner tubular portion (12).

20. A prefabricated pumping station unit according to claim 10, **characterized in that** the relationship between the height H1 of the portion of the inner tubular portion (15) outside the outer tubular portion (14) and the diameter D of the wellbore (2) satisfied: $H1 = (2 \sim 5) D$.

21. A prefabricated pumping station unit according to any one of claims 2 to 20, **characterized in that** the prefabricated pumping station unit further comprises a submersible pump (3), and the submersible pump (3) is mounted in the wellbore (2) or within the pump-

ing station body (1) and below the wellbore (2), the submersible pump (3) is an axial flow pump, a mixed flow pump or a cross flow pump.

22. A prefabricated pumping station unit according to claim 21, **characterized in that** said prefabricated pumping station unit further comprises a pump base (6), said pump base (6) being mounted in said pumping station body (1) and located below the wellbore (2); or the pump seat (6) is mounted in the wellbore (2), the submersible pump (3) being mounted on the pump base (6).

23. A prefabricated pumping station unit according to claim 22, **characterized in that** the pump base (6) comprises a bottom plate (60), a flow guiding portion (61) fixed to a central position of the bottom plate (60), and at least two flow dividing portions (62) fixed to the bottom plate (60) and the flow guiding portion (61), said at least two flow dividing portions (62) are uniformly distributed in the circumferential direction of the flow guiding portion (61).

24. A prefabricated pumping station unit according to claim 23, **characterized in that** said pump base (6) further comprises at least two support portions (63) fixed to said bottom plate (60), and the height of said support portion (63) is higher than the flow guiding portion (61) and the flow dividing portion (62), and a flange (64) is fixed to the top of the at least two supporting portions (63).

25. A prefabricated pumping station unit according to claim 1, **characterized in that** a liquid discharge pipe (25) is connected between the wellbore (2) and the liquid outlet (20), and the wellbore (2) is a split structure, which comprises a lower tubular portion (21) and an upper tubular portion (22) connected to the lower tubular portion (21), wherein the liquid outlet pipe (25) is in communication with the upper tubular portion (22); and the prefabricated pumping station unit further includes at least two fixing plates (23) uniformly disposed in a circumferential direction, and the lower tubular portion (21) is fixed to the pumping station body (1) by at least two of the fixing plates (23).

26. A prefabricated pumping station unit according to claim 25, **characterized in that** said upper tubular portion (22) is detachably coupled to said lower tubular portion (21).

27. A prefabricated pumping station unit according to claim 25, **characterized in that** said pumping station further comprises a pump base (6) mounted below said wellbore (2) or within said wellbore (2).

28. A prefabricated pumping station unit according to claim 25, **characterized in that** outer side of said at least two fixing plates (23) are fixed to said pumping station body (1), and said bottom end of said at least two fixing plates (23) are flush with the bottom end surface of said pumping station body (1) or fixed to the bottom plate (17) of the pumping station body (1), and the lower tubular portion (21) is fixed to the inner side of the at least two of the fixing plates (23).

29. A prefabricated pump station unit according to claim 27, **characterized in that** the pump base (6) is mounted below the lower tubular portion (21) and is fixed to the inner side of at least two of the fixing plates (23).

30. A prefabricated pumping station unit according to claim 29, **characterized in that** a gap between the fixing plate (23) and the pump base (6) is provided with a seal so that at least two of the fixing plates (23) separating the space between the lower tubular portion (21) and the pumping station body (1) into at least two independent flow channels (18) that are isolated from each other, each of said independent flow channels (18) has a corresponding water passage hole (65) provided on said pump base (6).

31. A prefabricated pumping station unit according to claim 25, **characterized in that** said pumping station body (1) further comprises a first tubular portion (11) having a larger diameter, a tapered portion (12) with gradually decreasing diameter connected to said first tubular portion (11) and a second tubular portion (13) having a smaller diameter connected to the tapered portion (12), and the tapered portion (12) is fixed with an auxiliary support member (24).

32. A prefabricated pumping station unit according to claim 27, 29 or 30, **characterized in that** said prefabricated pumping station unit further comprises a submersible pump (3) mounted to said pump base (6).

33. A water distribution unit comprising a water tank (100) having a liquid inlet (200), **characterized in that** the water distribution unit further comprises at least one prefabricated pumping station unit, each of the prefabricated pumping station units including a tapered portion (300) a wellbore (400) and a liquid outlet, the tapered portion (300) being fixed to an outer bottom of the water tank (100), the cross-sectional dimension of the tapered portion (300) being decreased from top to bottom, the wellbore (400) is mounted in the tapered portion (300) and extends upward into the water tank (100), the liquid outlet is connected to the wellbore (400), and extends out of said water tank (100).

34. A water distribution unit according to claim 33, **char-**

acterized in that said prefabricated pumping station unit further comprises a second tubular portion (500) connected to said tapered portion (300).

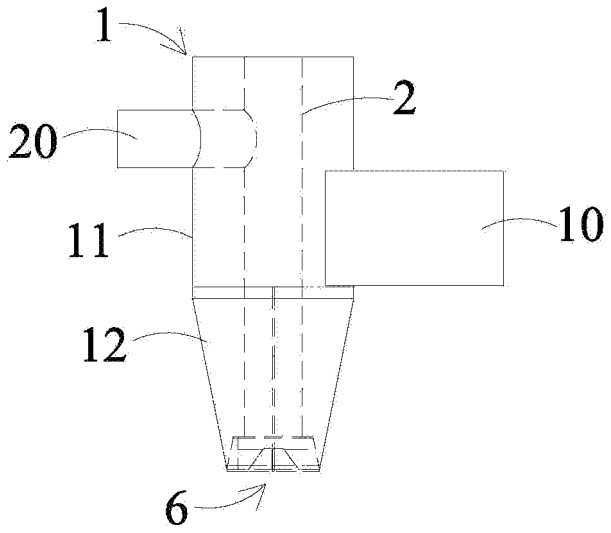
35. A water distribution unit according to claim 33, **characterized in that** said water distribution unit further comprises a submersible pump mounted in said wellbore (400).

36. A water distribution unit according to claim 33, **characterized in that** the water tank (100) is a prefabricated water tank or a civil structure; and/or the water tank (100) is a tank having a rectangular, circular, or elliptical cross section, and/or the water tank (100) is disposed horizontally.

37. A water distribution unit, comprising a water tank (100) having a liquid inlet (200), wherein the water distribution unit further comprises at least one prefabricated pumping station subunit, each of the prefabricated pump station subunits comprising an inner tubular portion (600), a wellbore (400) and a liquid outlet, the inner tubular portion (600) is fixed to the bottom of the water tank (100), the top end of the inner tubular portion (600) is open and extends into the water tank (100), and the wellbore (400) is mounted in the inner tubular portion (600) and extends upwardly from a top end opening of the inner tubular portion (600), the liquid outlet is connected to the wellbore (400), and extends out of the water tank (100).

38. A water distribution unit according to claim 37, **characterized in that** said water distribution unit further comprises a submersible pump mounted in said wellbore (400).

39. A water distribution unit according to claim 37 or 38, **characterized in that** the water tank (100) is a prefabricated water tank or a civil structure; and/or the water tank (100) has a rectangular, circular, or elliptical cross-sectional shape, and/or the water tank (100) is disposed horizontally.



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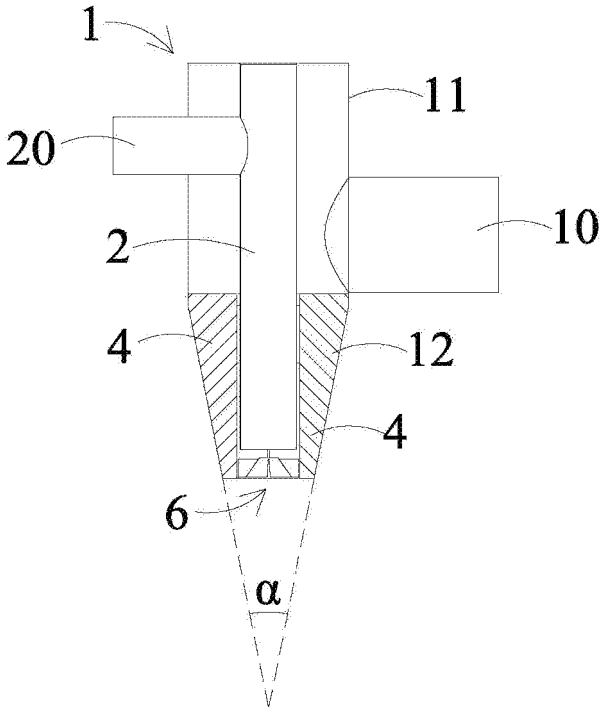

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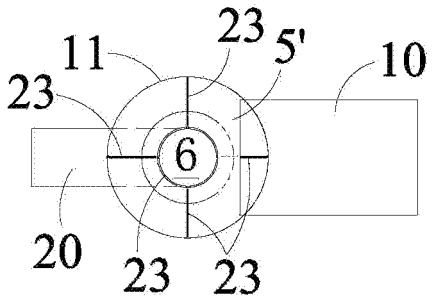

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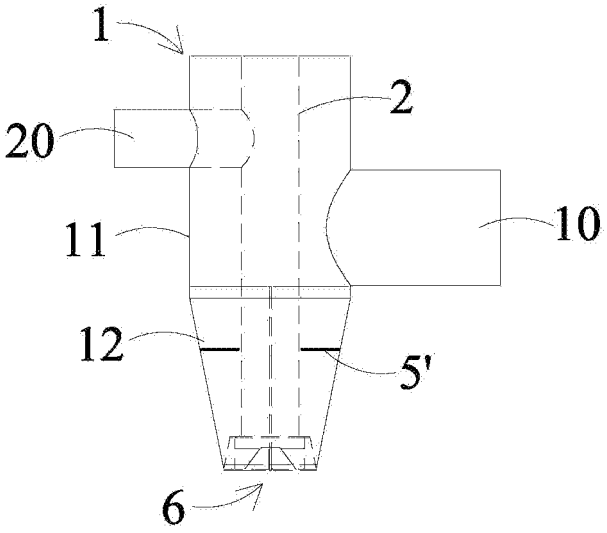

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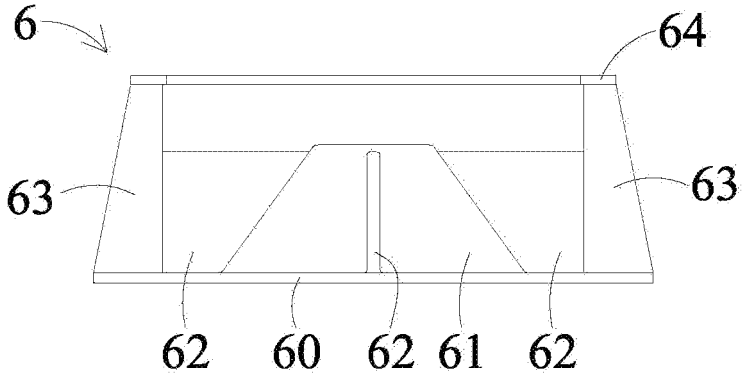

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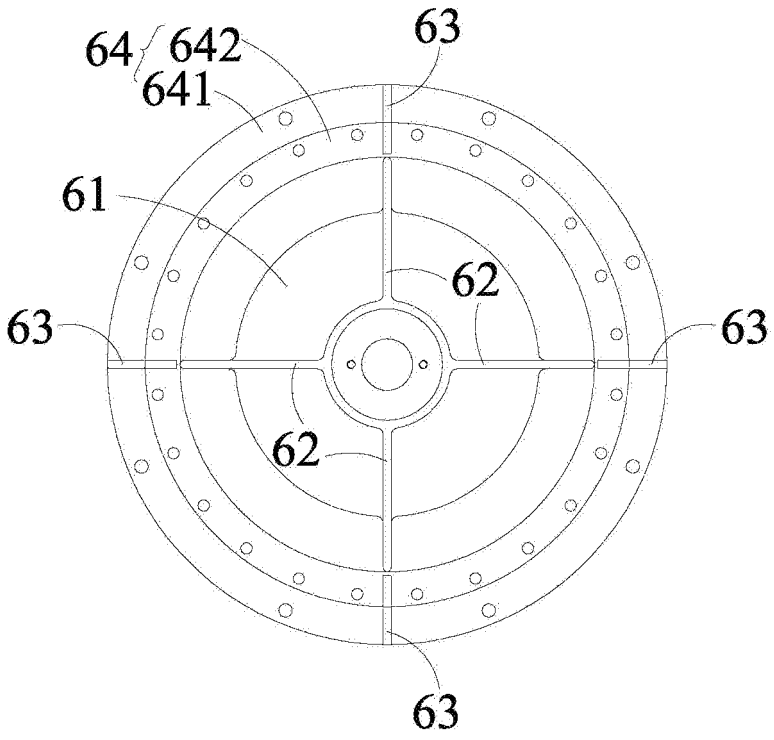

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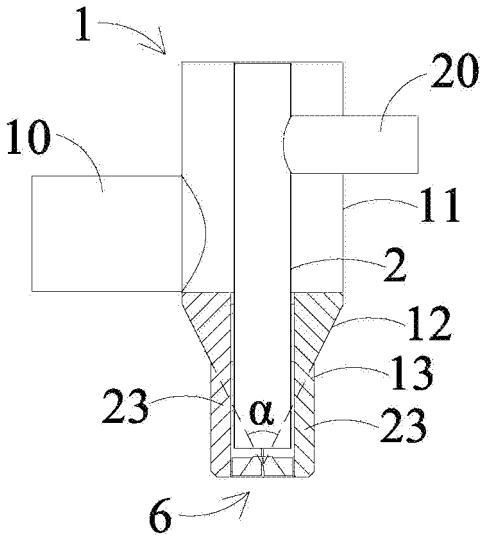

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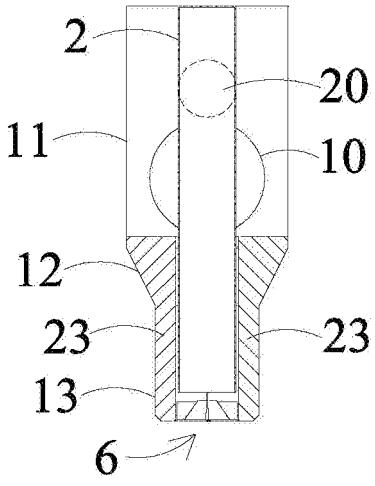

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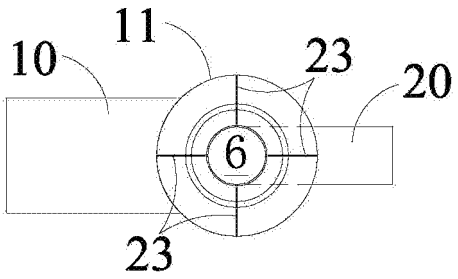

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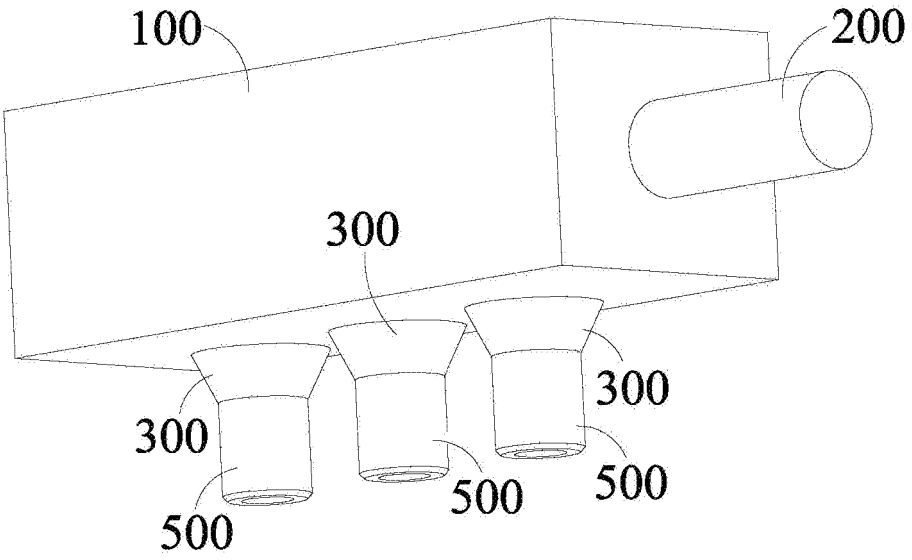
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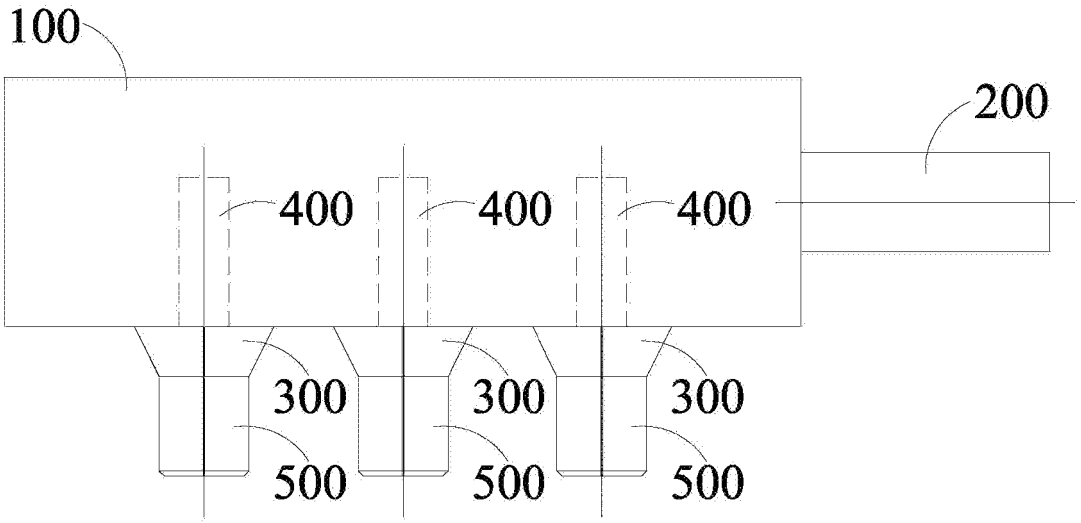
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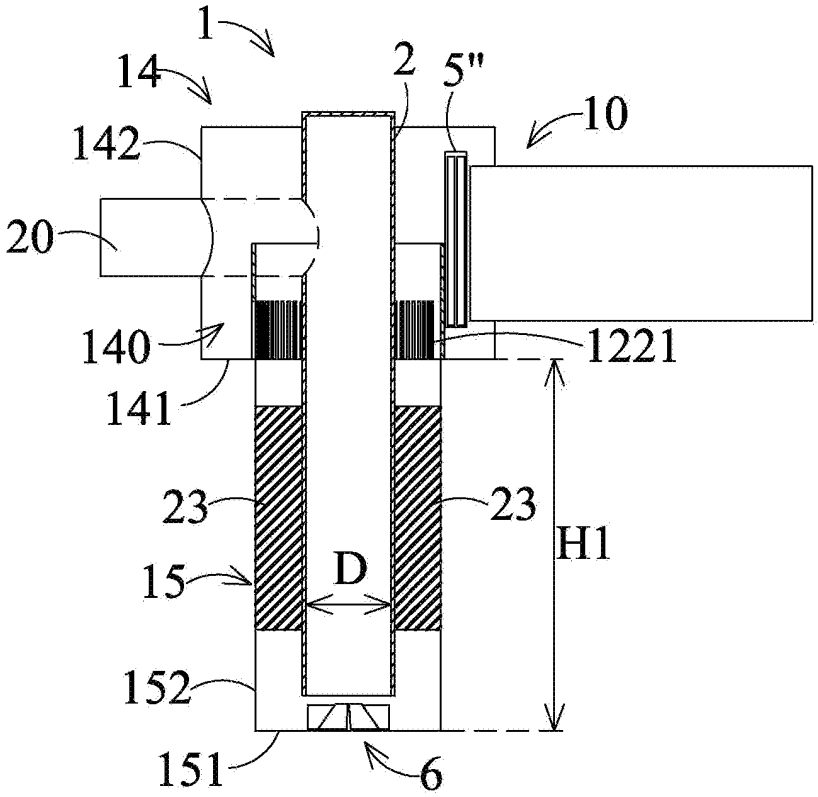
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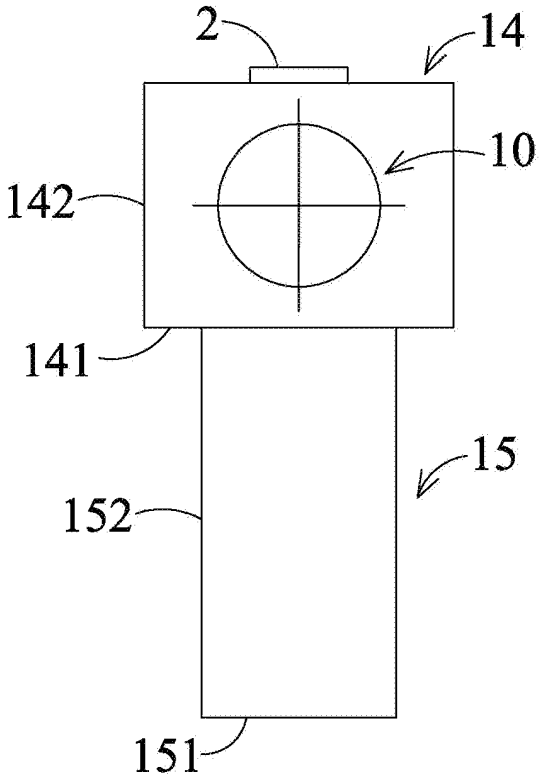
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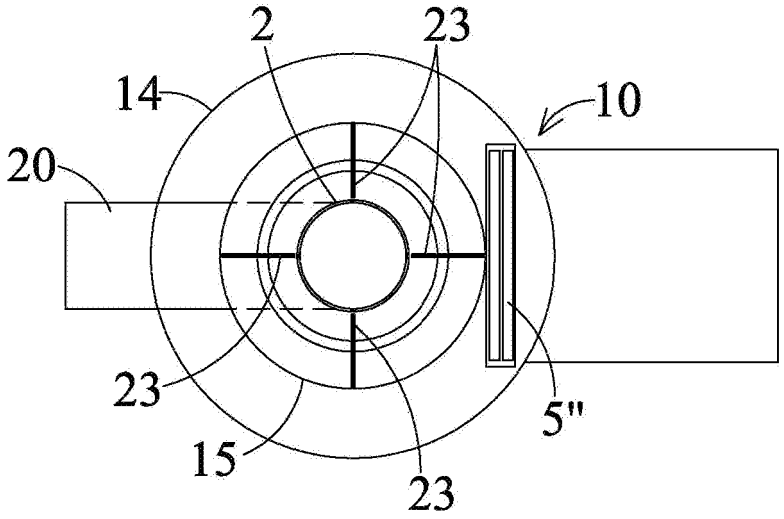

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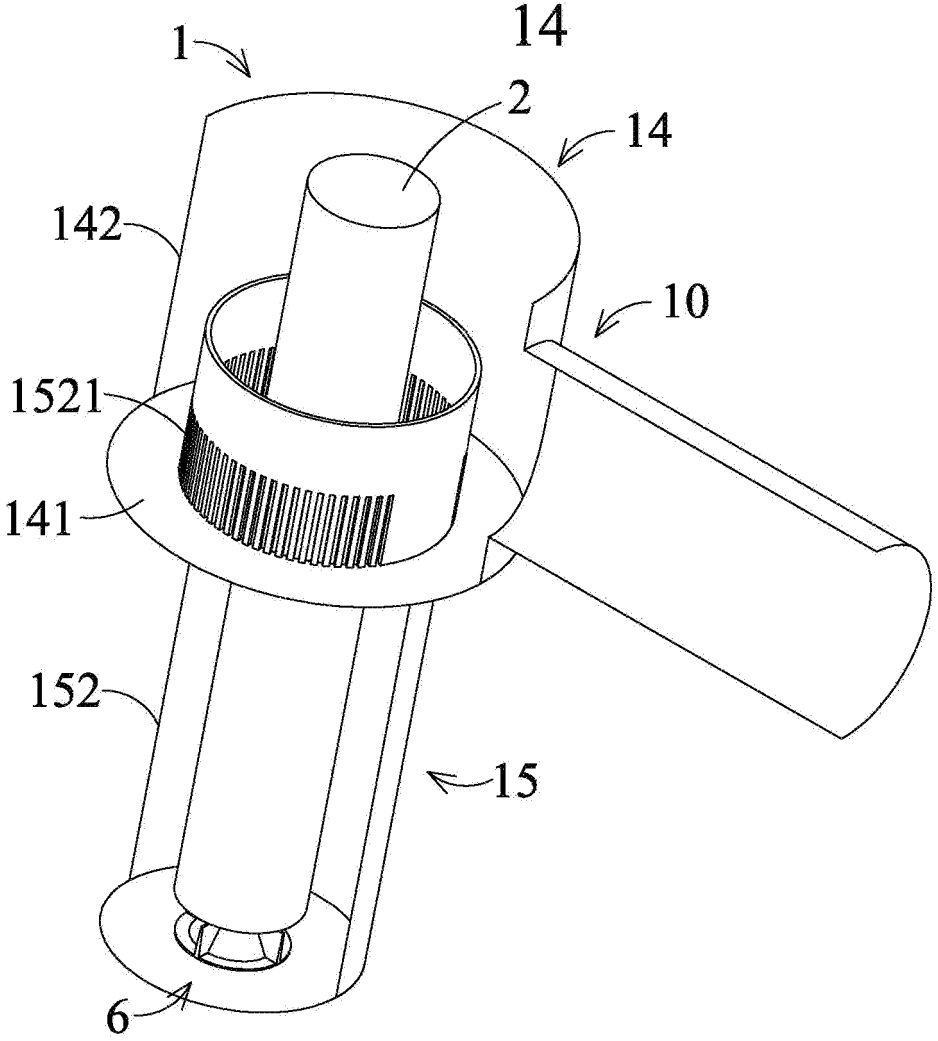

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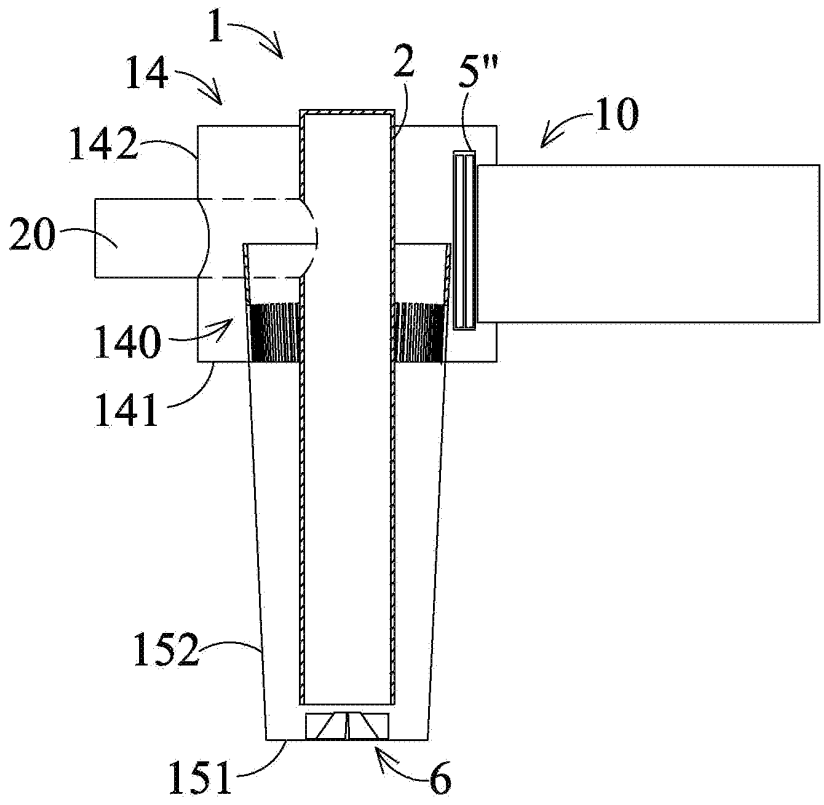

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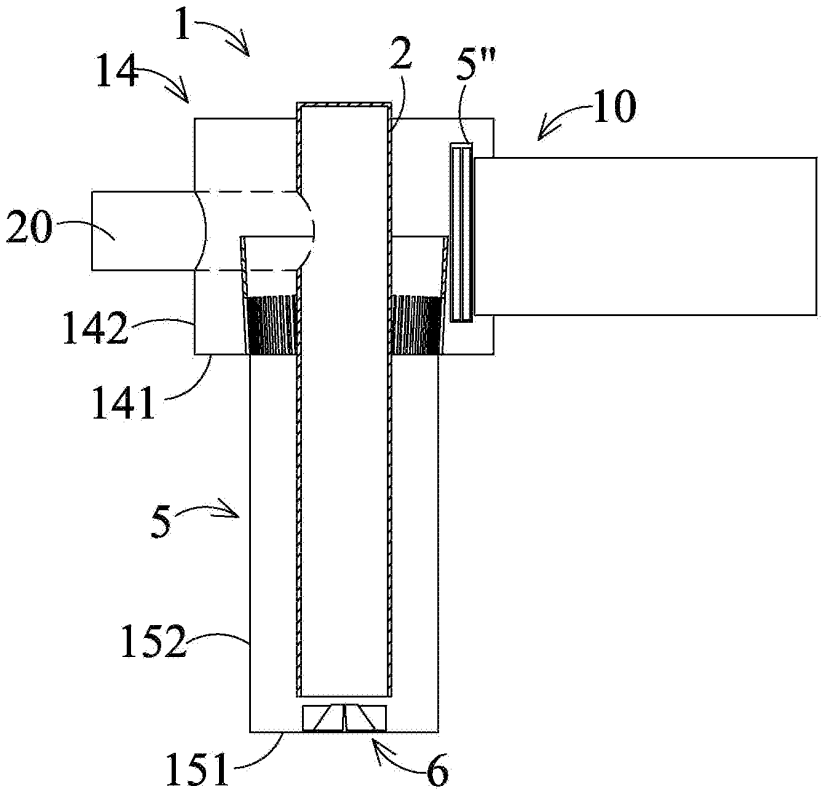

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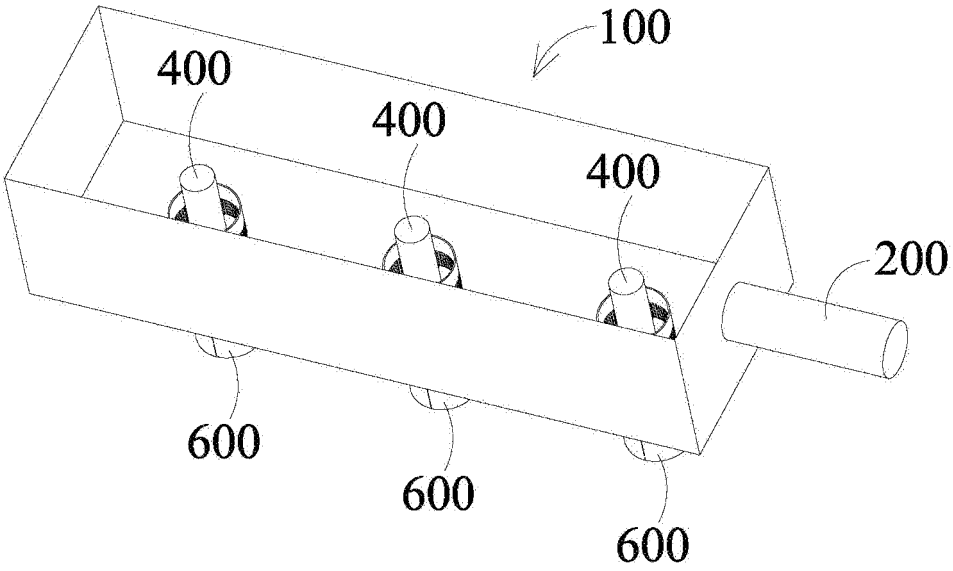

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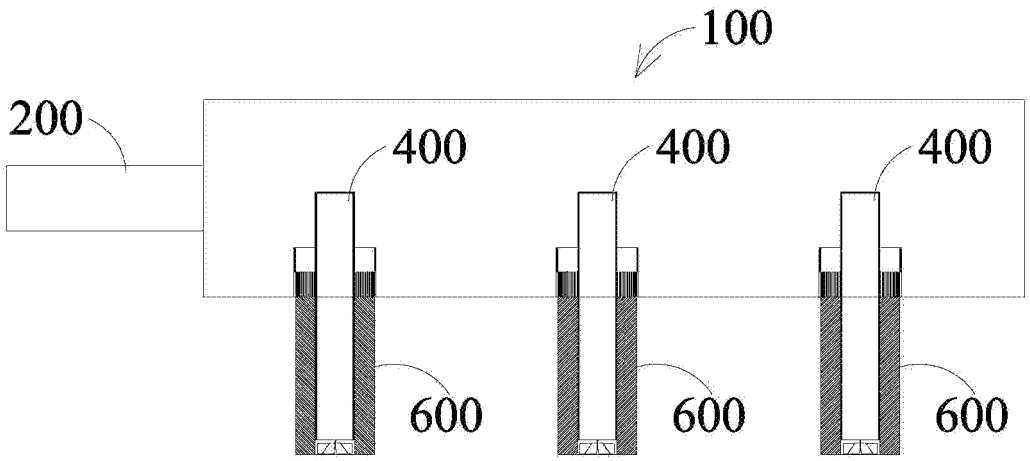

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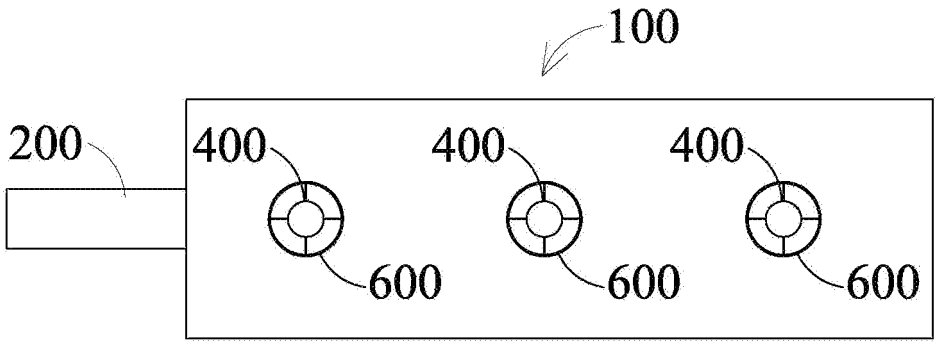

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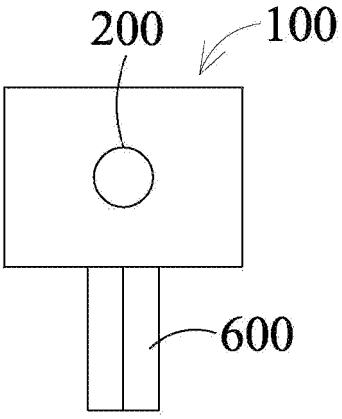

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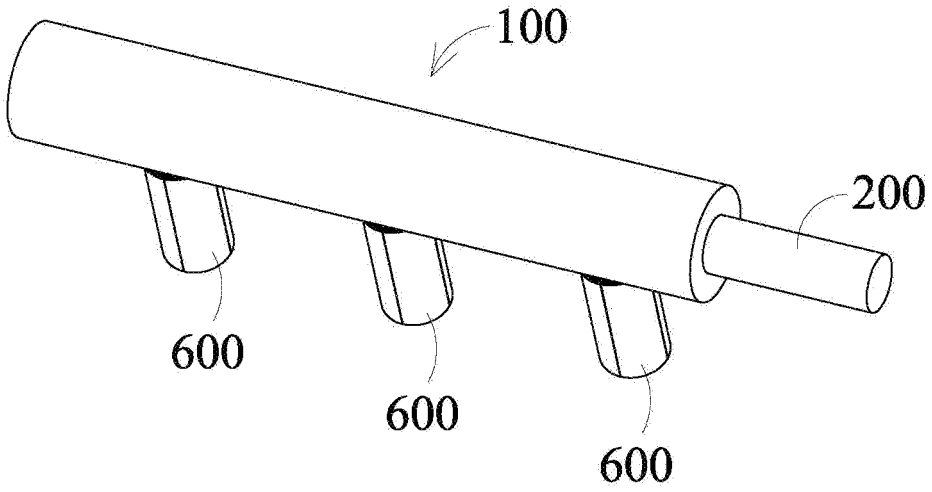

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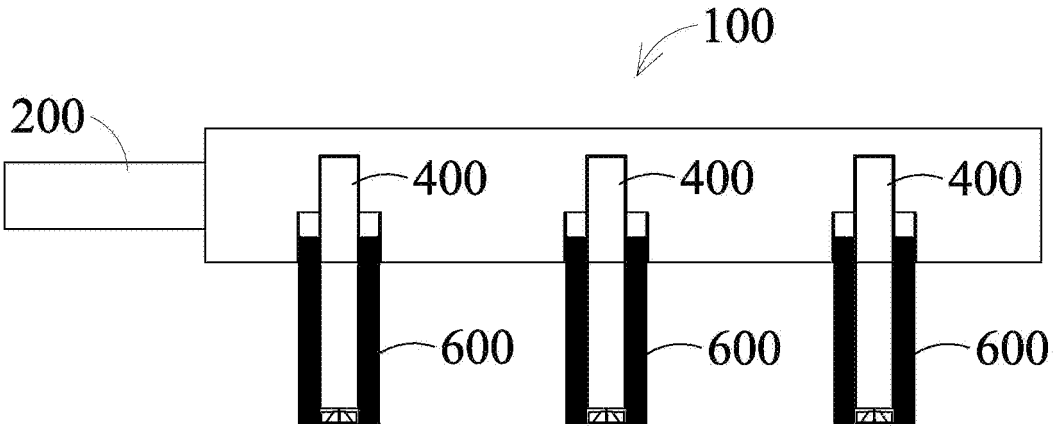

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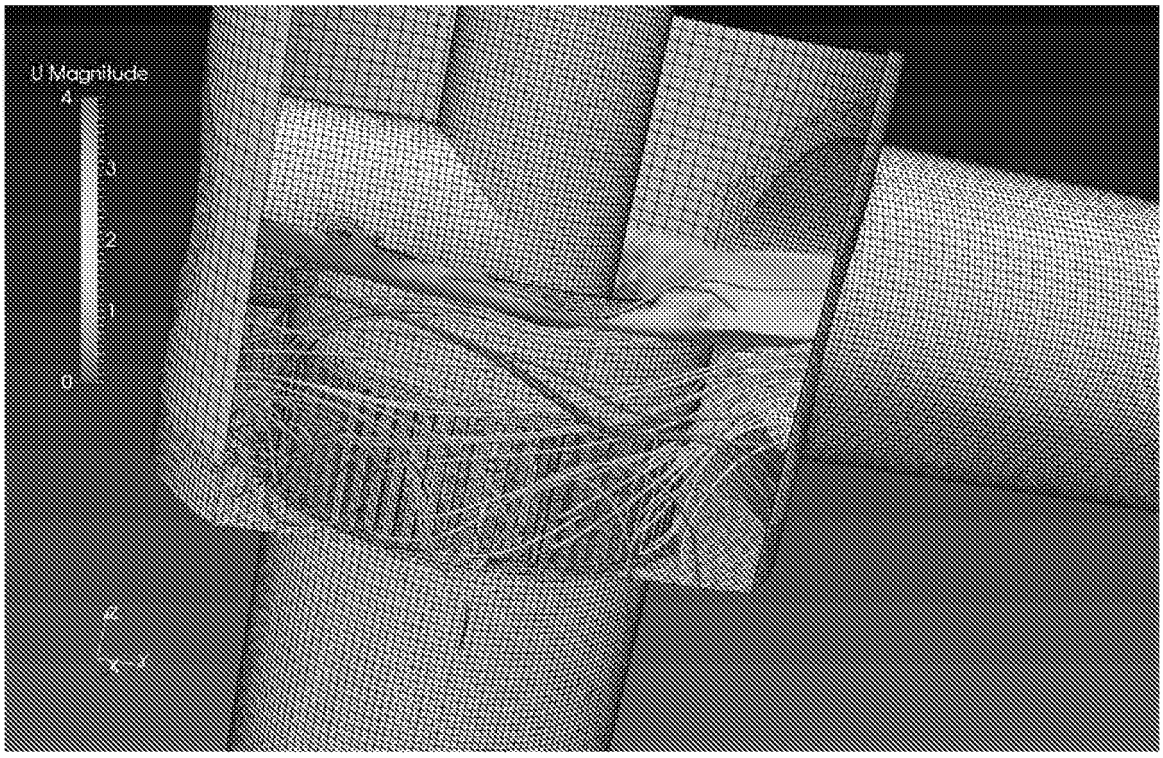

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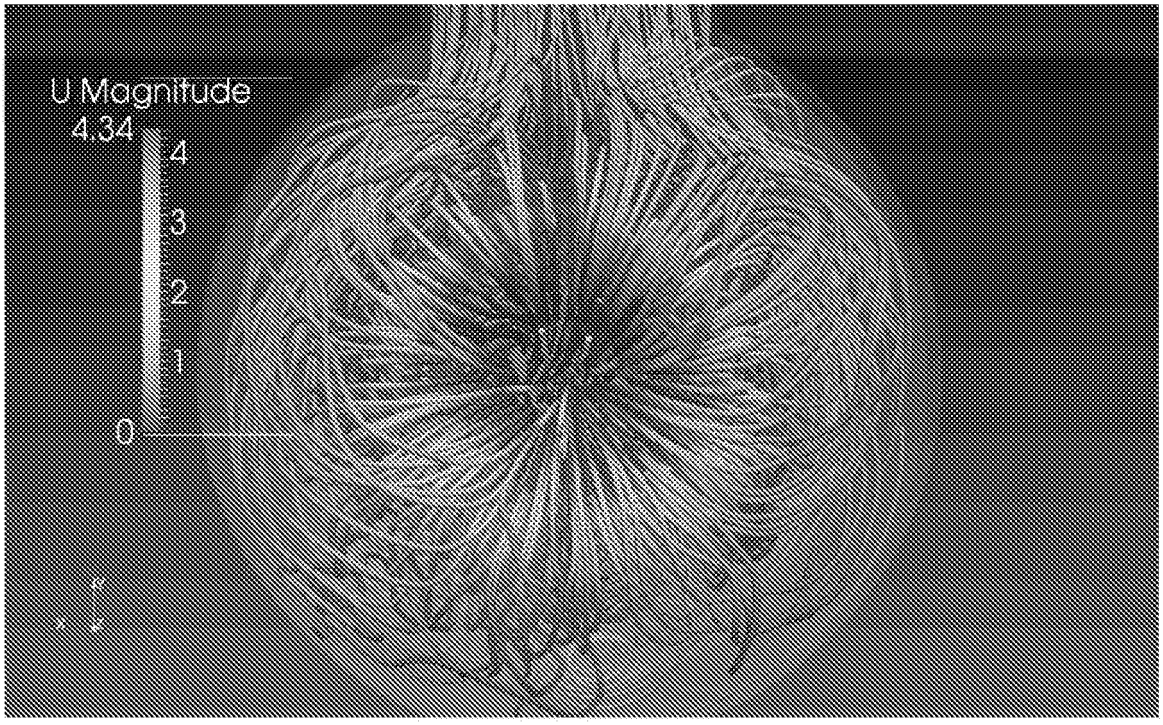

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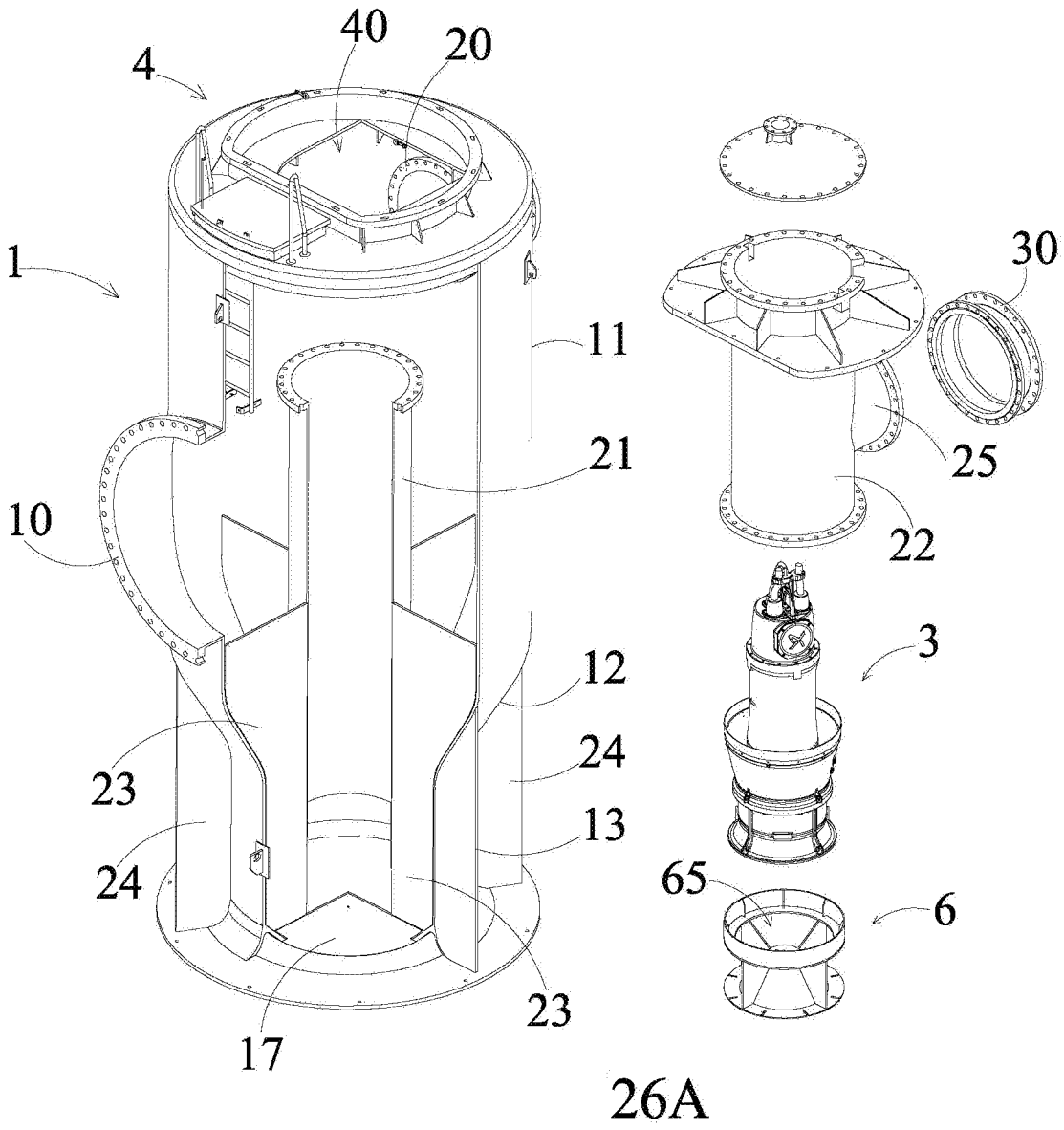
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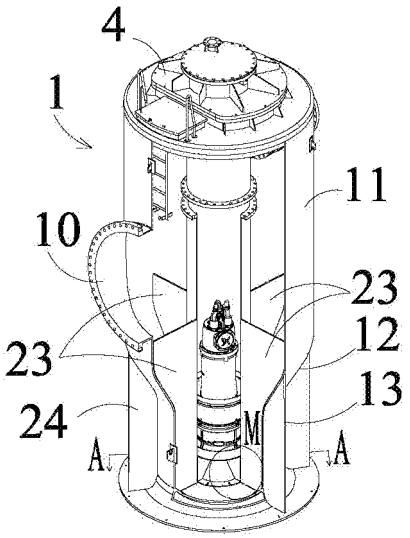

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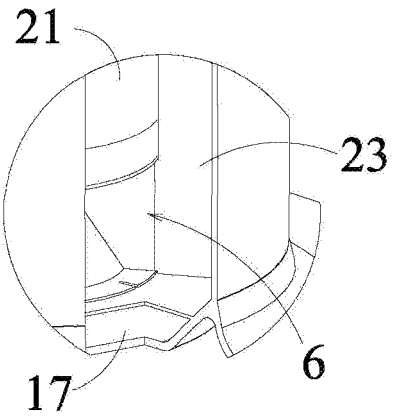

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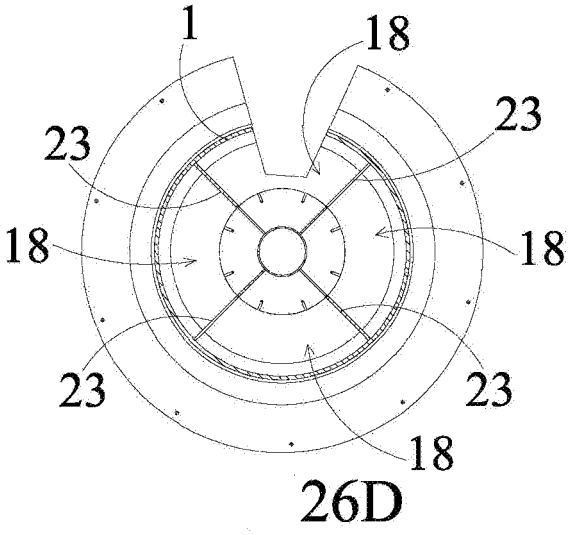

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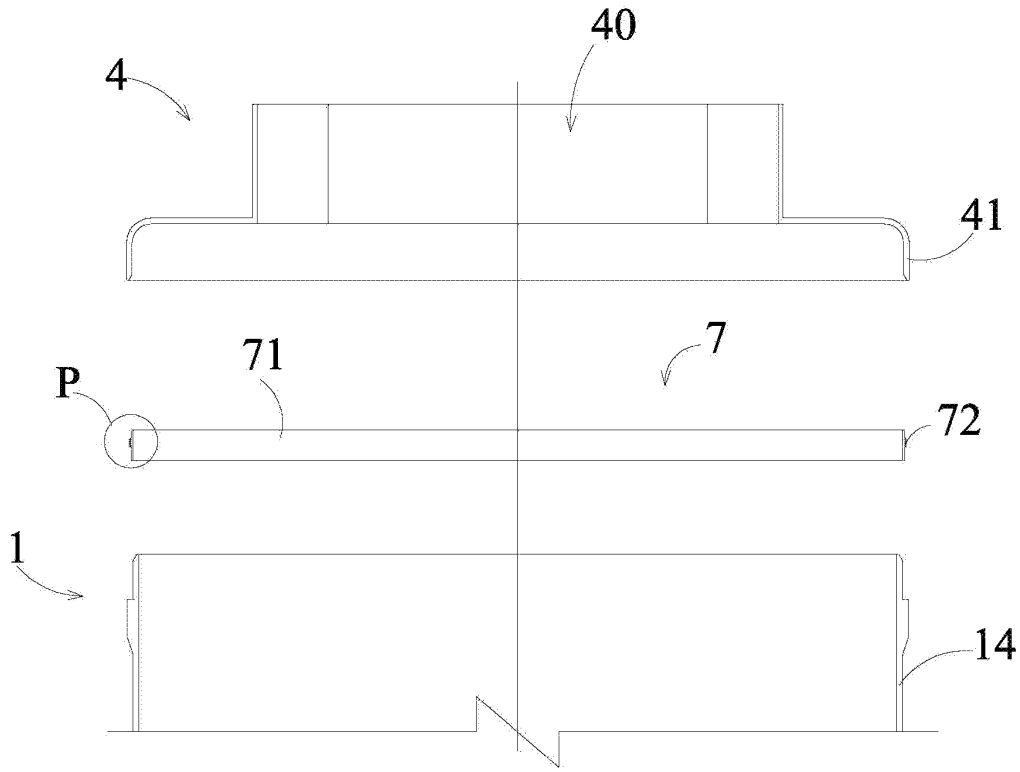

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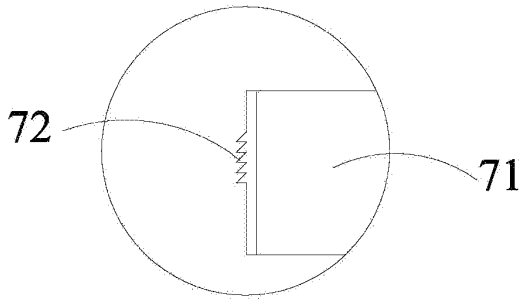

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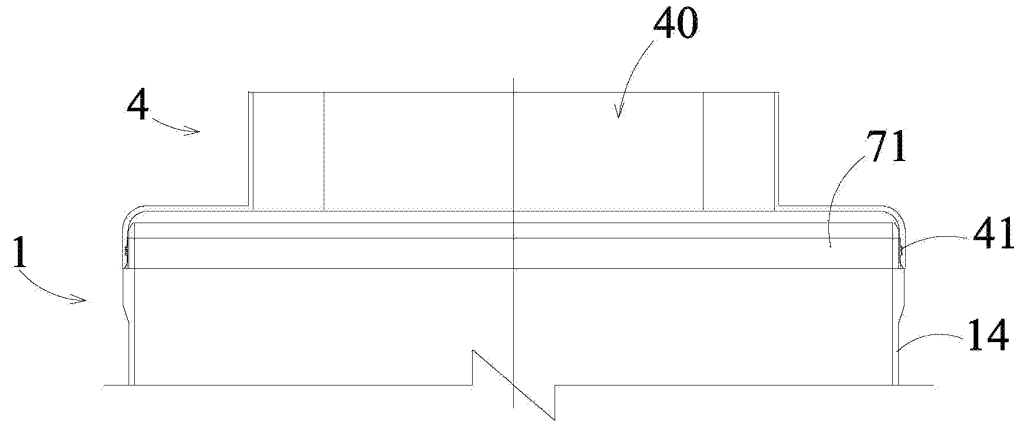

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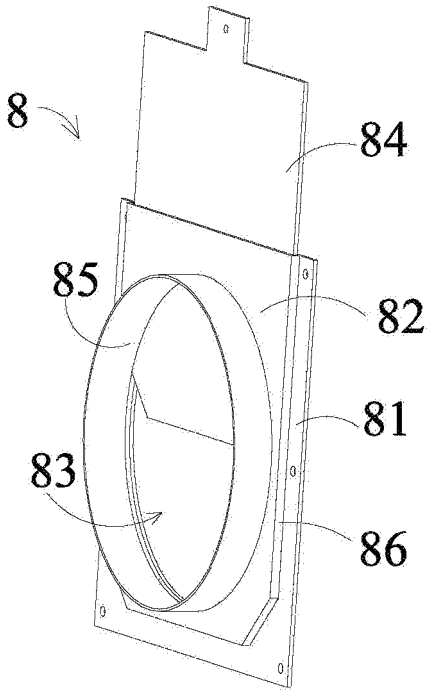

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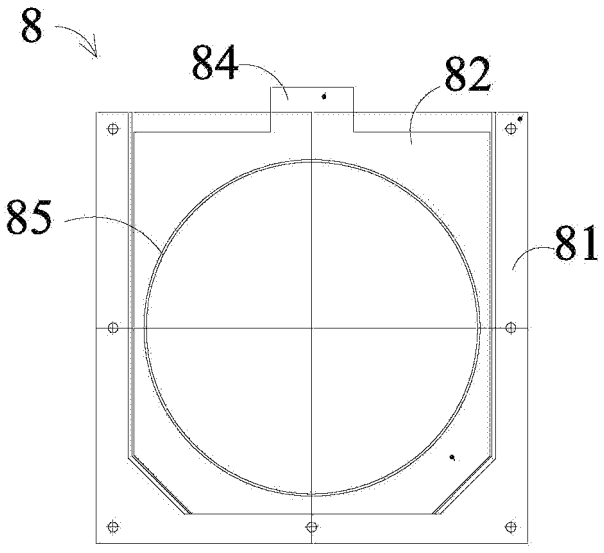

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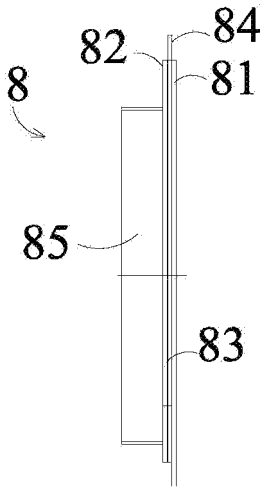

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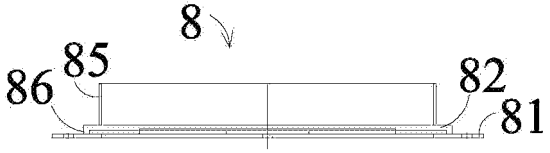

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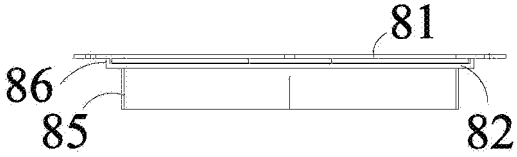

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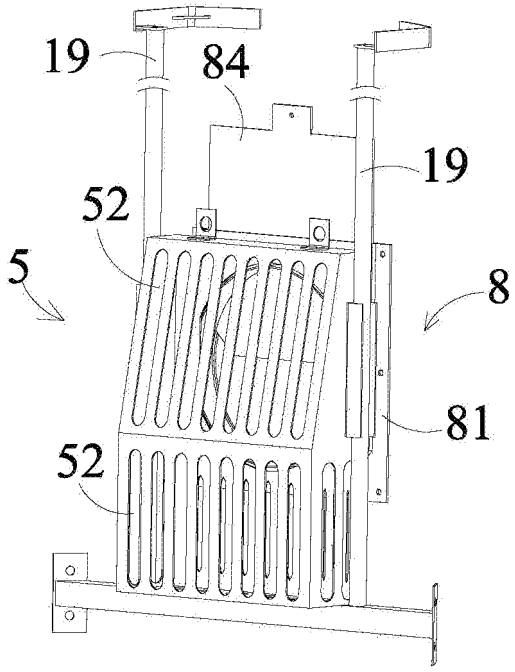

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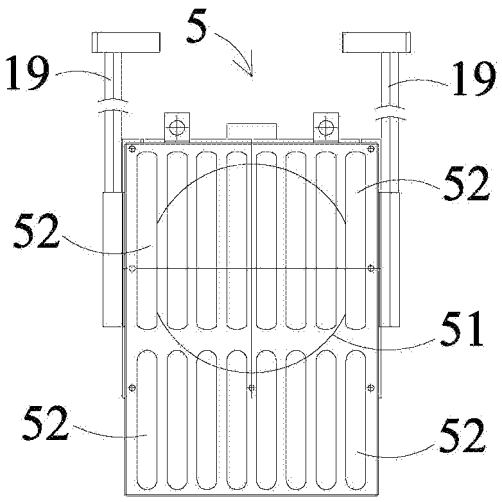

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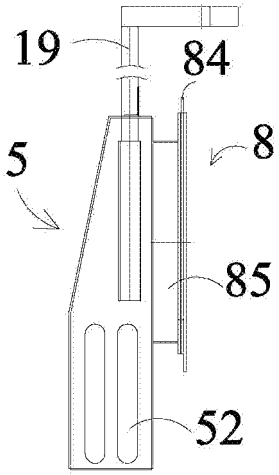

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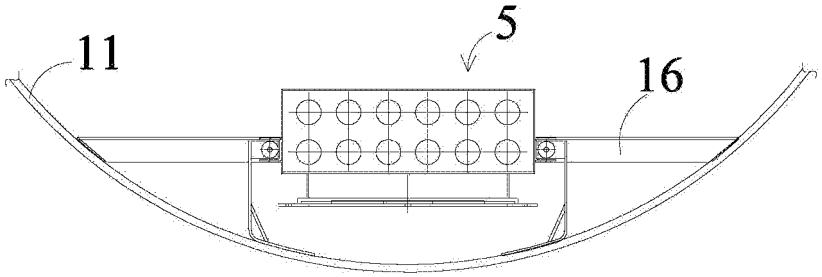

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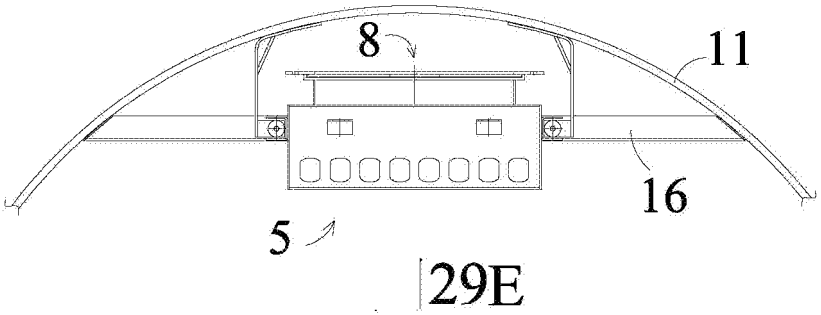

29E

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2016/113472

A. CLASSIFICATION OF SUBJECT MATTER

E03F 5/22 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E03F 5; F04B 23; F04D 29; F04D 13

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS, CNTXT, CNKI: pump, perimeter, shell, casing, sleeve, cone, taper, reduce, lessen

VEN: pump+, girth, perimeter, housing?, case?, casing, cover?, sleeve?, shell?, tape, reduce+, lessen+, shorten+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 201943392 U (SUZHOU INSTITUTE OF ARCHITECTURAL DESIGN CO., LTD.), 24 August 2011 (24.08.2011), description, paragraphs [0031]-[0038], and figures 1-4	1-6, 21, 22
PX	CN 205742511 U (GRUNDFOS HOLDING A/S et al.), 30 November 2016 (30.11.2016), description, paragraphs [0061]-[0100], and figures 1-16	claims 1, 10-24, 37-39
PX	CN 205475666 U (GRUNDFOS HOLDING A/S), 17 August 2016 (17.08.2016), description, paragraphs [0047]-[0067], and figures 1-11	claims 1-9, 21-24, 33-36
PX	CN 205742510 U (GRUNDFOS HOLDING A/S et al.), 30 November 2016 (30.11.2016), description, paragraphs [0061]-[0100], and figures 1-16	claims 1, 10-24, 37-39
A	US 2008011372 A1 (CZARNOTA, Z.), 17 January 2008 (17.01.2008), description, paragraphs [0028]-[0029], and figures 1-4	1-39
A	EP 1640510 A1 (GRUNDFOS AS), 29 March 2006 (29.03.2006), the whole document	1-39

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 March 2017 (17.03.2017)	**27 March 2017 (27.03.2017)**
Name and mailing address of the ISA/CN: State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	Authorized officer **CHEN, Jie** Telephone No.: (86-10) **62084958**

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2016/113472

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 204662649 U (SICHUAN CHANGHE ENVIRONMENTAL PROTECTION ENGINEERING CO., LTD.), 23 September 2015 (23.09.2015), the whole document	1-39
A	CN 203498998 U (GRUNDFOS HOLDING A/S), 26 March 2014 (26.03.2014), the whole document	1-39

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2016/113472

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 201943392 U	24 August 2011	None	
CN 205742511 U	30 November 2016	None	
CN 205475666 U	17 August 2016	None	
CN 205742510 U	30 November 2016	None	
US 2008011372 A1	17 January 2008	EP 1794380 B1	24 July 2013
		SE 526283 C2	16 August 2005
		EP 1794380 A1	13 June 2007
		SE 0402336 A	16 August 2005
		EP 1794380 A4	22 August 2012
		ES 2428629 T3	08 November 2013
		DK 1794380 T3	14 October 2013
		WO 2006036109 A1	06 April 2006
EP 1640510 A1	29 March 2006	AT 404741 T	15 August 2008
		EP 1640510 B1	13 August 2008
CN 204662649 U	23 September 2015	None	
CN 203498998 U	26 March 2014	None	

Form PCT/ISA/210 (patent family annex) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20080011372 A **[0003]**