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(54) **DRAINAGE PUMP ASSEMBLY**

(57) The invention relates to a drainage pump assembly (1) for pumping liquid comprising solid matter, comprising a drainage pump (2), wherein the drainage pump (2) comprises a drive unit having an electrical motor and a drive shaft, a hydraulic unit having an impeller connected to the drive shaft and arranged in a volute, an inlet opening located upstream the volute and an outlet opening located downstream the volute, and a rigid inlet strainer (13) located upstream the inlet opening and having a plurality of through holes (14) through which the pumped liquid will flow to reach the inlet opening. The drainage pump assembly (1) comprises a bristle trap (16), wherein the bristle trap (16) comprises a body (17) connected to the drainage pump (2) and comprises bristles (18) connected to and extending from said body (17), wherein the bristles (18) are arranged adjacent the inlet strainer (13) and the through holes (14) of the inlet strainer (13) are overlapped by said bristles (18).

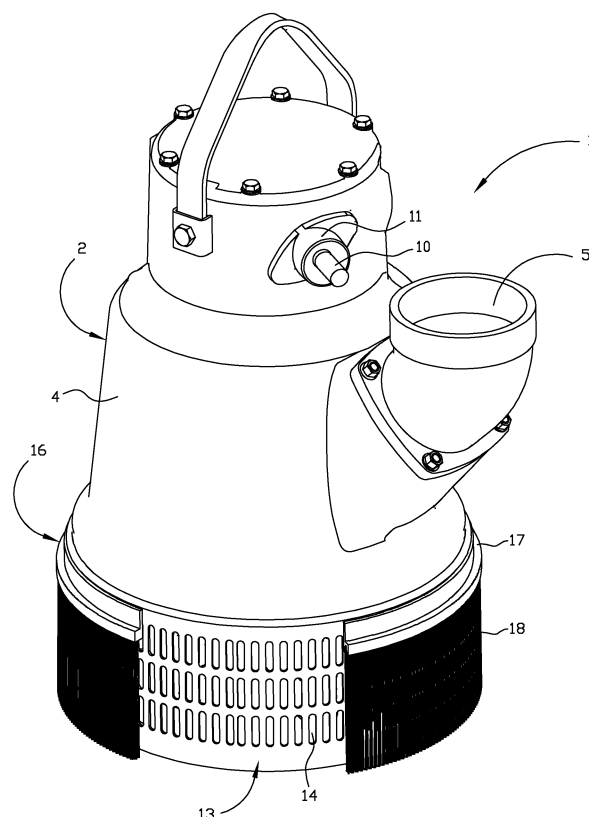


Fig. 1

Description

Technical field of the Invention

[0001] The present invention relates generally to the field of pumps configured to pump liquid comprising solid matter. Further, the present invention relates specifically to the field of drainage pump assemblies especially configured for pumping liquid comprising sand and stone material, such as drilling water in mining/tunneling applications or surface water on construction sites, i.e. dewatering applications. An equivalent term to drainage pump is dewatering pump.

[0002] The drainage/dewatering pump assembly comprises a drainage pump, wherein the drainage pump comprises a drive unit having an electrical motor and a drive shaft, a hydraulic unit having an impeller connected to the drive shaft and arranged in a volute, an inlet opening located upstream the volute and an outlet opening located downstream the volute, and an rigid inlet strainer located upstream the inlet opening and having a plurality of through holes through which the pumped liquid will flow to reach the inlet opening.

Background of the Invention

[0003] In mines, tunneling, quarries, on construction sites, and the like applications, there is almost always a need to remove unwanted water in order to secure a dry enough environment at the working site. In mining/tunneling/quarries applications a lot of drilling water is used when preparing for charging before blasting, and water is also used to prevent dust spreading after the blasting, and if the production water is not removed at least the location of the blast and the lower parts of the mine will become flooded. Surface water and groundwater will also add up to accumulation of unwanted water to be removed. It is customary to use drainage/dewatering pumps to lift the water out of the mine to a settling basin located above ground, and the water is lifted stepwise in the mine to different basins/pits located at different depths of the mine. Each step/lift may for instance be in the range 0-50 meters in the vertical direction, and the length of the outlet conduit, i.e. the transport distance, in each step/lift may for instance be in the range 10-300 meters. In mining applications a considerable amount of sand and stone material is suspended in the water, in some applications as much as 10%.

[0004] Generally the site manager, and the process at the working site, requires a constant low liquid level and therefor the drainage pump is in constant operation even though there is only little water available in the cavity/basins. The water can be constituted by ground water leakage, rain water, and especially process water from drilling, reducing dust, etc. If the water is not removed the production will be affected, which cannot be accepted. Thus, the water is pumped/transported by means of dewatering/drainage pumps. Thus, in many applications

the drainage pumps are in constant operation, irrespective of water being pumped or not. Constant operation of the drainage pump may damage the drainage pump and result in excessive energy consumption. If there is no or little inflow of water to the cavity housing the drainage pump, the drainage pump will start to heat the water, an operational mode referred to as boiling. During boiling, the elevated temperature in the drainage pump and in the water is especially harmful for the seals, and eventually all water will become evaporated. The combination of high operational speed and snoring accelerates pump wear and significantly shortens the operative life of the drainage pump. Constant operation is good and inevitable when there is a constant inflow of liquid to the pit/dent housing the drainage pump.

[0005] In other applications, the drainage pump is operated in an ON/OFF-manner, i.e. stopped when the water level in the specific basin housing the drainage pump is low, for instance the drainage pump is stopped when the drainage pump is snoring. The drainage pump is snoring when a mixture of air and water is sucked into the drainage pump. The drainage pump is stopped to decrease the use of energy when the drainage pump is not able to perform any positive duty, i.e. when snoring, and to spare the pump from additional wear.

[0006] In mining, tunneling, etc. the deeper a mine gets, the more humid, the saltier, and the higher pressure acts on the walls and roofs which needs to be reinforced/coated to prevent the walls and roofs from breaking, so called fall outs. The reinforcement can be made by various methods.

[0007] One method, especially used in mining applications, is to fill the coating/shotcrete, i.e. the concrete that is sprayed onto the walls and roof, with steel fibers/strips to reinforce the coating. This method has been successfully used for many years but the steel fibers have low resistance against corrosion, and they easily break due to fatigue when exposed to high dynamic forces due to movements in the mountain.

[0008] During recent years the steel fibers have been exchanged by plastic fibers, and also other materials are conceivable such as cellulose based materials. Such new fibers have longer life, they are resistant against corrosion and can withstand higher dynamic forces due to movements in the mountain.

[0009] However, the inventors have identified a disadvantage to use the new type of fibers. Quite a big share of the fibers in the shotcrete/coating will end up in the water that is pumped/removed by means of the drainage pump. When using steel fibers this is barely any problem since the steel fibers settle quickly at the bottom and will not reach the drainage pump, but when using plastic fibers or other light material fibers they float in the water and all fibers will unavoidably follow the fluid flow and reach the drainage pump. The plastic fibers will not only float at the surface, but will be suspended at different levels in the water since different amount of concrete is attached to the specific fiber.

[0010] The through holes of the rigid inlet screen need to be big enough to allow a big enough fluid flow when the pump is active and small enough to filter out particles of a specific size depending on the application and pump size, and thereto the inlet screen need to be robust in its design and able to support the entire weight of the pump. Should the thorough holes of the inlet screen be adapted to filter out the plastic fibers, either the fluid flow requirement or the robustness of the inlet screen will fail. Thus, the plastic fibers clogs the inlet screen of the pump and clogs the impeller of the pump, resulting in higher maintenance and primarily an increased risk for flooding due to malfunctioning pump. An even worse risk is that the plastic fibers passes the drainage pump and clogs the non-return valves in the pumping arrangement which is a great safety issue for the work and the personnel due to imminent risk for flooding.

Object of the Invention

[0011] The present invention aims at obviating the aforementioned disadvantages and failings of previously known drainage pump assemblies, and at providing an improved drainage pump assembly. A primary object of the present invention is to provide an improved drainage pump assembly of the initially defined type capable of filtering out solid matter of less size then before without having negative effect on the fluid flow capabilities of the drainage pump. It is another object of the present invention to provide a drainage pump assembly, having an inlet strainer accessory (extra filter) that needs no or little maintenance, i.e. is self-cleaning. It is a specific object of the present invention to provide a drainage pump assembly that is configured during operation of the drainage pump to prevent elongated fibers in the pumped liquid from reaching the inlet opening of the pump.

Summary of the Invention

[0012] According to the invention at least the primary object is attained by means of the initially defined drainage pump assembly having the features defined in the independent claim. Preferred embodiments of the present invention are further defined in the dependent claims.

[0013] According to a first aspect of the present invention, there is provided a drainage pump assembly of the initially defined type, which is characterized in that it further comprises a bristle trap, wherein the bristle trap comprises a body connected to the drainage pump and comprises bristles connected to and extending from said body, wherein the bristles are arranged adjacent the inlet strainer and the through holes of the inlet strainer are overlapped by said bristles.

[0014] Thus, the present invention is based on the insight of using an inlet strainer accessory this is able to filter out solid matter having smaller dimensions (at least in two dimensions/directions) without having negative ef-

fect on the fluid flow capabilities of the drainage pump, and thereto without having negative effect on the robustness of the inlet strainer.

[0015] In a preferred embodiment of the present invention, the bristles are arranged in bunches of bristles, wherein each bunch of bristles is inserted into a bore provided in the body. This entails a simple and efficient mounting of the bristles.

[0016] According to a preferred embodiment, said bores are distributed along one or more circumferential rows, wherein adjacent bores of a circumferential row are separated in the circumferential direction and wherein the center-to-center distance is equal to or more than 1,5 times the length of the bore and equal to or less than 4 times the length of the bore, the length of the bore being taken along the circumferential row. Thereby the flow path through the inlet strainer is blocked neither too much nor too little.

[0017] According to another preferred embodiment, the radial center-to-center distance between two mutually overlapping circumferential rows of bores is equal to or more than 1 times the width of the bore and equal to or less than 4 times the width of the bore, the width of the bore being taken perpendicular to the circumferential row. Thereby the flow path through the inlet strainer is blocked neither too much nor too little.

[0018] According to a preferred embodiment, the bristles are made of a material chosen from the group consisting of polyamide, polyvinylchloride, polypropylene and polyester. Thereby dirt, concrete, etc. will find it harder to stick/adhere to the bristles.

[0019] According to a preferred embodiment, the bristle trap is located upstream the inlet strainer, i.e. on the outside of the inlet strainer seen from the inlet opening of the pump.

[0020] Further advantages with the invention as well as features of the invention will be apparent from the other dependent claims as well as from the following detailed description of preferred embodiments.

Brief description of the drawings

[0021] A more complete understanding of the above-mentioned and other features and advantages of the present invention will be apparent from the following detailed description of preferred embodiments in conjunction with the appended drawings, wherein:

- Fig. 1 is a schematic illustration of an inventive drainage pump assembly shown in perspective from above (the bristle trap is partly removed),
- Fig. 2 is a schematic illustration of a part of the drainage pump assembly according to figure 1 shown in perspective from below,
- Fig. 3 is a schematic cross sectional side view of the drainage pump assembly according to figures 1 and 2,
- Fig. 4 is a schematic cross sectional side view of a

- section of the bristle trap and the inlet strainer, wherein the bristle trap is located upstream the inlet strainer,
- Fig. 5 is a schematic cross sectional side view of a section of the bristle trap and the inlet strainer, wherein the bristle trap is located downstream the inlet strainer,
- Fig. 6 is a schematic cross sectional side view from below of a bristle trap and an inlet strainer according to a first conceptual embodiment,
- Fig. 7 is an enlarged section of figure 6,
- Fig. 8 is a schematic cross sectional side view from below of a bristle trap and an inlet strainer according to a second conceptual embodiment, and
- Fig. 9 is an enlarged section of figure 8.

Detailed description of preferred embodiments of the invention

[0022] The present invention relates specifically to the field of drainage pumps especially configured for pumping liquid comprising solid matter, such as water comprising sludge/mud, sand and stone material.

[0023] Reference is initially made to figures 1-3, disclosing a schematic/conceptual embodiment of an inventive pump assembly, generally designated 1, suitable for pumping liquid comprising solid matter, i.e. a drainage/dewatering pump assembly.

[0024] The drainage pump assembly 1 comprises a drainage pump 2, the drainage pump 2 is preferably of centrifugal pump type.

[0025] The disclosed drainage pump 2 comprises an inlet opening 3, a pump housing 4 and an outlet opening 5. Thereto, in a conventional way, the drainage pump 2 comprises a hydraulic unit having a pump chamber/volute 6, and comprises a drive unit. The drive unit and the pump chamber 6 are arranged in the pump housing 4. The inlet opening 3 is located upstream the volute 6 and the outlet opening 5 is located downstream the volute 6, seen in the flow direction of the pumped liquid when the drainage pump 2 is active.

[0026] The drive unit comprises an electric motor 7 arranged in the liquid tight pump housing 4, and a drive shaft 8 extending from the electric motor 7. The hydraulic unit comprises an impeller 9 that is arranged in the pump chamber 6 and is connected to and driven in rotation by the drive shaft 8 during operation of the drainage pump 2, wherein liquid is sucked into said inlet opening 3 and pumped out of said outlet opening 5 when the drainage pump 2 is active. The pump housing 4 and the impeller 9, and other essential components, are preferably made of metal, such as aluminum and steel. The electric motor 7 is powered via an electric power cable 10 extending from a power supply, and the drainage pump 2 comprises a liquid tight lead-through 11 receiving the electric power cable 10. The impeller 9 may be an open impeller, i.e. having a cover disc and one or more vanes/blades ex-

tending from the cover disc, or a closed impeller, i.e. having two cover discs and one or more vanes extending between the cover discs.

[0027] The disclosed drainage pump 2, more precisely the electric motor 7, is operatively connected to a control unit 12, such as an Intelligent Drive comprising a Variable Frequency Drive (VFD). The control unit is a unit that is able to receive and read instructions/signals, interprets and processes the instructions and then gives requisite instructions to another unit. It shall be pointed out that the drainage pump 2 may be operated direct online, i.e. connected directly to the power mains and at a fixed operational speed.

[0028] Thus, the disclosed drainage pump 2 is configured to be operated at a variable operational speed [rpm], by means of said control unit 12. According to the disclosed and preferred embodiment, the control unit 12 is located inside the liquid tight pump housing 4, i.e. it is preferred that the control unit 12 is integrated into the drainage pump 2. The control unit 12 monitors the status of the pump and the nature of the pumping operation, and controls the pump 2 to operate according to given and/or optimal strategies/modes. According to an alternative embodiment the control unit is an external control unit. The operational speed of the drainage pump 2 is more precisely the rpm of the electric motor 7 and the impeller 9, and correspond/relate to a control unit 12 output frequency.

[0029] The components of the drainage pump 2 are usually, directly or indirectly, cold down by means of the liquid/water surrounding the drainage pump 2. The drainage pump 2 is designed and configured to be able to operate in a submerged configuration/position, i.e. during operation be located entirely under the liquid surface. However, it shall be realized that the submersible drainage pump 2 during operation must not be entirely located under the liquid surface but may continuously or occasionally be partly located above the liquid surface. The drainage pump 2 is intended to be located in a first/lower basin and arranged to transport/pump liquid comprising solid matter from said first/lower basin to a second/higher basin or location. Thereto, it shall be realized that it is conceivable that another drainage pump is located in the second basin and intended to transport the liquid from the second basin to a third basin, etc. The basins may be natural recesses/cavities/pits or prepared recesses/cavities/pits. In order to transport the pumped liquid from the drainage pump 2, an outlet conduit is connected to the outlet opening 5 of the pump 2. The drainage pump 2 may comprise or may be operatively connected to one or more level sensors configured for initiating change of operational mode of the pump 2, i.e. ON-OFF operation, increasing-decreasing operational speed, etc. based on the present liquid level surrounding the pump 2.

[0030] Thereto, the drainage pump 2 comprises a rigid inlet strainer 13, also known as inlet screen, located upstream the inlet opening 3 and having a plurality of through holes 14, also known as perforations, through

which the pumped liquid will flow to reach the inlet opening 3. The majority of the through holes 14 are located facing radially outwards, i.e. on the sides of the inlet strainer 13. Thereto, it is conceivable that the inlet strainer 13 also comprises one or a few drainage through holes 15 in the bottom of the inlet strainer 13, but these drainage through holes 15 are not the subject of the present invention.

[0031] It is essential for the present invention that the drainage pump assembly 1 also comprises a bristle trap, generally designated 16. The bristle trap 16 is an inlet strainer accessory and may also be named or described as a curtain or skirt. The bristle trap 16 comprises a body 17 connected to the drainage pump 2 and comprises bristles 18 connected to and extending from said body 17. The bristles 18 are arranged adjacent the inlet strainer 13 and the through holes 14 of the inlet strainer 13 are overlapped by said bristles 18.

[0032] Reference is now made to figures 4 and 5 disclosing different conceptual locations of the bristle trap 16 in relation to the inlet strainer 13.

[0033] As can be seen in figure 4 the bristle trap 16 is located upstream the inlet strainer 13, i.e. on the outside of the inlet strainer 13, wherein the bristle trap 16 body 17 is connected to the drainage pump 2 by being clamped by means of a circumferential tightening means 19, such as an eccentric lock or tightening screw, and/or attached by means of attachment means, such as bolts 20 and/or brackets, to the upper part of the inlet strainer 13 and/or to the pump housing 4. Preferably, the body 17 shall not overlap any of the through holes 14 of the inlet strainer 13.

[0034] As can be seen in figure 5 the bristle trap 16 is located downstream the inlet strainer 13, i.e. on the inside of the inlet strainer 13, wherein the bristle trap 16 body 17 is connected to the drainage pump 2 by being clamped by means of expansion means and/or attached by means of attachment means, such as bolts and/or brackets, to the upper part of the inlet strainer 13 and/or to the pump housing 4. Preferably, the body 17 shall not overlap any of the through holes 14 of the inlet strainer 13. The bristle trap 16 body 17 may also be clamped to the upper part of the inlet strainer 13 and/or to the pump housing 4 by its inherent spring force striving to straighten the circularly bent bristle trap 16 body 17.

[0035] In both embodiments above, the pump 2 may also comprise a bristle deflect restrictor 21 that is connected to the inlet strainer 13 in the region of the free ends of the bristles 18, i.e. at the lower region of the inlet strainer 13. The object of the bristle deflect restrictor 21 is to limit the movement of the bristles 18. The bristle deflect restrictor 21 may comprise barriers that prevent the bristles 18 from deflecting/bending radially outwards away from the inlet strainer 13 when the bristle trap 16 is located upstream the inlet strainer 13 or radially outwards towards the inlet strainer 13 when the bristle trap 16 is located downstream the inlet strainer 13, may comprise barriers that prevent the bristles 18 from deflecting/bending radially inwards away from the inlet strainer

13 when the bristle trap 16 is located downstream the inlet strainer 13 or radially inwards towards the inlet strainer 13 when the bristle trap 16 is located upstream the inlet strainer 13, and/or may comprise barriers that prevent the bristles 18 from deflecting/bending in the circumferential direction of the pump 2.

[0036] The bristle trap 16 body 17 has an axial height that is equal to or more than 10 millimeters and equal to or less than 80 millimeters, mostly depending on the specific application, i.e. the type and shape of the specific pump 2. Thereto, the body 17 has a radial width that is equal to or more than 5 millimeters and equal to or less than 30 millimeters, mostly depending on the specific application, i.e. the type and shape of the specific pump 2 and inlet strainer 13. The body 17 is made of a material chosen from the group consisting of thermoplastic rubbers, thermoplastic elastomers and thermoplastic vulcanisates. Due to said materials, the bristle trap 16 body 17, which is preferably manufactured from a straight elongated bar, tolerates to be bent around the inlet strainer 13 without experiencing detrimental stresses or strains.

[0037] The bristle trap 16 body 17 is provided with seats/bores 22 that are open downwards, i.e. located in the lower surface of the body 17, wherein the bristles 18 are located/inserted into the seats/bores 22. More precisely the upper end of the bristles 18 are located/inserted into the seats/bores 22. It shall be pointed out that the term seat/bore shall be understood as being a location in a pattern. The seat/bore is a recess/hole that may be drilled, moulded, etc. Herein the term bore is used for the sake of simplicity.

[0038] Preferably, the bores 22 are cylindrical and preferably the diameter of the bores 22 is equal to or more than 2 millimeter and equal to or less than 7 millimeters. Alternatively, the bores 22 may have another cross sectional shape. Thus, independently of the cross sectional shape of the bore 22, it shall be possible to inscribe a circle having a diameter of 2 millimeter into the bore 22, i.e. the minimum diameter of the bore 22 is 2 millimeter, and it shall be possible to inscribe the bore 22 into a circle having a diameter of 5 millimeters, i.e. the maximum diameter of the bore 22 is 5 millimeter. It shall be pointed out that the different bores 22 of the bristle trap 16 may have different or the same diameter/shape. Preferably the diameter of the bore is equal to or more than 4 millimeters.

[0039] Thereto, the depth of the bore 22 is equal to or more than 3 millimeters and equal to or less than 30 millimeters. The bore 22 shall preferably not extend all the way through the bristle trap 16 body 17. It shall be pointed out that the bores 22 may have different or the same depth. According to the preferred embodiment the bores 22 are parallel to each other and extend in the axial/vertical direction. However, according to an alternative embodiment the bores 22 may be inclined in the circumferential direction in relation to the axial/vertical direction, and it shall be pointed out that the bores 25 may have different or the same inclination/orientation.

[0040] According to an alternative embodiment, not disclosed, the bristle trap 16 body 17 is molded around the end of the bristles 18, such that bores according to the above dimensions are formed, i.e. concerning depth, diameter, orientation, etc.

[0041] The bristles 18 are preferably arranged in bunches of bristles 18, wherein one bunch of bristles is inserted into one bore 22 of the bristle trap 16 body 17. Preferably each bunch of bristles comprises ten or more bristles 18, most preferably fourteen or more bristles 18. Thereto, the bristles 18 may be folded at the upper end, i.e. a pair of bristles are interconnected at the upper end, wherein the upper end is inserted into the bore 22 of the bristle trap 16 body 17. Each bunch of bristles 18 preferably comprises two, three or more folded bristle pairs, i.e. adding up to four, six or more bristles 18. In a preferred embodiment each bunch of bristles comprises eight folded bristles pairs. One advantage of having one or more folded bristle pairs is that the bristles 18 may be secured into the bore 22 by means of a staple or the like pressed into the bore 22 together with the bristles 18, wherein the folded bristles 18 are securing/detained in the bore 22. It shall be pointed out that the bunches of bristles 18 may comprise different or the same number of bristles 18.

[0042] Preferably, the diameter of a single bristle 18 is equal to or more than 0,3 millimeters and equal to or less than 3 millimeters, preferably equal to or more than 0,8 millimeter and equal to or less than 2 millimeters. The bristles 18 are made of a material chosen from the group consisting of polyamide, polyvinylchloride, polypropylene and polyester. Due to said materials, the bristles 18 have enhanced resistance against fouling. The bristles 18 preferably have a circular cross sectional shape. Alternatively, the bristles 18 may have another cross sectional shape. Thus, independently of the cross sectional shape of the bristles 18, it shall be possible to inscribe a circle having a diameter of 1 millimeter into the bristle 18, i.e. the minimum diameter of the bristle 18 is 0,3 millimeter, and it shall be possible to inscribe the bristle 18 into a circle having a diameter of 3 millimeters, i.e. the maximum diameter of the bristle 18 is 3 millimeter. It shall be pointed out that the bristles 20 may have different or the same diameter/shape.

[0043] Preferably, more than 95 % of the through holes 14 of the inlet strainer 13 are overlapped by several bristles 18, preferably at least four bristles 18.

[0044] Reference is now made to figures 6 and 7 disclosing a schematic bristle trap 16 according to a first conceptual embodiment. Figure 6 is a schematic cross sectional side view from below of a bristle trap 16 according to a first conceptual embodiment and figure 7 is an enlarged section of figure 6, both taken at the lower end region of the body 17. The first conceptual embodiment is applicable when the bristle trap 16 is located upstream as well as downstream the inlet strainer 13.

[0045] According to figures 6 and 7, the bores 22 are distributed along one or more circumferential rows, i.e. the bunches of bristles 18 are distributed along one or

more circumferential rows. The circumferential rows of bores 22 most not be circular but follows the overall shape of the inlet strainer 13 or the pump 2. Preferably the bristle trap 16 comprises three circumferential rows of bores 22.

5 One circumferential row of bores 22 is preferably considered as being endless according to the first conceptual embodiment even thus the bristle trap 16 body 17 is divided having adjacent ends.

[0046] Adjacent bores 22 of a circumferential row are separated in the circumferential direction, wherein the center-to-center distance X is equal to or more than 1,5 times the length of the bore 22 and equal to or less than 4 times the length of the bore 22, the length of the bore 22 being taken/measured alongside the circumferential row/direction. Preferably, the center-to-center distance X is equal to or less than 2,5 times the length of the bore 22. The center-to-center distance X in the circumferential direction may vary within one circumferential row of bores 22 and/or may vary between different circumferential rows of bores 22. The bores 22 of one circumferential row may be inclined in a first circumferential direction, and the bores 22 of another circumferential row may be inclined in a second circumferential direction that is opposite the first circumferential direction. When observed in the radial direction and moving around the pump 2, at least 75 % of the total circumference of the bristle trap 16 shall comprise bores 22, preferably at least 90 %.

[0047] The radial center-to-center distance Y between two mutually overlapping circumferential rows of bores 22 is equal to or more than 1 times the width of the bore 22 and equal to or less than 4 times the width of the bore 22, the width of the bore being taken/measured perpendicular to the circumferential row/direction. Preferably, the radial center-to-center distance Y is equal to or less than 2,5 times the width of the bore 22. The bores 22 of one circumferential row are arranged offset in the circumferential direction in relation to the bores 22 of the neighboring circumferential row.

[0048] According to an alternative realization of the first conceptual embodiment (not disclosed) the bristle trap 16 comprises two or more bodies 17 each having a radial width at the lower end of the described range, wherein the bodies 17 are arranged one outside the other and each extending one turn around the pump 2. Thereby each body 17 is easier to bend around the pump 2 or inlet strainer 13, i.e. will follow the shape of the pump 2 or inlet strainer 13 better with less internal stress/strain. Each body 17 may comprise one or more circumferential rows of bores 22 as described above, preferably one row of bores 22.

[0049] Reference is now made to figures 8 and 9 disclosing a schematic bristle trap 16 according to a second conceptual embodiment. Figure 8 is a schematic cross sectional side view from below of a bristle trap 16 according to a second conceptual embodiment, and figure 9 is an enlarged section of figure 8, both taken at the lower end region of the body 17. The second conceptual embodiment is applicable when the bristle trap 16 is located

upstream as well as downstream the inlet strainer 13.

[0050] According to figures 8 and 9, the bores 22 are distributed along one or more circumferential rows, i.e. the bunches of bristles 18 are distributed along one or more circumferential rows. The circumferential rows of bores 22 follow the shape of the inlet strainer 13 or the pump 2. Preferably the bristle trap 16 comprises three circumferential rows of bores 22. One circumferential row of bores 22 is shaped as one turn of a spiral according to the second conceptual embodiment. According to the second conceptual embodiment the bristle trap 16 body 17 extends several turns around the pump 2 or inlet strainer 13. Wherein the radial width of the body 17 is at the lower end of the described range, wherein the body 17 is arranged as a spiral one turn outside the other. Thereby the body 17 is easier to bend around the pump 2 or inlet strainer 13, i.e. will follow the shape of the pump 2 or inlet strainer 13 better with less internal stress/strain. Each turn of the body 17 may comprise one or more circumferential rows of bores 22 as described above, preferably one row of bores 22.

[0051] The diameter, depth, orientation, etc. of the bores 22 as described in connection with the first conceptual embodiment is also applicable to the second conceptual embodiment.

Feasible modifications of the Invention

[0052] The invention is not limited only to the embodiments described above and shown in the drawings, which primarily have an illustrative and exemplifying purpose. This patent application is intended to cover all adjustments and variants of the preferred embodiments described herein, thus the present invention is defined by the wording of the appended claims and the equivalents thereof. Thus, the equipment may be modified in all kinds of ways within the scope of the appended claims.

[0053] It shall also be pointed out that all information about/concerning terms such as above, under, upper, lower, etc., shall be interpreted/read having the equipment oriented according to the figures, having the drawings oriented such that the references can be properly read. Thus, such terms only indicates mutual relations in the shown embodiments, which relations may be changed if the inventive equipment is provided with another structure/design.

[0054] It shall also be pointed out that even thus it is not explicitly stated that features from a specific embodiment may be combined with features from another embodiment, the combination shall be considered obvious, if the combination is possible.

[0055] Throughout this specification and the claims which follows, unless the context requires otherwise, the word "comprise", and variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or steps or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

Claims

1. A drainage pump assembly (1) for pumping liquid comprising solid matter, comprising a drainage pump (2), wherein the drainage pump (2) comprises:
 - a drive unit having an electrical motor (7) and a drive shaft (8),
 - a hydraulic unit having an impeller (9) connected to the drive shaft (8) and arranged in a volute (6),
 - an inlet opening (3) located upstream the volute (6) and an outlet opening (5) located downstream the volute (6), and
 - a rigid inlet strainer (13) located upstream the inlet opening (3) and having a plurality of through holes (14) through which the pumped liquid will flow to reach the inlet opening (3), **characterized in that** the drainage pump assembly (1) comprises a bristle trap (16), wherein the bristle trap (16) comprises a body (17) connected to the drainage pump (2) and comprises bristles (18) connected to and extending from said body (17), wherein the bristles (18) are arranged adjacent the inlet strainer (13) and the through holes (14) of the inlet strainer (13) are overlapped by said bristles (18).
2. The drainage pump assembly according to claim 1, wherein the bristles (18) are inserted into bores (22) provided in the body (17).
3. The drainage pump assembly according to claim 2, wherein the bristles (18) are arranged in bunches of bristles, wherein each bunch of bristles are inserted into each bore (22) provided in the body (17).
4. The drainage pump assembly according to claim 2 or 3, wherein the bores (22) are distributed along one or more circumferential rows.
5. The drainage pump assembly according to claim 4, wherein adjacent bores (22) of a circumferential row are separated in the circumferential direction and wherein the center-to-center distance is equal to or more than 1,5 times the length of the bore (22) and equal to or less than 4 times the length of the bore (22), the length of the bore being taken along the circumferential row.
6. The drainage pump assembly according to claim 4 or 5, wherein the radial center-to-center distance between two mutually overlapping circumferential rows of bores (22) is equal to or more than 1 times the width of the bore (22) and equal to or less than 4 times the width of the bore (22), the width of the bore being taken perpendicular to the circumferential row.

7. The drainage pump assembly according to any of claims 2-6, wherein the bores (22) are cylindrical and the diameter is equal to or more than 2 millimeter and equal to or less than 7 millimeters. 5
8. The drainage pump assembly according to any of claims 2-6, wherein each bore (22) has a depth that is equal to or more than 3 millimeters and equal to or less than 30 millimeters. 10
9. The drainage pump assembly according to any preceding claim, wherein the diameter of a single bristle (18) is equal to or more than 0,3 millimeters and equal to or less than 3 millimeters. 15
10. The drainage pump assembly according to any preceding claim, wherein the bristles (18) are made of a material chosen from the group consisting of polyamide, polyvinylchloride, polypropylene and polyester. 20
11. The drainage pump assembly according to any preceding claim, wherein the body (17) has an axial height equal to or more than 10 millimeters and equal to or less than 80 millimeters. 25
12. The drainage pump assembly according to any preceding claim, wherein the body (17) has a radial width equal to or more than 5 millimeters and equal to or less than 30 millimeters. 30
13. The drainage pump assembly according to any preceding claim, wherein the body (17) is made of a material chosen from the group consisting of thermoplastic rubbers, thermoplastic elastomers and thermoplastic vulcanisates. 35
14. The drainage pump assembly according to claim 1, wherein the bristle trap (16) is located upstream the inlet strainer (13). 40
15. The drainage pump assembly according to claim 1, wherein the bristle trap (16) is located downstream the inlet strainer (13). 45
16. The drainage pump assembly according to claim 14 or 15, wherein the drainage pump (2) comprises a bristle deflect restrictor (21) connected to the inlet strainer (13) in the region of the free end of the bristles (18). 50

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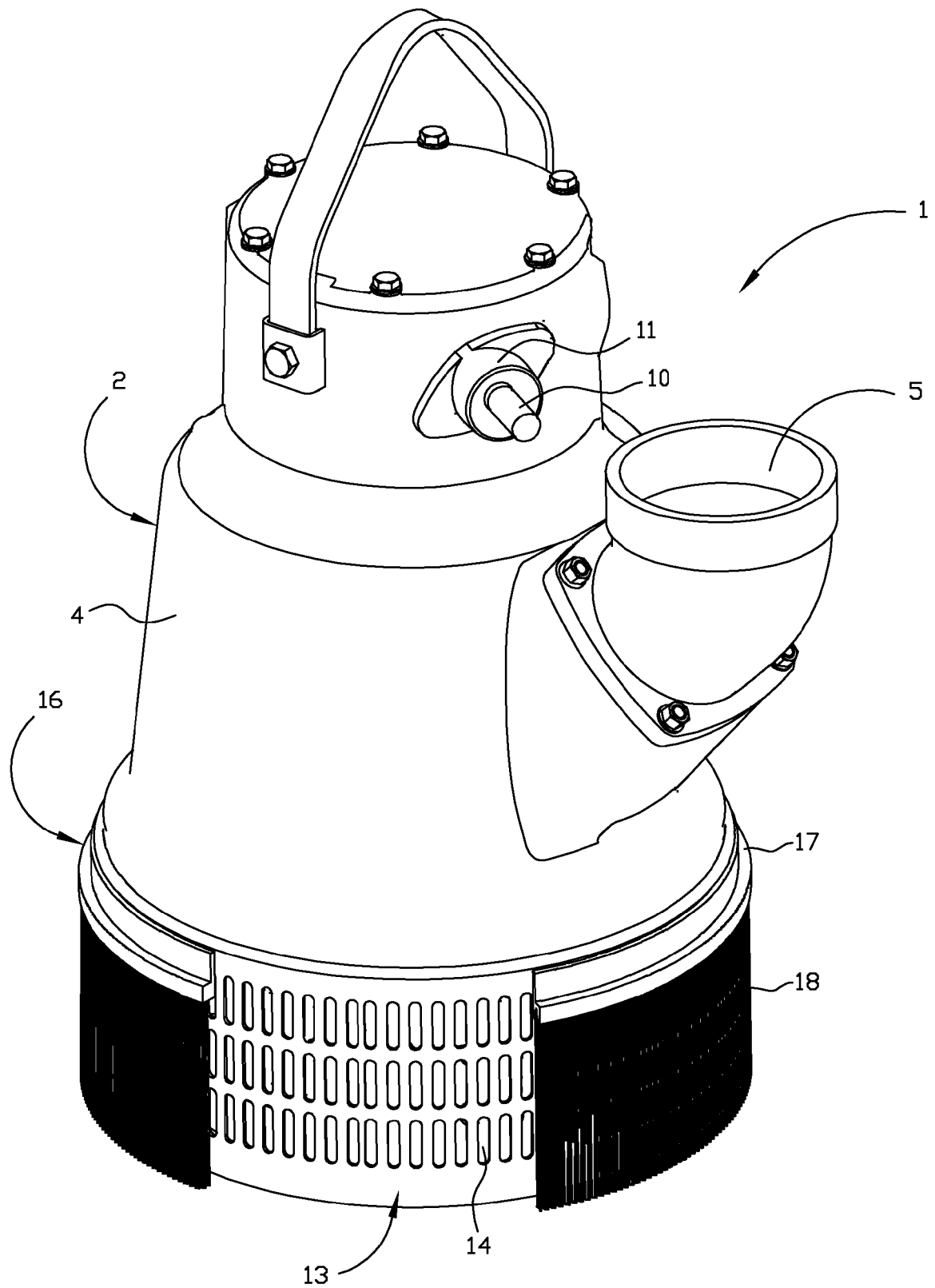


Fig. 1

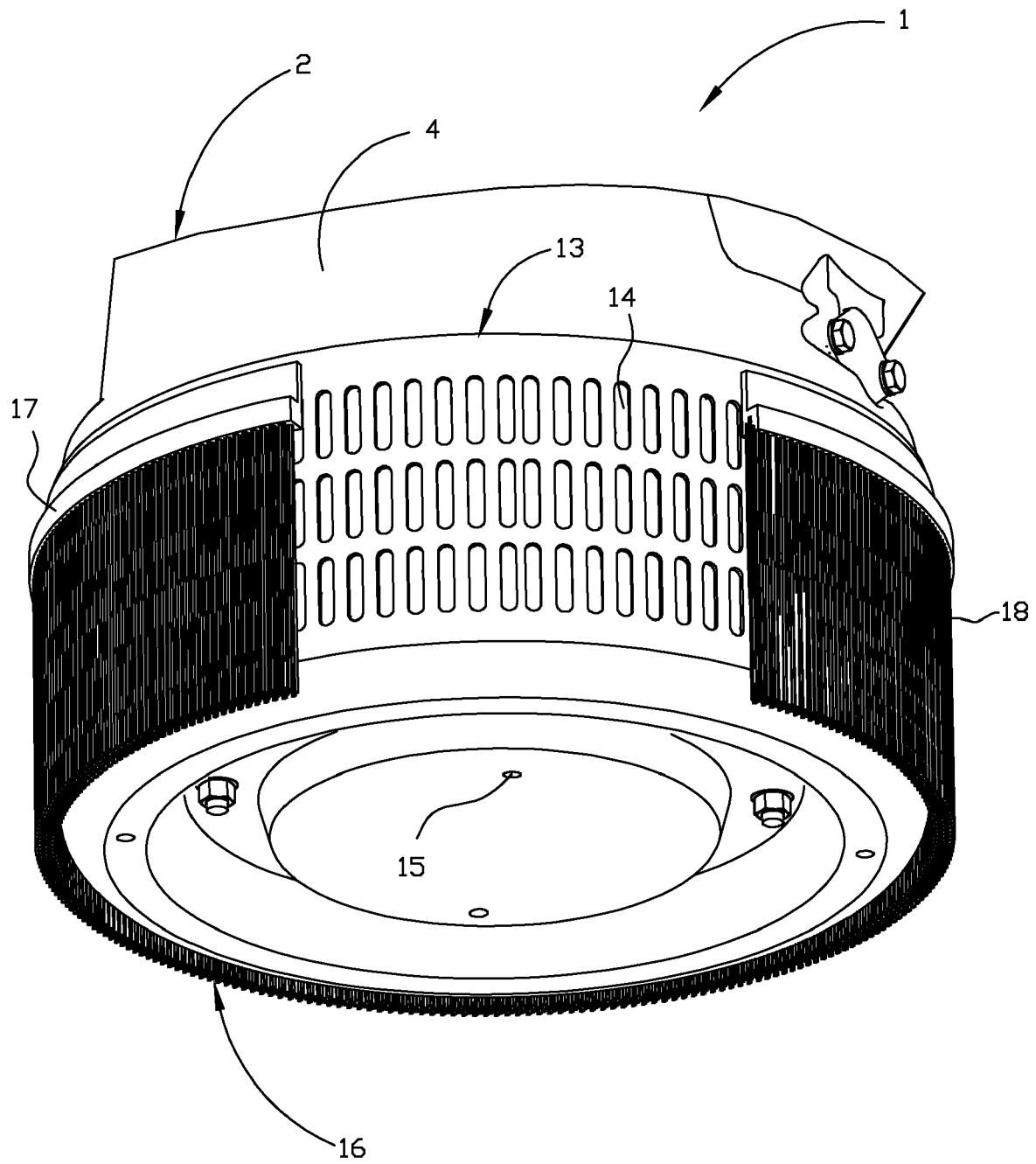


Fig. 2

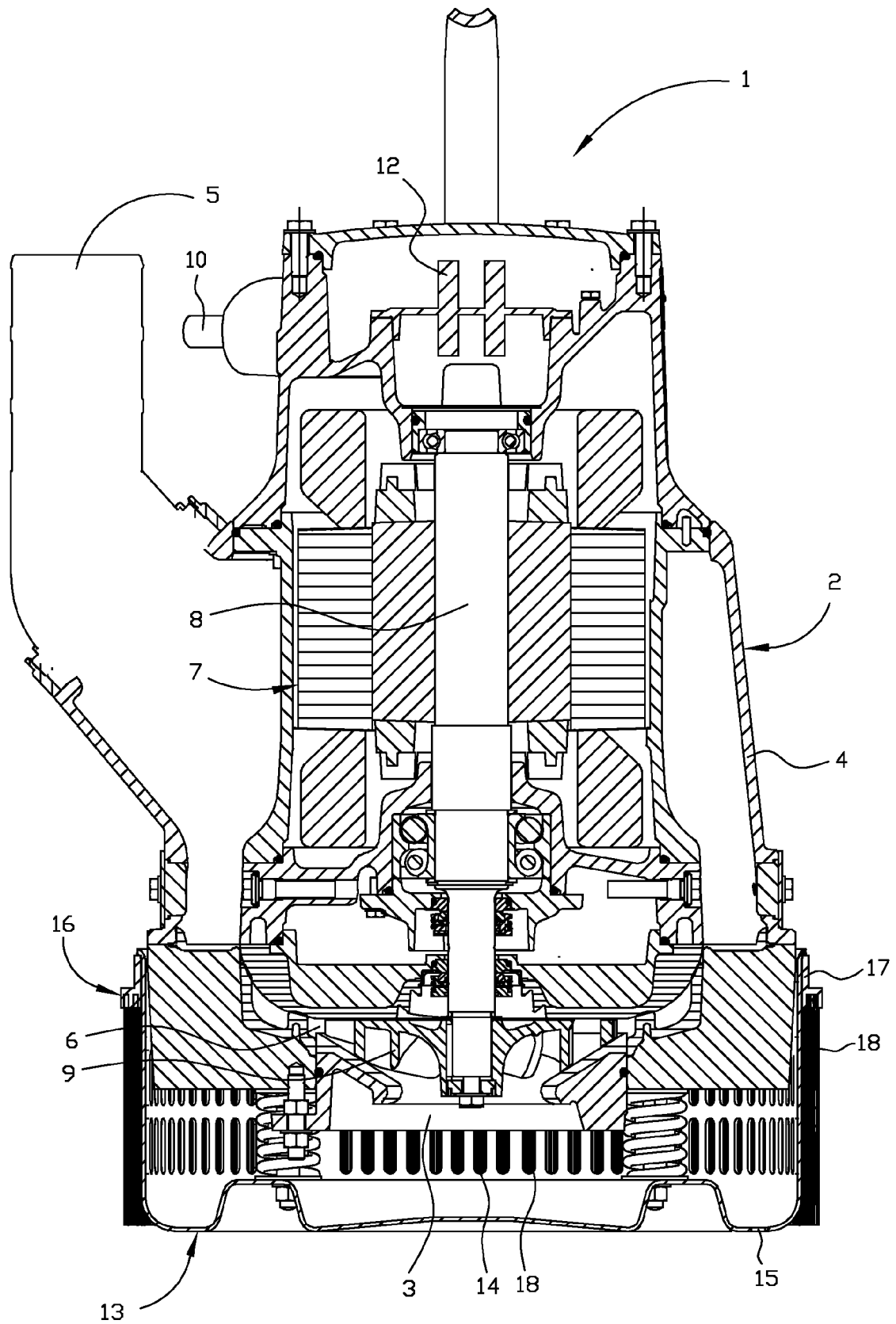


Fig. 3

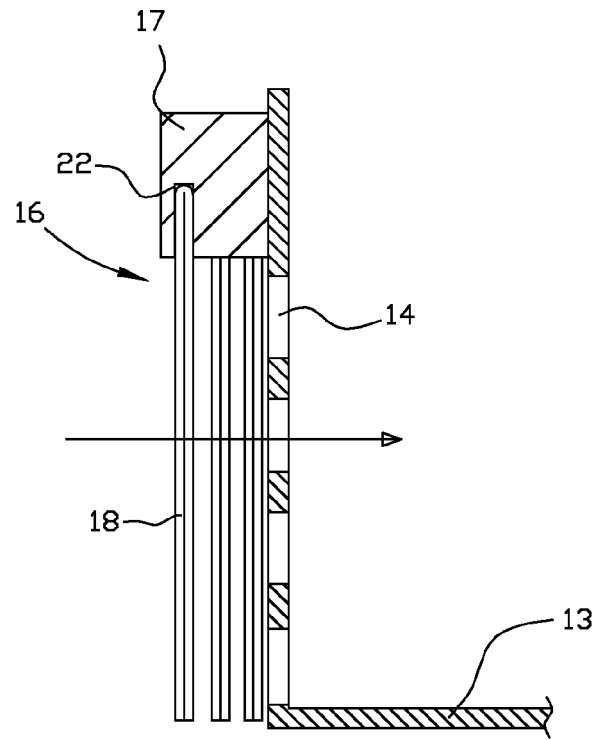


Fig. 4

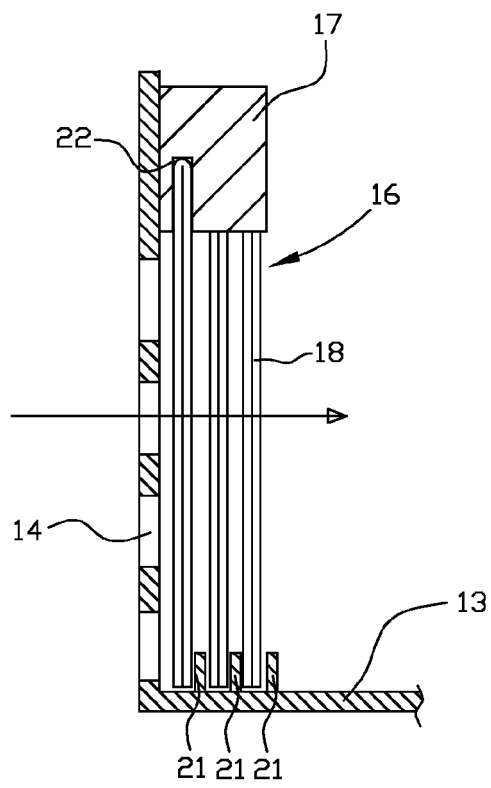


Fig. 5

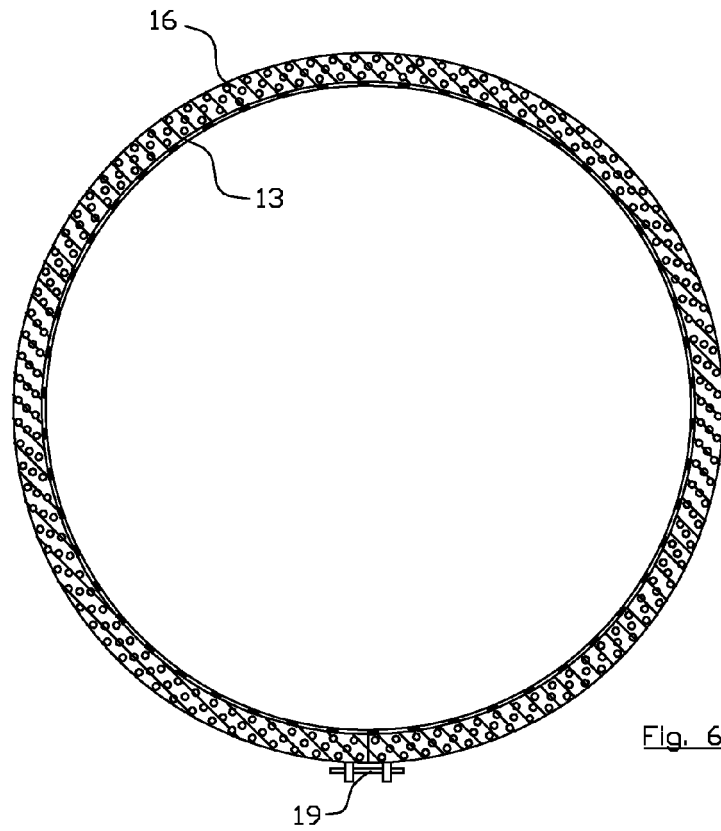


Fig. 6

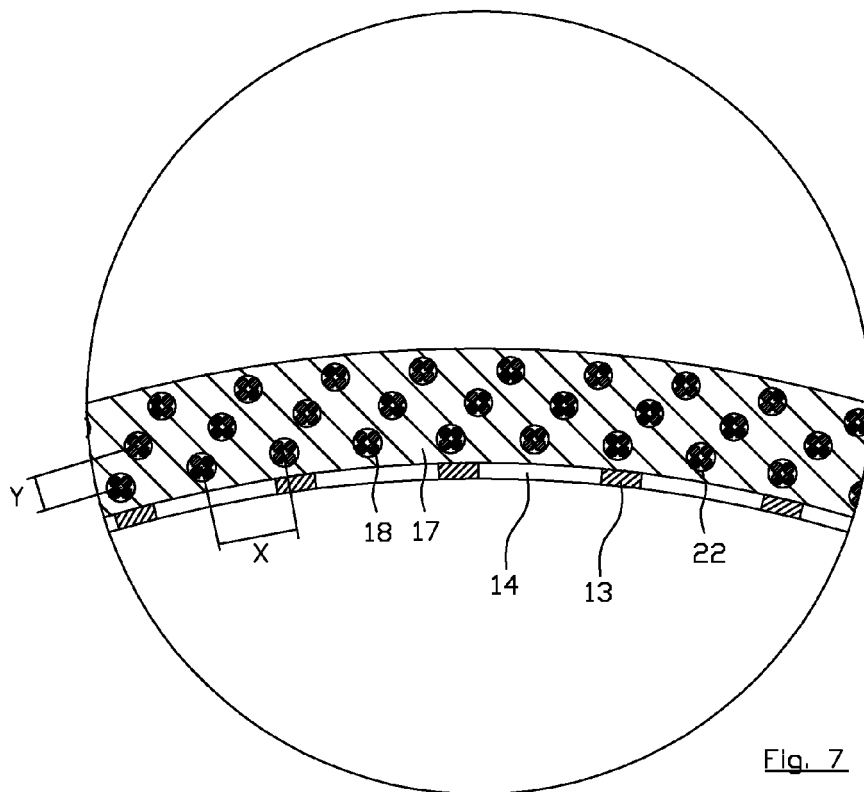


Fig. 7

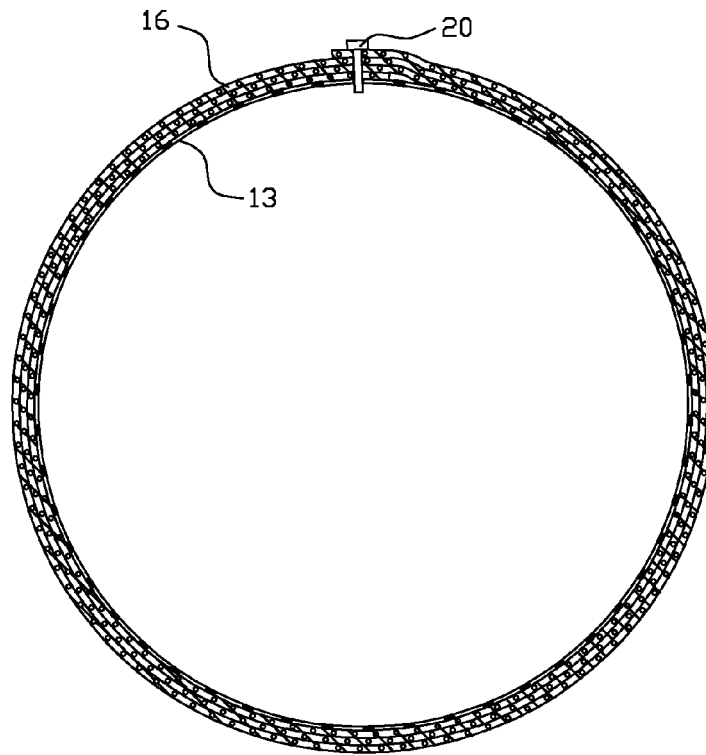


Fig. 8

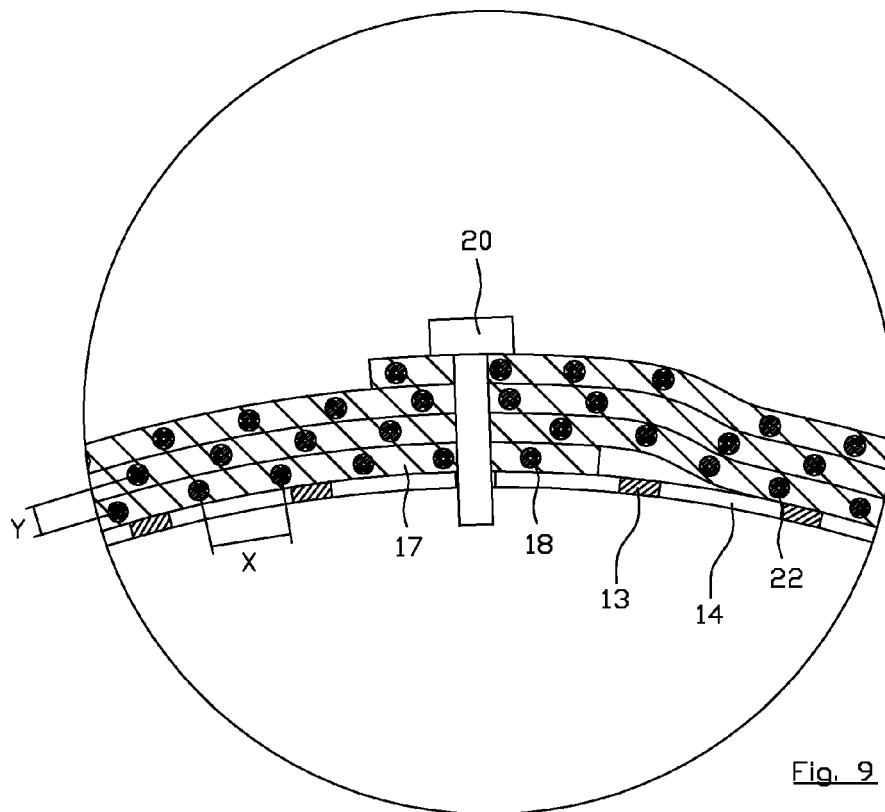


Fig. 9



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Place of search The Hague		Date of completion of the search 19 February 2020	Examiner De Tobel, David
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