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(54) DEVICE FOR PROTECTION OF WASTEWATER PUMPS FOR WET ACCUMULATION CHAMBERS

VORRICHTUNG ZUM SCHUTZ VON ABWASSERPUMPEN FÜR NASSSPEICHERKAMMERN

DISPOSITIF DE PROTECTION DE POMPES D'EAUX USÉES POUR CHAMBRES D'ACCUMULATION HUMIDES

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EP 3 724 508 B1

Description

Technical field

[0001] The technical solution relates to a device for protection of pumps in communal wastewater pumping stations, those from industry, agriculture, rain water or drinking and raw water.

Background art

[0002] At present bar screen baskets and manually or mechanically scraped bar screens or sieves are used for capturing solid particles in wastewater pumping stations. Accordingly, current technologies require frequent human intervention into the process. However, long-term and comprehensive experiences in operating such pumping stations show that said devices suffer from significant drawbacks. Necessary handling of caught solid particles (rakings) that have to be removed from the pumping station and transported to a waste dump or to a wastewater treatment plant is a disadvantage of baskets, bar screens and sieves.

[0003] There are also cases when no devices for separating those particles are installed into pumping stations. In those cases pumps having greater throughput rate and comprising crushing devices are chosen.

[0004] When chosing a pump enjoying a greater throughput rate, pumping over greater solid particles anticipated in wastewater is provided, however, it is a common practice that greater solid particles in wastewater tend to clump. If a pump sucks such a cluster having dimensions greater than a maximum possible throughput of an impeller of the respective pump the pump blocks. Such situations occur in practice quite often.

[0005] On the other hand, pumps comprising a crushing device often suffer from rapid abrasion of crushing devices resulting in their non-functioning. Consequently, the pumps are blocked and damaged, which require physical cleaning of pumps or their maintenance.

[0006] In these cases operation services of pumping stations are financially demanding due to frequent dispatch of maintenance workers to pumping stations. Handling the rakings and pump cleaining often result in contamination of surroundings of a pumping station by wastewater.

[0007] Document US 5 954 484 A discloses a sewage lifting station having at least two solid waste collection chambers for receiving pumped solid waste-contaminated sewage. The station has a collection tank for receiving pre-treated waste water flowing from the solid waste collection chambers via connection pipes. Each solid waste collection chamber is connected to a pump to empty the collection tank via one of the connection pipes and solid waste collection chambers to pump the current of sewage into a pressure pipeline.

Summary of the technical solution

[0008] The aforementioned drawbacks are removed by the device for protection of wastewater pumps for wet accumulation chambers according to the present technical solution, in which according to the first embodiment a device for protection of wastewater pumps according to claim 1 is provided.

[0009] Waste water containing solid particles flowing through an inlet pipe into a wet accumulation chamber is directed to the separation chamber through a supply pipe. It further flows from the separation chamber through the solid particles separator via the biderictional pipe and through a pump into the wet accumulation chamber. The solid particles separator captures solid particles and thereby they accumulate in the separation chamber. Particles having higher dimensional weight (sand, gravel) than a pumped medium accumulate at the bottom of the separation chamber due to sedimentation and they do not pass further onto a pump impeller. After starting the pump pressurised water is pumped back from the wet accumulation chamber through the bidirectional pipe, solid particles separator and through the separation chamber into the discharge pipe and further to a sewerage network. Simultaneously, the separator is washed by reverse pumping of wastewater. A reversing valve precludes reverse flow of wastewater into the supply pipe.

[0010] A solid particle is understood to be a solid particle having dimensions exceeding a throughput rate of a pump impeller installed in a pumping station or a particle capable of causing abrasion of blades of the pump impeller. Sand, gravel as well as fabrics, hygienic tissues, foils of various types, clusters of various materials and the likes can form the solid particle.

[0011] Preferably, the separation chamber is shaped as a cylinder that may be arranged either vertically or horizontally. The separation chamber comprises an upper part, bottom and side wall/walls. The separation chamber further comprises openings for respective pipes.

[0012] A bidirectional pipe and a discharge pipe are attached in a lower part of the separation chamber so that their orifices are situated opposite each other across the separation chamber. The lower part of the separation chamber is meant to be a space immediately above the bottom of the separation chamber. Such arrangement results in that solid particles pumped together with wastewater accumulated at the bottom of the separation chamber are discharged from the separation chamber into the discharge pipe and transported further to the sewerage network or to the wastewater treatment plant. That results in self-cleaning of the separation chamber from separated solid particles.

[0013] Preferably, the supply pipe is situated so that it opens into the separation chamber on its top. The reversing valve may consist of for example a seat and a float ball. During pumping water pressure presses the float ball into the seat preventing backflow of wastewater.

[0014] Preferably, the discharge pipe directs from a side wall of the chamber first obliquely upward at an angle of 30° to 70° with respect to the bottom of the separation chamber, more preferably at an angle of 50° and then it is curved so that it is directed perpendicularly upward. It is an advantage of said embodiment that the pipe does not include a right angle and solid particles are discharged through the discharge pipe without any problems by water pressure.

[0015] According to the invention the bidirectional pipe is branched. One branch opens through a side wall into the lower part of the separation chamber, like in the previous case, and the other branch opens through the side wall into the upper part of the separation chamber. The upper part of the separation chamber is understood as a space of the separation chamber below the reversing valve. Both branches are attached to the separation chamber through an individual solid particles separator. Branching of the bidirectional pipe into two height levels results in enhancement of hydraulic characteristics in the separation chamber. After the pump is switched on, pressurised flow is partially directed through one branch of the bidirectional pipe to the upper part of the separation chamber and a part of the pressurised flow is directed through another branch of the bidirectional pipe to the lower part of the separation chamber. This results in mixing of the contents of the separation chamber in the immediate moment prior to the discharge of the captured solid particles into the discharge pipe itself. The self-cleaning effect as such is even increased by the present solution and a risk that the separation chamber is not completely cleared of the separated solid particles is minimal.

[0016] Greater filtration capacity of the device that also deals with eventual occurrence of an impact plurality of deposited solid particles is another advantage of the branched bidirectional pipe. Said situation is not exceptional in the practice of sewerage network operations. Accumulation of solid particles at the bottom of the separation chamber may result in partial or total blockage of the flow capacity (clogging) of the first solid particles separator positioned in the lower part of the separation chamber. In the branched bidirectional pipe wastewater filtration will continue through the second solid particles separator positioned in the upper part of the separation chamber and through the upper branch of the bidirectional pipe. After the pump is switched on, wastewater is pumped reversely causing washing the separators and cleaning the separation chamber.

[0017] According to the invention the supply pipe is in the form of a perforated inlet trough. From a certain height walls of the inlet trough are provided with filtration perforations. The function of the trough is on one hand directing water into the separation chamber, but simultaneously also separation and filtration of storm sewage through perforations in the side walls of the trough. Size of perforations in the side walls of the trough is dimensioned according to the throughput rate of the pump impeller installed in the pumping station. Arrangement of perforations on the walls, their amount and design are determined by the value of the maximal critical inlet into the pumping station. Accordingly, an average daily flow is securely let into the separation chamber through the inlet trough and eventual critical flow is passed through the filtration perforation directly into the wet accumulation chamber in order to avoid flooding of the separation chamber. Filtration perforations prevent passing the solid particles of sizes greater than the throughput rate of the pump impeller into the accumulation chamber and said solid particles are passed through into the separation chamber by the trough.

[0018] The accumulation chamber may comprise a plurality of pumps, in that case each pump is provided with a separate device according to the present solution. Said devices may, however, share one supply pipe or inlet trough.

[0019] A sieve having opening sizes dimensioned according to the throughput rate of a pump impeller may be a solid particles separator. A disadvantage of the sieve is that it is quickly clogged, in particularly, when there are fabrics or disposable hygienic tissues and the like in wastewater. In addition, when wastewater is pumped reversely the separator is only partially washed as the said fabrics tend to enmesh into the sieve.

[0020] According to a preferred embodiment a device according to the present technical solution may comprise a rod solid particles separator. The rod separator consists of a frame provided about the inner circumference with rods having at minimum two or three or more lengths. The frame may preferably be of an annular shape. Alternatively, the outer circumference of the grame may be of a square, rectangular or other geometric shape. Rods are arranged alternately (long, short, long, short) on the frame. Rods protrude radially from the body plane onto one side at an angle in such a manner that a surface that longitudally intersects all rods forms a truncated cone or truncated pyramid (frustum). Rods are arranged so that a space between two neighboring rods and at the same time space between free ends of any two long rods does not exceed the size the throughput rate of the pump impeller is dimensioned for. In practice a distance between the rods is in the range of 15 to 100 mm. Rod length may be for example 20 and 50 mm, 20 and 60mm, 15 and 60mm, 20 and 80mm and the like. Length of the rods primarily depends on the throughput rate of the pump impeller. Said rod solid particles separator is positioned between a flange of the bidirectional pipe and a flange of the separation chamber in a way the rods are directed into the space of the separation chamber. The rod separator may be preferably provided with means for fastening in the flange e.g. in the form of openings. The rod separator may be preferably provided with at least one groove for mounting a sealing.

[0021] Increasing of filtration surface of the solid particles separator resulting in lowering a risk of clotting the separator is an advantage of the rod design of the sep-

arator. In addition, during reverse pumping of wastewater the separator is washed more thoroughly as fabrics tend to slip from the rods.

[0022] The pump is commonly positioned at the bottom of the wet accumulation chamber and according to the present technical solution it may be attached to bidirectional pipe of the device by means of a dismountable coupling through a pipe of the pump. The discharge pump of the device may be connected by a dismountable coupling to the discharge pump of the pumping station. Lengths of individual pipes depend on a depth of the pumping station and a distance of the inlet pipe of wastewater from the bottom of the pumping station.

[0023] For better handling during installation of the device according to the present technical solution into a pumping station the bidirectional pipes and the pipe of the pump as well as the discharge pipe and the discharge pipe of the pumping station are connected with dismountable couplings at the separation chamber proximity.

[0024] The device according to the present technical solution provides for the pump not to come into contact with solid particles that cause its excessive wearing-off, clogging and breakdowns.

[0025] The device according to the present technical solution provides a plurality of economic and ecologic advantages, namely the device can be installed into wet chambers of new as well as in a majority of existing pumping stations without a requirement of building modifications of the pumping stations. Accordingly, in majority cases the device requires no other than already existing space in the pumping station, nor further construction works. After installation, frequency of dispatching of operator's maintenance workers to the pumping stations for pump cleaning, maintenance and repair purposes decreases, pump life increases, the need for handling the rakings is eliminated resulting in reduction of ecological burden of environment in the surrounding of the pumping station.

Brief desciption of the drawings

[0026]

Fig. 1 shows a device for protection of waste water pumps for wet accumulation chambers according to a first example which is not a part of the present invention.

Fig. 2 shows a device for protection of waste water pumps for wet accumulation chambers according to a second example which is according to the present invention

Fig. 3 illustrates a design of a rod solid particles separator.

Fig. 4 shows a device for protection of waste water pumps for wet accumulation chambers which contains two pumps and a supply pipe which is in the form of a perforated inlet through according to the present invention.

Deatiled description

Example 1 (not a part of the present invention):

[0027] Fig. 1 shows a device for protection of wastewater pumps comprising separation chamber 4 substantially in the form of a perpendicularly positioned cylinder. Said separation chamber is provided in its lower part with discharge pipe 9 of the chamber that is further connected by a dismountable coupling onto discharge pipe 9.1 of a pumping station, that is further connected to sewerage network 11. The device further comprises supply pipe 2, connected to inlet pipe 1. Supply pipe 2 is from another side connected from the top to separation chamber 4 to inlet wastewater into separation chamber 4. A reversing valve for preventing reverse flow of wastewater into supply pipe 2 is positioned between supply pipe 2 and separation chamber 4. Said valve consists of seat 3 arranged on supply pipe 2 and corresponding float ball 5 positioned in separation chamber 4. Bidirectional pipe 7 is connected on chamber 4 in the lower part of separation chamber 4 opposite the orifice of discharge pipe 9 of the chamber. Said bidirectional pipe 7 is connected to pump pipe 7.1 and connects the device with pump 10 positioned in wet accumulation chamber 8. Rod separator 6 of solid particles is arranged between separation chamber 4 and bidirectional pipe 7. The role of the rod separator 6 of solid particles is separating solid particles contained in wastewater in separation chamber 4.

[0028] During operation of the device wastewater flows from separation chamber 4, through rod solid particles separator 6 via bidirectional pipe 7 into pump 10 and consequently to wet accumulation chamber 8. Solid particles contained in wastewater are filtrated by solid particles separator 6 and are accumulated at the bottom of separation chamber 4. When water surface in wet accumulation chamber 8 reaches a set switching level pump 10 is switched on. After pump 10 is switched on wastewater from wet accumulation chamber 8 is pumped back by pump 10 through bidirectional pipe 7 and rod solid particles separator 6 into separation chamber 4. An increasing level of pumped wastewater in separation chamber 4 presses float ball 5 onto seat 3, closing the inlet into supply pipe 2. Pumped waster continues further from separation chamber 4 into chamber discharge pipe 9 and further to pump station discharge pipe 9.1. Solid particles accumulated at the bottom of separation chamber 4 are also discharge from separation chamber 4 by pressure of pumped water into chamber discharge pipe 9 and through pump station discharge pipe 9.1 they are further transported into sewerage network 11.

Example 2:

[0029] Fig. 2 shows an embodiment of the device for pump protection according to the present invention.

[0030] The device comprises all parts of the device according to Example 1. The device differs from the device according to Example 1 in that bidirectional pipe 7 is branched. One branch opens into a lower part of separation chamber 4, as in Example 1, and another branch opens into an upper part of separation chamber 4. Both branches are connected to the separation chamber through a separate solid particles separator 6.1, 6.2. According to the invention, but not visible in figure 2, the supply pipe 2 is in the form of a perforated inlet trough.

Example 3:

[0031] Fig. 3 shows a rod solid particles separator which can be used in the device for protection of waste water pumps for wet accumulation chambers according to the present invention, consisting of frame 12 of annular shape where said ring is about its inner circumference provided with rods 13 and 14 of at least two lengths. The rods are on the frame, they are arranged alternately (long, short, long, short). Simultaneously, the rods radially protrude from the frame plane into one side at an angle in a way a plane intersecting their surfaces forms a truncated cone (frustum). The rods are arranged so that a space between any two rods does not exceed the size the throughput rate of the pump impeller is dimensioned for. In practice the distance between the rods is in the range of 15 to 100 mm.

Example 4:

[0032] Figure 4 shows connection of the devices according to the present technical invention in a wet accumulation chamber containing two pumps. The devices are similar to the device described in Example 2. The devices differ from the device in Example 2 in that they comprise only one common supply pipe 2 in the form of a perforated inlet trough. The inlet trough is connected to inlet pipe 1. From a certain height walls of the inlet trough are provided with filtration perforations. Size of the perforations is dimensioned according to the throughput rate of pump impeller 10 and 10'. Arrangement of perforations in the side walls of the inlet trough are determined by a value of the maximal critical inlet into the pumping station. Accordingly, the perforations are arranged in such height of the trough wall that an average daily flow is securely let in to separation chambers 4 and 4' through the inlet trough and eventual critical flow is passed directly into wet accumulation chamber 8.

List of reference signs:

[0033]

1 - Inlet pipe
2 - Supply pipe
3 - Reversing valve seat
4 - Separation chamber
5 - Float ball
6 - Solid particles separator
6.1 - First solid particles separator
6.2 - Second solid particles separator
7 - Bidirectional pipe
7.1 - Pump pipe
8 - Pumping station wet accumulation chamber
9 - Chamber discharge pipe
9.1 - Pump station discharge pipe
10 - Pump
11 - Sewerage network
12 - Solid particles separator rod body
13 - Separator short rod
14 - Separator long rod

Claims

1. Device for protection of wastewater pumps for wet accumulation chambers, wherein, it comprises:

- a separation chamber (4) provided with discharge pipe (9) for discharge wastewater into a sewerage network,
- a supply pipe (2), connected to the separation chamber (4), to supply solid particles containing wastewater into the separation chamber (4),
- a reversing valve arranged between the supply pipe (2) and the separation chamber (4) in order to prevent reversing flow of wastewater into the supply pipe (2),
- a bidirectional pipe (7), connected to the separation chamber (4), for connection of the separation chamber (4) with a pump (10), to supply wastewater from the separation chamber (4) through the pump (10) into a wet accumulation chamber (8) and for reverse flow of wastewater from the wet accumulation chamber (8) through the pump (10) and the separation chamber (4) into the discharge pipe (9),
- a solid particles separator (6), arranged between the separation chamber (4) and the bidirectional pipe (7), for retaining solid particles contained in wastewater into the separation chamber (4), and wherein
- the bidirectional pipe (7) and the discharge pipe (9) are arranged so that they open into the separation chamber (4) opposite to each other in a lower part of the separation chamber (4), and wherein
- the bidirectional pipe (7) is branched, where one branch opens into the lower part of separation chamber (4) and the second branch opens into the upper part of separation chamber (4),

whereas both branches are connected to the separation chamber by a separate solid particles separator (6.1) and (6.2),

characterized in that, the supply pipe (2) is in a form of perforated inlet trough.

2. Device according to Claim 1, **characterised in that**, the supply pipe (2) is connected to the separation chamber (4) from the top.

3. Device according to Claim 2, **characterised in that**, the reversing valve consists of a seat (3) and a respective float ball (5) positioned in the separation chamber (4).

4. Device according to any one of the preceding claims, **characterised in that**, the discharge pipe (9) extends from the separation chamber (4) slantwise upwards at an angle of 30° to 70° with respect to the bottom of the chamber (4), preferably at an angle of 50°.

5. Device according to any one of the preceding claims, **characterised in that**, the solid particles separator (6, 6.1, 6.2) contains a frame (12), provided on its inner circumference with rods (13, 14) of at minimum of two lengths, where the rods are on the frame arranged alternately, long rod (13), short rod (14), and where rods (13, 14) protrude radially at an angle from the frame plane on one side in such a manner that a surface that longitudally intersects all rods (13 and 14) forms a truncated cone or pyramid (frustum) and where rods (13, 14) are arranged so that a space between any two neighboring rods (13, 14) and a space between free ends of any two long rods (13) does not exceed the size the throughput rate of the pump impeller is dimensioned for.

6. Device according to Claim 5, **characterised in that**, the frame (12) is in a form of ring.

Patentansprüche

1. Vorrichtung zum Schutz von Abwasserpumpen für Nasssammelkammern, **dadurch gekennzeichnet, dass** sie umfasst:

- eine Trennkammer (4), die mit einem Abflussrohr (9) zum Ableiten von Abwasser in ein Kanalisationsnetz versehen ist,
- ein mit der Trennkammer (4) verbundenes Zufuhrrohr (2), um Feststoffpartikel enthaltendes Abwasser in die Trennkammer (4) zuzuführen,
- ein Umschaltventil, das zwischen dem Zufuhrrohr (2) und der Trennkammer (4) angeordnet ist, um einen Rückfluss von Abwasser ins Zufuhrrohr (2) zu verhindern,
- ein bidirektionales Rohr (7), das mit der Trennkammer (4) verbunden ist, zum Verbinden der Trennkammer (4) mit einer Pumpe (10), zum Zuführen von Abwasser aus der Trennkammer (4) durch die Pumpe (10) in eine Nasssammelkammer (8) und zum Rückfluss von Abwasser aus der Nasssammelkammer (8) durch die Pumpe (10) und die Trennkammer (4) in das Abflussrohr (9),
- einen Feststoffabscheider (6), der zwischen der Trennkammer (4) und dem bidirektionalen Rohr (7) angeordnet ist, um im Abwasser enthaltene Feststoffpartikel in der Trennkammer (4) zurückzuhalten, und wobei
- das bidirektionale Rohr (7) und das Abflussrohr (9) so angeordnet sind, dass sie in einem unteren Teil der Trennkammer (4) einander gegenüberliegend in die Trennkammer (4) münden, und wobei
- das bidirektionale Rohr (7) verzweigt ist, wobei ein Zweig in den unteren Teil der Trennkammer (4) und der zweite Zweig in den oberen Teil der Trennkammer (4) mündet, wobei beide Zweige mit der Trennkammer durch einen separaten Feststoffabscheider (6.1) und (6.2) verbunden sind,

dadurch gekennzeichnet, dass das Zufuhrrohr (2) die Form eines perforierten Einlasses hat.

2. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** das Zufuhrrohr (2) von oben an die Trennkammer (4) angeschlossen ist.

3. Vorrichtung nach Anspruch 2, **dadurch gekennzeichnet, dass** das Umschaltventil aus einem Sitz (3) und einer entsprechenden in der Trennkammer (4) positionierten Schwimmerkugel (5) besteht.

4. Vorrichtung nach einem beliebigen der vorherigen Ansprüche, **dadurch gekennzeichnet, dass** sich das Abflussrohr (9) von der Trennkammer (4) schräg nach oben in einem Winkel von 30° bis 70° zum Boden der Trennkammer (4) erstreckt, vorzugsweise in einem Winkel von 50°.

5. Vorrichtung nach einem beliebigen der vorherigen Ansprüche, **dadurch gekennzeichnet, dass** der Feststoffabscheider (6, 6.1, 6.2) einen Rahmen (12) enthält, der an seinem Innenumfang mit Stangen (13, 14) von mindestens zwei Längen versehen ist, bei denen die Stäbe abwechselnd am Rahmen angeordnet sind, langer Stab (13), kurzer Stab (14), und wo Stäbe (13, 14) radial schräg zur Rahmenebene auf einer Seite so hervorstehen, dass eine Fläche, die alle Stäbe (13 und 14) in Längsrichtung schneidet, einen Kegelstumpf oder eine Pyramide

(einen Pyramidenstumpf) bildet und wo die Stäbe (13, 14) so angeordnet sind, dass ein Raum zwischen beliebigen zwei benachbarten Stäben (13, 14) und ein Raum zwischen freien Enden zweier beliebiger langer Stangen (13) die Größe nicht überschreitet, für die der Durchsatz des Pumpenlaufrades ausgelegt ist.

6. Vorrichtung nach Anspruch 5, **dadurch gekennzeichnet, dass** der Rahmen (12) ringförmig ist.

Revendications

1. Dispositif de protection de pompes d'eaux usées pour chambres d'accumulation humides, comprenant:

- une chambre (4) de séparation pourvue d'un tuyau (9) d'évacuation pour évacuer les eaux usées dans un réseau d'assainissement,
- un tuyau (2) d'alimentation raccordé à la chambre (4) de séparation pour apporter des eaux usées contenant des particules solides dans la chambre (4) de séparation,
- une vanne d'inversion disposée entre le tuyau (2) d'alimentation et la chambre (4) de séparation pour empêcher un écoulement inverse d'eaux usées dans le tuyau (2) d'alimentation,
- un tuyau (7) bidirectionnel raccordé à la chambre (4) de séparation pour raccorder la chambre (4) de séparation à une pompe (10), servant à apporter les eaux usées de la chambre (4) de séparation à travers la pompe (10) dans une chambre d'accumulation humide (8) et pour un écoulement inverse d'eaux usées depuis la chambre (8) d'accumulation humide à travers la pompe (10) et la chambre (4) de séparation jusqu'à un tuyau (9) d'évacuation,
- un séparateur de particules (6) solides disposé entre la chambre (4) de séparation et le tuyau (7) bidirectionnel pour séparer les particules solides contenues dans les eaux usées dans la chambre (4) de séparation, et où
- le tuyau (7) bidirectionnel et le tuyau (9) d'évacuation sont disposés de façon à s'ouvrir dans la chambre de séparation (4) en regard l'un de l'autre dans une partie inférieure de la chambre (4) de séparation, et où
- le tuyau (7) bidirectionnel est ramifié, avec une branche qui s'ouvre dans la partie inférieure de la chambre (4) de séparation et l'autre branche qui s'ouvre dans la partie supérieure de la chambre (4) de séparation, les deux branches étant connectées à la chambre (4) de séparation à l'aide d'un séparateur (6.1) et (6.2) de particules solides indépendant,

caractérisé en ce que le tuyau (2) d'alimentation a la forme d'une gouttière d'entrée perforée.

2. Dispositif suivant la revendication 1 **caractérisé en ce que** le tuyau (2) d'alimentation est raccordé à la chambre (4) de séparation d'en haut.

3. Dispositif suivant la revendication 2 **caractérisé en ce que** la vanne d'inversion consiste en un siège (3) et en une balle flottante (5) correspondante positionnée dans la chambre (4) de séparation.

4. Dispositif suivant une ou plusieurs des revendications précédentes **caractérisé en ce que** le tuyau (9) d'évacuation s'étend en biais de la chambre (4) de séparation vers le haut, avec un angle de 30° à 70° par rapport au fond de la chambre (4), préférablement avec un angle de 50°.

5. Dispositif suivant une ou plusieurs des revendications précédentes **caractérisé en ce que** le séparateur (6, 6.1, 6.2) de particules solides contient un châssis (12) pourvu de tiges (13, 14) dans sa circonférence interne, avec minimum deux longueurs, où les tiges sont arrangées dans le châssis de manière alternée, tige (13) longue et tige (14) courte, et où les tiges (13, 14) avancent radialement avec un angle à partir du plan de la structure d'un côté, de sorte qu'une surface qui croise longitudinalement toutes les tiges (13 et 14) arrive à former un cône tronqué ou une pyramide (frustum), et où les tiges (13, 14) sont arrangées de façon que l'espace entre deux tiges (13, 14) adjacentes et l'espace entre les extrémités libres de n'importe quelle couple de tiges longues (13) ne dépassent pas la taille selon laquelle le débit du rotor de la pompe est conçu.

6. Dispositif suivant la revendication 5 **caractérisé en ce que** le châssis (12) a la forme d'une bague.

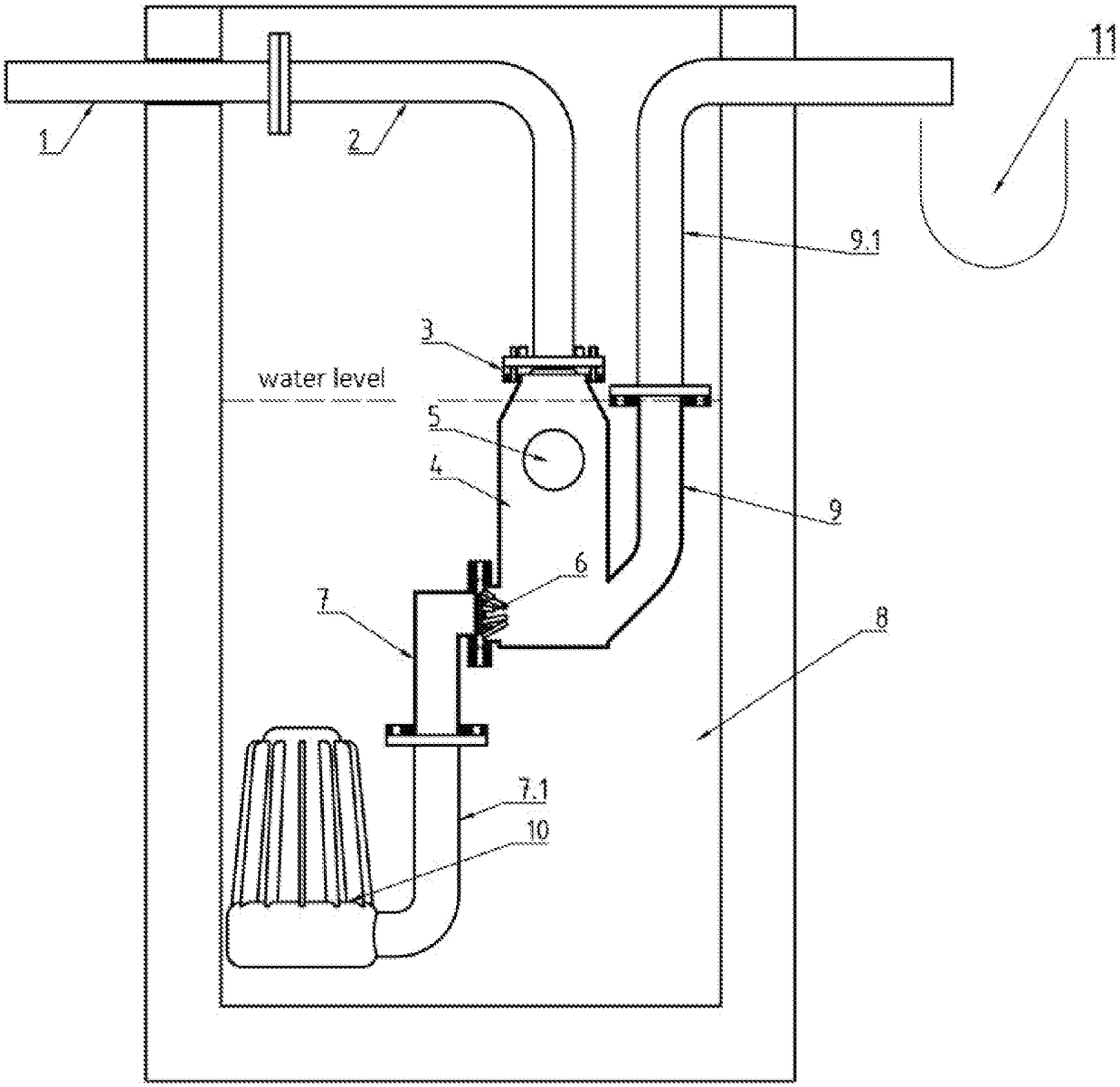

Fig. 1

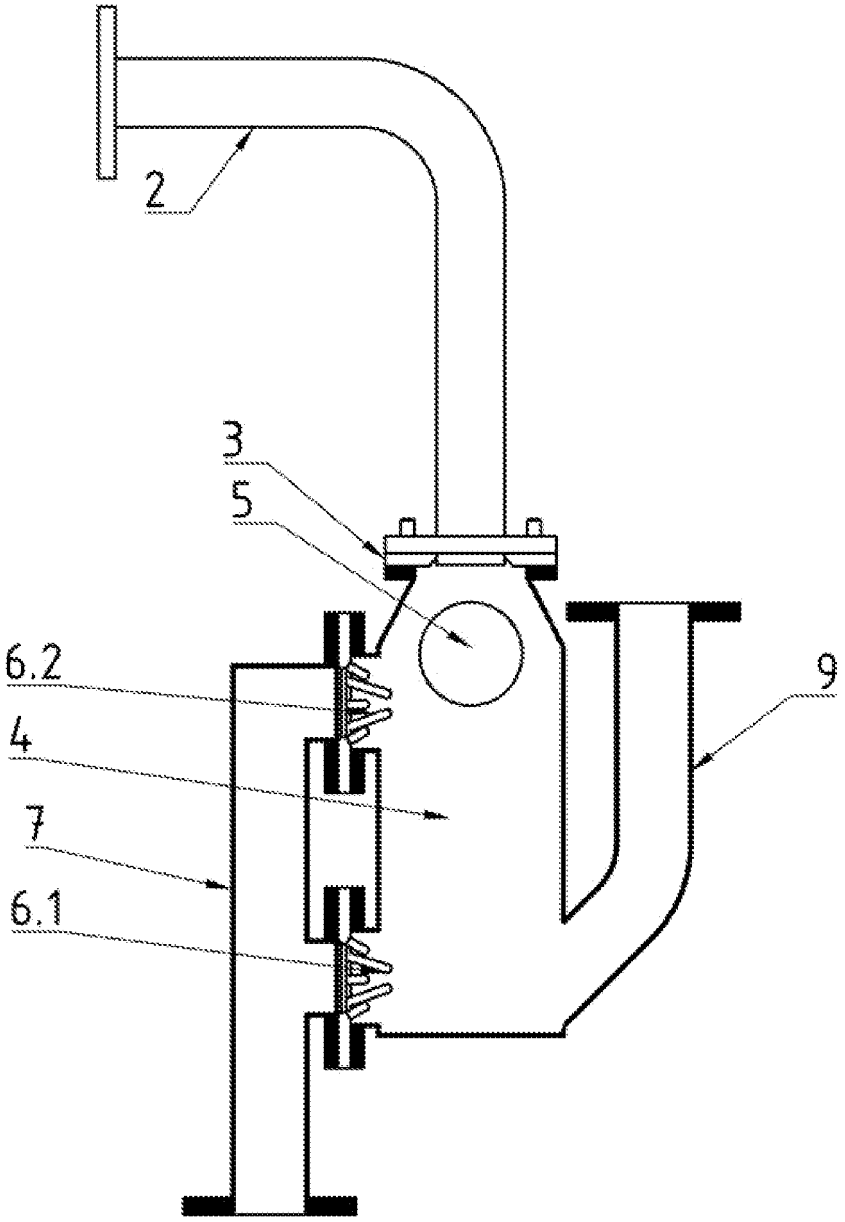

Fig. 2

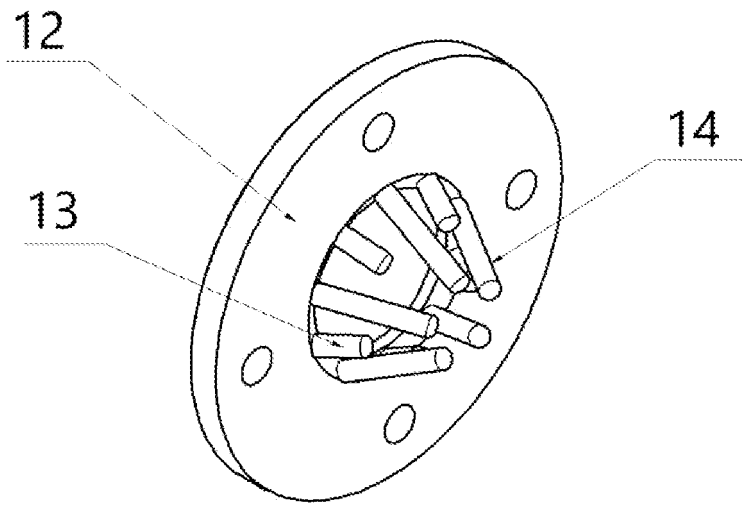

Fig. 3

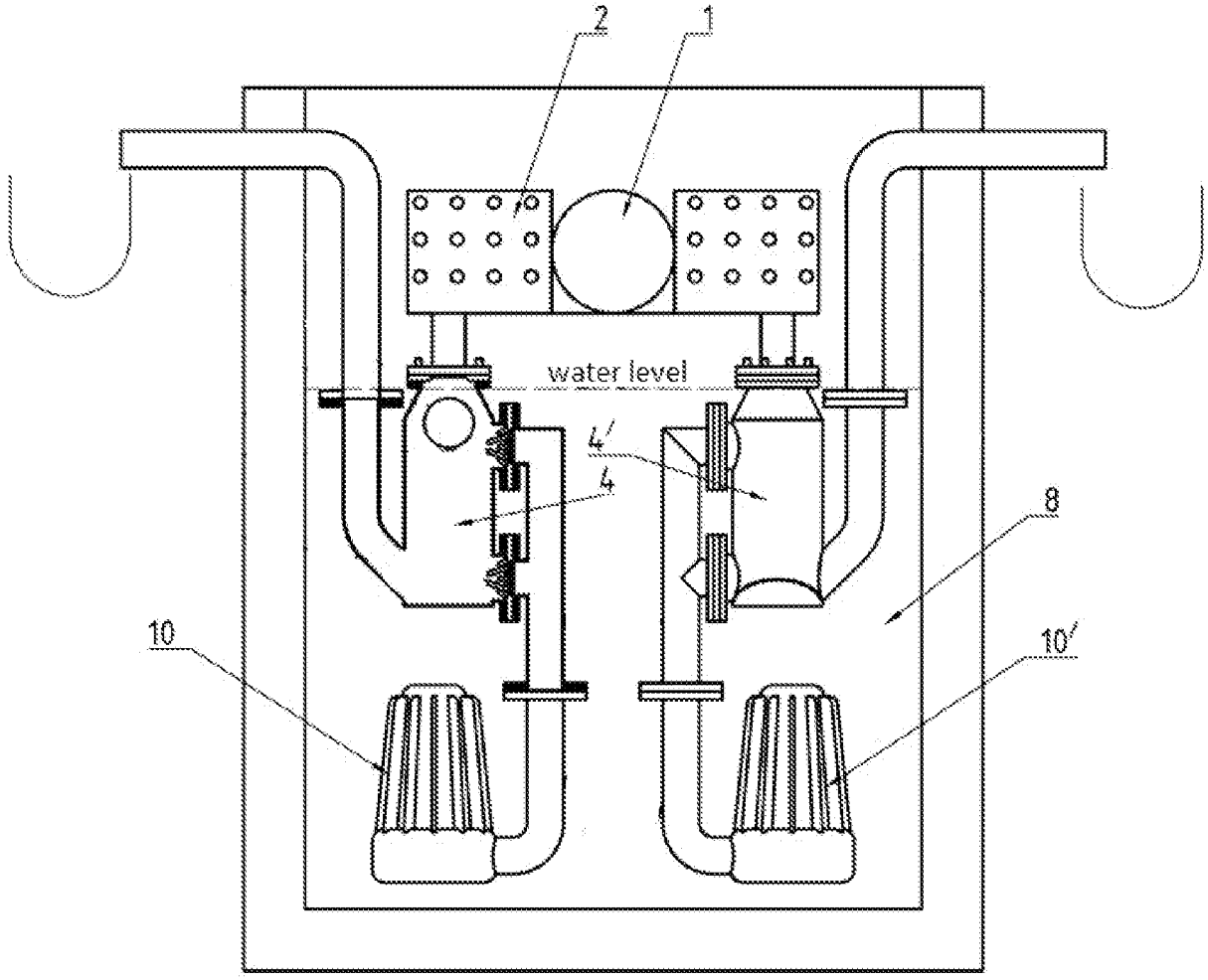

Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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