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(54) **PORTABLE PUMP STATION ARRANGEMENT**

(57) The invention relates to a portable pump station arrangement for collecting and transporting water slurry, the portable pump station arrangement comprising a chassis having a bottom configured to bear against the ground, a tank (3) supported by the chassis, an inlet conduit connected to the tank (3) and configured to lead water slurry into the tank (3), at least one discharge pump (5) arranged in the tank (3) and configured to transport the water slurry away from the tank (3), and an outlet pipe system (6) connected to the at least one discharge pump (5) and configured to lead the water slurry away from the tank (3). The portable pump station arrangement is characterized in that the chassis comprises at least one entry opening configured to receive forklift forks, and in that the outlet pipe system (6) comprises a pump station outlet connection (20) located at the upper end of the tank (3) and an outlet conduit (18) connected to said pump station outlet connection (20), wherein the discharge pump (5) is standing on a floor (22) in the tank (3) and the outlet conduit (18) is connected to the discharge pump (5).

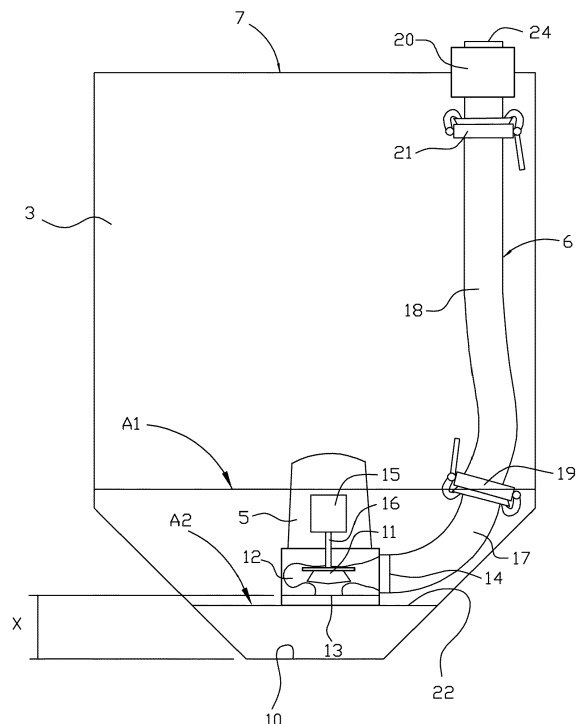


Fig. 2

Description

Technical field of the Invention

[0001] The present invention relates generally to the field of pump arrangements configured to pump water slurry, i.e. liquid comprising solid matter. Further, the present invention relates specifically to the field of pump arrangements especially configured for pumping water slurry comprising sand and stone material, such as drilling water in mining/tunneling applications or surface water on construction sites and quarries, i.e. dewatering applications at production sites.

[0002] The present invention is directed towards a portable pump station arrangement for collecting and transporting water slurry. The portable pump station arrangement comprises a chassis having a bottom configured to bear against the ground, a tank supported by the chassis, an inlet conduit connected to the tank and configured to lead water slurry into the tank, at least one discharge pump arranged in the tank and configured to transport the water slurry away from the tank, and an outlet pipe system connected to the at least one discharge pump and configured to lead the water slurry away from the tank.

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, and also a need to transport the water slurry to a location where it is more economically and efficiently handled. 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 from the lower parts of the mine to different basins/pits located at different depths of the mine. Each step/lift may for instance be in the range 25-50 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 100-300 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] The most common method to remove the water slurry from the front of the mine gallery is to blast cavities/pits into the gallery wall close to the front, at connection points, or at the like locations. The water comprising sand/stone at the front of the mine gallery is removed by

one or more first (smaller) dewater/drainage pump and pumped to the cavity/pit, or the water is allowed to automatically flow into the cavity/pit using gravity. A second (larger) dewatering/drainage pump is located in the cavity/pit and is arranged to pump the water to a second cavity located further up or at least closer to the mine opening, the pump in the second cavity pumps to a third cavity, the pump in the third cavity pumps to a forth cavity, etc. until the water slurry reaches a larger settling basin. The settling basin can be located in the mine or outside the mine. However, the dewatering pumps does usually not manage to remove all sand/stone from each cavity and every now and then a sludge truck needs to clean the cavity from sediment material, or the operators uses a front end loader to scoop out the sand/stone from the cavity. The use of sludge trucks is time consuming and costly. The use of a front end loader is really messy and very inefficient. If the sand/stone is not removed from the cavity the cavity will lose its volume capacity and the share of solids in the pumped water will increase and the pumps and hoses will become clogged/damaged. It is hard work, time consuming, costly and requires up to three operators to exchange a damaged pump in a cavity.

[0005] Thereto, the biggest problem is that the blasted cavities are stationary, i.e. the front of the mine gallery moves constantly and already when the cavity is ready to be used the location of the cavity is no longer optimal for its purpose.

[0006] In many production sites the removal of water is not in focus (it is necessary but no direct contribution to profit, on the contrary only a cost), since the focus is to remove ore (having direct contribution to profit). The operators are not interested in removing water, they only require that the water is removed otherwise they cannot remove ore.

Object of the Invention

[0007] The present invention aims at obviating the aforementioned disadvantages and failings of previously known dewatering application for production sites, and at providing an improved portable pump station arrangement. A primary object of the present invention is to provide an improved portable pump station arrangement of the initially defined type that will simplify and secure removal of water slurry from the production site. It is another object of the present invention to provide a dewatering application for production sites that is configured to be used at an optimal location at all times, i.e. a pump station arrangement that is truly portable/mobile. It is also an object of the present invention to provide a portable pump station arrangement wherein its capability to function properly is not affected by the orientation of the pump station arrangement, i.e. the discharge flow from the pump station arrangement is not affected by the ground being not perfectly horizontal.

Summary of the Invention

[0008] According to the invention at least the primary object is attained by means of the initially defined portable pump station arrangement having the features defined in the independent claim. Preferred embodiments of the present invention are further defined in the dependent claims.

[0009] According to the present invention, there is provided a portable pump station wherein the chassis of the portable pump station arrangement comprises at least one entry opening configured to receive forklift forks, and wherein the outlet pipe system comprises a pump station outlet connection located at the upper end of the tank and an outlet conduit connected to said pump station outlet connection, wherein the discharge pump is standing on a floor in the tank and the outlet conduit is connected to the discharge pump.

[0010] Thus, the present invention is based on the idea that once you have lifted water slurry, i.e. water together with sand/stone, from the ground at a production site, the water slurry is not thrown back on the ground before it reaches a settling basin intended for separating the water and solid matter.

[0011] Thus, according to the present invention, in order to be portable/mobile the pump station arrangement must comprise means for receiving lifting equipment of a vehicle (e.g. forklift forks of a wheel loader) suitable to work in mines and the like environments. It is also important to that the pump station arrangement is configured in such a way that installation and/or replacement of a discharge pump and/or outlet conduit can be made in a reliable, quick and efficient way.

[0012] According to various embodiments of the present invention, the discharge pump is standing on the bottom surface of the tank. Thereby the pump station does not need any extra equipment located in the tank, i.e. the discharge pump is lowered into the tank and landed on the bottom surface of the tank, and when the outlet conduit is connected to the pump station outlet connection the installation is ready. By having the discharge pump standing on the bottom surface of the tank, minimal amount of solid matter will accumulate in the tank and thereby the service interval of the tank can be prolonged.

[0013] According to various embodiments of the present invention, the outlet conduit is connected to the discharge pump and/or to the pump station outlet connection by means of a quick coupling. Thereby the time for replacing a damaged discharge pump and/or outlet conduit is drastically decreased at the same time as the sealing between the different components is guaranteed independently on the orientation of the pump station arrangement. The presence of quick couplings together with the flexibility of the outlet conduit makes it much less cumbersome to interconnect the different components.

[0014] According to various embodiments of the present invention, the chassis comprises a platform arranged outside the tank, and preferably the platform is

arranged at an elevated level located at least 25 percent of the combined height of the tank and the chassis above the bottom of the chassis. Since the inventive pump station arrangement is portable/mobile and stands on the ground, the work of installing/replacing the discharge pump and/or outlet conduit, i.e. reaching into the tank, is simplified by having a platform arranged on the outside of the tank.

[0015] According to various embodiments of the present invention, the pump station outlet connection comprises a non-return valve and preferably a vent valve located upstream said non-return valve. The object of the vent valve is to evacuate any gas/air that is entrapped between the impeller of the discharge pump and the non-return valve of the pump station outlet connection, since otherwise it can be more or less impossible for the discharge pump to start pump at low water slurry level in the tank. If the entire or most of the outlet conduit is filled with air/gas the pressure from the air/gas bubble will prevent the impeller of the discharge pump to get grip of the water slurry at the same time as the air/gas bubble will not provide enough pressure to open the non-return valve.

[0016] According to various embodiments of the present invention, the tank has an upper portion having a minimum diameter equal to or greater than 60 centimeter and a maximum diameter equal to or less than 200 centimeters, and a lower portion having a tapering shape from the upper portion towards the floor of the tank. It is important that the solid matter in the water slurry, when settling in the tank, is guided by the tank walls towards an area located in close vicinity of the inlet opening of the discharge pump.

[0017] According to various embodiments of the present invention, the area of the floor of the tank is equal to or more than 15 percent of the area of upper portion of the tank and equal to or less than 40 percent of said area of the upper portion of the tank. The area decrease rate from the area of the upper portion of the tank to the area of the floor cannot be too high or too low in order to guide the solid matter in the water slurry towards the area located in close vicinity of the inlet opening of the discharge pump.

[0018] According to various embodiments of the present invention, an inlet pump is connected to the inlet conduit and is configured to lift the water slurry from the ground and pump the water slurry into the tank via the inlet conduit. The inlet pump is preferably constituted by a dewatering/drainage pump. The inlet pump is configured/dimensioned to be able to lift the specific water slurry from the ground at the specific production site.

[0019] According to various embodiments the inlet opening of the at least one discharge pump is located straight above a bottom surface of the tank, wherein the vertical distance between the inlet opening and the bottom surface is equal to or greater than 30 millimeters and equal to or less than 250 millimeters. This range is optimal to prevent sedimentation of solid matter at the bottom

surface of the tank.

[0020] Further advantages with and 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 a preferred embodiment of an inventive portable pump station arrangement located in a mine,
 Fig. 2 is a schematic illustration of the tank of the inventive portable pump station arrangement, and
 Fig. 3 is a schematic illustration of a preferred embodiment of the inventive portable pump station arrangement.

Detailed description of preferred embodiments of the invention

[0022] The present invention relates specifically to the field of pump arrangements especially configured for pumping water slurry/sludge comprising for instance sand and stone material, such as drilling water in mining/tunneling applications and surface water on construction sites and quarries, i.e. pump arrangements for dewatering applications at production sites.

[0023] Reference is initially made to figure 1, disclosing a schematic illustration of a portable pump station arrangement, generally designated 1. The portable pump station arrangement 1 is configured for collecting/receiving and transporting/pumping water slurry.

[0024] The portable pump station arrangement 1 comprises a chassis 2 having a bottom configured to bear against the ground, a tank 3 supported by the chassis 2 and configured to hold liquid/slurry, an inlet conduit 4 connected to the tank 3 and configured to lead water slurry into the tank 3, at least one discharge pump 5 arranged in the tank 3 and configured to transport the water slurry away from the tank 3, and an outlet pipe system 6 connected to the at least one discharge pump 5 and configured to lead the water slurry away from the tank 3. The actual pump station, generally designated 7, is constituted by the chassis 2, the tank 3, the at least one discharge pump 5 and the outlet pipe system 6. The portable pump station arrangement 1 is configured to at least pump water slurry having a density between 1 and 1,3 kg/dm³, and particles having a maximum diameter of 20 millimeters.

[0025] The chassis 2 comprises at least one entry opening 8 configured to receive forklift forks. Different

lifting equipment such as forklift forks or straps connected to for instance a front wheel loader or the like vehicle is used to transport the pump station 7 to different locations by engagement with said at least one entry opening 8. Preferably the chassis 2 comprises entry openings 8 accessible from different sides of the pump station 7. When using forklift forks both forks may be inserted in the same entry opening 8, or each fork may be inserted into an individual entry opening 8. According to various embodiments, the entry opening is constituted by a so-called open entry opening, i.e. the entry opening is open downwards and is only enclosed on two or three sides of the four sides. An open entry opening may be accomplished by having two or more cross beams abutting the ground, wherein the cross beams are more or less parallel to each other, and thereto the rest of the chassis 2 is located on-top of the two cross beams. Thereby the area between the cross beams, and possibly outside the cross beams, constitute the open entry opening 8. According to other embodiments, the entry opening is constituted by a so-called closed entry opening, i.e. the entry opening is enclosed on all four sides such that the pump station 7 cannot tilt and fall off the forks during transportation. Straps or the like may also engage the entry opening 8, both open and closed entry openings, by being thread from one side of the chassis 2 to the other side.

[0026] In order to be truly portable/mobile, the combined vertical height of the chassis 2 and the tank 3 is preferably equal to or less than 3 meters, the maximum width of the chassis 2 and tank 3 is preferably equal to or less than 2 meters, and the maximum length of the chassis 2 and the tank 3 is preferably equal to or less than 4 meters. The smallest pump station comprises a tank 3 having a minimum width that is equal to 60 centimeters and has a minimum length that is equal 60 centimeter.

[0027] The chassis 2, also known as framework, is preferably made of metal, such as steel, in order to withstand rough handling and rough grounds. The chassis 2 is configured to support and protect the tank 3 and comprises preferably a bridge/platform 9 arranged outside the tank 3 for the operator to stand at when installing/replacing the discharge pump 5. The platform 9 is preferably arranged at an elevated level located at least 25 percent of the combined height of the tank 3 and the chassis 2 above the bottom of the chassis 2. The tank 3 is preferably made of fiberglass or plastic in order to minimize the weight, but also metal is a conceivable material. Thereto, fiberglass and plastic does not corrode and is easy to repair if torn/cracked.

[0028] In the disclosed embodiment of figure 1, the tank 3 has an upper portion and a lower portion, which are connected to each other to form the tank 3. It shall be pointed out that the upper portion and/or the lower portion can be constituted by one or more discrete elements/segments joined to each other, and it is also conceivable that the entire tank 3 is made of a single element. It is also conceivable that the tank 3 only comprises a

lower portion. The height of the lower portion of the tank 3 is equal to or more than 25 centimeters for small diameter tanks, preferably equal to or more than 40 centimeters for large diameter tanks, and equal to or less than 1 meter. Preferably the upper portion has the shape of a cylinder, i.e. having a circular cross section, however also other cross sectional shapes are conceivable such as oval, square, polygon, etc. The upper portion of the tank 3 has a minimum diameter equal to or greater than 60 centimeter and a maximum diameter equal to or less than 200 centimeters, i.e. the upper portion of the tank 3 can be inscribed in a circle having a diameter of 200 centimeters and a circle having a diameter equal to 60 centimeters can be inscribed in the upper portion of the tank 3. Preferably the lower portion has a tapering shape from the upper portion towards a bottom surface 10 of the tank 3. The bottom surface 10 is preferably plane/flat and parallel to the underside/bottom of the chassis 2.

[0029] According to a preferred embodiment the tank 3, preferably at the bottom surface 10, comprises a bottom/drain valve configured to empty the tank 3 from its content if needed. For instance before transportation.

[0030] The inlet conduit 4 is connected to the tank 3, meaning that the inlet conduit 4 is arranged in such a way that the water slurry is lead into the tank 3, i.e. the inlet conduit 4 cooperates with the tank 3. Preferably the inlet conduit 4 leads the water slurry from above into the tank 3, by hanging over the upper rim of the tank 3. The inlet conduit 4 can be temporarily fixed to the pump station 7, direct or indirect, in order to secure that the end of the inlet conduit 4 is not removed from the tank 3 by accident. According to the disclosed embodiment, the inlet conduit 4 is constituted by a hose. The inlet conduit 4 can also be constituted by an upwardly open channel (or hose) leading water slurry running from a higher altitude into the tank 3 by means of gravity.

[0031] The pump station 7 comprises at least one discharge pump 5, and preferably two discharge pumps in order to manage temporarily increased inflow and also as a backup if one of the discharge pumps malfunctions. The discharge pump 5 comprises an impeller 11 rotating in a volute 12, and is preferably constituted by a centrifugal pump having an axial inlet opening 13, i.e. an inlet, and a radial outlet opening 14, i.e. an outlet. (See also figure 2). The terms axial and radial are defined in relation to the axis of rotation of the impeller 11 of the pump, i.e. in the disclosed embodiment the water slurry is sucked into the discharge pump 5 in the axial/vertical direction and discharged from the discharge pump 5 in the radial/horizontal direction. Thus, the inlet 13 of the discharge pump 5 is open in the axial direction and the outlet 14 is open in the radial direction. The discharge pump 5 is preferably constituted by a dewatering pump. It is also conceivable that the discharge pump 5 is constituted by a slurry pump, a wastewater pump, a sludge pump, etc. It shall be pointed out that in the case the pump station 7 comprises two discharge pumps 5 they can be of different or the same type. The impeller 11 of the discharge

pump 5 is in various embodiments a so-called closed impeller having blades connected to an upper cover disc and to a lower cover disc, but it is also conceivable to have a so-called open impeller having blades connected to an upper cover disc, or a semi-open impeller wherein the blades comprises winglets at the lower edges instead of a lower cover disc.

[0032] The discharge pump 5 comprises in a conventional way a hydraulic unit having a pump chamber/volute 12, and comprises a drive unit. The drive unit and the pump chamber are arranged in a pump housing. The drive unit comprises an electric motor 15 arranged in the liquid tight pump housing, and a drive shaft 16 extending from the electric motor 15. The hydraulic unit comprises an impeller 11 that is arranged in the pump chamber 12 and is connected to and driven in rotation by the drive shaft 16 during operation of the discharge pump 5, wherein liquid is sucked into said inlet 13 and pumped out of said outlet 14 when the discharge pump 5 is active. The pump housing and the impeller, and other essential components, are preferably made of metal, such as aluminum and steel. The electric motor is powered via an electric power cable (not shown) extending from a power supply, and the discharge pump 5 comprises a liquid tight lead-through receiving the electric power cable.

[0033] According to a preferred embodiment the discharge pump 5, more precisely the electric motor 15, is operatively connected to a control unit, such as an Intelligent Drive comprising a Variable Frequency Drive (VFD). Thus, said discharge pump 5 is configured to be operated at a variable operational speed [rpm], by means of said control unit. The control unit is configured to monitor and control the operational speed of the discharge pump 5. The control unit can be located inside the liquid tight pump housing, i.e. integrated into the pump, or the control unit is an external control unit. The operational speed of the discharge pump 5 is more precisely the rpm of the electric motor 15 and the impeller 11, and correspond/relate to a control unit output frequency.

[0034] The components of the discharge pump 5 are usually cold down by means of the liquid/water surrounding the discharge pump 5. The discharge pump 5 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 discharge pump 5 during operation must not be entirely located under the liquid surface but may continuously or occasionally be partly located above the liquid surface.

[0035] The discharge pump 5 can preferably be operated in different drive modes, such as continuous operation using varying operational speed in order to save energy and/or reduce wear, or constant operation at rated power, or ON/OFF operation between a pump start liquid level and a pump stop liquid level.

[0036] The portable pump station arrangement 1 is configured to collect and transport at least water slurry having a density equal to or greater than 1 kg/dm³ and

equal to or less than $1,3 \text{ kg/dm}^3$, and wherein the elements of the sand/stone material has a diameter equal to or less than 20 millimeters, i.e. stones that can pass through a screen/sieve having a hole diameter of 20 millimeters.

[0037] The outlet pipe system 6 of the pump station 7 comprises, for each discharge pump 5, preferably a discharge connection 17 and comprises an outlet conduit/hose 18. Thus, the outlet conduit 18 is connected, direct or indirect via the discharge connection 17, to the discharge pump 5. The discharge connection 17 is preferably bolted to the outlet 14 of the discharge pump 5. The discharge pump 5 and the outlet conduit 18 are connected to each other and thereafter lowered into the tank 3 as a single/interconnected unit. The outlet conduit 18 is preferably connected to the discharge pump 5 by means of a quick coupling 19 comprising a male part and a female part, such as a perrot/miller/bauer type quick coupling, a camlock type quick coupling, a firehose connection type quick coupling, etc. or a hose clamp type quick coupling. According to various embodiments the outlet conduit/hose 18 is at least partly flexible and/or at least partly armoured/reinforced. According to other various embodiments the outlet conduit/hose 18 may be more or less rigid, and according to one embodiment the outlet conduit 18 is constituted by a rigid pipe.

[0038] The outlet pipe system 6 also comprises a pump station outlet connection 20 located at the upper end of the tank 3. The pump station outlet connection 20 is preferably connected to the upper rim of the tank 3. The outlet conduit 18 is preferably connected to the pump station outlet connection 20 after the interconnected discharge pump 5 and outlet conduit 18 have been lowered into the tank 3. The outlet conduit 18 is preferably connected to the pump station outlet connection 20 by means of a quick coupling 21 comprising a male part and a female part, such as a perrot/miller/bauer type quick coupling, a camlock type quick coupling, a firehose connection type quick coupling, etc. or a hose clamp type quick coupling.

[0039] The discharge pump 5 is lowered into the tank 3 during installation and thereafter during normal operation of the pump station 7, the discharge pump 5 is standing on a floor 22 in the tank 3. It shall be pointed out that the floor 22 in the tank is preferably constituted by the bottom surface 10 of the tank 3. It is conceivable that the floor 22 is a net/sieve or the like located at a distance above the bottom surface 10 of the tank 3. In the various embodiments comprising a floor 22 located at a distance from the bottom surface 10, the floor 22 is preferably parallel to the bottom surface 10. The lower portion of the tank 3 has a tapering shape from the upper portion of the tank 3 towards the floor 22.

[0040] When the discharge pump 5 is constituted by a dewatering pump or the like having an inlet screen 23, the discharge pump 5 is preferably standing on the bottom surface 10 of the tank 3, and when the discharge pump 5 is constituted by a wastewater pump or the like having no inlet screen, the discharge pump 5 is preferably

standing on the elevated floor 22.

[0041] Since the discharge pump 5 is constituted to be standing on the floor 22, both when the floor 22 is constituted by the bottom surface 10 of the tank 3 and by an elevated net/sieve, the area and shape of the floor 22 must be configured to have room for the discharge pump 5 or discharge pumps 5.

[0042] The outlet pipe system 6, and preferably the pump station outlet connection 20, comprises a non-return valve located at the upper end of the tank 3, and the outlet pipe system 6 terminates at an outlet opening 24. In the case the pump station 7 comprises two discharge pumps 5 and two outlet conduits/hoses 18, the pump station outlet connection 20 comprises two non-return valves, one for each discharge pump 5. The pump station outlet connection 20 preferably comprises a vent valve located upstream the non-return valve belonging to the respective discharge pump 5.

[0043] In order to lead the water slurry away from the pump station 7, a discharge hose/conduit 25 is releasably connected to the outlet opening 24 of the outlet pipe system 6. The discharge hose 25 may extend to another portable pump station 1, to a settling basin 26, to a cavity pit in the gallery, to a vehicle, etc.

[0044] In the preferred embodiment disclosed in figure 1, an inlet pump 27 is connected to the inlet conduit 4 and is configured to lift the water slurry from the ground and pump the water slurry into the tank 3 via the inlet conduit 4. Preferably the inlet pump 27 is constituted by a dewatering pump, also known as drainage pump. It is also conceivable that the inlet pump 27 is constituted by a slurry pump, a sludge pump, a wastewater pump, etc. Preferably the inlet pump 27 and the discharge pump 5 are of the same type and size.

[0045] The inlet pump 27 comprises an inlet 28 and a pump outlet 29. The inlet pump 27 comprises in a conventional way a hydraulic unit having a pump chamber/volute, and comprises a drive unit. The drive unit and the pump chamber are arranged in a pump housing. The drive unit comprises an electric motor 30 arranged in the liquid tight pump housing, and a drive shaft 31 extending from the electric motor 30. The hydraulic unit comprises an impeller 32 that is arranged in the pump chamber and is connected to and driven in rotation by the drive shaft 31 during operation of the inlet pump 27, wherein liquid is sucked into said inlet 28 and pumped out of said outlet 29 when the inlet pump 27 is active. The pump housing and the impeller 32, and other essential components, are preferably made of metal, such as aluminum and steel. The electric motor 30 is powered via an electric power cable extending from a power supply, and the inlet pump 27 comprises a liquid tight lead-through receiving the electric power cable. According to an alternative embodiment, the drive unit comprises an internal combustion engine and a suitable gear box arrangement, wherein the drive shaft is driven in rotation by the internal combustion engine via said gear box arrangement. Drainage pump arrangements comprising internal combustion en-

gines are conventionally used in dry installations, i.e. the entire pump is then located above the liquid surface and an inlet pipe extend from the pump inlet into the liquid.

[0046] The inlet pump 27, more precisely the electric motor 30, is operatively connected to a control unit 33, such as an Intelligent Drive comprising a Variable Frequency Drive (VFD). Thus, said inlet pump 27 is configured to be operated at a variable operational speed [rpm], by means of said control unit 33. According to the disclosed and preferred embodiment, the control unit is located inside the liquid tight pump housing, i.e. it is preferred that the control unit 33 is integrated into the inlet pump 27. The control unit 33 is configured to monitor and control the operational speed of the inlet pump 27. According to an alternative embodiment the control unit is an external control unit. The operational speed of the inlet pump 27 is more precisely the rpm of the electric motor 30 and the impeller 32, and correspond/relate to a control unit 33 output frequency.

[0047] The components of the inlet pump 27 are usually cold down by means of the liquid/water surrounding the inlet pump 27. The inlet pump 27 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 inlet pump 27 during operation must not be entirely located under the liquid surface but may continuously or occasionally be partly located above the liquid surface.

[0048] The inlet pump 27 is in the disclosed application located in a basin 34 and is intended to transport/pump water slurry, i.e. liquid comprising solid matter, from said basin 34 to the pump station 7. Thereto, it shall be realized that several inlet pumps 27 may be arranged to pump water slurry into the same pump station 7. The basin may be a natural recess/cavity/pit or a prepared recess/cavity/pit.

[0049] The inlet pump 27 can preferably be operated in different drive modes, such as continuous operation using varying operational speed in order to save energy and/or reduce wear, or constant operation at rated power, or ON/OFF operation between a pump start liquid level and a pump stop liquid level. Thereto, it is an explicit requirement from the operators/customers in a mine that the inlet pump 27 shall always be operating/running, since a standstill in the mine due to a flooded horizontal gallery is extremely costly and thus the operators/customers are more willing to have excessive wear on the inlet pumps than a stop in the production.

[0050] Reference is now also made to figure 2, disclosing the pump station 7 of the portable pump station arrangement 1.

[0051] In order to remove all water slurry entering the tank 3 the lower portion of the tank 3 is tapering downwards. The upper portion of the tank 3 has a first cross sectional area (A1) and the floor 22 (i.e. bottom surface 10 or elevated floor 22) has a second cross sectional area (A2), wherein the area of the floor 22 of the tank 3

is preferable equal to or more than 15 percent of the area of the upper portion of the tank 3 and equal to or less than 40 percent of said area of the upper portion of the tank 3. The area A2 of the floor 22 is preferably equal to or greater than 0,09 m² and equal to or less than 1,6 m². The area A1 of the upper portion of the tank 3 is preferably equal to or greater than 0,3 m² and equal to or less than 3,14 m². The tapering of the tank 3 can be symmetrical or asymmetrical. Preferably the tapering of the lower portion of the tank 3 continues also below the elevated floor 22 downwards to the bottom surface 10. The height of the lower portion of the tank 3 together with said ratio stipulates the tapering/inclination of the tank walls shall not be too steep or too moderate. A too steep tapering/inclination the solid matter will settle on the tank 3 walls and not glide downwards to the bottom surface 10, and a too moderate tapering/inclination the solid matter will settle on the bottom surface 10 too far away from the discharge pump 5 inlet opening.

[0052] The inlet opening 13 of the discharge pump 5 is located straight above the bottom surface 10 of the tank 3. In order to further secure removal/transportation of the water slurry away from the tank 3, the vertical distance (X) between the inlet opening 13 of the discharge pump 5 and the bottom surface 10 of the tank 3 is equal to or greater than 20 millimeters and equal to or less than 250 millimeters. Preferably the vertical distance (X) between the inlet opening 13 of the discharge pump 5 and the bottom surface 10 of the tank 3 is equal to or greater than 50 millimeters and equal to or less than 150 millimeters. The distance shall not be too big or too small. A too big vertical/axial distance the solid matter will not be affected by the pumped flow, and a too small distance the gap will become a bottleneck and there is a risk that the solid matter will block the inlet opening 13. The mentioned distances are optimal. Said distances are valid both when the floor 22 of the tank 3 is constituted by an elevated floor 22 and by the bottom surface 10.

[0053] Reference is now made to figure 3. In the disclosed embodiment, the pump station 7 comprises a crane 35, wherein the discharge pump 5 together with the outlet conduit 18 can be lowered and hoisted in the tank 3. The crane 35 is configured to turn about a vertical axis such that the discharge pump 5 can be moved over the upper rim of the tank 3. The wire 36 of the crane 35 can be manually operated using a winch 37 or be operated using an electric motor.

Feasible modifications of the Invention

[0054] 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 thus, the equipment may be modified in all kinds of ways within the scope

of the appended claims.

[0055] 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.

[0056] 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.

Claims

1. A portable pump station arrangement (1) for collecting and transporting water slurry, the portable pump station arrangement (1) comprising:
 - a chassis (2) having a bottom configured to bear against the ground,
 - a tank (3) supported by the chassis (2),
 - an inlet conduit (4) connected to the tank (3) and configured to lead water slurry into the tank (3),
 - at least one discharge pump (5) arranged in the tank (3) and configured to transport the water slurry away from the tank (3), and
 - an outlet pipe system (6) connected to the at least one discharge pump (5) and configured to lead the water slurry away from the tank (3), the portable pump station arrangement (1) being **characterized in that** the chassis (2) comprises at least one entry opening (8) configured to receive forklift forks, and **in that** the outlet pipe system (6) comprises a pump station outlet connection (20) located at the upper end of the tank (3) and an outlet conduit (18) connected to said pump station outlet connection (20), wherein the discharge pump (5) is standing on a floor (22) in the tank (3) and the outlet conduit (18) is connected to the discharge pump (5).
2. The portable pump station arrangement (1) according to any preceding claim, wherein the discharge pump (5) is standing on the bottom surface (10) of the tank (3).
3. The portable pump station arrangement (1) according to claim 1 or 2, wherein the outlet conduit (18) is connected to the discharge pump (5) by means of a quick coupling (19).
4. The portable pump station arrangement (1) according to any of claims 1-3, wherein the outlet conduit (18) is connected to the pump station outlet connection (20) by means of a quick coupling (21).
5. The portable pump station arrangement (1) according to any preceding claim, wherein the chassis (2) comprises a platform (9) arranged outside the tank (3).
6. The portable pump station arrangement (1) according to claim 5, wherein the platform (9) is arranged at an elevated level located at least 25 percent of the combined height of the tank (3) and the chassis (2) above the bottom of the chassis (2).
7. The portable pump station arrangement (1) according to any preceding claim, wherein the pump station outlet connection (20) comprises a non-return valve.
8. The portable pump station arrangement (1) according to claim 7, wherein the pump station outlet connection (20) comprises a vent valve located upstream said non-return valve.
9. The portable pump station arrangement (1) according to any preceding claim, wherein the tank (3) has an upper portion having a minimum diameter equal to or greater than 60 centimeter and a maximum diameter equal to or less than 200 centimeters, and a lower portion having a tapering shape from the upper portion towards the floor (22) of the tank (3).
10. The portable pump station arrangement (1) according to claim 9, wherein the area of the floor (22) of the tank (3) is equal to or more than 15 percent of the area of upper portion of the tank (3) and equal to or less than 40 percent of said area of the upper portion of the tank (3).
11. The portable pump station arrangement (1) according to any preceding claim, wherein an inlet pump (27) is connected to the inlet conduit (4) and is configured to lift the water slurry from the ground and pump the water slurry into the tank (3) via the inlet conduit (4).
12. The portable pump station arrangement (1) according to any preceding claim, wherein the portable pump station arrangement (1) comprises two discharge pumps (5) connected to the outlet pipe system (6).
13. The portable pump station arrangement (1) according to any preceding claim, wherein the vertical distance (X) between the inlet opening (13) of the at least one discharge pump (5) and a bottom surface (10) of the tank (3) is equal to or greater than 20 millimeters, preferably equal to or greater than 50

millimeters.

14. The portable pump station arrangement (1) according to claim 13, wherein the vertical distance (X) between an inlet opening (13) of the at least one discharge pump (5) and the bottom surface (10) of the tank (3) is equal to or less than 250 millimeters, preferably equal to or less than 150 millimeters. 5
15. The portable pump station arrangement (1) according to any preceding claim, wherein the at least one discharge pump (5) is constituted by a centrifugal pump comprising a pump volute having an axial inlet and a radial outlet. 10 15
16. The portable pump station arrangement (1) according to any preceding claim, wherein the at least one discharge pump (5) is constituted by a dewatering pump. 20
17. The portable pump station arrangement (1) according to any preceding claim, wherein a discharge hose (25) is connected to the pump station outlet connection (20). 25 30 35 40 45 50 55

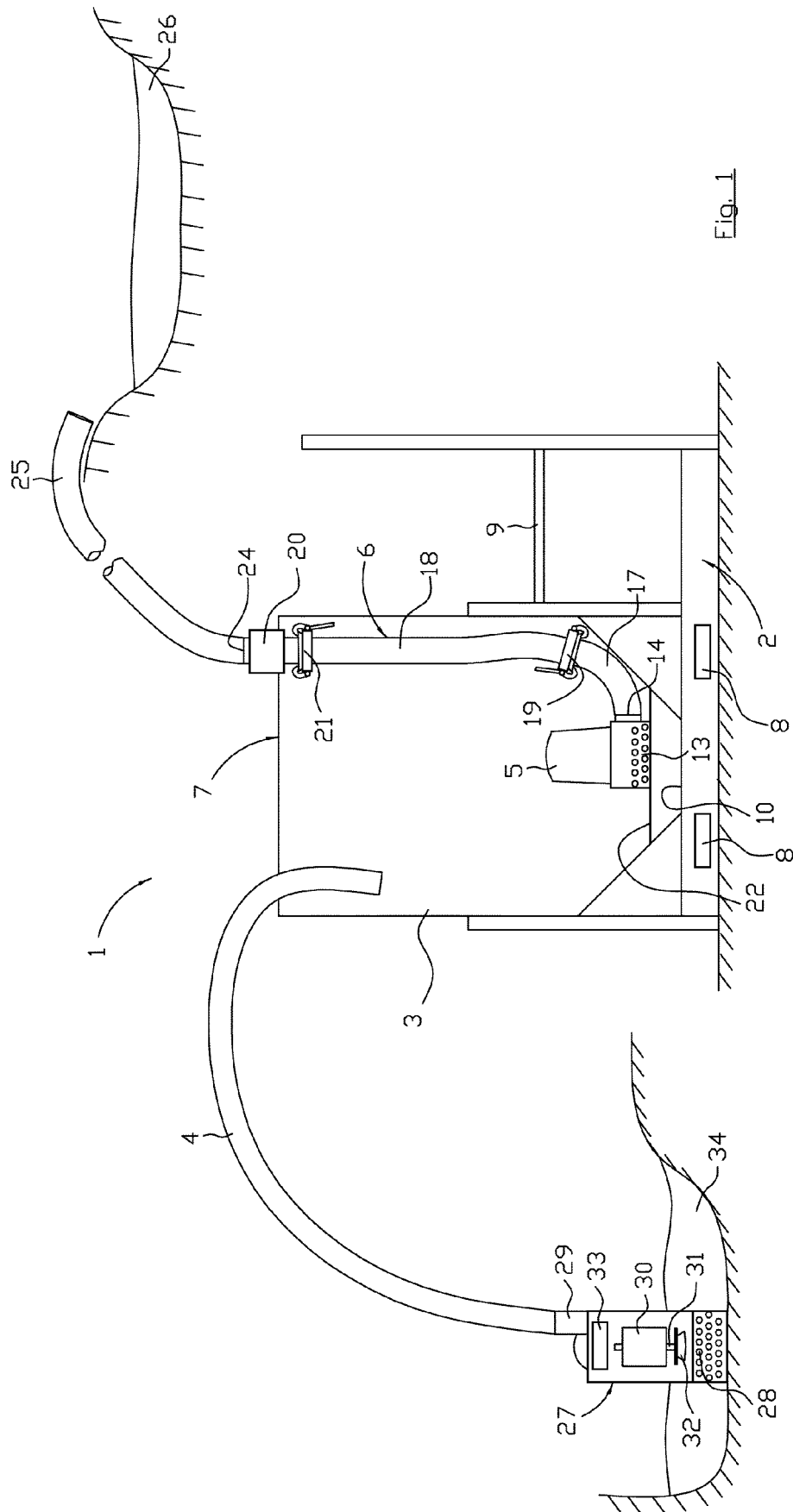


Fig. 1

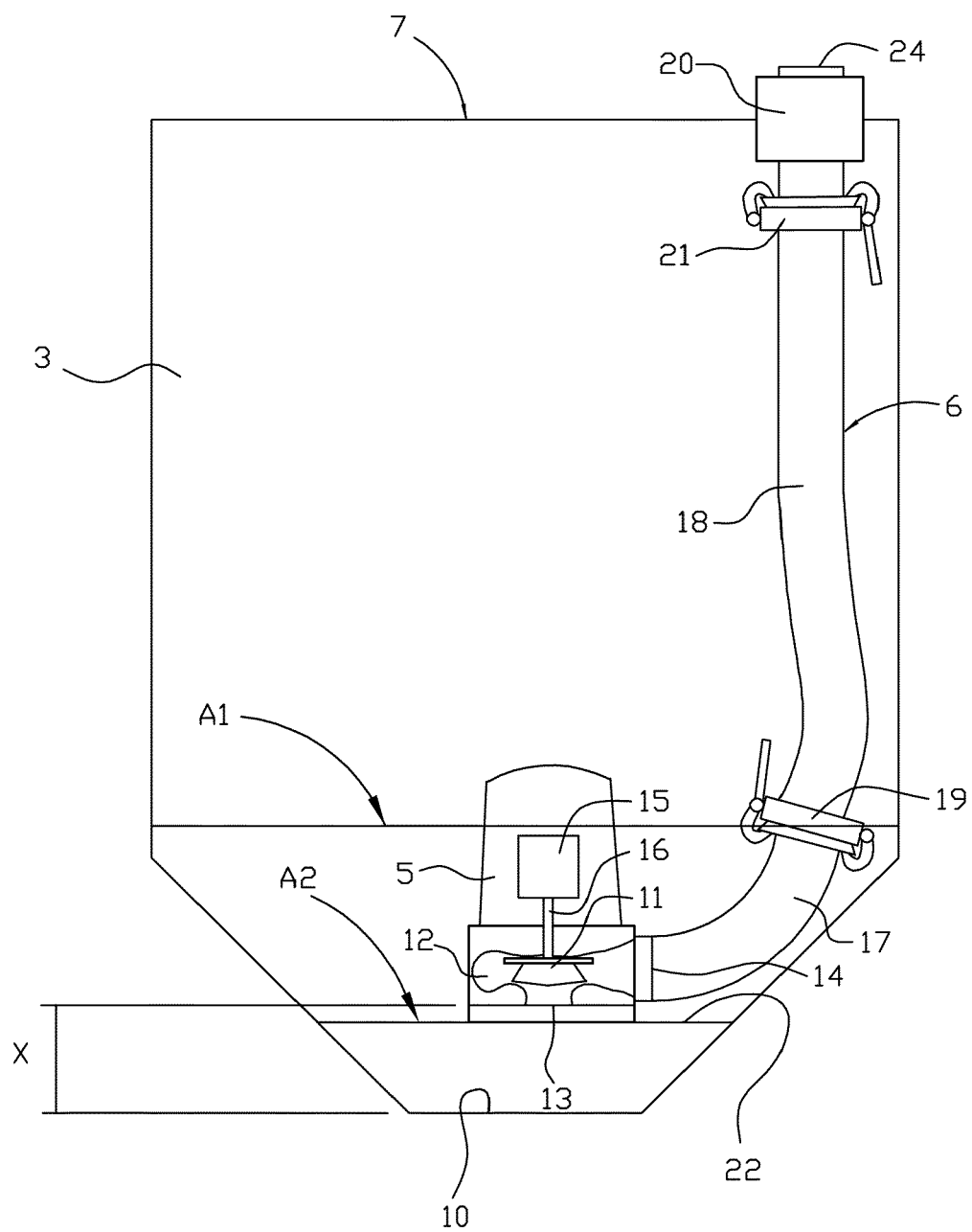


Fig. 2

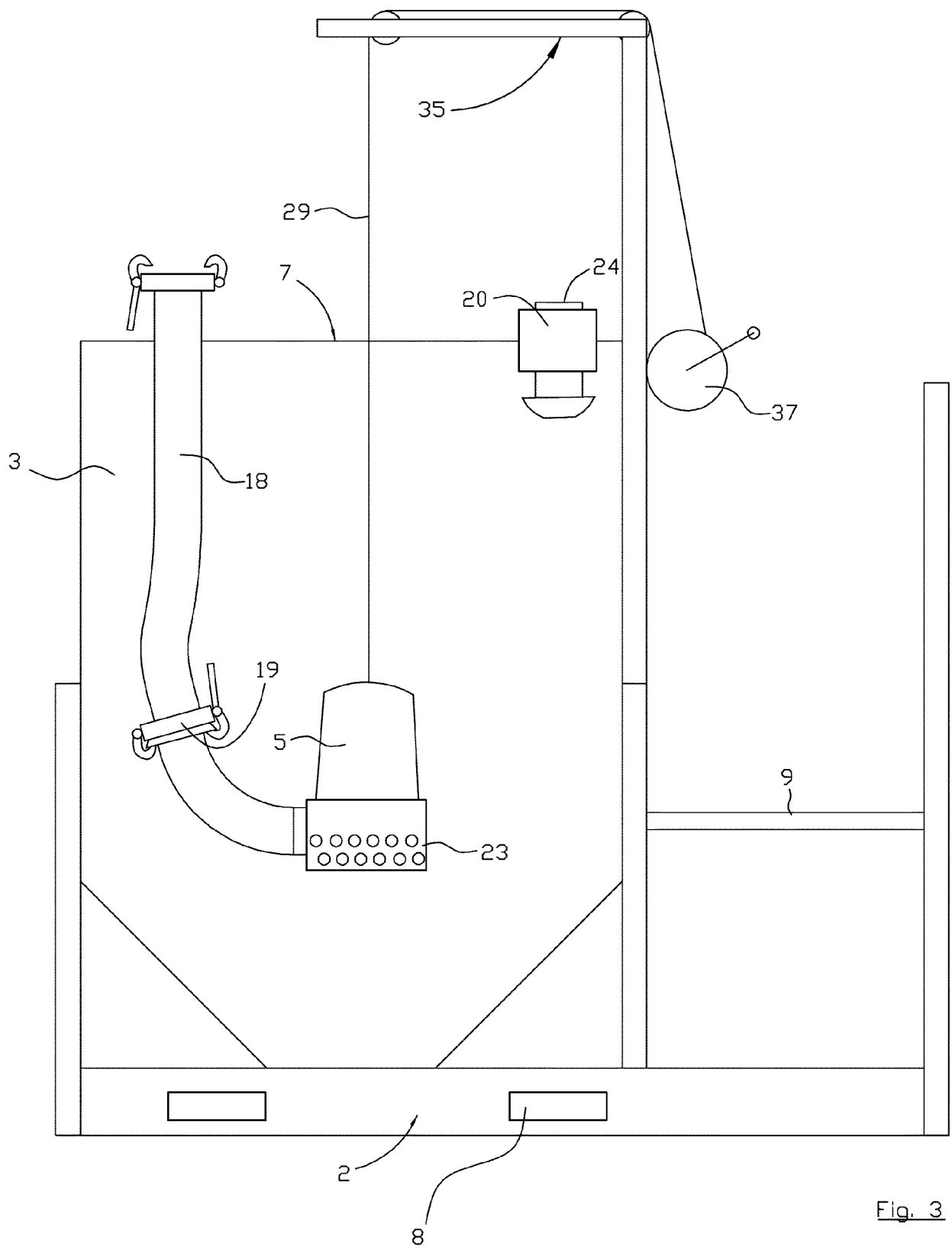


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
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			TECHNICAL FIELDS SEARCHED (IPC)
			E21F E03B F04D E03F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 18 June 2020	Examiner Ing, James
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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