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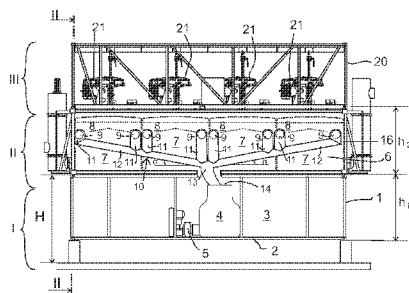


Fig. 1

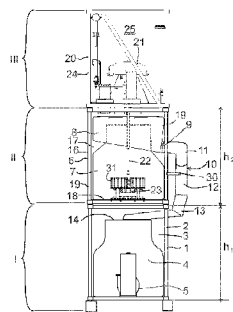


Fig. 3

(57) Abstract: A flotation plant which is built to a modular storeyed structure. The flotation plant has a first storey (I), the first storey being the lowest storey of the plant and comprising a pump sump module (1). The pump sump module (1) is a rigid and self-supporting unit capable of being transferable and hoistable as an integral entity. The pump sump module (1) has a height (h1). The pump sump module (1) comprises a self-supporting framework (2), a sump tank (4) in the inner space (3) of the self-supporting framework (2), and a pump (5) connected in fluid communication with the sump tank (4). The flotation plant has a second storey (II), which is located at the level above the first storey (I). The second storey (II) includes a tank module (6) which has a height (h2). The tank module is configured to implement flotation, produce an overflow and to discharge the overflow to the sump tank (4). The height (h1) of the pump sump module (1) is 35 – 70 % of the total height (h1 + h2) of the pump sump module (1) and the tank module (2).

A FLOTATION PLANT AND ITS USES, A PUMP SUMP MODULE AND ITS USES AND METHODS OF MAINTENANCE OF A FLOTATION PLANT

5 FIELD OF THE INVENTION

The present invention relates to a flotation plant. Further, the invention relates to uses of the flotation plant. Further, the invention relates to a pump sump module. Further, invention relates to uses of the pump sump module. Further, invention relates to methods of maintenance of a flotation plant.

SUMMARY OF THE INVENTION

According to a first aspect, the present invention provides a flotation plant. The flotation plant is built to a modular storeyed structure. The flotation plant comprises a first storey, the first storey being the lowest storey of the plant and comprising a pump sump module. The pump sump module is a rigid and self-supporting unit capable of being transferable and hoistable as an integral entity. The pump sump module has a height. The pump sump module comprises a self-supporting framework. The self-supporting framework has an inner space. The pump sump module comprises a sump tank. The sump tank is arranged in the inner space of the self-supporting framework. The pump sump module comprises a pump. The pump is connected in fluid communication with the sump tank. Further, the flotation plant comprises a second storey. The second storey is located at the level above the first storey. The second storey includes a tank module having a height. The tank module is configured to implement flotation, produce an overflow and to discharge the overflow to the sump tank. The height of the pump sump module is 35 - 70 % of the total height of the pump sump module and the tank module.

In this application the following definitions apply regarding flotation. Flotation involves phenomena related to the relative buoyancy of objects. The term flotation includes all flotation techniques. Flotation
5 can be for example froth flotation, dissolved air flotation (DAF) or induced gas flotation. Froth flotation is a process for separating hydrophobic materials from hydrophilic materials by adding gas, for example air, to process. Froth flotation could be made based on
10 natural hydrophilic/hydrophobic difference or based on hydrophilic/hydrophobic differences made by addition of a surfactant or collector chemical. Gas can be added to the feedstock subject of flotation (slurry or pulp) by a number of different ways. In one embodiment
15 gas can be added to the stream of feedstock subject to flotation before it is fed to the flotation tank. In one embodiment gas can be added to feedstock subject to flotation in the flotation tank. In one embodiment gas adding equipment can include gas dispersing equipment at the bottom of the tank. In one embodiment gas
20 adding equipment can include a feedstock (slurry or pulp) jet for jetting the feedstock to air. In one embodiment gas adding equipment includes a rotor inside the tank. In one embodiment gas can be added under the rotor. In one embodiment gas is added by a pipe ending
25 under rotor. The pipe can be inside the flotation tank. The pipe can go through the bottom of the flotation tank. In one embodiment the rotor takes gas from the surface of sludge by vortex. In one embodiment gas
30 is added by axis of the rotor. In one embodiment mixing equipment is arranged for mixing the slurry/pulp. Mixing equipment could be for example a pump or a rotor. When the mixing is made by pump, the feedstock subject of flotation could be taken from one part of
35 flotation tank and put back to another part of flotation tank. When mixing is made by the rotor, the rotor is inside the flotation tank. In one embodiment mixing

equipment can include a rotor inside the flotation tank. In one embodiment mixing equipment can include a stator inside the flotation tank. The stator is for boosting mixing and to diffuse air to the feedstock
5 (slurry or pulp) subject to flotation.

The technical effect of the invention is a minimized downtime for maintenance which can be achieved by a continuous process having a minimum of interruptions
10 and on the other hand by ability for quick maintenance. The continuous process can be achieved when no blockings occur. The height of the tank module defines limits within which a good enough inclination can be obtained for obtaining a good continuous flow for the
15 overflow which is conducted out from the tank module, so that no blocking in the channels conducting the overflow would occur. If the height of the tank module is too small, then a suitable inclination for a good flow cannot be obtained. On the other hand, the height
20 of the pump sump module must be great enough to ensure a high enough height for the sump tank. The high enough height for the sump tank is required to ensure a sufficient settling space for the overflow in the sump tank, so that gas contained in the overflow has a
25 sufficient time to exit from the overflow and blocking would not occur. The overflow entering the sump pump from the sump tank must be essentially gas-free. If the height of the sump tank would be too small due to a too small height of the pump sump module, then the
30 unsettled overflow containing gas would block the flow in the sump tank and in the sump pump. The technical effect of the invention is that the overflow can be conducted by gravity with the aid of a sufficient inclination from the tank module to the sump tank of the
35 pump sump module. The technical effect of the invention is also that a sufficient settling space is ensured for the overflow in the sump tank.

In one embodiment of the flotation plant, the height of the pump sump module is 40 - 65%, more preferably 45 - 55%, of the total height of the pump sump module and the tank module.

In one embodiment of the flotation plant, the tank module comprises one to four flotation tanks and an overflow receptacle for each flotation tank. The overflow receptacle is for receiving an overflow overflowing from the flotation tank.

In one embodiment of the flotation plant, each overflow receptacle has at least one overflow outlet for discharging the overflow from the overflow receptacle.

In one embodiment of the flotation plant, the flotation plant comprises an overflow channel comprising an overflow inlet portion connected to each of the overflow outlets for receiving the overflows from each of the overflow receptacles.

In one embodiment of the flotation plant, the overflow channel comprises at least one, preferably two sloping channel portions for receiving and conducting the overflows from the overflow inlet portions by gravity, and the overflow channel comprises one single outlet portion, and the sloping channel portions slopes towards the outlet portion, and the outlet portion opens to a mouth of the sump tank for discharging the overflow as one single flow to the sump tank.

In one embodiment of the flotation plant, the pump sump module comprises an upwards open top, and the outlet portion extends to the mouth of the sump tank via the open top.

In one embodiment of the flotation plant, the overflow channel has a widthwise diameter of at least 250 mm.

5 In one embodiment of the flotation plant, the widthwise diameter of the overflow channel is 250 to 1200 mm, preferably 400 mm to 1000 mm.

In one embodiment of the flotation plant, flotation is froth flotation.

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In one embodiment of the flotation plant, the flotation plant comprises gas adding equipment for adding gas to the feedstock subject of flotation.

15 In one embodiment of the flotation plant, the flotation plant comprises gas adding equipment to the stream of the feedstock subject of flotation before entering the flotation tank.

20 In one embodiment of the flotation plant, the flotation plant comprises gas adding equipment for adding gas to the feedstock subject of flotation in the flotation tank.

25 In one embodiment of the flotation plant, the gas adding equipment includes a rotor inside the flotation tank.

30 In one embodiment of the flotation plant, the gas adding equipment includes a hollow rotatable drive shaft and the rotor is connected to the drive shaft.

In one embodiment of the flotation plant, the feedstock subject of flotation is slurry or pulp.

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In one embodiment of the flotation plant, the flotation plant comprises mixing equipment.

In one embodiment of the flotation plant, the mixing equipment includes a rotor inside the flotation tank.

- 5 In one embodiment of the flotation plant, the mixing equipment includes a stator inside the flotation tank.

In one embodiment of the flotation plant, the flotation tank having a bottom is disposed inside a framework, and the stator is connected to the framework through the bottom.

According to a second aspect of the invention, the invention provides use of the flotation plant according to the first aspect for separating material by flotation based on differences of buoyancy properties of substances. For example there is buoyancy difference when organic material is separated from aqueous material.

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According to a third aspect of the invention, the invention provides use of the flotation plant according to the first aspect for separating solid material by froth flotation based on differences of hydrophilic properties of substances. Solid materials separated by froth flotation could be oil sands, carbon, coal, talk, industrial minerals and mineral particles. The minerals may include industrial minerals and ore. Froth flotation to solid material could be made based on natural hydrophilic/hydrophobic difference or based on hydrophilic/hydrophobic differences made by addition of a surfactant or collector chemical or other chemical.

35 According to a fourth aspect of the invention, the invention provides use of the flotation plant according to the first aspect for concentrating ore by froth

flotation. An ore is a type of rock that contains sufficient minerals with important elements including metals that can be economically extracted from the rock. Metal ores are generally oxides, sulfides, silicates, or metals such as native copper or gold. Froth flotation of ore could be made based on natural hydrophilic/hydrophobic difference or based on hydrophilic/hydrophobic differences made by addition of a surfactant or collector chemical or other chemical.

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According to a fifth aspect of the invention, the invention provides use of the flotation plant according to the first aspect for flotation of substances containing abrasive material. The abrasive mineral may be, for example, pyrite, silica, chromite. The drive module being hoistable and transferable as one unit to gain access to the tanks enables that the tanks can easily be maintained or replaced when they are outworn and are at the end of their life. This is important especially with the use in connection with abrasive material. Use of the flotation plant which is easy to maintenance is effective when flotation is made to abrasive material.

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According to a sixth aspect, the present invention provides use of the flotation plant according to the first aspect for froth flotation of ore containing pyrite, silica, chromite. Use of the flotation plant which is easy to maintenance and has preferably tanks made from PE or PP is effective when flotation is made to ore containing pyrite, silica, chromite. PE and PP are durable against the ore containing pyrite, silica, chromite.

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According to a seventh aspect, the present invention provides a pump sump module. The pump sump module is a rigid and self-supporting unit capable of being trans-

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ferable and hoistable as an integral entity. The pump sump module comprises a self-supporting framework, the self-supporting framework having an inner space; a sump tank, the tank being arranged in the inner space
5 of the self-supporting framework; and a pump, the pump being connected in fluid communication with the sump tank.

In one embodiment of the pump sump module, the sump
10 tank is arranged to collect fluid, when in use.

In one embodiment of the pump sump module, the pump is arranged to discharge the liquid collected in the sump tank from the tank, when in use.

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According to an eighth aspect of the invention, the invention provides use of the pump sump module according to the seventh aspect for separating material by flotation based on differences of buoyancy properties
20 of substances. For example there is buoyancy difference when organic material is separated from aqueous material.

According to a ninth aspect of the invention, the invention provides use of the pump sump module according to the seventh aspect for separating solid material by froth flotation based on differences of hydrophilic properties of substances. Solid materials separated by froth flotation could be oil sands, carbon, coal,
30 talk, industrial minerals and mineral particles. The minerals may include industrial minerals and ore. Froth flotation to solid material could be made based on natural hydrophilic/hydrophobic difference or based on hydrophilic/hydrophobic differences made by addition of a surfactant or collector chemical or other
35 chemical.

According to a tenth aspect of the invention, the invention provides use of the pump sump module according to the seventh aspect for concentrating ore by froth flotation. An ore is a type of rock that contains sufficient minerals with important elements including metals that can be economically extracted from the rock. Metal ores are generally oxides, sulfides, silicates, or metals such as native copper or gold. Froth flotation of ore could be made based on natural hydrophilic/hydrophobic difference or based on hydrophilic/hydrophobic differences made by addition of a surfactant or collector chemical or other chemical.

According to an eleventh aspect of the invention, the invention provides use of the pump sump module according to the seventh aspect for flotation of substances containing abrasive material. The abrasive mineral may be, for example, pyrite, silica, chromite. The drive module being hoistable and transferable as one unit to gain access to the tanks enables that the tanks can easily be maintained or replaced when they are outworn and are at the end of their life. This is important especially with the use in connection with abrasive material. Use of the flotation plant which is easy to maintenance is effective when flotation is made to abrasive material.

According to a twelfth aspect of the invention, the invention provides use of the pump sump module according to the seventh aspect for froth flotation of ore containing pyrite, silica, chromite. Use of the flotation plant which is easy to maintenance and has preferably tanks made from PE or PP is effective when flotation is made to ore containing pyrite, silica, chromite. PE and PP are durable against the ore containing pyrite, silica, chromite.

According to a thirteenth aspect of the invention, the invention provides a method of maintenance of a flotation plant of the first aspect of the invention. In the method an uppermost module in the stack of modules
5 is subject of maintenance, and the uppermost module is hoisted up and transferred aside from the top of the lower module and the uppermost module is replaced by a another uppermost module which is placed on top of the lower module.

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According to a fourteenth aspect of the invention, the invention provides a method of maintenance of a flotation plant of the first aspect of the invention. In the method a lower module underneath the uppermost
15 module is subject of maintenance, and the uppermost module is hoisted up from the top of the lower module and transferred aside for gaining access to the lower module.

20 In one embodiment of the method, while the uppermost module is away from the top of the lower module, maintenance operations are performed for the lower module.

25 In one embodiment of the method, while the uppermost module is away from the top of the lower module, the lower module is replaced by another lower module.

The embodiments of the invention described hereinbefore
30 fore may be used in any combination with each other. Several of the embodiments may be combined together to form a further embodiment of the invention. An apparatus, a method, a composition or a use, to which the invention is related, may comprise at least one of the
35 embodiments of the invention described hereinbefore.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention and constitute a part of this specification, illustrate embodiments of the invention and together with the description help to explain the principles of the invention. In the drawings:

Figure 1 is a side view of the flotation plant according to one embodiment of the invention,

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Figure 2 is a cross-section II-II of Figure 1,

Figure 3 is a cross-section of an alternative embodiment to the embodiment shown in Figure 2, and

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Figure 4 is an axonometric view of a pump sump module according to an embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Although flotation is disclosed in the following examples by reference to froth flotation, it should be noted that the principles according to the invention can be implemented regardless of the specific type of the flotation, i.e. the flotation technique can be any of the known *per se* flotation techniques, such as froth flotation, dissolved air flotation or induced gas flotation.

Figures 1 - 3 show embodiments of a simple froth flotation plant being a modular three-storeyed structure. The froth flotation plant is for froth flotation of mineral concentrate from slurry of liquid and mineral solids. The modules, from which the froth flotation plant has been built, are removably stacked on top of each other to form a modular three-storeyed structure, which can be assembled and dismantled quickly. This

kind of structure has a first storey I at the bottom, a second storey II in the middle and a top storey III.

5 The second storey II is elevated at a height H above the ground level. The second storey II includes a tank module 6. The tank module has a height h2.

10 The tank module 6 includes a self-supporting framework 16. The self-supporting framework 16 of the tank module 6 has a shape of a rectangular parallelepiped. The tank module 6 can be transferred and hoisted as one integral entity. The self-supporting framework 16 has an inner space 17. The self-supporting framework 16 comprises a framework bottom 18 and framework side-
15 walls 19 which together define the inner space. In Figure 1 the tank module 6 includes four froth flotation tanks 7 arranged in a row inside the inner space 17 of the self-supporting framework 16. The froth flotation tanks 7 are in fluid communication with each
20 other. Preferably the froth flotation tanks 7 are each self-supporting structures. The froth flotation tanks 7 are preferably placed in the inner space 17 of the self-supporting framework 16 without being attached to the framework bottom 18 and the framework sidewalls
25 19.

A preferable embodiment of the tank module 6 and its framework 16 is that they are compatible to intermodal freight container standards whereby they have dimen-
30 sions and corner fittings which enable intermodal transportability.

The tank module 6 is arranged for implementing froth flotation. It can produce an overflow and discharge
35 the overflow to an overflow receptacle 8. In this example of Figure 1, the tank module 6 comprises four froth flotation tanks 7 and a corresponding number of

overflow receptacles 8. The overflow receptacles 8 are in the inner space 17 of the self-supporting framework 16 and are arranged at the upper part of the froth flotation tanks 7 so that one overflow receptacle 8 is arranged for each one of the froth flotation tank 7. The overflow receptacle 8 is disposed to receive an overflow overflowing from the froth flotation tank 7.

In the third storey III, on top of the tank module 6, there is a drive module 20. Four drive units 21, one for each one of the four froth flotation tanks 7, are arranged for the rotation of a drive shaft 22 and a rotor 23 connected to the drive shaft, the drive shaft 22 and the rotor 23 residing inside the froth flotation tank 7. The rotor via which frothing gas is fed into the slurry mixes the slurry and forms bubbles therein in the froth flotation tank 7. The mixing and gas adding equipment also includes a stator 31 inside the flotation tank 7. The stator 31 is stationary and surrounds the rotor 23. The stator 31 is connected to the framework 16 through the bottom 32.

The drive module 20 is a self-supporting structure which is transferable and hoistable as an integral entity. The drive module 20 comprises a self-supporting framework 24 having a shape of a rectangular parallel-piped. The self-supporting framework 24 defines an inner space 25 within the self-supporting framework. The drive units 21 are supported to the self-supporting framework 24 in the inner space 25 the self-supporting framework. The drive units 2 are releasably connectable to the drive shafts 22.

A preferable embodiment of the drive module 20 and its framework 24 is that they are compatible to intermodal freight container standards whereby they have dimen-

sions and corner fittings which enable intermodal transportability.

As can be seen in Figures 1 - 3, each of the overflow
5 receptacles 8 has two overflow outlets 9 for discharging the overflow from the overflow receptacle 8. An overflow channel 10 is arranged on one side of the tank module 6. The overflow channel 10 comprises overflow inlet portions 11. The upper end of each of the
10 inlet portions 11 is connected to one overflow outlet 9 so that the inlet portions can receive the overflows from each of the overflow receptacles 8. Further, the overflow channel 10 comprises two sloping channel portions 12 to which the lower ends of the inlet portions
15 11 are connected so that the sloping channel portions 12 the overflows can flow via the overflow inlet portions 11 to the sloping channel portions 12. The overflow channel 10 comprises one single outlet portion 13. The sloping channel portions 12 slope towards the
20 outlet portion 13 with an inclination angle α so that the overflow can flow by gravity along the sloping channel portions 12 towards the outlet portion 13. In order to obtain optimal inclination angle for the sloping channel portions 12, the outlet portion 13 is
25 located in the middle area of the longitudinal direction of the tank module 6 within a range of 30-70% of the total length of the tank module 6. In the embodiment shown in Figure 1, the outlet portion 13 is located approximately in the middle of the total length
30 of the tank module 6. The outlet portion 13 opens to a mouth 14 of the sump tank 4 so that the overflow exiting from the outlet portion 13 can fall into the sump tank 4 where it can be let to settle before being pumped by the pump 5 for further processing.

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As can be seen also in Figure 4, the pump sump module is a rigid and self-supporting unit capable of being

transferable and hoistable as an integral entity. The pump sump module 1 comprises a self-supporting framework 2 having a shape of a rectangular parallelepiped and inner space 3 within the framework 2. A sump tank 4 is disposed in the inner space 3 of the self-supporting framework 2. The sump tank 4 has an open mouth 14 in its upper part.

In the embodiment of Figure 2, the pump sump module 1 comprises an upwards open top 15 (see also Figure 4). The outlet portion 13 of the overflow channel 10 extends into the mouth 14 of the sump tank 4 via the open top 15 of the pump sump module 1.

A preferable embodiment of the pump sump module 1 and its framework 2 is that they are compatible to intermodal freight container standards whereby they have dimensions and corner fittings which enable intermodal transportability.

In order to obtain an optimal continuous flow for the overflow via the overflow channel 10 and via the sump tank 4 the height h_1 of the pump sump module 1 should be in the range of 35 - 70 % of the total height $h_1 + h_2$ of the pump sump module 1 and the tank module 2. Preferably, the height h_1 of the pump sump module 1 is 40 - 65%, more preferably 45 - 55%, of the total height $h_1 + h_2$ of the pump sump module 1 and the tank module 2. Preferably, the overflow channel 10 has a widthwise diameter of at least 250 mm. Preferably, the widthwise diameter of the overflow channel 10 is 250 to 1200 mm, preferably 400 mm to 1000 mm.

In the embodiment of Figure 2, the overflow channel 10 is disposed inside an accessory module 26. The overflow channel 10 is supported by brackets 27 to a self-supporting framework 28 of the accessory module 26.

The self-supporting framework 28 of the accessory module 26 has a shape of a rectangular parallelepiped.

The accessory module 26 can be transferred and hoisted as one integral entity. The accessory module 26 is
5 disposed at the level of the second storey II and next to the tank module 6. The accessory module 26 is removably stacked on top of the pump sump module 1. Thereby the pump sump module 1 acts as a supporting foundation for the accessory module 26. In the embodiment of Figure 2, the tank module 1 and the drive module 20 are supported by a foundation module 29 on top of which they are removably stacked.

A preferable embodiment of the accessory module and
15 its framework is that they are compatible to intermodal freight container standards whereby they have dimensions and corner fittings which enable intermodal transportability.

20 In the embodiment shown in Figure 3, the pump sump module 1 acts as a supporting foundation for the stack of the tank module 6 and the drive module 20. In this embodiment the overflow channel 10 is supported by brackets 30 to the self-supporting framework 16 of the
25 tank module 6. The outlet portion 13 of the overflow channel extends through the framework sidewall of the self-supporting framework 2 of the pump sump module 1.

Maintenance of the flotation unit or plant is easy and
30 can be performed quickly. If an uppermost module in the stack of modules is subject of maintenance, the uppermost module is simply hoisted up and transferred aside and is replaced by another uppermost module. If a lower module located underneath the uppermost module
35 is subject of maintenance, then the uppermost module is hoisted up from the top of the lower module and transferred aside for gaining access to the lower mod-

ule. While the uppermost module is away from the top of the lower module, maintenance operations are performed for the lower module. Alternatively, the lower module can simply be replaced by another lower module.

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It is obvious to a person skilled in the art that with the advancement of technology, the basic idea of the invention may be implemented in various ways. The invention and its embodiments are thus not limited to the examples described above, instead they may vary within the scope of the claims.

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CLAIMS

1. A flotation plant, the flotation plant being built to a modular storeyed structure comprising
- 5 - a first storey, the first storey being the lowest storey of the plant and comprising a pump sump module, the pump sump module being a rigid and self-supporting unit capable of being transferable and hoistable as an integral entity, the pump sump module having a height,
- 10 and the pump sump module comprises
- a self-supporting framework, the self-supporting framework having an inner space,
 - a sump tank, the tank being arranged in the inner space of the self-supporting framework, and

15 -- a pump, the pump being connected in fluid communication with the sump tank,

 - a second storey the second storey being located at the level above the first storey, the second storey including a tank module having a height and the tank

20 module being configured to implement froth flotation, produce an overflow and to discharge the overflow to the sump tank, and

wherein the height of the pump sump module is 35 - 70 % of the total height of the pump sump module

25 and the tank module.
2. The flotation plant according to claim 1, wherein the height of the pump sump module is 40 - 65%, more preferably 45 - 55%, of the total height of the pump
- 30 sump module and the tank module.
3. The flotation plant according to claim 1 or 2, wherein the tank module comprises one to four flotation tanks and an overflow receptacle for each flotation
- 35 tank, the overflow receptacle being for receiving an overflow overflowing from the flotation tank.

4. The flotation plant according to claim 3, wherein each overflow receptacle has at least one overflow outlet for discharging the overflow from the overflow receptacle.

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5. The flotation plant according to claim 4, wherein the flotation plant comprises an overflow channel comprising an overflow inlet portion connected to each of the overflow outlets for receiving the overflows from each of the overflow receptacles.

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6. The flotation plant according to claim 5, wherein the overflow channel comprises at least one, preferably two sloping channel portions for receiving and conducting the overflows from the overflow inlet portions by gravity, and the overflow channel comprises one single outlet portion, and the sloping channel portion slopes towards the outlet portion, and the outlet portion opens to a mouth of the sump tank for discharging the overflow as one single flow to the sump tank.

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7. The flotation plant according to claim 6, wherein the pump sump module comprises an upwards open top, and the outlet portion extends to the mouth of the sump tank via the open top.

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8. The flotation plant according any one of the claims 4 to 8, wherein the overflow channel has a widthwise diameter of at least 250 mm.

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9. The flotation plant according to claim 8, wherein the widthwise diameter of the overflow channel is 250 to 1200 mm, preferably 400 mm to 1000 mm.

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10. The flotation plant according to any one of the claims 1 to 9, wherein flotation is froth flotation.

11. The flotation plant according to claim 10, wherein the flotation plant comprises gas adding equipment for adding gas to the feedstock subject of flotation.

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12. The flotation plant according to claim 11, wherein the flotation plant comprises gas adding equipment to the stream of the feedstock subject of flotation before entering the flotation tank.

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13. The flotation plant according to claim 11, wherein the flotation plant comprises gas adding equipment for adding gas to the feedstock subject of flotation in the flotation tank

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14. The flotation plant according to claim 13, wherein the gas adding equipment includes a rotor inside the flotation tank.

20

15. The flotation plant according to claim 13, wherein the gas adding equipment includes a hollow rotatable drive shaft and the rotor is connected to the drive shaft.

25

16. The flotation plant according to any one of the claims 1 to 15, wherein the feedstock subject of flotation is slurry or pulp.

30

17. The flotation plant according to any one of the claims 10 to 16, wherein the flotation plant comprises mixing equipment.

35

18. The flotation plant according to claim 17, wherein the mixing equipment includes a rotor inside the flotation tank.

19. The flotation plant according to claim 18, wherein the mixing equipment includes a stator inside the flotation tank.
- 5 20. The flotation plant according to claim 19, wherein the flotation tank having a bottom is disposed inside a framework, and the stator is connected to the framework through the bottom.
- 10 21. Use of the flotation plant according to any one of the claims 1 to 20 for separating material by flotation based on differences of buoyancy properties of substances.
- 15 22. Use of the flotation plant according to any one of the claims 1 to 20 for separating solid material by froth flotation based on differences of hydrophilic properties of substances.
- 20 23. Use of the flotation plant according to any one of the claims 1 to 20 for concentrating ore by froth flotation.
24. Use of the flotation plant according to any one of
25 the claims 1 to 20 for flotation of substances containing abrasive material.
25. Use of the flotation plant according to any one of
the claims 1 to 20 for froth flotation of ore contain-
30 ing pyrite, silica, chromite.
26. A pump sump module, the pump sump module being a rigid and self-supporting unit capable of being transferable and hoistable as an integral entity, the pump
35 sump module comprising
- a self-supporting framework, the self-supporting framework having an inner space,

- a sump tank, the tank being arranged in the inner space of the self-supporting framework, and
- a pump, the pump being connected in fluid communication with the sump tank.

5

27. The pump sump module according to claim 26, wherein the sump tank is arranged to collect fluid, when in use.

10

28. The pump sump module according to claim 26 or 27, wherein the pump is arranged to discharge the liquid collected in the sump tank from the tank, when in use.

15

29. Use of the pump sump module according to any one of the claims 26 to 28 for separating material by flotation based on differences of buoyancy properties of substances.

20

30. Use of the pump sump module according to any one of the claims 26 to 28 for separating solid material by froth flotation based on differences of hydrophilic properties of substances.

25

31. Use of the pump sump module according to any one of the claims 26 to 28 for concentrating ore by froth flotation.

30

32. Use of the pump sump module according to any one of the claims 26 to 28 for flotation of substances containing abrasive material.

35

33. Use of the pump sump module according to any one of the claims 26 to 28 for froth flotation of ore containing pyrite, silica, chromite.

34. A method of maintenance of a flotation plant according to any one of the claims 1 to 20, in which

method an uppermost module is subject of maintenance,
and the uppermost module is hoisted up and transferred
aside from the top of the lower module and the upper-
most module is replaced by a another uppermost module
5 which is placed on top of the lower module.

35. A method of maintenance of a flotation plant ac-
cording to any one of the claims 1 to 20, in which
method a lower module, which is underneath an upper-
10 most module, is subject of maintenance, and the upper-
most module is hoisted up from the top of the lower
module and transferred aside for gaining access to the
lower module.

15 36. The method of maintenance according to claim 35,
wherein while the uppermost module is away from the
top of the lower module, maintenance operations are
performed for the lower module.

20 37. The method of maintenance according to claim 35,
wherein while the uppermost module is away from the
top of the lower module, the lower module is replaced
by another lower module.

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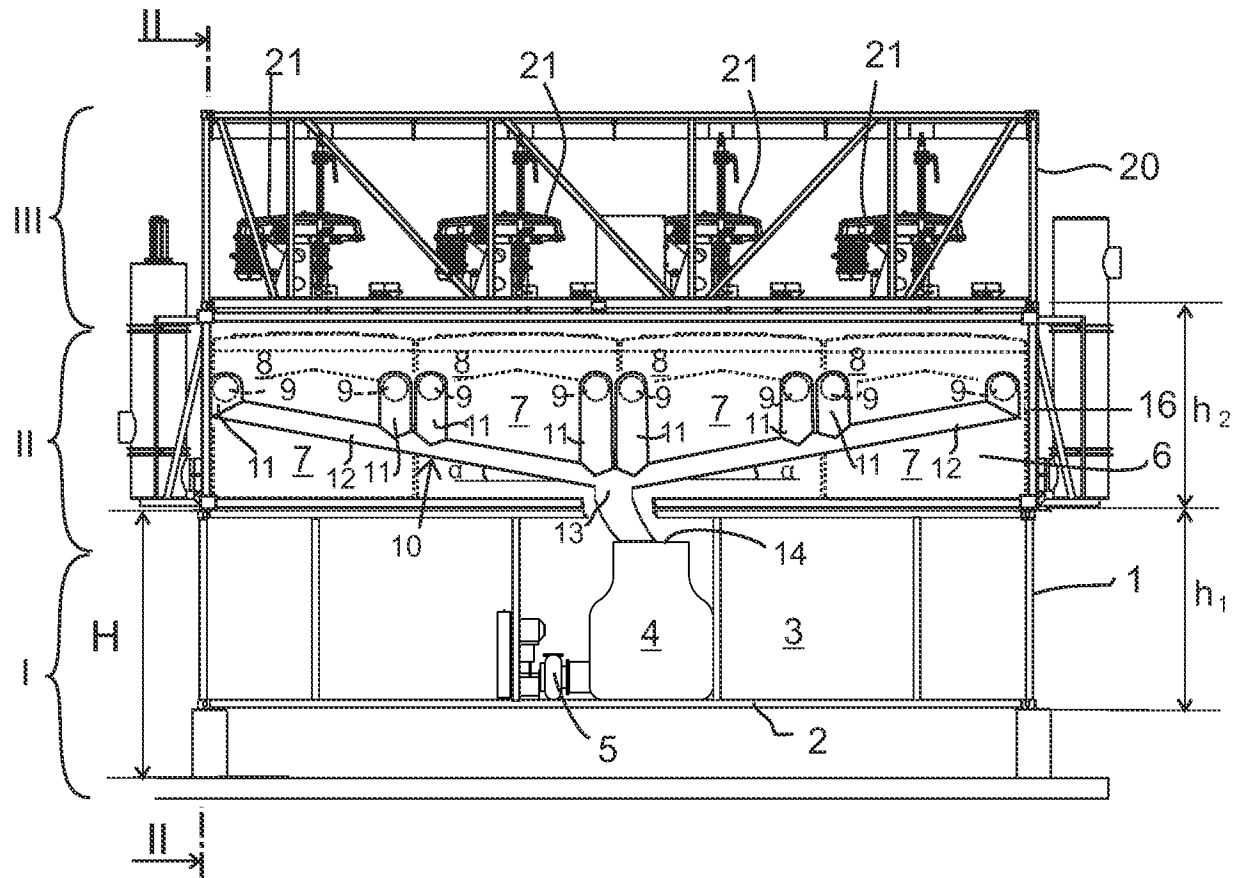


Fig. 1

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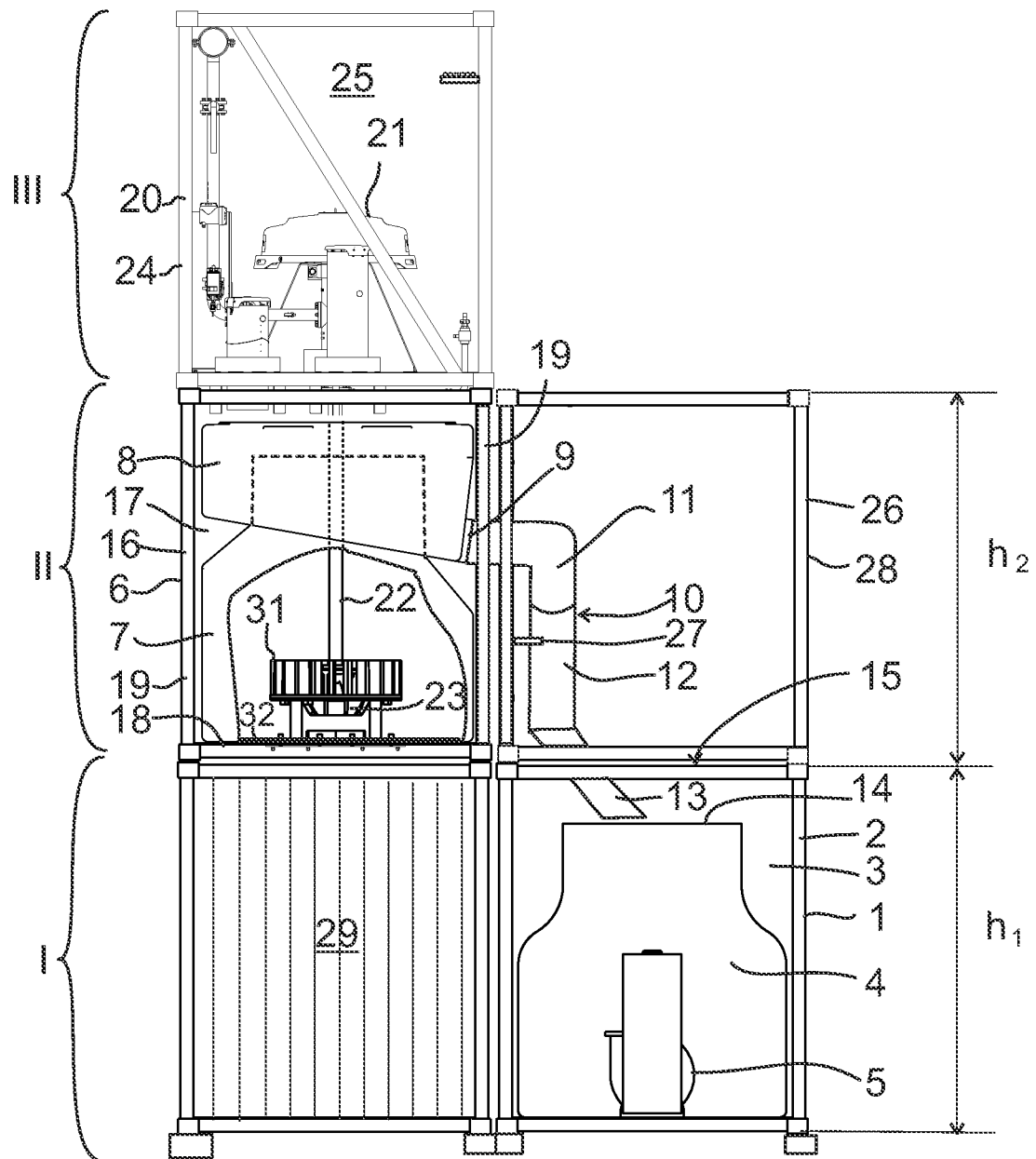


Fig. 2

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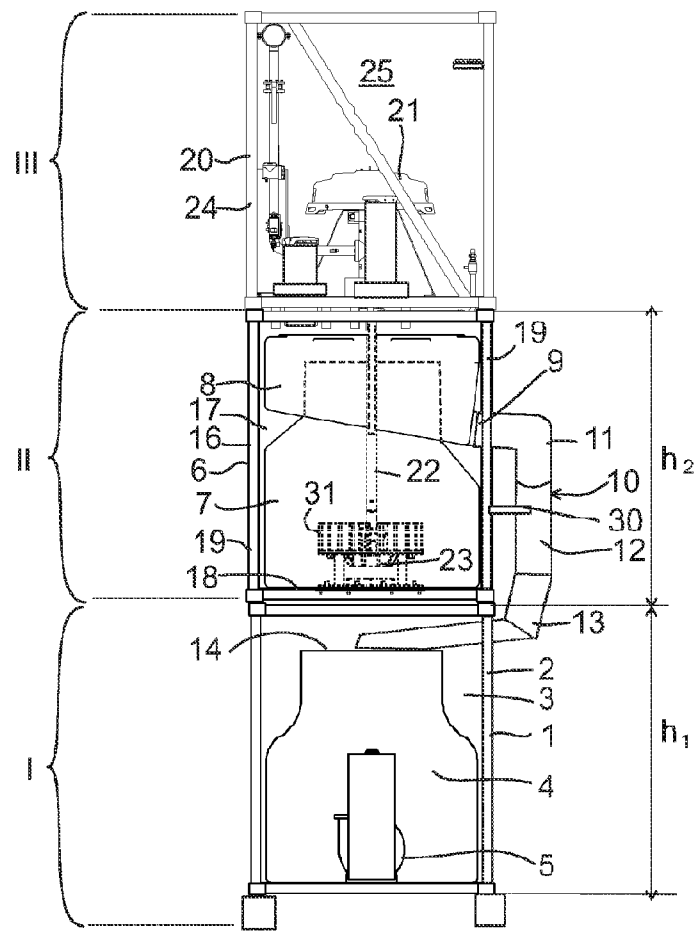


Fig. 3

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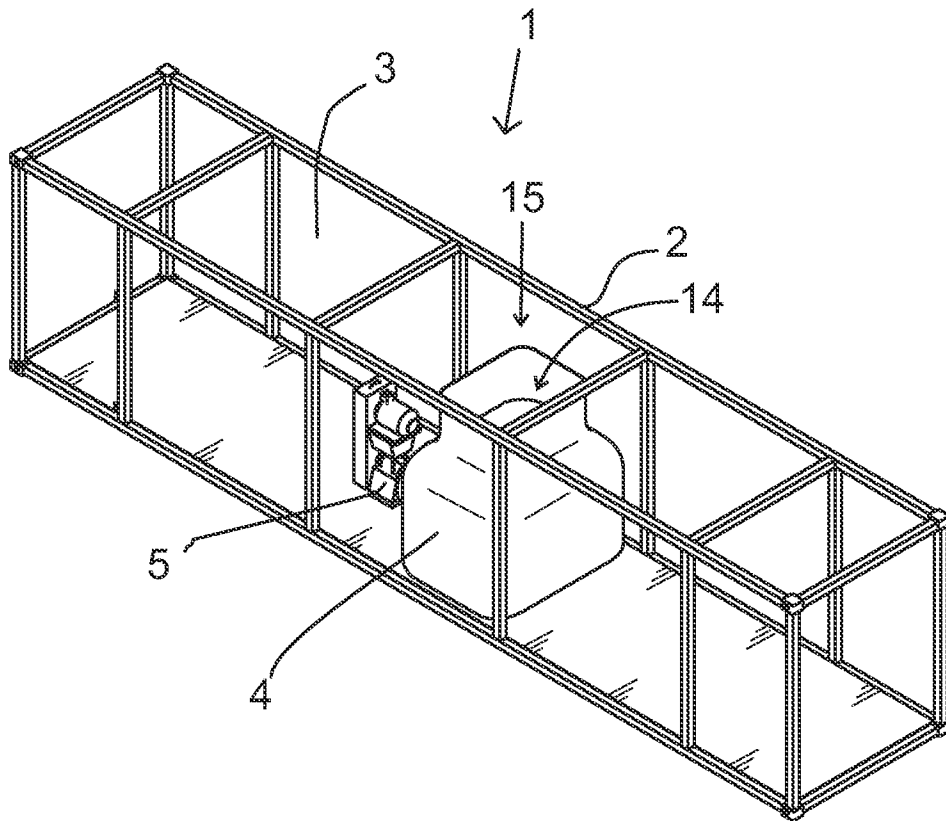


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/FI2015/050330

A. CLASSIFICATION OF SUBJECT MATTER

INV. B03D1/02 B03D1/14 B03D1/20
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B03D

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

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

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 156 699 A1 (MINEMET RECH SA [FR]) 2 October 1985 (1985-10-02)	1,2, 10-13, 16,17, 21-37
Y	page 1, line 3 - line 8 page 14, line 4 - line 20 page 17, line 25 - line 31; figures 1-7	3-9,14, 15,18-20
Y	US 2 413 015 A (WIGTON PAUL L) 24 December 1946 (1946-12-24) column 3, line 33 - line 38 column 4, line 1 - line 6 claims 1-17; figures 1-4	3-9,14, 15,18-20



Further documents are listed in the continuation of Box C.



See patent family annex.

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

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

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Date of the actual completion of the international search

13 January 2016

Date of mailing of the international search report

25/01/2016

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/FI2015/050330

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