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(54) **DREDGING VESSEL**

(57) Described is a dredging vessel (100) which is provided with a hold (101) for holding dredged material and with a pick-up means (9) for taking material in relatively dry state out of the hold (101) and feeding removed material to a processing unit (20). The processing unit comprises pump means (6) and is further configured to

bring supplied material together with a carrier liquid so that a pumpable substance results which can be pumped by means of said pump means to a storage. The dredging vessel allows a relatively dry load to be unloaded in efficient manner. The dredging vessel can also comprise a larger hold than usual.

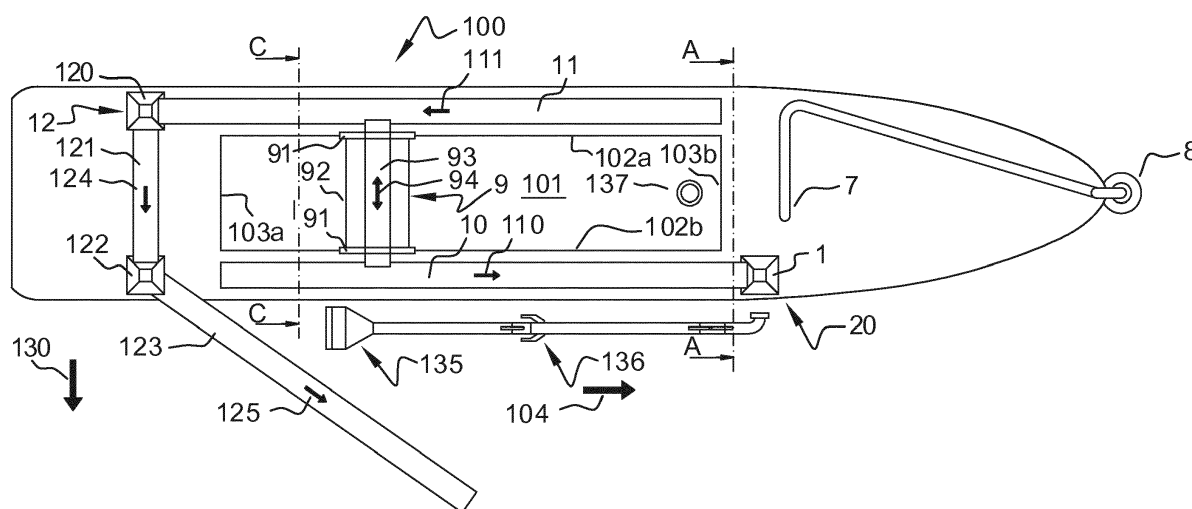


FIG. 1

Description

BACKGROUND OF THE INVENTION

[0001] The invention relates to a dredging vessel comprising a hold for holding dredged material and a pick-up means for taking dredged material out of the hold in relatively dry state. The invention also relates to a method for taking dredged material out of a hold of a dredging vessel and carrying thereof to a storage. The invention finally relates to a processing unit for carrying dredged material to a storage together with the dredging vessel.

SUMMARY OF THE INVENTION

[0002] During dredging with a dredging vessel, such as for instance a trailing suction hopper dredger, a mixture of bottom material and water is suctioned up via a drag head connected to a suction conduit and moving over the water bottom, and carried via an inlet into a hold (or hopper) of the dredging vessel until the hold is sufficiently filled. The maximum filling height of the hold is determined by the height position of an overflow which is present in the hold of the dredging vessel and which forms an open connection with the water, for instance via the underside of the dredging vessel.

[0003] The heavier material particles collected in the hold will settle after a period of time and thus form in the hold a settled layer increasing in height as the dredging progresses. On top of the settled layer forms a non-settled layer of finer particles floating in water which can for instance be drained by lowering the overflow into the vicinity of the settled layer. Because water is still present in the pores between the material particles, the water content in such a settled layer is generally higher than 20% by weight. Particularly in the case where coarser soil particles are extracted such as sand and gravel, a relatively dry load will form in the hold, wherein use can be made of a dry suction device as further elucidated below.

[0004] Such a relatively dry load can be taken out of the hold using an unloading installation (dry unloading). An unloading installation can for instance be embodied by means of one or more grippers, excavator bucket(s), cutting wheel(s), bucket chain(s) or elevator conveyor(s) or a combination of these systems. This method cannot be performed in all conditions. Because of the form of the hold of the dredging vessel and the obstacles occurring from time to time in this hold it is also not always possible in many cases to empty the hold in sufficient manner, and a load residue may occur.

[0005] JP H04 143190 A describes a device for reducing the salinity of sand and gravel extracted with a dredging vessel. The dredging vessel comprises a hold and a conveyor belt which carries the extracted material in saturated state to a clean water pit in which the salt is removed by flushing with clean water. The clean water pit is provided for this purpose with a stirrer and a slurry

pump. From a second vessel clean water is carried from a clean water reservoir to the clean water pit using a pump. The purified sand or gravel is pumped to a hold of the second vessel using the slurry pump.

[0006] WO 95/21303 A1 describes a method wherein the material dredged by a dredging vessel is transferred to transport vessels. Described among other aspects is that the hold of the dredging vessel is provided with a perforated pipe through which saturated dredged material can be carried to a rainbow pipe using a dredge pump. This document does not describe a pick-up means in the form of a conveyor belt.

[0007] The present invention has for its object to provide a dredging vessel which at least partially obviates the above stated drawbacks. Another object is to provide a dredging vessel with which relatively dry material held in a hold of the dredging vessel can be carried in efficient and flexible manner to a storage. Yet another object is to provide a dredging vessel which is able to carry dredged material to a storage in two ways, i.e. in relatively wet and in relatively dry state.

[0008] The invention provides for this purpose a dredging vessel comprising a hold for holding dredged material, a pick-up means for taking material in relatively dry state out of the hold and feeding removed material to a processing unit, wherein the processing unit comprises pump means and is further configured to bring supplied material together with a carrier liquid so that a pumpable substance results which can be pumped by means of the pump means to a storage. With the dredging vessel the dredged material can be discharged in efficient manner from the hold of the dredging vessel to a suitable storage. Because the relatively dry material is first carried in relatively dry state from the hold to pump means and subsequently brought into liquid state and pumped, initial losses are considerably limited compared to a situation in which relatively dry material is first brought into liquid form and subsequently guided in liquid form to pump means and pumped. This method also makes it possible to create a high density of the pumpable mixture and so increase the pump production.

[0009] In an embodiment the invention provides a dredging vessel comprising a hold for holding dredged material, a dry suction device received in the hold for bringing the material present in the hold into a relatively dry state, and a pick-up means for taking material in relatively dry state out of the hold and feeding removed material to a processing device, wherein the processing unit comprises pump means which are connected to a throughfeed conduit which is configured to bring together material fed to the throughfeed conduit with a carrier liquid so that a pumpable substance results which can be pumped by means of the pump means to a storage. In this embodiment of the invented device the material particles are suctioned into the throughfeed conduit and entrained with the flowing carrier liquid. Use need therefore not be made of a reservoir in which the material would have to be mixed with a carrier liquid. The direct mixing

taking place in the throughfeed conduit is efficient and the content of material particles in the carrier liquid can moreover be precisely adjusted by matching the flow rates of the carrier liquid flow and the material feed.

[0010] A further advantage of the present invention relates to the fact that no additional equipment need be installed in the hold, such as for instance a suction drain channel provided at the bottom of the hold for transporting the dredged material to the pump means.

[0011] A relatively dry state of the material is understood in the context of the present application to mean a state wherein the material has a water content of less than 20% by weight, more preferably less than 15% by weight, still more preferably less than 10% by weight, and most preferably less than 6% by weight. A relatively dry state of the dredged material received in the hold can for instance be obtained by applying a dry suction device. Such a dry suction device is generally situated at an underside of the hold and comprises for instance a drainage gutter which is screened from the load in the hold by means of filter means. The filter means allow passage of the water escaping from the load due to gravitational force but prevent the passage of material particles from the load to the drainage gutter. The water is discharged via the drainage gutter by means of pump means forming part of the dry suction device.

[0012] Provided in an embodiment of the invention is a dredging vessel wherein the processing unit comprises a receiving unit for the supplied material, and the receiving unit is provided with one or more jet pipes for supplying a liquid. The receiving unit is configured to receive the relatively dry material taken out of the hold by the pick-up means. The jet pipes feed a liquid to the relatively dry material received in the receiving unit, whereby this material is fluidized to the extent necessary. This facilitates transport of the material present in the receiving unit to the pump means.

[0013] Another embodiment of the invention relates to a dredging vessel wherein the processing unit comprises a feed conduit for feeding the carrier liquid. This embodiment makes it possible to feed sufficient carrier liquid to the optionally fluidized dredged material (and vice versa), and this can moreover take place in continuous manner. The pump means can be utilized here to draw in and pump the material brought together with the carrier liquid.

[0014] Yet another embodiment relates to a dredging vessel wherein an outlet of the receiving unit connects to a feed conduit for the carrier liquid. Because of the flow present in the feed conduit for the carrier liquid, in this embodiment the material coming from the receiving unit is automatically suctioned to the feed conduit in continuous manner so that a good mixing of the material with the carrier liquid results, and this at an optimal density.

[0015] A further embodiment of the invention provides a dredging vessel wherein the feed conduit for the carrier liquid connects to an inlet of the pump means, thereby reducing suction losses.

[0016] Provided in an embodiment according to the in-

vention is a dredging vessel wherein the feed conduit for the carrier liquid is configured to debouch with an inlet thereof into the surrounding water. This embodiment makes use of the surrounding water. In a further embodiment the dredging vessel is provided with a suction conduit for suctioning up dredged material, and the feed conduit for the carrier liquid comprises the suction conduit. A further embodiment of the dredging vessel has the feature that the dredging vessel comprises a dredge pump for pumping up dredged material, and the pump means for pumping the pumpable substance comprise the dredge pump.

[0017] In another embodiment of the invention the relatively dry material is carried into the receiving unit from a location situated outside the dredging vessel. This can be achieved for instance with a second vessel or pontoon present in the vicinity of the vessel.

[0018] There are further advantages to characterizing the dredging vessel according to an embodiment in that it comprises a transport means configured to receive, transport and feed to the processing unit material in relatively dry state taken out of the hold by the pick-up means. Suitable transport means comprise for instance conveyor belts. This can be provided in a suitable manner along side edges of the hold.

[0019] A further embodiment comprises a dredging vessel wherein the transport means has a direction of transport (or direction of forward movement), and this direction of transport can be changed to another direction of transport differing from the direction of transport, preferably a second direction of transport opposite to the direction of transport.

[0020] According to another embodiment, the dredging vessel has the feature that the transport means is configured to receive, transport in the second direction of transport and feed to a second processing unit material in relatively dry state taken out of the hold by the pick-up means. Provided in this way is a dredging vessel which is able to carry dredged material in two ways to a storage, i.e. in relatively wet and in relatively dry state.

[0021] An embodiment in which the second processing unit of the dredging vessel is configured to carry the material in relatively dry state to a storage has the advantage that the dredging vessel is suitable for several methods of storage. It does indeed become possible to remove dredged material in both relatively wet and relatively dry state from the hold and store it in a storage suitable for the purpose.

[0022] The invention likewise relates to a method for taking out of a hold of a dredging vessel and carrying dredged material to a storage. According to the invention the method comprises of taking material out of the hold with a pick-up means and feeding removed material in relatively dry state to a processing device of the dredging vessel, and bringing material fed to the processing unit together with a carrier liquid so that a pumpable substance results which is pumped by means of pump means to a storage.

[0023] Provided in an embodiment of the invention is a method further comprising of bringing the material present in the hold into a relatively dry state by means of a dry suction device received in the hold. Another embodiment relates to a method wherein bringing the supplied material together with the carrier liquid is performed in a throughfeed conduit to which the pump means are connected.

[0024] The invention likewise relates to a processing unit for carrying dredged material to a storage together with a dredging vessel, wherein the processing unit comprises pump means and is configured to bring supplied material together with a carrier liquid so that a pumpable substance results which can be pumped by means of the pump means to the storage. The processing unit is particularly suitable for providing on a dredging vessel, in particular in a below-decks pump chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The invention will now be elucidated in more detail with reference to the exemplary embodiments shown in the figures, without otherwise being limited thereto. In the figures:

Fig. 1 is a schematic top view of a dredging vessel according to an embodiment of the invention;

Fig. 2 is a schematic top view of a processing unit according to an embodiment of the invention;

Fig. 3 is a schematic cross-sectional view along line A-A in figure 1;

Fig. 4 is a schematic cross-sectional view along line B-B in figure 3; and

Fig. 5 is a schematic cross-sectional view along line C-C in figure 1.

DETAILED DESCRIPTION OF THE INVENTION

[0026] A dredging vessel 100 according to an embodiment of the invention is shown with reference to figure 1. Dredging vessel 100 comprises a vessel provided with a hold 101 for holding bottom material. The vessel can be embodied as a transport vessel into which the bottom material is loaded in dry or in wet state. The vessel can also be embodied as a trailing suction hopper dredger, in which case bottom material is dredged up with a suction head 135 which is connected to a suction pipe 136 and dragged over the bottom. It is also possible to embody the vessel as a cutter dredger, wherein a cutter head on a ladder and provided with teeth is hauled alternately from port to starboard over the bottom by means of winches. The vessel can further take yet another form, for instance as bucket dredger. In all cases at least a part of the dredged bottom material is stored in hold 101 which is enclosed by side walls (102a, 102b) running in a length direction 104 of dredging vessel 100 and by transverse side walls (103a, 103b). Hold 101 further comprises a bottom which is provided if desired with hatches to enable

unloading of a load present in hold 101. In addition to solid soil parts, the dredged material possibly also comprises a quantity of water which is loaded or dredged up together with the soil parts.

[0027] According to the invention dredging vessel 100 further comprises a pick-up means 9 for taking dredged material in relatively dry state out of hold 101. This relatively dry state can for instance be achieved by providing the hold in known manner with an overflow 137. The solid soil parts of the material stored in hold 101 will have settled after a certain period of time, whereby a watery layer results on a layer of more solid soil parts. By lowering an upper edge of the overflow into the watery layer a large part of the water can escape from hold 101 via the overflow, whereby hold 101 comprises only dredged material in relatively dry state. Pick-up means 9 is configured to take this material out of hold 101 and in the shown embodiment comprises a support frame 29 which can travel in length direction 104 over upper edges of side walls (102a, 102b) by means of a guide 91. Suspended from support frame 92 is a gripper 95 which can be lowered into hold 101 and take up relatively dry material therefrom. Pick-up means 9 is further provided with a transverse conveyor belt 93 onto which material picked up by the gripper can be deposited.

[0028] Dredging vessel 100 is also provided with two conveyor belts 10 and 11 which run in length direction 104 and which extend along respective side walls 102a and 102b of hold 101. The transverse conveyor belt 93 of pick-up means 9 is configured to move in two directions 94 and can discharge material if desired to both conveyor belts 10 and 11 depending on the setting of the direction of movement 94. Conveyor belt 10 is configured to carry relatively dry material from transverse conveyor belt 93 in a direction of movement 110 to a processing unit 20. Conveyor belt 11 is configured to carry relatively dry material from transverse conveyor belt 93 in a direction of movement 111 to a discharge device 12 for dry material. In the shown embodiment discharge device 12 comprises a receiving hopper 120 which connects to conveyor belt 11 and an outlet of which connects to a conveyor belt 121 running in transverse direction 130. This carries the dry material in a direction of movement 124 to the inlet of a receiving hopper 122, an outlet of which connects to an oblique conveyor belt 123. This discharges the dry material further in a direction of movement 125 to a suitable storage, for instance onshore.

[0029] Processing unit 20 is shown in more detail in figures 2-5 and comprises pump means in the form of a dredge pump 6 of the centrifugal pump type. Processing unit 20 is configured to bring relatively dry material fed from conveyor belt 10 together with a carrier liquid so that a substance pumpable by dredge pump 6 results. This substance is pumped by dredge pump 6 to a discharge pipe 7 which connects with an inlet to dredge pump 6 and with an outlet to a bow coupling 8 of dredging vessel 100 for discharge to an onshore storage (optionally via an intermediate station or booster) or for the pur-

pose of rainbowing or for the purpose of transfer to another means of transport.

[0030] Processing unit 20 comprises for this purpose a receiving unit in the form of receiving hopper 1 which connects with an inlet to conveyor belt 10. Receiving hopper 1 can be provided with one or more jet pipes 5 for supplying a liquid, usually water, under pressure and/or flow rate. Dry material present in receiving hopper 1 is hereby at least partially fluidized. Processing unit 20 is further provided on an underside of the receiving hopper with a feed conduit 34 for feed of a carrier liquid, in particular sea or river water. Feed conduit 34 runs from an inlet 3 debouching in the surrounding water to a suction side 4 of dredge pump 6. The outlet of receiving hopper 1 further connects via an outlet conduit 14 to feed conduit 34. The outlet of receiving hopper 1 can be closed by means of a shut-off valve 2. In the closed position of shut-off valve 2 relatively dry material is held in receiving hopper 1, for instance in order to be fluidized with jet pipes 5. When shut-off valve 2 is opened, material present in receiving hopper 1 flows via conduit 14 into feed conduit 34 where the material mixes with (sea)water supplied from inlet 3. This substance is suctioned in by dredge pump 6 and pumped to discharge pipe 7.

[0031] Inlet 3 of feed conduit 34 can if desired be connected to suction conduit 136 of dredging vessel 100, for instance when dredging vessel 100 comprises a trailing suction hopper dredger. In such an embodiment wherein dredging vessel 100 comprises a dredge pump connected to a suction conduit 136 for pumping up dredged material, dredge pump 6 will generally comprise the dredge pump of the trailing suction hopper dredger.

[0032] Dredging vessel 100 according to the invention is able in efficient manner to not only carry dry load to a storage but also to pump this load to a storage subject to the local conditions and regulations.

Claims

1. Dredging vessel comprising a hold for holding dredged material, a pick-up means for taking material in relatively dry state out of the hold and feeding removed material to a processing unit, wherein the processing unit comprises pump means and is further configured to bring supplied material together with a carrier liquid so that a pumpable substance results which can be pumped by means of the pump means to a storage.
2. Dredging vessel as claimed in claim 1, further comprising a dry suction device received in the hold for bringing the material present in the hold into a relatively dry state.
3. Dredging vessel as claimed in claim 1 or 2, wherein the pump means are connected to a throughfeed conduit which is configured to bring the supplied ma-

terial together with the carrier liquid so that a pumpable substance results which can be pumped by means of the pump means to a storage.

4. Dredging vessel as claimed in any of the foregoing claims, wherein the processing unit comprises a receiving unit for the supplied material, and the receiving unit is provided with one or more jet pipes for supplying a liquid.
5. Dredging vessel as claimed in any of the foregoing claims, wherein the processing unit comprises a feed conduit for feeding the carrier liquid.
6. Dredging vessel as claimed in claim 5, wherein the feed conduit for the carrier liquid connects to an outlet of the receiving unit.
7. Dredging vessel as claimed in claim 5 or 6, wherein the feed conduit for the carrier liquid connects to an inlet of the pump means.
8. Dredging vessel as claimed in any of the foregoing claims, wherein the feed conduit for the carrier liquid is configured to debouch with an inlet thereof into the surrounding water.
9. Dredging vessel as claimed in any of the foregoing claims, wherein the dredging vessel comprises a suction conduit for suctioning up dredged material, and the feed conduit for the carrier liquid comprises the suction conduit.
10. Dredging vessel as claimed in any of the foregoing claims, wherein the dredging vessel comprises a dredge pump for pumping up dredged material, and the pump means for pumping the pumpable substance comprise the dredge pump.
11. Dredging vessel as claimed in any of the foregoing claims, comprising a transport means configured to receive, transport and feed to the processing unit material in relatively dry state taken out of the hold by the pick-up means.
12. Dredging vessel as claimed in claim 11, wherein the transport means has a direction of transport and this direction of transport can be changed to another direction of transport differing from the direction of transport.
13. Dredging vessel as claimed in claim 12, wherein the direction of transport can be changed to a second direction of transport opposite to the direction of transport.
14. Dredging vessel as claimed in claim 12 or 13, wherein the transport means is configured to receive, trans-

port in the second direction of transport and feed to a second processing unit material in relatively dry state taken out of the hold by the pick-up means.

15. Dredging vessel as claimed in claim 14, wherein the second processing unit is configured to carry the material in relatively dry state to a storage. 5
16. Method for taking out of a hold of a dredging vessel and carrying dredged material to a storage, the method comprising of taking material in the relatively dry state out of the hold with a pick-up means and feeding removed material to a processing device of the dredging vessel, and bringing material fed to the processing unit together with a carrier liquid so that a pumpable substance results which is pumped by means of pump means to a storage. 10 15
17. Method as claimed in claim 16, further comprising of bringing the material present in the hold into a relatively dry state by means of a dry suction device received in the hold. 20
18. Method as claimed in claim 16 or 17, wherein bringing the supplied material together with the carrier liquid is performed in a throughfeed conduit to which the pump means are connected. 25

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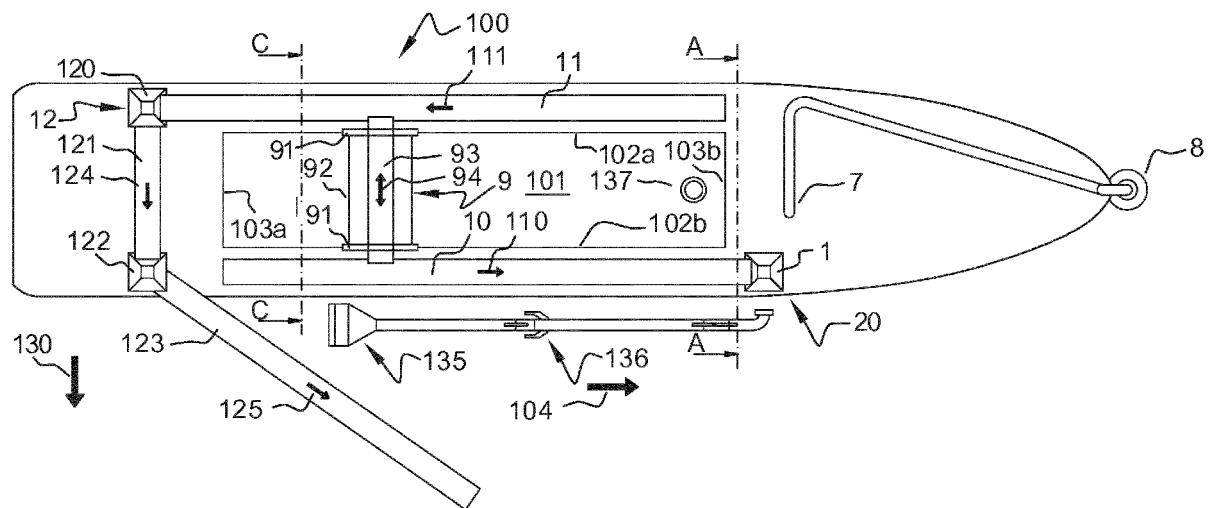


FIG. 1

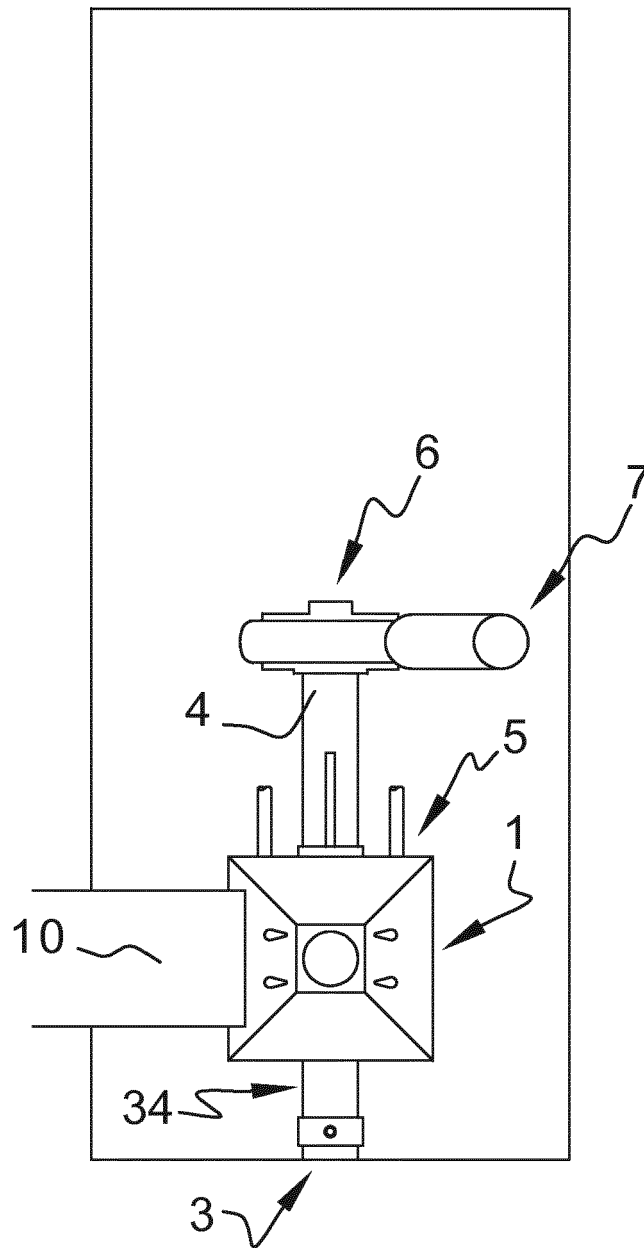


FIG. 2

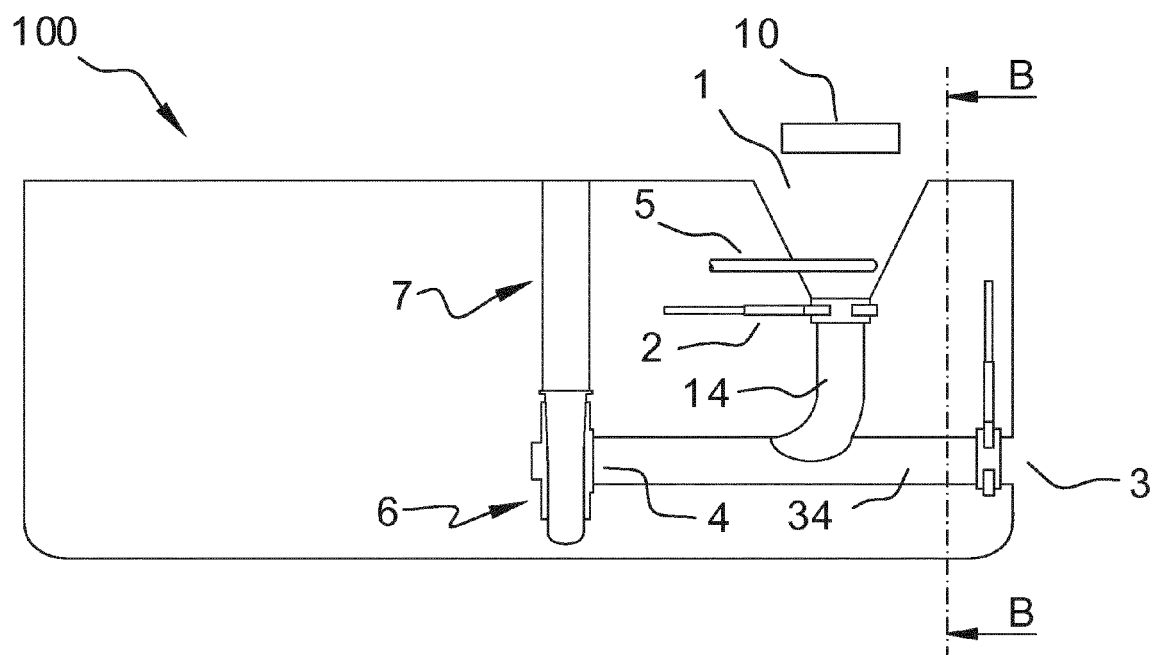
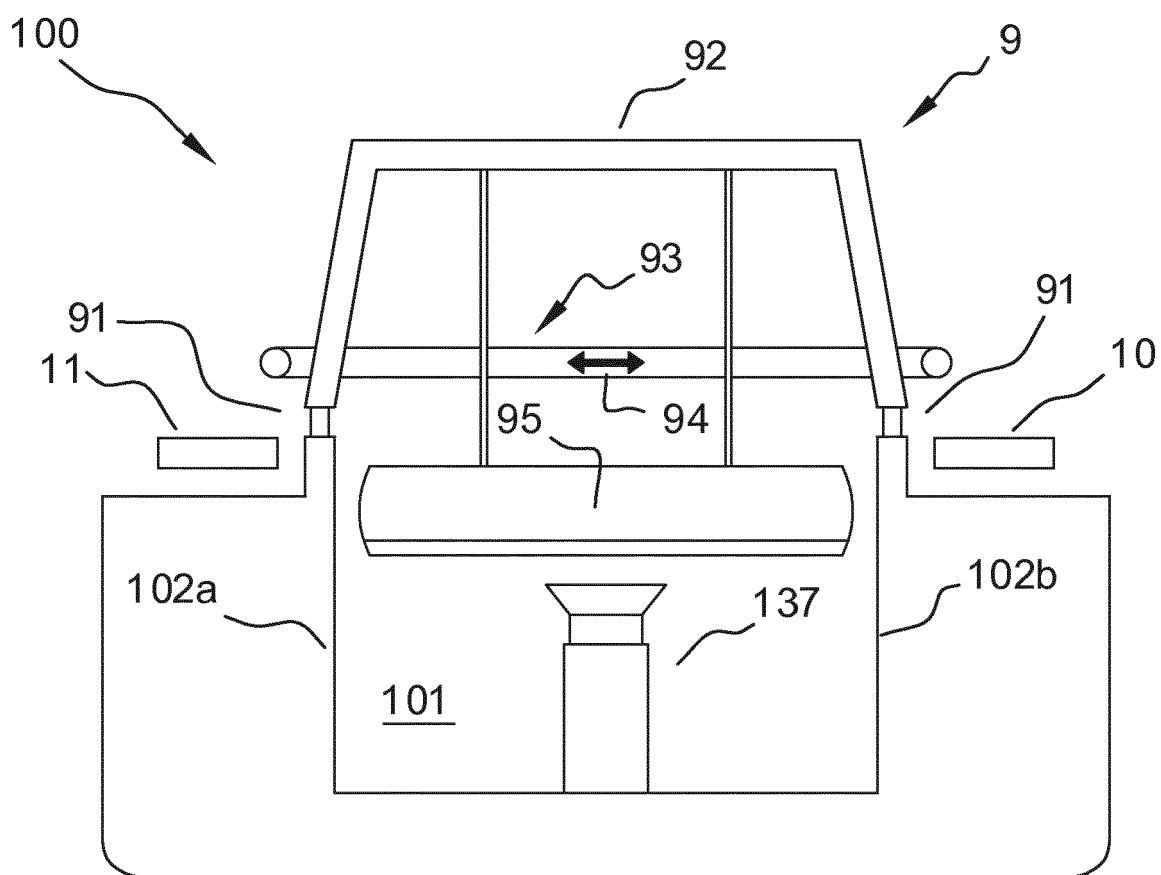
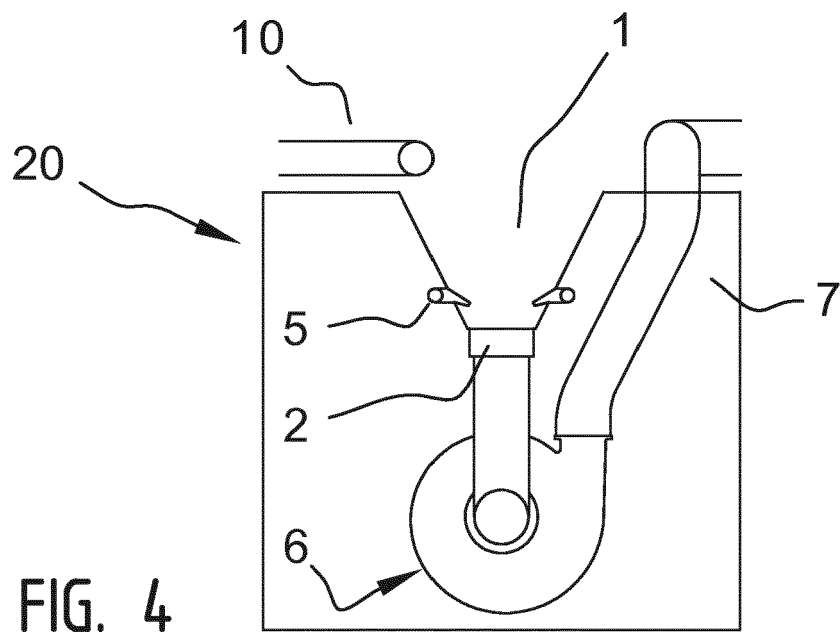


FIG. 3



REFERENCES CITED IN THE DESCRIPTION

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