

IMPROVED METHOD AND APPARATUS FOR SAND UNLOADING AND DELIVERY

Field of the Invention

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The invention relates to the transport and unloading of sand from a bulk carrier.

Background

10 As part of the land reclamation process sand is placed in large quantities so as to build up a granular base. In order to achieve this sand, in dry condition, may need to be obtained from a considerable distance from the reclamation site. To this end, in some cases the sand is transported using bulk carrier ships having several holds into which the sand is placed from the sand supply site then delivered to the reclamation site.

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It follows that this represents a significant cost and any improvement to the process may lead to substantial cost benefits. The economic viability of the project, for instance, may depend upon the efficient delivery of the sand.

20 Consequently, there is a need to minimise the operation period of the bulk carrier not only in terms of fuel costs but also the hire cost for the ship. Whilst optimization of the actual voyage in terms of speed and route are well established, the time taken for loading and unloading of the sand represents a substantial cost in terms the fees charged for the hire of the ship whilst it is at anchor during loading and unloading.

Therefore, two key determinants for economic viability are maximizing of the sand volume per trip and minimization of the turnaround or cycle time for the ship from loading to unloading and return.

- 5 With regard to techniques for unloading this is currently achieved by a grab bucket and crane with an expected unloading time of 4 to 5 days. Removing a finite volume of sand (generally no more than 12m³) in this conventional process is a time consuming and, subsequently, needs additional transshipment to actual reclamation area.

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Summary of Invention

- In a first aspect, the invention provides a method of unloading sand from a ship, the method comprising the steps of: providing at least one hold within said ship, said hold
15 containing a volume of unsaturated sand; flowing water into the hold, using water jets, and consequently; saturating a portion of the unsaturated sand; creating a pond of surface water on the sand within the saturated portion; agitating sand within the saturation zone so as to place sand particles into suspension within the pond; pumping out said suspended sand from the ship to a designated location.

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In a second aspect, the invention provides a system for unloading sand from at least one hold of a ship comprising: at least one water jet, said water jet arranged to direct a flow of water onto a volume of unsaturated sand so as to form a portion of saturated sand and

a pond of surface water within said portion of saturated sand, and; a sand pump arranged to be placed in the pond for pumping out sand in suspension.

Accordingly, the present invention provides a means for an innovative and fast
5 unloading by employing a direct suction and discharge system (i.e. no transshipments are necessary) for initially dry (unsaturated) sand in the holds.

By loading and transporting sand with low water content (by trying to exclude water when loading sand) from the sand source site, the first key determinant (i.e. the
10 maximizing of the sand volume per trip) can be achieved. The substantial exclusion of water from the hold maximizes the loading volume of the sand within the hold and so maximizes the quantity of sand delivered ready for unloading.

This does, however, prevent the use of prior art processes (i.e. full saturation unloading
15 method from a bulk carrier by using a float equipped with a mud/sand pump), and thus requires the use of the traditional grab bucket approach.

However by controlling the inflow of water into the hold and then pumping out the sand in suspension to a reclamation site directly, the sand can be removed quickly, as a
20 continuous and one-stop process (i.e. suction and discharging simultaneously), and at typically a much higher rate than the traditional grab bucket and crane, ultimately decreasing the period of unloading time significantly.

In one embodiment the inflow of water with water jetting and outflow of sand in suspension is predetermined (i.e. the amount of inflow is slightly larger than that of outflow) so as to control and maintain the partially saturated zone developed within the sand underlying the pond of water at the point of pumping. The process may also
5 include a consideration of the infiltration rate of water and additionally required amount of water for agitation by water jetting within the sand. The invention includes creating and controlling and/or maintaining a partial saturation of the sand within the hold until it is fully saturated by the infiltrated water while the pumping out of the water/sand mixture is working properly.

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In one embodiment a preceding step may include the formation of a hollow so as to facilitate the formation of the pond. This hollow may be achieved by a grab bucket scooping out a quantity of sand. Alternatively, the inflow of water may be applied in the form of water jets which agitate the sand at high pressure, so as to form a pond.
15 Whilst this assists in the agitation of sand during the pumping process, at the initiation of the process these water jets may simultaneously create a hollow and the pond from which to initiate the process.

During the pumping process, a pump may be suspended and/or supported by a cable
20 such as from a crane or other handling systems. The suspended pump may also be adjusted in the location by a crane or other handling systems (i.e. moveable both in vertical and horizontal directions) as the sand is removed so as to prevent any interruption to the process. This pumping out process may lead to the formation of high walls surrounding the pumping point. In a further embodiment the water jets may be

used to progressively control the walls by directing the water jets to intermittently collapse the walls into the pumping point. This may further facilitate suction of water/sand mixture within the pond as well as maintain a continuous suction process within the pond.

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To this end, the water jets may be mounted to bulk heads of the bulk carrier for instance at the peripheral edge of the hold so as to provide access to all areas of the hold. To ensure no “blind spots” are formed, multiple water jets may be used around the periphery of the hold. This has the advantage of removing “blind spots” as well as
10 minimizing remaining sand at the corner and bottom of vessel at the final stage of removing water/sand mixture.

In a further embodiment, a direct water jet system with multiple nozzles may be provided attached to the pump so as to direct the water jet into the pond from the sides
15 of the pump position. This is an essential water supply and jetting system which allows creating and maintaining a partially saturated zone, termed as water pond. This has the dual advantage of both ensuring a degree of agitation directly at the point of pumping as well as provide a cavity expansion effect proximate to the pump and so control the rate of progressive movement of the pump. This direct water jet may be directed
20 downwards in a direction of lowering of the pump. Alternatively, or in addition to, the direct water jet may be directed outwards at various, possibly pre-determined, angles of ejection, so as to provide an area effect to the agitation and so increase the area of cavity expansion. In a still further embodiment, they may be several water jets directed at

different angles so as to simultaneous eject water at the pre-determined angles. Such pre-determined angles may be, for example, 90°, 45° or 30°.

In one embodiment the pump may be of a sufficient capacity to pump the suspended
5 sand directly overboard and to a discharging point of such as on a reclamation area.

Brief Description of Drawings

It will be convenient to further describe the present invention with respect to the
10 accompanying drawings that illustrate possible arrangements of the invention. Other arrangements of the invention are possible and consequently, the particularity of the accompanying drawings is not to be understood as superseding the generality of the preceding description of the invention.

15 Figure 1 is a plan view of a bulk carrier having a plurality of sand unloading systems according to an embodiment of the present invention;

Figure 2 is an elevation cross-section of a hold of a bulk carrier having a sand unloading system according to a further embodiment of the present invention;

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Figure 3 is an elevation view of a detailed sand unloading system according to a further embodiment of the present invention, and;

Figure 4 is an elevation view of a detailed sand unloading system according to a still further embodiment of the present invention.

Detailed Description

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Figure 1 shows a ship, in this case a bulk carrier 10, having five holds 15 each of which has been fitted with a system 5 according to the present invention. In the case the bulk carrier is arranged to transport sand from a supply site to a reclamation site and then once it is arrived the system 5 can be installed to unload the hold 15 of the bulk carrier 10. It will be appreciated that the system according to the present invention is not limited to bulk carriers of a specific size, and therefore may be adapted to fit ships of a range of sizes and shapes.

As can be seen from Figure 1 the system comprises water jets 20, 30 directed to a portion of the hold in which is placed a pump 25. The water jets 20 place the sand into suspension whereupon the pump 25, which is immersed in a pond of surface water, pumps the sand in suspension out of the hold through outlet pipes 35. The pump will be selected based upon the requirements of the system and can be readily determined as a function of the desired rate of unloading of the sand, the volume of sand to be unloaded and the distance to which the sand must be pumped, etc. For instance, the designated location for the sand may be directly to the reclamation site (either onshore or offshore) or to an intermediary vessel or vehicle.

Figure 2 shows a cross-section of the hold 40 to which the system according to the present invention has been mounted. The bulk carrier 45 transports a volume of dry sand 50 to a point of unloading, which may be land reclamation site. The system is then mounted to the bulk carrier, with the system comprising water jets 55 and a pump with water jets 75 lowered into place using a cable 95 which may be suspended by a ship mounted crane or other handling systems (not shown). The process commences by water jets 55 projecting water 60 into the hold. The rate of flow of water from the water jets 55 is sufficient to create a pool of surface water 70 which is maintained by the flow of water 60 in excess of the infiltration rate of the sand. A growing partially saturated zone 85 is also maintained and is controlled by the outflow of sand in suspension taken from the pumping zone 80 and pumped through an outlet pipe 90.

The water jets 55 further act to not only provide a supply of water into which the pump 75 is immersed but also of sufficient pressure to agitate the surface of the sand 65 and so continuously place sand particles into suspension within the pond 70. Thus, a high sand content within the water pumped from the hold is maintained. It will be clear that the higher the volume of sand in suspension within the pond 70 the greater the rate of unloading of the hold 40 can be achieved, subject to the capacities of the pump.

In addition, the pump may have attached thereto, an additional water jet 62, providing a flow of water 63 into the sand so as to further excavate and agitate the sand into suspension. It will be appreciated that such direct water jets 62 may be attached to the pump, suspended from a cable or other such means so as to bring the direct water jet proximate to the pond into which the jets of water are directed.

Given the size of the hold and the volume of sand to be unloaded the water jets 55 may operate at a rate in excess of 1500 m³/h in order to create the pond 70. To this end, this would allow a pump system to pump the sand in suspension (i.e. a water/sand mixture)
 5 at 1500 to 2000 m³/h.

Figure 3 shows a pump assembly 100 according to a further embodiment of the present invention. Here, a similar pump 105 to that shown in Figure 2 includes water jets 135 mounted to the body of the pump 105 and secondary water jets 112 proximate to the
 10 pump intake 110. These water jets 135, 112 having a supply line 145, direct flow 140, 114 to agitate the sand 120 so as to place more sand in suspension within the pond 115. The localized water jets 135, 114 also allow a cavity expansion effect as they are directed generally along and around an axis defined by the lowering cable 125. Thus, the pump 105 can work down through the sand 120 at a more efficient rate. It will be
 15 appreciated that the direct water jets may be separately supported, other than on the pump, whilst still achieving the aforementioned benefits.

This may lead to walls of sand generated by the expansion of the bottom portion of the pond within the hold. These walls may be stable given a typical angle of repose for the
 20 dry sand of approximately 30 degrees. In order to induce the collapse of the walls, water jets placed peripherally around the hold, such as those shown in Figure 2, may be used together with the localized water jets 135, 114 of Figure 3. The peripheral water jets may then be used to provide a further supply of saturated sand into the pumping area.

In a further embodiment, the water jets 135 may be selectively movable 136 so as to vary the direction of the flow of water, using a hydraulic actuator or similar device for rotating or pivoting the nozzle of the direct water jet. For instance, the direct water jets
5 135 may also be used to collapse the walls of the unsaturated sand as the suspended sand is progressively pumped out of the hold. Alternatively, or as well as, the adjustability 136 of the direct water jets 135 may allow an operator to expand the size of the cavity into which the pump is lowered. This may also provide the operator the ability to increase the rate of suspended sand to be pumped out by increasing the
10 sand/water mixture within the pond. By increasing the area of available sand to agitate, it follows that the sand/water mixture will correspondingly increase.

In a still further embodiment, the variation in angle of the direct water jets may be achieved through the attachment of pipe fittings to the nozzle of the direct water jet, the
15 end fitting being an elbow of a pre-determined angle, such as, 90° , 45° or 30° .

Figure 4 shows the consequence of a system 150 having a 90° fitting at the end of the direct water jet. As shown, the direct water jet is in fact a side water jet 155 mounted to the pump 105. A flow of water, or ejection, 160 is directed to the side 165 of the pond
20 so as to dislodge sand from a higher position within the pond. Consequently, sand 170 released from the pond walls flows into the pond, increasing the volume of sand in suspension 175. The increase in the ratio of sand to water therefore improves the efficiency of the unloading process.

In effect, the side water jets 155 increase the surface area that is available for agitation, leading to an effectively larger volume of the pond holding sand in suspension.

It will be appreciated that the system may include several direct/side water jets acting
5 together at various angles of water ejection so as to agitate sand within the pond at several points simultaneously.

Claims

1. A method of unloading sand from a ship, the method comprising the steps of:
providing at least one hold within said ship, said hold containing a volume of
5 unsaturated sand;
flowing water into the hold, using water jets, and consequently;
saturating a portion of the unsaturated sand;
creating a pond of surface water on the sand within the saturated portion of the
unsaturated sand;
10 agitating sand by said water jets within the saturation portion so as to place sand
particles into suspension within the pond;
pumping out said suspended sand from the ship to a designated location using a
sand pump; and
controlling of a location of a pump as the sand within the hold is progressively
15 unloaded so as to maintain the pump immersed within the pond.
2. The method according to claim 1, further including, after the pumping step, the
steps of progressively and simultaneously, saturating the unsaturated sand,
agitating sand, using the water jets, into suspension and pumping out suspended
20 sand.
3. The method according to claim 2, wherein the progressively and simultaneously
saturating step includes balancing the rate of flow of water into the hold with the
rate of pumping out of the suspended sand.

4. The method according to any one of claims 1 to 3, further including the step, prior to the flowing step of hollowing the unsaturated sand in which the pond is formed.

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5. The method according to any one of claims 1 to 4, wherein the water introduction step includes the step of directing water against peripheral walls of sand, and collapsing the sand walls into the pond.

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6. The method according to any one of the preceding claims, wherein the flowing step includes jetting water at a pressure in the range 4 to 8 Bar.

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7. The method according to any one of the preceding claims, wherein the ship is any one of: a bulk carrier or barge.

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8. A system for unloading sand from at least one hold of a ship comprising:
at least one water jet, said water jet arranged to direct a flow of water onto a volume of unsaturated sand so as to form a portion of saturated sand and a pond of surface water within said portion of saturated sand;
a sand pump arranged to be placed in the pond for pumping out sand in suspension;
at least one direct water jet;
said at least one direct water jet arranged to be mounted to the sand pump so as to agitate the sand within the saturated portion of sand.

wherein the direct water jet is selectively movable relative to the sand pump so as to selectively vary the direction of water flow.

5 9. The system according to claim 8 wherein the water jets are arranged to be placed at a peripheral edge of said at least one hold.

10 10. The system according to claim 8 or 9 wherein the sand pump is suspended by a cable and arranged to progressively control of a location of the pump so as to ensure the sand pump remains immersed.

11. The system according to claim 8, wherein the direction of flow from the at least one direct water jet varies from 0° to 90° from a vertical axis of the sand pump.

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12. The system according to any one of claims 8 to 11, wherein said water jets are arranged to operate at a pressure in the range 4 to 8 Bar.

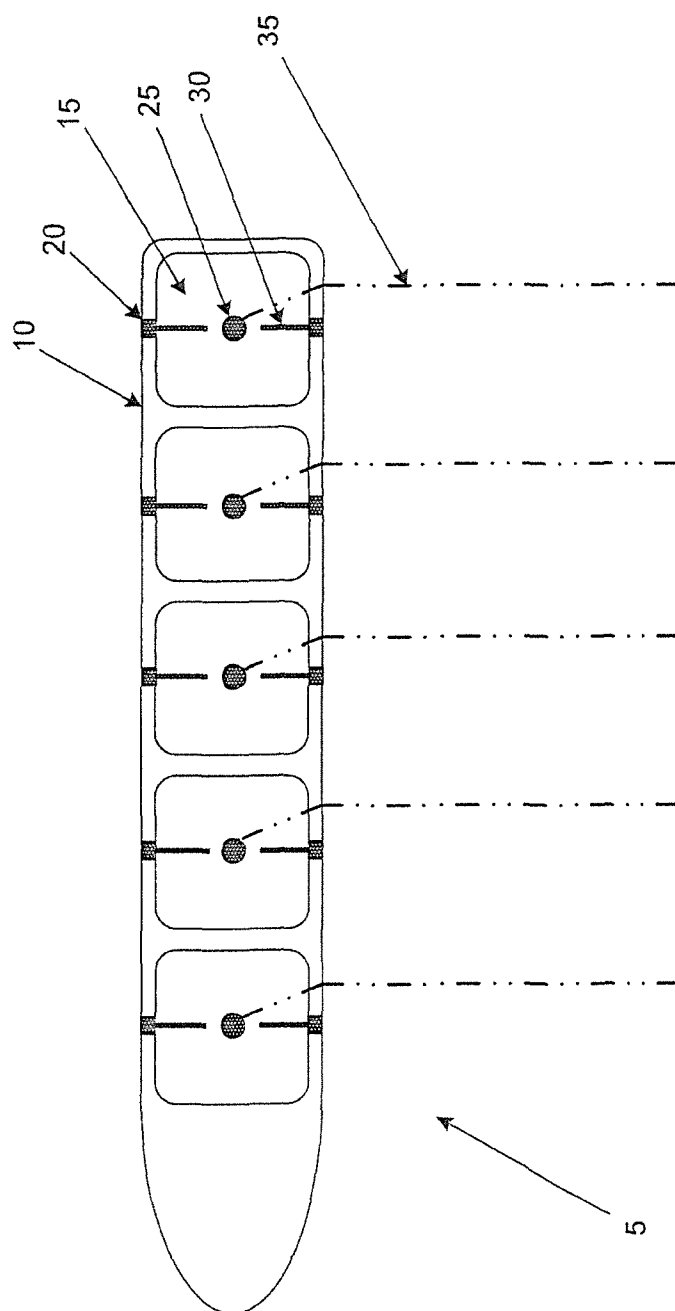


Figure 1

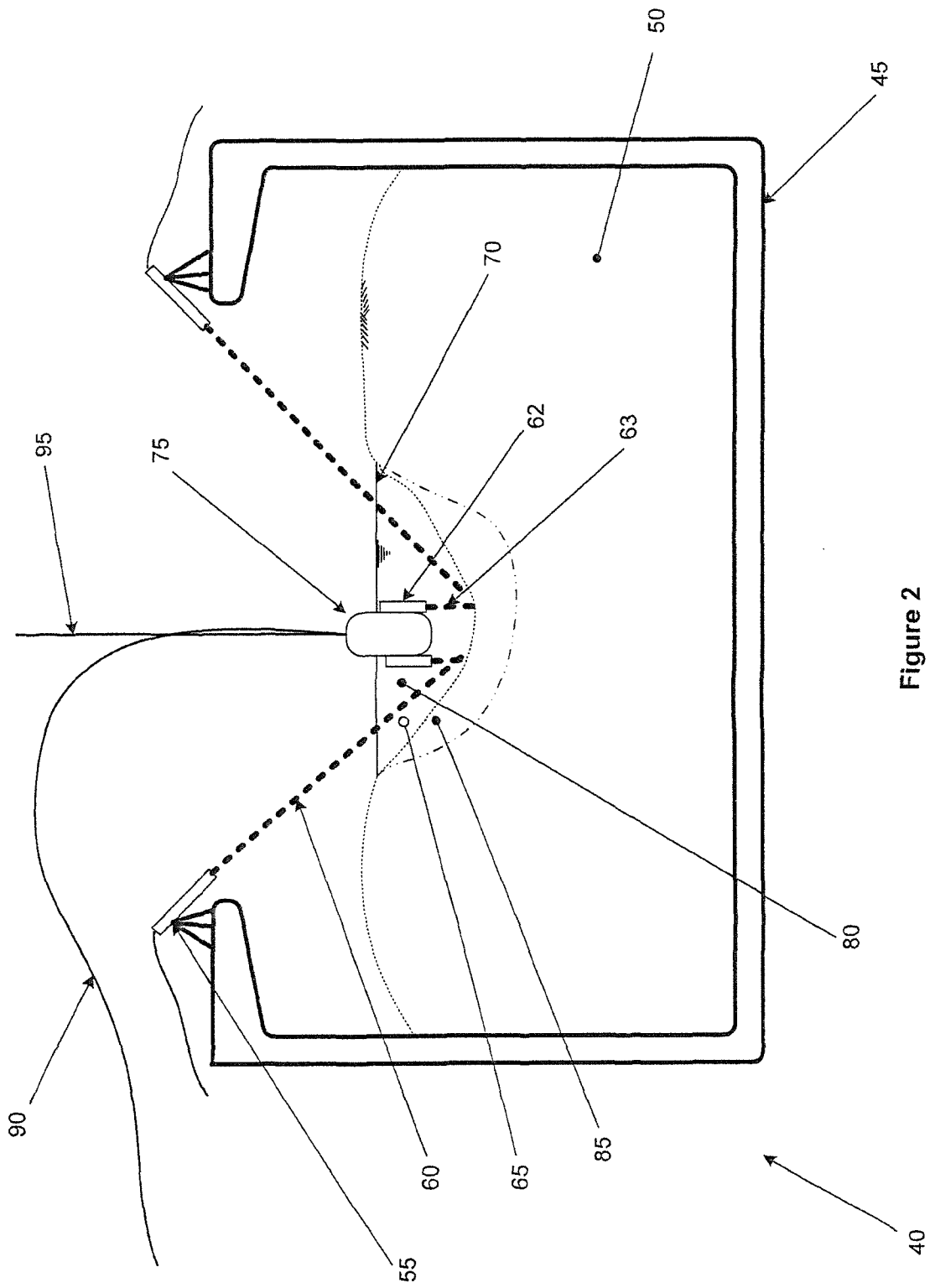


Figure 2

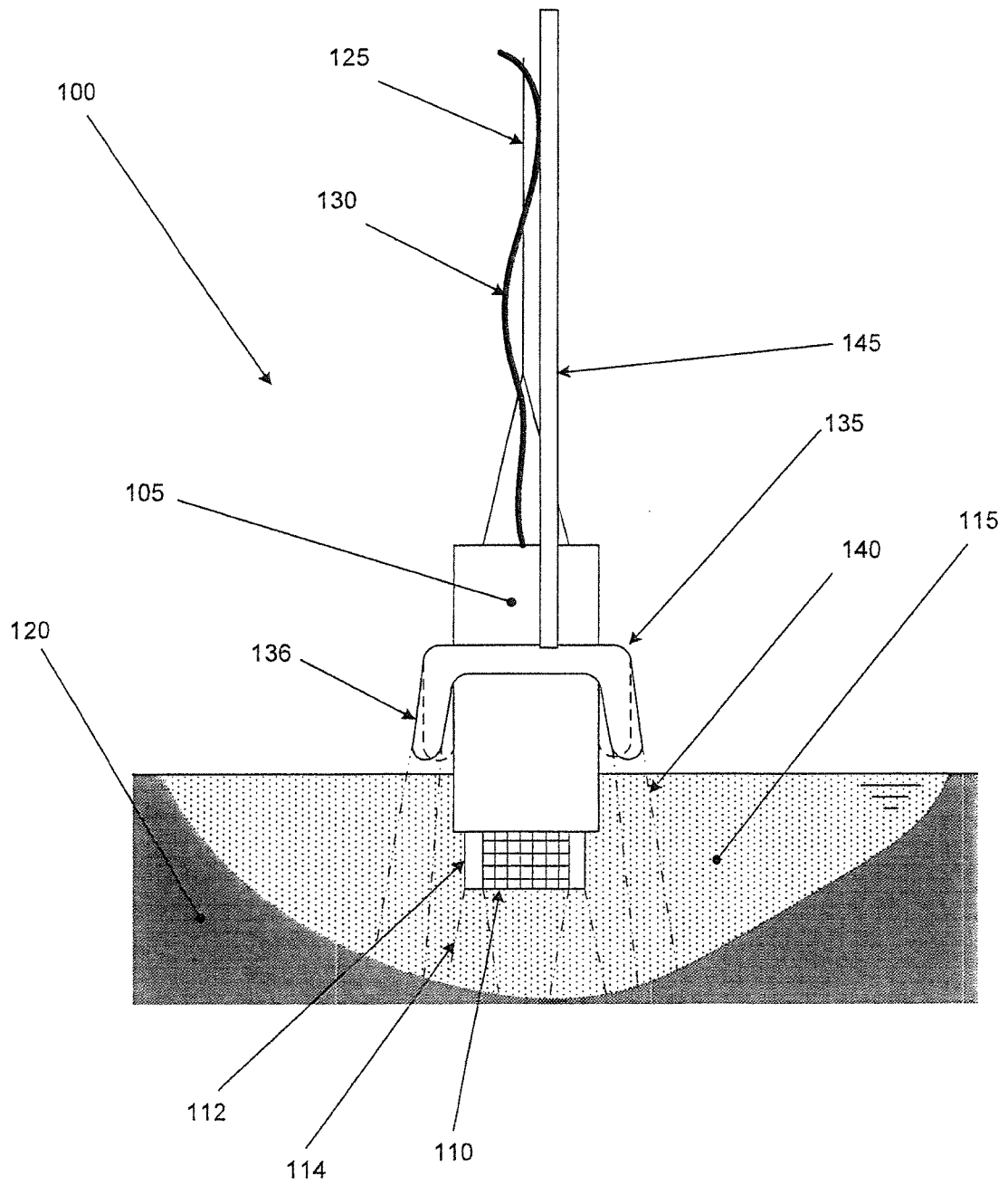


Figure 3

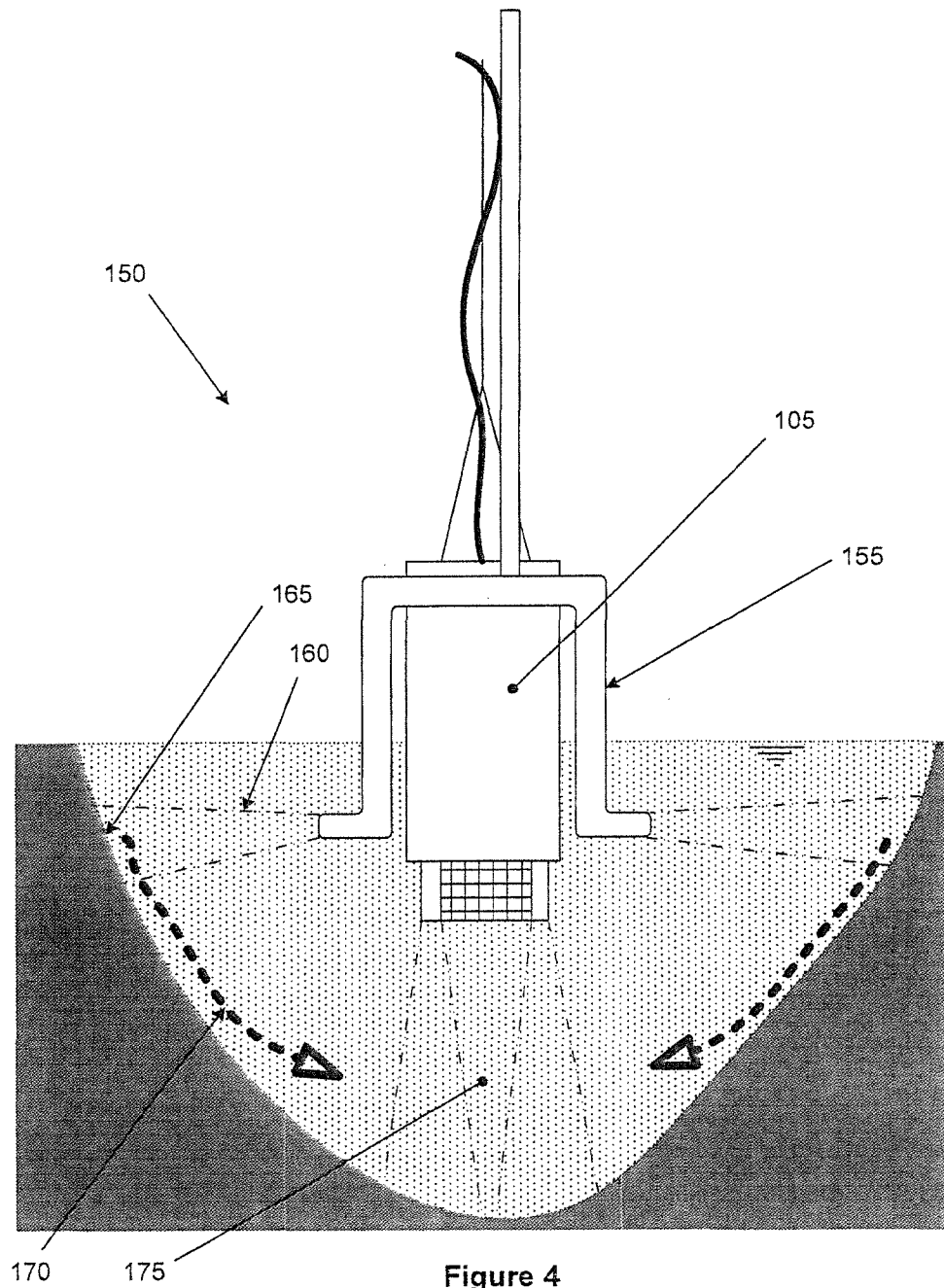


Figure 4