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Loading and unloading of solid substance having high degree of water content

The present invention relates to a method for unloading of solid substance having high degree of water content from a bulk carrier, said bulk carrier has one or more cargo holds receiving the solid substance, and the solid substance having such a high degree of water content that a layer of liquid is formed above at least areas of the solid substance, said solid substance being pumped out of the cargo hold by a suitable pump which is placed on a float being freely moveable on the layer of liquid in the cargo hold.

The invention also relates to a method for loading of solid substance having high degree of water content into the bulk carrier, in which the cargo holds include a float having a pump, the mixture of solid substance and water being pumped from outboard and into the cargo hold.

Further the invention relates to a float having a pump station for use at loading and unloading of bulk carriers transporting solid substance having high degree of water content, said float being dedicated for deployment in the cargo hold together with the solid substance.

In a continuously increasing extent, a need is present to reclaim land areas in order to make active use of the land. For that purpose, large volumes of substance, like sand, is transported from one land area to another by use of barges. One example is reclamation of land areas previously being sea areas. This is i.a. true for the new airport near Osaka in Japan. Another example is reclamation of land for expansion of city areas like in Singapore. Yet an example is desert sand being transported by barges from Sahara to the Canary Islands for developing beaches or establishing sand beaches on locations previously not having such.

In order to increase the productivity for these development projects, the thought of exploiting available bulk carriers as transportation means has been introduced. The present concept does introduce an effective way to load and unload a ship. Especially seabed substance, and in particular, though not exclusively, sand is exploited for these projects.

According to the present invention, a method for unloading as stated in the preamble of this specification is provided, which is distinguished in that the solid substance and water are pumped out of the cargo hold at a predetermined volumetric ratio and that water is replenished into the cargo hold at a volumetric rate which is substantially
5 corresponding to the water volume being pumped outboard.

Advantageously, the pump is supplying a mixture of water and solid substance at a volumetric ratio from 70:30 to 60:40.

10 The pump suction is suitably displaceable outwardly and inwardly in the vertical direction in respect of the float, in order to adjust and adapt itself according to the optimum ratio of the solid substance and the water in the discharged mixture.

Further, a method for loading as stated in the preamble of this specification is provided,
15 which is distinguished in that during loading, the water is pumped outboard again from the cargo hold by the pump on the float at substantially the same volumetric rate as the water arriving inboard, and the water layer is kept deeper than during unloading in order to let the solid matters settle and as little as possible of the solid matters are allowed to pass outboard again with the water being pumped outboard.

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Still further, a float as stated in the preamble of this specification is provided, which is distinguished in that at least the suction of the pump station can be elevated or lowered in respect of the float. As an alternative, the entire pump station can be elevated or lowered in respect of the float. The float can have a stationary guiding column to
25 which a beam, that can be elevated or lowered, carrying the entire pump station, is provided. The pump station can include a motor, which is in driving connection to a pump. Further, the motor can be connected to the pump via a transmission and a support. The pump can per se be a standard mud or sand pump.

30 The entire float, the accompanying pump station, pipelines and hoses are an easy task to assemble on existing bulk carriers. The equipment can be designed to the actual dimension of the ship. The installation proper does not require permanent modifications or interventions in the hull of the ship. Normally one of the for-and-aft sides of the ship will be dedicated for loading and the opposite for-and-aft side for unloading.

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Other and further objects, features and advantages will appear from the following description of one for the time being preferred embodiment of the invention, which is given for the purpose of description, without thereby being limiting, and given in context with the appended drawings where:

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Fig.1A-1C illustrate schematically a typical bulk carrier which is well suited for use with the present invention,

Fig.2 illustrates a cross section through a cargo hold of a ship hull that is filled with
10 sand and water, and a float deployed on the layer of water,

Fig.3A-3C illustrate the same as fig.2, but in three phases of the unloading operation wherein the float including the pump station work with the loosening and suction of the matter for emptying the cargo hold,

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Fig.4 illustrates again the same as fig.2 and 3, but in the last phase of the unloading operation in which the ship is tilted and nearly all the sand is unloaded,

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Fig.5 illustrates remote discharging of the solid substance from the ship by means of extended transportation hoses and another pump station,

Fig.6A-6C illustrate schematically the float with installed pump station, and show three different states of operation; loading, maintenance and unloading respectively,

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Fig.7A illustrates schematically the float according to fig.6 viewed from above,

Fig.7B illustrates schematically the float according to fig.6 viewed from below,

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Fig.8 illustrates schematically a cross section through the cargo hold of the ship hull in a situation during loading of sand and water, and

Fig.9A-9B illustrate schematically, from the side and above, how more coarse sand typically pile up into crests during a loading operation of the bulk carrier.

Fig.1A illustrate a typical bulk carrier 5 viewed from above. The ship 5 has a number of cargo holds 2 for receipt of solid substance and water, in particular sand and seawater.

Fig.1B shows the bulk carrier 5 from the for-and-aft side and fig.1C shows a cross sectional view through the cargo hold 2 in the ship hull. Each cargo hold 2 has an opening 3 in the deck level of the ship 5. In each opening 3 is a float 1 deployed that includes a pump station 4. The float 1 is displaceable on a water surface 9 in the cargo hold 2 and when the cargo hold is filled with substance, the float 1 is moveable within the boundaries of the opening 3 of the cargo hold 2 only. As the substance is being pumped outboard the float 1 will be able to move on the water surface in some more extent within the limits of the ship hull. For the filling of substance in the cargo holds 2, a loading manifold 10M is provided. The manifold 10M is branching off to the respective cargo holds 2 and can have a number of outlets 10D conveniently located around the opening 3. Here four outlets 10D are shown for each cargo hold.

Fig.2 shows a cargo hold 2 during the final stage of filling with a mixture of sand 6 and water. Due to the difference in specific gravity of sand and water, an increasingly more compact layer of sand is formed the closer to the bottom 8 of the ship 5 one comes. Correspondingly, the sand 6 comprises increasingly more water the more one approaches the water surface 9. On top a water layer 7 is formed and the depth of this is adapted to the draught of the float 1 and those conditions that are favourable during loading, respectively unloading. The extent of crest formation is depending of the particular substance that is carried onboard. The rule is that the more coarse the sand is, the steeper and higher crests T. With fine sand and sand having a content of mud, the crests T will be far less and in some situations totally absent and a pretty smooth surface layer is formed.

In order to control the float 1 on the water surface 9, two traction winches 24 can be installed on the edge of the hatch opening 3. One can be located in the transversal extending edge of the hatch opening 3 and one in the longitudinal extending edge. The winch wires are running in closed loops and pass over turn sheaves 25 at the opposite side of the hatch opening 3 and having both wire ends tied to the float 1. By alternatingly co-ordinating the pull in and pay out of the wires by means of the two winches, the float 1 can be positioned wherever within the cargo hold 2. Like the horizontal arrows R show, the float 1 is controllably movable on the water layer 7.

As presented in fig.2 and 3, a flexible hose 10 and a vertical pipeline 23 are included and are fixed to the float 1. The pipeline 23 bends approximately 90 degrees toward the for-and-aft side of the ship 5 and is dedicated for replenishing of water. One hose 11 for discharging of a mixture of sand 6 and water is provided on the opposite side. A rigid drenching pipe 22 from the pump station 4 extend initially substantially vertically over the deck level and bends approximately 90 degrees and is oriented towards the discharge side of the ship 5. The discharge hose 11 is flexible and is arranged to the free end of the discharge hose 22. The hose 11 is mobile and can, as the cargo hold 2 being emptied, be laid onto one or more sheaves 12 which the hose 11 will run over. The vertical pipes 22 and 23 limit the movements of the float 1 within the hatch opening 3.

The replenishing pipe 10 can, as an alternative, be stationary and be spaced well apart from the suction 13 of the pump. The pipeline 10 can be supplied with water by means of a submerged pump 26 or alternatively, the pipe can be fed from the ship ballast system if this is of sufficient capacity.

Fig.4 shows a situation when the cargo hold 2 is nearly emptied for sand 6. In order to remove as much as possible of the sand 6, the ship can be trimmed sideways, for example by an angle α of approximately 2 degrees as indicated in fig.4. Thus the remaining substance is concentrated towards the one for-and-aft sides of the cargo hold 2 where the suction 13 of the pump station 4 is located.

The equipment is otherwise well suited for connection to extension pipes 26 for remote discharge of the substance 6 over wider areas. This is illustrated in fig.5 and in order to improve the transportation, a separate pump station 27 is arranged outboard of the ship 5.

Fig.6A-6C show the combined float 1 and the pump station 4. As it appears from fig. 6A, the float 1 is flat bottomed and has handrails 20 so that one or more persons can stay there while the float 1 is in action. To the float 1 a guiding column 14 is stationary mounted in respect of the float 1. The entire pump station 4 is assembled to a beam 18 that can be elevated or lowered, which movements are guided by the guiding column 14. A motor 16 is mounted to the beam 18. A pump 15 is also mounted to the beam 18. The motor 16 is connected to the pump 15 via a transmission 17 and a support 19. In operation, the motor 16 will thus be driving the pump 15 at a predetermined speed and

feeding rate. The suction 13 of the pump 15 is located underneath the pump housing. The pump 15 can be a standard mud/sand pump corresponding to those that are used for removing soil and sand on the seabed. Further, a number of nozzles 30 can be arranged at the bottom of the float 1. The nozzles 30 can be activated in order to direct water jets
5 against the substance if it has settled too much and hardened.

As it appears from fig.6A-6C, the pump station 4 can be elevated or lowered in respect of the float 1. This is a material feature in order to adapt the equipment to the different situations that appear, like loading, maintenance and unloading. All the states are
10 illustrated in fig.6A, 6B and 6C respectively. Further, the suction 13 can be equipped with a cutter head, which is able to tear loose the substance if this has settled too much to come loose in other ways.

Fig.7A shows the float 1 from above and the pump station 4 is centrally arranged on the
15 float 1. A moon pool 21 is defined in the float 1 for elevating or lowering of the pump station 4 through the moon pool.

Fig.7B shows the float 1 viewed from below and illustrates how an array of nozzles 30, which are dedicated for jetting loose the substance that has hardened during the
20 transportation, can be arranged.

It is to be understood that it is possible to use a pump station 4 in which the suction 13 only can be elevated or lowered, while the motor 16 and the pump 15 are stationary. The suction 13 can be a telescopically arranged unit, which can be extended or retracted
25 in respect of the pump station 4.

A loading operation is shown in fig.8. A mixture of sand and water is brought onboard via the pipeline 10a and down into the cargo hold 2. The sand 6 settles and the water is forced up. The float 1 and associated pump station 4 are now utilised only to pass water
30 having as little sand content as possible outboard again. This take place via the discharge pipeline 11a.

As mentioned, the substance may form crests T during loading as illustrated in fig. 9A and 9B. This is in particular true for coarser sand having relatively high angle of repose,
35 towards 45 degrees. By finer sand the angle of repose is far less and for mud or soil it is

almost absent. For mud having a degree of sand content, a washing effect of the sand is possible by suitable adjustments of the water layer and the currents in the layer. In this way the fine matters are held suspended in the water and are passed outboard again with the discharge water from the pumps 15.

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Separate generator assemblies can be used and installed on the ship deck close to the pumps if the power supply on board is not sufficient.

During transportation between the different destinations, the substance is attempted, in
10 largest possible extent, to be covered with a suitable water layer 7 in order to hamper too hard settling of the substance or sand 6.

A float 1 and pump station 4 can be deployed for each cargo hold 2 to obtain a maximum efficiency. Alternatively, two or more assemblies of float/pump station are
15 available and can be transferred between the cargo holds 2 if an overall consideration of the economy dictate so.

An unloading operation will now be described with reference to fig.2, 3 and 4. The suction 13 of the sand pump is lowered to about 1,5 meter beneath the bottom 8 of the
20 float 1 – see fig.6C. The float 1 is moved in a zigzag pattern on the surface while the pump 15 is sucking out sand 6 and water in a predetermined volumetric ratio. If necessary, the nozzles 30 are activated. The key to efficient loading is to maintain an optimal water layer 7 for the substance 6 to be easy to suck out and still keep a high as possible content of solid substance in the mixture being pumped out. The sand pump 15
25 delivers a mixture of water/sand in a volumetric ratio close to that for a mud pump, i.e. 70/30 to 60/40. This means that the water supply through the replenishing pipe 10 have to be between 60 and 70% of the capacity of the sand pump 15.

The level of the water and the thickness of the water layer are controlled by an external
30 pump 26 for replenishing of water. At the latest step of the unloading operation the ship can be tilted to about two degrees to enable the pump suction 13 to suck out the remaining sand 6 at a for-and-aft side of the cargo hold 2.

As mentioned, a cutter head can be put on the suction 13 if the substance has hardened too much. This is extensively utilised equipment that is often used for removing soil and mud on the seabed.

- 5 The pump station 4 is elevatable within the hatch opening 21. The pump station 4 is elevated to a high level for maintenance purposes. The guiding column 14 and the beam 18 with associated levelling mechanisms may be standard commercial equipment. It may be manually or electrically powered. The suction 13 of the pump 13 is adjustable at such a height in respect of the float 1 that an optimal yield is given, which means at a
10 high level for discharge pumping of water while loading, and at a low level while sand is unloaded.

A loading sequence is now to be described with reference to fig.8. The external pump 26 delivers a mixture of water and sand 6 to the cargo hold 2 via the loading pipeline
15 10a. The volumetric ratio between water and sand 6 is normally between 70/30 and 60/40. The discharge pump 15 of the float is now located at the opposite end of the cargo hold 2 in respect of the outlet of the loading pipeline 10a. The discharge pump 15 is now used to control the maximum water level in the cargo hold 2. The water layer 7 is now kept deeper for the sand to be given reasonable chance to settle and thus achieve
20 that as little sand as possible is passed outboard again through the discharge pump 15 and the discharge hose 11a. The relatively large area of the cargo hold 2 combined with the capacity of the loading pipeline 10a and the discharge hose 11a and the distance between the two, maintains these parameters. At high soil content in the sand 6, different heights can be more optimal if a desire is present to pass as much soil as
25 possible outboard again. The water level can be controlled by shifting the discharge pump off and on or by throttling the outgoing water flow in the discharge hose 11a. The operation may be monitored locally or by CCTV and controlled from the bridge of the ship.

P a t e n t C l a i m s

1.

A method for unloading of solid substance having high degree of water content from a bulk carrier, said bulk carrier has one or more cargo holds receiving the solid substance, and the solid substance having such a high degree of water content that a layer of liquid is formed above at least areas of the solid substance, said solid substance being pumped out of the cargo hold by a suitable pump which is placed on a float being freely moveable on the layer of liquid in the cargo hold, c h a r a c t e r i s e d i n that the solid substance and water are pumped out of the cargo hold at a predetermined volumetric ratio and that water is replenished into the cargo hold at a volumetric rate which is corresponding substantially to the water volume being pumped outboard.

2.

Method according to claim 1, c h a r a c t r i s e d i n that the pump delivers a mixture of water and solid substance at a volumetric ratio between 70:30 and 60:40.

3.

Method according to claim 1 or 2, c h a r a c t e r i s e d i n that the inlet of the pump is displaceable outwardly and inwardly in the vertical direction in respect of the float for adjusting and adapting the inlet in accordance to the optimal conditions between the solid substance and water in the sucked out mixture.

4.

A method for loading of solid substance having high degree of water content into a bulk carrier, in which the cargo hold includes a float having a pump, the mixture of solid substance and water is pumped by an external pump from outboard and into the cargo hold, c h a r a c t e r i s e d i n that during loading, the water is pumped outboard again from the cargo hold by the pump on the float at substantially the same volumetric rate as the water arriving inboard, and the water layer is kept deeper than during unloading in order to let the solid matters settle and as little as possible of the solid matters are allowed to pass outboard again with the water being pumped out.



5.

A float (1) having a pump station (4) for use during loading and unloading of bulk carriers (5) that transport solid substance (6) having a high degree of water content, said float (1) is dedicated for deployment in a cargo hold (2) together with the substance (6), c h a r a c t e r i s e d i n that at least the suction (13) of the pump station (4) is able to be elevated or lowered in respect of the float (1).

6.

10 A float (1) according to claim 5, c h a r a c t e r i s e d i n that the entire pump station (4) is able to be elevated or lowered in respect of the float (1).

7.

15 A float (1) according to claim 6, c h a r a c t e r i s e d i n that the float (1) has a stationary guiding column (14) to which a beam (18), that is able to be elevated or lowered, carrying the entire pump station (4), is provided.

8.

20 A float (1) according to claim 7, c h a r a c t e r i s e d i n that the pump station (4) comprises a motor (16) which is in driving connection with the pump (15).

9.

25 A float (1) according to claim 8, c h a r a c t e r i s e d i n that the motor (16) is connected to the pump (15) via a transmission (17) and a support (19).

10.

30 A float (1) according to claim 8, c h a r a c t e r i s e d i n that the pump (15) is a per se standard mud/sand pump and that the float (1) has a number of downwardly directed water jet nozzles (30) provided in the bottom of the float.

**AMENDED CLAIMS**

[received by the International Bureau on 24 April 2000 (24.04.00);
new claim 4 added; claims 4-10 renumbered as claims 5-11 (3 pages)]

1.

A method for unloading of solid substance having high degree of water content from a bulk carrier by means of pumping systems, said bulk carrier has one or more cargo holds receiving the solid substance, and the solid substance having such a high degree of water content that a layer of water is formed above at least areas of the solid substance, c h a r a c t e r i s e d i n that said solid substance is pumped out of the cargo hold by a suitable pump which is placed on a float being freely moveable on the layer of water in the cargo hold, that the inlet (suction) of the pump is projecting into the water and is operated into the solid substance, and that the solid substance and water are pumped out of the cargo hold at a predetermined volumetric ratio and that water is replenished into the cargo hold at a volumetric rate which is corresponding substantially to the water volume being pumped outboard.

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2.

A method according to claim 1, c h a r a c t r i s e d i n that the pump delivers a mixture of water and solid substance at a volumetric ratio between 70:30 and 60:40.

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3.

A method according to claim 1 or 2, c h a r a c t e r i s e d i n that the inlet of the pump is displaceable outwardly and inwardly in the vertical direction in respect of the float for adjusting and adapting the inlet in accordance to the optimal conditions between the solid substance and water in the sucked out mixture.

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4.

A method according to any of the claims 1-3, c h a r a c t e r i s e d i n that cutting means and/or water jetting means are activated for loosening of the solid substance adjacent to the inlet of the pump.

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5.

A method for loading of solid substance having high degree of water content into a bulk carrier, said bulk carrier having at least one cargo hold, which cargo hold includes pumping systems, the mixture of solid substance and water is pumped by external pump

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from outboard and into the cargo hold, c h a r a c t e r i s e d i n that during loading, the water is pumped continuously outboard again from the cargo hold by a pump having an inlet, said pump being provided on a horizontally mobile float, the water being pumped at substantially the same volumetric rate as the water arriving inboard, and the water layer is kept deeper than during unloading in order to let the solid substance settle and as little as possible of the solid substance is allowed to pass outboard again with the water being pumped out.

6.
10 A float (1) having a pump station (4) for use during loading and unloading of bulk carriers (5) that transport solid substance (6) having a high degree of water content, said float (1) is dedicated for deployment in a cargo hold (2) together with the substance (6), c h a r a c t e r i s e d i n that at least the suction (13) of the pump station (4) is able to be elevated or lowered in respect of the float (1).

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7.
A float (1) according to claim 6, c h a r a c t e r i s e d i n that the entire pump station (4) is able to be elevated or lowered in respect of the float (1).

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8.
A float (1) according to claim 7, c h a r a c t e r i s e d i n that the float (1) has a stationary guiding column (14) to which a beam (18), that is able to be elevated or lowered, carrying the entire pump station (4), is provided.

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9.
A float (1) according to claim 8, c h a r a c t e r i s e d i n that the pump station (4) comprises a motor (16) which is in driving connection with the pump (15).

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10.
A float (1) according to claim 9, c h a r a c t e r i s e d i n that the motor (16) is connected to the pump (15) via a transmission (17) and a support (19).

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11.

A float (1) according to claim 9, c h a r a c t e r i s e d i n that the pump (15) is a per se standard mud/sand pump and that the float (1) has a number of downwardly directed water jet nozzles (30) provided in the bottom of the float.

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