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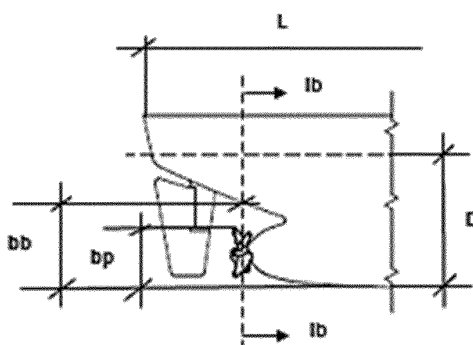
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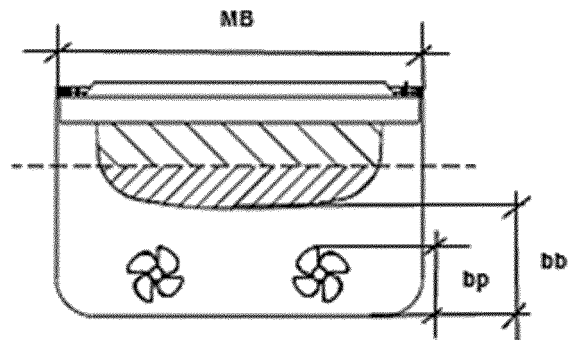
(54) **LARGE DISPLACEMENT HULL SHIP**

(57) Large displacement hull ship comprising a hull (10) and thrusting and governing means (100), arranged on each side of the center line of the ship (400), comprising at least one propeller (152), providing a thrust parallel to the center line for the propulsion of the ship (400). The means (100) are arranged on the port and starboard sides (11, 12) of the hull (10), the orthogonal projection onto the plane of the water being outside the surface of flotation of the ship (400), said means (100) being maintained within of the main beam, the length and the draught of the ship (400), the shape of the hull (10) being configured such that, the lower bound of the bottom of the hull (10), in the propeller (152) position, is below the upper bound of said propeller (152).



PRIOR ART

FIG. 1a



PRIOR ART

FIG. 1b

Description

TECHNICAL FIELD

[0001] The present invention relates to large displacement hull ships and methods for the modular building of large displacement hull ships.

PRIOR ART

[0002] A displacement hull ship moves through the water by pushing the water aside, and it is designed to cut through the water with limited propulsion. Displacement hull ships are generally limited to moderate speeds. Large displacement hull ships comprise a roundbottomed hull shape. Large ships as oil tankers, bulk cargo vessels, gas carriers, container ships, and great cruisers are displacement hull ships.

[0003] The design of the hull of a large displacement hull ship is critical in relation to the hydrodynamic behavior of said ship, because of its influence on the behavior of the ship when sailing in the water, taking into account also the increase in the speed of said ships. At the same time, and considering that they are long-distance marine ships that transport goods and/or people at great distances, they must have as much displacement as possible, so as to obtain the best displacement / hydrodynamic goodness ratio.

[0004] In large displacement hull ships the thrusting and governing means are arranged in the lower submerged area of the hull. The shape of the stern, conditioned by the location of the thrusting and governing means, generates little displacement and hydrodynamic restrictions, a long portion of length being necessary at the stern to support the weight of the machinery, accommodation, liquids, etc., the cargo carrying capacity of the ships being limited. We will refer to these thrusting and governing systems as ventral thrusting and governing systems. US3565029A describes a first type of large displacement hull ship. Figures 1a and 1b show in a schematic way the characteristics of such ships. This type of ship comprises a ventral-type thrusting and governing system with two bulbs located integrally in the hull at the stern of the ship, and extending parallel and symmetrical to the center line of the ship. At the end of each bulge there is arranged a propeller and abaft each propeller a rudder attached to the bottom. Each propeller is connected to a shaft coming out of the end of the bulge, an engine attached to the propeller through the shaft being arranged inside the hull.

[0005] US2014182501A1 describes a second type of large displacement hull ship. Figures 2a and 2b show in a schematic way the characteristics of such ships. This ship comprises a ventral-type thrusting and governing system, this thrusting and governing system comprising a thrusting and governing set arranged on each side of the center line of the ship, below the hull in the submerged area, but the hull does not include bulbs.

DISCLOSURE OF THE INVENTION

[0006] The object of the invention is to provide a ship, and a method for the modular building of a ship, as defined in the claims.

[0007] A first aspect of the invention relates to a large displacement hull ship comprising a hull and a thrusting and governing set arranged on each side of the center line of the ship, each thrusting and governing set comprising thrusting and governing means comprising at least one propeller, a thrust parallel to the center line being provided by both thrusting and governing means for the propulsion of the ship.

[0008] The thrusting and governing means of the ship of the invention are arranged on the port and starboard sides of the hull, such that the orthogonal projection of said thrusting and governing means onto the plane of the water, instead of being within the surface of flotation of the ship as is the case of the large displacement hull ships of the prior art, is outside the surface of flotation. However, said thrusting and governing means remain within the main beam, the length and the draught of the ship as in the prior art. Because of this alternative arrangement of the thrusting and governing means, space is released under the surface of flotation, and in the ship of the invention the shape of the hull is configured such that the lower bound of the bottom of the hull, in a vertical and orthogonal plane to the center line in the propeller position, is below the upper bound of said propeller.

[0009] Therefore, in the large displacement hull ship of the invention the hull is designed as a full stern shape, a remarkable gain of useful displacement being obtained as the lower bound of the hull of the ship is below the upper bound of the propellers. The hull of the ship is thus designed without restrictions, with rounded shapes, free of bulbs, propellers and rudders arranged under the surface of flotation, not being necessary that the bottom of the hull progressively rises towards the end of the stern, so that the fluid stream runs correctly into the propeller, as in ventral type systems. The lower bound of the bottom remains unchanged until areas near the end of the stern. Compared to ships with ventral type systems, the displacement of the ship increases and the hydrodynamic goodness is not conditioned by the thrusting and governing means. A better displacement / hydrodynamic goodness compromise is obtained for the same values of length, beam, and draught.

[0010] The hull of the ship designed in this way allows increasing the cargo capacity of the ship, that is, with the same length, beam and draught, as master parameters of a ship, it increases the displacement of said ship in the water, and therefore increases the available cargo space, improving the carried tonnage/master parameters ratio, this being particularly important in large displacement hull ships such as oil tankers, gas carriers, bulk cargo vessels, container ships, and great cruisers.

[0011] Another aspect of the invention relates to a method for the modular building of a large displacement

hull ship according to the first aspect of the invention, from a plurality of modules joined together, one of said modules being the stern of the ship. When building a ship, usually all the elements are set up in a shipyard and the ship is then built and put together in that same shipyard, which can cause unwanted delays in completion deadlines, for example. With the method of the invention for the modular building of a ship, the ship is built from a plurality of ship modules being built separately, in different locations (usually shipyards). One of the modules corresponds with the stern of the ship according to the first aspect of the invention, which meets the conditions of tightness, stability and navigability as opposed to the characteristics of the stern of the ships with thrusting and governing systems of the ventral type. Once built, the stern of the ship of the invention navigates by itself to a specific destination, where it is attached to at least one other module of the ship to form the ship.

DESCRIPTION OF THE DRAWINGS

[0012]

Figure 1a shows a partial schematic side view of the stern of a first large displacement hull ship of the prior art.

Figure 1b shows a schematic sectional view along line Ib - Ib of the stern of Figure 1a.

Figure 2a shows a partial schematic side view of the stern of a second large displacement hull ship of the prior art.

Figure 2b shows a schematic sectional view along the line IIb - IIb of the stern of Figure 2a.

Figure 3 shows a perspective view of an embodiment of the ship of the invention.

Figure 4 shows a side view of the ship of Figure 3.

Figure 5 shows a plan view of the ship of Figure 3.

Figure 6a shows a partial schematic side view of the stern of the ship of Figure 3.

Figure 6b shows a schematic sectional view along the line VIb - VIb of the stern of Figure 6a.

Figure 7a shows a detailed perspective view of a thrusting and governing set of the ship of Figure 3.

Figure 7b shows a side view of the thrusting and governing set of Figure 7a.

Figure 8 shows a lower view of the stern of the ship of Figure 3.

Figure 9a shows a detailed perspective view of the stern of the ship of Figure 3, with the collision avoidance means retracted.

Figure 9b shows a detailed perspective view of the stern of the ship of Figure 3, with the collision avoidance means deployed.

Figure 10a shows a perspective view of the stern of the ship of Figure 3, with the collision avoidance means deployed and replacing a propeller of the thrusting and governing means.

Figure 10b shows an elevational view of the stern of the ship of Figure 3, with the collision avoidance means deployed and replacing a propeller of the thrusting and governing means.

Figure 11 shows a cross-section view of the ship according to line IX - IX of Figure 4.

Figure 12a shows a first perspective view of the stern of a ship of the invention built by means of modules.

Figure 12b shows a second perspective view of the stern of Figure 12a.

Figures 13 to 17 show the steps of an embodiment of the method of the invention.

DETAILED DISCLOSURE OF THE INVENTION

[0013] A first aspect of the invention relates to a large displacement hull ship 400. In the context of the invention, a displacement hull ship is a ship with a single hull or a single navigable body. Large displacement hull ships are for example oil tankers, bulk cargo vessels, gas carriers, container ships, and great cruisers. It can be a large ship with a length L close to 300 meters, and a main beam MB close to 50 meters.

[0014] Figures 3 to 5 show, respectively, a perspective view, an elevational view, and a plan view, of an embodiment of the large displacement hull ship 400 of the invention, and Figures 6a and 6b show a partial schematic side of the stern 40 of the ship 400, and a sectional view, along the line VIb - VIb of Figure 6a, of the stern 40 of the ship 400, wherein said ship 400 is a carrier ship, for example a liquefied natural gas carrier.

[0015] The large displacement hull ship 400 comprises a thrusting and governing system 300 allowing governance and navigability of said ship 400, and comprising a hull 10 and a thrusting and governing set 200 arranged at the stern 40 on each side of the center line CL of the ship 400. The hull 10, as shown in Figure 5, is the outer shell or covering of the ship 400, forming its frame. The center line CL, as shown in Figure 5, is the imaginary line which, going from bow 80 to stern 40 of the ship 400, divides it into two equal halves. Each thrusting and gov-

erning set 200 comprises thrusting and governing means 100 comprising at least one propeller 152, a thrust parallel to the center line CL being provided by both thrusting and governing means 100 for the propulsion of the ship 400.

[0016] As shown in Figure 5, the thrusting and governing means 100 are arranged on the port 11 and starboard 12 sides of the hull 10, such that the orthogonal projection of said thrusting and governing means 100 onto the plane of the water, instead of being within the surface of flotation of the ship 400, as is the case of the large displacement hull ships of the prior art when they are at the scantling draught, is outside the surface of flotation. The surface of flotation is the surface defined by the intersection of the plane of the water in which a ship is floating and the hull of the ship itself. The scantling draught is the maximum draught for which the ship is configured.

[0017] In any case, as shown in Figure 5, said thrusting and governing means 100 remain within the main beam MB, and the length L. The beam is the transverse dimension of the ship 400, from port 11 to starboard 12, and the main beam MB is the largest beam of the ship 400. The length L is the dimension of the ship 400 taken along its length, from bow 80 to stern 40. Furthermore, as shown in Figure 6a, the thrusting and governing means 100 are also maintained within the draught D of the ship 400. The draught D is the vertical distance between a point of the waterline 17 and the keel of the ship 400.

[0018] On the other hand, as shown in Figure 6a, the shape of the hull 10 is configured such that the lower bound bb of the bottom 13 of the hull 10, in a vertical and perpendicular plane to the center line CL, in the position of the propeller 152, is below the upper bound bp of said propeller 152. The bottom 13 is the outer surface of the hull 10. When reference is made to the position of the propeller 152 in the context of the invention, logically reference is made to an operating position of said propeller 152, since it is possible that said propeller 152 can be moved vertically to a non-operating position for example for its cleaning, repairing or maintenance.

[0019] Comparing Figures 6a-6b with Figures 1a-1b and with Figures 2a-2b, showing the stern of large displacement hull ships of the prior art, it is verified how the hull 10 of ship 400 of the invention has, at the stern 40, a substantially larger volume than the hulls of ships of the prior art. It will be seen that in the ships shown schematically in Figures 1a-1b and 2a-2b, the bottom of the hull progressively rises towards the end of the stern, the bottom of the hull being, in the length position of the propellers, above said propellers. Thus, the lower bound bb of the bottom of the hull of said ships, in a vertical and perpendicular plane to the center line in the position of the propeller, is above the upper bound bp of said propeller.

[0020] This configuration of the hull 10 allows a remarkable gain of the useful displacement of the ship 400, by taking advantage of the space on all existing large displacement hull ships of the prior art with the same length,

beam and draught than the ship 400 of the invention, is occupied by the thrusting and governing set, that is, by the bulbs, and / or propellers, and / or engines, and / or rudders.

[0021] In addition to the increase in the volume of the hull 10 of the ship 400 of the invention with respect to ships of the prior art, another advantage of the ship 400 of the invention is that the fluid stream, i.e., the flow of water through the hull of the ship, runs horizontally into the propellers 152. In contrast, in ships of the prior art, as is apparent from Figures 1a and 2a, the fluid stream runs into the propellers from the bottom of the hull in an upward direction towards the end of the stern. This makes propulsion more efficient on the ship 400 of the invention.

[0022] On the other hand, since the thrusting and governing means 100, even though they are arranged so that the orthogonal projection of said thrusting and governing means 100 onto the plane of the water is outside said surface of flotation, remain within the main beam MB, said propulsion and steering means 100 are laterally protected.

[0023] Each thrusting and governing set 200 of the ship 400 comprises, in the embodiment shown at the figures, a support structure 110 supporting the corresponding thrusting and governing means 100, each support structure 110 being fixed to each of the sides of the ship 400, on the port 11 and starboard 12 sides. The hull 10 is normally smooth, but in areas where the support structures 110 are fixed, said hull 10 can form protuberances or projections 126. The support structures 110, in this embodiment of the ship 400, are arranged above the waterline 17 of the ship 400. The waterline 17 is the imaginary line forming the intersection of the plane of the surface of the water with the hull 10; the waterline 17 is variable since it changes according to the cargo status of the ship 400.

[0024] Figure 7a shows a detailed perspective view of the thrusting and governing set 200 of the ship 400 of Figures 3-5, and Figure 7b shows a side view of the thrusting and governing set 200 of Figure 7a.

[0025] The thrusting and governing means 100 comprise, in this embodiment of the ship 400, a thrusting and governing unit 100 with a propelling unit 150 and a rudder 160, and a thrusting unit 140 comprising a propelling unit 150. In addition, each support structure 110 comprises a first structure 120a supporting the thrusting and governing unit 100, and a second structure 120b supporting the thrusting unit 140. Both, the first structure 120a and the second structure 120b of each thrusting and governing set 200 are fixed to each of the port and starboard sides 11, 12 by means of metal plates and by fixing means such as screws, bolts, rivets, etc., or by other means known in the state of the art, on the protuberances or projections 126 of the hull 10.

[0026] Said first structure 120a and second structure 120b of each support structure 110 are arranged, in this embodiment of the ship 400, above the waterline 17 of the ship 400, but in other embodiments, not shown in the

drawings, they can be partially below the waterline 17, but never completely below said waterline 17. Each rudder 160 comprises, in this embodiment of the ship 400, an electric motor 125 which allows the movement and therefore the governance of said ship 400.

[0027] The first structure 120a and the second structure 120b of each support structure 110 are arranged, in this embodiment of the ship 400, at the stern 40, and more specifically on each of the quarters, i.e., the port 14 quarter and starboard 15 quarter.

[0028] In a preferred embodiment, the design of the hull 10 of the ship 400 is done such that the beam starts to decrease with hydrodynamic criterion from a distance to the end 19 of the stern 40 of approximately 35% or less than the length L of the ship 400. Thus, a good hydrodynamic behavior of the hull 10 is obtained.

[0029] In the preferred embodiment, the design of the hull 10 of the ship 400 that is done such that the bottom 13 of the ship 400, in the center of the length L, is maintained up to a distance from the end 19 of the stern 40 equal to or less than 10% of the total length L of the ship 400, which makes it possible to obtain a substantial increase in volume of the hull 10 with respect to ships of the prior art. In other words, in a ship that is 280 meters in length, for example, in the ship 400 of this preferred embodiment, the bottom 13 starts to decrease at a distance of less than 30 meters from the end of the stern 40, instead of more than 100 meters as would occur in the case of a similar ship with ventral-type thrusting and governing system.

[0030] The hull 10 of the ship 400 thus designed, with a progress decrease in the beam towards the stern 40 starting from a position that is closer to the transom of the ship 400, a decrease in the bottom 13 that drops close to the stern 40, and a respective thrusting and governing system 300 arranged on the port 11 and starboard 12 sides of the ship 400, allows increasing the volume thereof. It therefore increases the volume of the hull 10 of said ship 400, and thereby increases the cargo capacity in a range of 5%-15% with respect to other ships with ventral-type thrusting and governing systems. The carried tonnage/master parameters ratio of the ship 400 is thereby improved, this being particularly important in large displacement hull ships such as for example oil tankers, gas carriers, bulk cargo vessels, and container ships.

[0031] Figure 8 shows a lower view of the stern 40 of the ship 400 of Figure 3, and Figures 9a and 9b show perspective and elevational views of the stern 40 of the ship 400 of Figure 3, with the collision avoidance means 60 deployed, and replacing a propeller 152 of the thrusting and governing means 100.

[0032] Each propelling unit 150 of each thrusting and governing unit 130 and of each thrusting unit 140 comprised in the thrusting and governing means 100, comprises, in this embodiment of the ship 400, a submersible electric motor 151 and a propeller 152, said propellers 152 being attached to an output shaft 153 of each respective motor 151. The propeller 152 of the propelling

unit 150 of the thrusting and governing unit 130 and the propeller 152 of the propelling unit 150 of the thrusting unit 140 are arranged along one and the same imaginary axis as an extension of the output shafts 153 of the respective motors 151, both propellers 152 rotating in opposite directions, forming counter-rotating propellers. Counter-rotating propellers are propellers that are well-known in the state of the art which allow having smaller propellers, achieving an outflow speed of the fluid parallel to the inflow speed, thereby decreasing the necessary absorbed energy with respect to the energy absorbed with a single propeller in order to obtain the same thrust. It is also possible to arrange two propellers 152 on the same output shaft 153 of a motor 151, rotating in opposite directions and forming counter-rotating propellers (not shown in the drawings).

[0033] The output shaft 153 of the motor 151 of each propelling unit 150 is arranged in a horizontal plane when the ship 400 is balanced or trimmed in calm water, i.e., being parallel to the horizontal plane passing through the waterline 17 of said ship 400, because the fluid stream also follows a horizontal path with respect to said plane. However, in ships with ventral-type thrusting and governing systems, the fluid stream follows an upward path to properly runs into the propellers, and a tilt of the propellers in the vertical plane to put them parallel to the fluid stream is suitable, for optimizing as well, the ship thrusting efficiency.

[0034] The output shaft 153 of the motor 151 of each propelling unit 150, in the preferred embodiment, is arranged in a vertical plane forming a fixed angle α equal to or less than 8° with respect to the vertical plane passing through the center line CL. The angle α can vary from one ship to another with the characteristics defined above, depending on the dimensions of said ship, basically its length and its beam. In the preferred embodiment of the ship 400 the beam progressively decreases by the dimensions described above, and the port 11 and starboard 12 sides of the ship 400 are tilted such that the fluid stream of the water, that is displaced by said port 11 and starboard 12 sides, is oriented towards the thrusting and governing means 100, directly hitting the propellers 152, improving the hydrodynamic behavior with respect to ships with ventral-type thrusting and governing systems.

[0035] With these arrangements of the output shafts 153 of the motors 151 of the propelling units 150, both with respect to their horizontal positioning and their angled positioning with respect to the center line CL of the ship 400, a thrust or impulsion parallel to the center line CL is obtained for the thrusting of the ship 400.

[0036] In this embodiment of the ship 400, the thrusting and governing means 100 can move heightwise along the support structure 110 corresponding to each thrusting and governing set 200. Therefore, if the thrusting and governing means 100 are moved until they are outside the water, since each thrusting and governing set 200 is furthermore at least partially accessible from each side

of the ship 400, above the waterline 17, it allows performing certain cleaning tasks, maintenance tasks, and even tasks for replacing or modifying the respective thrusting and governing means 100, without having to be submerged in water or having to drydock the ship. The first structure 120a and the second structure 120b each comprise a guiding element 123 which, in this embodiment of the ship 400, is a vertically arranged column. The two propelling units 150 and the rudder 160 of the thrusting and governing means 100 are fixed to corresponding supports 122, which are metallic structures that can move along the corresponding guiding element 123, and which can be fixed to the structure 110 by means of pins or by any other fixing means. In other embodiments of the ship 400, not shown in the drawings, the supports 122 are perforated plates that can move along the guiding elements 123 and are fixed by conventional fixing means, such as screws.

[0037] The propelling units 150 and the rudders 160 can be adjusted heightwise by means of the guiding elements 123, and can be arranged above the waterline 17 of the ship 400. In this embodiment of the ship 400, the first structure 120a and the second structure 120b are arranged completely above the waterline 17, and comprise in their upper part motor-operated means 124, which are attached to the supports 122 with attachment means such as cables, chains or racks. Therefore, when so required, the motor-operated means 124 allow moving each propelling unit 150 and each rudder 160 along the guiding element 123, being able to arrange them at different heights.

[0038] This configuration of the thrusting and governing sets 200, allows arranging the propelling units 150 and the corresponding rudders 160 in more than one operating position along the respective structure support 110, the operating positions being each of the positions in which they thrust the ship 400. So, for example, when the ship 400 is carrying its cargo, the hull 10 is more submerged and both the propelling units 150 and the rudders 160 are arranged at the height suitable, for thrusting said ship 400 with the highest efficiency using the fluid stream. However, when the ship 400 modifies its cargo, the draught D of the ship 400 changes, and both the propelling units 150 and the rudders 160 can be arranged at the height suitable for propelling said ship 400 with the highest efficiency using the fluid stream. The arrangement and accessibility of the thrusting and governing means 100 allows installing propellers 152 having a design that is optimal for the cargo status of the ship 400.

[0039] An extreme case would be when the ship 400 is travelling cargo-free. In ships with ventral-type thrusting and governing systems, the stern has less buoyancy, because it has less displacement, and the cargo-free ship would tend to tilt towards the stern. For cargo-free ships with ventral-type thrusting and governing systems to be trimmed or balanced, they have spaces inside the hull that are filled completely or partially with ballast water,

and they therefore submerge the hull in the bow area in order to achieve said trim or balance and be able to navigate. In the ship 400 of the invention, this is not necessary because the ship is trimmed with very little ballast due to the considerable displacement at the stern 40. The thrusting and governing system 300 can be fixed at the suitable height as the propelling units 150 and rudders 160 can be adjusted heightwise, and can work with propellers 152 having a design that is suitable for the cargo level in the ship 400.

[0040] Needing a smaller amount of ballast water, makes it possible to reduce the discharge of said water at the site where liquefied gas is loaded on the ship 400, which aids in complying with international health regulations with respect to ballast water discharging.

[0041] Furthermore, the draught D at the stern 40 of the ship 400 is less than the draught at the stern of a ship with a ventral-type thrusting and governing system, and this allows increasing the speed of the ship 400 since the penetration of the hull 10 in the water improves and offers less resistance to forward movement. The improvement can amount to an at least 2% increase in speed with respect to ships with a ventral-type thrusting and governing system. When the ship 400 navigates at the usual speed, the decrease in the fuel consumption, in cargo-free trips, can amount to at least 5%.

[0042] The ship 400 with the characteristics described above could navigate without using the rudders 160. This is because given the characteristics of laterality and the arrangement of the thrusting and governing means 100 on the port 11 and starboard 12 sides of the ship 400, the motors 151 of the propelling units 150 could receive independent speed setpoints to allow acting on the governance of the ship 400, in replacement of the rudders 160. When the ship 400 navigates at a cruising speed, given the large torque arm of said ship 400 due to the arrangement of the thrusting and governing means 100 with respect to the center line CL, independently assigning, when necessary, different speeds to the motors 151 of the propelling units 150 arranged on both port 11 and starboard 12 sides, the ship 400 can be controlled without requiring the rudders 160. Therefore, in other embodiments the ship 400 could dispense with the rudders 160 and be controlled by the propulsion units 150 themselves as described. Although said way of controlling the ship 400 may be sufficient even at low speeds during maneuvers in a port, given the considerable length of said ship 400, transverse propulsion systems 210a, 210b could furthermore be arranged both at the stern 40 and at the bow 80, respectively, providing transverse thrust to the ship 400 with respect to the center line CL, and helping in maneuverability of said ship 400.

[0043] Figure 9a shows a detailed perspective view of the stern 40 of the ship 400 of Figure 3, with the collision avoidance means 60 retracted, and Figure 9b shows a detailed perspective view of the stern 40 of the ship 400 of Figure 3, with the collision avoidance means 60 deployed. These retractable collision avoidance means 60

are arranged on the port 11 and starboard 12 sides in the area of the stern 40, and protect the thrusting and governing sets 200 against impacts. During maneuvers for bringing the ship to port and sailing the ship 400, despite the fact that the thrusting and governing sets 200 are arranged on the port 14 and starboard 15 quarters of the ship 400, and do not exceed the main beam MB of the ship 400, there is a certain level of risk that at least the propellers 152 may hit the wall of the port. To that end, the collision avoidance means 60, which are retracted when the ship 400 is navigating, can be deployed when the ship 400 is doing maneuvers such that if there is an impact against the wall of the port, this impact will be absorbed by the collision avoidance means 60.

[0044] The ship 400 comprises in the preferred embodiment lifting means 70 arranged on the main deck 20 in the area of the stern 40 close to the thrusting and governing means 100 of the ship 400, as shown in Figures 10a and 10b. These lifting means 70 are a gantry crane, but can also be jib cranes or cranes arranged on said main deck 20. To optimize thrusting efficiency, the propellers 152 can be replaced in order to adapt them to the different operating modes of the ship 400. Furthermore, due to maintenance operations or cleaning operations it is periodically necessary, or specifically necessary, when there is a problem, to replace any of the propellers 152, or any of the motors 151, or to even intervene or replace any of the rudders 160. The lifting means 70 also allow lowering and lifting people and/or components on the port 11 and starboard 12 sides for performing maintenance and/or cleaning tasks on the thrusting and governing system 300.

[0045] Figure 11 shows a cross-section view of the ship 400 according to line IX-IX of Figure 4. The ship 400 is a gas carrier, i.e., a gas-carrying ship, and as such, it carries liquefied gas at about -162°C. The gas tanks are insulated, but nevertheless the gas inside the tanks heats up and evaporates. In gas-carrying ships today, that evaporated gas is burned off or used as fuel to power the machinery of the ship itself. Nevertheless, in situations such as docking in a port to perform any operation or due to a malfunction, the gas keeps evaporating but is not used by the machinery. In said situations, it would be good to store said gas and then use it as fuel. The hull 10 of the ship 400 is a double hull comprising an outer first hull 9 which is in contact with the water, and an inner second hull 8 inside the first hull 9. A closed space 7 is formed between both first hull 9 and second hull 8, and said space 7 can be used. In other ships, this closed space 7 is used to store ballast water for the cargo-free return trips. In the ship 400 of the invention, the ballast water is drastically reduced, and part of that closed space 7 can be used to store the evaporated gas at a low pressure of 10 atmospheres, for example, and later use it as fuel of the ship 400 itself or however it is needed.

[0046] A second aspect of the invention relates to a method for the modular building of a ship 400'.

[0047] Figure 12a shows a first perspective view of the

stern 40' of the ship 400' of the invention built by means of modules, and Figure 12b shows a second perspective view of the stern 40' of Figure 12a. Said stern 40' can comprise a thrusting and governing system 300 such as the one described for the ship 400, in any of its embodiments, and can be part of a ship 400' which is built by means of modules, said stern 40' being one of the modules, particularly the stern of said ship 400'. Said stern 40' can navigate by itself by means of the thrusting and governing means 100 to a specific destination. In fact, said stern 40' has an arrangement of weights and thrust such that it is stable and is able to navigate by itself, unlike a stern of a ship with a thrusting and governing system of the ventral type.

[0048] Figures 13-17 show the steps of an embodiment of the method of the invention for building the ship 400'. Said ship 400' is built, in this embodiment, from a module that is the stern 40', a module that is a bow 500', and a module that is a central area 600' for the housing most of the cargo to be carried, and all the features described for the ship 400 described above.

[0049] The method of the invention for the modular building of the ship 400' comprises in this embodiment:

- a building step for building the stern 40' of the ship 400',
- a navigation step in which the stern 40' of the ship 400' navigates by itself by means of the thrusting and governing means 100 to a second shipyard, and
- an attachment step in which at said second shipyard, said stern 40' of the ship 400' is attached to the bow 500' and to the central area 600', giving place to the ship 400'.

[0050] The method further comprises a preparation step prior to the navigation step, in which one end 42' of the stern 40' built, including the navigation and power generating systems in the building step, as shown in Figure 12a, is rendered leak-tight, and anchoring elements, a fuel tank and navigation lights are furthermore added to said stern 40'. This allows having a stern 40' which can navigate by itself to a second shipyard, without being towed or transported by other means, in the navigation step.

[0051] The thrusting and governing sets 200 of the stern 40' are fixed in the building step, such that the thrusting and governing means 100 are mounted on the port 11 and starboard 12 sides, thrusting the stern 40' in the navigation step, and doing with their arrangement and the thrusting direction they provide, the end 42' of the stern 40' act as the stern of said stern 40' during said navigation.

[0052] After the navigation step, the arrangement of the thrusting and governing means 100 arranged at the stern 40' in the building step is modified, arranging them in such a way that, once the ship 400' is built, said thrusting and governing means 100 thrust said ship 400', making the stern 40' act as the stern of the ship 400'. So, the

thrusting and governing means 100 of the modular ship 400', once it is finished, generate thrusting of the modular ship 400' in a direction of advance contrary to the direction of advance to the thrusting direction in which said thrusting and governing means 100 thrust the stern 40' during the navigation step of the method.

[0053] In this embodiment of the method for the modular building of the ship 400', in the attachment step a new module formed by the bow 500' and the central area 600' is built in the dock 2 of the second destination, as shown in Figure 15. In other embodiments of the method, the central area 600' comprises several modules, said modules being built in one or in several shipyards, one or several new modules being formed.

[0054] The attachment step further comprises a phase in which the stern 40' and a new ship module formed by the bow 500' and the central area 600', to which said stern 40' is attached, are aligned in flotation for their correct subsequent attachment, as shown in Figure 16, the ship 400' finally being formed as shown in Figure 17.

[0055] In the particular event that the ship module 500', 600' corresponds to a ship already in use from which the stern has been removed, the same operation of attaching the stern 40' is performed, the ship 400' being formed.

[0056] The method for the modular building of a ship 400' offers the possibility of better resource management, and the possibility of working in parallel, in different shipyards, on the modular building of the ship 400'. It allows managing technological capabilities of different shipyards, and the possibility of building sterns 40' of ships 400' in smaller shipyards. In the case of replacing the stern of a ship in use, minimum down time with the ship being out of service is obtained.

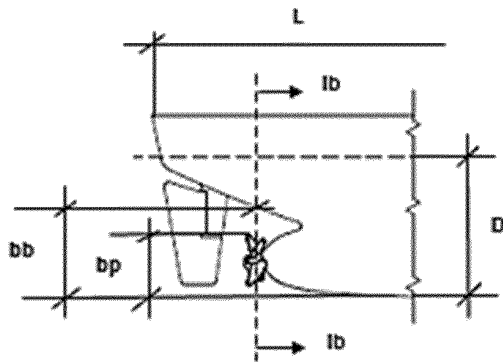
Claims

1. Large displacement hull ship comprising a hull (10) and a thrusting and governing set (200) arranged on each side of the center line (CL) of the ship (400, 400'), each thrusting and governing set (200) comprising thrusting and governing means (100) comprising at least one propeller (152), a thrust parallel to the center line (CL) being provided by both thrusting and governing means (100) for the propulsion of the ship (400, 400'), **characterized in that** the thrusting and governing means (100) are arranged on the port and starboard sides (11, 12) of the hull (10), such that the orthogonal projection of said thrusting and governing means (100) onto the plane of the water is outside the surface of flotation of the ship (400, 400'), said thrusting and governing means (100) remaining within the main beam (MB), the length (L) and the draught (D) of the ship (400, 400'), the shape of the hull (10) being configured such that the lower bound (bb) of the bottom (13) of the hull (10), in a vertical and orthogonal plane to the center line (CL) in the propeller (152) position, is below the

upper bound (bp) of said propeller (152).

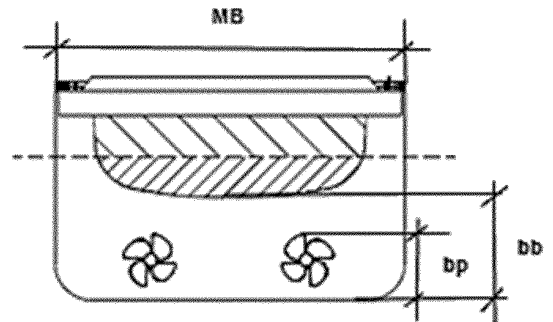
2. Ship according to claim 1, wherein the thrusting and governing sets (200) are arranged at the stern (40, 40') of the ship (400, 400').
3. Ship according to claim 1 or 2, wherein the bottom (13) in the center of the length (L) of the ship (400) is maintained up to a distance of the transom (19) of the stern (40) equal to or less than 10% of the length (L) measured from the transom (19).
4. Ship according to any of the preceding claims, wherein the beam of the ship (400) starts to decrease up to the transom (19) of the stern (40) from a distance equal to or less than 35% of the length (L) of said ship (400) measured from the transom (19).
5. Ship according to any of the preceding claims, wherein the thrusting and governing means (100) comprise at least one propelling unit (150), said propelling unit (150) comprising at least one motor (151), said motor (151) being an electric motor, and at least the propeller (152), said motor (151) comprising an output shaft (153) parallel to the surface of flotation and attached to the propeller (152).
6. Ship according to claim 5, wherein the output shaft (153) of the motor (151) of each propelling unit (150) is arranged in a vertical plane forming a fixed angle (α) equal to or less than 8° with respect to the vertical plane passing through the center line (CL)
7. Ship according to any of the preceding claims, wherein the thrusting and governing means (100) are configured for being moved heightwise and for being arranged in more than one operating position depending on the load of the ship (400, 400').
8. Ship according to claim 7, wherein the thrusting and governing means (100) are configured for being arranged above the waterline of the ship (400, 400') in a non-operating position.
9. Ship according to any of the preceding claims, wherein each thrusting and governing set (200) comprises a support structure (110), attached to the port and starboard sides (11, 12) of the hull (10), supporting the corresponding thrusting and governing means (100).
10. Ship according to any of the preceding claims, comprising retractable collision avoidance means (60) arranged on the port and starboard sides (11, 12), protecting the thrusting and governing sets (200) against impacts when they are deployed during maneuvers of the ship (400, 400').

11. Ship according to any of the preceding claims, which is built from a plurality of modules joined together, one of said modules being the stern (40') of the ship (400').
- 5
12. Method for building a ship (400') according to claim 11, the method comprising:
- a building step for building the stern (40') of the ship (400'),
 - a navigation step in which the stern (40') of the ship (400') navigates by itself by means of the thrusting and governing means (100) to a specific destination, and
 - an attachment step in which at said specific destination, the stern (40') of the ship (400') is attached to at least one module (500', 600') of the ship (400').
- 10
- 15
- 20
- 25
- 30
13. Method according to claim 12, wherein the thrusting and governing means (100) of the ship (400') are fixed in the building step to the stern (40') of the ship (400'), such that the direction of advance of the stern (40') of the ship (400') is contrary to the direction of advance of the ship (400') to be built, said thrusting and governing means (100) being arranged in its final position after the navigation step.
- 35
- 40
- 45
- 50
- 55
14. Method according to claim 12 or 13, wherein the module (500', 600') of the ship (400') corresponds to a ship in use.



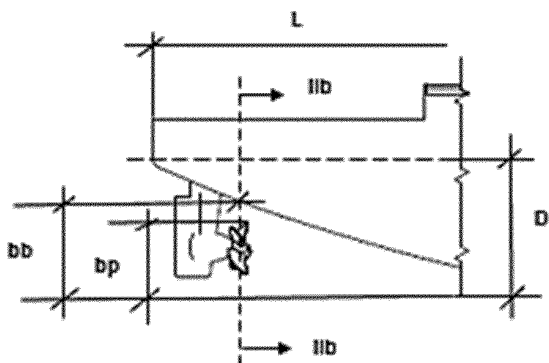
PRIOR ART

FIG. 1a



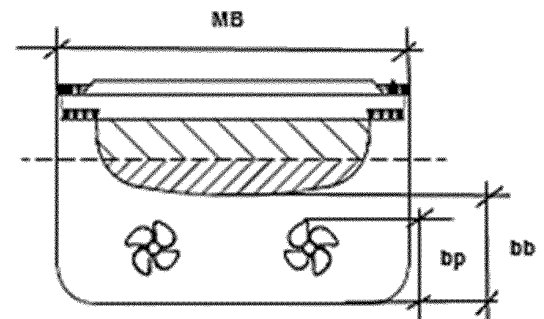
PRIOR ART

FIG. 1b



PRIOR ART

FIG. 2a



PRIOR ART

FIG. 2b

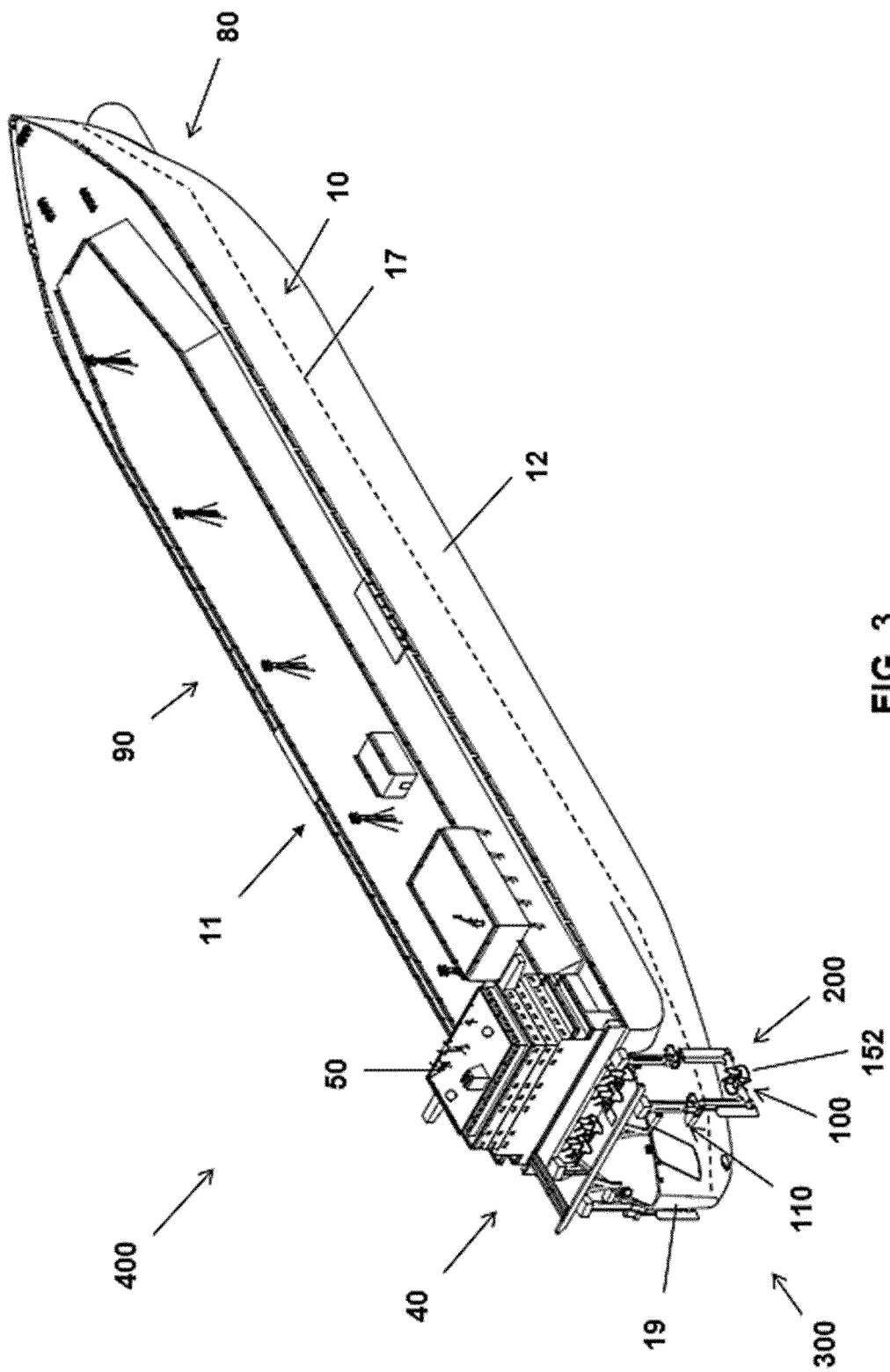


FIG. 3

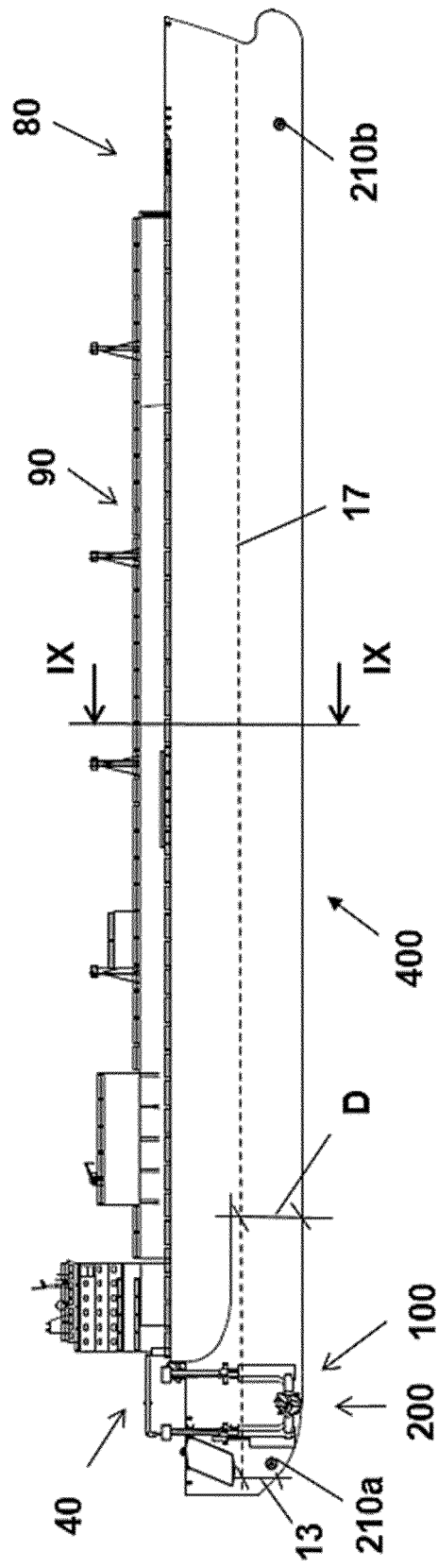


FIG. 4

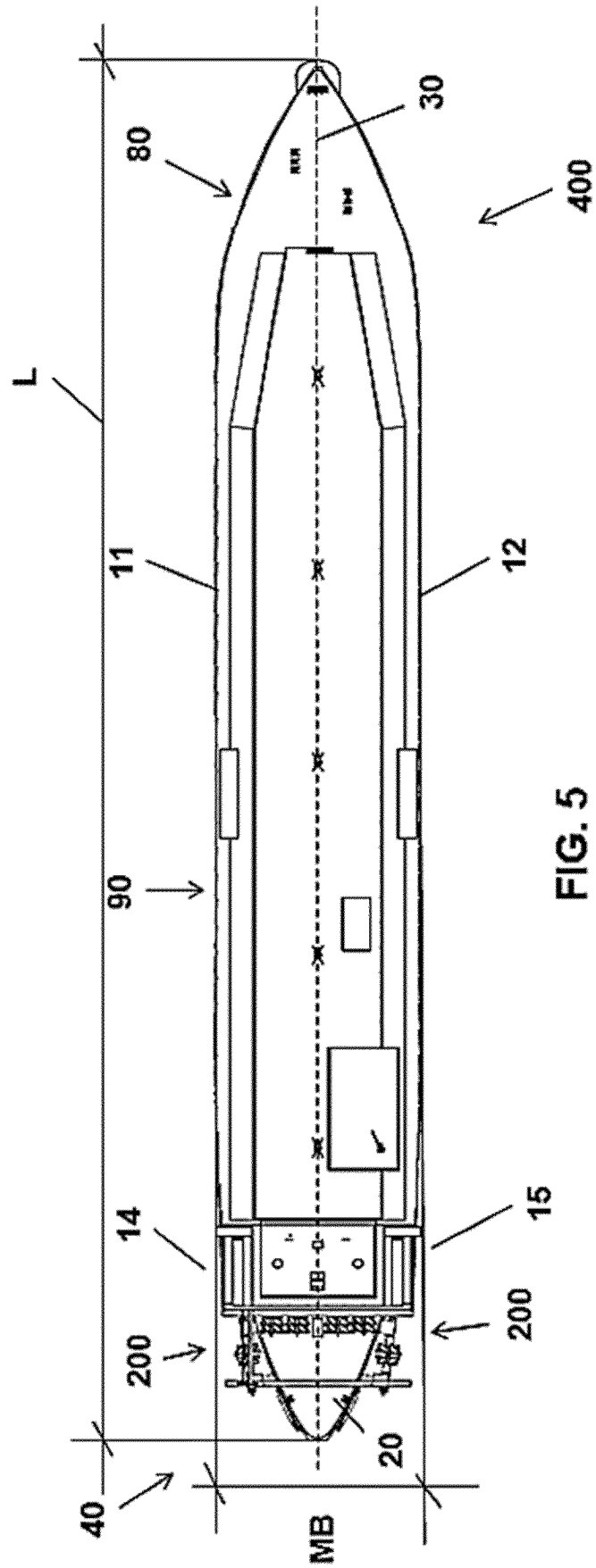


FIG. 5

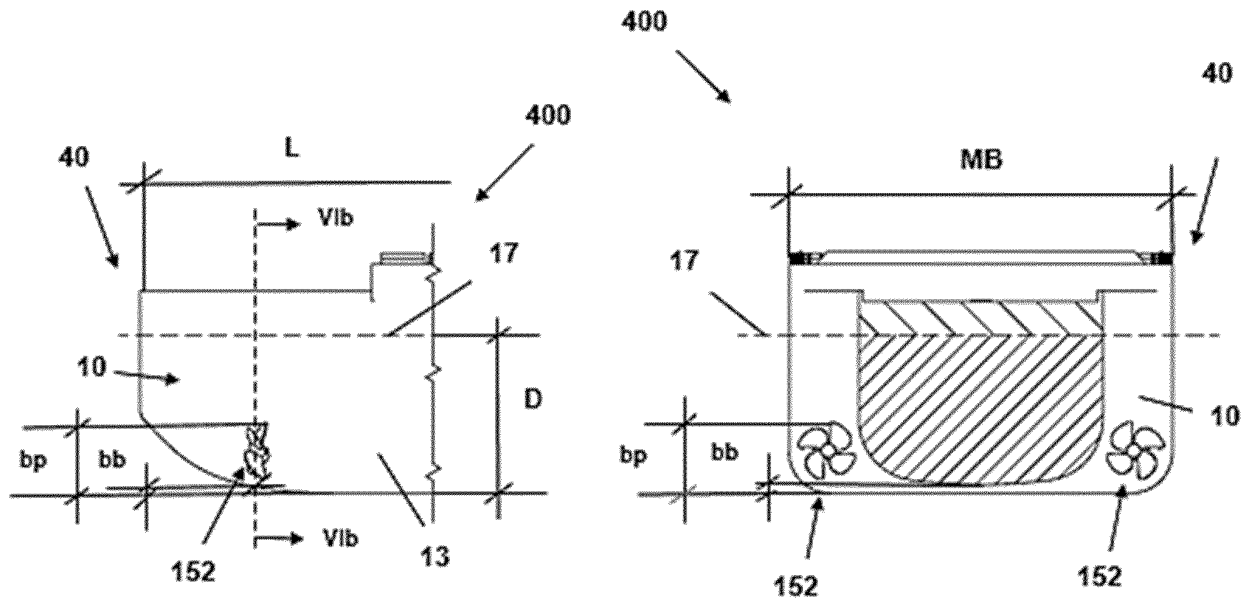


FIG. 6a

FIG. 6b

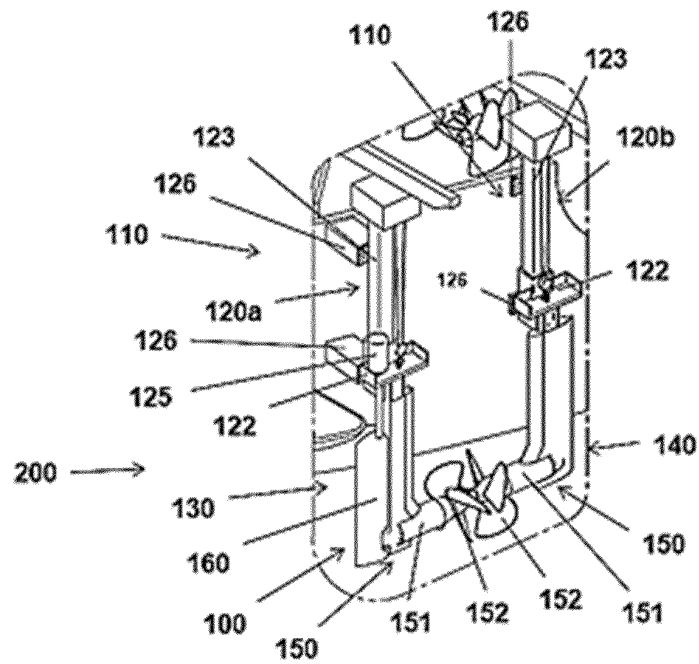


FIG. 7 a

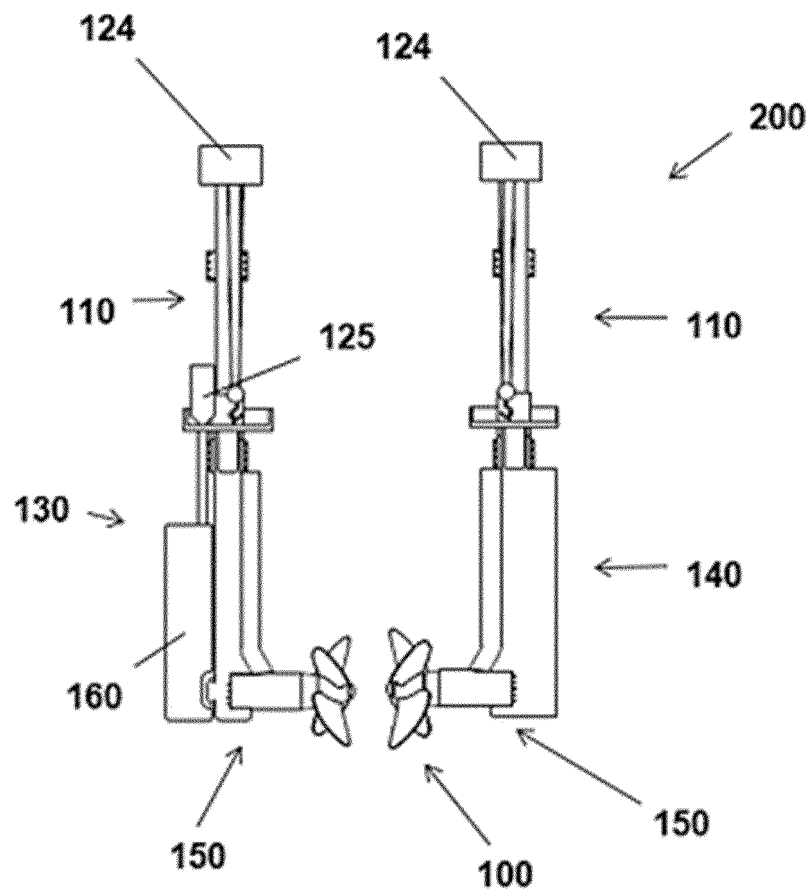


FIG. 7 b

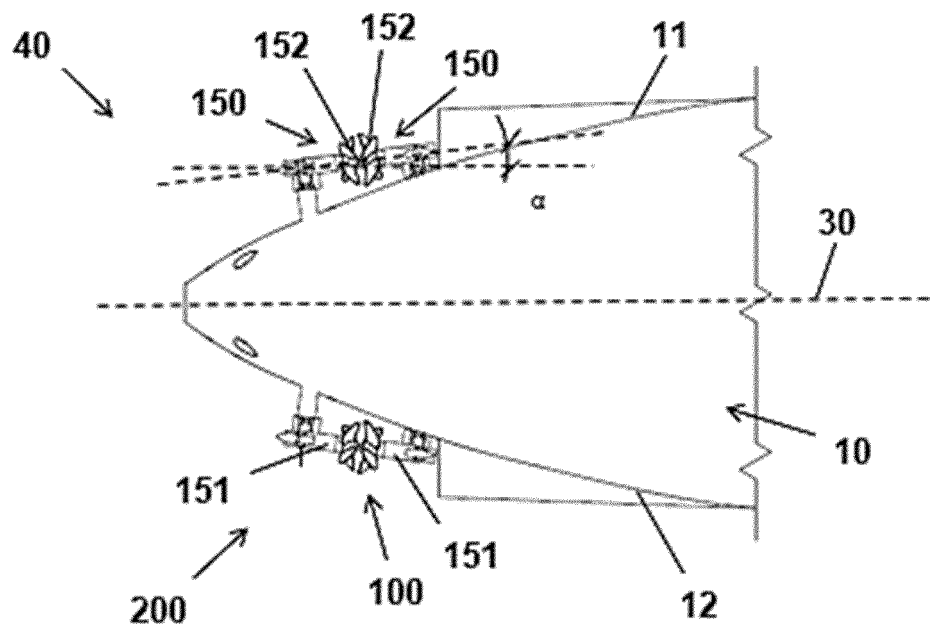


FIG. 8

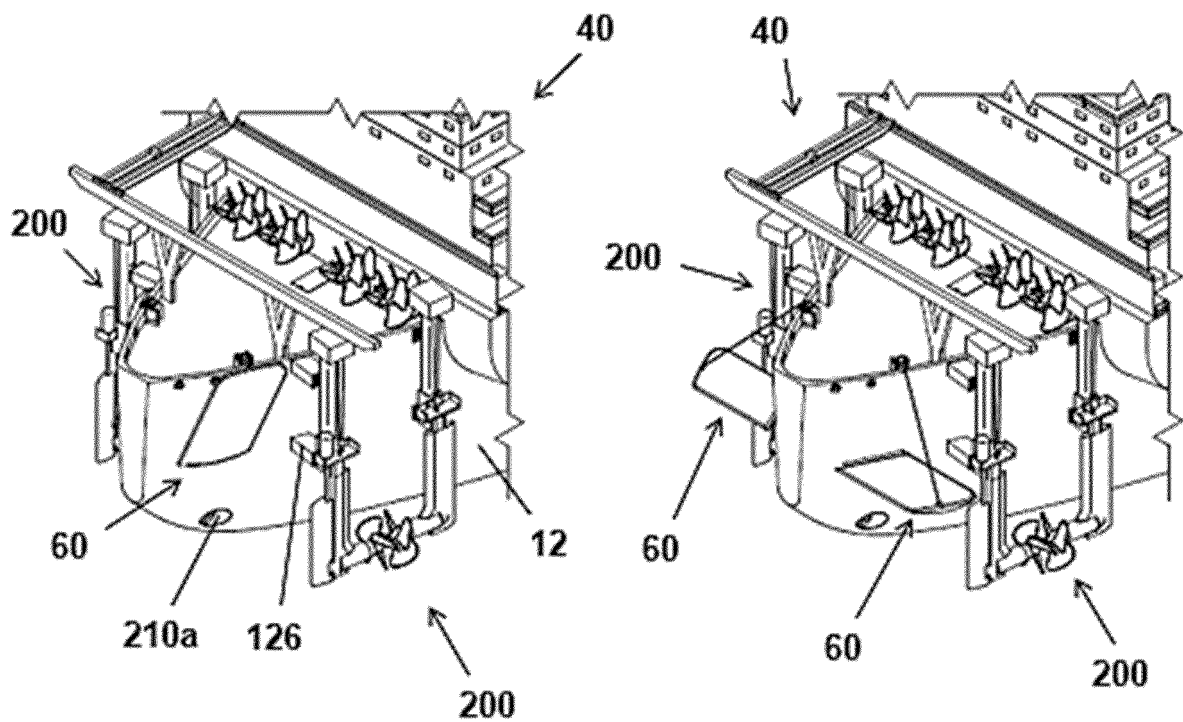


FIG. 9 a

FIG. 9 b

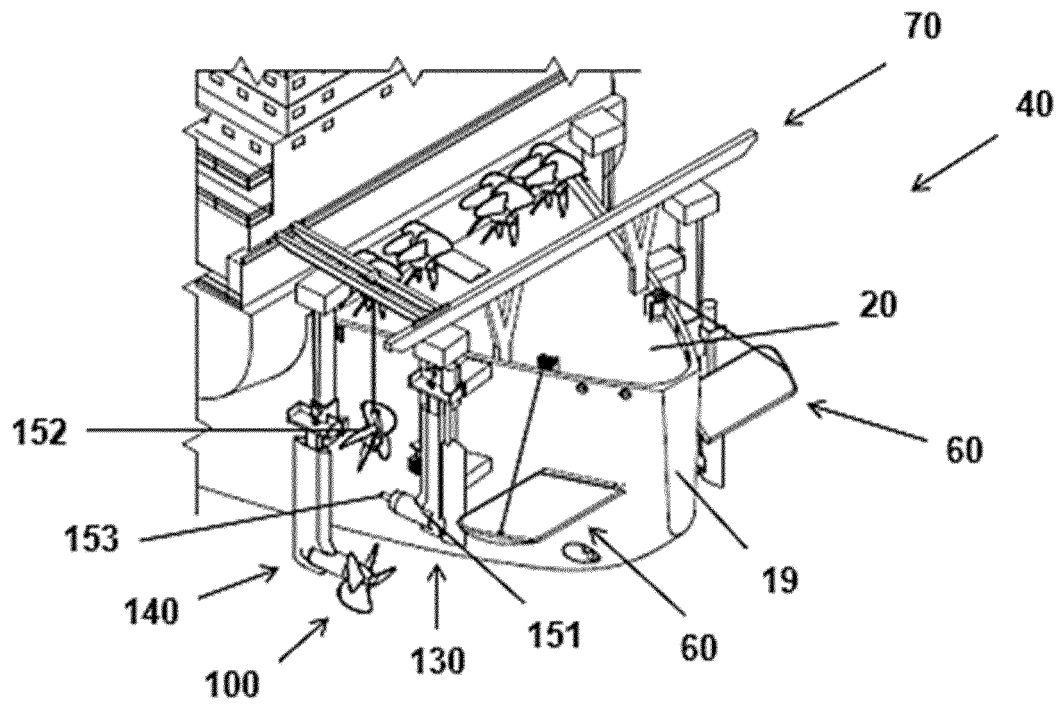


FIG. 10 a

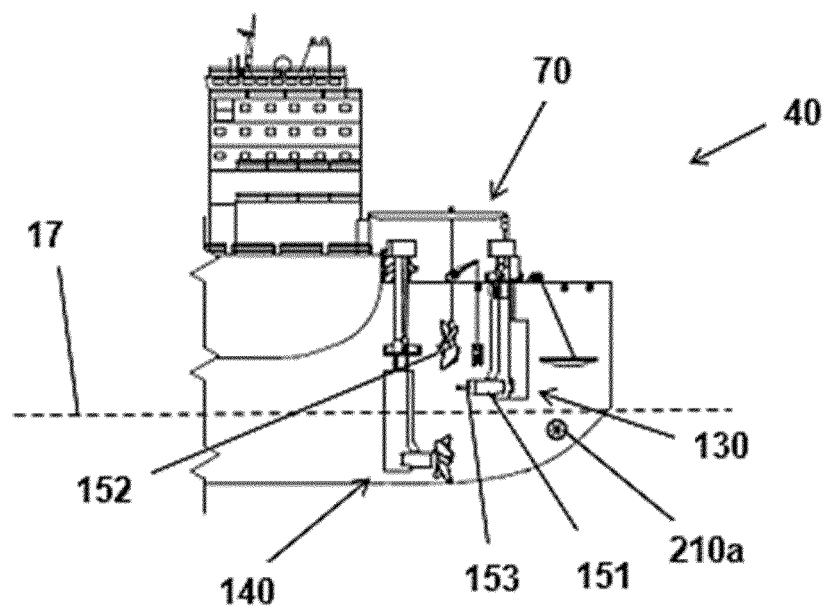


FIG. 10 b

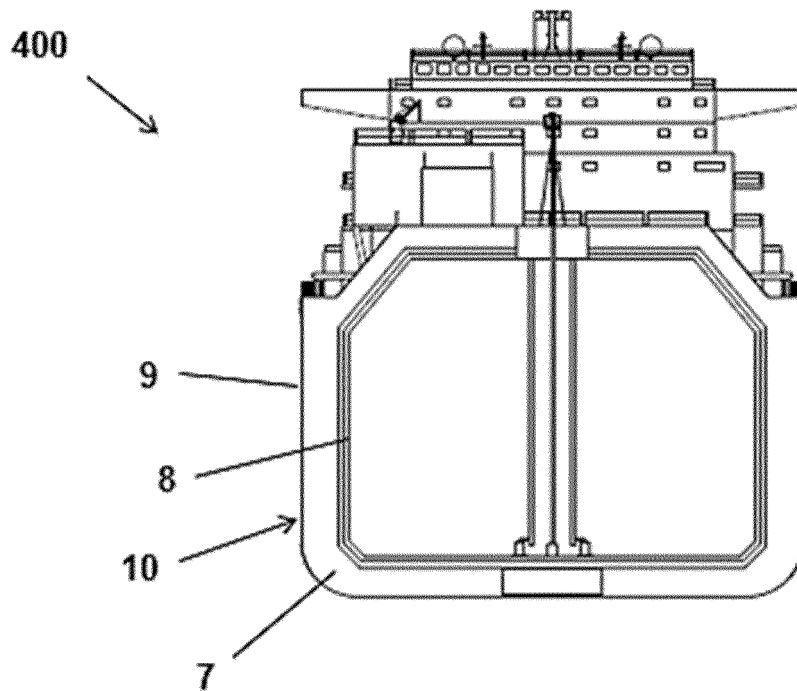


FIG. 11

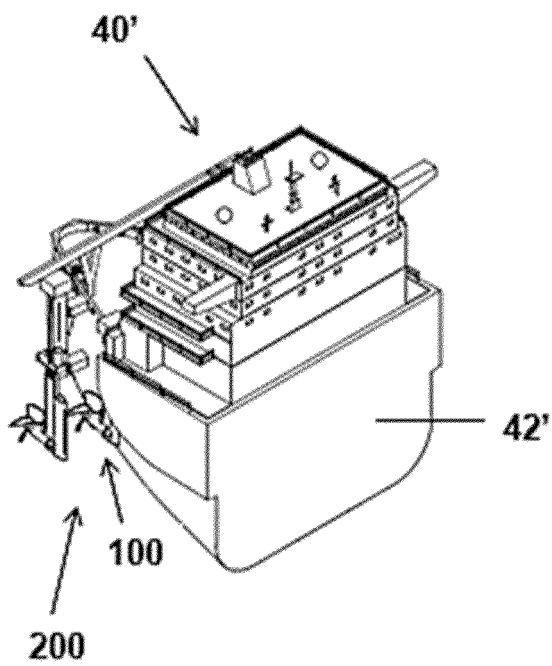


FIG. 12 a

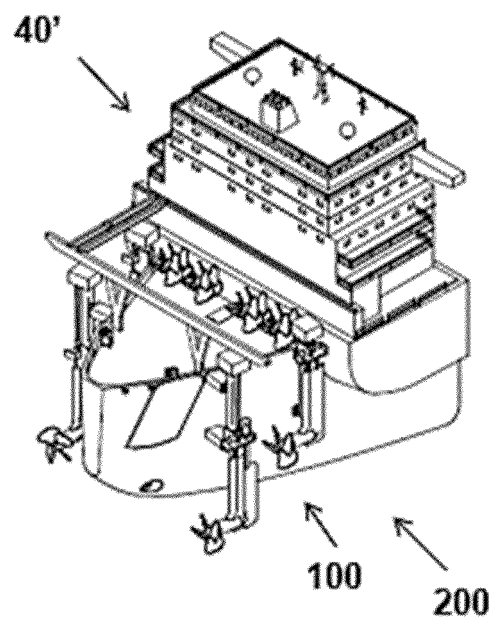


FIG. 12 b

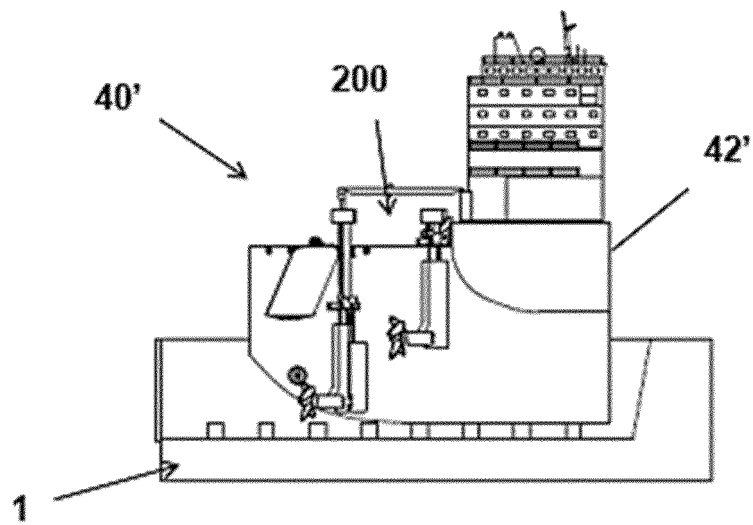


FIG. 13

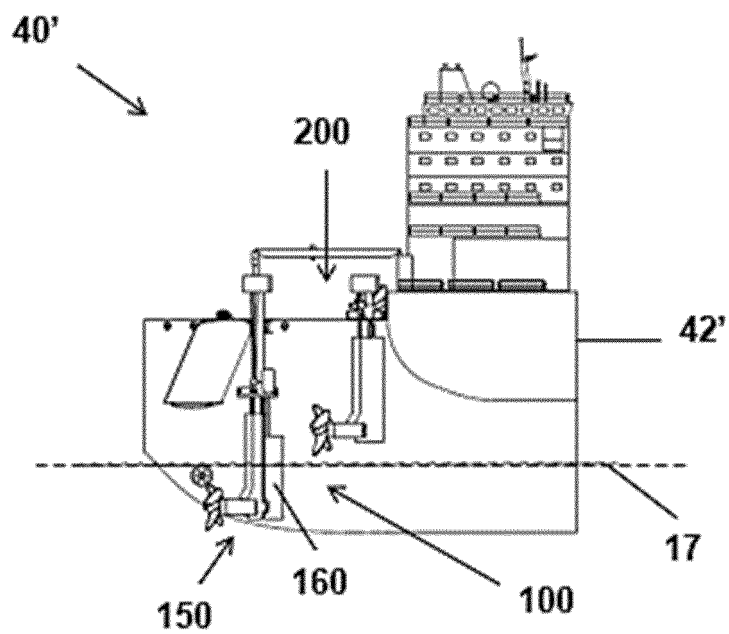


FIG. 14

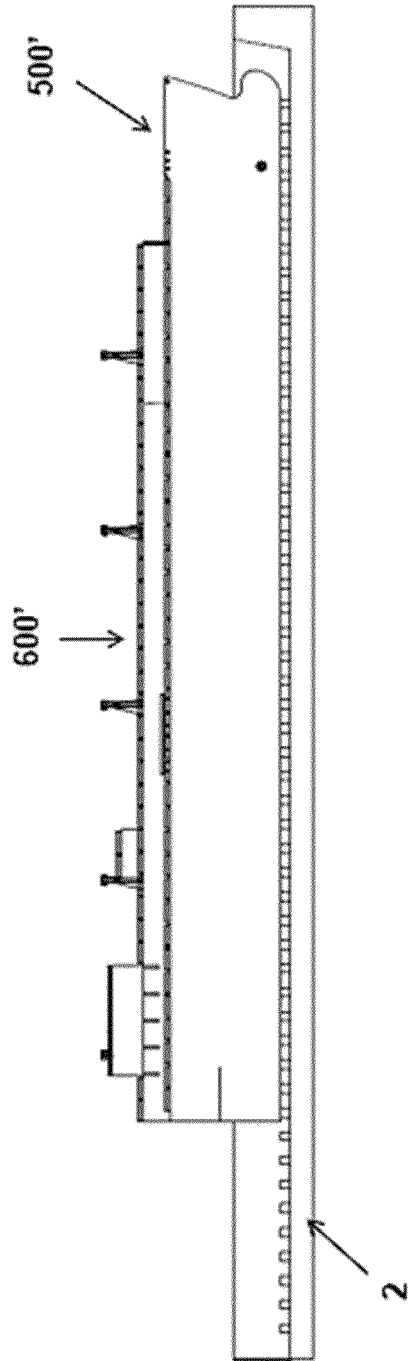


FIG. 15

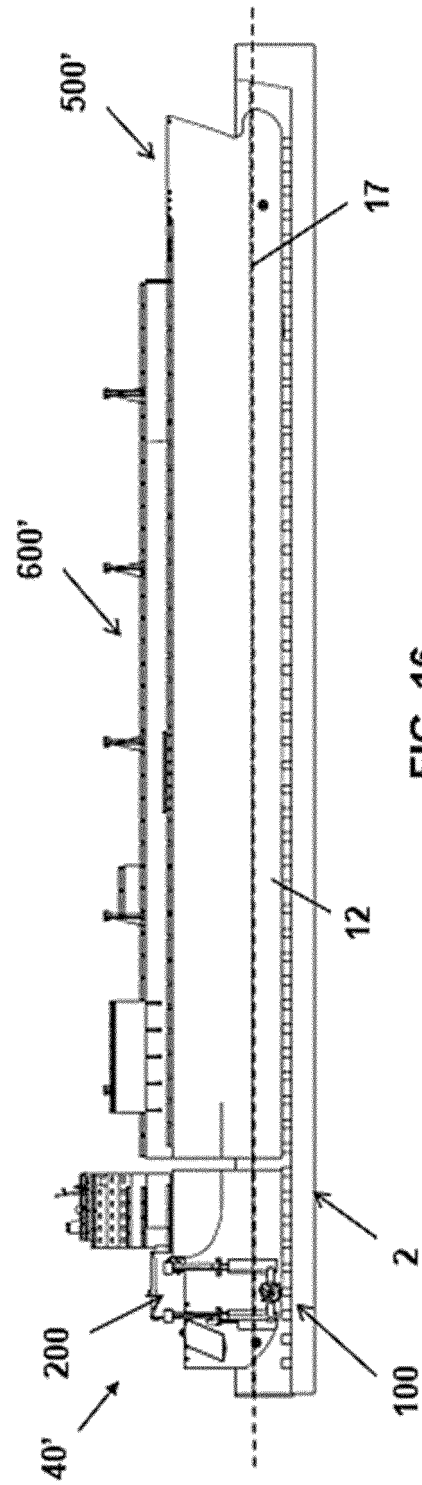


FIG. 16

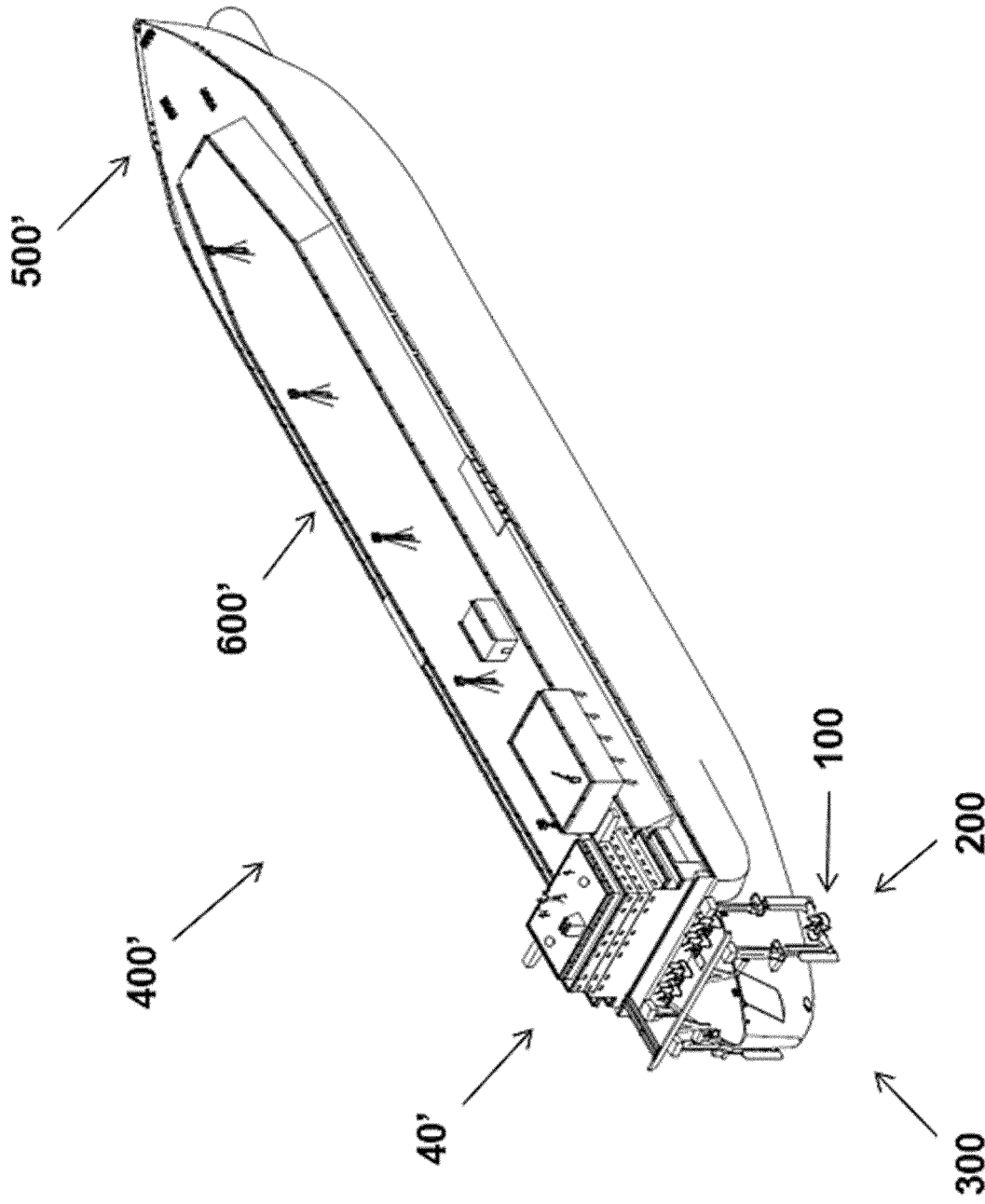


FIG. 17

INTERNATIONAL SEARCH REPORT

International application No
PCT/ES2017/070234

A. CLASSIFICATION OF SUBJECT MATTER		
INV. B63B9/06 ADD.	B63H5/08	B63H5/18
	B63B3/02	
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) B63B B63H		
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) EPO-Internal		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 131 875 A (LEE WARREN D [US]) 21 July 1992 (1992-07-21)	1-11
Y	column 4, line 17 - column 6, line 56; figures 1-4	12-14
X	US 3 711 755 A (MEYER C) 16 January 1973 (1973-01-16)	1-11
Y	column 1, line 53 - column 3, line 31; figures 3-6	12-14
X	US 2 213 520 A (GENTRY HERMOND G) 3 September 1940 (1940-09-03)	1-11
Y	page 1, line 50 - page 2, line 61; figures 1-3	12-14
X	US 2005/159053 A1 (RUFFE STEVEN E [US]) 21 July 2005 (2005-07-21)	1,2,6, 8-11
	paragraphs [0026] - [0045]; figures 1-6	
	-/-	
☒	Further documents are listed in the continuation of Box C.	☒
	See patent family annex.	
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Date of the actual completion of the international search	Date of mailing of the international search report	
11 August 2017	11/09/2017	
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Brumer, Alexandre	

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INTERNATIONAL SEARCH REPORT

International application No
PCT/ES2017/070234

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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X	US 6 848 382 B1 (BEKKER JOANNES RAYMOND MARI [US]) 1 February 2005 (2005-02-01) column 4, line 7 - column 6, line 3; figures 1-4 -----	1-5,7,8, 10,11
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X	GB 217 395 A (GIOVANNI DOMENICO PIETRO PARIE) 19 June 1924 (1924-06-19) page 2, line 106 - page 3, line 101; figure 1 -----	1-11
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Y	EP 0 945 336 A1 (FB DESIGN SRL [IT]) 29 September 1999 (1999-09-29) paragraphs [0013] - [0041]; figures 1, 2 -----	12-14
Y	US 3 983 830 A (MORGAN GEORGE W) 5 October 1976 (1976-10-05) column 5, line 25 - column 11, line 13; figures 1-8 -----	12-14
Y	EP 0 469 655 A1 (IHC HOLLAND NV [NL]) 5 February 1992 (1992-02-05) column 3, line 51 - column 5, line 31; figures 1-5 -----	12-14

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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- US 2014182501 A1 [0005]