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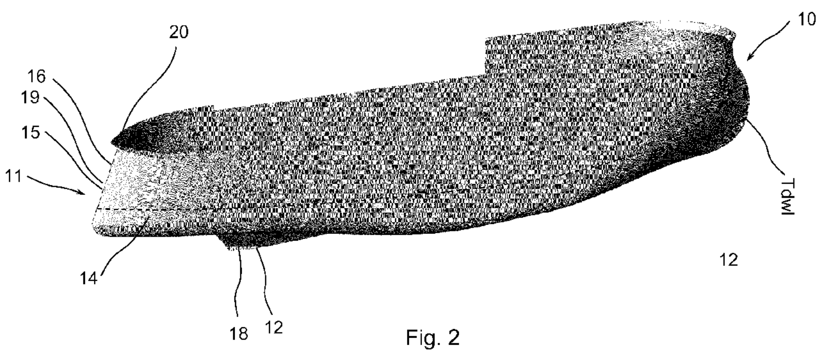

Fig. 2

(57) **Abstract**: This relates to vessels in general, but in particular to vessel designed to be exposed from low to medium to high waves. Both for comfort of persons, animals or fragile goods, steady sailing is preferred, without causing the waves slamming in on the vessel hull or excessive pitching of the vessel. This is also the case for service and supply vessels performing operations in relation to offshore or subsea installations. To obtain a solution to the aforementioned issues the present invention provides a vessel, wherein a stern (11) of the vessel extend below a design waterline (Tdwl), and wherein opposite side faces (14,15) of the stern (11), when seen in an opposite direction of the vessels primary sailing direction, form an acute angle under and above the design waterline (Tdwl) to decrease the vessels displacement in the rear end and are adjoined along at a line of symmetry forming a stern centerline (CL).

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VESSEL HAVING AN IMPROVED HULL SHAPE

FIELD OF THE INVENTION

The present invention relates to ocean going vessels, and in particular to an ocean going vessel with a hull shape designed to mitigate impacts on the vessel from low to medium to high waves.

BACKGROUND OF THE INVENTION

Steady sailing of vessels, or a steady state of the vessel when anchoring, are providing comfort for persons, animals or fragile goods. In particular, waves providing slamming on the vessel hull, or is providing excessive pitching of the vessel hull, may be a problem in marine operations. This is also the case for service and supply vessels performing operations in relation to offshore or subsea installations. One particular critical operation with respect to offshore situations is when a vessel is supporting a helicopter platform.

A steady motion of the vessel has been considered for aircraft carriers, where aircrafts need to be able to start and land under severe weather conditions. The solution for aircraft carriers appears to be combining the objective of steady sailing, or even in anchored state, with a desire to be able to have as many aircrafts on board as possible, and arriving at making very large vessels having large sea to deck height. In this way the vessel becomes large compared to even high waves. Moreover, because aircraft carriers, when aircrafts have to start and land, normally are facing a direction of incoming wind, this means that the bow of the aircraft carrier will always face the direction of incoming waves, since directions of incoming waves coincides with the direction of incoming wind.

Resorting to such large vessels having large sea to deck height is not a solution for leisure vessels, ordinary transport vessels, service and supply vessels as well as other types of vessels.

Hence, there is a need for an improved hull shape design of a vessel, which may provide more steady sailing with less pitching, slamming of waves and a reduced response to impact of loads from waves hitting the vessel. And not just for sailing, but also when the vessel is anchored, or in a fixed position due to subsea and offshore operations for example. Also, during sailing, it is not always possible to choose an upwind route, so a vessel needs to be steady and stable for the aforementioned reasons under any direction of incoming waves relative to the vessel´s sailing direction.

OBJECT OF THE INVENTION

In particular, it may be seen as an object of the present invention to provide a steadier and more stable vessel, where the vessel may be of any desired practical size by providing a stern design reducing drag and impact loads from slamming waves.

It is a further object of the present invention to provide an alternative to the prior art.

Other objects appear from the description, claims and Figures.

SUMMARY OF THE INVENTION

The above described object and several other objects are intended to be obtained in a first aspect of the invention by providing a displacement type of vessel comprising a rear end arrangement, which rear end consists of the part of the vessel backwards from the vessel's midship mark when seen in the vessels primary sailing direction, and which vessel has a transversely symmetrical hull shape about its center line, wherein a stern of the vessel extend below a design waterline, and wherein opposite side faces of the stern when seen in an opposite direction of the vessels primary sailing direction forms an acute angle under and above the design waterline decreasing the vessels displacement in the rear end, wherein the opposite side faces of the stern are adjoined along a line of symmetry forming a stern centerline, and wherein a vessel bottom of the rear end arrangement conforms to an engine drive propulsion system.

When compared to the known art, which e.g. are known to have a stern raised above the design waterline (Tdwl) in order to gradually raise the hull of the vessel at the rear end above the water to obtain a somewhat smooth transition from below the water and above the water. This means that the so-called transom, the area of the hull separating the hull from the water is mostly generally undefined due to the nature of the waves through which the vessel propagates. This is a fact, which technical has an effect of increasing turbulence in an area or volume behind the vessel. Also, normally a flat upright stern, which is transverse to the hull symmetry line, which is often chosen for reasons of cost and simplicity in the manufacture of the vessel. However, these known designs have been found to greatly increase the displacement of the rear end of the vessel, which result in a high degree of a slamming impact and wave impact pressure loads of waves hitting the rear end of the vessel as well as a high degree of pitching or accelerations and retardations due to the high increase in displacement of the rear end of the vessel. Moreover, a risk in very high waves of the vessel is that it may have a surfing-like ride downwards on a wave side surface which should be mitigated. This is all obtained by the features of claim 1 which result in a slender vessel having a smooth, pointed rear end, and thereby having a stern which in majority stays in the water even under high waves, which reduces the risk of surfing. Also, the slender and pointed rear end forms a smooth transition during sailing, which results in less water resistance, i.e. lower drag, which further on reduces the amount of power and fuel needed for sailing. Furthermore, the shape of the vessels rear end will distribute the impact of side wards or backwards incoming waves and will hence result in reduced slamming impact as well as impact pressure loads from incoming waves.

The centerline of a stern of the vessel above the design water line (Tdwl) may be sloped forwards in the vessels primary sailing direction. This kind of inverted-type stern further enhance the benefits described above, but also result in particular in reduced slamming of waves coming in from behind, such as during sailing at reduced speed, where the speed of the propagating waves may by similar or higher than the speed of the vessel. Also, this shape of the stern will reduce the displacement of the stern, which will result in less pitching and reduced risk of surfing.

In addition the centerline of a stern of the vessel above the design water line (Tdwl) may have a convex-shape or be straight. Hereby a decreasing buoyancy increase is provided. Further, the side faces of the stern may have a substantial convex-like configuration. The stern having a convex-shaped or straight centerline and side faces forming an acute angle, provides less pitching, slamming of waves and a reduced response to impact loads from waves hitting the stern area of the vessel.

Further, frame lines of the stern may be outwardly sloping from the design water line (Tdwl) and run upwards in a convex-like shape gradually back towards the center line (CL), so as to provide a decreasing buoyancy increase in the upward direction of a the stern in combination with the shape of the centerline of the stern.

The shape of the stern may be outwardly sloping from the design water line (Tdwl) to create at least a lower portion of the stern which is concave, and wherein the shape of the stern runs upwardly in a convex-like shape, and following gradually and upwardly runs back towards the center line (CL), so as to provide a decreasing buoyancy increase, in the upward direction of a major part of the stern, by a combination of the convex-like shape of the centerline of the stern and the shape of the stern. These aspects will again reduce the displacement of the stern, which will result in less pitching and reduced risk of surfing.

The centerline of the stern may rise and has a substantially increasing curvature in the forward direction of the vessel in a lower part of the stern and in an upper part continues to rise with a substantially diminishing curvature. This will have both a bonus effect in medium or low height waves, where a the decreased displacement as described above have a number of benefits, but here also will deflect waves of a higher nature. However, without taking away the overall benefit of this aspect.

A convex-like shape of the centerline of the stern may have one or more straight portions. This will make it less costly to manufacture the vessel as rounded, double curvature hull parts are more time consuming and complex to manufacture.

A spray board may extend out from an uppermost part of the stern. This will reduce an amount of so-called green water splashing and spraying in over the stern and may cause hazards for persons working on the deck of the vessel.

At an upper portion of the stern located at above midway between the design waterline (Tdwl) and the top of the stern, the vessels have flare angles of the stern are in the range of 5 — 50 degrees relative to a vertical direction. Also, the stern centerline may have a curvature at an upper part of the stern upwardly increases from around 0 degrees to around 60 degrees relative to a vertical direction. It is hereby obtained, that when very high forces stemming from the waves and lower part of the hull has reduced pitching and overall operation enhancing general motions, that when the vessel plunges deeply, that there in an increase in displacement which prevent overly deep plunges for reasons of safety.

The vessel may comprises a foreship arrangement, which foreship consists of the part of the ship in front of the vessels midship mark, when seen in the vessels primary sailing direction, and which vessel has a transversely symmetrical hull shape about its center line (CL) and a substantially conventional form below its design water line (Tdwl), wherein a centerline of a bow of the vessel by the design water line (Tdwl) is curved backwards in the vessels primary sailing direction, and wherein a shape of the bow is outwardly sloping from the design water line (Tdwl) to create at least a lower portion of the bow, which is concave, and wherein the shape of the bow runs upwardly in a curved shape, which gradually runs back towards the center line of the vessel (CL) to create an upper portion, which is convex, so as to provide a decreasing buoyancy increase, in the upward direction of a major part of the bow, by a combination of the curvature of the centerline of the stern and the shape of the stern. It is hereby obtained that both the stern and the bow may provide steady sailing, which contributes to the comfort of persons, animals or fragile goods, steady sailing is preferred, in particular without the waves slamming in on the vessel hull or excessive pitching of the vessel. Moreover the vessel according to the invention may be used in case of service and supply vessels performing operations in relation to offshore or subsea installations, where it is necessary to keep the vessel in a stationary position for loading or offloading items or being connected to a subsea installation or facility, or performing a subsea operation. In such situations where the vessel is stationary, the wave direction may change during the operation, whereby both an improved stern as well as an improved bow design may have a combined beneficiary vessel shape.

Respective aspects of the present invention may each be combined with any of the other aspects. These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

BRIEF DESCRIPTION OF THE FIGURES

The vessel according to the present invention will now be described in more detail with reference to the accompanying figures. The accompanying figures illustrates examples of embodiments of the present invention and is not to be construed as being limiting to other possible embodiments falling within the scope of the attached claim set.

Figure 1 illustrates a side view of an example of embodiment of the present invention.

Figure 2 illustrates a perspective view of an example of embodiment of the present invention.

Figure 3 illustrates a frame line view of a rear part of an example of embodiment of the present invention.

Figure 4 illustrates a frame line side view of an example of embodiment of the present invention.

DETAILED DESCRIPTION OF AN EMBODIMENT

Figure 1 illustrates a side view of an example of a vessel design according to the present invention. The illustrated vessel is a displacement type of vessel comprising a rear end arrangement or stern 11 and a bow 10. With reference to Figure 4 a more detailed illustration of the rear end arrangement 11 is outlined. The rear end arrangement or stern is symmetrically shaped around a center line (CL). A bulb arrangement 12 is arranged on a bottom surface of the stern providing an outlet position on the hull of the vessel for a propeller shaft (not illustrated). In Figure 4 there is also illustrated an opening 13 wherein the propeller shaft may extend out from the hull into free water below the vessels bottom surface 17. As indicated in Figure 4, the stern may extend below a design water line (Tdwl) and the bottom surface conforms to an engine driven propulsion system 18 below the rear end of a below water vessel bottom 17, when in use.

In Figure 4 the shape of the stern centerline above the design water line (Tdwl) is convex-like shape. The center line may also incorporate straight sections as shown in figure 1 and 2. Figure 4 further shows how frame lines 21 of the stern are outwardly sloping from the design water line (Tdwl) and how the frame lines 21 run upwards in a convex-like shape and gradually backwards towards the center line (CL) when the vessel is seen in cross-section.

An aspect of the present invention is to reduce the buoyancy of the stern compared to a more traditional design of sterns in the prior art. In the example illustrated in Figure 2 it is illustrated how side surfaces 14, 15 are adjoined along a line of symmetry forming a stern centreline 16, wherein the side surfaces 14, 15 form an acute angle under and above the design waterline Tdwl thereby decreasing the vessels displacement volume in the rear end 11 compared to many prior art designs.

In another example of embodiment of the present invention the stern centerline 16 from the design water line Tdwl is sloped forward in the vessels primary sailing direction. This design contributes also to decrease the vessels displacement volume in the rear end 11. In addition, the sloping may also provide a changing buoyancy sine the sloping is providing a gradual decreasing of the displacement volume of the stern hull in upward direction from the design water line Tdwl.

In another example of embodiment of the present invention a shape of the stern hull is arranged to be outwardly sloping from the design water line Tdwl thereby providing that at least a lower portion of the stern hull is concave in shape, and wherein the hull shape of the stern hull runs upwardly in a convex-like hull shape, and is following gradually and upwardly back towards the center line (CL), so as to provide a decreasing buoyancy increase, in the upward direction of a major part of the stern, by a combination of the convex-like shape of the centerline of the stern and the shape of the stern.

In another example of embodiment of the present invention the centerline 16 of the stern 11 rises and has a substantially increasing curvature in the forward direction of the vessel in a lower part of the stern and in an upper part continues to rise with a substantially diminishing curvature. Examples of respective possible curvatures are illustrated in Figure 4. The examples of angles are non-limiting values. In an example of embodiment the stern centerline curvature at an upper part of the stern increases upwardly from around 0 degrees to around 60 degrees relative to a vertical direction.

It is further possible to arrange one or more straight portions 19 of the stern centerline 16. It is also possible to add a spray board 20 on an uppermost part of the stern.

In another example of embodiment of the present invention an upper portion of the stern at an upper portion located above midway between the design waterline (Tdwl) and the top of the stern, the vessels have flare angles of the stern are in the range of 5 — 50 degrees relative to a vertical direction.

In another example of embodiment of the present invention, the hull below the design waterline (Tdwl) forms a bend or knuckle between a bottom of the hull and the stern, which bend or knuckle is of a smaller curvature than a lowest curvature of the centerline of the stern.

According to another example of embodiment of the present invention the vessel may comprise a foreship arrangement, which foreship consists of the part of the ship in front of the vessels midship mark, when seen in the vessels primary sailing direction, and which vessel has a transversely symmetrical hull shape about its center line (CL) and a substantially conventional form below its design water line (Tdwl), wherein a centerline of a bow of the vessel by the design water line (Tdwl) is curved backwards in the vessels primary sailing direction, and wherein a shape of the bow hull is outwardly sloping from the design water line (Tdwl) to provide at least a lower portion of the bow hull to be concave in shape, and wherein the shape of the bow hull runs upwardly in a curved shape, which gradually runs back towards the center line of the vessel (CL) thereby providing an upper portion, which is convex, so as to provide a decreasing buoyancy increase, in the upward direction of a major part of the bow, by a combination of the curvature of the centerline of the stern and the shape of the stern. It is also within the scope of the present invention that the bow hull of the vessel may comprise a bulbous bow below the design water line (Tdwl), and/or a knuckle or beak above the design water line Tdwl.

Embodiments of the present invention may be applied in all kinds of displacement type of vessels. Within this concept it is also important to note that the term “displacement” refers to situations where the stern is submerged into the water. This can also be the case with semi planning ship designs and is therefore within the scope of the present invention.

Embodiments of the present invention are beneficial to use in vessels engaged in service and supply operations of offshore facilities. This includes loading or offloading of items from the vessel to and from an offshore facility. Further, the use of embodiments of the present invention includes stationary subsea operations, during which the vessel is connected to a subsea facility or is involved in repair, maintenance or installation of a subsea facility. Embodiments of the present invention are further beneficial on vessels supporting helicopter platforms.

An aspect of the present invention, besides providing better sea going qualities of vessels in low to medium to high wave height, is that it is possible to manufacture vessels with lower sea to deck height when mitigating possible problems with high wave heights facing ocean going vessel designs.

Although the present invention has been described in connection with the specified embodiments, it should not be construed as being in any way limited to the presented examples. The scope of the present invention is set out by the accompanying claim set. In the context of the claims, the terms “comprising” or “comprises” do not exclude other possible elements or steps. Also, the mentioning of references such as “a” or “an” etc. should not be construed as excluding a plurality. The use of reference signs in the claims with respect to elements indicated in the figures shall also not be construed as limiting the scope of the invention. Furthermore, individual features mentioned in different claims, may possibly be advantageously combined, and the mentioning of these features in different claims does not exclude that a combination of features is not possible and advantageous.

Claims:

1.

A displacement type vessel comprising a rear end arrangement for reducing wave impact loads on the vessel, which rear end consists of the part of the vessel backwards from the vessel's midship mark, when seen in the vessels primary sailing direction, and which vessel has a transversely symmetrical hull shape about its center line (CL), and a vessel bottom (17) of the rear end arrangement conforms to an engine driven propulsion system (18), **characterized in that** a stern (11) of the vessel extend below a design waterline (Tdwl), wherein opposite side faces (14, 15) of the stern (11), when seen in an opposite direction of the vessels primary sailing direction, form an acute angle under and above the design waterline (Tdwl) to decrease the vessels displacement in the rear end, the opposite side faces being adjoined along at a line of symmetry forming a stern centerline (16), wherein the stern centerline of the vessel above the design water line (Tdwl) has a non-concave shape and is sloped forwards in the vessels primary sailing direction, and wherein frame lines (21) of the stern are outwardly sloping from the design water line (Tdwl) and run upwards in a convex-like shape gradually back towards the center line (CL) thereby providing side faces of the stern have a substantial convex-like configuration, so as to provide a decreasing buoyancy increase in the upward direction of a the stern in combination with the shape of the centerline of the stern.

2.

The vessel according to claim 1, wherein the centerline of the stern rises and has a substantially increasing curvature in the forward direction of the vessel in a lower part of the stern and in an upper part continues to rise with a substantially diminishing curvature.

3.

The vessel according to any preceding claim, wherein the centerline of the stern is arranged with one or more sections (19) that are straight.

4.

The vessel according to any preceding claim, wherein a spray board (20) arranged in an uppermost part of the stern is extending outwards from the stern.

5.

The vessel according to any of preceding claim, wherein at an upper portion located above midway between the design waterline (Tdwl) and the top of the stern, the vessels have flare angles of the stern are in the range of 5 — 50 degrees relative to a vertical direction.

6.

The vessel according to any preceding claim, wherein a curvature of the stern centerline located at an upper part of the stern increases from around 0 degrees to around 60 degrees in an upwardly direction relative to a vertical direction.

7.

The vessel according to any preceding claim, wherein the hull below the design waterline (Tdwl) forms a bend or knuckle between a bottom of the hull and the stern, which bend or knuckle is of a smaller curvature than a lowest curvature of the centerline of the stern.

8.

The vessel according to any preceding claim, wherein the vessel comprises a foreship arrangement, which foreship consists of the part of the ship in front of the vessels midship mark, when seen in the vessels primary sailing direction, and which vessel has a transversely symmetrical hull shape about its center line (CL) and a substantially conventional form below its design water line (Tdwl), wherein a centerline of a bow of the vessel by the design water line (Tdwl) is curved backwards in the vessels primary sailing direction, and wherein a shape of the bow is outwardly sloping from the design water line (Tdwl) to create at least a lower portion of the bow, which is concave, and wherein the shape of the bow runs upwardly in a curved shape, which gradually runs back towards the center line (CL) of the vessel to create an upper portion, which is convex, so as to provide a decreasing buoyancy increase, in the upward direction of a major part of the bow, by a combination of the curvature of the centerline of the stern and the shape of the stern.

9.

The vessel according to claim 8, wherein the vessel bow comprises a bulbous bow below the design water line (Tdwl), or a knuckle or beak above the design water line (Tdwl).

10.

The vessel according to any preceding claim, wherein there is arranged a helicopter platform on the vessel.

Fig. 1

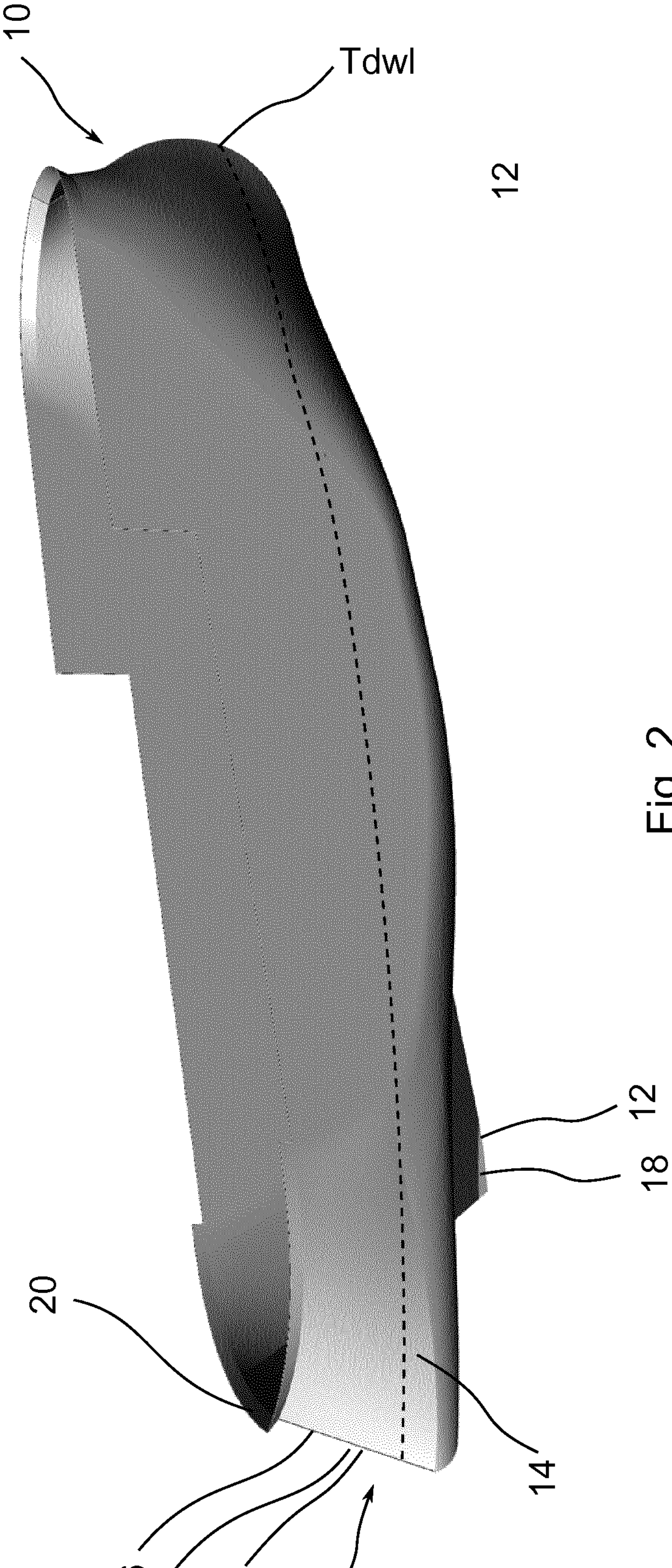

Fig. 2

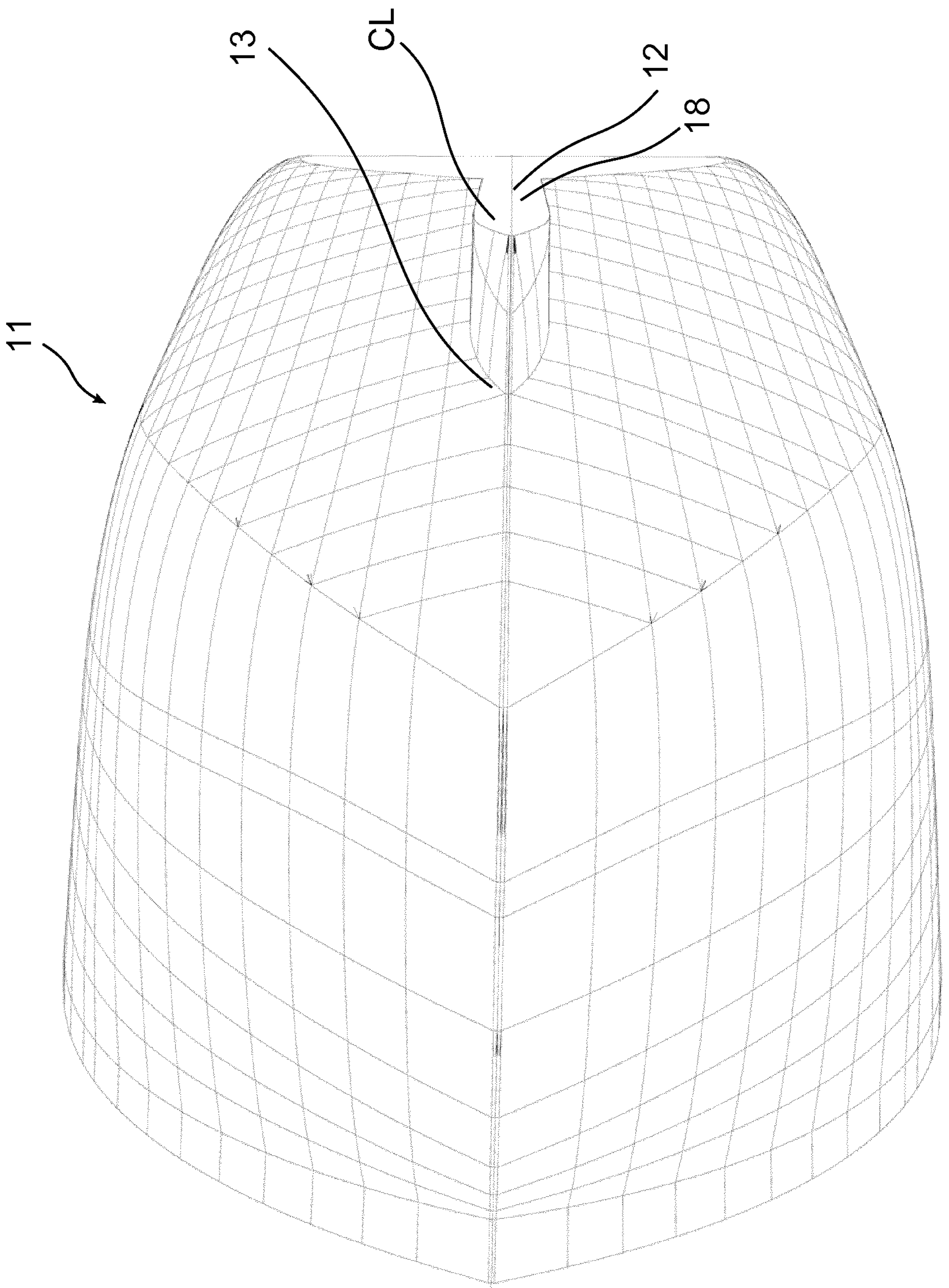

Fig. 3

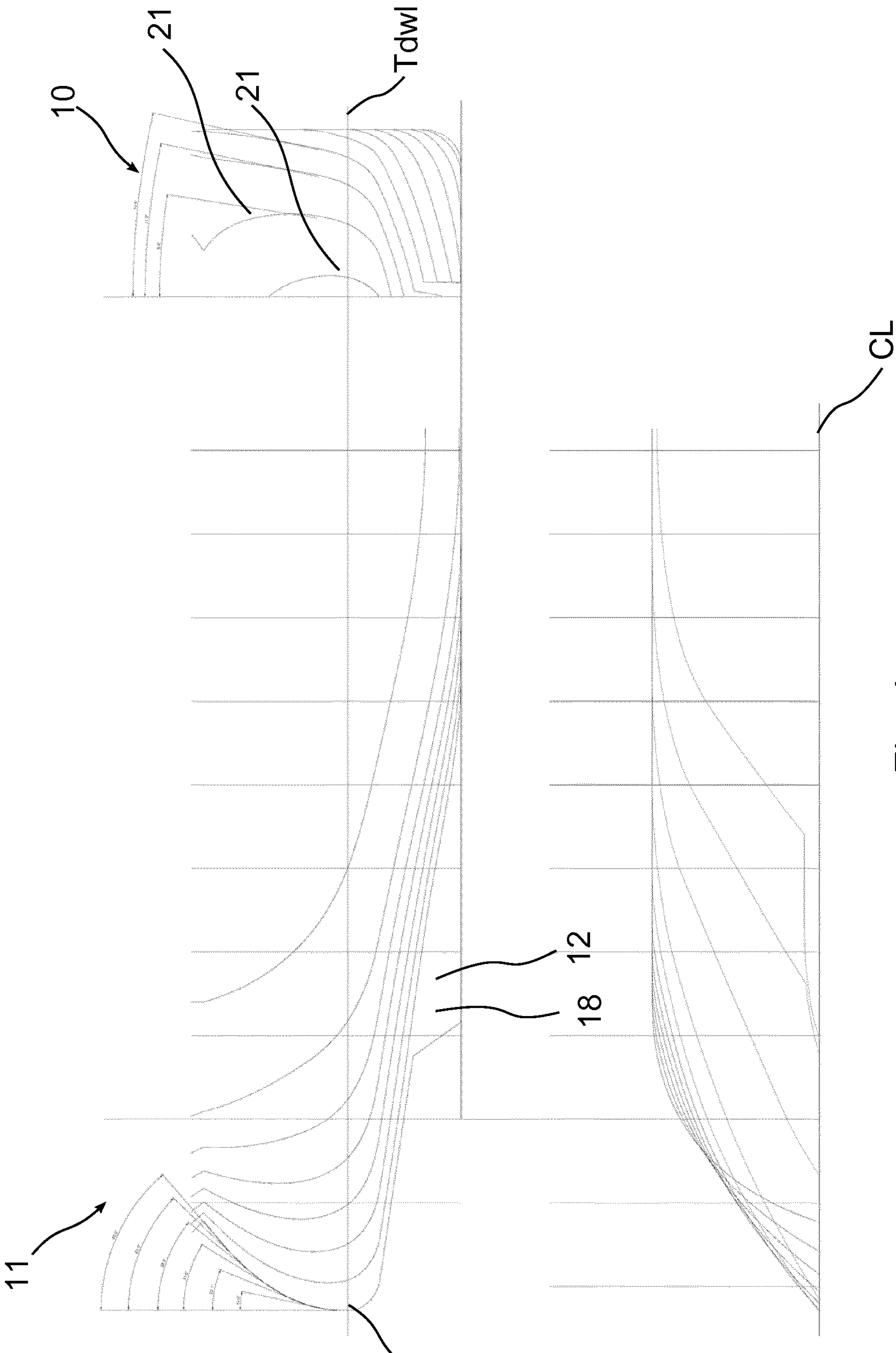

Fig. 4