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(54) **WATERCRAFT**

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a watercraft, and in particular an outrigger stabilised watercraft.

[0002] Watercraft with a catamaran arrangement (i.e. with two symmetrical hulls which are joined together) are well known in the art. However, when such watercraft are used in rough water conditions, the craft may have poor seakeeping, and be subject to large movements in response to waves. In order to improve seakeeping, small waterplane area twin hull (SWATH) vessels can be used. However, such crafts are typically sensitive to changes in loading of the watercraft, for example when being used to transport heavy equipment. This may cause the trim of the craft to be affected, and may make it impractical for such craft to carry large payloads.

[0003] Monohull boats are known to have improved response to changes in loading. The drag of monohull boats can be reduced by making the hull shape more slender (i.e. increasing its length relative to its width, or beam). Such boats may be provided with an outrigger which is used to stabilise the boat. Such a boat may be known as a "proa" configuration boat. However, such boats may have high drag in the water due to the outrigger, and reduced efficiency. FR 2 978 420 and FR 2 534 874 disclose various arrangements of boats with outriggers.

[0004] It is an aim of the present invention to at least partially address the problems noted above.

SUMMARY OF THE INVENTION

[0005] According to the present invention as claimed, there is provided a motorised outrigger stabilised watercraft comprising a main hull extending in a fore-aft direction, a single outrigger arranged to stabilise the main hull, extending substantially parallel to the main hull and spaced laterally from the main hull and at least one hydrofoil mounted at or proximate the stern of the main hull. This may provide good seakeeping, improved response to changes in loading, and low drag, resulting in improved fuel efficiency. The outrigger may also allow a more slender hull to be used, which may also reduce drag, whilst the presence of the outrigger may provide improved static stability even when a slender hull is used.

[0006] The hydrofoil is dynamically adjustable and arranged to apply a variable force to the main hull. This may provide improved response to changes in loading and improve seakeeping of the watercraft, and allow control of the trim of the watercraft.

[0007] Optionally, the outrigger is a small waterplane area hull. This may reduce drag whilst maintaining stability.

[0008] According to the invention, the outrigger comprises a first portion arranged to be submerged below the waterline during operation. This may provide buoy-

ancy whilst avoiding a large increase in drag.

[0009] The outrigger comprises a joining portion joining the first portion to the watercraft. The joining portion has a width perpendicular to the fore-aft direction which is less than that of the first portion. The joining portion may also have a length which is shorter in the fore-aft direction than the first portion. This may provide a small waterplane area, which may reduce drag.

[0010] The outrigger further comprises a second portion arranged to float during operation. The joining portion joins the first portion to the second portion.

[0011] Optionally, the watercraft further comprises an arm connecting the second portion to the main hull.

[0012] Optionally, the first portion has substantially the same length as the second portion in the fore-aft (or front-rear) direction.

[0013] Optionally, the length of the outrigger parallel to the fore-aft direction is between 25% and 80% of the length of the main hull, preferably between 30% and 75% of the length of the main hull.

[0014] Optionally, the extent of the outrigger in the fore-aft direction is between the stern and a point 80% of the total length of the main hull forward of the stern.

[0015] Optionally, the hydrofoil is mounted aft of the stern.

[0016] Optionally, the dynamically adjustable hydrofoil mounted at or proximate the stern of the main hull is arranged to be adjusted such that the hydrofoil supports between 0% and 30% of the total displacement of the vessel, preferably between 0% and 20% of the total displacement of the vessel.

[0017] Optionally, the hydrofoil comprises a main hydrofoil body and a trailing edge flap arranged to move relative to the main body to thereby vary the force applied to the main hull. This may provide improved control over the lift produced by the hydrofoil. In some arrangements, more than one trailing edge flap may be provided.

[0018] The angle of attack of the hydrofoil is adjustable to thereby vary the force applied to the main hull. This may provide improved control over the lift produced by the hydrofoil.

[0019] Optionally, the hydrofoil is retractable. This may prevent damage to the hydrofoil when it is not in use and/or during shallow water operation.

[0020] Optionally, the width of the hydrofoil is larger than the beam of the main hull.

[0021] Optionally, the hydrofoil is further joined to the outrigger. This may increase the lift of the hydrofoil and improve seakeeping.

[0022] Optionally, the hydrofoil is arranged to control the trim of the watercraft.

[0023] Optionally, the hydrofoil is arranged to compensate for changes in loading of the watercraft.

[0024] Optionally, the main hull comprises a plurality of hydrofoils.

[0025] Optionally, the outrigger further comprises at least one hydrofoil. This may provide improved control over roll of the watercraft.

[0026] Optionally, the hydrofoil located on the outrigger is dynamically adjustable and arranged to apply a variable force to the outrigger. This may allow the roll response of the watercraft to be adjusted.

[0027] Optionally, the hydrofoil located on the outrigger is located at or proximate the stern of the first portion.

[0028] Optionally, the hydrofoil located on the outrigger extends toward the main hull.

[0029] Optionally, the hydrofoil located on the outrigger is arranged to control roll of the watercraft.

[0030] Optionally, the main hull supports 70% or more of the total static displacement of the watercraft, preferably 70% to 95% of the total static displacement of the watercraft.

[0031] Optionally, the outrigger supports 30% or less of the total static displacement of the watercraft, preferably 5% to 30% of the total static displacement of the watercraft.

[0032] Optionally, the watercraft further comprises a control system arranged to dynamically adjust the hydrofoil. The control system may optionally comprise an inertial measurement unit.

[0033] Optionally, the watercraft further comprises a motorised propulsion device arranged to propel the watercraft, wherein the motorised propulsion device is positioned forward of the hydrofoil in the fore-aft direction.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034] The present invention will now be described, by way of non-limitative example only, with reference to the accompanying drawings, in which:

Figure 1 shows a perspective view of a watercraft according to the present invention;

Figure 2 shows a second perspective view of a watercraft according to the present invention;

Figure 3 shows a third (rear) perspective view of a watercraft according to the present invention;

Figure 4 shows a profile view of a watercraft according to the present invention;

Figure 5 shows a plan view of a watercraft according to the present invention;

Figure 6 shows a frontal view of a watercraft according to the present invention;

Figure 7 shows a first perspective view of a watercraft according to the present invention including a small waterplane area hull outrigger;

Figure 8 shows a second perspective view of a watercraft according to the present invention including a small waterplane area hull outrigger;

Figure 9 shows a third (rear) perspective view of a watercraft according to the present invention including a small waterplane area hull outrigger;

Figure 10 shows a profile view of a watercraft according to the present invention including a small waterplane area hull outrigger;

Figure 11 shows a plan view of a watercraft according to the present invention including a small waterplane area hull outrigger;

Figure 12 shows a frontal view of a watercraft according to the present invention including a small waterplane area hull outrigger; and

Figure 13 shows a modified version of the watercraft of Figure 3 with the hydrofoil extending to the outrigger.

DETAILED DESCRIPTION

[0035] The present invention relates to an outrigger stabilised watercraft. As shown in Figure 1, the watercraft comprises a main hull 10 and an outrigger 11. The main hull 10 extends in a fore-aft direction, and the outrigger 11 extends substantially parallel to this direction, spaced laterally (i.e. separated in a direction perpendicular to the fore-aft direction) from the main hull 10. The outrigger 11 is a single outrigger. That is, the watercraft has only one outrigger and does not have a second outrigger, as in the case of a trimaran. The main hull 10 and the outrigger 11 are joined by an arm 17. The watercraft further comprises a hydrofoil 12 mounted at or proximate the stern of the main hull 10, as shown in Figure 2. During operation, the hydrofoil 12 is submerged (i.e. below the waterline) so that flow around the hydrofoil causes a resultant lift force, which is in turn transmitted to the main hull 10. The watercraft (and thus the main hull) may be used in a displacement mode, a semi-planing mode, or a fully planing mode, and may transition between these modes, depending, for example, on the speed of the vessel.

[0036] In the configuration shown in Figures 1-6, it will be noted that the hydrofoil is shown as mounted aft of the stern (i.e. aft of the transom, or the rear-most part of the main hull 10). However, it will be understood that the hydrofoil 12 (which may be referred to as the main hull hydrofoil 12) may also be located at a position near, but not at the rear-most part, (i.e. the stern) of the main hull 10. For example, the hydrofoil may be located at a position in the rear 25% of the main hull 10. It will also be understood that the point at which the hydrofoil is mounted (i.e. attached) to the main hull 10 may be the same in the front-rear (i.e. fore-aft) direction as the position in the front-rear direction of the hydrofoil itself, or that these two locations may be offset from each other. For example, the hydrofoil 12 may be mounted to the main hull 10 using struts, which may extend vertically downwards, or at a

different angle to the vertical.

[0037] In the arrangement shown in Figures 1-6 (which is not according to the claimed invention), the outrigger has the form of a conventional displacement hull, in which the lower part of the outrigger hull is submerged, and the upper part of the outrigger hull is above the waterline. In other words, the hull of the outrigger 11 can be considered to act like a small displacement hull, being smaller than the main hull 10. However, as will be described below, other arrangements of outrigger 11 are possible, such as the arrangement shown in Figures 7-12.

[0038] In the arrangement shown in Figures 7-12, the outrigger 11 has the form of a small waterplane area hull. The small waterplane area hull comprises a first portion 13 which is completely submerged during operation. This portion may be known as a "submarine" portion. The small waterplane area hull may further comprise a joining portion 14 joining the first portion to the rest of the watercraft. In particular, the joining portion 14 is a thin joining portion, having a width in the beamwise direction (i.e. the horizontal direction perpendicular to the fore-aft direction) that is smaller than that of the first portion 13. That is, in the view shown in Figure 12, the width of the joining portion 14 is less than that of the first portion 13. The joining portion may also have a length which is shorter in the fore-aft direction than the first portion. In some arrangements, the length of the joining portion may vary with height. During normal operation, the thin joining portion is at the waterline, which provides a small cross sectional area at the waterline. This provides the "small waterplane area" of this hull type.

[0039] The small waterplane area hull further comprises a second portion 15 which is above the waterline, and may float (during operation). The second portion 15 may come into contact with the water, and thus float, producing a righting moment, when the boat is at a large heel (i.e. list) angle. Such a large heel angle may occur due to wave motion, or during a turn in the direction which causes the main hull 10 to roll towards the outrigger 11. The second portion is joined to the first portion by the joining portion, and the second portion may be joined to the rest of the watercraft by the arm 17. It will also be understood that the second portion 15 may be omitted. When the second portion 15 is omitted, the joining portion 14 may be joined directly to the arm 17.

[0040] As best seen in Figure 7, the first portion 13 of the outrigger and the second portion 15 of the outrigger may have substantially the same length as each other in the front-rear direction. Alternatively, in some arrangements, the lengths of the first portion 13 and the second portion 15 may be different to each other. For example, the first portion 13 may be longer than the second portion 15. These relative lengths can be varied according to the desired volume of the first portion 13, which may be chosen depending on the distance between the outrigger 11 and the main hull 10.

[0041] Conventionally, small waterplane area hulls are typically used in vessels with a small waterplane area

twin hull (SWATH) configuration, with two hulls of this type joined together. However, the present invention provides arrangements in which only the outrigger 11 has a small waterplane area hull, and the main hull 10 has a different hull form. For example, the configuration of the arrangement of outrigger stabilised watercraft shown in Figures 7-12 has an outrigger 11 with a small waterplane area hull configuration, and a main hull 10 with a conventional hull.

[0042] The combination of a conventional hull 10 (such as a displacement hull, a semi-displacement/semi-planing hull, or a planing hull) with a small waterplane area outrigger may give particularly good stability and sea-keeping, for example in rough water conditions, whilst allowing changes in loading (e.g. from cargo) to be accommodated without the trim or efficiency of the vessel being compromised. Further, this configuration, when combined with the hydrofoil 12 mounted at or proximate the stern of the main hull 10, may give particularly good seakeeping due to the effect of the hydrofoil, whilst at the same time reducing fuel consumption due to the reduced drag associated with a small waterplane area hull outrigger. Further still, the use of an outrigger may allow the main hull to be longer than that of a conventional catamaran for a given construction area (i.e. amount of material used in the construction) or deck area, which may in turn reduce resistance and improve seakeeping.

[0043] It will be understood that all of the options and variations as set out below are equally applicable to the embodiments of hull and outrigger shown in Figures 1-6 and 7-12.

[0044] The main hull 10 may have a slender hull shape. In some arrangements, the outrigger 11 and hydrofoil 12 may allow the use of main hull shapes which, due to their slenderness (which can be measured by the ratio of length to displacement or length to beam) would otherwise be unstable and impractical to use. That is, the outrigger 11 and hydrofoil arrangement of the present invention may allow the reduced drag that such slender hull shapes provide, whilst providing increased stability and improved seakeeping.

[0045] In some arrangements, the hydrofoil 12 may be dynamically adjustable. In other words, the position of the hydrofoil when submerged in the water may be varied, such that it applies a variable force to the main hull 10. This may allow yet improved seakeeping, and may allow the trim of the boat to be actively controlled, in response to, for example, changes in water conditions (e.g. waves) and/or changes in loading of the boat due to, for example, the cargo being carried.

[0046] During operation, the main hull hydrofoil 12 may typically support between 0% and 30% of the total displacement (i.e. weight of the vessel), and preferably between 0% and 20% of the total displacement of the vessel. It will be understood that, when a dynamically adjustable hydrofoil 12 is used, the proportion of the displacement of the vessel supported by the hydrofoil (i.e. the force applied to the main hull 10 by the hydrofoil 12)

may vary as the hydrofoil is dynamically adjusted. In some circumstances, the hydrofoil 12 may also provide a negative lift. For example, in some arrangements, the hydrofoil 12 at the stern of the main hull 10 may typically support between -30% and 30% of the total displacement, depending on the water conditions.

[0047] In some arrangements, the hydrofoil 12 may comprise a main hydrofoil body and a trailing edge flap arranged to move relative to the main hydrofoil body. In this arrangement, the main hydrofoil may be fixed. The trailing edge flap may be moved relative to the main body to provide dynamic adjustment of the force applied to the main hull 10 by the hydrofoil 12. Further, in some arrangements, multiple trailing edge flaps may be used on the hydrofoil 12 along its length (i.e. along the span of the hydrofoil). This may provide improved control over the force applied by the hydrofoil and thus over the displacement of the vessel carried by the hydrofoil 12, by allowing the lift produced by the hydrofoil to be varied along its span. In particular this may allow roll and trim to be independently controlled.

[0048] Alternatively or additionally, the angle of attack of the hydrofoil 12 itself may be variable. In other words, the position (or angle) of the hydrofoil when submerged may be varied such that the force applied to the main hull 10 by the hydrofoil 12 changes.

[0049] In some arrangements, the hydrofoil 12 may be arranged so that it can move to a position out of the water when the vessel is in the water. For example, the hydrofoil may be arranged to rotate aft about a pivot point such that it is lifted out of the water. The hydrofoil may also be retractable into the main hull 10 or to a position near the main hull. In the retracted position the foil may preferably still be below the waterline, though a retracted position at or above the waterline is possible. This may allow the boat to be operated in shallow water even if the water depth is such that the hydrofoil cannot be used. This may also allow the hydrofoil to be protected when not in use (e.g. when the boat is berthed, moored or otherwise stored).

[0050] In some arrangements, the span of the hydrofoil 12 (i.e. the width as shown in Figure 12) may be larger than the beam (i.e. the width) of the main hull 10. This may provide improved control over stability. In the arrangement shown in Figures 6 and 12, the hydrofoil 12 extends inboard of the main hull toward the outrigger. It will be understood that the hydrofoil may alternatively or additionally extend outboard of the main hull 10 (i.e. in a direction away from the outrigger 11, and to the left in the view shown in Figures 6 and 12).

[0051] Further, in some arrangements, and as shown in Figure 13, the hydrofoil 12 may extend from the main hull 10 to the outrigger, and be joined to the outrigger 11. In other words, the hydrofoil 12 may span between the main hull 10 and outrigger 11.

[0052] In some arrangements, a plurality of hydrofoils may be mounted on the main hull. When more than one hydrofoil is present on the main hull, each hydrofoil may

be used in any of the arrangements described above. For example, a plurality of hydrofoils may be mounted at or proximate the stern of the main hull. In such an arrangement, the hydrofoils may be mounted in the beamwise direction, with each hydrofoil being separately controllable (i.e. dynamically adjustable). In other arrangements, there may be a mixture of fixed and dynamically adjustable hydrofoils.

[0053] As shown in Figures 6 and 12, the outrigger may also comprise a hydrofoil 16. That is, as well as the hydrofoil 12 provided on the main hull, a separate hydrofoil 16 (i.e. an outrigger hydrofoil) may be provided on the outrigger 11. The outrigger hydrofoil 16 may be located at any suitable location on the outrigger. In some arrangements, the outrigger hydrofoil 16 may be located at or proximate the stern of the outrigger 11. In other arrangements, the outrigger hydrofoil may be located at or proximate the midships position of, or the centre of gravity of, the watercraft. This may provide improved roll control of the watercraft.

[0054] As described above in relation to the main hull hydrofoil 12, the angle of attack of the outrigger hydrofoil 16 may be controllable so as to vary the force applied to the outrigger by the outrigger hydrofoil 16, and/or one or more trailing edge flaps may be provided on the outrigger hydrofoil 16. It will be understood that the arrangement in Figure 13 in which the hydrofoil 12 is also connected to the outrigger 11, may also be considered as a main hull hydrofoil 12 and an outrigger hydrofoil 16 which are joined together. It will also be understood that arrangements are possible in which the main hull hydrofoil 12 extends to the outrigger 11, and the outrigger hydrofoil 16 extends to the main hull 10, such that there are two full width hydrofoils spanning between the main hull 10 and the outrigger 11. Further, one of either of the main hull hydrofoil 12 and the outrigger hydrofoil 16 may span the full width of the vessel (and thus join the outrigger or main hull respectively), and the other may span only part of the width of the vessel, and not be joined to another component. Further still, additional hydrofoils may be added such that there are three or more hydrofoils. Such additional hydrofoils may be mounted to the main hull 10, the outrigger 11, or span between both the main hull and the outrigger.

[0055] The outrigger hydrofoil 16 may be of any suitable configuration. In the arrangements shown in Figure 12, the outrigger hydrofoil 16 is located inboard of the outrigger 11. That is, the span of the outrigger hydrofoil 16 extends from the first portion of the outrigger 15 toward to main hull 10 in the beamwise direction. However, it will be understood that the hydrofoil outrigger 16 may also be provided on the outboard side of the outrigger 11 (i.e. extending in a direction away from the main hull 10). The outrigger hydrofoil 16 may provide improved control over the attitude of the watercraft, in particular, the balance (roll) of the watercraft and the heave amplitude of the outrigger. In arrangements where the outrigger hydrofoil 16 extends and is joined to the main hull, the out-

outrigger foil may carry some of the main hull weight, reducing the resistance of the vessel.

[0056] In some arrangements, one or both of the hydrofoils 12, 16 may have an anhedral or dihedral arrangement. That is, the span of the hydrofoil may not be horizontal when in use, but rather be at an angle to the horizontal. In the case of a dihedral arrangement, the hydrofoil may have two parts which slope upward, and in the case of an anhedral arrangement, the hydrofoil may have two parts which slope downward.

[0057] The watercraft may further comprise a control system arranged to provide dynamic control of the position of the hydrofoil 12, and where present, the outrigger hydrofoil 16. As explained above, the angle of attack of the hydrofoil(s) may be controlled by the control system, and/or the angle of a trailing edge flap on one or more of the hydrofoil(s) may be controlled by the control system. The control may be optimised so as to control at least one of the trim of the watercraft, rotational motions of the boat (i.e. pitch, roll and yaw), translational motions of the boat (heave, sway and surge), and/or to compensate for changes in loading of the watercraft. The control system may be arranged to provide the control above automatically and/or in response to an input by a user. The control system may use an inertial measurement unit in order to measure the state of the vessel, and command the hydrofoils accordingly. The control system may use, for example, at least one of rudder angle, input steering angle, yaw angle from the inertial measurement unit, and velocity (e.g. from a GPS unit) in order to command the hydrofoils.

[0058] The upper surface of the arm 17 may be arranged so that it forms part of the deck of the vessel. For example, it may be continuous with the deck of the main hull. This may allow a larger usable deck space, providing for increased vessel capacity.

[0059] The outrigger 11 may be of any suitable length, but is typically between 25% and 80% of the length of the main hull 10, and preferably between 30% and 75% of the length of the main hull 10. The outrigger may be positioned so that it is located between the stern of the main hull 10 and a point 80% of the total length of the main hull 10 forward of the stern.

[0060] It will be understood that the static displacement (i.e. weight) of the watercraft is carried by the main hull and the outrigger. In some arrangements, the main hull supports 70% or more of the total static displacement of the watercraft, and preferably 70% to 95% of the total static displacement. Thus, in such arrangements, the outrigger may support 30% or less of the total static displacement of the watercraft, and preferably 5% to 30% of the total static displacement. It will be understood that the proportions of the total static displacement carried by the main hull and the outrigger are not fixed, and may vary due to loading conditions (which may change due to changes in external load such as cargo, due to the use of fuel and stores, and due to the movement of the crew) and dynamically when the craft is travelling through wa-

ter.

[0061] The watercraft is a motorised watercraft (i.e. a powerboat). In such an arrangement, the watercraft may be predominantly propelled by any suitable motorised propulsion system. For example, one or more propellers, water jets or pod drives may be located on the main hull 10, in any suitable configuration. The type of propulsion system and location thereof may be chosen to take account of the position of the main hull hydrofoil 12 such that the hydrofoil and propulsion unit do not interfere with each other. In particular, in some arrangements, the propulsion system (and in particular, a propulsion device thereof) is positioned forward of the hydrofoil in the fore-aft direction, or level with the hydrofoil in the fore-aft direction. It will be appreciated that other arrangements with different relative positions of propulsion device and hydrofoil are also possible.

[0062] Further, an additional propulsion unit may be provided on the outrigger. Again, the propulsion unit on the outrigger may use any known suitable propulsion system. In arrangements with a propulsion unit on the outrigger (i.e. an additional propulsion unit), the additional propulsion unit may be used to provide extra propulsive force to propel the watercraft, and/or to provide additional manoeuvring capability (e.g. to act as a bow thruster).

[0063] The watercraft according to the present invention has been described as a monohull watercraft which is stabilised by an outrigger. However, it will be understood that the watercraft could also be considered to be an "asymmetric catamaran", with the main hull 10 and the outrigger 11 forming two hulls of a catamaran. It will be understood that the watercraft of the present invention incorporates the advantages of both monohull watercraft (which can readily accommodate changes in loading), and multi-hull watercraft, which may have improved sea-keeping characteristics and reduced drag.

[0064] It should be understood by those skilled in the art that while the present invention has been described with reference to exemplary embodiments, it is not limited to the disclosed exemplary embodiments. Various modifications, combinations, sub-combinations and alterations may occur depending on design requirements and other factors insofar as they are within the scope of the appended claims. Features from any example or embodiment of the present disclosure can be combined with features from any other example or embodiment of the present disclosure.

Claims

1. A motorised outrigger stabilised watercraft comprising:

a main hull (10) extending in a fore-aft direction;
a single outrigger (11) arranged to stabilise the main hull, extending substantially parallel to the main hull and spaced laterally from the main hull;

and
at least one hydrofoil (12) located at or proximate the stern of the main hull **characterised in that** the outrigger comprises:

a first portion (13) arranged to be submerged below the waterline during operation;
a joining portion (14) joining the first portion to the watercraft, the joining portion having a width perpendicular to the fore-aft direction which is less than that of the first portion; and
a second portion (15) arranged to float during operation, the joining portion joining the first portion to the second portion; and

wherein the angle of attack of the hydrofoil is dynamically adjustable and arranged to apply a variable force to the main hull.

2. The watercraft according to claim 1, wherein the outrigger (11) is a small waterplane area hull.
3. The watercraft according to claim 1 or 2, further comprising an arm (17) connecting the outrigger to the main hull.
4. The watercraft according to any preceding claim, wherein the first portion (13) has substantially the same length as the second portion (15) in the fore-aft direction.
5. The watercraft according to any preceding claim, wherein the length of the outrigger (11) parallel to the fore-aft direction is between 25% and 80% of the length of the main hull, preferably between 30% and 75% of the length of the main hull.
6. The watercraft according to any preceding claim, wherein the extent of the outrigger (11) in the fore-aft direction is between the stern and a point 80% of the total length of the main hull forward of the stern.
7. The watercraft according to any preceding claim, wherein the hydrofoil (12) is mounted aft of the stern.
8. The watercraft according to any preceding claim, wherein the dynamically adjustable hydrofoil (12) mounted at or proximate the stern of the main hull is arranged to be adjusted such that the hydrofoil supports between 0% and 30% of the total displacement of the vessel, preferably between 0% and 20% of the total displacement of the vessel.
9. The watercraft according to any preceding claim, wherein the hydrofoil (12) comprises a main hydrofoil body and a trailing edge flap arranged to move rel-

ative to the main body to thereby vary the force applied to the main hull.

10. The watercraft according to any preceding claim, wherein at least one of:

the hydrofoil is retractable;
the span of the hydrofoil is larger than the beam of the main hull;
the hydrofoil is further joined to the outrigger;
the hydrofoil is arranged to control the trim of the watercraft and/or to compensate for changes in loading of the watercraft; and
the main hull comprises a plurality of hydrofoils.

11. The watercraft according to any preceding claim, wherein the outrigger further comprises at least one hydrofoil (16) ;
optionally wherein the hydrofoil (16) located on the outrigger is dynamically adjustable and arranged to apply a variable force to the outrigger.

12. The watercraft according to claim 11, wherein the hydrofoil located on the outrigger is located at or proximate the stern of the first portion; and/or wherein the hydrofoil located on the outrigger extends toward the main hull and/or wherein the hydrofoil located on the outrigger is arranged to control roll of the watercraft.

13. The watercraft according to any preceding claim, wherein the main hull supports 70% or more of the total static displacement of the watercraft, preferably 70% to 95% of the total static displacement of the watercraft.

14. The watercraft according to any preceding claim, wherein the outrigger supports 30% or less of the total static displacement of the watercraft, preferably 5% to 30% of the total static displacement of the watercraft.

15. The watercraft according to any preceding claim, further comprising:

a control system arranged to dynamically adjust the hydrofoil; and/or
a motorised propulsion device arranged to propel the watercraft, wherein the motorised propulsion device is positioned forward of the hydrofoil in the fore-aft direction.

Patentansprüche

1. Motorisiertes, auslegerstabilisiertes Wasserfahrzeug, das umfasst:

- einen Haupttrumpf (10), der sich in einer Längsrichtung erstreckt;
einen einzelnen Ausleger (11), der zur Stabilisierung des Haupttrumpfes ausgelegt ist, sich im Wesentlichen parallel zum Haupttrumpf erstreckt und seitlich vom Haupttrumpf beabstandet ist; und
mindestens eine Tragfläche (12), die sich am oder in der Nähe des Hecks des Haupttrumpfes befindet, **dadurch gekennzeichnet, dass** der Ausleger Folgendes umfasst:
- einen ersten Abschnitt (13), der so ausgelegt ist, dass er während des Betriebs unter die Wasserlinie getaucht werden kann;
einen Verbindungsabschnitt (14), der den ersten Abschnitt mit dem Wasserfahrzeug verbindet, wobei der Verbindungsabschnitt eine Breite senkrecht zur Längsrichtung hat, die geringer ist als die des ersten Abschnitts; und
einen zweiten Abschnitt (15), der so ausgelegt ist, dass er während des Betriebs schwimmt, wobei der Verbindungsabschnitt den ersten Abschnitt mit dem zweiten Abschnitt verbindet; und
wobei der Anstellwinkel der Tragfläche dynamisch einstellbar und so ausgelegt ist, dass er eine variable Kraft auf den Haupttrumpf ausübt.
2. Wasserfahrzeug nach Anspruch 1, wobei der Ausleger (11) ein Rumpf mit kleiner Wasserfläche ist.
 3. Wasserfahrzeug nach Anspruch 1 oder 2, das ferner einen Arm (17) umfasst, der den Ausleger mit dem Haupttrumpf verbindet.
 4. Wasserfahrzeug nach einem der vorhergehenden Ansprüche, wobei der erste Abschnitt (13) im Wesentlichen die gleiche Länge wie der zweite Abschnitt (15) in Längsrichtung hat.
 5. Wasserfahrzeug nach einem der vorhergehenden Ansprüche, wobei die Länge des Auslegers (11) parallel zur Längsrichtung zwischen 25% und 80% der Länge des Haupttrumpfes, vorzugsweise zwischen 30% und 75% der Länge des Haupttrumpfes, beträgt.
 6. Wasserfahrzeug nach einem der vorhergehenden Ansprüche, wobei die Ausdehnung des Auslegers (11) in Längsrichtung zwischen dem Steven und einem Punkt liegt, der 80% der Gesamtlänge des Haupttrumpfes vor dem Steven ausmacht.
 7. Wasserfahrzeug nach einem der vorhergehenden Ansprüche, wobei die Tragfläche (12) achtern am Steven angebracht ist.
 8. Wasserfahrzeug nach einem der vorhergehenden Ansprüche, wobei die dynamisch einstellbare Tragfläche (12), die am oder in der Nähe des Stevens des Haupttrumpfes angebracht ist, so ausgelegt ist, dass sie so eingestellt werden kann, dass die Tragfläche zwischen 0% und 30% der Gesamtverdrängung des Schiffes, vorzugsweise zwischen 0% und 20% der Gesamtverdrängung des Schiffes, trägt.
 9. Wasserfahrzeug nach einem der vorhergehenden Ansprüche, wobei die Tragfläche (12) einen Hauptkörper der Tragfläche und eine Hinterkantenklappe umfasst, die so ausgelegt ist, dass sie sich relativ zum Hauptkörper bewegt, um dadurch die auf den Haupttrumpf ausgeübte Kraft zu verändern.
 10. Wasserfahrzeug nach einem der vorhergehenden Ansprüche, wobei mindestens eines der Folgenden gilt:
 - die Tragfläche ist einziehbar;
 - die Spannweite der Tragfläche ist größer als die Breite des Haupttrumpfes;
 - die Tragfläche ist außerdem mit dem Ausleger verbunden;
 - die Tragfläche ist dafür ausgelegt, den Trimm des Wasserfahrzeugs zu steuern und/oder Änderungen der Beladung des Wasserfahrzeugs zu kompensieren; und
 - der Haupttrumpf umfasst eine Vielzahl von Tragflächen.
 11. Wasserfahrzeug nach einem der vorhergehenden Ansprüche, wobei der Ausleger ferner mindestens eine Tragfläche (16) umfasst; wobei optional die Tragfläche (16), die sich auf dem Ausleger befindet, dynamisch einstellbar und dafür ausgelegt ist, eine variable Kraft auf den Ausleger auszuüben.
 12. Wasserfahrzeug nach Anspruch 11, wobei die auf dem Ausleger befindliche Tragfläche am oder in der Nähe des Stevens des ersten Abschnitts angeordnet ist; und/oder
wobei sich die am Ausleger befindliche Tragfläche in Richtung des Haupttrumpfes erstreckt und/oder wobei die am Ausleger befindliche Tragfläche so ausgelegt ist, dass sie das Rollen des Wasserfahrzeugs kontrolliert.
 13. Wasserfahrzeug nach einem der vorhergehenden Ansprüche, wobei der Haupttrumpf 70% oder mehr der gesamten statischen Verdrängung des Wasserfahrzeugs trägt, vorzugsweise 70% bis 95% der gesamten statischen Verdrängung des Wasserfahrzeugs.
 14. Wasserfahrzeug nach einem der vorhergehenden

Ansprüche, wobei der Ausleger 30% oder weniger der gesamten statischen Verdrängung des Wasserfahrzeugs trägt, vorzugsweise 5% bis 30% der gesamten statischen Verdrängung des Wasserfahrzeugs.

15. Wasserfahrzeug nach einem der vorhergehenden Ansprüche, das ferner umfasst:

ein Steuersystem, das dafür ausgelegt ist, die Tragfläche dynamisch einzustellen; und/oder eine motorisierte Antriebsvorrichtung, die dafür ausgelegt ist, das Wasserfahrzeug anzutreiben, wobei die motorisierte Antriebsvorrichtung vor der Tragfläche in Längsrichtung angeordnet ist.

Revendications

1. Bateau stabilisé par stabilisateur comprenant :

une coque principale (10) s'étendant dans une direction avant-arrière ;
un stabilisateur unique (11) agencé pour stabiliser la coque principale, s'étendant sensiblement parallèlement à la coque principale et espacé latéralement de la coque principale ; et
au moins un hydroptère (12) situé au niveau ou à proximité de la poupe de la coque principale, **caractérisé en ce que** le stabilisateur comprend :

une première partie (13) agencée pour être immergée sous la ligne de flottaison pendant le fonctionnement ;
une partie de jonction (14) joignant la première partie au bateau, la partie de jonction ayant une largeur perpendiculaire à la direction avant-arrière qui est inférieure à celle de la première partie ; et
une seconde partie (15) agencée pour flotter pendant le fonctionnement, la partie de jonction joignant la première partie à la seconde partie ; et
dans lequel l'angle d'attaque de l'hydroptère est réglable dynamiquement et conçu pour appliquer une force variable à la coque principale.

2. Bateau selon la revendication 1, dans lequel le stabilisateur (11) est une petite coque d'hydravion.
3. Bateau selon la revendication 1 ou 2, comprenant en outre un bras (17) reliant le stabilisateur à la coque principale.
4. Bateau selon l'une quelconque des revendications précédentes, dans lequel la première partie (13) a

sensiblement la même longueur que la seconde partie (15) dans la direction avant-arrière.

5. Bateau selon l'une quelconque des revendications précédentes, dans lequel la longueur du stabilisateur (11) parallèle à la direction avant-arrière est comprise entre 25 % et 80 % de la longueur de la coque principale, de préférence entre 30 % et 75 % de la longueur de la coque principale.

6. Bateau selon l'une quelconque des revendications précédentes, dans lequel l'étendue du stabilisateur (11) dans la direction avant-arrière se situe entre la poupe et un point situé à 80 % de la longueur totale de la coque principale en avant de la poupe.

7. Bateau selon l'une quelconque des revendications précédentes, dans lequel l'hydroptère (12) est monté à l'arrière de la poupe.

8. Bateau selon l'une quelconque des revendications précédentes, dans lequel l'hydroptère réglable dynamiquement (12) monté au niveau ou à proximité de la poupe de la coque principale est agencé pour être ajusté de telle sorte que l'hydroptère supporte entre 0 % et 30 % du déplacement total du bateau, de préférence entre 0% et 20% du déplacement total du bateau.

9. Bateau selon l'une quelconque des revendications précédentes, dans lequel l'hydroptère (12) comprend un corps principal d'hydroptère et un volet de bord de fuite agencé pour se déplacer par rapport au corps principal pour ainsi faire varier la force appliquée à la coque principale.

10. Bateau selon l'une quelconque des revendications précédentes, dans lequel au moins l'un des éléments suivants est présent :

l'hydroptère est rétractable ;
l'envergure de l'hydroptère est plus grande que la largeur de la coque principale ;
l'hydroptère est en outre relié au stabilisateur ;
l'hydroptère est agencé pour contrôler l'assiette du bateau et/ou pour compenser les changements de charge du bateau ; et
la coque principale comprend une pluralité d'hydroptères.

11. Bateau selon l'une quelconque des revendications précédentes, dans lequel le stabilisateur comprend en outre au moins un hydroptère (16) ;
éventuellement, l'hydroptère (16) situé sur le stabilisateur est réglable dynamiquement et agencé pour appliquer une force variable au stabilisateur.

12. Bateau selon la revendication 11, dans lequel l'hy-

droptère situé sur le stabilisateur est situé au niveau ou à proximité de la poupe de la première partie ; et/ou

l'hydroptère situé sur le stabilisateur s'étendant vers la coque principale et/ou l'hydroptère situé sur le stabilisateur étant agencé pour contrôler le roulis du bateau.

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13. Bateau selon l'une quelconque des revendications précédentes, dans lequel la coque principale supporte 70 % ou plus du déplacement statique total du bateau, de préférence 70 % à 95 % du déplacement statique total du bateau.

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14. Bateau selon l'une quelconque des revendications précédentes, dans lequel le stabilisateur supporte 30 % ou moins du déplacement statique total du bateau, de préférence 5 % à 30 % du déplacement statique total du bateau.

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15. Bateau selon l'une quelconque des revendications précédentes, comprenant en outre :
un système de commande conçu pour ajuster dynamiquement l'hydroptère ; et/ou un dispositif de propulsion motorisé conçu pour propulser le bateau, le dispositif de propulsion motorisé étant positionné en avant de l'hydroptère dans la direction avant-arrière.

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Fig. 1

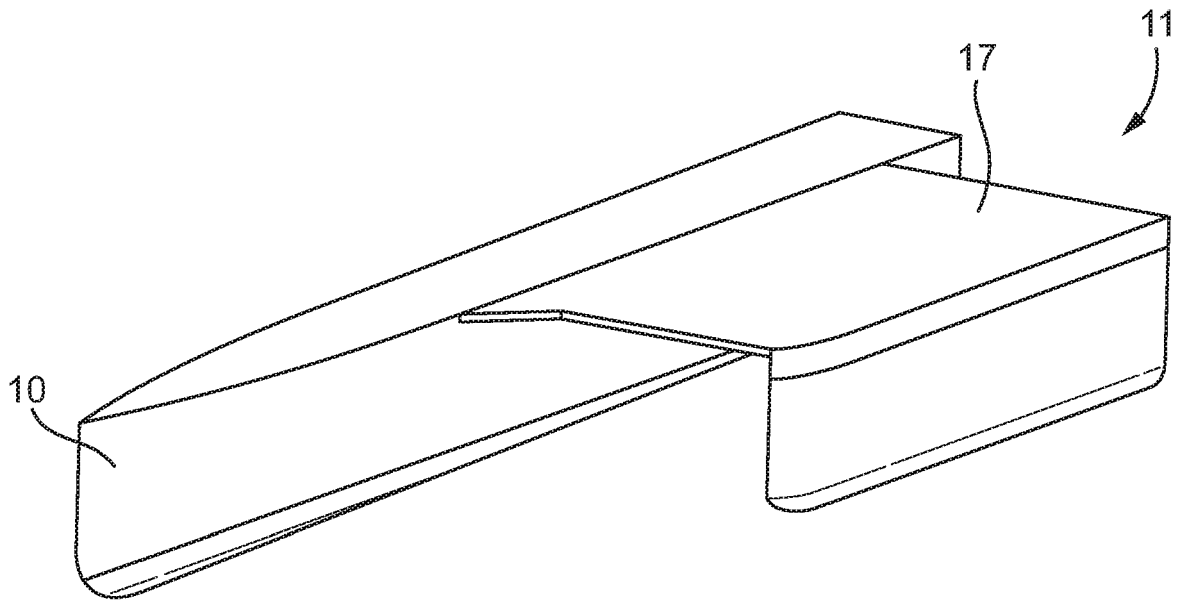


Fig. 2

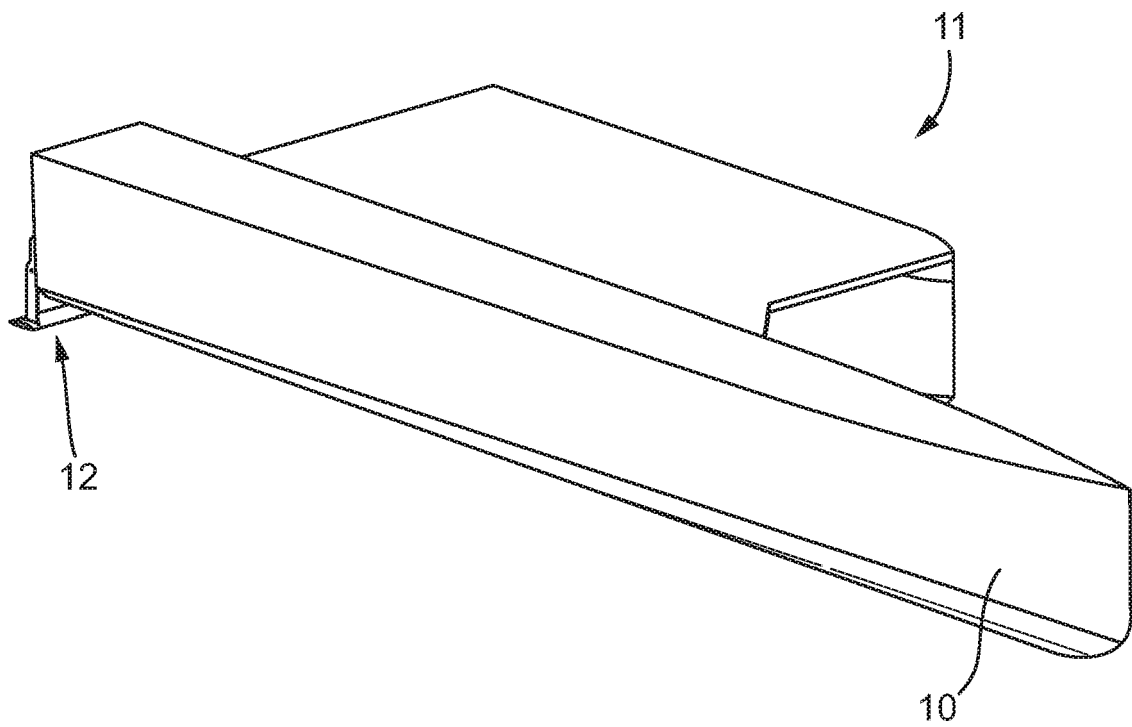


Fig. 3

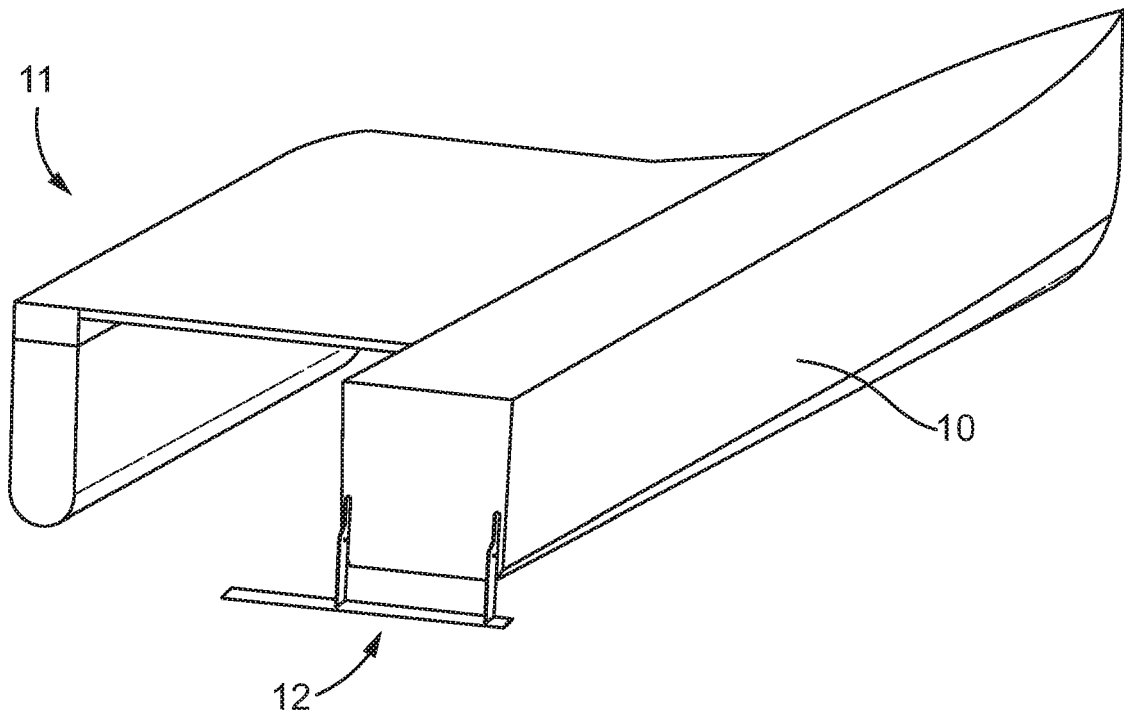


Fig. 4

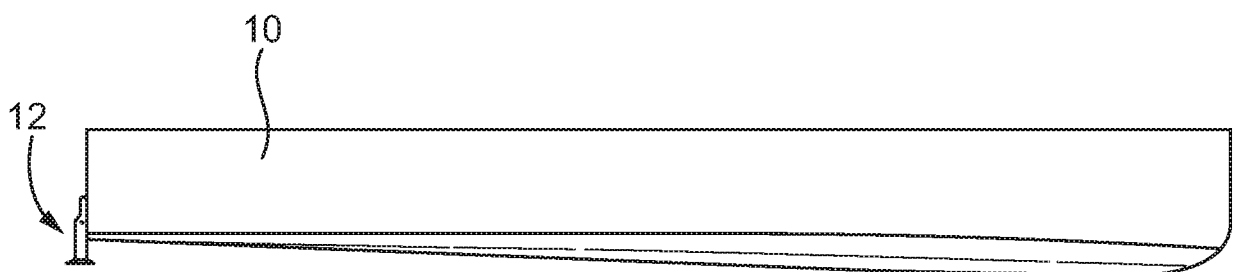


Fig. 5

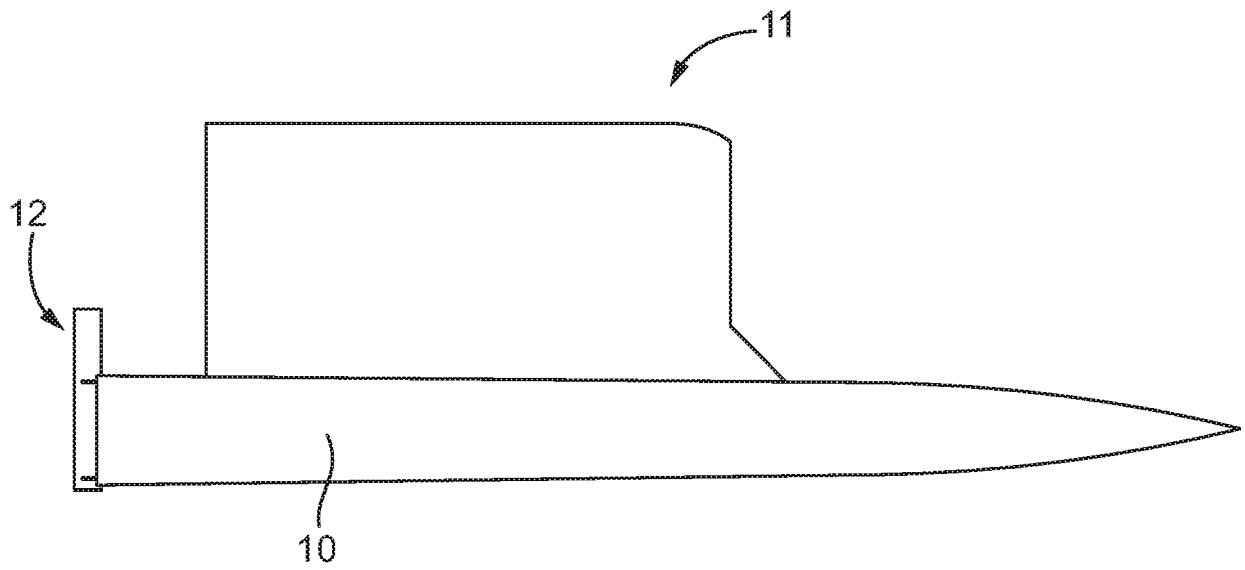


Fig. 6

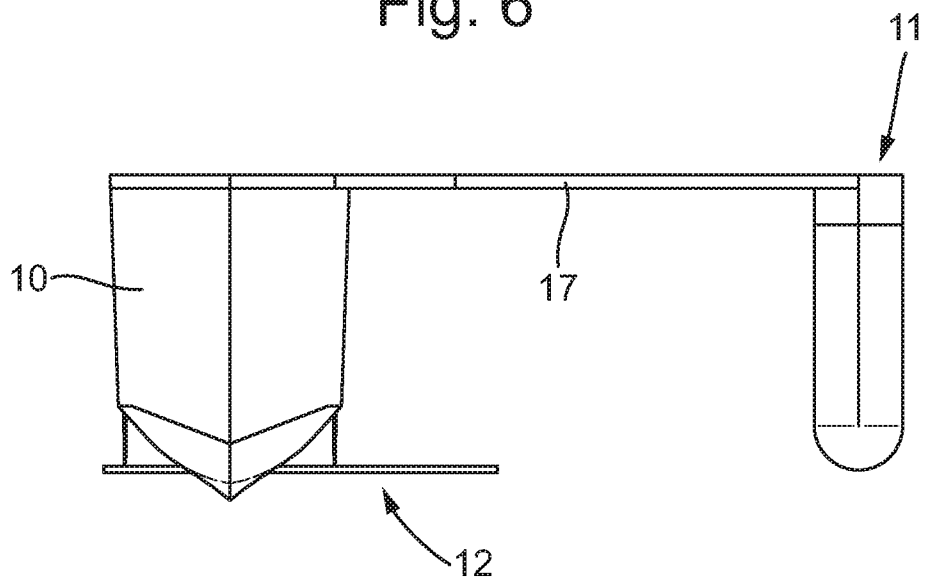


Fig. 7

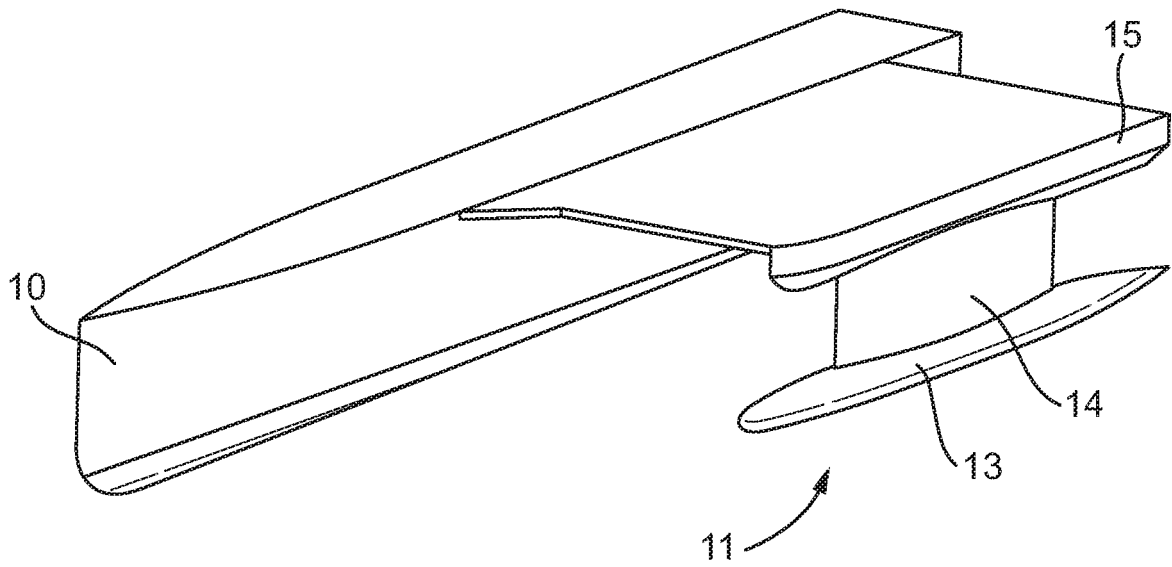


Fig. 8

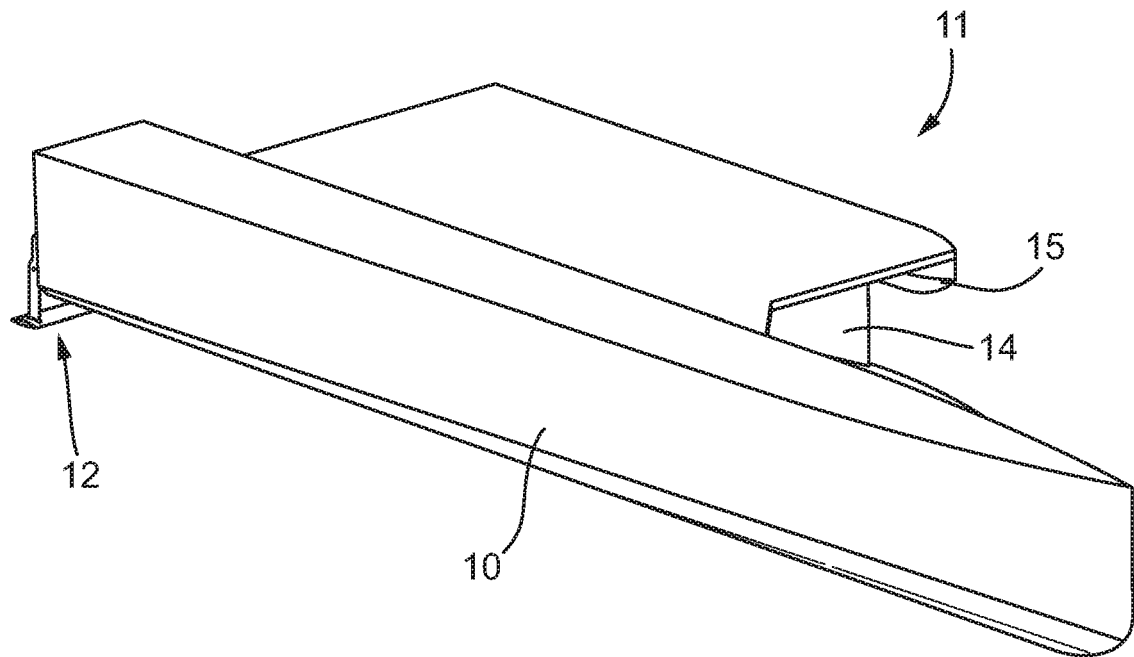


Fig. 9

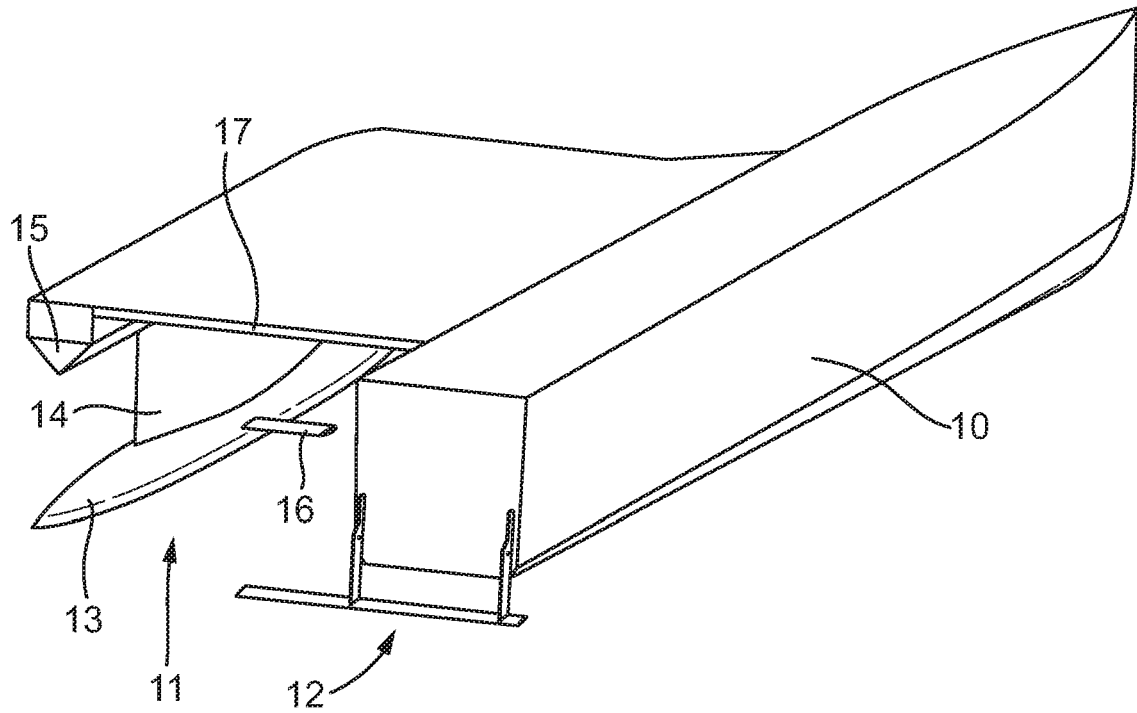


Fig. 10

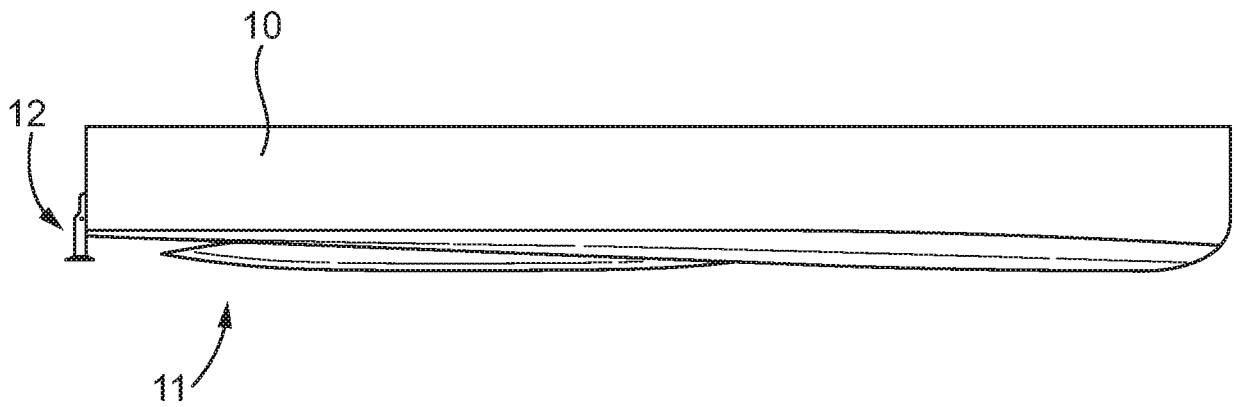


Fig. 11

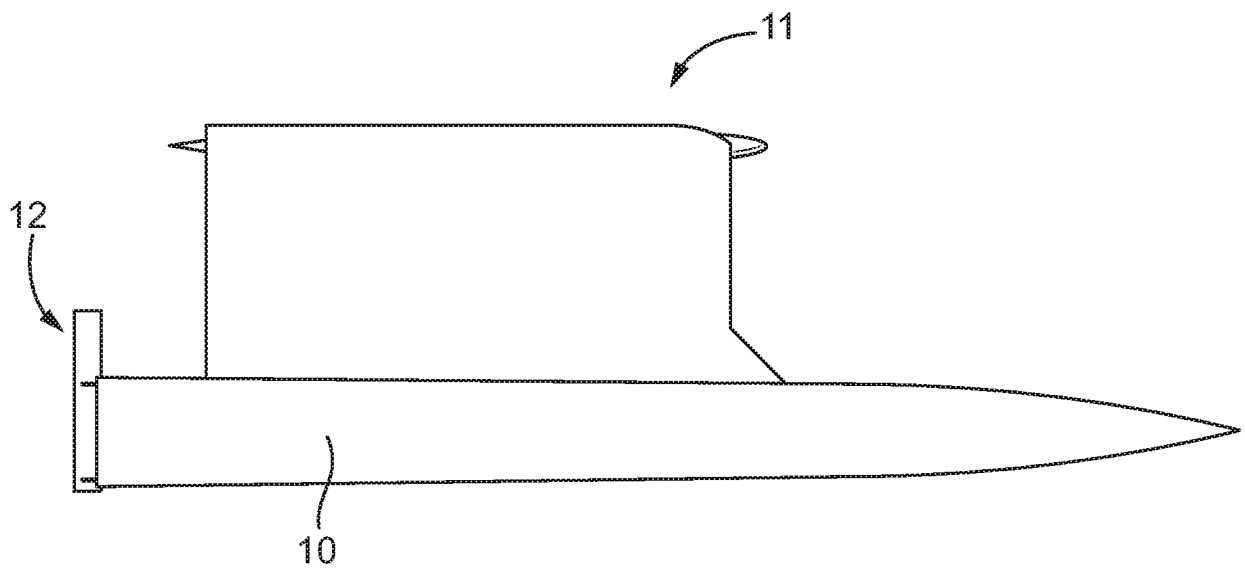


Fig. 12

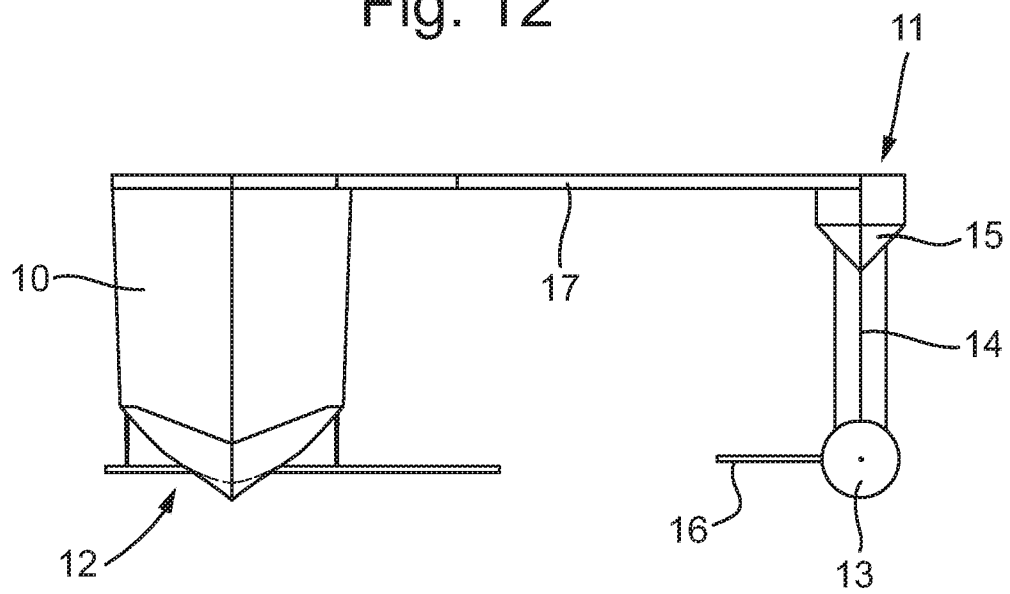
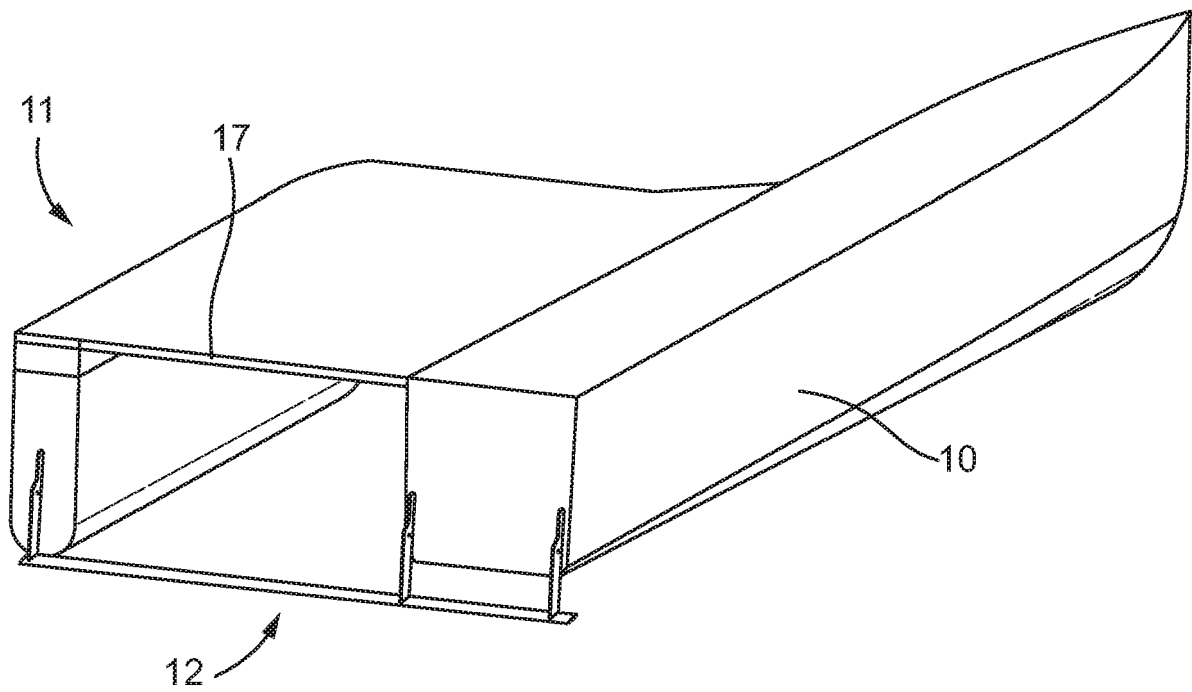


Fig. 13



REFERENCES CITED IN THE DESCRIPTION

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