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(54) VESSEL WITH ROTATING POD

FAHRZEUG MIT ROTIERENDEM PROPELLERGONDEL

VASSEAU AVEC POD PROPULSEUR DE ROTATION

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Description

Field of the invention

[0001] The invention relates to a water-displacement vessel comprising a hull with a longitudinal axis, comprising a bottom and comprising a pod drive arranged close to the bottom, said pod drive being provided with a housing containing a propeller shaft which protrudes through the housing and to which propeller shaft a propeller is attached at a propeller end, and a drive for said propeller shaft, which propeller shaft defines a first axis, which housing is rotatable with respect to the hull between a rearward position and a forward position about a rotation shaft which defines a second axis which is not vertical and forms an angle (α) of 40°-90°, preferably between 60°-80°, with the first axis.

[0002] More particularly, the present invention relates to relatively large vessels, i.e. vessels having a length of more than 20 metres and in particular more than 50, or even more than 80, metres and having a water displacement of 500 tons or more. The invention also relates to a method for the propulsion of vessels of this type.

Background of the invention

[0003] A pod drive is a more attractive alternative to a conventional drive which uses a propeller shaft in a fixed position with respect to the vessel, to which propeller shaft a propeller is attached, and which uses a rudder for manoeuvring. In particular when using electrically driven pods, it is possible to provide diesel-electric propulsion which can be optimized depending on the operating conditions. By using a number of units to generate electricity, it is possible to increase the operational reliability and also the efficiency. It is also possible, depending on the position, to comply with current regulations, such as environmental regulations.

[0004] Document US 7641526 constitutes the closest prior art.

[0005] A water-displacement vessel is described in GB 2 009 156, wherein two Voith-Schneider propellers are attached under respective hulls of a vessel designed as a catamaran, comprising a propeller and optionally a casing. The rotation shaft of the suspension of the propellers is at an angle with respect to the vertical. As a result, during rotation into a sideward position, for example during manoeuvring, the propellers can be directed obliquely downwards and obliquely upwards in such a way that the resulting flow of the propeller on one hull does not disrupt the operation of the propeller of the other hull. In the straight-ahead position, the rotation shafts of the propellers are parallel to the longitudinal axis of the vessel.

[0006] In order to achieve sufficient buoyancy, the known vessel has a depth which is such that the propellers are at all times situated sufficiently far below the surface of the water to have a good propulsive effect.

[0007] US 3,306,246 discloses a planing vessel, wherein a propeller arranged at an angle raises the hull out of the water in a rearward position and pulls the hull into the water in a forward position, without a hydrofoil being necessary for this purpose.

[0008] In other vessels known from the prior art, the axis of the propeller shaft is perpendicular to the axis of rotation of the pod housing with respect to the vessel. In addition, the second axis, i.e. the axis of rotation of the pod housing with respect to the vessel, is vertical. In this way, the horizontal position of the first axis, i.e. the axis of the propeller shaft, is always ensured when the housing is rotated with respect to the vessel. This position is optimum for driving the vessel over relatively great distances.

[0009] Although, in theory, a horizontally arranged propeller shaft offers the optimum thrust for propelling a ship, in specific cases the designer may choose to set the propeller shaft at a (slight) angle in sailing conditions, for example parallel to the flow along a hull shape.

[0010] If a vessel of this type makes a round trip where little or no load is present, it is necessary to provide said vessel with ballast. If no measures were taken, the relatively low weight would cause the vessel to ride higher and would lead to conditions which are no longer optimum for propulsion by means of the propeller.

[0011] Conversely, it has been found that if the surface area or the volume of the vessel which is in contact with the water decreases, the flow resistance decreases, as a result of which it is possible to sail either at increased speed or with lower consumption.

[0012] It is the object of the present invention to provide a vessel which has operating conditions in the loaded state which are comparable to those of a conventional vessel known from the prior art. However, the intention is to further improve the operating conditions of the vessel in a state in which the vessel is less loaded.

[0013] It is a further object of the invention to provide a water-displacement vessel comprising a rotatable pod which is suspended by means of a rotation shaft arranged at an angle with respect to the vertical, with it being possible to propel said vessel in an effective and efficient manner both with a large draught and a relatively small draught.

Summary of the invention

[0014] In a vessel of the type described above, this object is achieved by virtue of the fact that an annular jet pipe is arranged around the propeller, comprising a peripheral edge which is at a distance from the propeller shaft and is situated further below a predetermined waterline in the forward position than in the rearward position, wherein the direction of rotation of the propeller shaft in the forward position is adjustable in such a way that the jet pipe has a water-suction effect.

[0015] The invention is defined by independent product claim 1 and method claim 12.

[0016] As a result of the non-vertical placement of the

second axis in combination with the non-perpendicular positioning of the first axis with respect to the second axis, in the case of rotation about the second axis the first axis will always be moved into a different position with respect to the horizontal (and the vertical) depending on the rotation. In the simplest embodiment, the first axis, i.e. the axis of the propeller shaft, defines a cone during rotation about the second axis, i.e. the axis of rotation of the pod. More complicated movements are also possible. This enables the position of the axis of the propeller shaft to be adjusted depending on the rotation position of the housing of the pod. In other words, in a drive position, or rearward position, said axis of the propeller shaft is preferably in the usual horizontal position. However, following rotation through 180 ° into the forward position of the pod, the axis of the propeller shaft will form a considerable angle with the horizontal. As a result of this tilting of the propeller shaft and thus of the propeller, the depth of the inlet of the annular jet pipe under the surface of the water increases with respect to the vertical, since it receives a horizontal component. The upper side of the peripheral edge of the jet pipe therefore lies deeper in the water in the forward position and is able to suck in this water, without a disruptive amount of air being sucked in during the process.

[0017] It has been found that this enables, inter alia, a vessel provided with little or no ballast ballast to be driven. The starting point is the position described above in which the propeller and the jet pipe are inclined with respect to the horizontal. As a result of the incline, the propeller and the inlet of the jet pipe are in a position in which they do not protrude above the surface of the water, which would risk the suction of air. The rotation of the propeller is then started and the vessel is driven. In this case, the propeller rotates "in reverse" in order to suck water into the jet pipe and to move the vessel forwards. The non-horizontal position means that the efficiency of the drive is less than when the propeller is in the horizontal position. However, this operation is temporary. As soon as the vessel has gained some speed, a stern wave will arise and the propeller can once again be positioned such that the propeller shaft is substantially horizontal. The propeller then rotates "forwards" again in order to move the vessel forwards.

[0018] The design of the pod is not relevant to the present invention. That is to say that the pod may either have an engine located in the vessel which drives the propeller shaft in the housing by means of a shaft and gear wheels, a thruster, or may be provided with an (electric) motor arranged in the housing which drives the propeller shaft optionally by means of reduction gearing which may be configured in any conceivable manner.

[0019] Surprisingly, it has been found that the jet pipe according to the invention which is arranged at an angle demonstrates a very good propulsive effect, even if the peripheral edge of the inlet is only slightly below the surface of the water. Air which flows in is pressed against the inner wall of the jet pipe by means of the centrifugal effect of the propeller, without the air bubbles which flow in entering the propeller and greatly reducing the efficiency of the propulsion.

[0020] The term "water-displacement" according to the invention is intended to refer to vessels having a Froude number which is less than 1, i.e.: $F_r = V/(g.L)^{1/2} < 1$, where V is the velocity in m/s, g is the gravitational acceleration and L is the length of the vessel in m.

[0021] An embodiment of a water-displacement vessel according to the invention comprises an elongate hull which is provided with a front end and a rear end, wherein the pod is attached close to the rear end, wherein, in the case of a low degree of loading, the peripheral edge is situated close to or above the waterline in the rearward position and is situated a distance of at least in the order of 10% of the propeller diameter below the waterline in the forward position.

[0022] By reversing the orientation and the direction of rotation of the pod in the case of a low degree of loading, the peripheral edge of the jet pipe is situated far enough below the surface of the water to realize effective propulsion. This enables sailing with a low draught without ballast.

[0023] If, after a predetermined speed has been reached, a sufficient stern wave has built up that the pod is situated sufficiently far below the surface of the water to ensure effective propulsion, the pod can be rotated about the rotation shaft into the rearward position after a predetermined speed has been reached, with reversal of the direction of rotation of the propeller. Preferably, the first axis is substantially parallel to the longitudinal axis in the rearward position.

[0024] According to a particular embodiment of the present invention, the second axis, i.e. the axis of rotation of the housing of the pod with respect to the vessel, extends at an angle of 5-30 ° to the vertical.

[0025] In combination with the above-described angle of 60-80°, in the above-described position rotated through 180 °, starting from a horizontal position at 0°, a displacement of 15-60° with respect to the horizontal occurs. As a result, the propeller which is optionally provided with a jet pipe can be considerably limited in terms of height (depth).

[0026] According to a further advantageous embodiment of the invention, the pod is arranged at the rear side of the hull of the vessel, which rear side is slightly inclined with respect to the horizontal. In this case, it is possible to arrange the rotation shaft, i.e. the second axis, perpendicularly to said inclined plane, as a result of which the above-described deviation from the vertical is realized.

[0027] The displacement of the second axis with respect to the vertical is effected preferably at least in the vertical central longitudinal plane of the vessel, which vertical central longitudinal plane of the vessel comprises the longitudinal axis of the vessel. In other words, the second axis is preferably arranged at an incline with respect to the vertical in the forward or rearward direction

with respect to the longitudinal direction of the vessel.

[0028] It is also possible to displace said second axis, i.e. the axis about which the housing of the pod rotates, with respect to the vertical in a direction perpendicular to the longitudinal direction of the vessel. This is preferably realized in the case where two (or more) pods are present in a preferably symmetrical position with respect to the vertical central longitudinal plane.

[0029] According to a further advantageous embodiment of the present invention, an annular jet pipe is arranged around the propeller, said jet pipe being provided at the top side with a (detachable) projection which extends in the direction away from the housing and functions as a flow guide. The propeller is able to suck in water as soon as this projection is submerged under water in the downwardly tilted position.

[0030] According to a further embodiment of the present invention, the rotational movement of the second axis is more complex. In the embodiments described above, the second axis, i.e. the axis of rotation of the pod with respect to the vessel, is arranged in a fixed position with respect to the vessel.

[0031] According to a variant of the invention, this position of the second axis is varied depending on the rotation position with respect to the vessel. This may be realized by providing a bush in the vessel in which the pod may rotate about the second axis in the manner described above. However, said bush is itself rotatable about a third axis which deviates from the second axis. By means of the mutual positioning of the rotation position of the pod and the bush, a wide range of angles of the propeller shaft, i.e. the first axis, may be realized.

[0032] The present invention also relates to a method for driving a vessel, which vessel comprises a hull, a pod, or thruster, which is rotatable with respect to the hull and attached to the rear side under said hull, which pod comprises a housing which is rotatably attached to said hull and a driven propeller shaft arranged in said housing, which propeller shaft protrudes through the housing and to which a propeller is attached outside the housing, wherein said pod serves to propel said vessel in both sailing conditions and manoeuvring conditions, wherein said pod is rotated out of a sailing condition, in which the axis of said propeller shaft is substantially horizontal, into a manoeuvring position, in which the axis of said propeller shaft forms an angle of 25-80° with respect to the horizontal.

[0033] In an embodiment in which the vessel is provided with at least two pod drives, at least one pod drive may be in the forward position, and the other in the rearward position. When sailing away at low speed, the propeller of the pod in the rearward position may not be driven and the pod in the forward position can provide the propulsion by means of water suction. If, after a predetermined speed has been reached, a sufficiently large stern wave has built up, the rotation of the propeller of the pod in the forward position may be ended and the pod in the rearward position may assume the propulsion. The second pod may then also be rotated into the rearward position in order to assist with the propulsion. This permits an efficient transfer of the propulsion from the pod in the forward position, without interruptions.

[0034] Apart from the situation described above, in which it is possible to start up a vessel in a state in which it is not fully loaded without negatively influencing the operation of the propeller, such a method may also be used for sailing in shallow water and other manoeuvres. It will be understood that the construction according to the present invention may also optimally cover other operating conditions. For example, the invention may be used for pontoons and other maritime structures which must remain in an accurately defined location. In the case of said maritime structures, the rearward position should be understood to mean the main thrust direction in the case of a sufficient draught and the forward position in the case of a low draught. The same approach should be used in the case of structures comprising a plurality of pods, possibly at the corners of the installation.

Brief description of the drawings

[0035] The invention will be explained in greater detail below with reference to exemplary embodiments illustrated in the drawing, in which:

Fig. 1 diagrammatically shows a side view of a vessel in the loaded state provided with the pod according to the invention in the rearward position;
Fig. 2 shows the vessel according to Fig. 1 in an entirely or partially empty state;
Fig. 3 shows the vessel according to Fig. 2 in an entirely or partially empty state, with the pod in the forward position,
Fig. 4 shows the vessel according to the present invention in an entirely or partially empty state once it has gained speed, with the pod in the rearward position;
Fig. 5 shows details of the pod structure in the rearward position;
Fig. 6 shows the details according to Figure 5, with the pod in the forward position;
Figs 7a-d diagrammatically show top views and rear views of various positions of a variant comprising two pods; and
Fig. 8 shows a variant of the pod according to the invention.

Detailed description of the invention

[0036] In Fig. 1, a vessel is designated overall by 1. According to the present invention, this is a relatively large vessel, such as an inland vessel, coaster or larger vessel. The length of the vessel is preferably greater than 20 or 40 metres. The driving power used for such vessels may, for example, be in the range of many kilowatts to several megawatts. The vessel is designated overall by

1 and is provided with a pod 2 at the rear side which is designated by 3. The pod 2 comprises a jet pipe 17 with an inlet delimited by a peripheral edge 11. The waterline in Fig. 1 is indicated by 10 and the longitudinal axis of the hull is indicated by 15. Fig. 1 illustrates the loaded state in which the propeller is entirely under the waterline.

[0037] Fig. 2 illustrates the same vessel I in an unladen state, in which the pod is attached in the manner customary in the prior art. It can be seen that the pod, and in particular its propeller, and the inlet of the jet pipe 17 are above the waterline 10, as a result of which sailing is not readily possible. The present invention proposes to tilt the pod and in particular the axis of the propeller shaft and thus the propeller in the manner described below, as a result of which the same vessel as illustrated in Fig. 2, in the same loading state, can in fact now set sail, because the propeller is below the waterline level 10. This is illustrated in Fig. 3, in which the pod has been rotated through 180° and, as a result of the particular positioning thereof, the propeller and associated casing are below the waterline 10. In order to move forwards, the direction of rotation of the propeller in the pod is of course reversed, and the vessel can be set in motion.

[0038] As soon as the vessel has gained some speed, a stern wave will arise and as a result the propeller may be moved back into the usual position, i.e. with a substantially horizontal propeller shaft and a substantially vertical propeller plane. This is illustrated in Fig. 4, in which the pod once again has the usual direction of rotation.

[0039] Fig. 5 illustrates an exemplary embodiment in which it is possible to realize the tilting of the propeller illustrated in Figs 1-4 and more particularly in Fig. 3. A bearing bush 8 is arranged in the rear side 3 of the vessel. The bearing bush 8 contains a pin 9 comprising an axis of rotation (second axis) 12. In contrast to the prior art, said second axis 12 is not vertical, but deviates from the vertical, for example by an angle β of 5-30°. In the present example, this deviation occurs solely in the vertical central longitudinal plane which constitutes the longitudinal axis 15 of the vessel. Depending on the incline of the rear side 3, it is possible to arrange the bearing bush 8 perpendicularly on said rear side. The other end of the pin 9 is connected to the housing 4 of the pod 2. Said housing contains a propeller shaft 5 which protrudes through the housing 4 to the exterior and is connected to the propeller 6. The axis of the propeller shaft is indicated by 7 and is designated as the first axis. The jet pipe 17 comprising the inlet delimited by the peripheral edge 11 is arranged around the propeller. Said jet pipe 17 may be provided at the top side with a (detachable) projection 13 which extends away from the housing. The pod 2 may be provided with a drive which is situated in the ship's hull, in which case a drive shaft will extend through the pin 9. It is also possible to provide the pod 2 with an electrical drive which is situated in the housing 4. In that case, cabling will extend through the hollow pin 9. Other variants are also possible which are not illustrated in the drawing for the purpose of emphasizing these different variant embodiments.

[0040] As shown in Fig. 5, the first axis 7 forms an angle, indicated by α, with the second axis 12, said angle being unequal to 90° and more particularly between 60-80°. In combination with the angle β, it is possible to realize the position illustrated in Fig. 5, in which the propeller shaft, i.e. the first axis 7, is substantially horizontal, i.e. is in an optimum position for driving the vessel over long periods of time.

[0041] By rotating the pin 9, the pod housing will rotate along with the propeller. A rotation through 180° will result in the situation illustrated in Figs 3 and 6. In that case, the propeller is at an angle to the horizontal, i.e. the first axis is no longer horizontal. This situation is somewhat less optimal for driving a vessel over large distances. However, this situation does mean that the underside of the propeller and of the jet pipe arranged around it is higher and the top side is lower. On the one hand, this provides the possibility of sailing in shallow water, and on the other hand it is possible, in the case of a vessel which rides high, to first develop its speed. As described with reference to Fig. 4, it will subsequently be possible, as a result of the formation of a stern wave, to rotate the pod back into the position in Fig. 5, in which case a sufficient amount of water will always be present to enable the problem-free operation of the propeller.

[0042] Fig. 5 further illustrates the intersection X between the propeller arc and the propeller shaft (or 1 st axis) and the intersection Y between the propeller shaft and the oblique rotation shaft (or 2nd axis). The distance between the two points (A) determines the geometric tilting and height position of the propeller in the oblique downwards position. If the value A = 0, the propeller will tilt about point Y, which in this case is the same as X, and the point X will not move vertically downwards and the propeller will not protrude lower in the tilted position than in the horizontal position. This selection for A applies in particular to ships which sail in shallow water (including inland vessels). If a greater value is chosen for A, for example values in the order of 50-100% of the propeller diameter, the propeller will tilt about point Y and will both tilt and move vertically downwards in the tilted position. This selection for A applies in particular to ships which sail with a low draught (including seagoing vessels).

[0043] Fig. 7 illustrates various operating states brought about by adjusting the pod 2. Fig. 7a illustrates a top view of a vessel, in which a pod is arranged on either side of a central longitudinal axis 15. It is possible to rotate these pods into a position of 90° as illustrated in Fig. 7b or even to rotate them further into a position of, for example, 120° as illustrated in Fig. 7c. In these positions, it is possible to carry out manoeuvres in slow sailing conditions or, in the case of fast sailing, to additionally achieve a braking effect.

[0044] Fig. 7d illustrates a rear view of a vessel which shows that the second axes 12 are tilted with respect to the vertical in a plane which is perpendicular to the lon-

gitudinal axis 15. This tilting can be combined with the above-described tilting as illustrated in Figs 5 and 6.

[0045] Fig. 8 illustrates a further variant of Figs 5 and 6, wherein as far as possible the same reference numerals have been used. In this case, the pin which is connected to the housing 4 of the pod is designated by 29 and defines a second axis 32. Said pin is accommodated in a sleeve 30 which is rotatable along a third axis 31 with respect to the stern of a ship and for this purpose is mounted in a bearing bush 28. The second and third axes diverge by an angle γ, as can be seen from the drawing. Mutual rotation about the second and third axes allows a wide range of different positions of the pod to be realized, as a result of which the above-described effect of tilting the propeller can be even more pronounced and it is also possible, in the 0° or 180° position, for example, to provide the housing of the pod with a different angle of inclination. It is even possible to change the angle which the propeller shaft forms with the horizontal by rotating the sleeve 30 whilst keeping the pin 29 stationary.

Claims

1. Water-displacement vessel (1) comprising a hull with a longitudinal axis (15), comprising a bottom and comprising a pod drive (2) arranged close to the bottom, said pod drive (2) being provided with a housing (4) containing a propeller shaft (5) which protrudes through the housing and to which propeller shaft (5) a propeller is attached at a propeller end, and a drive for said propeller shaft, which propeller shaft (5) defines a first axis (7), which housing (4) is rotatable with respect to the hull between a rearward position and a forward position about a rotation shaft (9, 29) which defines a second axis (12, 32) and an annular jet pipe (17) is arranged around the propeller, comprising a peripheral edge (11) which is at a distance from the propeller shaft (5) **characterized in that** said second axis is not vertical and forms an angle (α) of 40°-90°, preferably between 60°-80°, with the first axis and said annular jer pipe is situated further below a predetermined waterline in the forward position than in the rearward position, wherein the direction of rotation of the propeller shaft (5) in the forward position is adjustable in such a way that the jet pipe has a water-suction effect.

2. Water-displacement vessel according to Claim 1, comprising an elongate hull which is provided with a front end and a rear end, wherein the pod is attached close to the rear end, wherein, in the case of a low degree of loading, the peripheral edge (11) is situated close to or above the waterline in the rearward position and is situated a distance of at least in the order of 10% of the propeller diameter below the waterline in the forward position.

3. Water-displacement vessel according to Claim 1 or 2, wherein the first axis (7) is substantially parallel to the longitudinal axis (15) in the rearward position.

4. Water-displacement vessel according to Claim 1, 2 or 3, wherein the pod is designed, in the case of a low degree of loading, to drive the vessel in the forward position by means of suction and, after a predetermined speed has been reached, to rotate about the rotation shaft (9, 29) into the rearward position, with reversal of the direction of rotation of the propeller.

5. Water-displacement vessel according to Claim 1, 2, 3 or 4, wherein the second axis (12, 32) forms an angle (β) of 5-30° with the vertical in the position of use.

6. Water-displacement vessel according to one of the preceding claims, wherein the hull is inclined with respect to the horizontal at the location (3) where the pod (2) is attached to the hull, and wherein the second axis (12) is perpendicular to the hull at the location of the attachment.

7. Water-displacement vessel according to one of the preceding claims, wherein said hull comprises a vertical central longitudinal plane and said second axis (12) is situated in said vertical central longitudinal plane or in a plane parallel thereto.

8. Water-displacement vessel according to one of the preceding claims, wherein said hull comprises a vertical central longitudinal plane, two pods are present on either side of said plane, wherein the second axes (12) of said pods are arranged mirror-symmetrically with respect to said vertical central longitudinal plane.

9. Water-displacement vessel according to Claim 8, wherein one pod can be moved into a rearward position while the other pod is in a forward position.

10. Water-displacement vessel according to Claim 8 or 9, wherein the second axes (12) are not in a plane parallel to said central longitudinal plane.

11. Water-displacement vessel according to one of the preceding claims, wherein the jet pipe (17) is annular and is provided at a top side of a peripheral edge with a projection (13) which extends away from said housing.

12. Method for driving a water-displacement vessel (1) comprising a hull with a longitudinal axis (15), comprising a bottom and comprising a pod drive (2) arranged close to the bottom, said pod drive (2) being provided with a housing (4) containing a propeller

shaft (5) which protrudes through the housing and to which propeller shaft (5) a propeller is attached at a propeller end, and a drive for said propeller shaft, which propeller shaft (5) defines a first axis (7), which housing (4) is rotatable with respect to the hull between a rearward position and a forward position about a rotation shaft (9, 29) which defines a second axis (12, 32) which is not vertical and forms an angle (α) of 40°-90°, preferably between 60°-80°, with the first axis, wherein an annular jet pipe (17) is arranged around the propeller, comprising a peripheral edge (11) which is at a distance from the propeller shaft, wherein the method comprises the following steps:

- rotating the housing about the rotation shaft into the forward position, and
- adjusting the direction of rotation of the propeller so that the jet pipe has a water-suction effect and the vessel is driven.

13. Method according to Claim 12, wherein, after a predetermined speed has been reached, the housing is rotated about the rotation shaft (9, 29) into the rearward position, with reversal of the direction of rotation of the propeller.

14. Method according to Claim 12 or 13, wherein the vessel is provided with at least two pod drives (2), wherein at least one pod drive is situated in the forward position, and the other pod drive is situated in the rearward position.

15. Method according to Claim 12, 13, or 14, wherein the vessel is substantially unladen.

Patentansprüche

1. Wasserverdrängungsfahrzeug (1), das einen Rumpf mit einer Längsachse (15) umfasst, das einen Boden umfasst und einen Pod-Antrieb (2) umfasst, der in der Nähe des Bodens angeordnet ist, wobei der Pod-Antrieb (2) mit einem Gehäuse (4) ausgestattet ist, das eine Propellerwelle (5), die durch das Gehäuse vorsteht und an der ein Propeller an einem Propellerende befestigt ist, und einen Antrieb für die Propellerwelle enthält, wobei die Propellerwelle (5) eine erste Achse (7) definiert, wobei das Gehäuse (4) in Bezug auf den Rumpf zwischen einer Rückwärtsposition und einer Vorwärtsposition um eine Drehwelle (9, 29) drehbar ist, die eine zweite Achse (12, 23) definiert, und wobei ein ringförmiges Strahlrohr (17) um den Propeller angeordnet ist, das eine Umfangskante (11) umfasst, die in einem Abstand von der Propellerwelle (5) liegt, **dadurch gekennzeichnet, dass** die zweite Achse nicht vertikal ist und einen Winkel (α) im Bereich von 40° bis 90°, vorzugsweise von 60° bis 80°, mit der ersten Achse bildet, und sich das ringförmige Strahlrohr in der Vorwärtsposition weiter unter einer vorgegebenen Wasserlinie als in der Rückwärtsposition befindet, wobei die Richtung der Drehung der Propellerwelle (5) in der Vorwärtsposition in der Weise anpassbar ist, dass das Strahlrohr einen Wasseransaugeffekt aufweist.

2. Wasserverdrängungsfahrzeug nach Anspruch 1, das einen langgestreckten Rumpf umfasst, der mit einem vorderen Ende und einem hinteren Ende ausgestattet ist, wobei die Pod in der Nähe des hinteren Endes angebracht ist, wobei sich die Umfangskante (11) in dem Fall eines niedrigen Beladungsgrads in der Rückwärtsposition in der Nähe der Wasserlinie oder darüber befindet und sich in der Vorwärtsposition in einem Abstand in der Größenordnung von mindestens 10 % des Propellerdurchmessers unter der Wasserlinie befindet.

3. Wasserverdrängungsfahrzeug nach Anspruch 1 oder 2, wobei die erste Achse (7) in der Rückwärtsposition im Wesentlichen parallel zu der Längsachse (15) ist.

4. Wasserverdrängungsfahrzeug nach Anspruch 1, 2 oder 3, wobei die Pod entworfen ist, in dem Fall eines niedrigen Beladungsgrads das Fahrzeug in der Vorwärtsposition mit Saugunterstützung anzutreiben und, nachdem eine vorgegebene Geschwindigkeit erreicht wurde, sich mit einer Umkehrung der Drehrichtung des Propellers um die Drehwelle (9, 29) in die Rückwärtsposition zu drehen.

5. Wasserverdrängungsfahrzeug nach Anspruch 1, 2, 3 oder 4, wobei die zweite Achse (12, 32) in der Verwendungsposition einen Winkel (ß) im Bereich von 5° bis 30° mit der Vertikalen bildet.

6. Wasserverdrängungsfahrzeug nach einem der vorhergehenden Ansprüche, wobei der Rumpf in Bezug auf die Horizontale an dem Ort (3), an dem die Pod (2) an dem Rumpf befestigt ist, geneigt ist und wobei die zweite Achse (12) an dem Ort der Befestigung senkrecht zu dem Rumpf ist.

7. Wasserverdrängungsfahrzeug nach einem der vorhergehenden Ansprüche, wobei der Rumpf eine vertikale zentrale Längsebene umfasst und sich die zweite Achse (12) in der vertikalen zentralen Längsebene oder in einer dazu parallelen Ebene befindet.

8. Wasserverdrängungsfahrzeug nach einem der vorhergehenden Ansprüche, wobei der Rumpf eine vertikale zentrale Längsebene umfasst, zwei Pods auf jeder Seite der Ebene vorhanden sind, wobei die zwei Achsen (12) der Pods spiegelsymmetrisch in Bezug auf die vertikale zentrale Längsebene ange-

ordnet sind.

9. Wasserverdrängungsfahrzeug nach Anspruch 8, wobei eine Pod in eine Rückwärtsposition bewegt werden kann, während die andere Pod in einer Vorwärtsposition ist.

10. Wasserverdrängungsfahrzeug nach Anspruch 8 oder 9, wobei die zwei Achsen (12) nicht in einer Ebene parallel zu der zentralen Längsebene liegen.

11. Wasserverdrängungsfahrzeug nach einem der vorhergehenden Ansprüche, wobei das Strahlrohr (17) ringförmig ist und an einer oberen Seite einer Umfangskante mit einem Vorsprung (13), der sich von dem Gehäuse weg erstreckt, versehen ist.

12. Verfahren zum Antreiben eines Wasserverdrängungsfahrzeugs (1), das einen Rumpf mit einer Längsachse (15) umfasst, das einen Boden umfasst und einen PodPod-Antrieb (2), der in der Nähe des Bodens angeordnet ist, umfasst, wobei der PodPod-Antrieb (2) mit einem Gehäuse (4) ausgestattet ist, das eine Propellerwelle (5), die durch das Gehäuse vorsteht und an der ein Propeller an einem Propellerende befestigt ist, und einen Antrieb für die Propellerwelle enthält, wobei die Propellerwelle (5) eine erste Achse (7) definiert, wobei das Gehäuse (4) in Bezug auf den Rumpf zwischen einer Rückwärtsposition und einer Vorwärtsposition um eine Drehwelle (9, 29) drehbar ist, die eine zweite Achse (12, 23) definiert, die nicht vertikal ist, und einen Winkel (α) im Bereich von 40° bis 90°, vorzugsweise von 60° bis 80°, mit der ersten Achse bildet, wobei ein ringförmiges Strahlrohr (17) um den Propeller angeordnet ist, das eine Umfangskante (11) umfasst, die in einem Abstand von der Propellerwelle liegt, wobei das Verfahren die folgenden Schritte umfasst:

- Drehen des Gehäuses um die Drehwelle in die Vorwärtsposition und
- Anpassen der Richtung der Drehung des Propellers, so dass das Strahlrohr einen Wasseransaugeffekt aufweist und das Fahrzeug angetrieben wird.

13. Verfahren nach Anspruch 12, wobei, nachdem eine vorgegebene Geschwindigkeit erreicht wurde, das Gehäuse mit einer Umkehrung der Drehrichtung des Propellers um die Drehwelle (9, 29) in die Rückwärtsposition gedreht wird.

14. Verfahren nach Anspruch 12, 13 oder 14, wobei das Fahrzeug mit mindestens zwei PodPod-Antrieben ausgestattet ist, wobei sich mindestens ein PodPod-Antrieb in der Vorwärtsposition befindet und sich der andere PodPod-Antrieb in der Rückwärtsposition befindet.

15. Verfahren nach Anspruch 12 oder 13, wobei das Fahrzeug im Wesentlichen nicht beladen ist.

Revendications

1. Navire à déplacement d'eau (1) comprenant une coque avec un axe longitudinal (15), comprenant un fond et comprenant un pod propulseur (2) disposée à proximité du fond, ledit pod propulseur (2) étant pourvu d'un boîtier (4) contenant un arbre d'hélice (5) qui fait saillie à travers le boîtier et auquel arbre d'hélice (5) une hélice est fixée au niveau d'une extrémité d'hélice, et un propulseur pour ledit arbre d'hélice, lequel arbre d'hélice (5) définit un premier axe (7), lequel boîtier (4) peut tourner par rapport à la coque entre une position vers l'arrière et une position vers l'avant autour d'un arbre de rotation (9, 29) qui définit un second axe (12, 32) et une tuyau de jet annulaire (17) est disposé autour de l'hélice, comprenant un bord périphérique (11) qui se trouve à une certaine distance de l'arbre d'hélice (5), **caractérisé en ce que** ledit second axe n'est pas vertical et forme un angle (α) compris entre 40° et 90°, de préférence entre 60° et 80°, avec le premier axe, ladite tuyau de jet annulaire est située plus profondément en dessous d'une ligne de flottaison prédéterminée dans la position vers l'avant que dans la position vers l'arrière, dans lequel le sens de rotation de l'arbre d'hélice (5) dans la position vers l'avant est réglable de telle manière que la tuyau de jet ait un effet d'aspiration de l'eau.

2. Navire à déplacement d'eau selon la revendication 1, comprenant une coque allongée qui est pourvue d'une extrémité avant et d'une extrémité arrière, dans lequel le pod est attaché près de l'extrémité arrière, dans lequel, en cas de faible degré de chargement, le bord périphérique (11) est situé à proximité ou au-dessus de la ligne de flottaison dans la position vers l'arrière et est situé à une certaine distance de l'ordre d'au moins 10 % du diamètre de l'hélice en dessous de la ligne de flottaison dans la position vers l'avant.

3. Navire à déplacement d'eau selon les revendications 1 ou 2, dans lequel le premier axe (7) est substantiellement parallèle à l'axe longitudinal (15) dans la position vers l'arrière.

4. Navire à déplacement d'eau selon les revendications 1, 2 ou 3, dans lequel le pod est conçue, dans le cas d'un faible degré de chargement, pour conduire le navire en position vers l'avant par aspiration et, après qu'une vitesse prédéterminée a été atteinte, pour tourner autour de l'arbre de rotation (9, 29) dans la position vers l'arrière, avec inversion du sens de la rotation de l'hélice.

5. Navire à déplacement d'eau selon les revendications 1, 2, 3 ou 4, dans lequel le second axe (12, 32) forme un angle (β) de 5 et 30° avec la verticale, en position d'utilisation.

6. Navire à déplacement d'eau selon l'une quelconque des revendications précédentes, dans lequel la coque est inclinée par rapport à l'horizontale à l'emplacement (3) où le pod (2) est attaché à la coque, et dans lequel le second axe (12) est perpendiculaire à la coque à l'emplacement de l'attachement.

7. Navire à déplacement d'eau selon l'une quelconque des revendications précédentes, dans lequel ladite coque comprend un plan longitudinal central vertical et ledit second axe (12) est situé dans ledit plan longitudinal central vertical ou dans un plan parallèle à celui-ci.

8. Navire à déplacement d'eau selon l'une quelconque des revendications précédentes, dans lequel ladite coque comprend un plan longitudinal central vertical, deux pods sont présentes de chaque côté dudit plan, dans lequel les seconds axes (12) desdites pods sont disposées en symétrie-miroir par rapport au dit plan longitudinal central vertical.

9. Navire à déplacement d'eau selon la revendication 8, dans lequel une pod peut se déplacer dans une position vers l'arrière alors que l'autre pod se trouve dans une position vers l'avant.

10. Navire à déplacement d'eau selon les revendications 8 ou 9, dans lequel les seconds axes (12) ne se trouvent pas dans un plan parallèle au dit plan longitudinal central.

11. Navire à déplacement d'eau selon l'une quelconque des revendications précédentes, dans lequel la tuyau de jet (17) est annulaire et est prévu sur le dessus d'un bord périphérique avec une protubérance (13) qui s'étend à distance dudit boîtier.

12. Procédé pour conduire un navire à déplacement d'eau (1) comprenant une coque avec un axe longitudinal (15), comprenant un fond et comprenant un pod propulseur (2) disposée à proximité du fond, ledit propulseurpod propulseur (2) étant pourvu d'un boîtier (4) contenant un arbre d'hélice (5) qui fait saillie à travers le boîtier et auquel arbre d'hélice (5) une hélice est fixée au niveau d'une extrémité d'hélice, et un propulseur pour ledit arbre d'hélice, lequel arbre d'hélice (5) définit un premier axe (7), lequel boîtier (4) peut tourner par rapport à la coque entre une position vers l'arrière et une position vers l'avant autour d'un arbre de rotation (9, 29) qui définit un second axe (12, 32) qui n'est pas vertical et qui forme un angle (α) compris entre 40° et 90°, de préférence entre 60° et 80°, avec le premier axe, dans lequel une tuyau de jet annulaire (17) est agencée autour de l'hélice, comprenant un bord périphérique (11) qui se trouve à une certaine distance de l'arbre d'hélice, dans lequel le procédé comprend les étapes suivantes :

- rotation du boîtier autour de l'arbre de rotation dans la position vers l'avant, et
- réglage du sens de la rotation de l'hélice de telle sorte que la tuyau de jet ait un effet d'aspiration de l'eau et que le navire soit entrainé.

13. Procédé selon la revendication 12, dans lequel, après que une vitesse prédéterminée a été atteinte, le boîtier tourne autour de l'arbre de rotation (9, 29) dans la position vers l'arrière, avec inversion du sens de rotation de l'hélice.

14. Procédé selon les revendications 12 ou 13, dans lequel le navire est muni d'au moins deux pod propulseurs (2), dans lequel au moins un pod propulseur est situé dans la position vers l'avant et l'autre pod propulseur est placé dans la position vers l'arrière.

15. Procédé selon les revendications 12, 13 ou 14, dans lequel le navire est substantiellement à vide.

Fig. 1

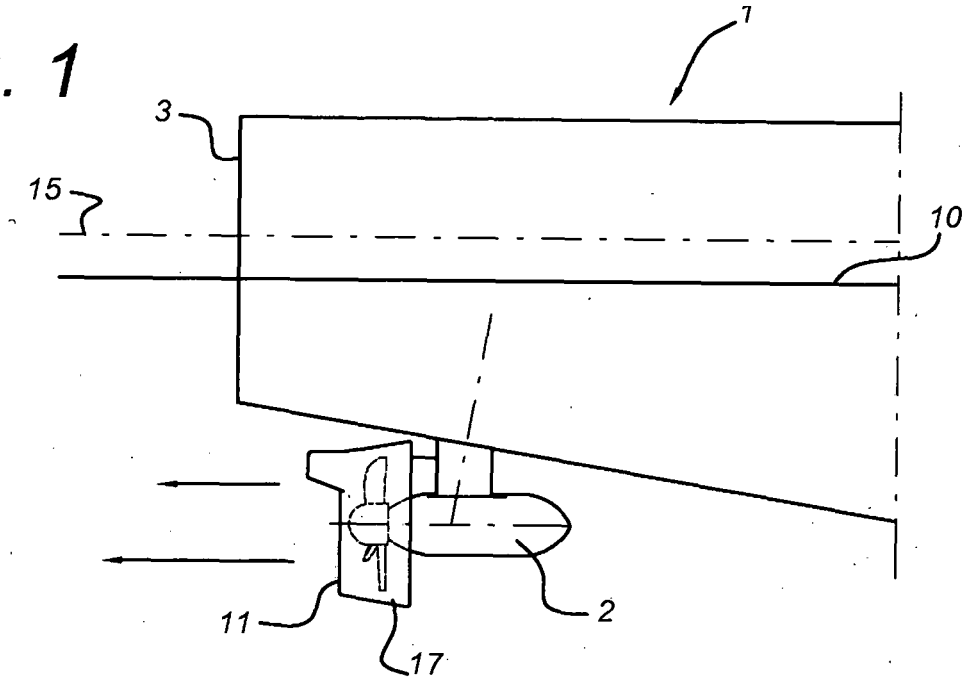


Fig. 2

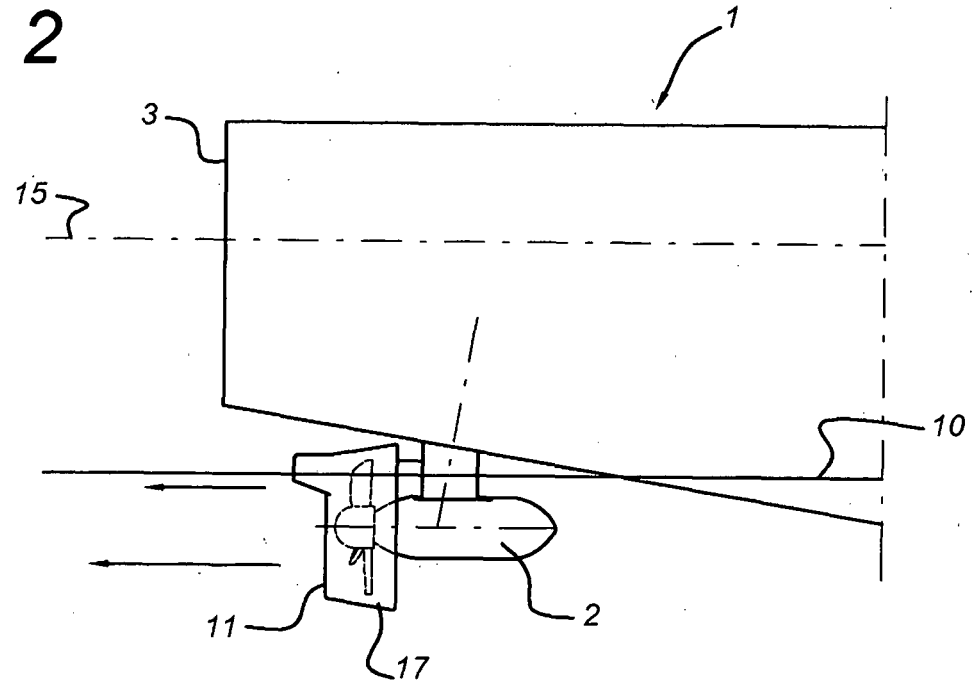


Fig. 3

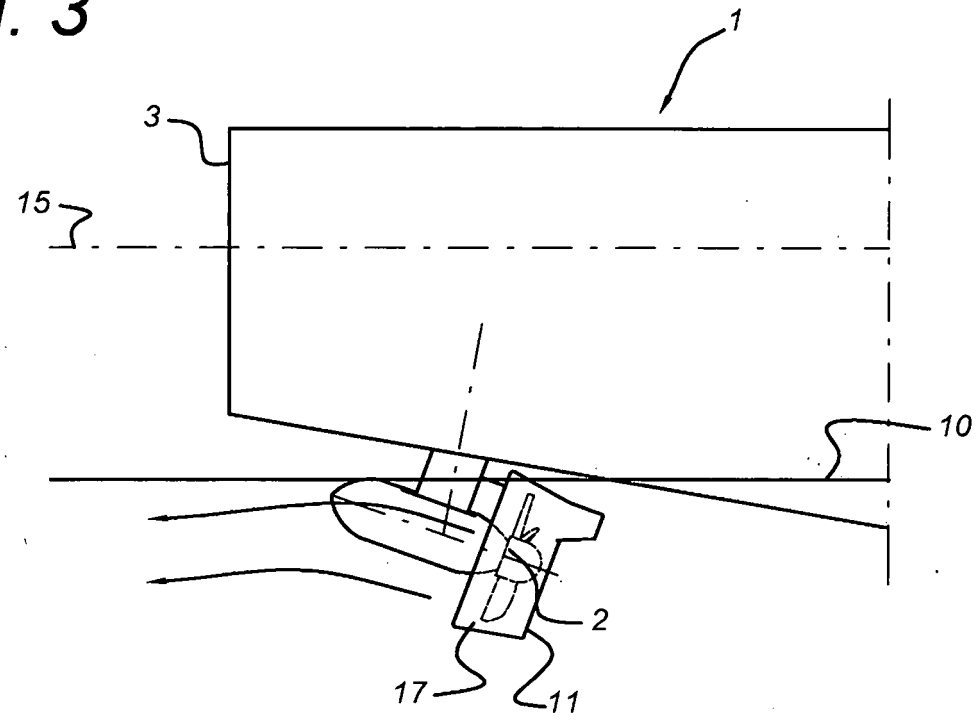


Fig. 4

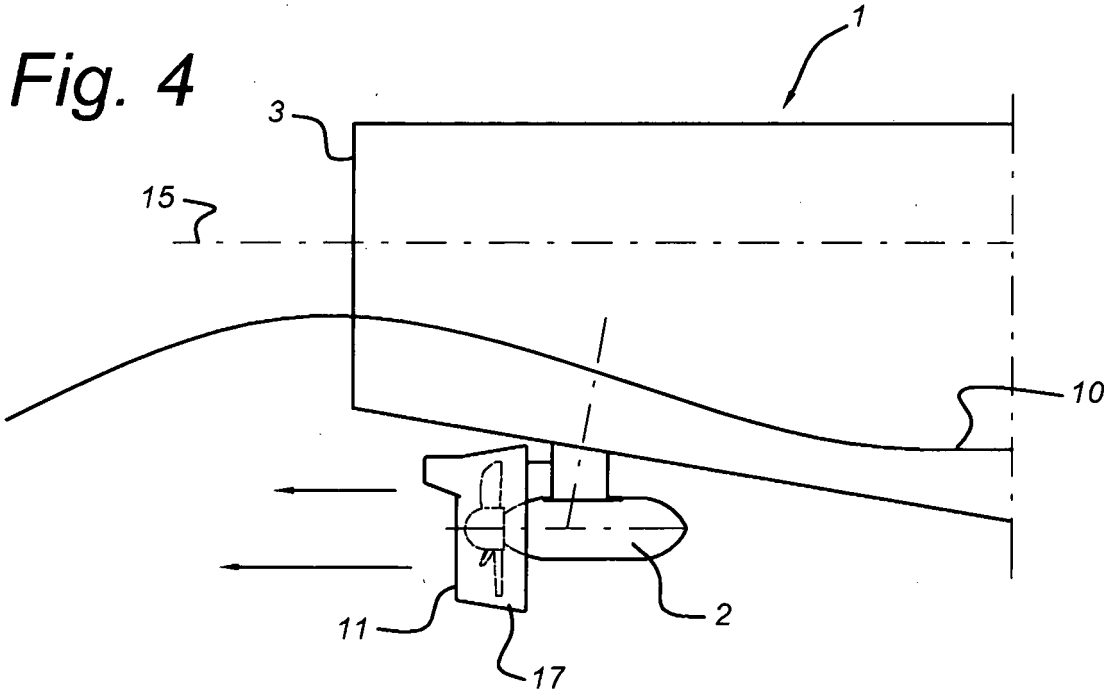


Fig. 5

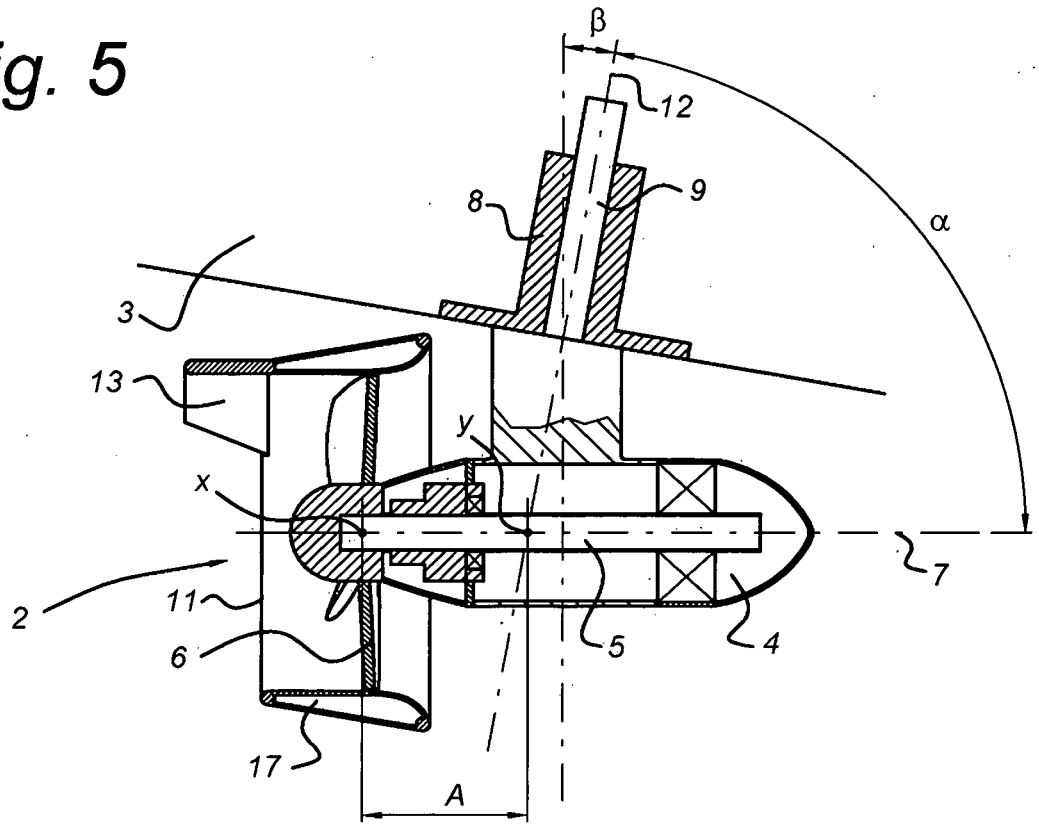


Fig. 6

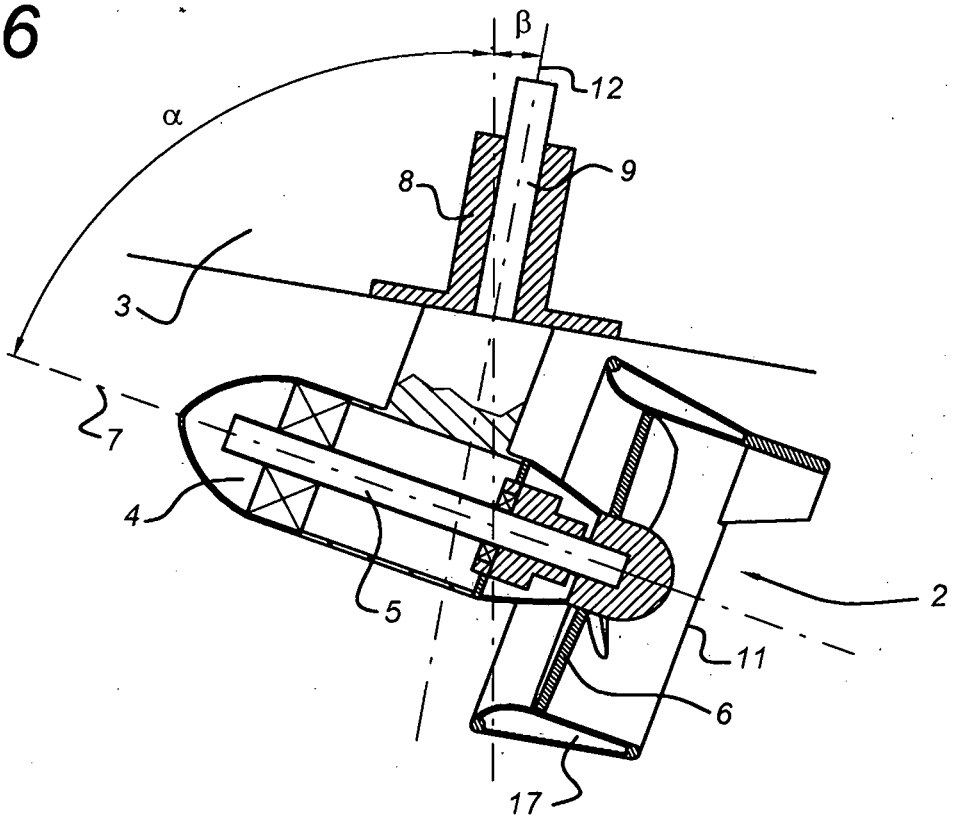


Fig. 7a

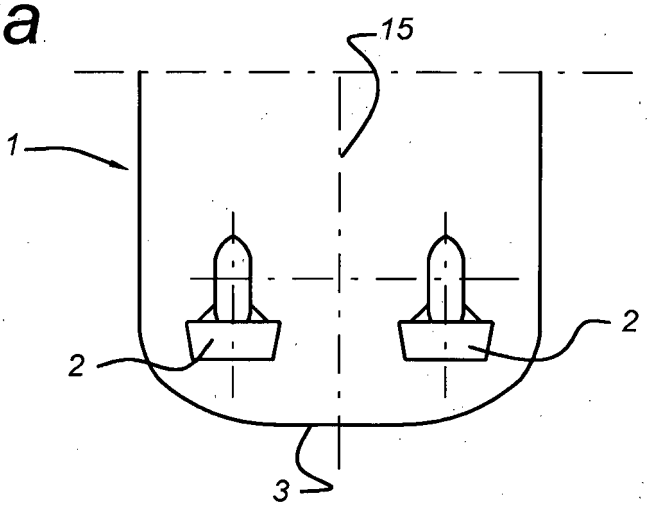


Fig. 7b

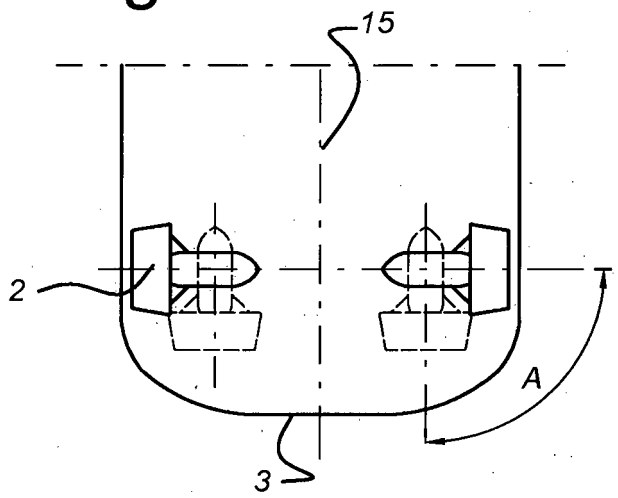


Fig. 7c

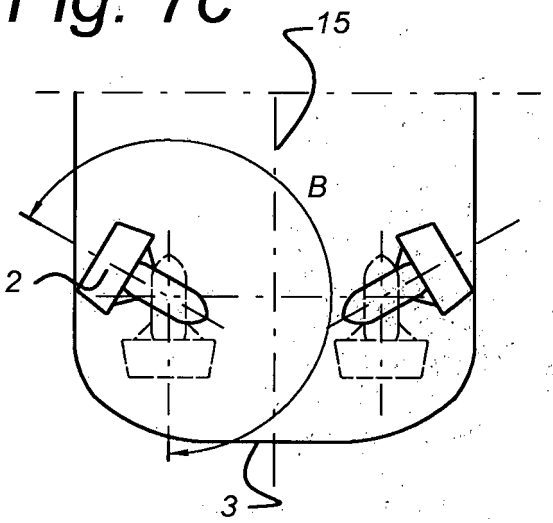


Fig. 7d

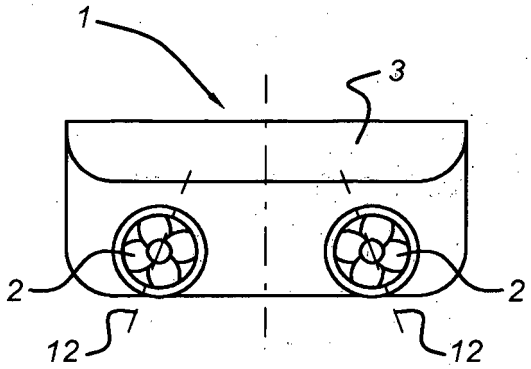
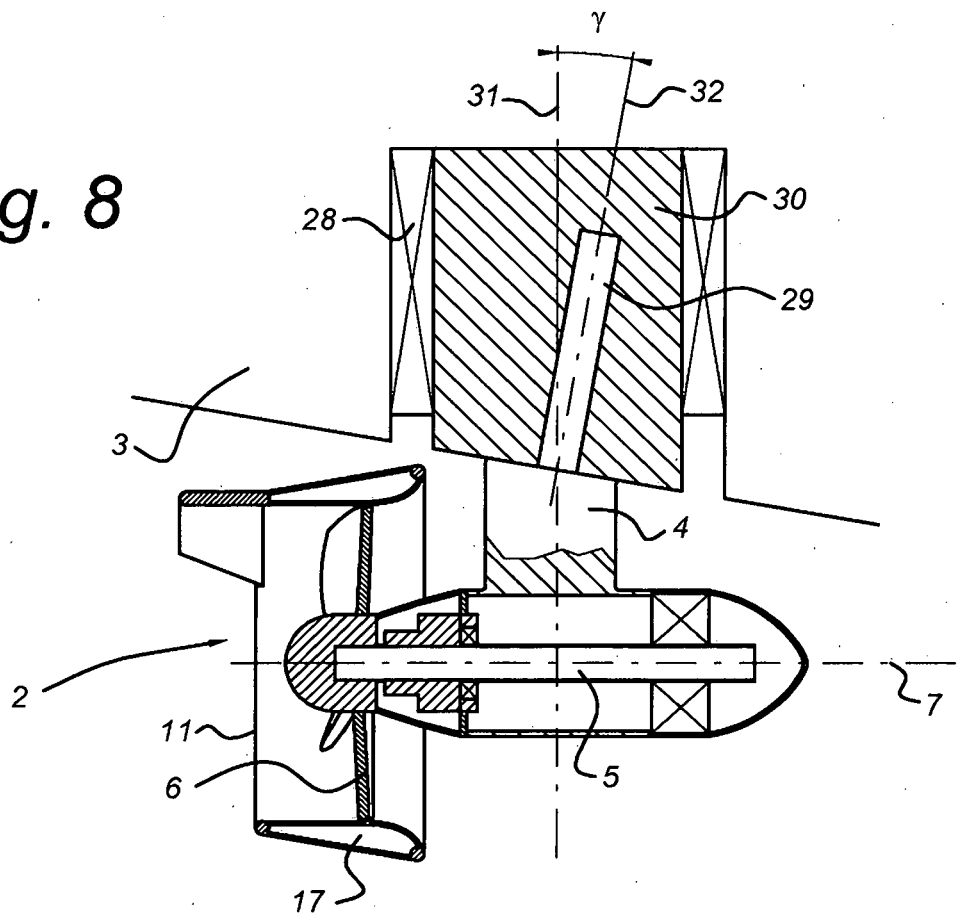


Fig. 8



REFERENCES CITED IN THE DESCRIPTION

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