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(54) **A METHOD OF PROVIDING A SHIP WITH A LARGE DIAMETER SCREW PROPELLER AND A SHIP HAVING A LARGE DIAMETER SCREW PROPELLER**

VERFAHREN ZUR AUSSTATTUNG EINES SCHIFFS MIT EINER ANTRIEBSSCHRAUBE VON HOHEM DURCHMESSER UND SCHIFF MIT ANTRIEBSSCHRAUBE VON HOHEM DURCHMESSER

PROCÉDÉ POUR ÉQUIPER UN NAVIRE D'UN PROPULSEUR À HÉLICE DE DIAMÈTRE IMPORTANT ET NAVIRE ÉQUIPÉ DE CELUI-CI

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Description

TECHNICAL FIELD

[0001] The present invention relates to a method of increasing propulsion efficiency and onboard ship comfort performance.

[0002] It also relates to a ship having a propeller arrangement that provides increased propulsion efficiency and onboard ship comfort performance.

[0003] The term "ship" as used herein designates a marine vessel that usually has enough size to carry its own boats, such as lifeboats, dinghies, or runabouts. A rule of thumb used is "a boat can fit on a ship, but a ship can't fit on a boat".

[0004] Further, the term "transom" as used herein designates the surface that forms the stem of a vessel. Transoms may be flat or curved and they may be vertical, raked forward (known as retroussé), or raked aft. The bottom tip of the transom can be approximately on the waterline, in which case the stem of the vessel is referred to as a "transom stern", or the hull can continue so that the centerline is well above the waterline before terminating in a transom, in which case it is referred to as a "counter stern".

BACKGROUND ART

[0005] One problem facing ship designers is that of keeping hull vibration to an acceptable level. Excessive vibration not only causes unpleasant noise in the vessel but may also produce dangerous stressing of the ship's structure. In addition, the forces causing hull vibration also cause other undesirable effects.

[0006] The problem of hull vibration arises more nowadays than in the past because ships are generally larger and more powerful. The increase in power results in an increase in the excitation forces which cause hull vibration and the increase in size makes the hull more susceptible to vibration by these forces

[0007] A principal cause of hull vibration is pressure fluctuations in the water generated by the propeller which act on the hull above the propeller. Due to variations in the wake across the propeller disc, that is, the area swept out by the propeller blades, the blades undergo substantial changes in loading as the propeller rotates. With a conventional single screw stem construction, the maximum wake at the propeller disc may be as much as eight times the minimum wake there. One effect of the rapidly changing loading on the propeller blades as the propeller rotates is to produce the strong pressure pulses in the water which excite hull vibrations and may cause serious cavitation erosion of the propeller blades.

[0008] In a conventional ship, the stem profile is curved rearwardly in an arc over the propeller and is then curved upwardly to form the aft extremity of the ship. This curved shape is necessary to provide the large clearance between the propeller and the part of the hull which lies above the propeller that is necessary in order to moderate the effects on the hull of the propeller-excited pressure fluctuations in the water, and to conform to the wake pattern produced by the rest of the ship. This curved shape is usually formed in one piece as a stern frame casting. For a 400,000 dwt ship, the stern frame may be 50 ft (15 m) high and weigh 600 tons. It is extremely expensive to manufacture and when it arrives at the shipyard it is often found to be twisted so that additional pieces have to be welded on to correct its shape.

[0009] US 3,983,829 suggests to solve this problem by making a complex profile adjacent the stern, comprising to improve the wake pattern and thereby enable fitting of a propeller of larger diameter. As is well known, improved propulsive efficiency can be obtained by reducing the shaft RPM and increasing the propeller diameter. However, as already mentioned the design suggested by US 3,983,829 is very complex and therefore indeed expensive, which most likely is one of the reasons why this known design from 1974 has never been a success on the market.

[0010] DE 33 03 554 A1 discloses a method and a ship according to the preamble of the annexed claims 1 and 8.

SUMMARY OF THE INVENTION

[0011] The object of the present invention is to permit the use of a large diameter screw propeller to increase propulsion efficiency and on board ship comfort performance, which is achieved in accordance with the present invention as defined in the appended claims.

[0012] The above solutions to the stated problem will facilitate the possibility of increasing propeller diameter without increasing the induced pressure impulses to the hull and thus make possible to gain propulsion efficiency and increase the on board ship comfort performance.

[0013] Further advantages and aspects of the invention will become evident by the independent claims and the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] In the following, the invention will be described in more detail with reference to preferred embodiments and the appended drawings.

Fig. 1 is a is a schematic side-view of a preferred embodiment of a ship having a rotary large diameter screw propeller included in a containerized propulsive unit in accordance with the present invention,

Fig. 2 is a simplified schematic side view of the stern of the ship of Fig. 1 having a containerized tiltable unit in a normal operating position,

Fig. 3 is a simplified schematic side view similar to Fig. 2, but with the containerized unit in a tilted

position to swing up the propeller blade tip to the level of the base line of the ship's hull,

Fig. 4 is a principle sketch showing the movement of the containerized unit on tilting,

Fig. 5 is a view from behind of a twin-screw ship based on a design according to Fig. land having one screw propeller in normal operation position and the other lifted by tilting the containerized unit,

Fig. 6 is a schematic view from above of the stern of the twin-screw ship shown in Fig. 5, showing *inter alia* a plurality of hydraulically controlled stud bolts, and

Fig. 7 is an enlarged view partly in cross section of one of the hydraulically controlled stud bolts shown in Fig. 6 for locking the container of the containerized tiltable unit in a recess in the transom of the ship.

MODE(S) FOR CARRYING OUT THE INVENTION

[0015] In Fig. 1 there is shown a schematic side-view of a ship 1. The ship 1 has a hull 10 having a base line 11, a stem 12, a stem 14 and a transom 13. In the stem 14 there is arranged a propulsion unit 2, comprising a propeller 20. An engine or motor 24 is arranged to drive the propeller 20. Fig. 1 also shows the waterline 16 (*i.e.* the "design waterline" corresponding to the waterline for the ship 1 when carrying a "standard load" for its use). Further, it is shown that the ship 1 is floating in water 4. The surface 40 of the water 4 is schematically shown as also the crest 41 of a rising wave formed at a distance behind transom 13 of the hull 10 when the ship 1 is propelled at cruising speed.

[0016] The propulsive units 6 are "containerized", *i.e.* they include "containers" that are modular housings 60 surrounding equipment for the proper operation of the propulsive unit 6. The hull design shown in Figs. 1 and 5 comprises a structure at the transom 13 including generally vertical recesses/pockets 13' (see Figs. 5 and 7) for the containers 60 of the propulsive units. Each container or housing 60 has its associated thruster unit or pod unit 6 fitted adjacent its lower end, and it extends vertically across the transom 13 and fits into the recess/pocket 13' having a sloping fore wall 13" (se figs.2 and 3). In the recess/pocket 13' the housing/container 60 may be tilted between a position where the tip of the propeller 20 extends below the base line 11 (fig. 2) and a up tilted position (fig. 3) where no tip of the propeller 20 extends below the base line 11. Thanks to the arrangement in accordance with the invention a larger propeller 20 may be used which provides considerable advantages. Further the arrangement easily facilitates positioning of the thruster unit or pod unit 6 at a location, where its propeller 20 will be positioned at a distance from the transom 13, which provides further advantages.

[0017] As is illustrated in figs. 1-3, the propeller 20 is mounted to be located at a distance behind the transom 13 of the hull 10. The distance aft of the transom is here shown to be chosen such that the propeller 20 will be positioned substantially centrally in relation to the crest of the rising stem wave 41, which in some situations may provide additional advantages, but such a positioning is in no way limiting regarding the basic principle of the invention.

[0018] In prior art designs, the diameter of the propeller normally is at most about 80 % of the distance H between the base line 11 and the waterline 16, since firstly the propeller may not extend below the base line 11, secondly there must be sufficient clearance between the propeller tip and the hull not to create vibrations and thirdly there must be a certain distance between the surface 40 and the propeller tip to not have air sucked in.

[0019] Thanks to the arrangement according to the invention it is feasible, as indicated in Figs. 1-3, to use a propeller 20 having an outer diameter that is much larger than traditionally, *i.e.* sometimes possibly even larger than the distance H between the base line 11 and the deadweight waterline 16. In this regard it is to be understood that the invention is applicable to a large variety of ships, from 10 dwt (preferably at least 100 dwt) to 500,000 dwt, i.e. ships using relatively large propellers of at least 0.5m, e.g. from 0.5-15 m in diameter. Indeed the main focus is seagoing commercial vessels where the invention may have a drastically positive influence regarding both cost and environmentally. As a consequence a much higher power output may be achieved, merely due to the larger propeller diameter. Indeed some 7-15 % increased output efficiency may be achieved merely by that parameter, in accordance with the invention. Further, the preferred positioning of the propeller 20 will eliminate any major impact regarding vibrations on the hull 10, which in turn provides improved comfort and indeed eliminates some traditional design restrictions. Moreover, it will also have a positive effect regarding load on the propeller 20, e.g. since the hull 10 may be designed to create fewer pulsations at this position, compared to being positioned ahead of the transom 13. An especially large propeller 20 may be used, in embodiments using the fact that the crest 41 is at a much higher level than the surrounding surface 40, mostly about 1-1.5 m higher for a midsized ship at cruising speed.

[0020] In the design shown in Fig. 1, the propulsive unit is a rotatable thruster, e.g. a pod unit 6. Primarily, the inventive concept is intended for pushing pod propellers and rotatable thrusters, but it is useful also with pulling units and non-rotatable thrusters. As a consequence, a very large propeller 20 may be used, which has it upper end near the deadweight waterline 16, but which at cruising speed is safely submerged in water thanks to the stem wave 41. As is conventional with pod units 6, the vertical extending portion thereof 30' may be formed to

act as a rudder. Here, the diameter D1 of the propeller 20 in some applications may be chosen within the range of about 85-100 % of the height H between the base line 11 and the waterline 16. However, in the embodiment shown in Fig. 3 it is illustrated that the propeller 20 might even be designed to be much larger, i.e. having D1 to be larger than 100 % of H, e.g. about 130 %. If desired, this may be achieved in combination with a control system, including a break pin 18 protruding deeper than the propeller tip and which is positioned near/at the stem 12 of the ship 1. This system is described more in detail in connection with Fig. 5.

[0021] Fig. 2 is a simplified schematic side view of the stem 14 of the ship of Fig. 1 presenting more details regarding the containerized tiltable unit 6 in a normal operating position. The container or housing 60 is substantially vertical and mounted in the transom recess or pocket 13', which has an forward sloping fore wall 13" for permitting the containerized propulsor to be tilted. Preferably, the unit 6 is designed to have sufficient buoyancy to float, which brings about some advantages, e.g. that it may be towed by a minor vessel in connection with exchange/mounting of a unit 6 to desired location for exchange/mounting. A tilting mechanism 62, e.g. hydraulic piston/s, is arranged within a pocket 63 of the fore wall 13", to enable movement/tilting. Thanks to the ability of tilting, a larger propeller may be used compared to conventional arrangements, due to allowing the propeller to extend below the baseline during propulsion on deep water. On shallow water the housing 60 may be tilted to such an extent, that the tip of the lowermost propeller blade 20 does not extend past the base line 11 of the ship as shown in Fig. 3. The slope of the forward sloping fore wall 13" is determined by the desired tilt of the containerized propulsor and is decided during the planning and designing of the ship. The propeller may preferably be located under the crest 41 of the stem wave rising behind the ship, and the tip of the lowermost propeller blade 20 extends downward past the base line 11 of the hull 10.

[0022] Fig.4 is a principle sketch showing the movement of the containerized unit 6 on tilting. The containerized unit 6 includes the propeller 20 having the diameter *D* and a rotational axis 20', and the container or housing 60 stands on a support plane 15. A slewing bearing 61 for permitting rotation of the propulsive unit 6 around a generally vertical axis 62 is provided at the bottom of the container or housing 60 and displaced toward a rear wall of the container or housing 60. A pivotal axis permitting the tilting of the containerized unit 6 in the recess or pocket 13' is designated 63 and is located in the corner formed by the front wall and the bottom of the container or housing 60. In Fig. 4,

- *A* is the distance between the support plane 15 and the rotational axis 20' of the propeller 20,
- *B* is the distance between the vertical rotational axis 62 of the propulsive unit 6 and a central plane of the propeller 20,
- *C* is the distance between the vertical rotational axis 62 of the propulsive unit 6 and the tilting axis 63,
- *D* is the diameter of the propeller 20,
- *E* is the distance between the tilting axis 63 and the support plane 15,
- *F* is the vertical distance that the propeller blade tip is lifted on tilting the containerized unit 6, and
- α is the tilt angle.

[0023] With a tilt angle α on the order of 10°, the propeller blade tip will be lifted a vertical distance *F* of about $0.15 \times D$. Fig. 4 clearly illustrates how the vertical distance *F* that the propeller blade tip at its bottom position is lifted depends on the tilt angle α and the sizes of and relations between *A*, *B*, *C*, *D*, and *E*. Of course, an increased propeller diameter may require that the propeller axis 20' be mounted at a lower level to avoid that the propeller blade tip at its normal top position, *i.e.* before tilting, cuts through the crest of the stem wave into the air.

[0024] In Fig. 5, there is shown a view from behind, *i.e.* presenting a ship 10 in accordance with the invention, equipped with a pair of propellers, but also using a single propeller is within the ambit of the invention.

[0025] Further, Fig. 5 depicts one embodiment of the present invention in combination with a specific control system for enabling automatic upward tilting of the housing 6, if the ship enters into a shallow area. In a forward part of the ship bottom 11, for example on the bulbous bow, there is mounted an/several actuation pin/s 18 protruding downwards, having a length L that positions the end of the pin 18 a sufficient distance beneath the base line 11, to protrude deeper than the distance that any tip of the propeller may reach beneath the base line 11. Preferably, the pin 18 is arranged to be retractable or pivotal or telescopic to enable it to "dip down" when needed, for instance in harbor or shallow water. If the actuation pin 18 is pivoted a signal will be sent to the control system (not shown) to engage the tilting system and tilt the housing 6 to the position in line with the forward sloping wall 13" thereby positioning the propeller 20 safely above the baseline 20. For a 100 m ship, the time frame for the control sequence would be about 28 seconds at 7 knots, which may be seen as a good margin for performing the tilting operation, that by means of a sufficiently powerful tilt-mechanism 62 may easily be performed within that time frame. At 5 knots it would be about 39 seconds. However, a combination of the tilting of the containerized propulsor with the possibility of stopping the propeller with its blades in a $\times$ position instead of a + position, and use of an auxiliary propulsion unit, e.g. a swing-down/up thruster (not shown), makes it possible to use still larger propellers. This will make it possible to increase the propeller diameter with some 30-40 %. It means that a running propeller may have its tip at about 40 % of the radius beneath the "base line". For a 4-blade propeller with a diameter of 5.3 m, it means that it is possible to increase the diameter to above 7 m with a loading that is half of

the original loading. This would give roughly at least 15 % improved propulsion efficiency.

[0026] Fig.6 is a schematic view from above of the stem of the twin-screw ship shown in Fig. 5, showing *inter alia* a plurality of retractable, controlled stud bolts 70 arranged in the side walls 13a, 13b of each pocket 13', used for securing the containers or housings 60 in at least two positions in the pocket 13', *viz.* the normal operating position and the tilted position. In fig. 6 there is indicated an encircled area depicting a stud bolt 70 schematically illustrated in Fig. 7, having a piston rod 71, which is axially displaceable by a conventional actuator, (e.g. hydraulic or screw mechanism not shown). The piston rod 71 has a free end carrying a head 72, having a tapered front portion. The side wall 13b of the pocket 13' is provided with a matching chamber 73, to provide a snug fit of the head 72 within the recess 73, which recess 73 can receive the entire head 72. (Alternatively the chamber 73 may also be tapered, and they are so matched to each other that only a portion of the tapered head 72 can be pushed out of the chamber 73). The container or housing 60 has a side wall provided with a recess 64 that has a taper matching that of the top portion of the tapered head 72. The taper ensures a positive locking of the containerized propulsor 6 in the desired position in the recess or pocket 13'. To facilitate loosening of the fit of the tapered head 72 against the tapered chamber 73 and the tapered recess 64, channels 74 and 65, respectively, are provided for injecting oil or grease between the tapered surfaces.

[0027] In summary, the following advantages may be gained by the invention;

- By increasing the propeller diameter at a given engine power supply, the distributed load on the propeller disc area is reduced. In practice this means that efficiency losses due to friction when accelerating the water is decreased and that the risk of the propeller sucking air from the atmosphere is reduced.
- Also, by allowing a more rearward positioning of the propeller, e.g. in the crest of the stern wave, the margin to air suction will be further improved.
- Also, by positioning the propeller away from the hull, the suction on the hull from the propeller (the so called thrust deduction factor) will be reduced, which together with the reduced water velocities also may be used to increase the hull efficiency.
- Reduced onboard vibrations and improved comfort,
- Furthermore, the total wave system of the hull may be used in a synergistic manner, i.e. reducing the total resistance of the hull.
- Improved flexibility regarding use of propulsion arrangement.

[0028] A further advantage in using "containerized propulsion units" relies in the fact that they may be easily/quickly exchanged, which brings about many advantages per se, e.g. quick exchange by another unit, e.g. if the existing one needs maintenance, without need of stoppage. Moreover it makes it possible to use different propulsion units depending/adapted to different needs, if a modularized concept is used that may provide a range of different propulsion units to optimize propulsion efficiency depending on need of power in relation to load and/or need of speed, etc.

[0029] The invention is not limited by the examples described above but may be varied within the scope of the appended claims. For instance, the skilled person realizes from the above mentioned advantages that the basic principle of the invention is not related to positioning the propeller in the event of the wave, but indeed to the fact of having the propeller tiltable an preferably in a position behind the transom, i.e. away from the hull. Further it is understood that in some cases, it may be advantageous to position a rudder in front of the containerized propulsor 6.

Claims

1. A method of providing a ship of at least 10dwt with a rotary screw propeller (20) at a stem of the ship hull (10), said method comprising:

   determining a design water line (16) of the ship and a base line (11) of the ship hull (10);
   determining a vertical distance (H) between the water line (16) and the base line (11);
   choosing a diameter of the screw propeller (20) that is at least 0.5m and 50 - 200% of the vertical distance (H);
   providing the screw propeller (20) in a propulsive unit (6),
   containerizing the propulsive unit (6) with a modular housing (60), the modular housing (60) surrounding equipment for the operation of the propulsive unit (6);
   characterized by
   providing at least one generally vertical recess (13') in a transom (13) of the hull (10), the recess (13') shaped to receive the modular housing (60), and tiltably mounting the modular housing (60) in said recess (13') using a tilting mechanism (62) arranged to tilt the modular housing (60), to enable moving/tilting of the screw propeller (20) between at least two different positions.

2. A method according to claim 1, **characterized by** mounting the propeller (20) at a distance behind the transom (13).

3. A method according to claim 1 or 2, wherein the modular housing (60) is tiltable between at least two different positions comprising:

a cruising position, in which at least a part of the screw propeller (20) extends below the base line (11),and
a second position, in which no part of the screw propeller (20) is below the base line (11), and the modular housing (60) may be secured mechanically in the recess (13') in transom (13) in at least the two different positions.

4. A method as claimed in claim 3, wherein, in the cruising position, at least part of the screw propeller (20) extends above the design water line (16), but is submerged under an expected crest (41) of a rising stem wave when the ship is propelled at a cruising speed.

5. A method as claimed in any preceding claim, wherein the propulsive unit (6) can be tilted an angle on the order of 5 - 20°, preferably 5 - 15°.

6. A method as claimed in any one of claims 1-5, wherein said propulsive unit (6) is arranged with sufficient buoyancy to float, wherein preferably said buoyancy mainly is provided for in said modular housing (60).

7. A method as claimed in any one of claims 1-6, wherein the screw propeller (20) has a diameter that is 85-150 %, of the vertical distance (H).

8. A ship having at least 10dwt and comprising a hull (10), a stem (14) comprising a transom (13), and a screw propeller (20), the ship having:

a design water line (16) of the ship;
a base line (11) of the hull (10); and
a vertical distance (H) between the water line (16) and the base line (11);
characterized in that:

the screw propeller (20) has a diameter that is at least 0.5m and 50-200% of the vertical distance (H);
the screw propeller (20) is provided as a propulsive unit (6) containerized with a modular housing (60) surrounding equipment for the operation of the propulsive unit (6);
characterized in that
the transom (13) includes at least one generally vertical recess (13') shaped to receive the modular housing (60) and a tilting mechanism (62) arranged to tilt the modular housing (60); and
in that
the modular housing (60) is tiltably mounted in the recess (13') such that the screw propeller (20) may be moved/tilted between at least two different positions.

9. A ship as claimed in claim 8, further comprising a securing arrangement (70) arranged to secure said modular housing (60) in the recess (13') in the transom (13) in the two different positions.

10. A ship as claimed in claim 9, wherein a first position is a normal cruising position and a second position is where no part of the rotary screw propeller (20) is located below the a base line (11).

11. A ship as claimed in any of claims 8-10, wherein the tilting mechanism (62) is arranged to tilt the modular housing (60) an angle on the order of 5 - 20°, preferably 5 - 15°.

12. A ship as claimed in any one of claims 8 - 11, wherein the propeller (20) is positioned at a distance behind the transom (13) and preferably such that the propeller (20) will be submerged under the crest (41) of the wave when propelling the ship at cruising speed.

13. A ship as claimed in any one of claims 8 - 12, wherein the ship is at least 100 dwt and the housing (60) is pivotable to extend at least an upper tip of the propeller above the water line in at least one position and to extend a lower tip of the propeller below the base line in at least another position.

14. A ship as claimed in any of claims 8 - 13, said ship having a single screw propeller (20).

15. A ship as claimed in any of claims 8 - 13, said ship being a twin-screw ship.

16. A ship as claimed in any of claims 8 -15, said ship being a multi-propulsive ship.

17. A ship as claimed in any of claims 8-16, wherein the propeller (20) has a diameter that is larger than the distance (H) between the water line (16) and the base line (11)

18. A ship as claimed in any of claims 8-17, wherein the two different positions include:

a cruising position in which a lowermost tip of the screw propeller (20) extends below the base line (11), and
a second position in which the lowermost tip of the screw propeller (20) does not extend below the base line (11).

Patentansprüche

1. Verfahren, um ein Schiff mit mindestens 10 DWT mit einem drehbaren Schraubenpropeller (20) an einem Heck des Schiffrumpfs (10) zu versehen, wobei das Verfahren umfasst:

Bestimmen einer Auslegungs-Wasserlinie (16) des Schiffs und einer Grundlinie (11) des Schiffrumpfs (10);
Bestimmen einer vertikalen Entfernung (H) zwischen der Wasserlinie (16) und der Grundlinie (11);
Auswählen eines Durchmessers des Schraubenpropellers (20), der mindestens 0,5 m und 50-200% der vertikalen Entfernung (H) beträgt;
Bereitstellen des Schraubenpropellers (20) in einer Antriebseinheit (6);
Verkleiden der Antriebseinheit (6) mit einem modularen Gehäuse (60), wobei das modulare Gehäuse (60) Ausrüstung für den Betrieb der Antriebseinheit (6) umgibt;
gekennzeichnet durch
Bereitstellen von mindestens einer allgemein vertikalen Aussparung (13') in einem Heckspiegel (13) des Rumpfs (10), wobei die Aussparung (13') geformt ist, um das modulare Gehäuse (60) aufzunehmen, und wobei das modulare Gehäuse (60) neigbar in der Aussparung (13') angebracht ist unter Verwendung eines Neigungsmechanismus' (62), der eingerichtet ist, das modulare Gehäuse (60) zu neigen, um ein Bewegen/Neigen des Schraubenpropellers (20) zwischen mindestens zwei verschiedenen Positionen zu ermöglichen.

2. Verfahren nach Anspruch 1, **gekennzeichnet durch** Anbringen des Propellers (20) in einer Entfernung hinter dem Heckspiegel (13).

3. Verfahren nach Anspruch 1 oder 2, wobei das modulare Gehäuse (60) zwischen mindestens zwei verschiedenen Positionen geneigt werden kann, umfassend:

eine Reiseposition, in der sich mindestens ein Teil des Schraubenpropellers (20) unterhalb der Grundlinie (11) erstreckt; und
eine zweite Position, in der sich kein Teil des Schraubenpropellers (20) unterhalb der Grundlinie (11) erstreckt, und wobei das modulare Gehäuse (60) in der Aussparung (13') im Heckspiegel (13) mechanisch in mindestens zwei verschiedenen Positionen gesichert werden kann.

4. Verfahren nach Anspruch 3, wobei sich in der Reisestellung mindestens ein Teil des Schraubenpropellers (20) oberhalb der Auslegungswasserlinie (16) erstreckt, aber unterhalb einer erwarteten Krone (41) einer ansteigenden Heckwelle eingetaucht ist, wenn das Schiff bei einer Reisegeschwindigkeit angetrieben wird.

5. Verfahren nach irgendeinem vorhergehenden Anspruch, wobei die Antriebseinheit (6) in einem Winkel der Größenordnung 5-20°, bevorzugt 5-15° geneigt werden kann.

6. Verfahren nach einem der vorhergehenden Ansprüche 1-5, wobei die Antriebseinheit (6) mit ausreichendem Auftrieb eingerichtet ist, um zu schwimmen, wobei der Auftrieb bevorzugt hauptsächlich in dem modularen Gehäuse (60) bereitgestellt wird.

7. Verfahren nach einem der vorhergehenden Ansprüche 1-6, wobei der Schraubenpropeller (20) einen Durchmesser aufweist, der 85-150% der vertikalen Entfernung (H) entspricht.

8. Schiff mit mindestens 10 DWT und umfassend einen Rumpf (10), ein Heck (14) umfassend einen Spiegel (13), und einen Schraubenpropeller (20), wobei das Schiff aufweist:

eine Auslegungswasserlinie (16) des Schiffs;
eine Grundlinie (11) des Rumpfs (10); und
eine vertikale Entfernung (H) zwischen der Wasserlinie (16) und der Grundlinie (11);
dadurch gekennzeichnet, dass
der Schraubenpropeller (20) einen Durchmesser aufweist, der mindestens 0,5 m und 50-200% der vertikalen Entfernung (H) beträgt;
der Schraubenpropeller (20) als eine Antriebseinheit (6) bereitgestellt ist, die durch ein modulares Gehäuse (60) verkleidet ist, das die Ausrüstung für den Betrieb der Antriebseinheit (6) umgibt;
dadurch gekennzeichnet, dass
der Heckspiegel (13) mindestens eine allgemein vertikale Aussparung (13') aufweist, die geformt ist, das modulare Gehäuse (60) aufzunehmen, und einen Neigungsmechanismus (62), der eingerichtet ist, um das modulare Gehäuse (60) zu neigen; und
dass das modulare Gehäuse (60) neigbar in der Aussparung (13') angebracht ist, so dass der Schraubenpropeller (20) zwischen mindestens zwei verschiedenen Positionen bewegt/geneigt werden kann.

9. Schiff nach Anspruch 8, weiter umfassend eine Sicherungsanordnung (70), die eingerichtet ist, das modulare Gehäuse (60) in zwei verschiedenen Positionen in der Aussparung (13') des Heckspiegels (13) zu sichern.

10. Schiff nach Anspruch 9, wobei eine erste Position eine normale Reiseposition ist und eine zweite Position derart ist, dass sich dort kein Teil des drehbaren Schraubenpropellers (20) unterhalb der Grundlinie (11) befindet.

11. Schiff nach einem der Ansprüche 8-10, wobei der

Neigemechanismus (62) eingerichtet ist, das modulare Gehäuse (60) in einem Winkel der Größenordnung 5-20°, bevorzugt 5-15° zu neigen.

12. Schiff nach einem der Ansprüche 8-11, wobei der Propeller (20) in einer Entfernung hinter dem Heckspiegel (13) und bevorzugt so positioniert ist, dass der Propeller (20) unter der Krone (41) der Welle eingetaucht ist, wenn das Schiff bei Reisegeschwindigkeit angetrieben wird.

13. Schiff nach einem der Ansprüche 8-12, wobei das Schiff mindestens 100 DWT aufweist und das Gehäuse (60) schwenkbar ist, so dass mindestens eine obere Spitze des Propellers sich in mindestens einer Position oberhalb der Wasserlinie erstreckt und sich in mindestens einer anderen Position eine untere Spitze des Propellers unterhalb der Grundlinie erstreckt.

14. Schiff nach einem der Ansprüche 8-13, wobei das Schiff einen einzelnen Schraubenpropeller (20) aufweist.

15. Schiff nach einem der Ansprüche 8-13, wobei das Schiff ein Doppelschraubenschiff ist.

16. Schiff nach einem der Ansprüche 8-15, wobei das Schiff ein mehrfach angetriebenes Schiff ist.

17. Schiff nach einem der Ansprüche 8-16, wobei der Propeller (20) einen Durchmesser aufweist, der größer als die Entfernung (H) zwischen der Wasserlinie (16) und der Grundlinie (11) ist.

18. Schiff nach einem der Ansprüche 8-17, wobei die zwei verschiedenen Positionen einschließen:

eine Reiseposition, in der sich eine unterste Spitze des Schraubenpropellers (20) unterhalb der Grundlinie (11) erstreckt; und
eine zweite Position, in der sich die unterste Spitze des Schraubenpropellers (20) nicht unterhalb der Grundlinie (11) erstreckt.

Revendications

1. Procédé pour équiper un navire d'au moins 10 tpl d'un propulseur à hélice rotative (20) au niveau d'une poupe de la coque du navire (10), ledit procédé comprenant :

la détermination d'une ligne de flottaison de calcul (16) du navire et d'une ligne de base (11) de la coque du navire (10) ;
la détermination d'une distance verticale (H) entre la ligne de flottaison (16) et la ligne de base (11) ;
le choix d'un diamètre du propulseur à hélice (20) qui est d'au moins 0,5 m et qui représente 50-200 % de la distance verticale (H) ;
la fourniture du propulseur à hélice (20) dans une unité de propulsion (6), la containerisation de l'unité de propulsion (6) avec un logement modulaire (60), le logement modulaire (60) entourant un équipement pour le fonctionnement de l'unité de propulsion (6) ;
caractérisé par
la fourniture d'au moins un évidement généralement vertical (13') dans une arcasse (13) de la coque (10), l'évidement (13') étant formé pour recevoir le logement modulaire (60), et le montage de façon inclinée du logement modulaire (60) dans ledit évidement (13') au moyen d'un mécanisme d'inclinaison (62) agencé pour incliner le logement modulaire (60), pour permettre le déplacement/l'inclinaison du propulseur à hélice (20) entre au moins deux positions différentes.

2. Procédé selon la revendication 1, **caractérisé par** le montage du propulseur (20) à une certaine distance derrière l'arcasse (13).

3. Procédé selon la revendication 1 ou 2, dans lequel le logement modulaire (60) peut être incliné entre au moins deux positions différentes comprenant :

une position de croisière, dans laquelle au moins une partie du propulseur à hélice (20) s'étend sous la ligne de base (11), et
une seconde position, dans laquelle aucune partie du propulseur à hélice (20) n'est sous la ligne de base (11), et le logement modulaire (60) peut être fixé mécaniquement dans l'évidement (13') dans l'arcasse (13) dans au moins les deux positions différentes.

4. Procédé selon la revendication 3, dans lequel, dans la position de croisière, au moins une partie du propulseur à hélice (20) s'étend au-dessus de la ligne de flottaison de calcul (16), mais est submergée sous une crête attendue (41) d'une vague de poupe montante lorsque le navire est propulsé à une vitesse de croisière.

5. Procédé selon l'une quelconque des revendications précédentes, dans lequel l'unité de propulsion (6) peut être inclinée selon un angle de l'ordre de 5-20°, de préférence de 5-15°.

6. Procédé selon l'une quelconque des revendications 1 à 5, dans lequel ladite unité de propulsion (6) est dotée d'une flottabilité suffisante pour flotter, dans lequel de préférence ladite flottabilité est principale-

ment fournie dans ledit logement modulaire (60).

7. Procédé selon l'une quelconque des revendications 1 à 6, dans lequel le propulseur à hélice (20) présente un diamètre qui représente 85-150 % de la distance verticale (H).

8. Navire d'au moins 10 tpl comprenant une coque (10), une poupe (14) comprenant une arcasse (13), et un propulseur à hélice (20), le navire présentant :

une ligne de flottaison de calcul (16) du navire ;
une ligne de base (11) de la coque (10) ; et
une distance verticale (H) entre la ligne de flottaison (16) et la ligne de base (11) ; **caractérisé en ce que** :

le propulseur à hélice (20) présente un diamètre qui est d'au moins 0,5 m et qui représente 50-200 % de la distance verticale (H) ;
le propulseur à hélice (20) est fourni sous la forme d'une unité de propulsion (6) conteneurisée avec un logement modulaire (60) entourant un équipement pour le fonctionnement de l'unité de propulsion (6) ;
caractérisé en ce que
l'arcasse (13) comprend au moins un évidement généralement vertical (13') formé pour recevoir le logement modulaire (60) et un mécanisme d'inclinaison (62) agencé pour incliner le logement modulaire (60) ; et
en ce que
le logement modulaire (60) est monté de manière à pouvoir être incliné dans l'évidement (13') de sorte que le propulseur à hélice (20) puisse être déplacé/incliné entre au moins deux positions différentes.

9. Navire selon la revendication 8, comprenant en outre un agencement de fixation (70) agencé pour fixer ledit logement modulaire (60) dans l'évidement (13') dans l'arcasse (13) dans les deux positions différentes.

10. Navire selon la revendication 9, dans lequel une première position est une position de croisière normale et une seconde position est une position dans laquelle aucune partie du propulseur à hélice rotative (20) n'est située sous la ligne de base (11).

11. Navire selon l'une quelconque des revendications 8 à 10, dans lequel le mécanisme d'inclinaison (62) est agencé pour incliner le logement modulaire (60) selon un angle de l'ordre de 5-20°, de préférence de 5-15°.

12. Navire selon l'une quelconque des revendications 8 à 11, dans lequel le propulseur (20) est positionné à une certaine distance derrière l'arcasse (13) et de préférence de sorte que le propulseur (20) soit submergé sous la crête (41) de la vague lors de la propulsion du navire à une vitesse de croisière.

13. Navire selon l'une quelconque des revendications 8 à 12, dans lequel le navire est d'au moins 100 tpl et le logement (60) peut pivoter pour étendre au moins une extrémité supérieure du propulseur au-dessus de la ligne de flottaison dans au moins une position et pour étendre une extrémité inférieure du propulseur sous la ligne de base dans au moins une autre position.

14. Navire selon l'une quelconque des revendications 8 à 13, ledit navire comprenant un seul propulseur à hélice (20).

15. Navire selon l'une quelconque des revendications 8 à 13, ledit navire étant un navire à hélices jumelles.

16. Navire selon l'une quelconque des revendications 8 à 15, ledit navire étant un navire à éléments de propulsion multiples.

17. Navire selon l'une quelconque des revendications 8 à 16, dans lequel le propulseur (20) présente un diamètre qui est supérieur à la distance (H) entre la ligne de flottaison (16) et la ligne de base (11).

18. Navire selon l'une quelconque des revendications 8 à 17, dans lequel les deux positions différentes comprennent :

une position de croisière dans laquelle l'extrémité la plus inférieure du propulseur à hélice (20) s'étend sous la ligne de base (11), et
une seconde position dans laquelle l'extrémité la plus inférieure du propulseur à hélice (20) ne s'étend pas sous la ligne de base (11).

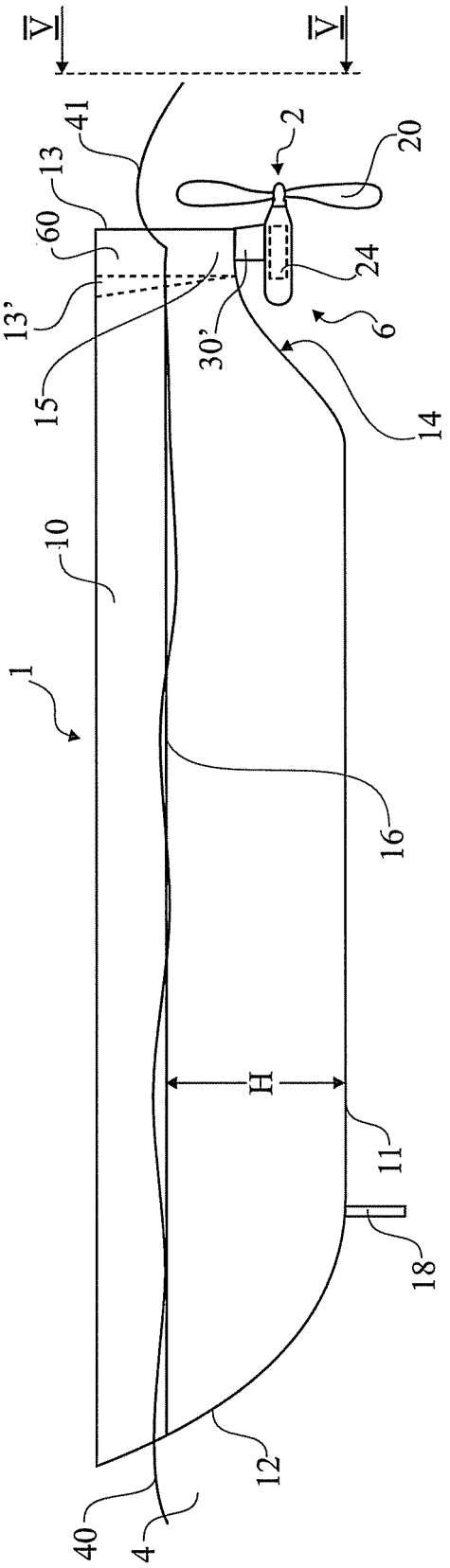


Fig. 1

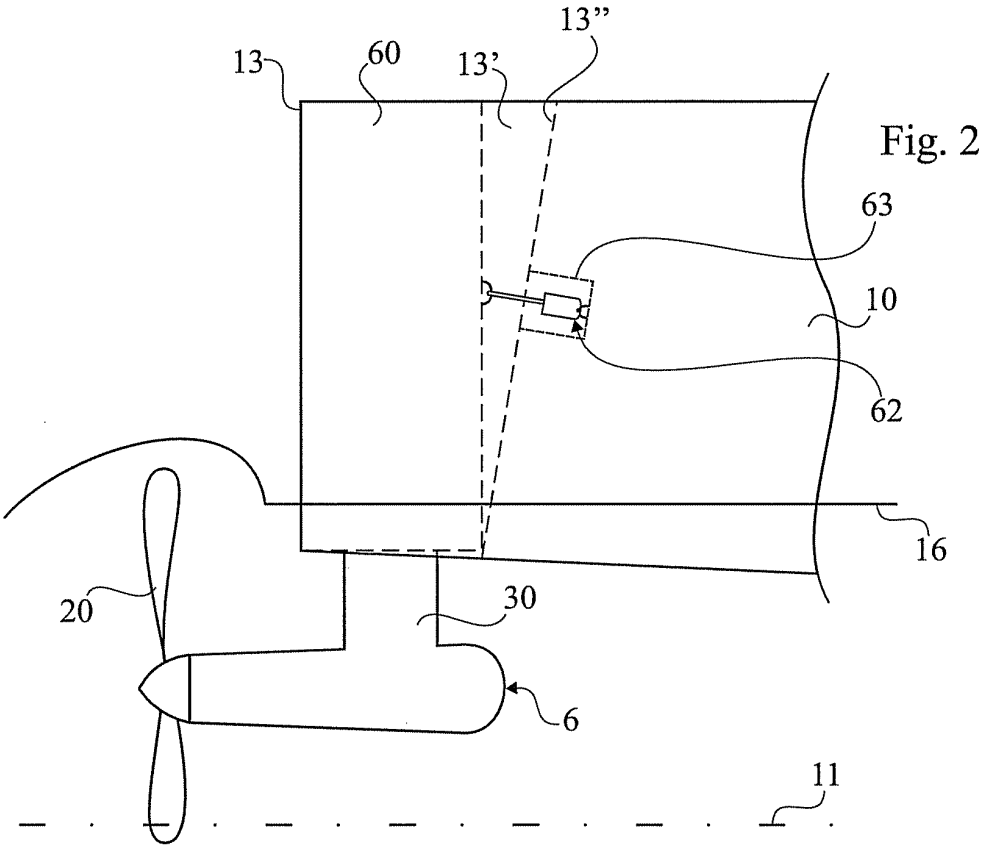


Fig. 2

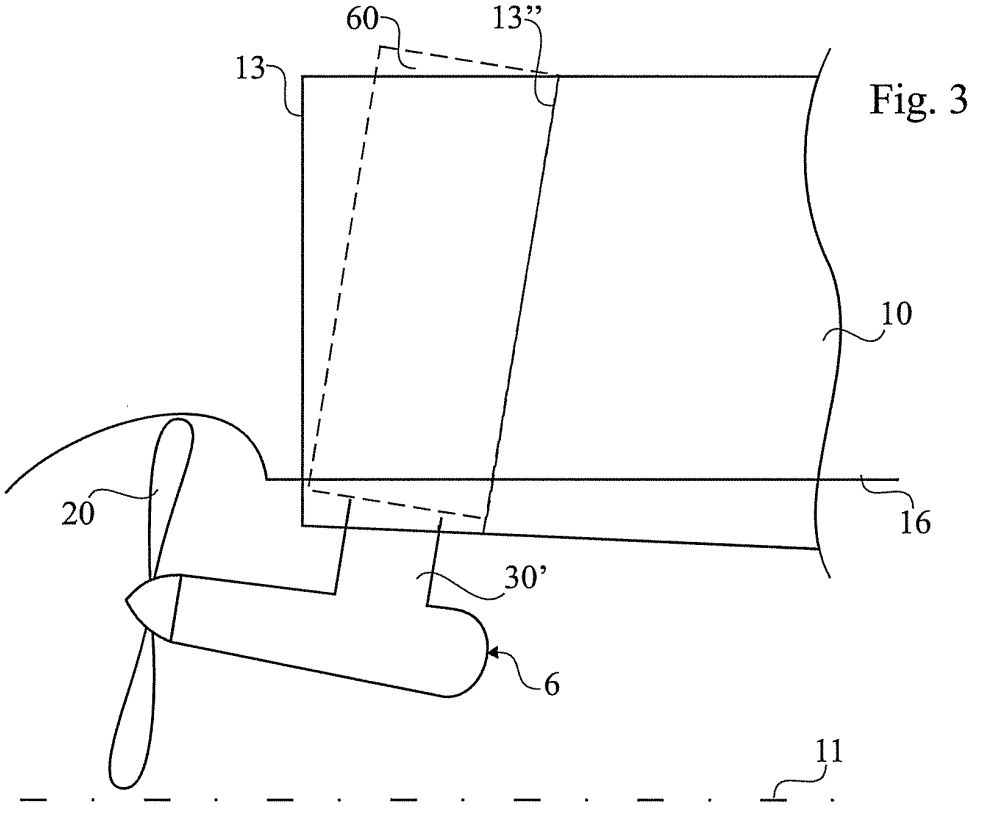


Fig. 3

Fig. 4

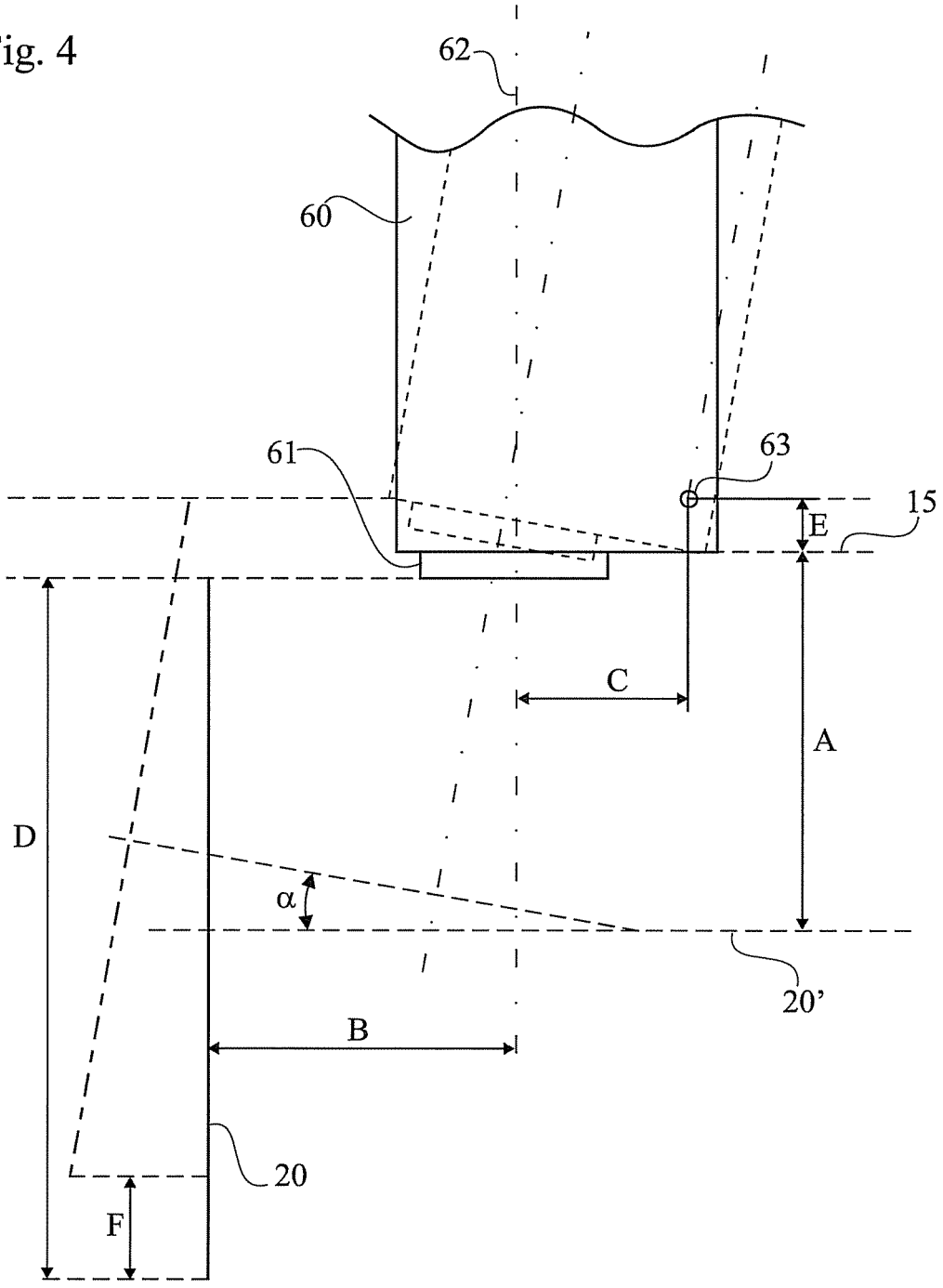


Fig. 5

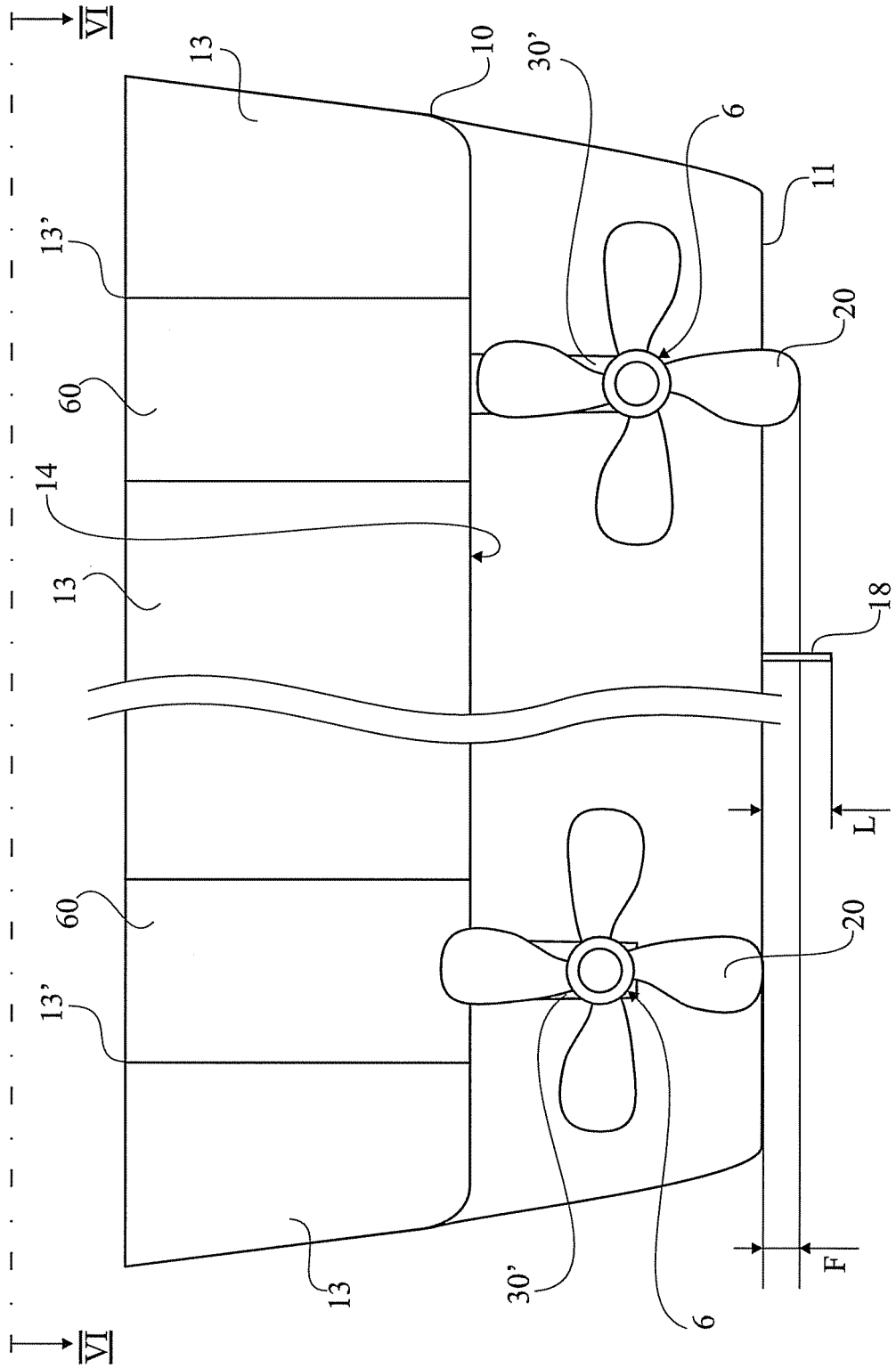


Fig. 6

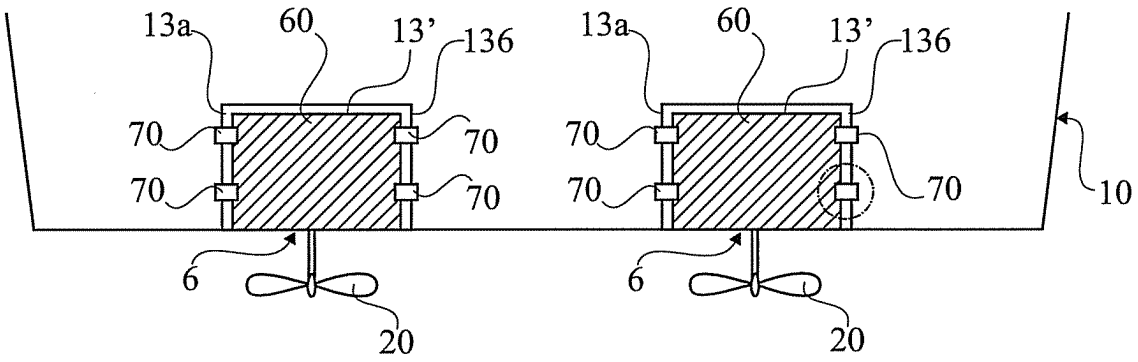
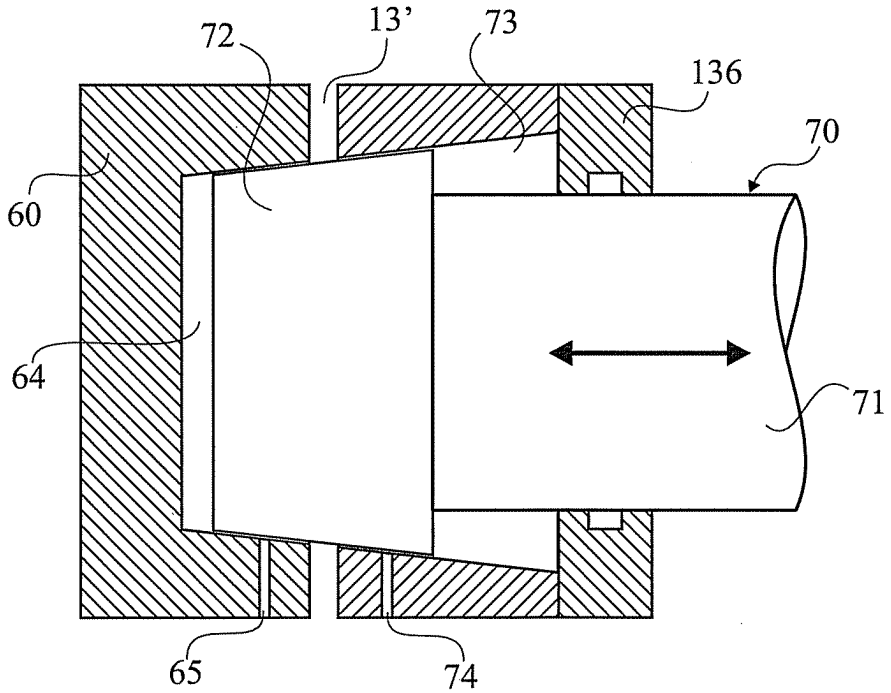

13a
60
13'
136
70
70
70
70
13a
60
13'
136
70
70
70
10
6
20
6
20

Fig. 7


72
13'
73
136
70
60
64
71
65
74

REFERENCES CITED IN THE DESCRIPTION

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