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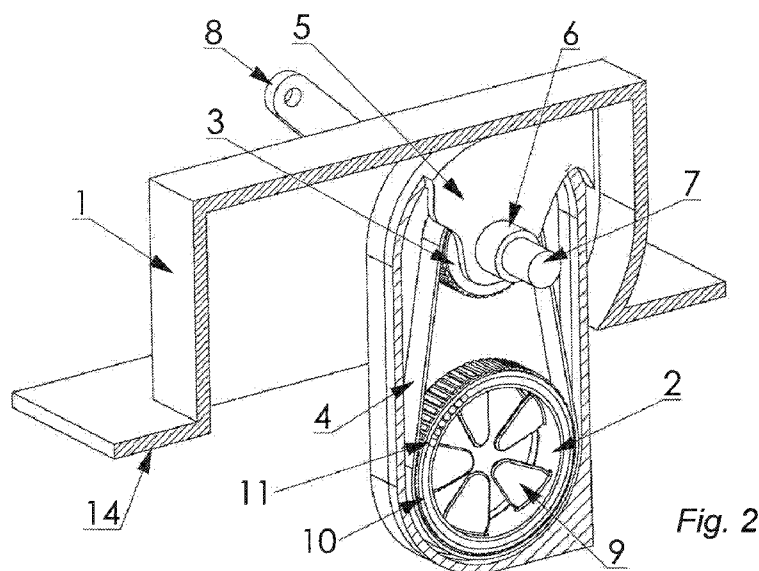
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(54) Title: BOW THRUSTER



(57) Abstract: The invention relates to an operation device for marine vessels, comprising a housing (1), a propeller (2) peripherally journaled in a bearing (11), said bearing being fixedly arranged in said housing, and a driving device (4) for rotating said propeller (2). The operation device is characterized in that the bearing is water lubricated. The invention further relates to a marine vessel, comprising such an operation device.

BOW THRUSTER

Technical field

The present invention relates generally to a marine operation device used on a marine vessel as bow or stern thruster or main drive. More particularly, the present invention relates to an operation device for marine
5 vessels as defined in the introductory parts of claim 1.

Background art

Thruster devices for marine vessels are used to give the vessel manoeuvring possibilities not possible to achieve using only the rudder and
10 the main drive. A thruster is in principle not very different from a main drive of a marine vessel, but is often not as powerful. The most common thruster for small and medium sized marine vessels are bow thrusters driving the bow either to the starboard or to the port side when used e.g. in a mooring operation of the vessel.

15 A common way to arrange a bow thruster is to install a pipe in the hull, through the stem, perpendicular to the centreline of the vessel. In the middle of the pipe, a propeller is installed having an engine, often electrical, in the boat on the outside of the pipe. This pipe is naturally installed under the waterline and at a place in the hull where the pipe can be kept as short as
20 possible. This arrangement is static and robust since the propeller is protected inside the pipe from damage by larger objects in the water.

A problem with installing a pipe through the stem is the influence it has on the hull shape, in terms of turbulence and water resistance. One solution to that problem is to instead of a pipe, use a hatch in the hull that can be
25 submerged from the hull under side together with a propeller. One such solution is shown in the patent US 4,294,186, where a bow thruster is folded down from the hull and a propeller is driven via two gears. The propeller is held by the device housing and slides against a recess in the housing.

Another way of avoiding water resistance and turbulence of a pipe
30 through the stern is to have a, to the hull, externally arranged foldable propeller arrangement as e.g. shown in the patent US 7,644,675. This example has an engine coupled to a driving axis and a belt that drives a

propeller having a peripheral ball bearing. The arrangement is mounted on the outside of hull at the stem or stern of the vessel above the water line. The arrangement is hinged around the driving axis and can be folded to place the propeller under water. The arrangement having the propeller above water
5 when not used, limits the problems of turbulence and water resistance.

The solutions according to the state of the art suffer from a number of drawbacks. The gear-driven foldable propeller arrangement of US 4,294,186 is complicated, and thus expensive. The complicated structure with gears make the construction less reliable and difficult to repair. The solution also
10 lacks a bearing having the propeller simply sliding against the housing, which will reduce the efficiency of the propeller.

The belt driven solution of US 7,644,675 also suffer from weaknesses. The solution has a peripheral ring bearing for the propeller that is lubricated with oil, which has a number of drawbacks. The bearing is hard to seal
15 completely since the bearing is mounted with the propeller. If leakage occur it is a hazard to the marine environment. The manufacturing of the bearing also require a very accurate manufacturing process to work correctly. To keep out water from the bearing, oil lubricated ball bearings are often pressurized to keep water from leaking, increasing the risk of oil leakage if the sealing of the
20 bearing is damaged.

The bow thrusters according to the state of the art are often heavy designs which is motivated by a certain amount of ruggedness. This is a problem for performance boats, especially sailing yachts where extra weight is a drawback that potentially slow the boat to some degree.

25

Summary of the invention

It is an object of the present invention to improve the current state of the art, to solve the above problems, and to provide a bow and/or stern thruster and/or main drive for marine vessels that reduces water resistance
30 and turbulence and providing a light weight alternative for performance boats. These and other objects are achieved by an operation device for marine vessels, comprising a housing, a propeller peripherally journaled in a bearing, said bearing being fixedly arranged in said housing, and a driving device for

rotating said propeller. The operation device is characterized in that said bearing is water lubricated.

The marine vessel can be any marine vessel from a small sailing yacht to a big motor yacht or a ferry.

- 5 The use of a bearing enhance the propeller efficiency compared to solutions not having a bearing. Using a water lubricated bearing is an environmental friendly solution that avoids the risk of oil leakage which is a potential environmental hazard. It is also not needed to pressurize the bearing and the sealing of the bearing is not as crucial as for an oil lubricated bearing.
- 10 This will keep maintenance at a minimum and lead to a cheaper and more robust solution for marine use, that is well suited for the tough conditions prevailing in marine environments without the risk of damage.

 The peripherally journalled propeller has the advantage over the prior art that it can be built in light weight materials such as carbon fibre materials, which is an advantage to yachts where weight has to be kept at a minimum for performance reasons.

- It is further preferred that the bearing is a ball bearing, although the bearing could be of some other type as e.g. plain bearings, other types of rolling-element bearings, jewel bearings or fluid bearings. It is also preferred that the bearing is corrosion resistant to withstand lubrication by ocean water as well as the tough marine conditions. If the balls of the bearing corrode, the efficiency of the bearing will decrease substantially.

- According to a preferred embodiment of the present invention the driving device is further mechanically connected to said propeller. A mechanical connection is an advantageous way to be able to place the driving device at a remote location, due to simplicity and ruggedness. It is further preferred that the driving device is mechanically connected to said propeller by means of a belt. Using a belt is a robust, potentially corrosion free, and cheap solution to enable a remote location of the driving mechanism. Although a belt is preferred, the connection could also be achieved by gears, shafts, or through magnetism.

 It is further preferred that the driving device is an electric or hydraulic motor. The driving mechanism can, however, also be a hydraulic device, or a

normal combustion motor connected by a mechanical transmission. Using an electrical or hydraulic engine is preferred, since they are small, robust, and can easily be placed near the optimal location for the thrusters or driving device and via the mechanical transmission drive the propeller of the operation device.

To further make the operation device adjustable to different situations it is preferred that the propeller has detachably arranged propeller blades. It is still further preferred that the blades of the propeller are detachably fastened to the peripheral side of the propeller periphery. This solution makes it easy to adjust the propeller for the actual conditions adjusting e.g. thrust, rotation speed and the size of the propeller. The blade angles and propeller blade shape and size is easily adjusted by rotating or replacing the blade. A main drive device is probably bigger using lower rotational speed. The size of the chosen propeller is however dependent on the size of the vessel.

According to a further embodiment of the present invention the operation device is rotatable around a substantially vertical axis. When the operation device is rotatable around a vertical axis, it is possible to direct the driving force in arbitrary directions. This means that a boat having two rotatable operation devices according to the present invention will be able to manoeuvre in all directions. Together with an accurate positioning device as e.g. a global navigation satellite system or a radar based navigation system, the feature of rotation of the operation device will provide the possibility to stay in a fixed geographic position, also called "hovering".

According to a still further embodiment of the present invention a marine vessel is provided, comprising an operation device according to the above. The marine vessel preferably comprise immersion means for immersing the operation device from a lower section of the marine vessel. It is further preferred that the immersion means is attached to an submersible part of the inside of the lower section of the marine vessel.

When the operation device is not immersed, it is protected from outer damage from anything the marine vessel might run over or bump into. The mentioned lower section of the marine vessel is preferably a hatch in the hull so that when not immersed, it will form part of the hull. This limits water

resistance on the vessel when not using the operation device. This is especially important for performance boats as e.g. competition sailing yachts. It is however desirable for all sailing vessels to minimize water resistance, due to the relatively low travel speeds of such vessels and the subsequently long travel times. A small improvement in speed performance often leads to considerable effects in the context of travel time. The device will be housed in a closed compartment inside the hull which is also possible to drain to reduce corrosion on the operation device, especially the propeller. A clean and not corroded operation device will increase its performance. It may also be desirable to drain the operation device compartment to reduce displacement.

It is further preferred that the immersion means of the marine vessel comprises a shaft around which the operation device is pivotable. The shaft is provided to achieve the immersion of the operation device by rotating the operation device around the shaft. It is further preferred that the driving belt is driven by the same shaft, thereby decreasing the number of parts needed for the device, keeping the construction simpler, and thereby keeping manufacturing costs down. If the operation device is driven by a hydraulic engine, the engine may be placed in the wet part of the device, since it is small, rugged and water resistant. In that case the shaft is only used for immersion of the operation device.

According to a further embodiment of the present invention the immersion means of the marine vessel is adapted to be submerged along an substantially vertical axis parallel to the normal direction of the lower section of the marine vessel. It is desirable to submerge the operation device essentially perpendicular to the water surface if the operation device is rotatable to be able to drive in all directions. The operation device is in that case preferably rotatable around the same substantially vertical axis, presenting a driving force for the marine vessel that can be directed arbitrarily in a horizontal plane.

According to a still further embodiment of the present invention, the marine vessel comprises two or more of the operation devices described above. If the vessel has two operation devices they could be one bow thruster and one stern thruster, giving the vessel capabilities to rotate around its hull's

turning point. If the two, or one of the two, thrusters in the example above are rotatable around a vertical axis the marine vessel will be able to move in any given direction. It will also be able to rotate while moving in any direction, meaning that it has full freedom of movement in the water. A third operation
5 device giving thrust in the direction of the centreline of the vessel could be added as the main drive for the marine vessel, preferably positioned at the aft of the vessel. In this case none of the drives need to be able to rotate around a vertical axis in order to achieve full freedom of movement. The main drive is preferably a bigger model of the operation device having a more powerful
10 motor and it may also have a bigger propeller. If the main drive is rotatable to direct its propulsion, the aft thruster may be omitted.

According to a still further embodiment of the present invention a marine vessel is provided having an anchor device having a releasably arranged anchor adjacent to the operation device above the lower section of
15 the vessel. The anchor is fastened in an attachment means as e.g. a chain, a cable, a wire, a rope or the like. The anchor is adapted to be released when the submersible part of the lower section of the marine vessel is in an immersed position.

Placing the anchor in the same submersible compartment as the
20 operation device has many advantages over the current state of the art, some of which are the same as for the operation device itself. The placement of the anchor device inside the hull will protect the anchor from the marine environment and from outer force that may harm the anchor or its attachment means. The anchor is also kept from causing any form of water resistance
25 slowing the marine vessel down. Compared to the common placement of the anchor at the top part of the stem, the present invention has a number of advantages. Placing the anchor at the top of the bow will make it interfere with several other functions, e.g. on a sailing vessel if it is desirable to have a bowsprit, furling mechanisms for sails etc. If the anchor in that case is placed
30 to one side in order not to interfere with the bowsprit, the weight distribution will be asymmetrical and affect the performance of the vessel. The placement of the anchor in the bow also makes it more difficult to walk to and access the

forestay that usually extend to the most forward point of the vessel, which could be at the bow and / or at the front of the bowsprit if the vessel has one.

For performance sailing yachts another big advantage is that the anchor, anchor chain and windlass can be placed much lower in the vessel,
5 thus lowering the centre of gravity and increasing the sailing performance.

When the vessel has a bowsprit it often also has a bobstay to stabilise the bowsprit and to take up forces from a forestay on a sailing yacht. When the vessel is at anchor the anchor chain will for some angles of the boat against the wind rub against and damage the bobstay, which is avoided by
10 the anchor arrangement according to the present invention.

Brief description of the drawings

The above objects, as well as additional objects, features and advantages of the present invention, will be more fully appreciated by
15 reference to the following illustrative and non-limiting detailed description of preferred embodiments of the present invention, when taken in conjunction with the accompanying drawings, wherein:

Fig. 1 shows a sectional view of an operation device according to the present invention having a submersible propeller.

20 Fig. 2 shows a sectional view of the same operation device as in Fig.1, where the propeller is in an immersed position.

Fig. 3a shows a sectional view of a marine vessel having two submersible operation devices.

Fig. 3b shows a sectional view of a marine vessel having two rotatable
25 and submersible operation devices.

Fig. 4 shows a sectional view of another embodiment of the present invention where an anchor is incorporated in the compartment holding the operation device.

30 Detailed description of preferred embodiments of the invention

Fig 1 shows a sectional view of an operation device according to the invention. The operation device is intended to be mounted in the hull 12, 14 of a marine vessel for example a sailing yacht, reference number 12 indicating

the inside of the hull and reference number 14 indicating the outside of the hull. The operation device comprises a housing 1 which is, or will be, water filled when the operation device is in use. The housing is sealed to keep water from entering the inside of the vessel. A drive shaft 7 intended to drive the operation device penetrates the housing. A second hollow shaft 6 that is fastened to a second inner housing 5 is also penetrated by the driving shaft 7. A lever 8 is fastened to the hollow shaft 6 for rotating the second housing 5 around the driving shaft 7. The second housing 5 contains a wheel 3 that drives a propeller device 2 via a belt 4. The belt is preferably made of rubber. The wheel 3 and the propeller device 2 may be designed for a toothed belt 4, to increase friction between the wheel 3 and the belt 4 and between the propeller device 2 and the belt 4. The propeller device 2 is held by the second housing 5 and a ball bearing is created by balls 11 that are placed in grooves, 10 in the propeller device and in a corresponding groove (not shown) in the second housing 5. The thrust of the propeller device 2 is achieved by propeller blades 9 detachably fastened to the inside of the circular propeller device ring 2.

Fig. 2 shows the operation device of Fig. 1 in an immersed position. All parts of the device in Fig. 2 has the same reference numbers as in Fig. 1. As can be seen in Fig. 2, the lever 8 and the second housing 5 with its inner parts are rotated approximately 90° compared to its position in Fig. 1. The result of the rotation is that the propeller device 2 is immersed under the general surface of the hull.

Fig. 3a shows a sailing yacht having two of the operation devices shown in Fig. 1 and Fig. 2. The operation devices are able to be rotated around the driving shaft 7 in the directions of the arrow 21. In Fig 3a, the operation devices are in an immersed position.

Fig. 3b shows a sailing yacht having two operation devices according to another embodiment of the present invention. The construction of the operation device is principally the same, having a driving shaft 7, a belt 4, a propeller device 2. According to this embodiment, the operation devices are immersed by lowering each operation device along an axis 24, that is substantially vertical and thus perpendicular to the water surface. The device

moves along axis 24 as indicated by the arrow 22. Each operation device is also rotatable around the axis 24, indicated by the arrow 23. The bottom part of the housing 5 that is holding the propeller device 5 is circular and the compartment 25 intended to store the operation device when not immersed, is shaped as a cylinder with a circular cross section to allow the rotation of the operation device.

Fig. 4 shows still another embodiment of the present invention. The operation device has the same principal construction as in the other embodiments having a propeller device 2', a belt 4', and a driving shaft 7' driving the propeller 2' via the belt 4', contained in the second inner housing 5'. The device also has extra rolls 32, 33 to link the belt 4. The construction of the inner second housing 5' and the outer housing 1' is, however, altered so that the outer housing 1' contains not only the operation device, but also an anchor 30. The anchor 30 is fastened in an attachment means 31, e.g. a chain, cable, wire, rope or the like. The anchor is received in a guiding device 34. The guiding device 34 slides with the anchor attachment means for a small distance when the anchor is released until it is stopped by the anchor guiding device stopping means 35 as shown in Fig. 4. The guiding device is meant to receive the anchor when it is retrieved to force the anchor into the right position before closing the housing 1'. The housing is closed by rotating the operation device until the lower inner housing part 5' is aligned with the hull and thus closes the housing 1'.

Referring to Fig. 1 and Fig. 2, the operation of the operation device will be described. When a marine vessel, as e.g. a sailing yacht, is involved in a mooring procedure it is often required or at least preferred to use a thruster of some sort to be able to control the movement of the bow and or stern of the vessel. In windy weather especially light weight sailing yachts have a tendency to drift making mooring in some directions very difficult or even impossible. The operation device according to Figs. 1 and 2 may then be used in the vessel placed in the bow and/or stern, as shown in Fig. 3.

The operation device is mounted in the hull as far to the stern or as far to the bow as possible to get the most manoeuvring effect from the thruster(s) as possible. When not in use the operation device is kept inside the housing

1, 1'. The bottom side of the housing is part of the bottom side of the marine vessel hull, forming a hatch in the hull. When not in use the operation device will thus not invoke any considerable extra water resistance, since the hull shape is un-altered. When the operation device is needed, it is immersed by
5 rotating the inner housing 5 containing the propulsion around the driving shaft 7. The rotation is done by moving the lever 8, counter clockwise in Fig. 1 and Fig. 2, until the propeller device 2 is fully submerged below the hull surface 14. The propeller device 2 is driven by the driving shaft 7 via the belt 4 and the wheel 3 mounted on the driving shaft 7. The ball bearing that is formed by
10 the balls 11 and grooves in the propeller device 2 and the inner second housing 5 makes the friction between the propeller device and the housing very small, thus providing an effective power transmission between the driving shaft 7 and the propeller device 2. The ball bearing is lubricated by water and not oil, making the manufacturing process easier since the
15 requirements of sealing the bearing is not crucial as when using oil for lubrication. It should however be noted that the inventive concept may be achieved by another type of bearing as a sliding bearing, a rolling bearing, magnetic bearings etc. The driving shaft 7 is driven by a power source (not shown) as e.g. a combustion engine, electric engine or a hydraulic system.

20 It should be noted that the operation device also is suitable for the main drive for sailing yachts. When used as main drive the, the dimension may be bigger than when used as bow or stern thrusters. The motivation for using the operation device according to the present invention also for the main drive for sailing yachts is that when the yacht is sailing, the propeller
25 based propulsion system will cause extra water resistance, slowing the yacht down. That issue has traditionally been solved by using a folding propeller that folds the blades of the propeller when the propeller is not used. A folded propeller will however still cause water resistance and unwanted turbulence, slowing the yacht down, while the operation device according to the present
30 invention will retract into the hull and avoid water resistance.

Referring to Fig. 3b, the two operation devices that are rotatable, as previously described, will further enhance the manoeuvring possibilities of the marine vessel, a sailing yacht in the figure. Since the propulsion force can be

pointed in any direction both in the bow and in the stern of the vessel, the boat can be moved in any direction. The aft operation device is in that case preferably also the main drive, directing its propulsion power to the aft in normal propulsion of the yacht for transportation purposes. When difficult
5 manoeuvring is required, the aft operation device can be rotated to direct the propulsion force in any direction.

When having two rotatable operation devices as in Fig. 3b, these are preferably controlled by a joystick by the operator of the yacht. In a preferred embodiment the device is controlled by a boat shaped joystick, wherein the
10 boat shaped element has a width of a few centimetres and a proportional length. The size is adapted to be easy to grip for the operator using one hand. When the boat shaped element is moved forward, the boat moves forward by rotating both the operation devices to direct their propulsion forces aft. When the boat shaped element is moved to the left, the operation devices are
15 rotated 90° to direct their propulsion force to the right moving the boat to the left. This can obviously be implemented for any direction it is desired to move the boat. When the boat shaped element is rotated to the left the boat also rotates by directing the propulsion force of the bow operation device to the right and the propulsion force of the aft operation device to the left. By using a
20 suitable control system, the boat shaped element of the joystick and thus also the yacht can be simultaneously rotated and moved in a direction.

Using an accurate positioning system, the rotatable operation devices according to Fig. 3b can also be used to keep the yacht at a fixed geographic position. Preferably a control button is provided that, when activated, will
25 affect a control system to operate the two operation devices to keep the marine vessel at the same position and in the same orientation as when the button was pressed. The operation of the joystick is then preferably limited to rotation only.

Referring to Fig. 4, the operation device is accompanied by an anchor
30 30. When using the operation device, the anchor device naturally being in the immersed position, the anchor 30 is kept at its storage position having the guiding device 34 at its top position, near the top of the operation device. The anchor 30 is in that situation contained inside the guiding device 34. When it

is desired to lay anchor, the anchor 30 is released by releasing the attachment means 31. The guiding device 34 then slides down until it is stopped by the stopping means 35, the stopping means e.g. being a wire, rope or a chain fastened inside the housing as seen in Fig. 4 or any other
5 stopping device integrated with the operation device housing 5'. The anchor is then dropped to the bottom. The operation device may or may not be used during operation of the anchor.

When it is decided to weigh anchor, a windlass (not shown) starts to pull in the attachment means 31. The anchor 30 is collected by the guiding
10 means 34, being in its extended position as described above. When the anchor is fully inside the guiding means the guiding means is pulled with the anchor 30 to its top position. The operation device may then be lifted, if it is not used, to close the hull, thus encasing the anchor, protecting it from damage and from causing any water resistance or turbulence.

15 It is understood that other variations in the present invention are contemplated and in some instances, some features of the invention can be employed without a corresponding use of other features. Accordingly, it is appropriate that the appended claims be construed broadly in a manner consistent with the scope of the invention.

20

CLAIMS

1. Operation device for marine vessels, comprising
a housing (5, 5'),
5 a propeller (2, 2') peripherally journaled in a bearing, said bearing
being fixedly arranged in said housing, and
a driving device for rotating said propeller,
c h a r a c t e r i z e d in that said bearing is water lubricated.
- 10 2. Operation device according to claim 1, wherein said bearing is a ball
bearing (11).
3. Operation device according to claim 2, wherein said ball bearing (11)
has corrosion resistant balls (11).
15
4. Operation device according to any one of the preceding claims,
wherein said driving device is mechanically connected to said propeller (2, 2').
5. Operation device according to claim 4, wherein said driving device is
20 mechanically connected to said propeller (2, 2') by means of a belt (4, 4').
6. Operation device according to any one of the preceding claims,
wherein said driving device is an electric or hydraulic motor.
- 25 7. Operation device according to any of the preceding claims, wherein
the propeller (2, 2') has detachably arranged propeller blades (9, 9').
8. Operation device according to any one of the preceding claims,
wherein the operation device is rotatable around a substantially vertical axis
30 (24).
9. A marine vessel, comprising an operation device according to any
one of the claims 1-8.

10. A marine vessel according to claim 9, further comprising immersion means for immersing said operation device from a lower section of the marine vessel.

5

11. A marine vessel according to claim 10, wherein said immersion means is attached to an submersible part (5, 5') of the inside of said lower section of the marine vessel.

10

12. A marine vessel according to claim 10 or 11, wherein said immersion means comprises a shaft (7, 7') around which the operation device is pivotable.

15

13. A marine vessel according to any one of claims 10-11, wherein said immersion means is adapted to be submerged along an essentially vertical axis (24).

20

14. A marine vessel according to any of claims 10-5, comprising two or more of said operation devices.

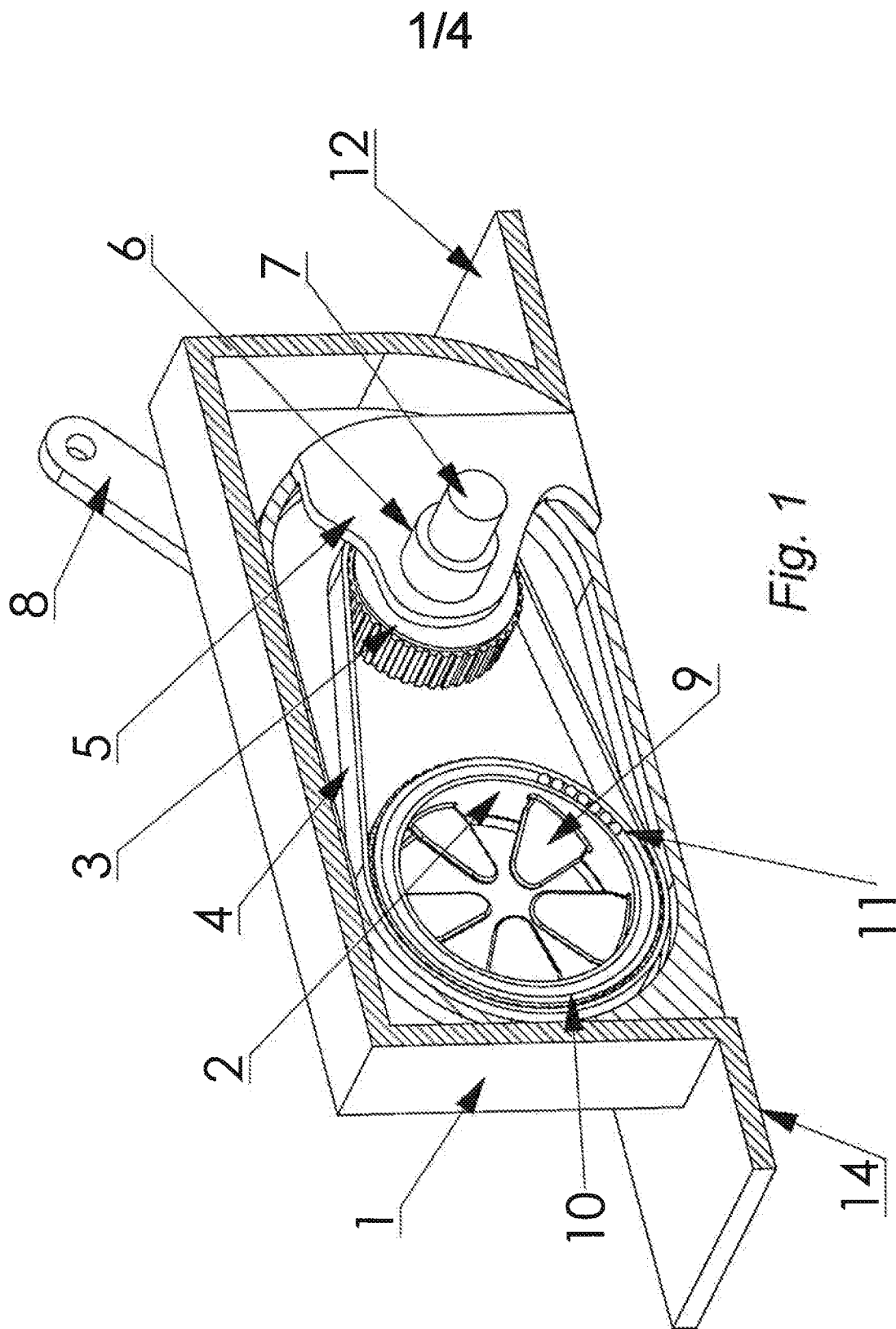
25

15. A marine vessel according to any of claims 11-14, wherein an anchor device (30) is releasably arranged adjacent said operation device above said lower section of the marine vessel,

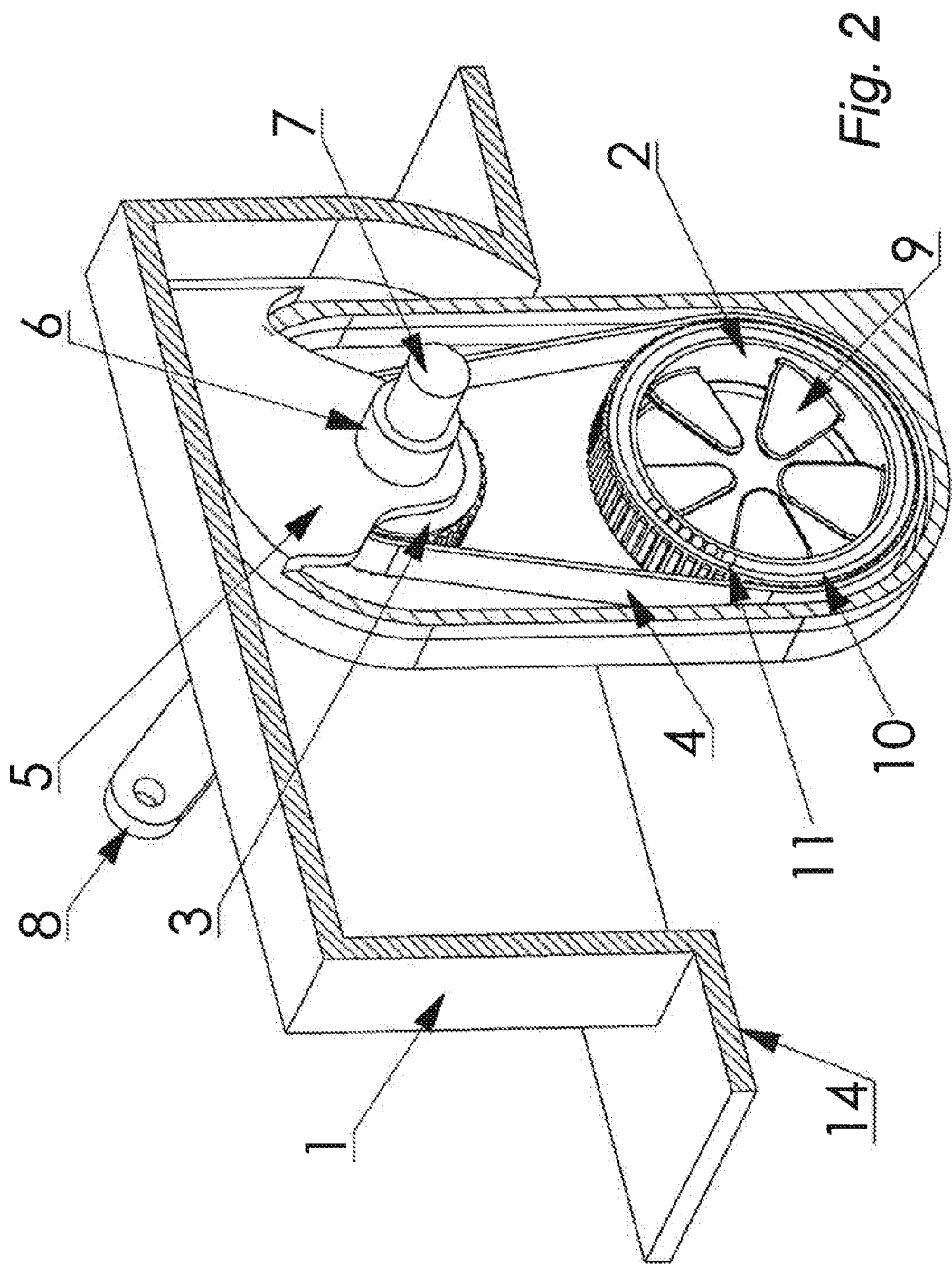
said anchor device (30) being fastened in an attachment means (31),

25

wherein said anchor device (30) is adapted to be released when said submersible part (5, 5') of the lower section of the marine vessel is in an immersed position.



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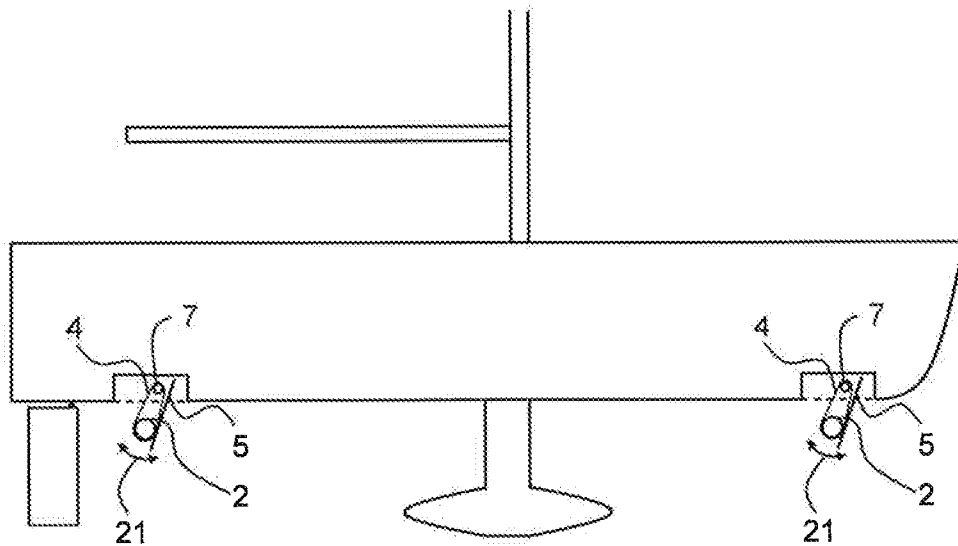


Fig. 3a

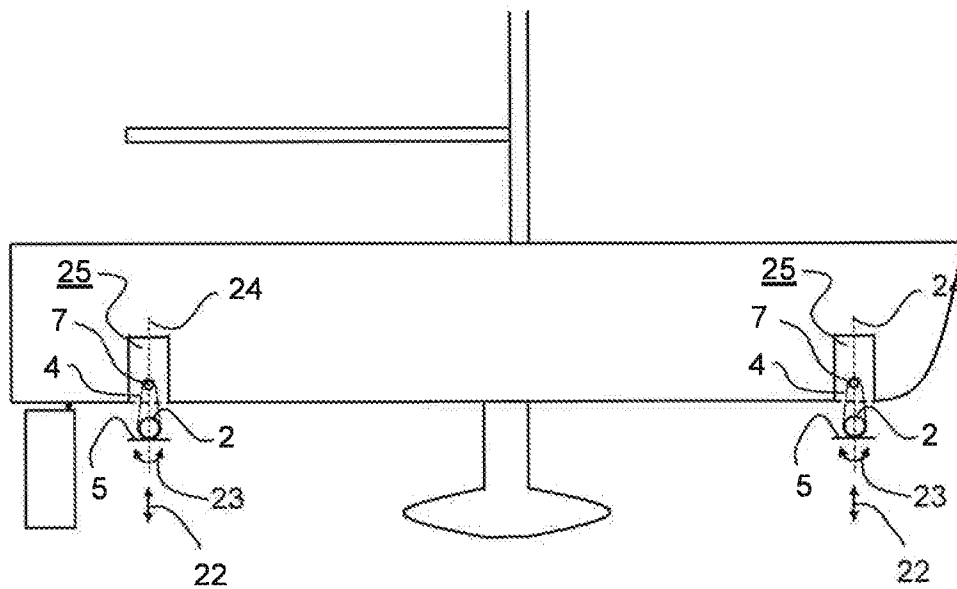


Fig. 3b

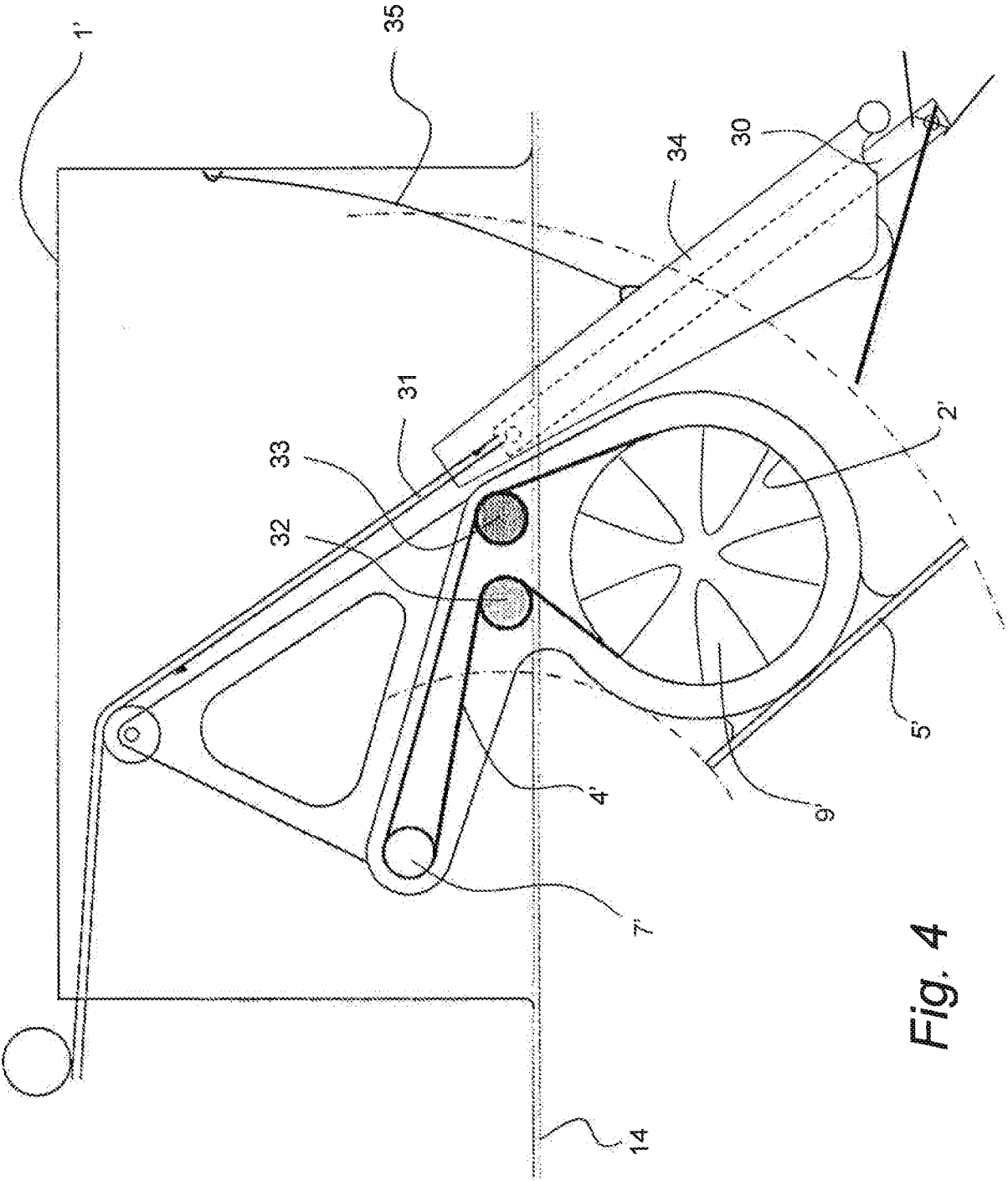


Fig. 4

INTERNATIONAL SEARCH REPORT

 International application No.
 PCT/SE2011/051436

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B63B, B63H, F16C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3610713 A (SATTERTHWAITE JAMES GLENN ET AL), 5 October 1971 (1971-10-05); abstract; column 2, line 58 - column 3, line 37; figures 1,2 --	1-15
A	US 5435763 A (PIGNATA RICHARD), 25 July 1995 (1995-07-25); abstract; column 3, line 63 - column 4, line 48; figures 3-5 --	1-15
A	US 5152240 A (FONTANILLE GUY), 6 October 1992 (1992-10-06); abstract; figures --	1-15



Further documents are listed in the continuation of Box C.



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“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

22-02-2012

Date of mailing of the international search report

06-03-2012

Name and mailing address of the ISA/SE

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2011/051436

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

The following separate inventions were identified:

- 1: Claims 1-14 directed to an operation device for marine vessels comprising a propeller peripherally journaled in a water lubricated bearing and to a marine vessel comprising the operation device.
- 2: Claim 15 directed to a marine vessel comprising a releasable arranged anchor device.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORTInternational application No.
PCT/SE2011/051436

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 2127964 Y (JINAN HYDRAULIC PUMP FACTORY), 10 March 1993 (1993-03-10); figures; (abstract) Retrieved from: EPODOC database -- -----	1-15

Continuation of: second sheet

International Patent Classification (IPC)

B63H 25/42 (2006.01)

B63H 5/125 (2006.01)

B63H 5/14 (2006.01)

B63H 25/46 (2006.01)

F16C 17/14 (2006.01)

F16C 19/02 (2006.01)

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Cited literature, if any, will be enclosed in paper form.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/SE2011/051436

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