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(54) **MARINE DRIVE SYSTEM WITH CENTERING BEARING SURFACE**

(57) A drive system (1) for a marine vessel (30) comprising a first housing (2) fixed to an opening (32) in a hull (31) of the marine vessel (30), and a drive unit (3) arranged inside the first housing (2), where the drive unit (3) comprises a second housing (4) comprising an electric or combustion drive motor (5) and a marine propulsion system (6) attached to the second housing (4), where the drive system (1) is provided with a parking position (20) in which the marine propulsion system (6) is positioned inside the first housing (2), a drive position (21) in which the marine propulsion system (6) is positioned outside of the first housing (2), where the first housing (2) is provided with an inwardly extending flange (17) arranged around the circumference of the opening (16), and that the second housing (4) is provided with an edge (18) at the circumference of a lower side (15) of the second housing (4), where the flange shape and the edge shape are complementary, such that the edge (18) of the second housing (4) bears on the flange (17) of the first housing (2) when the drive system (1) is in the drive position (21).

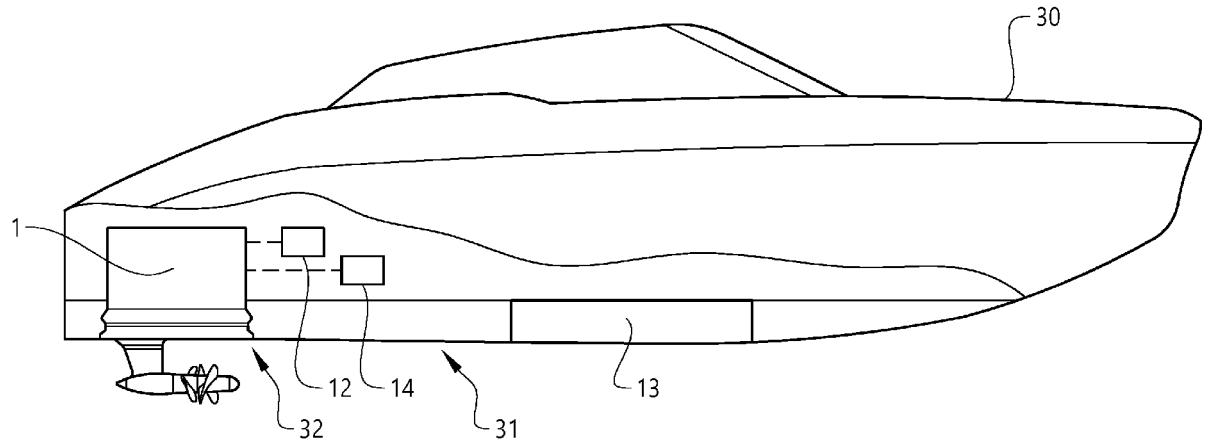

FIG. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to a marine drive system in which the drive unit can be extended out of and retracted into the hull of the vessel. The drive system is positioned in a housing mounted inside the hull of a marine vessel, and the drive unit can be lowered from a parking position to a drive position. The drive system comprises a drive motor and a marine propulsion system provided with at least one propeller.

BACKGROUND ART

[0002] Electric propulsion of vehicles is getting more and more common in order to replace combustible fuels. Slowly, electrical propulsion of marine vehicles are also gaining more interest. Electrical drive systems for slower boats, such as gigs or sailboats, are relatively energy efficient when the boat travels at low speeds. A further advantage for sailboats is that they normally do not need the motor, and that the motor is mostly used in emergencies and when docking. In such cases, an electric drive may be plausible.

[0003] Smaller sailboats are often provided with an outboard combustion motor that is used to drive the sailboat when there is no wind or when docking. Larger sailboats have an inboard combustion engine that is either provided with a straight axle that drives a propeller arranged at the rear of the sailboat, or is provided with a so called saildrive mounted to the hull of the sailboat. The saildrive may be provided with a fixed propeller or a foldable propeller. A foldable propeller will induce less drag when sailing, but is not suitable for charging a battery when sailing. A fixed propeller induce more drag when sailing but is more suited for charging a battery when sailing. When charging a battery, the propeller is connected to a generator that is powered by the propeller which will induce some drag. When not charging, the propeller is disconnected from the generator and rotates more or less freely, but will still induce a small amount of drag.

[0004] WO 2019160509 and US 2014022097 show examples of a fixed propeller that can be retracted into the hull of a boat. In a retracted position, drag is minimized and the propeller is less vulnerable.

[0005] Even if these systems functions well for their intended use, there is room for an improved drive system for a marine vessel.

DISCLOSURE OF INVENTION

[0006] An object of the invention is therefore to provide an improved drive system for a marine vessel. A further object of the invention is to provide a marine vessel comprising such a drive system.

[0007] The solution to the problem according to the invention is defined by the features of the main claims. The other claims contain advantageous further developments of the drive system.

[0008] In a drive system for a marine vessel comprising a first housing provided with an opening and being fixed to an opening inside a hull of the marine vessel, and a drive unit arranged inside the first housing, where the drive unit comprises a second housing comprising a drive motor and a marine propulsion system attached to the second housing, where the marine propulsion system comprises a leg and a hub provided with at least one propeller, where the drive system comprises an adjustment mechanism arranged to adjust the position of the drive unit in the first housing, where the drive system is provided with a parking position in which the marine propulsion system is positioned inside the first housing and a drive position in which the marine propulsion system is positioned outside of the first housing, the object of the invention is achieved in that the first housing is provided with an inwardly extending flange having a flange shape, where the inwardly extending flange is arranged around the circumference of the opening, and that the second housing is provided with an edge at the circumference of a lower side of the second housing, having an edge shape complementary to the flange shape, such that the edge of the second housing bears on the flange of the first housing when the drive system is in the drive position. The first housing is arranged to be resiliently connected to a hull of the marine vessel.

[0009] By this first embodiment of the drive system for a marine vessel, the height position of the propeller can be adjusted. In a parking position, the complete drive unit is positioned within the first housing and thus within the hull of the marine vessel, such that the propeller is completely concealed. In this position, the marine propulsion system and the propeller will not induce any drag which is of advantage when sailing. A further advantage is that the marine propulsion system is less prone to be subjected to biofouling. By filling the space with a gas, such as air or exhaust gas, the biofouling problem is further minimized. In a drive position, the lower side of the second housing of the drive unit is aligned with the hull, and the marine propulsion system extends completely into the water. This position is used when the boat is driven by the motor, and can also be used when the battery needs to be charged when sailing. By having the first housing arranged to be resiliently connected to a hull of the marine vessel, any vibrations generated by the drive system will be dampened before reaching the hull, leading to an improved driving experience.

[0010] The first housing may be arranged to be resiliently connected to the hull of the marine vessel by means of O-rings arranged above and below a protrusion arranged at a lower end of the first housing. With O-ring is meant a resilient annular member, made in rubber or other resilient material. In general, it can be any form of resilient gasket member.

[0011] The O-rings may have a material thickness of 3-50 mm.

[0012] The drive motor is in one example an electric drive motor, and in another example a combustion engine.

[0013] The first housing is provided with an inwardly extending flange arranged around the circumference of the opening in the first housing. The inner diameter of the flange is smaller than the outer diameter of the second housing. In this way, the flange will function as an end stop for the drive unit when the drive unit is positioned in the drive position. Thus, the drive unit will not be able to fall out should the adjustment mechanism fail. The shape of the flange may be straight or may be tapered with an angle relative to the vertical axis of the drive unit. The angle may e.g. be within 30 to 60 degrees. The flange may be provided with a seal of some type.

[0014] The second housing is provided with an edge at the circumference of the lower side of the second housing. The shape of the edge is complementary to the flange of the first housing, and may thus be straight or tapered. With a tapered edge, the drive unit will also be centred by the cooperation between the flange and the edge when the drive unit is in the drive position. The edge may be provided with a seal of some type.

[0015] The height position of the drive unit may be controlled manually by a user. A user may e.g. retract the drive unit when the boat is parked. The position of the drive unit may also be controlled automatically by an ECU. In one example, the drive unit is lowered when the electric motor is engaged, e.g. when a user selects the drive mode of the boat, and the drive unit is retracted when the drive mode is deselected.

[0016] The position of the drive unit in the cylinder-shaped housing is controlled by an adjustment mechanism that extends and retracts the drive unit out of and into the first housing. The position may e.g. be set with a linear actuator of some kind, such as a hydraulic cylinder or an electric linear actuator. The adjustment mechanism may also comprise a locking means that fixates the drive unit in the selected position. The locking means may e.g. be a self-locking gear of an electric motor that is used to position the drive unit in the cylinder-shaped housing.

[0017] The first housing and the second housing have the same shape, and may be circular or non-circular. A circular shape may be of advantage if the drive unit is to be rotated in the first housing, e.g. for steering of the vessel. A non-circular shape may be of advantage if the rotational orientation of the drive unit should be fixed. By using a non-circular shape for the first housing and the second housing, there is no need to use an anti-rotational means to hold the drive unit in a fixed position.

[0018] The drive unit is in on example rotationally fixed in the first housing, such that it cannot rotate and such that the propeller is directed in a fixed orientation. In another example, the drive unit can be rotationally adjustable such that the propeller can be directed in any desired direction. In this example, the drive unit can be used to steer the boat. The drive unit may be provided with a single propeller or with two propellers that rotate in different directions.

BRIEF DESCRIPTION OF DRAWINGS

[0019] The invention will be described in greater detail in the following, with reference to the attached drawings, in which

Fig. 1 shows a schematic marine vessel provided with a drive system according to the invention,

Fig. 2 shows the drive unit in the parking position,

Fig. 3 shows the drive unit in the drive position, and

Fig. 4 shows a detail of a flange and an edge.

MODES FOR CARRYING OUT THE INVENTION

[0020] The embodiments of the invention with further developments described in the following are to be regarded only as examples and are in no way to limit the scope of the protection provided by the patent claims.

[0021] Fig. 1 shows a schematic marine vessel 30, Fig. 2 shows the drive unit in a parking position, Fig. 3 shows the drive unit in the in a drive position, and Fig. 4 shows a detail of a flange of the first housing and an edge of the second housing.

[0022] Fig. 1 shows a schematic marine vessel 30 provided with a drive system 1 for propelling the marine vessel or for generating electric energy. The drive system 1 comprises a first housing 2 that is mounted to an opening 32 in the hull 31 of the marine vessel 30. The opening 16 of the first housing 2 is mounted flush with the hull such that the first housing 2 does not extend out of the hull. The first housing is fixedly mounted to the hull. The opening 16 of the first housing 2 is provided with a flange 17 extending inwards from the inner side of the first housing. The vessel is also provided with a gas pressure source 14 that can supply pressurized gas, such as air or another suitable gas.

[0023] The inwardly extending flange 17 is arranged around the circumference of the opening 16 in the first housing. The inner diameter of the flange is smaller than the outer diameter of the second housing. In this way, the flange will function as an end stop for the drive unit 3 when the drive unit is positioned in the drive position 21. In this way, the drive unit will not be able to fall out should the adjustment mechanism 10 fail. The shape of the flange may be straight or may be tapered with an angle relative to the vertical axis 19 of the drive unit. The angle is in one example within 30 to 60 degrees and in a further example within 40 to 50 degrees. The flange may be provided with a seal of some type. The seal will seal the area between the first housing and the second housing and may also function as a shock absorber when the drive unit is positioned in the drive position.

[0024] A drive unit 3 is arranged inside the first housing 2. The drive unit 3 comprises a second housing 4 that comprises a drive motor 5 that drives a drive shaft to the propeller 9. The drive shaft may be driven directly by the electric motor and may be directly attached to the drive motor, or may be driven through a transmission of some type. The drive unit may also comprise an electronic control unit (ECU) 12 used to control the drive motor. The second housing 4 is arranged to slide inside the first housing 2 such that the height position of the drive unit in the first housing 2 can be adjusted. The second housing is in one example watertight.

[0025] The drive motor 5 is in one example an electric motor powered by a battery 13. One advantage of using an electric drive motor is that the motor can also be used to charge the battery when the drive system is installed in a sailboat. The drive motor may also be an internal combustion engine, either fuelled by petrol or diesel. In the shown example, an electric motor is used as the drive motor.

[0026] A marine vessel 30 may be provided with one or more drive systems 1. A smaller regular sailboat may e.g. be provided with a single drive system that is rotationally fixed and that replaces a regular saildrive installation, where the sailboat is steered with a rudder. Larger sailboats may also be provided with two or more drive systems, which may be either rotationally fixed or rotatable. The drive system is also suitable for motorboats. A smaller motorboat may e.g. be provided with a single drive system where the boat is steered by rotating the drive unit. A larger motorboat may be provided with two or more drive systems, where the steering may be performed by either driving the propellers with different rotational speeds or by rotating the drive units.

[0027] The second housing 4 is provided with an edge 18 at the circumference of the lower side 15 of the second housing. The shape of the edge 18 is complementary to the flange 17 of the first housing, and may thus be straight or tapered. With a tapered edge, the drive unit 3 will also be centred by the cooperation between the flange and the edge when the drive unit is in the drive position. The edge may be provided with a seal of some type.

[0028] The edge 18 of the second housing 4 will cooperate with the flange 17 of the first housing 2. The shape of the edge 18 and the flange 17 is preferably the same, such that they can cooperate with each other with a form fit. In one example, the flange is tapered with a 45 degrees angle, and the edge 18 is consequently provided with a 45 degrees angle. Other angles or shapes are also possible.

[0029] A marine propulsion system 6 is attached to the lower side 15 of the second housing 4. The marine propulsion system 6 comprises a leg 7 and a hub 8 and may be provided with a single propeller 9 or with two counter-rotating propellers 9, depending on the drive installation. The drive shaft of the drive unit extends through the leg and the hub is provided with a bevel gear which transfers the rotation of the motor to the propeller. In a double propeller installation, concentric drive shafts are used.

[0030] The position of the drive unit 3 is adjusted with an adjustment mechanism 10 which is arranged at the upper part of the drive unit. The adjustment mechanism may e.g. comprises one or more linear actuators, such as hydraulic cylinders or electric linear actuators. The adjustment mechanism may also comprise a threaded pin running in a threaded nut attached to the second housing.

[0031] The inwardly extending flange 17 and the edge 18 are metal surfaces and lock in the drive position by means of friction. A gearbox connected to the adjustment mechanism is used to lower the drive unit 3 and an electro-mechanic brake lock the drive unit 3 in the drive position 21 when the gearbox experiences a threshold torque.

[0032] The hull 31 comprises a protrusion 23 arranged at a lower end 24 of the hull 31. At least one O-ring 25 is arranged above and below the protrusion 23 such that a first O-ring abuts the first housing 2 and a second O-ring abuts a clamping ring 26. The O-rings 25 are clamped together during assembly of the marine vessel 30 and may not be shown to scale. In this way, the first housing 2 is arranged to be resiliently connected to the hull 31 of the marine vessel 30.

[0033] During operation of the propulsion system 6, vibrations generated run from the hub 8 through the leg 7 to the lower side 15 of the second housing 4 and further to the cooperating flange 17 and edge 18. Finally, all vibrations from the first housing 2 are dampened by the O-rings 25 before reaching the hull 31. This leads a reduction of vibrations experienced by the hull 31.

[0034] The O-rings 25 have a material thickness of 3-50 mm, in order to provide the desired vibration dampening effect.

[0035] The first housing 2 and the second housing 4 have the same shape, and may be circular or non-circular. A circular shape may be of advantage if the drive unit 3 is to be rotated in the first housing 2, e.g. for steering of the vessel. A non-circular shape may be of advantage if the rotational orientation of the drive unit 3 should be fixed. By using a non-circular shape for the first housing 2 and the second housing 4, there is no need to use an anti-rotational means to hold the drive unit in a fixed position.

[0036] The drive unit 1 can be set in different positions. One position is a parking position 20, shown in Fig. 2, in which the drive unit 1 and the marine propulsion system 6 is positioned completely inside the first housing 2. In this position, the complete drive unit is positioned within the first housing 2 and thus within the hull of the marine vessel, such that the propeller is completely concealed. In this position, the marine propulsion system and the propeller will not induce any drag which is of advantage when sailing. This may also be an advantage when the vessel is transported. A further advantage is that the marine propulsion system is less prone to be subjected to biofouling. By filling the space with a gas, such as air or

exhaust gas, the biofouling problem is further minimized.

[0037] The drive unit 1 is also provided with a drive position 21, shown in Fig. 3, in which the lower side 15 of the cylinder-shaped part 4 of the drive unit 1 is aligned with the hull 31 of the vessel 30. In the drive position, the leg 7 extends completely into the water. This position resembles a fixed, regular installation of a saildrive in a sailboat. This position is used when the boat is driven by the drive motor, and can also be used when the battery 13 needs to be charged when sailing.

[0038] The position of the drive unit 1 in the first housing 2 may be controlled manually by a user, or may be automatically controlled. A user may e.g. retract the drive unit to the parking position when the boat is parked, and may select the drive position when driving the vessel with the motor.

[0039] The position of the drive unit may also be controlled automatically by an ECU 12. In one example, the drive unit is lowered when the drive motor is engaged, e.g. when a user selects the drive mode of the boat, and the drive unit is retracted when the drive mode is deselected.

[0040] The drive unit 3 is intended to be either a primary propulsion system for the marine vessel 30 or a secondary propulsion system that can function when a primary propulsion system is not available, preferably for marine vessels with electric propulsion systems. The drive unit 3 is not intended to be used as a steering assistance or to provide additional propulsion to complement another drive unit, electric or otherwise.

[0041] The drive unit 3 and thereby the first and second housings 2, 4 are arranged at an angle relative a vertical axis of the marine vessel. This means that when in the drive position 21, the leg 7 and hub 8 with propellers 9 protrude out of the hull 31 at an angle relative a bottom part of the hull 31.

[0042] The invention is not to be regarded as being limited to the embodiments described above, a number of additional variants and modifications being possible within the scope of the subsequent patent claims.

REFERENCE SIGNS

[0043]

1: Drive system
2: First housing
3: Drive unit
4: Second housing
5: Drive motor
6: Marine propulsion system
7: Leg
8: Hub
9: Propeller
10: Adjustment mechanism
11: Centre axis
12: Electronic control unit
13: Battery
14: Gas pressure source
15: Lower side
16: Opening
17: Flange
18: Edge
19: Vertical axis
20: Parking position
21: Drive position
22: Intermediate position
23: Protrusion
24: Lower end
25: O-rings
26: Clamping ring

30: Marine vessel
31: Hull
32: Opening

Claims

1. A drive system (1) for a marine vessel (30) comprising a first housing (2) provided with an opening (16) and being fixed to an opening (32) inside a hull (31) of the marine vessel (30), and a drive unit (3) arranged inside the first housing (2), where the drive unit (3) comprises a second housing (4) comprising a drive motor (5) and a marine propulsion system (6) attached to the second housing (4), where the marine propulsion system (6) comprises a leg (7) and a hub (8) provided with at least one propeller (9), where the drive system (1) comprises an adjustment mechanism (10) arranged to adjust the position of the drive unit (3) in the first housing (2), where the drive system (1) is provided with a parking position (20) in which the marine propulsion system (6) is positioned inside the first housing (2) and a drive position (21) in which the marine propulsion system (6) is positioned outside of the first housing (2), wherein the first housing (2) is provided with an inwardly extending flange (17) having a flange shape, where the inwardly extending flange (17) is arranged around the circumference of the opening (16), and that the second housing (4) is provided with an edge (18) at the circumference of a lower side (15) of the second housing (4), having an edge shape complementary to the flange shape, such that the edge (18) of the second housing (4) bears on the flange (17) of the first housing (2) when the drive system (1) is in the drive position (21), **characterized in that** the first housing (2) is arranged to be resiliently connected to the hull (31) of the marine vessel (30).

2. Drive system according to claim 1, wherein the first housing (2) is arranged to be resiliently connected to the hull (31) of the marine vessel (30) by means of at least one O-ring (25) arranged above and below a protrusion (23) arranged at a lower end (24) of the

first housing (2).

3. Drive system according to claim 2, wherein the O-rings (25) have a material thickness of 3-50 mm.

4. Drive system according to any one of claims 1-3, wherein the drive motor (5) is an electric drive motor.

5. Drive system according to any one of claims 1-3, wherein the drive motor (5) is an internal combustion engine.

6. Drive system according to any one of the preceding claims, wherein the flange shape and the edge shape is tapered.

7. Drive system according to claim 6, wherein the angle of the tapered flange (17) of the first housing (2) and the edge (18) of the second housing (4) is between 30 to 60 degrees with respect to a vertical axis (19) of the drive system (1).

8. Drive system according to claim 7, wherein the angle of the tapered flange (17) of the first housing (2) and the edge (18) of the second housing (4) is between 40 to 50 degrees with respect to a vertical axis (19) of the drive system (1).

9. Drive system according to any of claims 1 to 8, wherein the flange (17) of the first housing (2) further comprises a seal and/or the edge (18) of the second housing (4) further comprises a seal.

10. Drive system according to any of claims 1 to 9, wherein the outer shape of the first housing (2) and the second housing (4) is circular.

11. Drive system according to any of claims 1 to 9, wherein the outer shape of the first housing (2) and the second housing (4) is non-circular.

12. Drive system according to any of claims 1 to 10, wherein the second housing (4) is rotationally adjustable in the first housing (2).

13. Drive system according to any of claims 1 to 10, wherein the second housing (4) is rotationally fixed in the first housing (2).

14. Drive system according to any of claims 1 to 13, wherein the drive unit (3) is provided with a locking means that is adapted to lock the adjustment mechanism (10) in the selected position (20; 21; 22).

15. Marine vessel, comprising at least one drive system (1) according to any of claims 1 to 14.

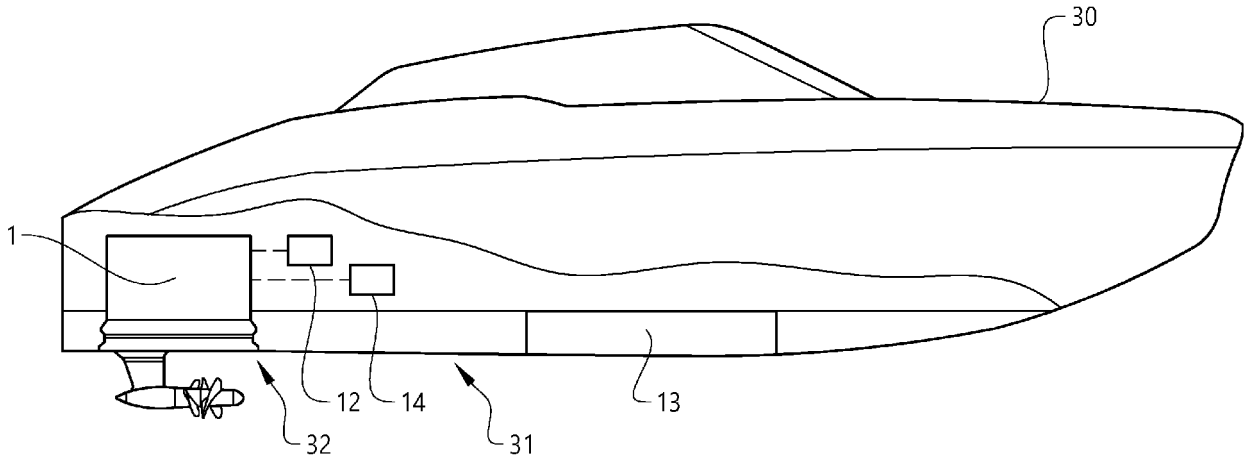

FIG. 1

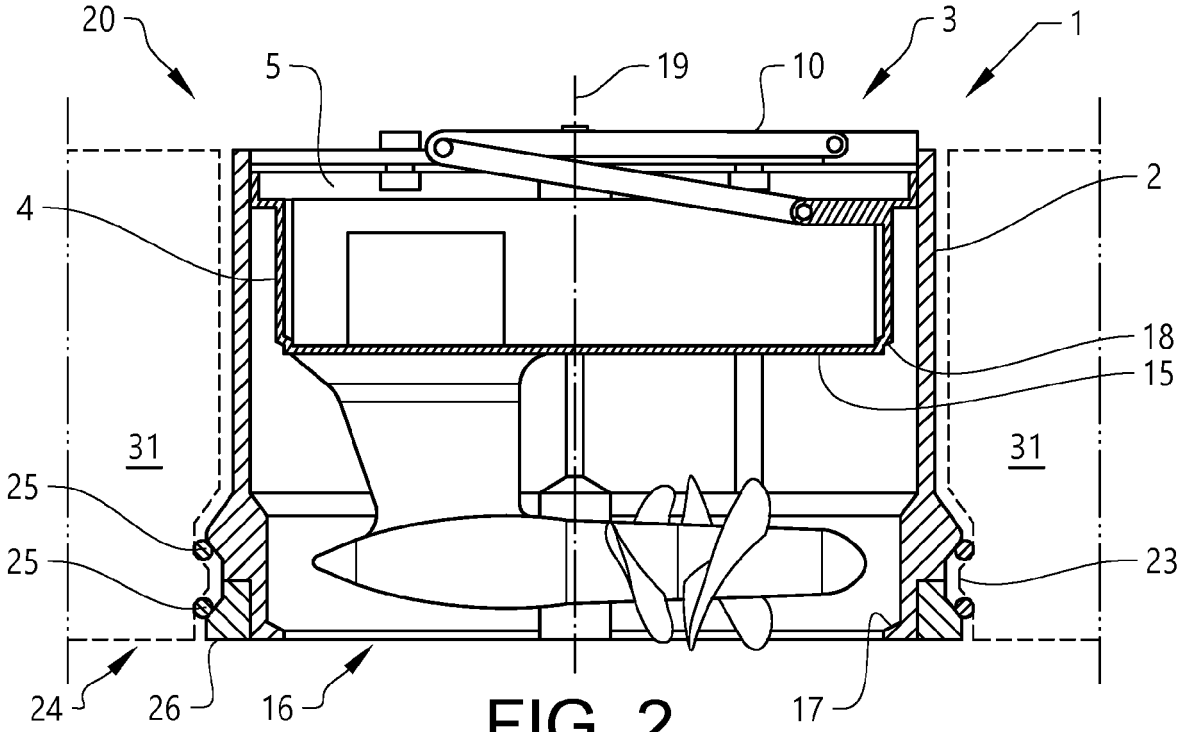
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FIG. 2

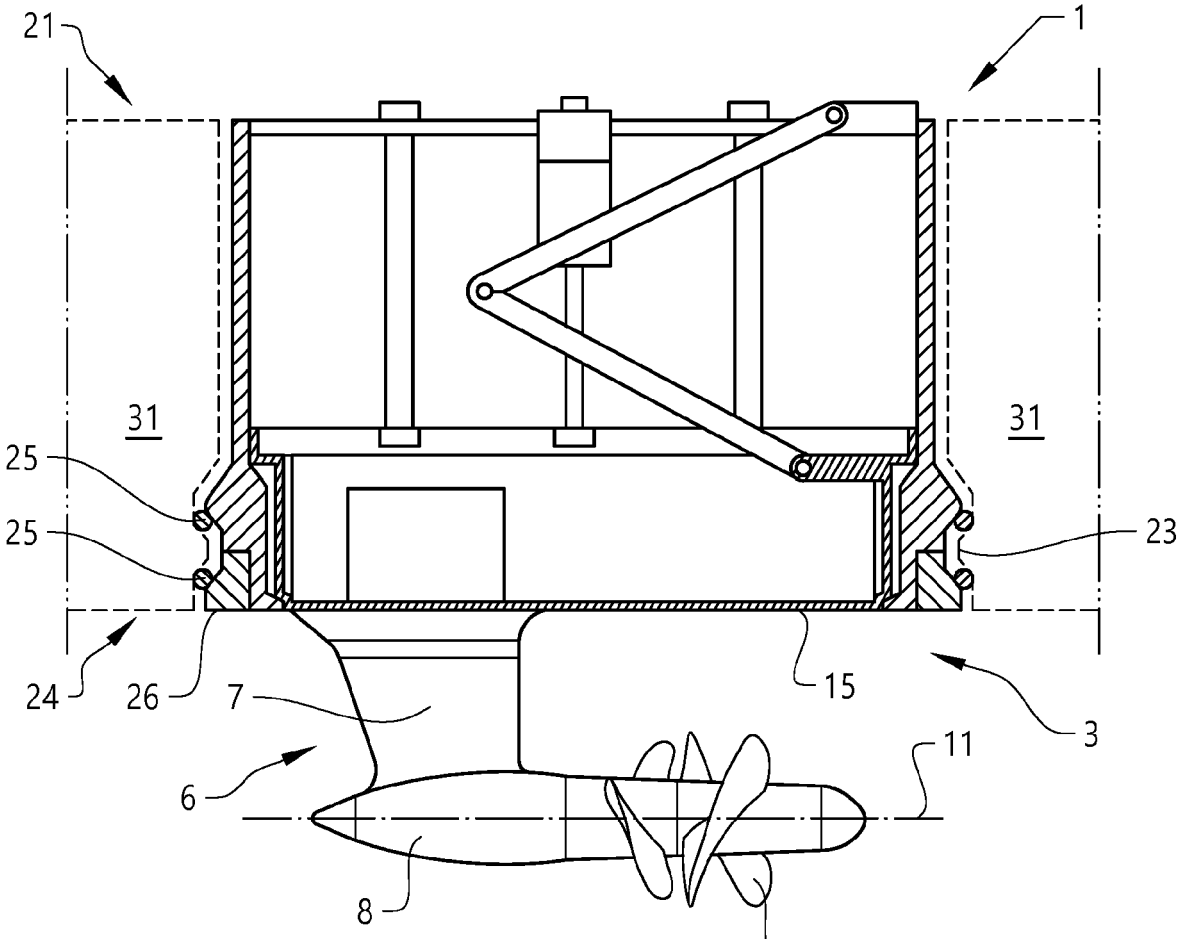
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FIG. 3

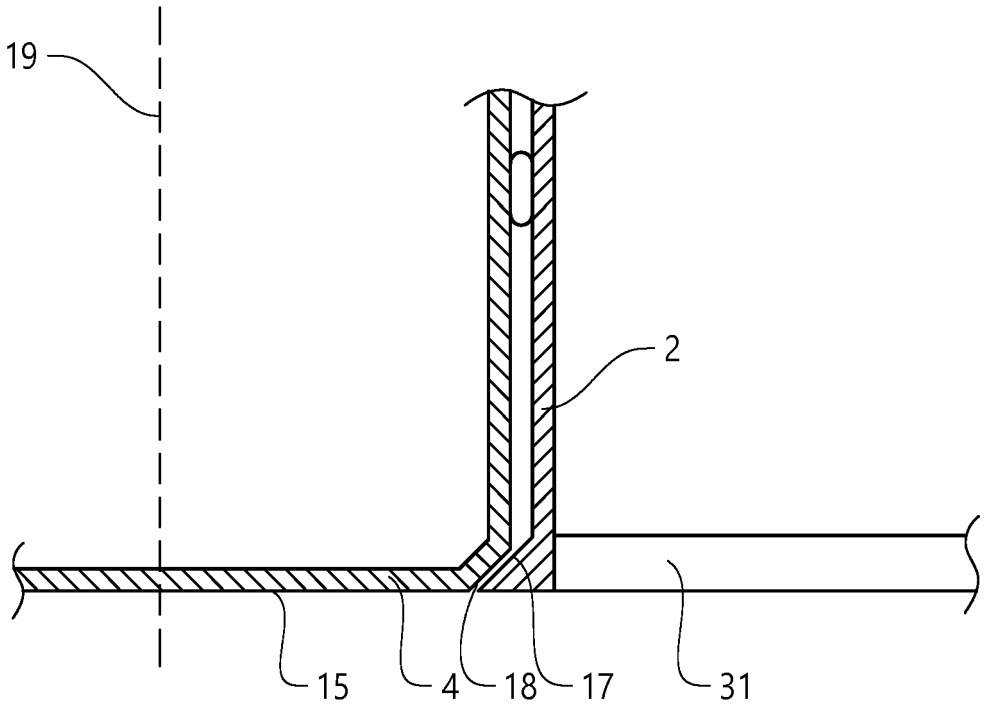

FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 23 20 0292

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	19 January 2024	Knoflacher, Nikolaus

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X : particularly relevant if taken alone
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Patent documents cited in the description

- WO 2019160509 A **[0004]**
- US 2014022097 A **[0004]**