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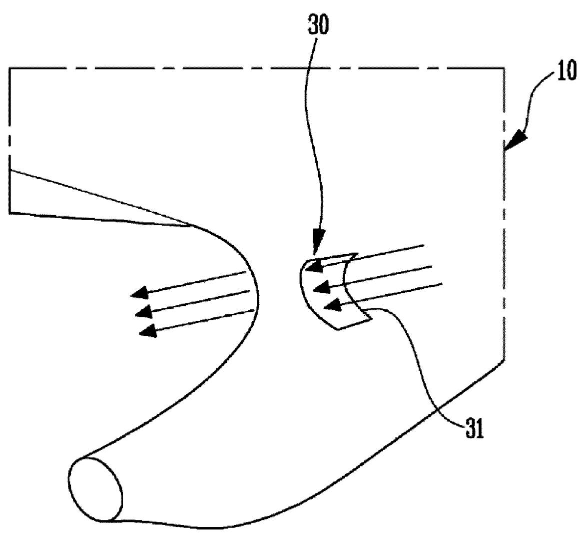
(54) **SHIP STRUCTURE**

(57) According to the present invention, a ship structure includes a hull of a ship; and an attached structure provided to be attachable to a stern of the hull, wherein the attached structure may include a penetration part provided to allow fluid to flow from one side to the other side, and the penetration part may include: an intake hole formed on one side of the attached structure; and an exhaust hole formed on the other side of the attached structure at a rear of the intake hole.

FIG. 1



Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of priority under 35 U.S.C. §119(a) to Korean Patent Application Nos. 10-2022-0093480, filed on July 27, 2022, and 10-2023-0097778, filed on July 26, 2023, all the entire contents of which are incorporated herein as part of this specification.

BACKGROUND

(a) Technical Field

[0002] The present invention relates to a ship structure.

(b) Background Art

[0003] In the case of a large ship, a flow of fluid generated when a propeller installed at a stern rotates is used as propulsion power to move forward. In this case, a rudder is attached to a rear side of the propeller, and the sailing direction is changed by controlling the flow direction of fluid as the rudder rotates left and right.

[0004] In order to obtain the propulsion power of the large ship using the propeller, a fuel such as diesel and LPG is used to drive an engine, but a large amount of fuel is consumed and additional exhaust gas and greenhouse gas are emitted, causing environmental destruction.

[0005] Recently, in order to protect the environment, measures to reduce greenhouse gases when operating a ship are being discussed, and shipbuilders have also been continuously researching and developing fuel-saving technologies that may reduce fuel consumption and greenhouse gas emissions.

[0006] Examples of fuel saving technologies include an energy saving device (ESD) that improves the shape of the stern, propeller, duct, rudder, etc., of a ship or change the flow of fluid by attaching separate appendages to increase propulsion efficiency and save fuel. These energy saving devices are already being applied and used on a significant number of ships.

[0007] However, these energy saving devices affect resistance while increasing the propulsion efficiency of the ship by improving the shape of a hull or attaching separate appendages, and may be destroyed or damaged by floating objects, external forces, etc., during the operation of the ship, so maintenance requires attention.

SUMMARY OF THE INVENTION

[0008] The present invention is devised to solve the problems of the prior art as described above, and the object of the present invention is to provide a ship structure that improves propulsion efficiency of a ship by improving the ship structure and has the ease of manufacturing and maintenance.

[0009] According to an aspect of the present invention, there is provided a ship structure, including: a hull of a ship; and an attached structure provided to be attachable to a stern of the hull, wherein the attached structure may include a penetration part provided to allow fluid to flow from one side to the other side, and the penetration part may include: an intake hole formed on one side of the attached structure; and an exhaust hole formed on the other side of the attached structure at a rear of the intake hole.

[0010] The penetration part may induce fluid introduced into the intake hole to flow into a propeller disposed at the rear of the ship through the exhaust hole.

[0011] The attached structure may be disposed in front of a rudder connected to an end portion of the stern of the hull.

[0012] The attached structure may have a shape corresponding to a curved portion of the stern of the hull.

[0013] When viewed from the rear of the ship, a connecting line where one side and the other side of the attached structure meet may be formed to be inclined so as not to be aligned with a central axis perpendicular to an axis of a propeller.

[0014] A degree to which the connecting line is inclined with respect to a central axis may gradually increase as it goes upward from an axis of the propeller.

[0015] A portion of the attached structure and a portion of the stern of the hull may be formed by a fitting-in structure.

[0016] A filler may be formed in an internal space of the attached structure.

[0017] The internal space of the attached structure may be formed in a honeycomb structure.

[0018] An opening/closing device for controlling a flow of fluid may be disposed in the intake hole and the exhaust hole.

[0019] An injection device for injecting the fluid of the penetration part may be disposed in the exhaust hole, or a suction device for sucking fluid may be disposed in the intake hole.

[0020] The intake hole may be provided at 20% or more and 120% or less of a radius of the propeller with respect to the axis of the propeller, and the exhaust hole may be provided at 20% or more and 100% or less of the radius of the propeller with respect to the axis of the propeller.

[0021] An attached structure is provided to be attached to a stern of a hull of a ship, in which the attached structure may include a penetration part provided to allow fluid to flow from one side to the other side, and the penetration part may include: an intake hole formed on one side of the attached structure; and an exhaust hole formed on the other side of the attached structure.

[0022] According to the ship structure of the present invention, it is possible to improve the propulsion efficiency of the ship by improving the ship structure and facilitate the manufacturing and maintenance.

BRIEF DESCRIPTION OF DRAWINGS

[0023]

FIG. 1 is a perspective view of a ship structure according to a first embodiment of the present invention.
FIG. 2 is a side view of the ship structure according to the first embodiment of the present invention.
FIG. 3 is a rear view of a ship structure according to a second embodiment of the present invention.
FIG. 4 is a conceptual diagram of a recess in the ship structure according to an embodiment of the present invention.
FIG. 5 is a comparison diagram of a degree of improvement in transmission horsepower required to operate the ship through a CFD of the ship structure according to an embodiment of the present invention.
FIG. 6 is a comparison diagram of the results of analyzing the CFD of the ship structure according to an embodiment of the present invention.
FIG. 7 is a comparison diagram of the results of analyzing the CFD of the ship structure according to an embodiment of the present invention.
FIG. 8 is a perspective view of a ship structure according to a third embodiment of the present invention.
FIG. 9 is a perspective view of the ship structure viewed from a different direction from FIG. 8.
FIG. 10 is a side view of the ship structure of FIG. 8.
FIG. 11 is a rear view of a ship structure according to a fourth embodiment of the present invention.
FIG. 12 is a perspective view of the ship structure of FIG. 11.

DETAILED DESCRIPTION

[0024] The objects, specific advantages and novel features of the present invention will be more apparent from the following detailed description and preferred embodiment taken in conjunction with the accompanying drawings. In this specification, when adding reference numerals to components in each drawing, it should be noted that like reference numerals designate like components even if the components are illustrated in different drawings. Further, when it is determined that the detailed description of the known art related to the present invention may obscure the gist of the present invention, the detailed description thereof will be omitted.

[0025] In addition, it is to be understood that the accompanying drawings are provided only for easy understanding of embodiments disclosed in this specification, and the technical idea disclosed in this specification is not limited by the accompanying drawings, but includes all the modifications, equivalents, and substitutions included in the spirit and the technical scope of the present invention.

[0026] Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings. The present invention is a ship structure. In this case, it is noted that a ship 1 is an expression that encompasses not only general commercial ships such as carriers transporting liquefied gas, but also marine plants such as FLNG and FSRU.

[0027] FIG. 1 is a perspective view of a ship structure according to a first embodiment of the present invention, and FIG. 2 is a side view of the ship structure according to the first embodiment of the present invention.

[0028] Referring to FIGS. 1 and 2, the ship structure according to the first embodiment of the present invention may include a penetration part 30 penetrating through a stern 10.

[0029] The penetration part 30 may be formed above and in front of an axis of a propeller 20 to penetrate through the stern 10, and may include an intake hole 31 provided on one side of the stern 10 and an exhaust hole 32 connected to the intake hole 31 on the other side.

[0030] The penetration part 30 may include a passage (not shown) from the intake hole 31 to the exhaust hole 32. The passage may be formed as one passage or as multiple passages, and therefore, the number of passages is not limited. In the case of the multiple passages, each passage may have a different area or shape.

[0031] Referring to FIG. 2, the intake hole 31 and the exhaust hole 32 are each illustrated as one, but the number and shape of intake hole 31 and exhaust hole 32 are not limited, and a combination of one passage or multiple passages is possible, so that ship structures having various shapes are possible.

[0032] When the ship 1 is operating or anchored, the fluid generated by the current flows along the shape of the ship 1, and when the fluid meets the penetration part 30 at the stern 10, it may pass through the penetration part 30 and be transmitted to the propeller 20.

[0033] Depending on the size and height of the intake hole 31 and the exhaust hole 32, the flow of fluid passing through the penetration part 30 may vary. When a height of the intake hole 31 is set higher than that of the exhaust hole 32, the fluid passing through the penetration part 30 flows downward. When the height of the intake hole 31 is set relatively low, the fluid passing through the penetration part 30 flows upward.

[0034] The relative heights and positions of the intake hole 31 and the exhaust hole 32 may be set differently depending on a rotation direction of the propeller 20, etc., and generally, the intake hole 31 is set higher than the exhaust hole 32 so that the fluid passing through the penetration part 30 may flow downward.

[0035] In addition, as an example, when the propeller 20 turns right, the intake hole 31 may be provided on a starboard and the penetration part 30 may be formed by penetrating from the starboard to a portside, and when the propeller 20 turns left, the intake hole 31 may be provided on the portside and the penetration part 30 may be formed by penetrating from the portside to the starboard.

[0036] The intake hole 31 may be provided on the stern 10 above the axis of the propeller 20, and the exhaust hole 32 may be provided on the stern 10 at the rear of the intake hole 31. Therefore, the exhaust hole 32 may be provided closer to the propeller 20 than the intake hole 31, but a certain distance needs to be provided between the intake hole 31 and the propeller 20 in order to transmit the flow of fluid discharged through the intake hole 31 to the propeller 20.

[0037] In order to increase the velocity of the fluid discharged through the exhaust hole 32, the area of the exhaust hole 32 may be made smaller than that of the intake hole 31. In other words, the size and area of the intake hole 31 may be provided to be at least equal to or larger than the size and area of the exhaust hole 32.

[0038] This is because the equation for the fluid is based on the 'Bernoulli equation', and when the flow rate of the fluid passing through the penetration part 30 is constant, the flow rate is calculated by the product of the unit area and the fluid velocity, so the fluid velocity may be increased in the exhaust hole 32 having a small unit area.

[0039] Referring to FIG. 2, the positions of the intake hole 31 and the exhaust hole 32 are provided at the stern 10 on the upper side of the axis of the propeller 20 as described above, but may be positioned at the rear of the watertight bulkhead (S.F.B.H) provided separately at the stern 10. The watertight bulkhead (S.F.B.H) is a stern frame bulkhead, and is a wall to prevent adjacent compartments from being flooded when one compartment of the ship 1 is damaged and flooded, and may also serve as a longitudinal/lateral member.

[0040] The watertight bulkhead may be provided at a bow, the stern 10, an engine room, etc., and in the ship structure according to the first embodiment of the present invention, the intake hole 31 and the exhaust hole 32 may be positioned at the rear of the watertight bulkhead (S.F.B.H) provided at the stern 10. Accordingly, the intake hole 31 and the exhaust hole 32 may be provided between the watertight bulkhead provided at the stern 10 and the propeller 20.

[0041] The intake hole 31 and the exhaust hole 32 are provided above the axis of the propeller 20, but may be provided within or around a radius R of the propeller 20 in order to transmit the flow of fluid to the propeller 20.

[0042] The intake hole 31 may be provided at 20% or more and 120% or less of the radius of the propeller 20 with respect to the axis of the propeller 20, and the exhaust hole 32 may be provided at 20% or more and 100% or less of the radius of the propeller 20 with respect to the axis of the propeller 20.

[0043] That is, the intake hole 31 and the exhaust hole 32 may be provided between 20% and 120% of the radius with respect to the axis of the propeller 20, and since the size of the intake hole 31 may be provided larger than that of the exhaust hole 32, the height of the exhaust hole 32 may be provided at 120% or less of the radius.

[0044] The distance between the intake hole 31 and the exhaust hole 32 and the propeller 20 may be maintained at a certain distance, and may be maintained at a certain distance by adjusting the distance between the stern 10 provided with the intake hole 31 and the exhaust hole 32 and the propeller 20.

[0045] Referring to FIG. 2, the distance or length b between the stern 10 (hereinafter referred to as the stern 10) provided with the intake hole 31 and the exhaust hole 32 and the propeller 20 may be calculated by measuring at a height of 70% of the radius of the propeller 20, and may be expressed by an equation for a diameter D of the propeller 20, which is twice the radius of the propeller 20, and the number Z of fins provided on the propeller 20.

[0046] The length b between the stern 10 and the propeller 20 is set to be longer than (0.35 - 0.02Z)D, and may be expressed as $b > (0.35 - 0.02Z)D$ in an equation. Therefore, the larger the diameter D of the propeller 20 and the smaller the number Z of fins provided on the propeller 20, the longer the length b between the stern 10 and the propeller 20 is set, and the farther away the stern 10 and the propeller 20 may be.

[0047] FIG. 2 is a side view of the ship structure according to the first embodiment of the present invention, and it may be seen that a side view of a conventional ship structure is illustrated in the upper left of FIG. 2 for comparison.

[0048] Referring to FIG. 2, it may be seen that a length b' between the stern 10 and the propeller 20 in the conventional ship structure and the length b between the stern 10 and the propeller 20 in the ship structure according to the first embodiment of the present invention are different.

[0049] In the conventional ship structure, the length b' between the stern 10 and the propeller 20 is provided relatively long, so the stern 10 has a sunken shape and only the propeller 20 protrudes from the stern 10.

[0050] On the other hand, in the ship structure according to the first embodiment of the present invention, the length b between the stern 10 and the propeller 20 is provided relatively short, so the intake hole 31 and the exhaust hole 32 may be provided in the newly formed stern 10 portion compared to the conventional ship structure.

[0051] However, since a certain distance should be secured between the stern 10 and the propeller 20 according to the classification rules, the length b between the stern 10 and the propeller 20 according to the first embodiment of the present invention may be provided longer than the certain distance according to the classification rules.

[0052] Referring to FIGS. 1 and 2, the shapes of the intake hole 31 and the exhaust hole 32 are shown as a square, but the shapes of the intake hole 31 and the exhaust hole 32 may be provided as either a square or polygon. The square refers to a shape such as a circle or an oval, and a polygon refers to a shape having other angles such as a triangle, a square, a pentagon, a trapezoid, and the like.

[0053] The shapes of the intake hole 31 and the exhaust hole 32 may be provided differently. For example, the intake hole 31 may be provided as a square and the exhaust hole 32 may be provided as a circle. When the area of the squared intake hole 31 is provided to be larger than that of the circular exhaust hole 32, the flow rate in the circular exhaust hole 32 may be formed relatively quickly according to the 'Bernoulli equation' described above.

[0054] In addition, the fluid is discharged to the exhaust hole 32 through the intake hole 31 and the passage, and the shape and velocity of the discharged fluid may vary depending on the shape of the exhaust hole 32. For example, even if the exhaust hole 32 is formed in an oval shape, the shape and velocity of the discharged fluid may vary depending on the location or curvature of the center of the oval shape.

[0055] FIG. 3 is a rear view of a ship structure according to a second embodiment of the present invention.

[0056] Hereinafter, a difference between the present embodiment and the previous embodiment will be mainly described, and the parts where descriptions are omitted will be replaced with the previous contents.

[0057] Referring to FIG. 3, it may be seen that a control fin 40 is provided inside the penetration part 30. Although three control fins 40 are shown, this is only an example, and at least one control fin 40 may be provided.

[0058] The control fin 40 may include an internal pin (not shown) provided inside the penetration part 30 and a protruding pin (not shown) protruding from the penetration part 30. The control fin 40 is provided with at least one internal pin, and may not have a protruding pin. That is, the control fin 40 may exist only on the inside of the penetration part 30 and may not be provided to protrude from the penetration part 30.

[0059] The internal pin may refer to a pin that is provided in the passage (not shown) of the penetration part 30 and does not protrude from the penetration part 30. The angle and position at which the internal pin is provided may vary, but the internal pin may generally be disposed in a horizontal direction that is a longitudinal direction of the ship or in a vertical direction that is a height direction.

[0060] The internal pin may be provided in the passage of the penetration part 30 between the intake hole 31 and the exhaust hole 32. The sizes and shapes of the intake hole 31 and the exhaust hole 32 may be the same, but preferably, the size of the intake hole 31 may be provided larger than that of the exhaust hole 32, so the internal pin may have a shape such as a trapezoid in which the size in the direction of the intake hole 31 is relatively large.

[0061] The internal pin may not have strong fluid resistance because it is provided in the passage of the penetration part 30, but the protruding pin may have strong fluid resistance because it protrudes from the penetration part 30, so it may have a different material and shape from the internal pin.

[0062] If present, the protruding pin may protrude from the penetration part 30 and may protrude out of the intake hole 31 or the exhaust hole 32. The protruding pin may be provided separately from the internal pin, and may be linearly connected to the internal pin and protrude out of the intake hole 31 or the exhaust hole 32.

[0063] The angle of the protruding pin may be provided to be the same as or different from the angle of the internal pin, and it may be determined whether the internal pin and the protruding pin are connected regardless of the angle.

[0064] When the multiple control fins 40 are provided in the penetration part 30, each control fin 40 may have its angle set individually to generate various fluid flows, and when the penetration part 30 has multiple passages, the disposition of the control fin 40 may vary for each passage.

[0065] The control fin may not only change the flow of fluid flowing into the intake hole 31, but also control the amount of fluid flowing in through the protruding pin provided in the intake hole 31, and may also control the amount and flow of fluid flowing out through the protruding pin provided in the exhaust hole 32.

[0066] The control fin 40 may be provided fixedly, and in some cases, the angle or position may be changed, and an operating device (not shown) for this may be disposed.

[0067] When the operating device is disposed, the control fin 40 may be used to block the intake hole 31 or the exhaust hole 32 to prevent the fluid passing through the penetration part 30, which may be performed even while the ship 1 is operating.

[0068] In the case of the protruding pin, it may be provided by protruding out of the intake hole 31 or the exhaust hole 32, but may be positioned within the diameter of the propeller 20, and when it does not interfere with the fluid transmitted to the propeller 20, the protruding pin may be provided inside and outside the diameter of the propeller 20.

[0069] FIG. 4 is a conceptual diagram of a recess 50 in the ship structure according to an embodiment of the present invention.

[0070] Hereinafter, the difference between the present embodiment and the previous embodiment will be mainly described, and the omitted parts will be replaced with the previous contents.

[0071] Referring to FIG. 4, it may be seen that the recess 50 (symbol not shown) is provided around the intake hole 31 or the exhaust hole 32. The recess 50 is provided to have a larger area than the shape of the intake hole 31 or the exhaust hole 32, and may have a more dented shape than an outer plate of the stern 10.

[0072] Accordingly, the recess 50 provided in the intake hole 31 may allow the fluid flowing through the stern 10 to be well collected into the intake hole 31, and the recess 50 provided in the exhaust hole 32 may cause the fluid to be dispersed or concentrated depending on its shape.

[0073] The shape of the recess 50 may generally be provided in a shape similar to the shapes of the intake hole 31 and the exhaust hole 32, but this may be different. When the recess 50 is provided, the passage of the penetration part 30 may be shorter than when the recess 50 is not provided. That is, since the recess 50 is provided in the dented shape that is collected into the intake hole 31 or the exhaust hole 32, the intake hole 31 or the exhaust hole 32 may be provided at a specific point of the dented recess 50 and formed relatively inside.

[0074] Although the recess 50 is expressed as a diagram including the shape of the intake hole 31 or the exhaust hole 32, it may be positioned only in a portion of the shape of the intake hole 31 or the exhaust hole 32, and may also be formed in the shape of a line or a point rather than the diagram.

[0075] The conventional ESD changes the flow of fluid by improving the asymmetrical shape of the stern, propeller, duct, rudder, etc., of the ship or attaching a separate appendage to the symmetrical shape. Therefore, the asymmetrical shape or the separate appendage may cause flow deviation and unevenness of the left starboard, and an additional process was required compared to the general the ship 1 process, which inevitably increased the cost.

[0076] Since the ship structure according to an embodiment of the present invention is provided with the penetration part 30 and the control fin 40 penetrating through the stern 10, the ship structure may be easily manufactured with a relatively simple structure compared to the conventional ESD, structurally more stable, and have at least the same improvement in the amount of transmitted horsepower required to operate the ship 1 as the conventional ESD.

[0077] The above-described case of the limitation of the position of the exhaust hole 32, the intake hole 31, and the control fin is only an example according to an embodiment, and may be designed to deviate from the limitation of the position depending on the design.

[0078] FIG. 5 is a comparison diagram of a degree of improvement in transmission horsepower required to operate the ship 1 through a CFD of the ship structure according to an embodiment of the present invention, FIG. 6 is a comparison diagram of the results of analyzing the CFD of the ship structure according to an embodiment of the present invention, and FIG. 7 is a comparison diagram of the results of analyzing the CFD of the ship structure according to an embodiment of the present invention.

[0079] Referring to FIG. 5, it can be seen whether the transmission horsepower of the ship 1 provided with different ESDs is improved compared to the conventional ship provided without ESD (Self-Propulsion, verification based on contract speed).

[0080] The figure in FIG. 5 is expressed as a ratio of 100% of the conventional ship (Without ESD) provided without the first rod, ESD, for comparison.

[0081] The second rod (with PSD) is a ship equipped with a pre-swirl duct (PSD), and it can be seen that the transmission horsepower of the ship has improved by about 3% compared to the conventional ship (without ESD).

[0082] A third rod (with intake hole) is the ship 1 equipped with the penetration part 30 (intake hole), which is a characteristic of the present invention, and it can be seen that the transmission horsepower of the ship 1 has improved by about 3% like the second rod (with PSD).

[0083] A fourth rod (with FCF) is a ship equipped with a flow control fin (FCF), and it can be seen that the transmission horsepower of the ship is improved by about 1% compared to the conventional ship (without ESD).

[0084] A fifth rod (with AFG) is a ship equipped with an asymmetric flow generator (AFG), and it can be seen that the transmission horsepower of the ship is improved by about 2% compared to the conventional ship (without ESD).

[0085] Referring to FIG. 5, it can be seen that the third rod (with Intake hole) for the ship 1 provided with the penetration part 30 (intake hole), which is a characteristic of the present invention, improves the transmission horsepower of the ship 1 by about 3% compared to the conventional ship (without ESD), just like the second rod (with PSD).

[0086] The second bar (with PSD) is a ship equipped with a pre-swirl duct (PSD), and is an additional structure in which a duct is provided in front of a propeller. The third rod (with intake hole) to which the penetration part 30, which is a characteristic of the present invention, is applied has the same degree of improved effect, so that the ship structure of the present invention may have an improvement amount that is at least equal to or superior to the conventional ESD in terms of the improvement amount of the transmitted horsepower required to operate the ship 1.

[0087] FIGS. 6 and 7 are CFD analysis results for the conventional ship and a ship having the ship structure of the present invention, and it can be seen that the results for propeller rotation speed n, torque Q, thrust T, and transmission horsepower Power are shown.

[0088] As shown on an x-axis of FIGS. 6 and 7, Existing is a conventional ship that is not equipped with the penetration part 30, which is a characteristic of the present invention, and NEW is the ship 1 having a ship structure equipped with the penetration part 30, which is a characteristic of the present invention.

[0089] The ship (NEW) having a ship structure provided with the penetration part 30, which is a characteristic of the present invention, has the smaller propeller rotation speed n, torque Q, and transmission horsepower Power, and the larger thrust T when compared to the conventional ship (Existing) not provided with the penetration part 30, which is a characteristic of the present invention, when the same speed is taken as the standard, so it can be seen that it is improved compared to the conventional ship (Existing).

[0090] In the transmission horsepower Power of FIG. 7, the ship (NEW) having a ship structure provided with the penetration part 30, which is a characteristic of the present invention, has about 3.2% improved transmission horsepower (Power) compared to the conventional ship (Existing), so it can be seen that this is consistent with the result of FIG. 5 described above.

[0091] FIG. 8 is a perspective view of a ship structure according to a third embodiment of the present invention.

[0092] FIG. 9 is a perspective view of the ship structure viewed from a different direction from FIG. 8.

[0093] FIG. 10 is a side view of the ship structure of FIG. 8.

[0094] The ship 1 of FIGS. 8, 9, and 10 may include an attached structure 100 in addition to the ship 1 of FIG. 1. The ship 1 of FIGS. 8, 9, and 10 may reference features that overlap with the ship 1 of FIGS. 1 to 7.

[0095] Referring to FIGS. 8 to 10, the attached structure 100 may be disposed on the stern 10 of the hull of the ship 1. The attached structure 100 may be provided to be attachable to the stern 10. The penetration part 30 may be formed on the attached structure 100 separate from the hull of the ship 1.

[0096] When the penetration part is directly formed on the stern 10 of the ship 1, the problem of reduced ship structural stability may occur, and in order to resolve the design limitation due to not allowing the formation of the penetration part 30 on the hull depending on the ship owner, the attached structure 100 manufactured separately from the hull and attachable to the stern 10 may be formed.

[0097] In addition, in the case of a large ship with a long distance between the stern 10 and the propeller 20, the effect of the horsepower transmitted to the propeller 20 by the fluid passing through the penetration part 30 may be insignificant. By forming the penetration part 30 on the attached structure 100 whose size may be adjusted, the gap between the penetration part 30 and the propeller 20 may be adjusted as needed even in a large ship with a long distance between the stern 10 and the propeller 20. By adjusting the gap between the penetration part 30 and the propeller 20, the effect of the horsepower transmitted to the propeller 20 may be increased.

[0098] The attached structure 100 may be attached to the stern 10 of the hull in front (e.g., +y direction) of the rudder 60 connected to the end portion 12 of the stern 10 of the hull.

[0099] The stern 10 of the hull may include a curved portion 11 that is bent forward (e.g., +y direction). The curved portion 11 may connect a portion of the hull coupled with the rudder 60 and another portion of the hull coupled with the propeller 20.

[0100] The attached structure 100 may be formed symmetrically with respect to a central axis (C-axis of FIGS. 9 and 10) perpendicular to the axis (P-axis) of the propeller. For example, when viewed from the rear of the ship 1, the attached structure 100 may be formed symmetrically with respect to the central axis (C-axis).

[0101] The attached structure 100 may be formed in a shape corresponding to the hull. For example, the attached structure 100 may be formed in a streamlined shape corresponding to the hull. However, the shape of the attached structure 100 is not limited thereto. For another example, the shape of the attached structure 100 may be formed in a partially angular shape.

[0102] The attached structure 100 may be attached to the curved portion 11. For example, the attached structure 100 may be formed in a shape corresponding to the curved portion 11 of the stern 10 of the hull and may be attached to the curved portion 11.

[0103] Since the attached structure 100 is formed in the shape corresponding to the hull of the ship 1, the manufacturer may provide a ship owner with a ship without a sense of incongruity between the ship and the attached structure 100. For example, the attached structure 100 may form an appearance identical to the hull of the ship 1. For example, even though the attached structure 100 is separately connected to the hull, an image of one ship 1 may be formed.

[0104] The attached structure 100 may be attached to the stern 10 of the hull by a connecting member (not shown). The connecting member may include at least one of a welding member, a bolting member, a riveting member, a bonding member, and a taping member.

[0105] For another example, the attached structure 100 may be fitted to the hull of the ship 1. For example, a portion of the attached structure 100 and a portion of the stern 10 of the hull may be formed as a fitting-in structure (not shown). For example, a portion of the attached structure 100 may be formed as an intaglio shape, and a portion of the stern 10 of the hull may be formed as a relief shape. By fitting the intaglio shape of the attached structure 100 and the relief shape of the stern 10, the attached structure 100 may be attached to the hull. For another example, a portion of the attached structure 100 may be formed as the relief shape, and a portion of the stern 10 of the hull may be formed as the intaglio shape.

[0106] Since the attached structure 100 is formed to be attachable to the hull of the ship 1 by the coupling member, the manufacturer may mount the attached structure 100 on the ship 1 or detach the attached structure 100 according to the requirements of the ship owner.

[0107] In order to enhance the durability of the attached structure 100, a filler may be formed in the internal space of the attached structure 100. For example, the filler that provides buoyancy to the ship 1 may be filled in the internal space of the attached structure 100. For another example, the filler that does not provide buoyancy to the ship 1 may be filled in the internal space of the attached structure 100.

[0108] The above-described internal space may include a space between the attached structure 100 and the hull when the attached structure 100 is attached to the hull.

[0109] For another example, a reinforcing member that supports the attached structure may be formed in the internal space of the attached structure 100. For example, a honeycomb structure may be formed in the internal space of the attached structure 100.

[0110] Since the attached structure 100 that may be detached from the hull is formed, the maintenance may be easily performed by separating only the attached structure 100 even after the hull manufacturing process. For example, when the attached structure 100 is damaged during operation of the ship 1, only the attached structure 100 may be separated for easy maintenance.

[0111] The attached structure 100 may include the penetration part 30. The penetration part 30 may refer to the penetration part 30 of FIGS. 1 to 7. For example, the penetration part 30 may form a flow path through which a fluid may move from one side 101 of the attached structure 100 to the other side 102.

[0112] The penetration part 30 may include the intake hole 31 formed on one side 101, and the exhaust hole 32 formed on the other side 102 from the rear of the intake hole 31. The penetration part 30 may induce the fluid introduced into the intake hole 31 and discharged through the exhaust hole 32 to be introduced into the propeller 20 disposed on the rear of the ship 1.

[0113] As described above in FIGS. 5, 6, and 7, by introducing the fluid into the propeller 20 through the penetration part 30, the propulsion efficiency of the ship may be improved compared to the conventional ship (without ESD).

[0114] By using the penetration part 30 instead of a separate pre-swirl duct (PSD) member, the problem of the propeller 20 being damaged during the operation due to the external impact may be prevented. For example, in the case of the existing member such as an additional structure in which the duct is provided, when the existing member falls off from the ship due to the external impact, the duct may cause damage to the propeller 20 as it is disposed in an area adjacent to the propeller 20. When formed with the penetration part 30, the problem of the propeller 20 being damaged may be prevented as there is no problem of it falling off from the hull.

[0115] As the area where the attached structure 100 is coupled with the hull increases, the structural stability may be improved by being coupled with the hull more strongly than the duct. For example, the conventional duct-shaped PSD may have a cantilever-shaped structure in which a part is fixed to the hull. Since the conventional duct-shaped PSD has a cantilever-shaped structure, the duct has a narrow area where it is coupled to the hull, so the coupling force with the hull may be weak. On the other hand, since the attached structure 100 has a large area connected to the hull, and since the attached structure 100 has the coupling structure that is generally attached to the hull, the structural stability may be improved.

[0116] Since the penetration part 30 is formed in the attached structure 100, the propeller 20 and the penetration part 30 may be disposed adjacently. For example, the penetration part 30 may be disposed relatively more adjacently to the propeller 20 than when the penetration part 30 is formed in the hull. When the penetration part 30 is formed in the hull, the location of the penetration part 30 may be limited due to the structural stability required by the classification society, but when the penetration part 30 is formed in the attached structure 100, the penetration part 30 may be disposed adjacently to the propeller 20.

[0117] Since the propeller 20 and the penetration part 30 are disposed adjacently, the effect of improving the propulsion efficiency of the ship may be increased.

[0118] An opening/closing device for controlling the flow of fluid may be disposed in the intake hole 31 and the exhaust hole 32. For example, a mesh for controlling the flow of fluid may be disposed in the intake hole 31 and the exhaust hole 32.

[0119] An injection device for injecting the fluid of the penetration part 30 may be disposed in the exhaust hole 32, or a suction device for sucking fluid may be further disposed in the intake hole 31.

[0120] FIG. 11 is a rear view of a ship structure according to a fourth embodiment of the present invention.

[0121] FIG. 12 is a perspective view of the ship structure of FIG. 11.

[0122] **In** FIGS. 11 and 12, unlike FIGS. 8 to 10, the attached structure 100 may be attached to the stern 10 of the ship 1 while being tilted in one direction.

[0123] Referring to FIG. 11, when viewed from the rear of the ship 1, the attached structure 100 may be attached to the stern 10 of the ship 1 while being tilted in one direction (e.g., the -x direction).

[0124] One side 101 and the other side 102 of the attached structure 100 may meet to form the connecting line 103. When viewed from the rear of the ship 1, the connecting line 103 may be formed so as not to be aligned with the central axis (C-axis) orthogonal to the axis (P-axis) of the propeller. For example, the connecting line 103 may be formed to be tilted so as not to be aligned with the central axis (C-axis) of the axis (P-axis) of propeller.

[0125] The degree to which the connecting line 103 is tilted with respect to the central axis (C-axis) may gradually increase as it goes upward from the axis (P-axis) of propeller. For example, referring to FIGS. 11 and 12, when the length of the propeller blade is 1.0R, the degree to which the connecting line 103 is tilted from the central axis (C-axis) may gradually increase in the order of 0.3R, 0.5R, 0.7R, and 1.0R.

[0126] Since the connecting line 103 is tilted with respect to the central axis (C-axis), when viewed from the rear of the ship 1, the attached structure 100 may be attached to the stern 10 by being turned in one lateral direction (e.g., -x direction) with respect to the central axis (C-axis). Since the attached structure 100 is turned in the one lateral direction and is attached to the stern 10, the propulsion efficiency of the ship 1 may be improved compared to the case where it is aligned with the central axis (C-axis).

[0127] The present invention is not limited to the embodiments described above, and may include a combination of the embodiments or a combination of at least one of the embodiments and a known technology as another embodiment.

[0128] Although the present invention has been described in detail through specific embodiments, these embodiments are to specifically describe the present invention, the present invention is not limited to these embodiments, and it will be obvious that their modifications and alterations may be made by those skilled in the art within the technical spirit of the present invention.

[0129] Accordingly, all simple modifications or changes of the present invention fall within the scope of the present invention, and the specific scope of protection of the present invention will be clarified by the accompanying claims.

Claims

1. A ship structure, comprising:

> a penetration part provided above an axis of a propeller and penetrating through a stern, wherein the penetration part includes:
>
> > an intake hole; and
> > an exhaust hole positioned at a rear side of the intake hole, and
> > a fluid passing through the penetration part is transmitted to the propeller.

2. The ship structure of claim 1, wherein when the propeller turns right, the intake hole is provided on a starboard and the penetration part is penetrated from the starboard to a portside, and
when the propeller turns left, the intake hole is provided on the portside and the penetration part is penetrated from the portside to the starboard.

3. The ship structure of claim 2, wherein the intake hole is provided to have at least the same size as the exhaust hole and is positioned at a rear side of a watertight bulkhead provided at the stern.

4. The ship structure of claim 3, wherein the intake hole is provided at 20% or more and 120% or less of a radius of the propeller with respect to the axis of the propeller.

5. The ship structure of claim 4, wherein the exhaust hole is provided at 20% or more and 100% or less of the radius of the propeller with respect to the axis of the propeller.

6. The ship structure of claim 5, wherein a length between the propeller and the stern at a height of 70% of the radius of the propeller is provided to be longer than (0.35 - 0.02Z)D for a diameter D of the propeller and the number Z of fins of the propeller.

7. The ship structure of claim 6, wherein shapes of the intake hole and the exhaust hole are provided as a square or a polygon, respectively.

8. The ship structure of claim 7, wherein a recess having a larger area than the shape is provided on a circumference of the shape.

9. The ship structure of claim 8, wherein the penetration part further includes at least one control fin inside, and
the control fin includes at least one protruding pin protruding from the penetration part or an internal pin that does not protrude at all.

10. The ship structure of claim 9, wherein the control fins are individually set at an angle, and
the angles of the protruding pin and the internal pin are set to be the same or different.

11. The ship structure of claim 10, wherein the protruding pin is positioned within a diameter of the propeller.

12. A ship structure, comprising:

> a hull of a ship; and
> an attached structure provided to be attachable to a stern of the hull,
> wherein the attached structure includes a penetration part provided to allow fluid to flow from one side to the other side, and
> the penetration part includes:
>
> > an intake hole formed on one side of the attached structure; and
> > an exhaust hole formed on the other side of the attached structure at a rear of the intake hole.

13. The ship structure of claim 12, wherein the penetration part induces fluid introduced into the intake hole to flow into a propeller disposed at the rear of the ship through the exhaust hole.

14. The ship structure of claim 12, wherein the attached structure is disposed in front of a rudder connected to an end portion of the stern of the hull.

15. The ship structure of claim 12, wherein the attached structure has a shape corresponding to a curved portion of the stern of the hull.

16. The ship structure of claim 12, wherein when viewed from the rear of the ship, a connecting line where one side and the other side of the attached structure meet is formed to be inclined so as not to be aligned with a central axis perpendicular to an axis of a propeller.

17. The ship structure of claim 16, wherein a degree to which the connecting line is inclined with respect to the central axis gradually increases as it goes upward from an axis of the propeller.

18. The ship structure of claim 12, wherein a portion of the attached structure and a portion of the stern of the hull are formed by a fitting-in structure.

19. The ship structure of claim 12, wherein a filler is formed in an internal space of the attached structure.

20. The ship structure of claim 12, wherein the internal space of the attached structure is formed in a honeycomb structure.

21. The ship structure of claim 12, wherein an opening/closing device for controlling a flow of fluid is disposed in the intake hole and the exhaust hole.

22. The ship structure of claim 12, wherein an injection device for injecting the fluid of the penetration part is disposed in the exhaust hole, or a suction device for sucking fluid is disposed in the intake hole.

23. The ship structure of claim 12, wherein the intake hole is provided at 20% or more and 120% or less of a radius of the propeller with respect to the axis of the propeller, and

the exhaust hole is provided at 20% or more and 100% or less of the radius of the propeller with respect to the axis of the propeller.

24. An attached structure provided to be attachable to a stern of a hull of a ship, wherein the attached structure includes a penetration part provided to allow fluid to flow from one side to the other side, and

the penetration part includes:

an intake hole formed on one side of the attached structure; and

an exhaust hole formed on the other side of the attached structure.

FIG. 1

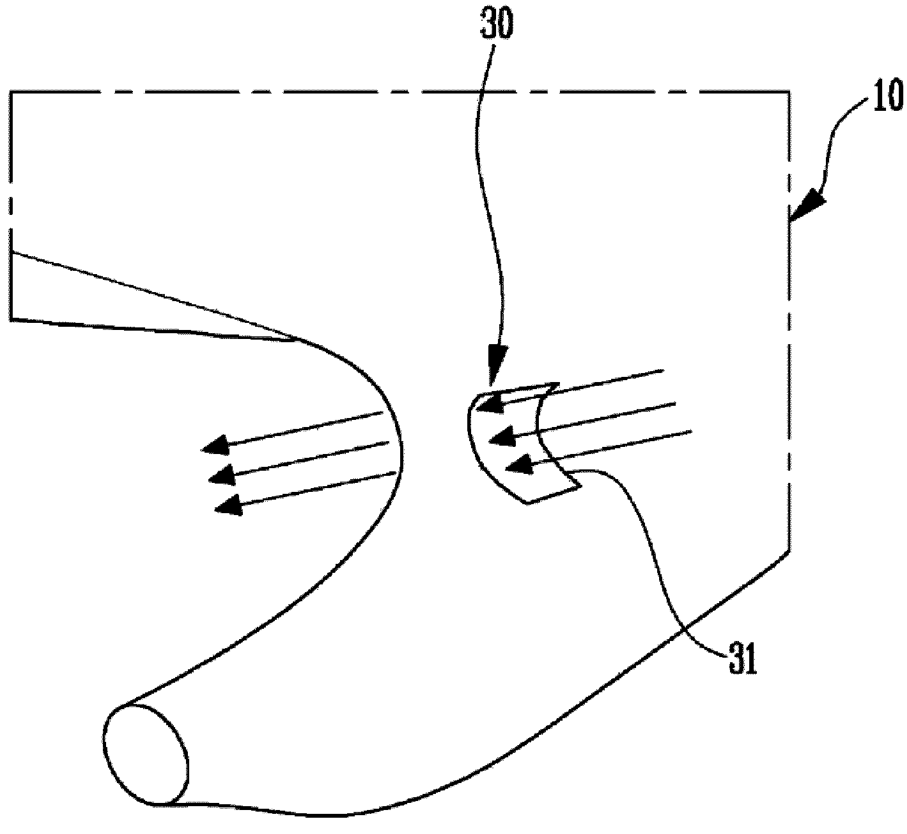


FIG. 2

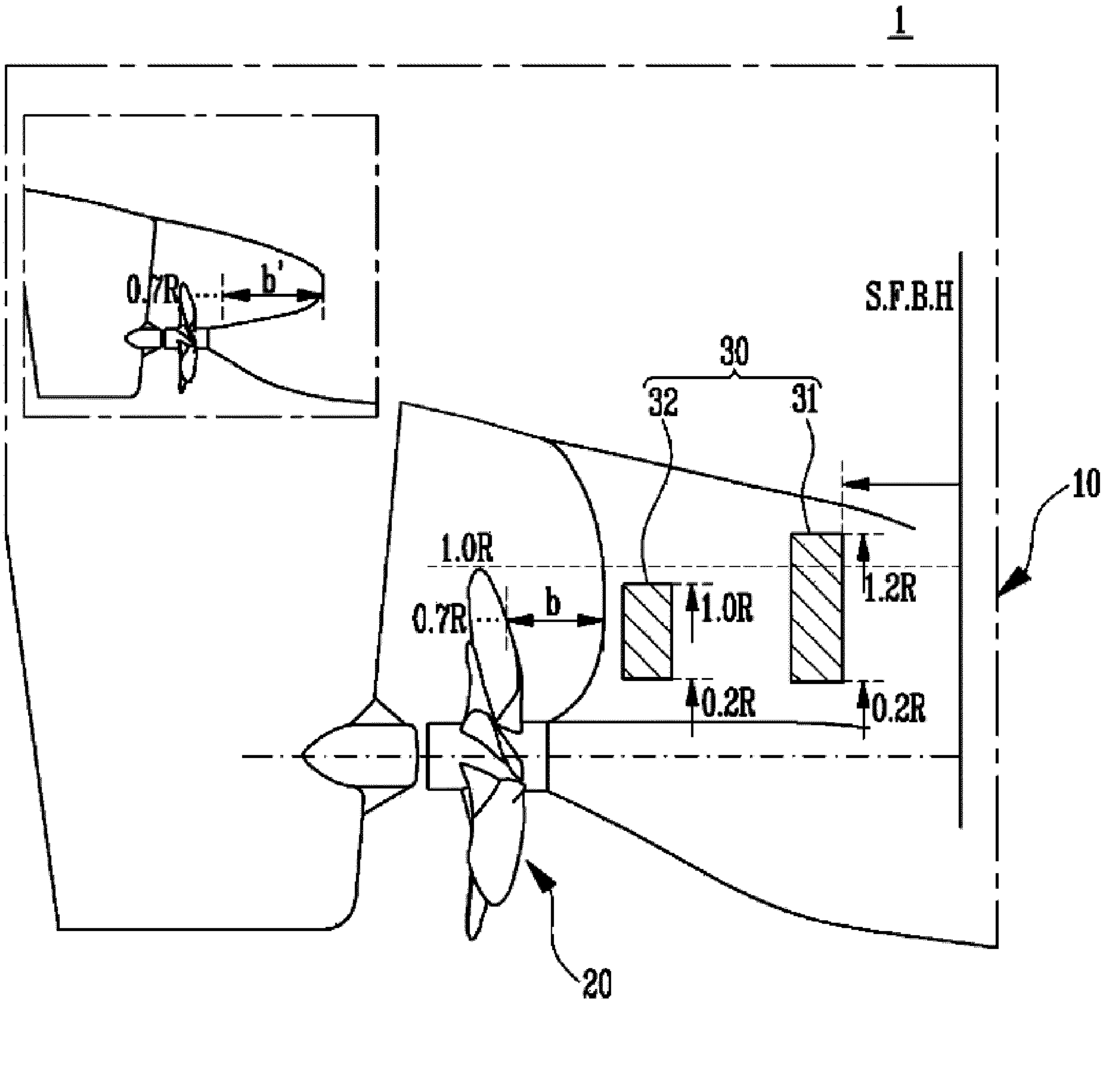


FIG. 3

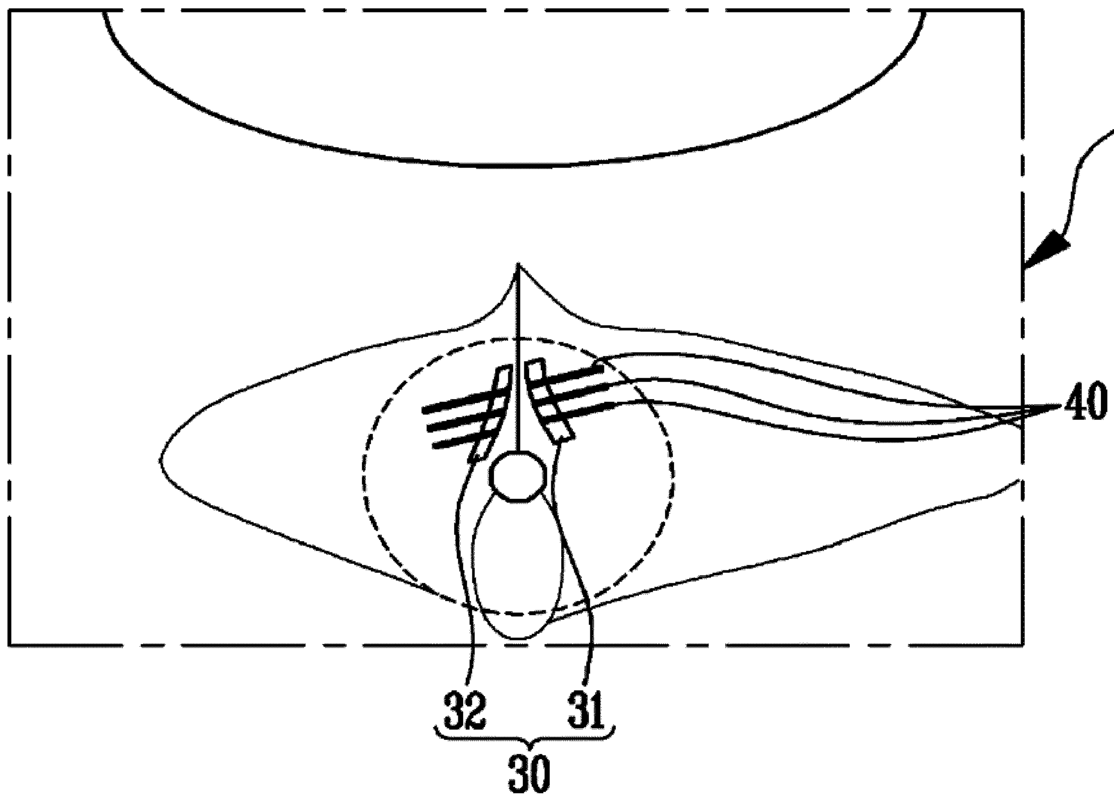


FIG. 4

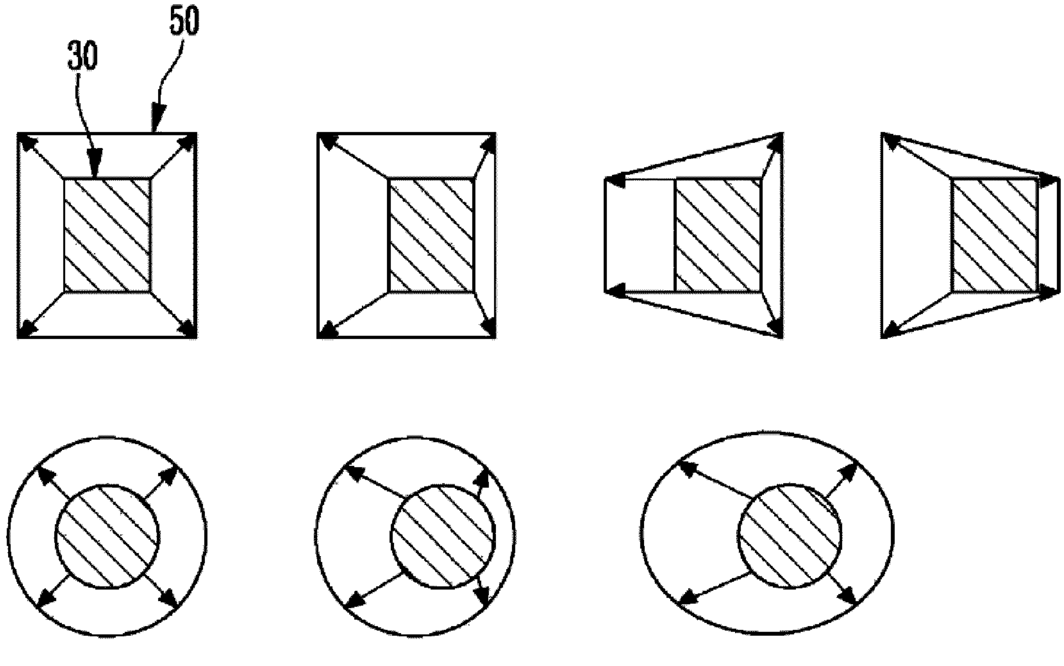


FIG. 5

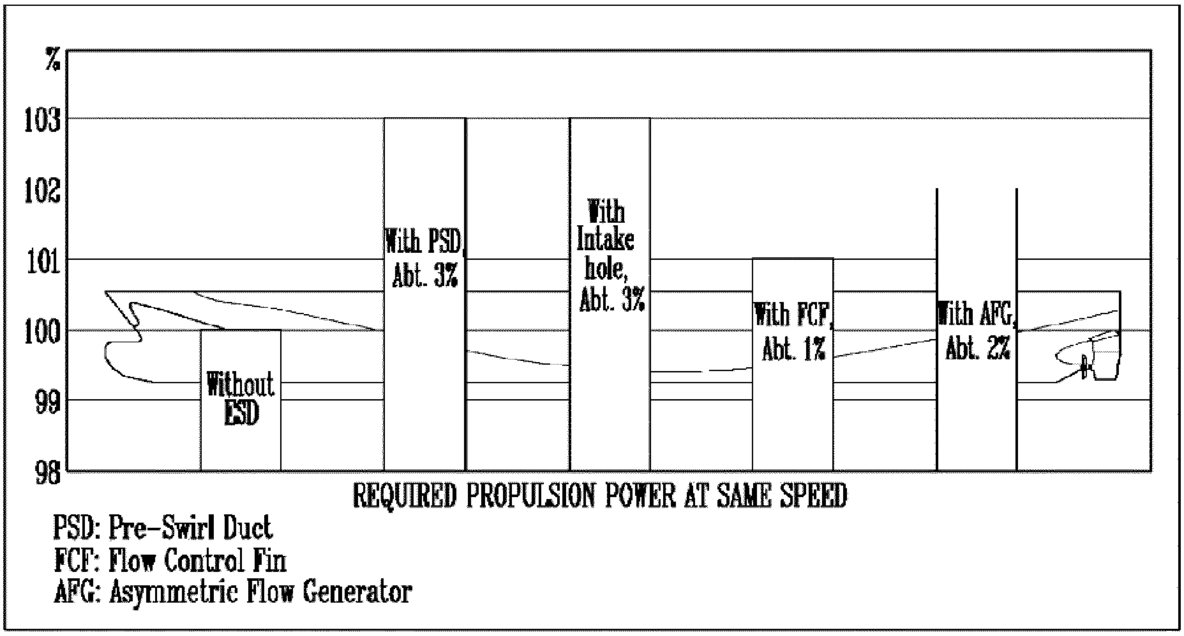
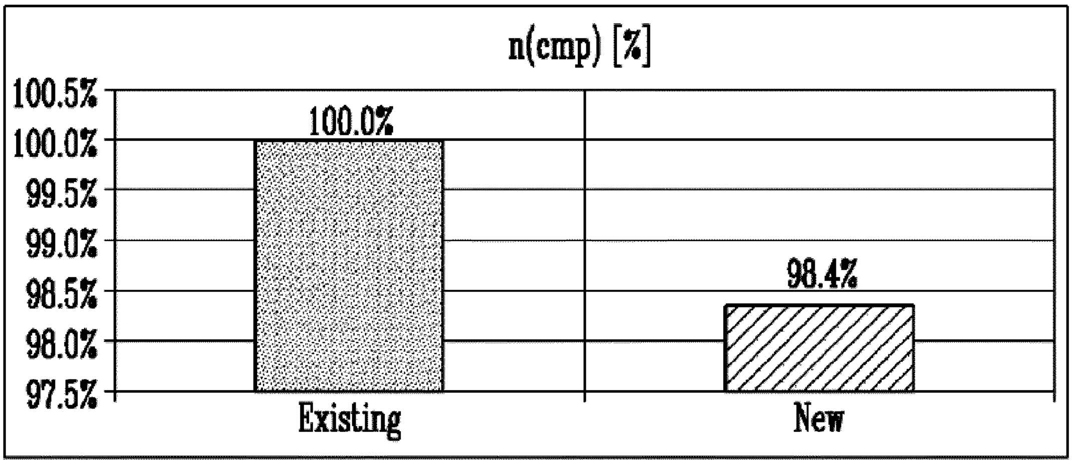

%
103
102
101
100
99
98
Without ESD
With PSD, Abt. 3%
With Intake hole, Abt. 3%
With FCF, Abt. 1%
With AFG, Abt. 2%
REQUIRED PROPULSION POWER AT SAME SPEED
PSD: Pre-Swirl Duct
FCF: Flow Control Fin
AFG: Asymmetric Flow Generator

FIG. 6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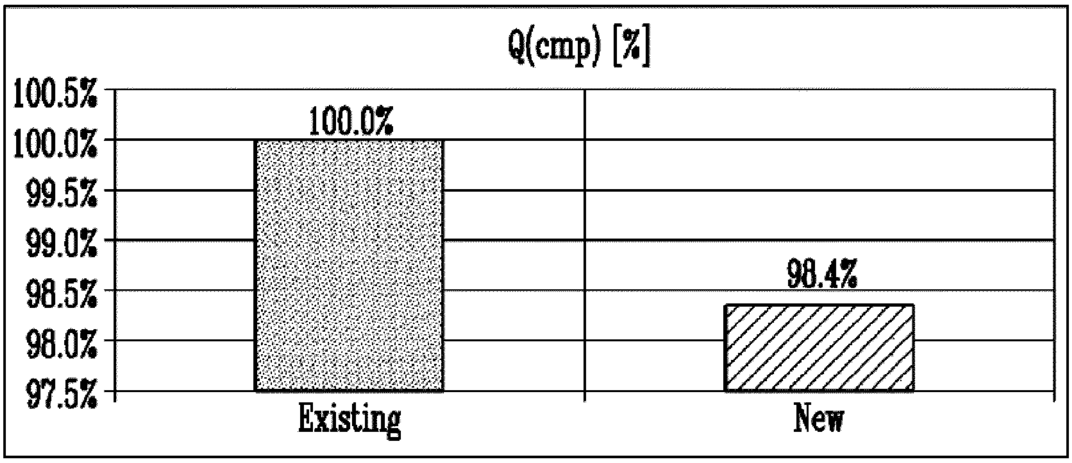
98.5%
98.0%
97.5%
100.0%
98.4%
Existing
New


Q(cmp) [%]
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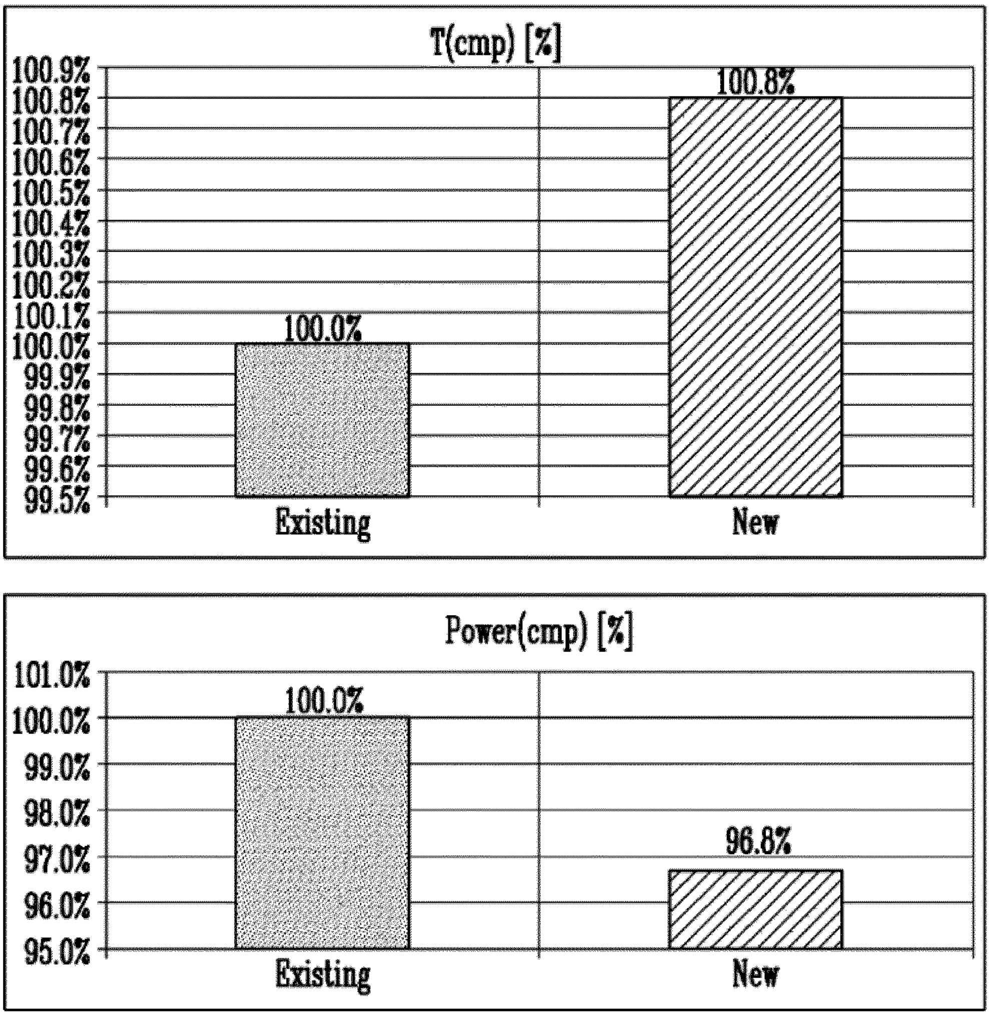
98.5%
98.0%
97.5%
100.0%
98.4%
Existing
New

FIG. 7


T(cmp) [%]
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100.3%
100.2%
100.1%
100.0%
99.9%
99.8%
99.7%
99.6%
99.5%
100.0%
100.8%
Existing
New
Power(cmp) [%]
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95.0%
100.0%
96.8%
Existing
New

FIG. 8

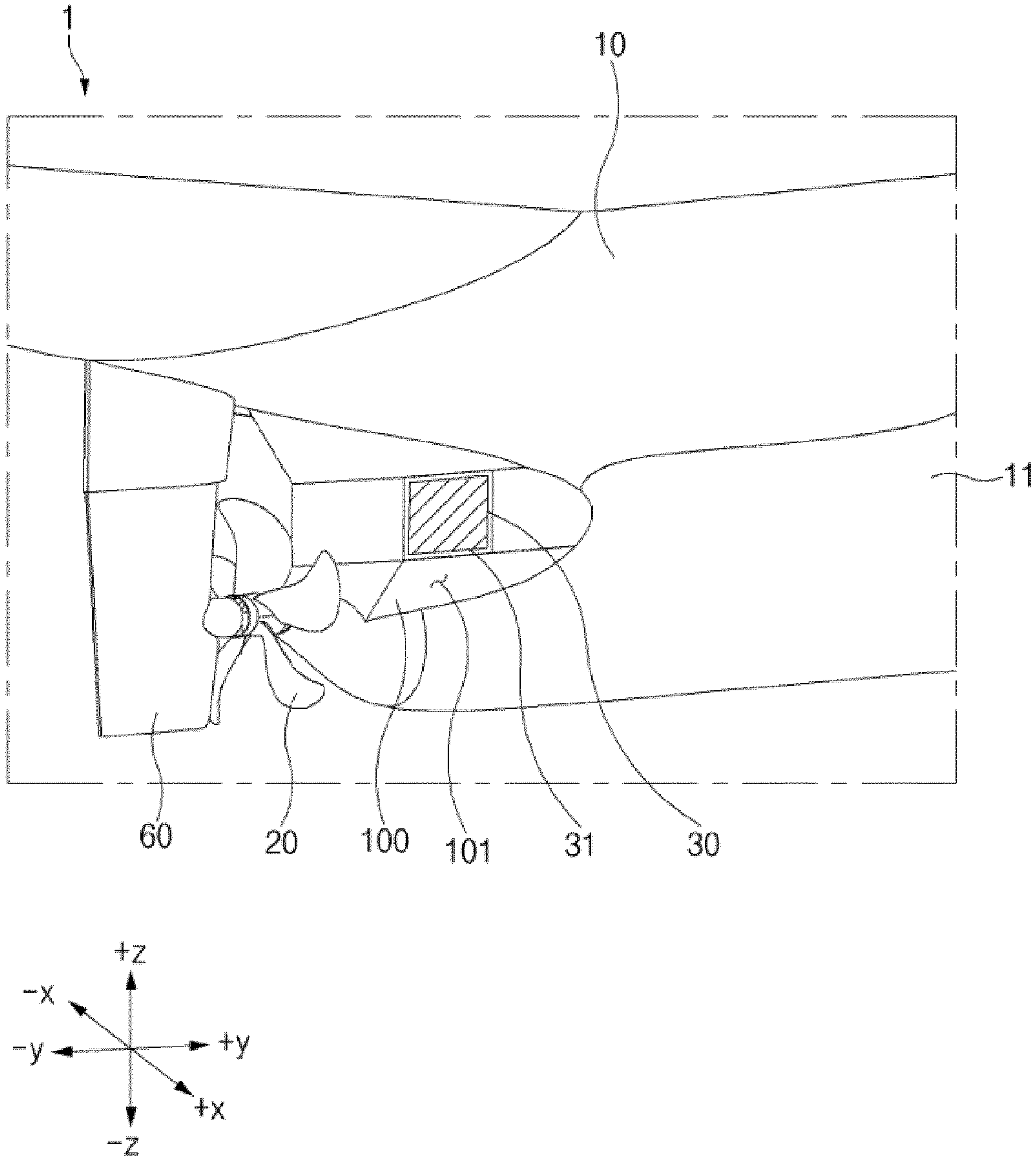


FIG. 9

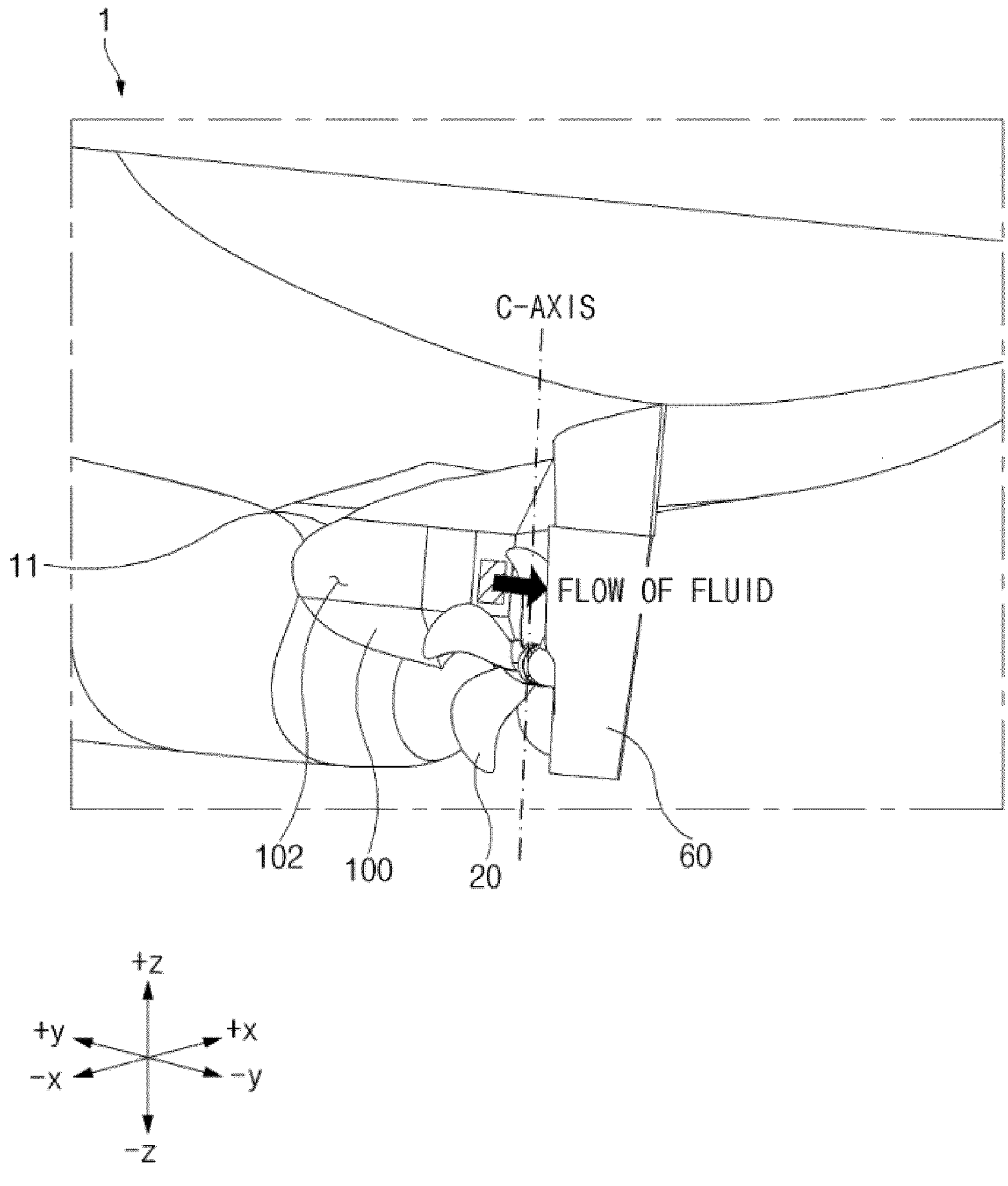


FIG. 10

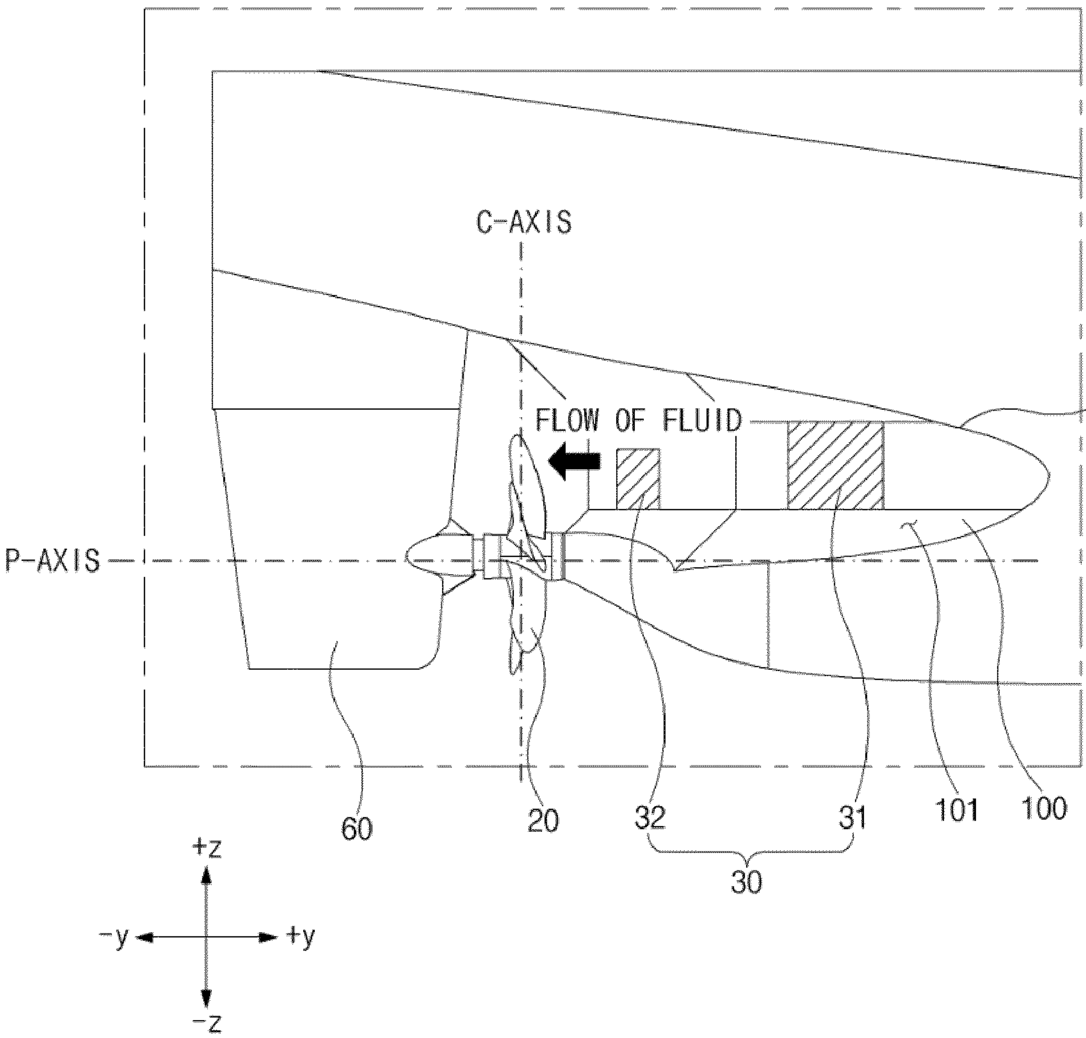


FIG. 11

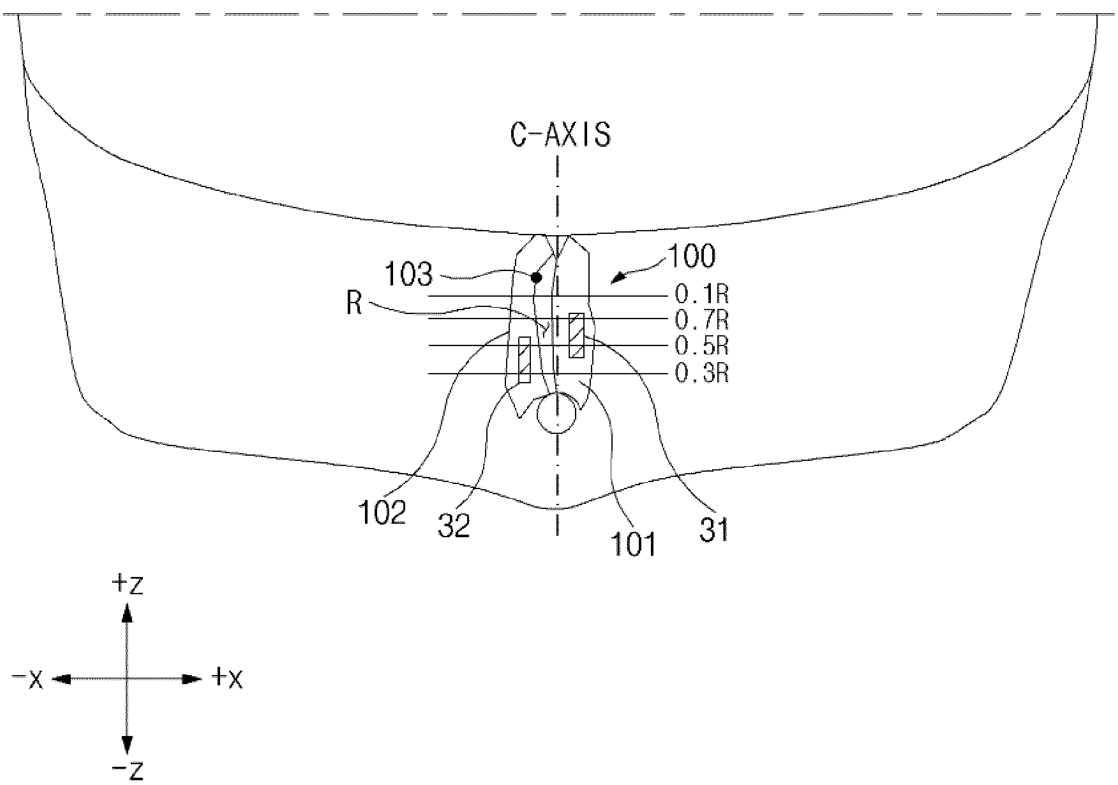
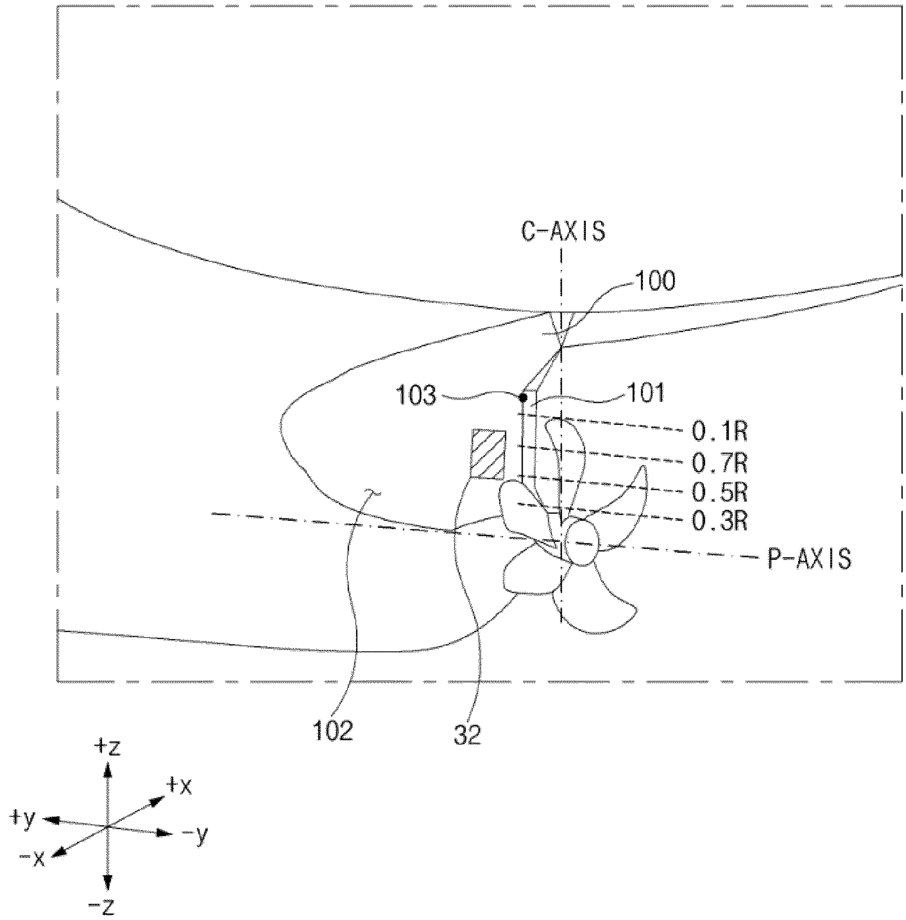


FIG. 12



INTERNATIONAL SEARCH REPORT

International application No. **PCT/KR2023/010991**

A. CLASSIFICATION OF SUBJECT MATTER

B63B 13/02(2006.01)i; **B63H 5/16**(2006.01)i; **B63H 1/28**(2006.01)i

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)

B63B 13/02(2006.01); B63B 1/08(2006.01); B63B 1/32(2006.01); B63H 1/28(2006.01); B63H 5/15(2006.01); B63H 5/16(2006.01)

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

Korean utility models and applications for utility models: IPC as above
Japanese utility models and applications for utility models: IPC as above

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

eKOMPASS (KIPO internal) & keywords: 선박(ship), 각도(angle), 핀(pin), 프로펠러(propeller), 선미(stern)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-2017-0108381 A (HYUNDAI HEAVY INDUSTRIES CO., LTD.) 27 September 2017 (2017-09-27) See paragraphs [0021]-[0030] and figures 1-2.	1-3
Y		4-11,21-23
X	KR 10-2021-0062729 A (NATIONAL INSTITUTE OF MARITIME, PORT AND AVIATION TECHNOLOGY) 31 May 2021 (2021-05-31) See paragraphs [0057]-[0085] and figures 1-5 and 9-10.	12-13,15-20,24
Y		4-11,14,21-23
Y	KR 10-2014-0131725 A (HYUNDAI HEAVY INDUSTRIES CO., LTD.) 14 November 2014 (2014-11-14) See paragraph [0027] and figure 2.	6-11
Y	KR 10-2021-0024140 A (BECKER MARINE SYSTEMS GMBH) 04 March 2021 (2021-03-04) See paragraphs [0038], [0068] and [0076] and figures 3, 6-7 and 9.	9-11,14

☑ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
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"O" document referring to an oral disclosure, use, exhibition or other means
"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	Date of mailing of the international search report
26 October 2023	**30 October 2023**

Name and mailing address of the ISA/KR	Authorized officer
Korean Intellectual Property Office Government Complex-Daejeon Building 4, 189 Cheongsa-ro, Seo-gu, Daejeon 35208	
Facsimile No. **+82-42-481-8578**	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2023/010991

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
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		WO 2014-180605 A1	13 November 2014
JP 08-318896 A	03 December 1996	None	

Form PCT/ISA/210 (patent family annex) (July 2022)

REFERENCES CITED IN THE DESCRIPTION

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- KR 1020230097778 **[0001]**