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(54) **Azimuth propeller device**

(57) An azimuth propeller device includes a streamlined plate member (4), and an azimuth pod (2) fixed to the lower portion of the streamlined plate member. An auxiliary steering member (6) provided with the stream-

lined plate member (4). The azimuth pod (2) is provided with a propeller member (5), and the streamlined plate member (4) and the azimuth pod (2) are provided so as to be rotatable together along a vertical axis with respect to the bottom of a ship (1).

FIG. 1A

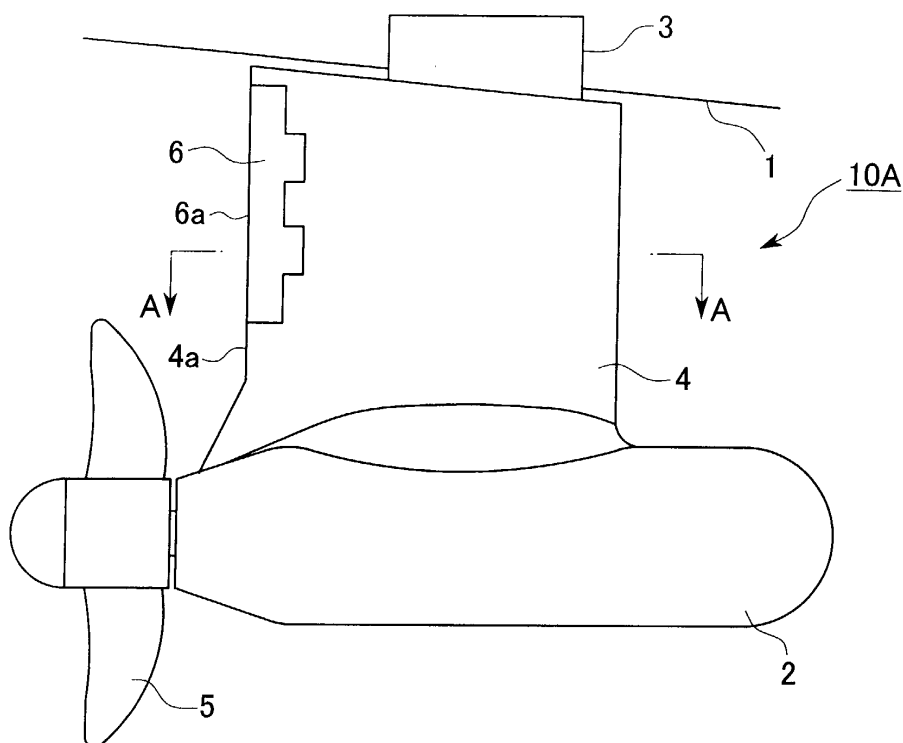
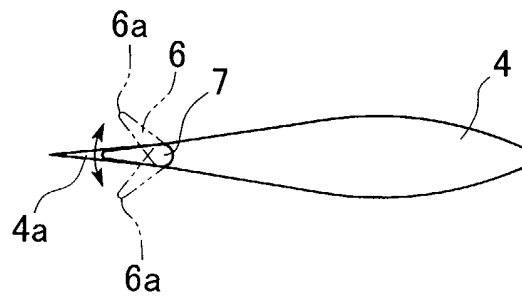


FIG. 1B



Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to an azimuth propeller device. More specifically, the present invention relates to an azimuth propeller device which may be attached to the bottom of a ship to drive and steer the ship.

Description of Related Art

[0002] In general, a conventional ship is provided with a propeller and a rudder separately provided with the propeller, which are attached to the stern of the ship so that the driving force for the ship is exerted by the propeller, and operations, such as turning of the ship, are performed by the rudder.

[0003] Recently, however, the propeller used for driving the ship and the rudder used for operating the ship are integrated, and an azimuth propeller device, simply called an azimuth propeller, which is attached to the ship to be rotatable in the vertical direction of the ship, has been developed.

[0004] The structure of a conventional azimuth propeller device will be briefly described with reference to FIGS. 12 and 13A and 13B. FIG. 12 is a schematic diagram showing an attachment of an azimuth propeller device at the stern portion of a ship. FIG. 13A is a diagram showing the right hand side view of the azimuth propeller device. FIG. 13B is a diagram showing a cross-sectional view of the azimuth propeller device shown in FIG. 13A taken along the line F-F. In the figures, the numeral 1 indicates a rear portion of the ship's bottom, 2 indicates an azimuth pod, 3 indicates a shaft, 4 indicates a current plate member, 5 indicates a propeller member, and 10 indicates an azimuth propeller device.

[0005] As shown in the figures, the azimuth propeller device 10 is rotatably attached to the rear portion of the ship's bottom 1 via the shaft 3. The azimuth propeller device 10 includes the propeller member 5, the azimuth pod 2, and the current plate member 4. The propeller member 5, which exerts the driving force for the ship, may be attached to the front or back of the azimuth device 10. The azimuth pod 2 accommodates a propeller drive mechanism (not shown in the figures) in the inside thereof. The current plate member 4 is integrally fixed to the upper portion of the azimuth pod 2 and has a streamline cross sectional shape. The current plate member 4 is attached to the lower portion of the shaft 3 which extends in the vertical direction, and the upper portion of the shaft 3 is coupled with a driving mechanism (not shown in the figures), which is disposed in the hull so that the shaft 3, the current plate member 4, the azimuth pod 2, and the propeller member 5 are integrally rotated.

[0006] By using the azimuth propeller device 10 hav-

ing the above described structure, it becomes possible to drive the ship using the driving force generated by rotating the propeller member 5, and to obtain steering function by rotating the azimuth propeller device 10 with respect to the rear portion of the ship's bottom 1 to change the travelling course of the ship. Note that a motor used for outputting the driving force for the propeller member 5 may be disposed in the azimuth pod 2 or in the hull of the ship.

[0007] In the conventional azimuth propeller device 10 described above, however, it is necessary, in order to maintain the direction of the ship, i.e., a course of the ship in a straight line, to frequently change the angle of the shaft 3 within a relatively small angle range so that the direction of the propeller member 5 may be varied to finely adjust the direction of the ship. Moreover, when making a turn, it is necessary to rotate the shaft 3 at a large angle to change the direction of the propeller member 5. In addition, when making an emergency stop, it is required to counterrotate the propeller member 5 to stop the ship.

[0008] For these reasons, it is necessary to frequently actuate a large driving mechanism in order to rotate the azimuth propeller device 10 which is large and heavy. Accordingly, a further improvement in the conventional azimuth propeller device 10 has been awaited from the viewpoints of reducing energy consumption, improving durability, and decreasing manufacturing cost.

SUMMARY OF THE INVENTION

[0009] The present invention takes into consideration the above-mentioned circumstances, and has as an object to provide an azimuth propeller device which is capable of maintaining the course of a ship without rotating the entire azimuth propeller device, and the steering force thereof is further improved when making a ship turn.

[0010] In order to achieve the above object, the present invention provides an azimuth propeller device including: a current plate member; an azimuth pod fixed to a lower portion of the current plate member, the azimuth pod being provided with a propeller member; and an auxiliary steering member provided with the current plate member, wherein the current plate member and the azimuth pod are provided so as to be rotatable together along a vertical axis with respect to the bottom of a ship.

[0011] In accordance with another aspect of the invention, the auxiliary steering member is a rear flap member rotatably attached to a trailing edge portion of the current plate member.

[0012] In yet another aspect of the invention, the auxiliary steering member is a front flap member rotatably attached to a front edge portion of the current plate member.

[0013] In yet another aspect of the invention, the auxiliary steering member is a front flap member rotatably

attached to a front edge portion of the current plate member, and a rear flap member rotatably attached to a trailing edge portion of the current plate member.

[0014] The present invention also provides an azimuth propeller device including: a current plate member; an azimuth pod fixed to the lower portion of the current plate member, the azimuth pod being provided with a propeller member; a vertical stabilizer disposed at a lower portion of the azimuth pod; and a trailing edge flap member rotatably attached to a rear edge portion of the vertical stabilizer, wherein the current plate member and the azimuth pod are provided so as to be rotatable together along a vertical axis with respect to the bottom of a ship.

[0015] In accordance with yet another aspect of the invention, the auxiliary steering member is a pair of open-close flap members attached to a side wall portion of the current plate member, the pair of open-close flap members being disposed so as to open and close independently.

[0016] In yet another aspect of the invention, the pair of open-close flap members are fully opened to make an emergency stop of a ship.

[0017] In yet another aspect of the invention, the auxiliary steering member set forth above is combined with another auxiliary steering member described above.

[0018] The present invention also provides the above azimuth propeller device further including: a pair of open-close members attached to a side wall portion of the vertical stabilizer, the pair of open-close flap members being disposed so as to open and close independently.

[0019] According to the azimuth propeller device described above, since an auxiliary steering member is provided with the current plate member of the azimuth propeller device, it becomes possible to maintain the direction of a ship by the operation of the auxiliary steering member, without the necessity of operating the whole azimuth propeller device, and hence, the straightness of the travel of the ship can be secured.

[0020] Also, since the steering force of the azimuth propeller device can be improved by operating the auxiliary steering member, a desired turning of the ship can be made by decreasing the steering angle of the azimuth propeller device as compared with the case where only the azimuth propeller device is used to make a ship turn.

[0021] Accordingly, power required for the operation of the azimuth propeller device according to the present invention can be decreased as compared with a conventional azimuth propeller device, the entire body of which is operated to make, for instance, a ship turn. Therefore, remarkable effects, such as reduction in cost and improvement in durability, can be obtained according to the azimuth propeller device of the present invention.

[0022] In yet another aspect of the present invention, the azimuth propeller device further includes at least

one radiation member provided with an outer periphery of the azimuth pod, wherein the propeller member is a POD propeller member provided with the azimuth pod, and a motor which drives the POD propeller member is provided inside the azimuth pod.

[0023] In accordance with another aspect of the present invention, the radiation member is a fin extending in the front and back direction of the azimuth pod.

[0024] In yet another aspect of the present invention, the fin is twisted in the rotation direction of the POD propeller member from the front to back of the fin.

[0025] According to the above azimuth propeller device, since at least one radiation member is provided with the outer periphery of the azimuth pod, it becomes possible to effectively release the heat, which is generated by the rotation of the motor inside the azimuth pod, into the surrounding water via the radiation member. That is, it becomes possible to effectively carry out a water-cooling operation using water of the ocean, a river, a lake, etc., in which the ship is traveling, and hence the air cooling operation can be eliminated or decreased to a minimum level. Accordingly, it has a remarkable effect on the reduction in the size and cost of the azimuth propeller device.

[0026] Also, since at least one of the fins extending in the front and back direction of the azimuth pod is adopted as a radiation member, it becomes possible to secure a large heat transfer area to improve the radiation efficiency.

[0027] Moreover, since the fin is twisted in the rotation direction of the POD propeller member from the front to back of the fin, water flow adjusting effect can be obtained in addition to the above-mentioned radiation effect. Accordingly, the present invention can also contribute to the improvement in the driving force.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] Some of the features and advantages of the invention have been described, and others will become apparent from the detailed description which follows and from the accompanying drawings, in which:

FIG. 1A is a schematic diagram showing a side view of an azimuth propeller device according to the first embodiment of the present invention, and FIG. 1B is a diagram showing a cross-sectional view of the azimuth propeller device taken along the line A-A shown in FIG. 1A;

FIG. 2A is a schematic diagram showing a side view of an azimuth propeller device according to the second embodiment of the present invention, and FIG. 2B is a diagram showing a cross-sectional view of the azimuth propeller device taken along the line B-B shown in FIG. 2A;

FIG. 3A is a schematic diagram showing a side view of an azimuth propeller device according to the third embodiment of the present invention, and FIG. 3B

is a diagram showing a cross-sectional view of the azimuth propeller device taken along the line C-C shown in FIG. 3A;

FIG. 4A is a schematic diagram showing a side view of an azimuth propeller device according to the fourth embodiment of the present invention, and FIG. 4B is a diagram showing a cross-sectional view of the azimuth propeller device taken along the line D-D shown in FIG. 4A;

FIG. 5A is a schematic diagram showing a side view of an azimuth propeller device according to the fifth embodiment of the present invention, and FIG. 5B is a diagram showing a bottom of the azimuth propeller device shown in FIG. 5A;

FIG. 6A is a schematic diagram showing a side view of an azimuth propeller device according to the sixth embodiment of the present invention, and FIG. 6B is a diagram showing a cross-sectional view of the azimuth propeller device taken along the line E-E shown in FIG. 6A;

FIG. 7 is a schematic diagram showing a cross-sectional view of main parts of the azimuth propeller device according to the seventh embodiment of the present invention;

FIG. 8 is a schematic diagram showing a cross-sectional view of main parts of the azimuth propeller device according to the eighth embodiment of the present invention;

FIG. 9 is a schematic diagram showing a cross-sectional view of main parts of the azimuth propeller device according to the ninth embodiment of the present invention;

FIG. 10A is a schematic diagram showing a side view of an azimuth propeller device according to the tenth embodiment of the present invention, and FIG. 10B is a diagram showing a front elevational view of the azimuth propeller device shown in FIG. 10A;

FIG. 11 A is a schematic diagram showing a side view of an azimuth propeller device according to the eleventh embodiment of the present invention, and FIG. 11B is a diagram showing a front elevational view of the azimuth propeller device shown in FIG. 11A;

FIG. 12 is a schematic diagram showing an attachment of a conventional azimuth propeller device at the stern portion of a ship; and

FIG. 13A is a schematic diagram showing a side view of a conventional azimuth propeller device, and FIG. 13B is a diagram showing a cross-sectional view of the azimuth propeller taken along the line F-F shown in FIG. 13A.

DETAILED DESCRIPTION OF THE INVENTION

[0029] The invention summarized above and defined by the enumerated claims may be better understood by referring to the following detailed description, which

should be read with reference to the accompanying drawings. This detailed description of particular preferred embodiments, set out below to enable one to build and use particular implementations of the invention, is not intended to limit the enumerated claims, but to serve as particular examples thereof.

[0030] The azimuth propeller device according to an embodiment of the present invention will be described with reference to FIGS. 1A and 1B. Note that in the following figures, elements which are the same as those described in the prior art are indicated by using the same numerals, and explanations thereof will be omitted.

[0031] In the azimuth propeller device according to the first embodiment of the present embodiment shown in FIGS. 1A and 1B, the numeral 1 indicates a rear portion of the ship's bottom, 2 indicates an azimuth pod, 3 indicates a shaft, 4 indicates a current plate member, 5 indicates a propeller member, 6 indicates a rear flap member, and 10A indicates an azimuth propeller device.

[0032] As shown in the figures, the azimuth propeller device 10A is rotatably attached to the rear portion of the ship's bottom 1 via the shaft 3. In this specification, the term "the rear portion of the ship's bottom" means a portion of the bottom of a ship which is located at the back of a hull with respect to the travelling direction of the ship.

[0033] The azimuth propeller device 10A includes the azimuth pod 2 accommodating a propeller drive mechanism (not shown in the figures) in the inside thereof, to which the propeller member 5 that exerts the driving force for the ship by delivering water backwards, is attached to the front or back thereof (back in the device 10A shown in FIG. 1A). The current plate member 4 having a streamlined cross sectional shape is integrally fixed to the upper portion of the azimuth pod 2. The current plate member 4 is attached to the lower portion of the shaft 3 which extends in the vertical direction, and the upper portion of the shaft 3 is coupled with a driving mechanism (not shown in the figures), which is disposed in the hull so that the shaft 3, the current plate member 4, the azimuth pod 2, and the propeller member 5 can be integrally rotated. Note that a motor used for outputting the driving force for the propeller member 5 may be disposed in the azimuth pod 2 or in the hull of the ship.

[0034] In the azimuth propeller device 10A, the rear flap member 6 is attached to a trailing edge portion 4a of the current plate member 4 as an auxiliary steering member. The rear flap member 6 is a thin plate member extending in the vertical direction. As shown in FIG. 1B, the front end portion of the rear flap member 6 is rotatably supported along a rotation axis 7 in the vertical direction with respect to the current plate member 4 so that the rear end portion 6a of the rear flap member 6 can be pivoted around the rotation axis 7 in the horizontal direction. A part or the whole of the driving mechanism (not shown in the figure) for pivoting the rear flap member 6 may be accommodated in the current flow plate member 4, and its operation is controlled to be

linked with that of the azimuth propeller device 10A. That is, the timing, the direction, and the angle for pivoting the rear flap member 6 are controlled to be interlocked with the rotation angle or the driving force of the azimuth propeller device 10A.

[0035] The azimuth propeller device 10A having the above-mentioned structure is capable of driving a ship using the driving force generated by the rotation of the propeller member 5, and obtaining steering function by rotating the whole azimuth propeller device 10A with respect to the rear portion of the ship's bottom 1 to change the travelling course of the ship.

[0036] Also, when the ship travels in a certain direction, it becomes possible, by using the azimuth propeller device 10A, to maintain the direction of the ship by appropriately pivoting the rear flap member 6. That is, the ship provided with the azimuth propeller device 10A can suitably travel in a straight line by the operation of only the rear flap member 6, which is significantly smaller in size and weight compared with the azimuth propeller device 10A, without the necessity of rotating the entire azimuth propeller device 10A within a small angle range by using a huge driving mechanism.

[0037] Also, when the ship makes a turn, if the rear flap member 6 is rotated in accordance with the rotation direction of the ship, in addition to the rotation of the azimuth propeller device 10A, the steering force for the ship can be further improved as compared with the case where only the azimuth propeller device 10A is employed. That is, according to the embodiment of the present invention provided with the rear flap member 6, a desired turn of the ship can be made by using substantially the same steering force although the steering angle of the azimuth propeller device 10A required is made smaller as compared with the case where only the azimuth propeller device 10A is used. Moreover, when making a turn of relatively small turning angle (i.e., a large turning radius), only the rear flap member 6 may need to be operated, and it is not necessary to rotate the azimuth propeller device 10A at all, to obtain a required steering force.

[0038] Note that when the ship makes a turn, the rear flap member 6 is rotated in the same direction as the azimuth propeller device 10A. That is, when the ship makes a right turn with respect to its traveling direction, the trailing edge portion 4a of the azimuth propeller device 10A is rotated in the right hand side direction and the rear end portion 6a of the rear flap member 6 is also rotated in the right hand side direction with respect to the traveling direction of the ship.

[0039] Next, a second embodiment according to the present invention will be described with reference to FIGS. 2A and 2B. In FIGS. 2A and 2B, the numeral 1 indicates a rear portion of the ship's bottom, 2 indicates an azimuth pod, 3 indicates a shaft, 4 indicates a current plate member, 5 indicates a propeller member, 8 indicates a front flap member, and 10B indicates an azimuth propeller device, and elements which are the same as

those described in the first embodiment are indicated by using the same numerals, and the explanations thereof will be omitted.

[0040] In the azimuth propeller device 10B according to the second embodiment of the present embodiment shown in FIGS. 2A and 2B, the front flap member 8 is attached to a front edge portion 4b of the current plate member 4 as an auxiliary steering member. The front flap member 8 is a thin plate member extending in the vertical direction, and is attached to the current plate member 4 so as to be protruding forward from the front edge portion 4b. As shown in FIGS. 2A and 2B, the rear end portion of the front flap member 8 is rotatably supported along a rotation axis 9 in the vertical direction with respect to the current plate member 4 so that the front end portion 8a of the front flap member 8 can be pivoted around the rotation axis 9 in the horizontal direction. A part or the whole of the driving mechanism (not shown in the figure) for pivoting the front flap member 8 may be accommodated in the current flow plate member 4, and its operation is controlled to be linked with that of the azimuth propeller device 10B. That is, the timing, the direction, and the angle for pivoting the front flap member 8 are controlled to be interlocked with the rotation angle or the driving force of the azimuth propeller device 10B.

[0041] The azimuth propeller device 10B having the above-mentioned structure is capable of driving a ship using the driving force generated by rotating the propeller member 5, and obtaining steering function by rotating the whole azimuth propeller device 10B with respect to the rear portion of the ship's bottom 1 to change the course of travel of the ship. Note that the adoption of the front flap member 8 has an advantage that the effect of the water flow generated by the rotation of the propeller member 5 is likely to be smaller as compared with the case where the rear flap member 6 is adopted.

[0042] Also, when the ship travels in a certain direction, it becomes possible to maintain the direction of the ship by appropriately pivoting the front flap member 8. That is, the ship provided with the azimuth propeller device 10B can suitably travel in a straight line by the operation of only the front flap member 8, which is significantly smaller in size and weight compared with the azimuth propeller device 10B, without the necessity of rotating the entire azimuth propeller device 10B within a small angle range by using a huge driving mechanism.

[0043] Moreover, when the ship makes a turn, if the front flap member 8 is rotated in accordance with the rotation direction of the ship, in addition to the rotation of the azimuth propeller device 10B, the steering force for the ship can be further improved as compared with the case where only the azimuth propeller device 10B is employed. That is, according to this embodiment of the present invention provided with the front flap member 8, a desired turning of the ship can be made by using substantially the same steering force although the steering angle of the azimuth propeller device 10B required

is made smaller as compared with the case where only the azimuth propeller device 10B is employed. Further, when making a turn of relatively small turning angle (i. e., a large turning radius), only the front flap member 8 may need to be operated, and it is not necessary to rotate the azimuth propeller device 10B at all to obtain a required steering force.

[0044] Note that when the ship makes a turn, the front flap member 8 is rotated in the same direction as the azimuth propeller device 10B. That is, when the ship makes a right turn with respect to its traveling direction, the trailing edge portion of the azimuth propeller device 10B is rotated in the right hand side direction and the front end portion 8a of the front flap member 8 is also rotated in the right hand side direction with respect to the traveling direction of the ship.

[0045] Next, a third embodiment according to the present invention will be described with reference to FIGS. 3A and 3B. In FIGS. 3A and 3B, the numeral 1 indicates a rear portion of the ship's bottom, 2 indicates an azimuth pod, 3 indicates a shaft, 4 indicates a current plate member, 5 indicates a propeller member, 6 indicates a rear flap member, 8 indicates a front flap member, and 10C indicates an azimuth propeller device, and elements which are the same as those described in the first and second embodiments are indicated by using the same numerals, and the explanation thereof will be omitted.

[0046] In the azimuth propeller device 10C according to the third embodiment of the present embodiment shown in FIGS. 3A and 3B, the rear flap member 6 and the front flap member 8 are attached to a trailing edge portion 4a and a front edge portion 4b, respectively, of the current plate member 4 as auxiliary steering members. That is, the rear flap member 6 described in the first embodiment, and the front flap member 8 described in the second embodiment are combined in this third embodiment according to the present invention. The operations of the rear flap member 6 and the front flap member 8 are controlled to be linked with the azimuth propeller device 10C. That is, the timing, the direction, and the angle for pivoting the rear flap member 6 and the front flap member 8 are controlled to be interlocked with the rotation angle or the driving force of the azimuth propeller device 10C.

[0047] The azimuth propeller device 10C having the above-mentioned structure is capable of driving a ship using the driving force generated by rotating the propeller member 5, and obtaining steering function by rotating the whole azimuth propeller device 10C with respect to the rear portion of the ship's bottom 1 to change the course of travel of the ship.

[0048] Also, when the ship travels in a certain direction, it becomes possible to maintain the direction of the ship by appropriately pivoting the rear flap member 6 and the front flap member 8. That is, the ship provided with the azimuth propeller device 10C can suitably travel in a straight line by the operation of only the rear flap

member 6 and the front flap member 8, each of which is significantly smaller in size and weight compared with the azimuth propeller device 10C, without the necessity of rotating the entire azimuth propeller device 10C within a small angle range by using a huge driving mechanism.

[0049] Moreover, when the ship makes a turn, if the rear flap member 6 and the front flap member 8 are rotated in accordance with the rotation direction of the ship, in addition to the rotation of the azimuth propeller device 10C, the steering force for the ship can be further improved as compared with the case where only the azimuth propeller device 10C is employed. That is, according to this embodiment of the present invention provided with the rear flap member 6 and the front flap member 8, a desired turn of the ship can be made by using substantially the same steering force although the steering angle of the azimuth propeller device 10C required is made smaller as compared with the case where only the azimuth propeller device 10C is used. Further, when making a turn of relatively small turning angle (i.e., a large turning radius), only the rear flap member 6 and the front flap member 8 may need to be operated, and it is not necessary to rotate the azimuth propeller device 10C at all to obtain a required steering force.

[0050] Note that when the ship makes a turn, the rear flap member 6 and the front flap member 8 are rotated in the same direction as the azimuth propeller device 10C. That is, when the ship makes a right turn with respect to its traveling direction, the trailing edge portion 4a of the azimuth propeller device 10C is rotated in the right hand side direction, and the rear end portion 6a of the rear flap member 6 and the front end portion 8a of the front flap member 8 are also rotated in the right hand side direction with respect to the traveling direction of the ship.

[0051] Also note that in the above mentioned third embodiment according to the present invention, the rear flap member 6 and the front flap member 8 may also be effectively used for stopping the ship in an emergency. That is, if the rear flap member 6 and the front flap member 8 are rotated 90 degrees in the right hand side and left hand side direction, respectively, with respect to the travelling direction of the ship, thereby forming a plate-shaped resistance member orthogonal to the traveling direction of the ship, the traveling distance required for the ship to make an emergency stop can be shortened.

[0052] Next, a fourth embodiment according to the present invention will be described with reference to FIGS. 4A and 4B. In FIGS. 4A and 4B, the numeral 1 indicates a rear portion of the ship's bottom, 2 indicates an azimuth pod, 3 indicates a shaft, 4 indicates a current plate member, 5 indicates a propeller member, 10D indicates an azimuth propeller device, and 11R and 11L indicate (right and left) open-close flap members. Elements which are the same as those described in the first through third embodiments are indicated by using the same numerals, and the explanations thereof will be omitted.

[0053] In the azimuth propeller device 10D according to the fourth embodiment of the present embodiment shown in FIGS. 4A and 4B, the open-close flap members 11L and 11R, respectively, are attached to side wall portions of the current plate member 4 as auxiliary steering members. The operations of the open-close flap members 11L and 11R are controlled to be linked with the azimuth propeller device 10D. That is, the timing, the direction, and the angle for pivoting the pair of open-close flap members 11L and 11R are controlled to be interlocked with the rotation angle or the driving force of the azimuth propeller device 10D. Note that the numeral 11 a in FIGS. 4A and 4B indicates a shaft for supporting the rotation of the open-close flap members 11L and 11R.

[0054] The azimuth propeller device 10D having the above-mentioned structure is capable of driving a ship using the driving force generated by rotating the propeller member 5, and obtaining steering function by rotating the whole azimuth propeller device 10D with respect to the rear portion of the ship's bottom 1 to change the travelling course of the ship.

[0055] Also, when the ship travels in a certain direction, it becomes possible to maintain the direction of the ship by appropriately pivoting the open-close flap members 11L and 11R. That is, the ship provided with the azimuth propeller device 10D can suitably travel in a straight line by the operation of only the open-close flap members 11L and 11R, each of which is significantly small in size and weight as compared with those of the azimuth propeller device 10D, without the necessity of rotating the entire azimuth propeller device 10D within a small angle range by using a huge driving mechanism.

[0056] Moreover, when the ship makes a turn, if the open-close flap members 11L and 11R are rotated in accordance with the rotation direction of the ship, in addition to the rotation of the azimuth propeller device 10D, the steering force for the ship can be further improved as compared with the case where only the azimuth propeller device 10D is employed. That is, according to this embodiment of the present invention provided with the open-close flap members 11L and 11R, a desired turning of the ship can be made by using substantially the same steering force although the steering angle of the azimuth propeller device 10D required is made smaller as compared with the case where only the azimuth propeller device 10D is used. Further, when making a turn of relatively small turning angle (i.e., a large turning radius), only the open-close flap members 11L and 11R may need to be operated, and it is not necessary to rotate the azimuth propeller device 10D at all, to obtain a required steering force.

[0057] Next, the opening and closing operations of the open-close flap members 11L and 11R, when the ship makes a turn, will be described in detail. First, one of the open-close flap members 11L and 11R which is located at the outer side relative to the turning azimuth propeller device 10D, i.e., the open-close flap member

disposed at the side wall of the current plate member 4 farther to the rotation center of the turn, is opened, and the other one of the open-close flap members is kept closed. Accordingly, when the ship makes a right turn with respect to the traveling direction of the ship, the open-close flap member 11L, which is attached to the left hand side wall portion of the current plate member 4 in the azimuth propeller device 10D, is opened and the open-close flap member 11R disposed at the right hand side wall portion is closed.

[0058] Note that in the above mentioned fourth embodiment according to the present invention, the open-close flap members 11L and 11R may also be effectively used for stopping the ship in an emergency. That is, if the open-close flap members 11L and 11R are rotated 90 degrees in the right hand side and left hand side direction, respectively, with respect to the travelling direction of the ship, thereby forming a plate-shaped resistance member orthogonal to the traveling direction of the ship, the traveling distance required for the ship to make an emergency stop can be shortened.

[0059] In addition, the structure used for providing the open-close flap members 11L and 11R on the respective side wall portion of the current plate member 4 has an advantage, as compared with the structure used for providing the above mentioned rear flap member 6 or the front flap member 8 with the trailing edge portion 4a and the front edge portion 4b, respectively, of the current plate member 4, in that it becomes easy to design the structure since a large installation area can be secured for the flap members 11L and 11R.

[0060] Next, a fifth embodiment according to the present invention will be described with reference to FIGS. 5A and 5B. In FIGS. 5A and 5B, the numeral 2 indicates an azimuth pod, 4 indicates a current plate member, 5 indicates a propeller member, 10E indicates an azimuth propeller device, 12 indicates a vertical stabilizer (fin), and 13 indicates a trailing edge flap member. Elements which are the same as those described in the first through fourth embodiments are indicated by using the same numerals, and the explanations thereof will be omitted. Note that in FIG. 5, the upper portion of the azimuth propeller device 10E, i.e., a rear portion of the ship's bottom 1 and a shaft 3, are not shown.

[0061] In the azimuth propeller device 10E according to the fifth embodiment of the present embodiment shown in FIGS. 5A and 5B, the vertical stabilizer 12 is disposed at the bottom portion of the azimuth pod 2 as a current plate member, and the trailing edge flap member 13 is attached to a rear edge portion 12a of the vertical stabilizer 12 as an auxiliary steering member. That is, the vertical stabilizer 12 which exerts the same function as the current plate member 4 is disposed at the lower portion of the azimuth pod 2, and the trailing edge flap member 13 is attached to the vertical stabilizer 12.

[0062] The trailing edge flap member 13, similar to the rear end flap member 6 attached to the current plate member 4 explained in the first embodiment, is a thin

plate member extending in the vertical direction. The front end portion of the trailing edge flap member 13 is rotatably supported along a rotation axis (not shown in the figures) extending in the vertical direction with respect to the vertical stabilizer 12 so that a rear end portion 13a of the trailing edge flap member 13 may be pivoted around the rotation axis 9 in the horizontal direction. A part or the whole of the driving mechanism (not shown in the figures) for pivoting the trailing edge flap member 13 may be accommodated in the vertical stabilizer 12, and its operation is controlled to be linked with that of the azimuth propeller device 10E. That is, the timing, the direction, and the angle for pivoting the trailing edge flap member 13 are controlled to be interlocked with the rotation angle or the driving force of the azimuth propeller device 10E.

[0063] The azimuth propeller device 10E having the above-mentioned structure is capable of driving a ship using the driving force generated by rotating the propeller member 5, and obtaining steering function by rotating the whole azimuth propeller device 10E including the vertical stabilizer 12 with respect to the rear portion of the ship's bottom 1 to change the course of travel of the ship.

[0064] Also, when the ship travels in a certain direction, it becomes possible to maintain the direction of the ship by appropriately pivoting the trailing edge flap member 13. That is, the ship provided with the azimuth propeller device 10E can suitably travel in a straight line by the operation of only the trailing edge flap member 13, which is significantly smaller in size and weight compared with the azimuth propeller device 10E, without the necessity of rotating the entire azimuth propeller device 10E within a small angle range by using a huge driving mechanism.

[0065] Moreover, when the ship makes a turn, if the trailing edge flap member 13 is rotated in accordance with the rotation direction of the ship, in addition to the rotation of the azimuth propeller device 10E, the steering force for the ship can be further improved as compared with the case where only the azimuth propeller device 10E is employed. That is, according to this embodiment of the present invention provided with the trailing edge flap member 13, a desired turning of the ship can be made by using substantially the same steering force although the steering angle of the azimuth propeller device 10E required is made smaller as compared with the case where only the azimuth propeller device 10E is employed. Further, when making a turn of relatively small turning angle (i.e., a large turning radius), only the trailing edge flap member 13 may need to be operated, and it is not necessary to rotate the azimuth propeller device 10E at all, to obtain a required steering force.

[0066] Note that when the ship makes a turn, the trailing edge flap member 13 is rotated in the same direction as the azimuth propeller device 10E. That is, when the ship makes a right turn with respect to its traveling di-

rection, the trailing edge portion 4a of the azimuth propeller device 10E is rotated in the right hand side direction and the rear end portion 13a of the trailing edge flap member 13 is also rotated in the right hand side direction with respect to the traveling direction of the ship.

[0067] The vertical stabilizer 12 fixed to the bottom of the azimuth pod 2 including the trailing edge flap member 13 has an advantage in that the disturbance in the water flow in the vicinity of the bottom of the ship can be minimized even if the steering operation is carried out by using the trailing edge flap member 13 since the distance between the bottom of the ship and the vertical stabilizer 12 is relatively large.

[0068] Also, it becomes easy to design the structure for providing the trailing edge flap member 13 with the vertical stabilizer 12, since space can be easily secured on and in the vertical stabilizer 12.

[0069] Next, a sixth embodiment according to the present invention will be described with reference to FIGS. 6A and 6B. In FIGS. 6A and 6B, the numeral 1 indicates a rear portion of the ship's bottom, 2 indicates an azimuth pod, 3 indicates a shaft, 4 indicates a current plate member, 5 indicates a propeller member, 6 indicates a rear flap member, 10F indicates an azimuth propeller device, and 11R and 11L indicate (right and left) open-close flap members. Elements which are the same as those described in the first through fourth embodiments are indicated using the same numerals, and the explanations thereof will be omitted.

[0070] The azimuth propeller device 10F according to the sixth embodiment is formed by combining the first and fourth embodiments according to the present invention described above, and the rear flap member 6 and the open-close flap members 11L and 11R are provided as auxiliary steering members. As mentioned above, the operation of the rear flap member 6 and the open-close flap members are controlled to be linked with the azimuth propeller device 10F.

[0071] The azimuth propeller device 10F having the above-mentioned structure is capable of driving a ship using the driving force generated by rotating the propeller member 5, and obtaining steering function by rotating the whole azimuth propeller device 10F with respect to the rear portion of the ship's bottom 1 to change the course of travel of the ship.

[0072] Also, when the ship travels in a certain direction, it becomes possible to maintain the direction of the ship by appropriately pivoting the rear flap member 6 and the open-close flap members 11L and 11R, and a ship provided with the azimuth propeller device 10F can suitably travel in a straight line.

[0073] Moreover, when the ship makes a turn, if the rear flap member 6 and the open-close flap members 11L and 11R are rotated in accordance with the rotation direction of the ship, in addition to the rotation of the azimuth propeller device 10F, the steering force for the ship can be further improved as compared with the case where only the azimuth propeller device 10F is em-

ployed. That is, according to this embodiment of the present invention provided with the open-close flap members 11L and 11R, a desired turning of the ship can be made by using substantially the same steering force although the steering angle of the azimuth propeller device 10F required is made smaller as compared with the case where only the azimuth propeller device 10F is used. Further, when making a turn of relatively small turning angle (i.e., a large turning radius), only the rear flap member 6 and the open-close flap members 11L and 11R may need to be operated, and it is not necessary to rotate the azimuth propeller device 10F at all, to obtain a required steering force.

[0074] The operations of the rear flap member 6 and the open-close flap members 11L and 11R, when the ship makes a turn, are the same as those described in the first and the fourth embodiment described above, and a further improvement in the straightness of the travel and steering of the ship can be expected by combining the operations of the rear flap member 6 and the open-close flap members 11L and 11R.

[0075] Also, when making an emergency stop of the ship, the open-close flap members 11L and 11R may be rotated 90 degrees in the right hand side and left hand side direction, respectively, with respect to the travelling direction of the ship, thereby forming a plate-shaped resistance member orthogonal to the traveling direction of the ship in order to shorten the traveling distance required for the ship to make an emergency stop.

[0076] Next, a seventh embodiment according to the present invention will be described with reference to FIG. 7. The azimuth propeller device 10G according to the seventh embodiment is formed by combining the second and fourth embodiments of the present invention described above. That is, in the azimuth propeller device 10G, a structure is adopted in which the front flap member 8 shown in FIGS. 2A and 2B and the open-close flap members 11R and 11L shown in FIGS. 4A and 4B are combined so that a further improvement in the straightness of the travel and steering of the ship can be expected by combining the operations of the two members 8 and 11L and 11R.

[0077] Also, when making an emergency stop of the ship, the open-close flap members 11L and 11R may be rotated 90 degrees in the right hand side and left hand side direction, respectively, with respect to the direction of travel of the ship, thereby forming a plate-shaped resistance member orthogonal to the direction of the travel of the ship in order to shorten the traveling distance required for the ship to make an emergency stop.

[0078] Next, an eighth embodiment according to the present invention will be described with reference to FIG. 8. The azimuth propeller device 10H according to the eighth embodiment is formed by combining the third and fourth embodiments of the present invention described above. That is, in the azimuth propeller device 10H, a structure is adopted in which the rear flap member 6 shown in FIGS. 1A and 1B, the front flap member

8 shown in FIGS. 2A and 2B, and the open-close flap members 11R and 11L shown in FIGS. 4A and 4B are combined so that a further improvement in the straightness in the travel and steering of the ship can be expected by combining the operations of the members 6 and 8 and 11L and 11R.

[0079] Also, when making an emergency stop of the ship, the open-close flap members 11L and 11R may be rotated at 90 degrees in the right hand side and left hand side direction, respectively, with respect to the travelling direction of the ship, and the rear flap member 6 and the front flap member 8 may be operated in the opposite directions, thereby forming two plate-shaped resistance members orthogonal to the traveling direction of the ship in order to shorten the traveling distance required for the ship to make an emergency stop.

[0080] Next, a ninth embodiment according to the present invention will be described with reference to FIG. 9. The azimuth propeller device 10I according to the ninth embodiment is formed by combining the fourth and fifth embodiments of the present invention described above. That is, in the azimuth propeller device 10I, a structure is adopted in which the vertical stabilizer 12 and the trailing edge flap member 13 shown in FIGS. 5A and 5B and the open-close flap members 11R and 11L shown in FIGS. 4A and 4B are combined so that a further improvement in the straightness in the travel and steering of the ship can be expected by combining the operations of the members 12 and 13 and 11L and 11R.

[0081] Also, when making an emergency stop of the ship, the open-close flap members 11L and 11R may be rotated 90 degrees in the right hand side and left hand side direction, respectively, with respect to the travelling direction of the ship, thereby forming a plate-shaped resistance member orthogonal to the traveling direction of the ship in order to shorten the traveling distance required for the ship to make an emergency stop.

[0082] As explained above, according to the azimuth propeller device of the present invention, since the auxiliary steering member(s) is provided, it becomes possible to obtain excellent straightness in the travel of the ship without the necessity of operating the entire azimuth propeller device, and to improve the steering function of the ship.

[0083] Also, by using the open-close flap members 11L and 11R and/or the rear flap member 6 and the front flap member 8, it becomes possible to shorten the traveling distance required for the ship to make an emergency stop.

[0084] Next, a tenth embodiment according to the present invention will be described with reference to FIGS. 10A and 10B. The azimuth propeller device 10J according to the tenth embodiment is formed by combining the first embodiment of the present invention described above with a (plurality of) radiation fins 14 (i.e., a radiation member).

[0085] The azimuth propeller device 10J includes the azimuth pod 2 accommodating a motor for driving the

POD propeller (not shown in the figures) in the inside thereof, to which the POD propeller member 5 that exerts the driving force for the ship by driving water backwards, is attached to the front or back thereof (back in the device 10A shown in FIG. 1A).

[0086] As shown in FIGS. 10A and 10B, a number of radiation fins 14 are attached to the outer periphery of the azimuth pod 2 so as to extend therefrom. Each of the radiation fins 14 is a plate-like member extending in the front-to-back direction of the azimuth pod 2, i.e., the travelling direction by the driving force of the POD propeller member 5. It is preferable to use a member having excellent thermal conductivity for the radiation fins 14.

[0087] Note that although eighteen of the radiation fins 14 are radially attached to the outer periphery of the azimuth pod 2 with an equal interval between each other, the present invention is not limited to this particular configuration.

[0088] In the azimuth propeller device 10J having the above-mentioned structure, heat generated from the motor (not shown in the figures) for rotating the POD propeller member 5 is transmitted to each of the radiation fins 14 via the wall of the azimuth pod 2, and is released into the surrounding water from the surface of each radiation fin 14. That is, the azimuth pod 2 is cooled by means of a water-cooling system via the radiation fins 14 according to the tenth embodiment of the present invention. For this reason, components required in an air-cooling system of a conventional art, such as a power source for the air-cooling system, a driving source for actuating an impelling means, such as a fan, and a passage for the cooling air, become unnecessary, and hence, not only can the space, energy consumption, and cost be reduced, but also the durability and the reliability of the azimuth propeller device can be improved according to the tenth embodiment of the present invention.

[0089] Also, if the entire heating value cannot be covered by the water-cooling system of the embodiment of the present invention, such as for the case where the heating value of the motor is large, it is possible to use the water-cooling system of the present invention together with the conventional air-cooling system. In such a case, since the burden for the air-cooling system can be eased as compared with that in the conventional system, the size of the fan or of the passage for the cooling air can be decreased.

[0090] Next, the eleventh embodiment according to the present invention will be described with reference to FIGS. 11A and 11B. Note that elements which are the same as those described in the embodiment shown in FIGS. 1A through 10B are indicated by using the same numerals, and the explanations thereof will be omitted.

[0091] In this embodiment, the azimuth propeller device 10K according to the eleventh embodiment is formed by combining the first embodiment of the present invention described above with a current plate fin 15 which is adopted as a radiation member. The current

plate fin 15 is formed by, in general, twisting the above-mentioned fin 14 in the rotation direction of the POD propeller 5 from the front to the back thereof. In the example shown in FIGS. 11A and 11B, the POD propeller 5 rotates in a clockwise direction viewed from the front (in the traveling direction) of the azimuth propeller device 10K as indicated by the arrow 13 in FIG. 11B, and each of the current plate fins 15 is angled or inclined from the front toward the back. The inclination is due to the twist of the current plate fin 15 so as to upturn the tail portion of the current plate fin 15 in the rotation direction of the POD propeller 5 with respect to the axis of the azimuth pod 2. That is, an inclination surface 15a of the current plate fin 15 is formed along the flow of water which is drawn by the POD propeller 5.

[0092] If the current plate fins 15 having the above-mentioned structure are adopted, it becomes possible to obtain water flow adjusting function for the water drawn by the POD propeller 5 in addition to the above-mentioned water-cooling function. Accordingly, it becomes possible to decrease the loss, and hence, the driving force exerted by the rotating the POD propeller 5 can be increased.

[0093] Note that the structures of the azimuth propeller device according to the embodiments of the present invention are not limited to those described above, and can be modified within the scope of the present invention. For instance, the structure according to any one of the second to ninth embodiments of the present invention can suitably be combined with the radiation member described in the tenth or eleventh embodiment of the present invention. Also, a member having an excellent thermal conductive property may be intervened between the azimuth pod and the motor so as to further enhance the thermal conduction from the motor.

[0094] Having thus described example embodiments of the invention, it will be apparent that various alterations, modifications, and improvements will readily occur to those skilled in the art. For instance, a front flap member may be provided also with the vertical stabilizer 12. Such alterations, modifications, and improvements, though not expressly described above, are nonetheless intended and implied to be within the spirit and scope of the invention. Accordingly, the foregoing discussion is intended to be illustrative only; the invention is limited and defined only by the following claims and equivalents thereto.

Claims

1. An azimuth propeller device, comprising:

a current plate member;
an azimuth pod fixed to a lower portion of said current plate member, said azimuth pod being provided with a propeller member, and said current plate member and said azimuth pod being

provided so as to be rotatable together along a vertical axis with respect to the bottom of a ship; and
an auxiliary steering member provided with said current plate member.

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2. An azimuth propeller device according to claim 1, wherein said auxiliary steering member is a rear flap member rotatably attached to a trailing edge portion of said current plate member.

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3. An azimuth propeller device according to claim 1, wherein said auxiliary steering member is a front flap member rotatably attached to a front edge portion of said current plate member.

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4. An azimuth propeller device according to claim 1, wherein said auxiliary steering member is a front flap member rotatably attached to a front edge portion of said current plate member, and a rear flap member rotatably attached to a trailing edge portion of said current plate member.

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5. An azimuth propeller device, comprising:

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a current plate member;
an azimuth pod fixed to the lower portion of said current plate member, said azimuth pod being provided with a propeller member, and said current plate member and said azimuth pod being provided so as to be rotatable together along a vertical axis with respect to the bottom of a ship; a vertical stabilizer disposed at a lower portion of said azimuth pod; and
a trailing edge flap member rotatably attached to a rear edge portion of said vertical stabilizer.

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6. An azimuth propeller device according to claim 1, wherein

said auxiliary steering member is a pair of open-close flap members attached to a side wall portion of said current plate member, said pair of open-close flap members being disposed so as to be opening and closing independently.

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7. An azimuth propeller device according to claim 6, wherein said pair of open-close flap members are fully opened to make an emergency stop of a ship.

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8. An azimuth propeller device according to claim 1, wherein

said auxiliary steering member set forth in any one of claims 2-4 is combined with said auxiliary steering member set forth in claim 6 or 7.

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9. An azimuth propeller device according to claim 5, further comprising:

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a pair of open-close members attached to a side wall portion of said vertical stabilizer, said pair of open-close flap members being disposed so as to be opening and closing independently.

10. An azimuth propeller device according to claim 1, further comprising:

at least one radiation member provided at an outer periphery of said azimuth pod, wherein said propeller member is a POD propeller member and a motor which drives said POD propeller member is provided inside said azimuth pod.

11. An azimuth propeller device according to claim 10, wherein

said auxiliary steering member set forth in any one of claims 2-4 is combined with said auxiliary steering member set forth in claim 6 or 7.

12. An azimuth propeller device according to claim 10, wherein said radiation member is a fin extending in the front and back direction of said azimuth pod.

13. An azimuth propeller device according to claim 12, wherein said fin is twisted in the rotation direction of said POD propeller member from the front to back of said fin.

14. An azimuth propeller device according to claim 5, further comprising:

at least one radiation member provided at an outer periphery of said azimuth pod, wherein said propeller member is a POD propeller member and a motor which drives said POD propeller member is provided inside said azimuth pod.

15. An azimuth propeller device according to claim 14, further comprising:

a pair of open-close members attached to a side wall portion of said vertical stabilizer, said pair of open-close flap members being disposed so as to be opening and closing independently.

FIG. 1A

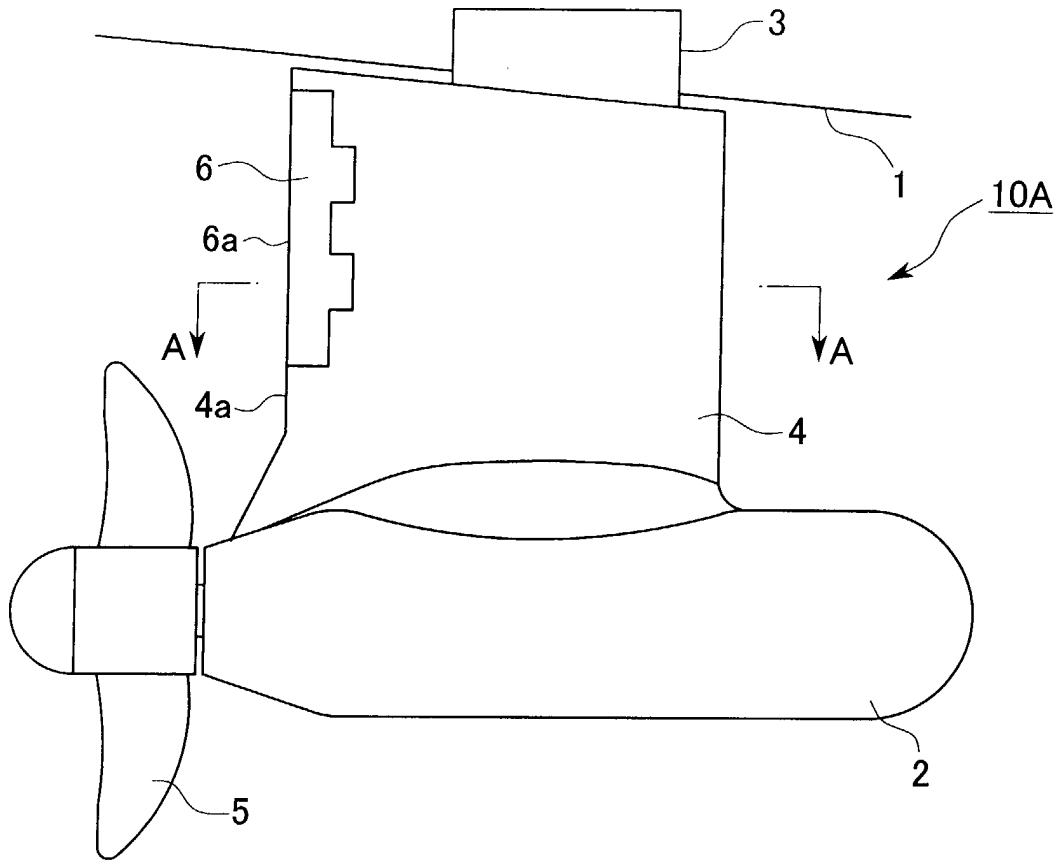


FIG. 1B

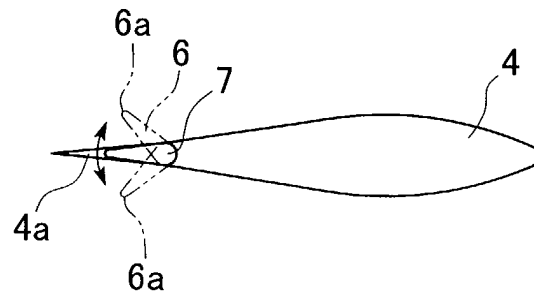


FIG. 2A

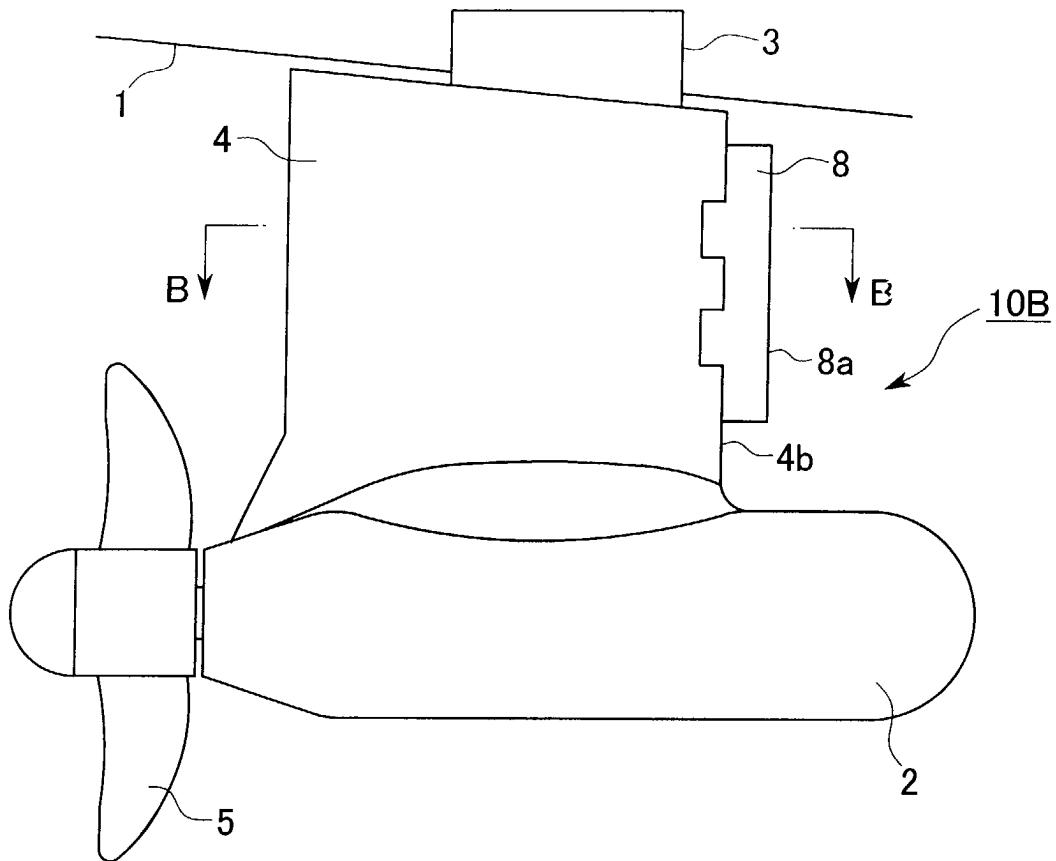


FIG. 2B

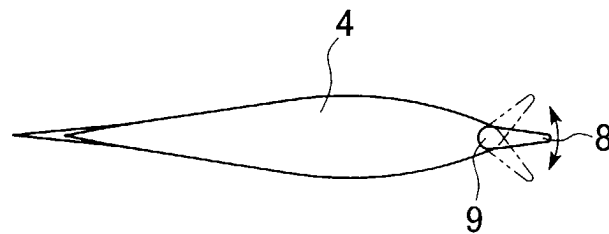


FIG. 3A

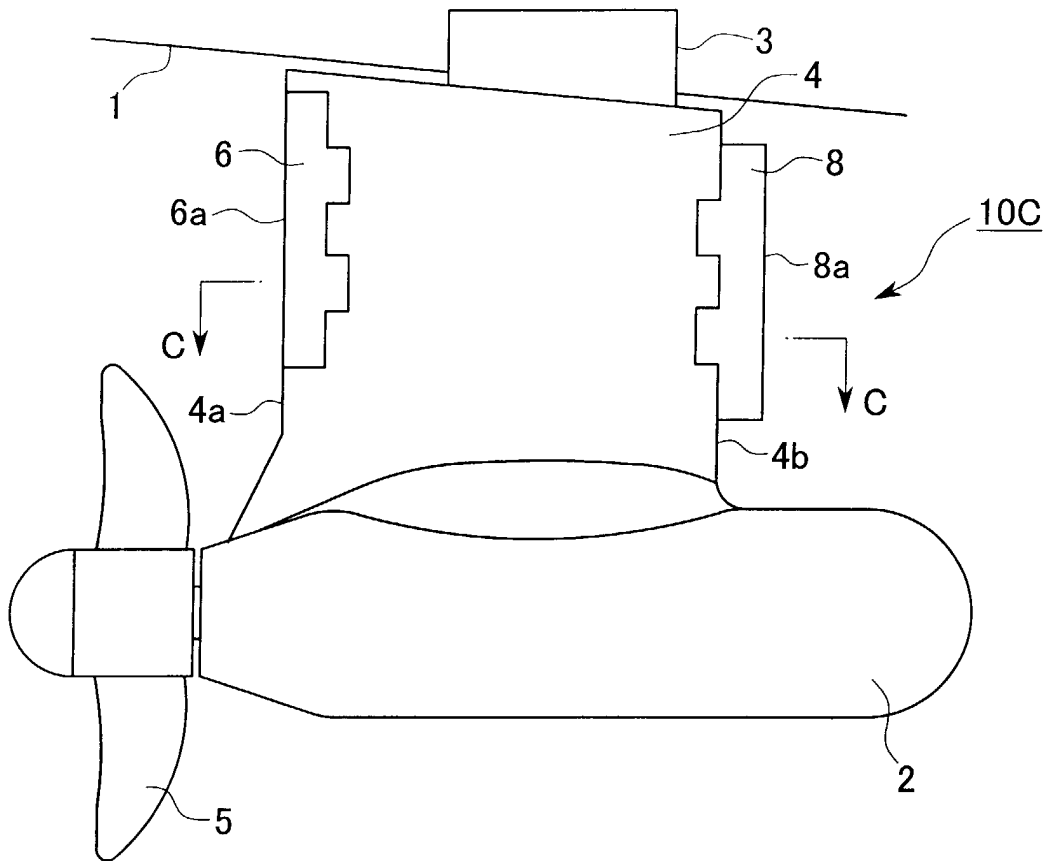


FIG. 3B

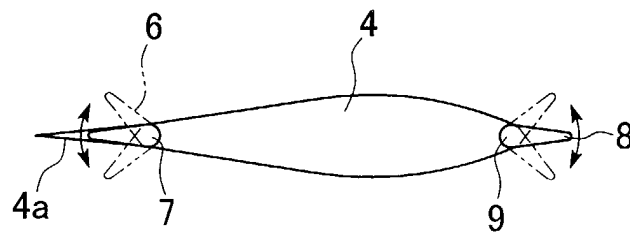


FIG. 4A

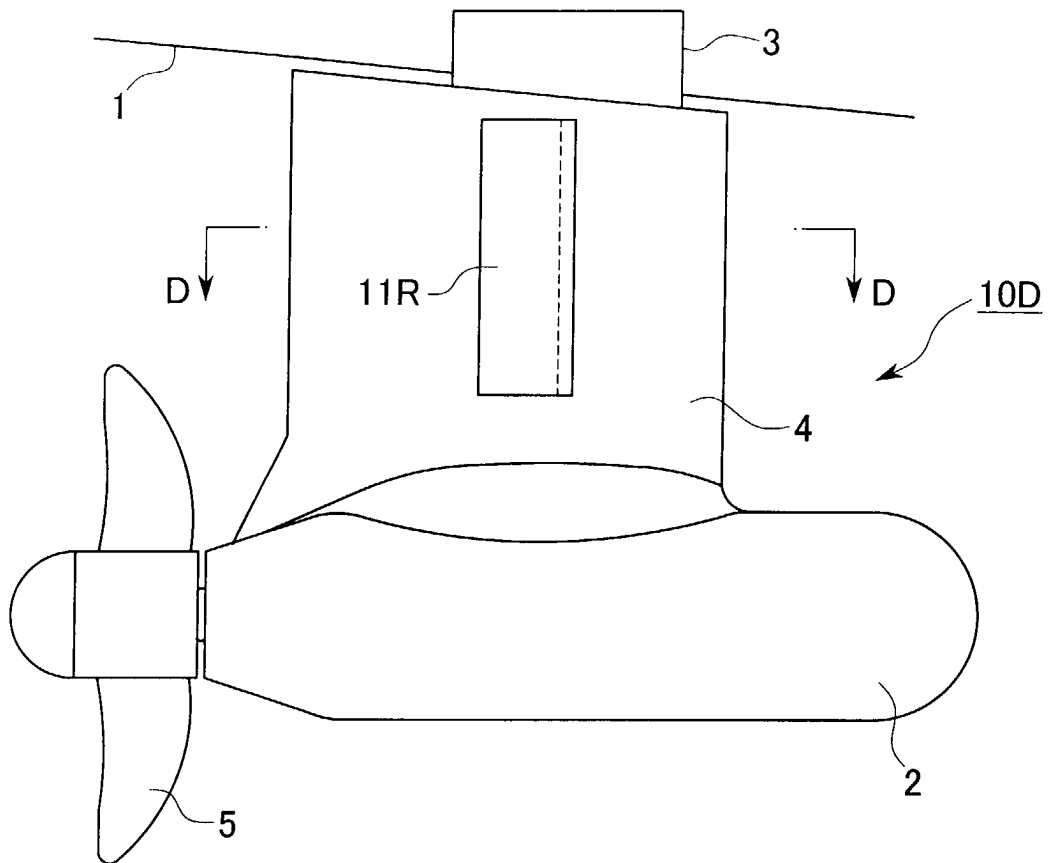


FIG. 4B

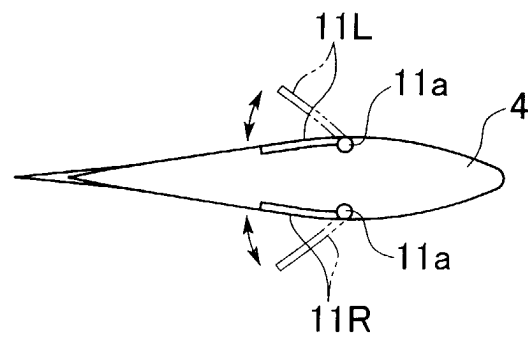


FIG. 5A

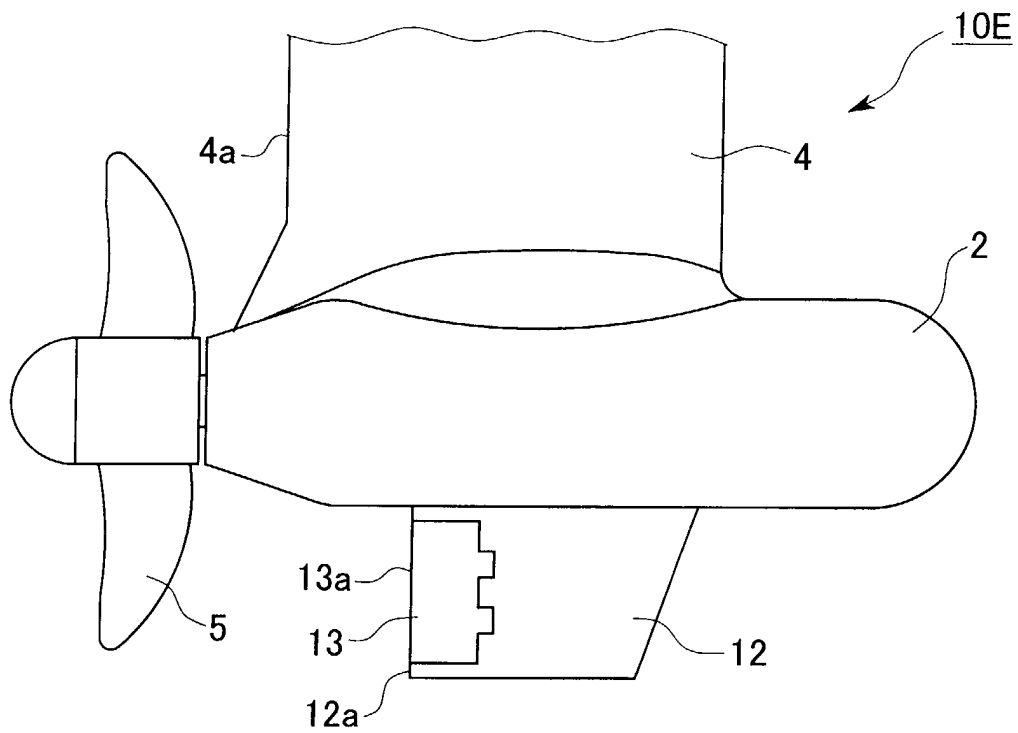


FIG. 5B

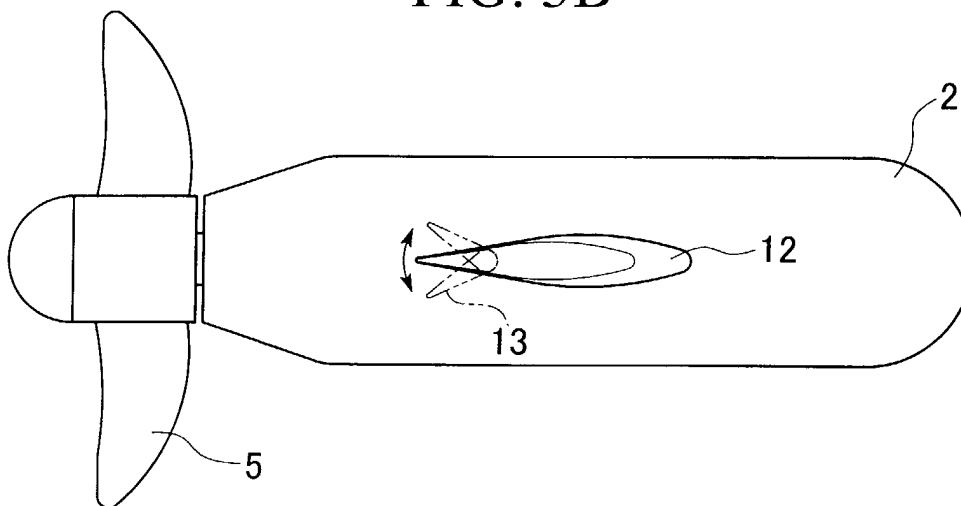


FIG. 6A

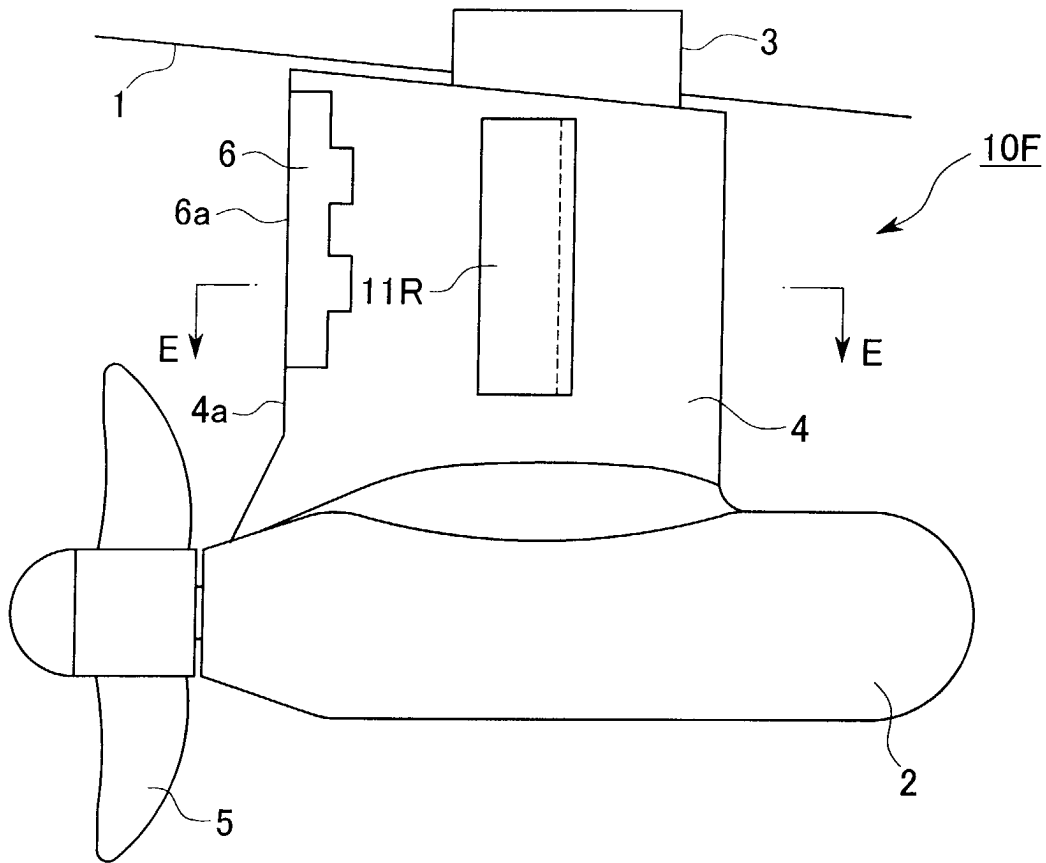


FIG. 6B

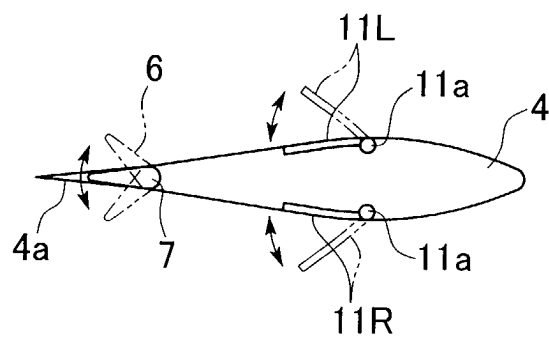


FIG. 7

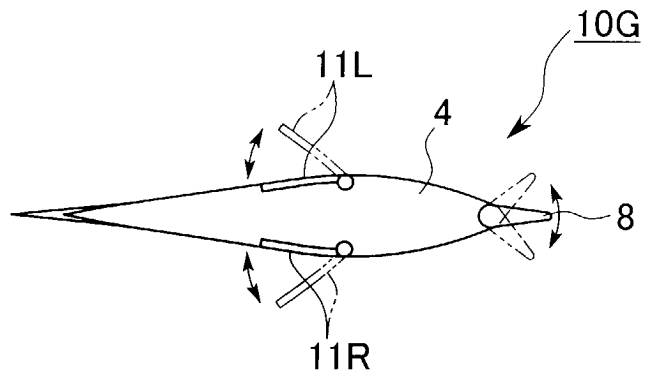


FIG. 8

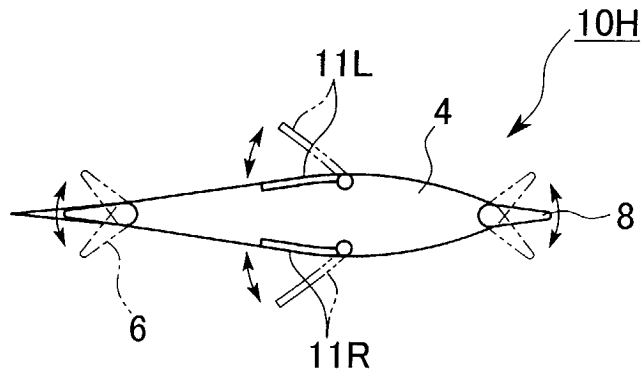


FIG. 9

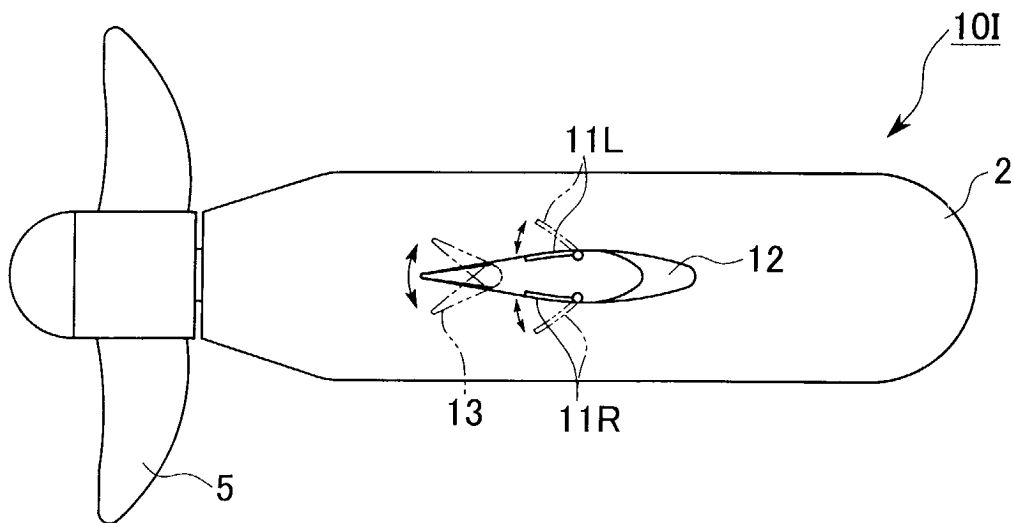


FIG. 10A

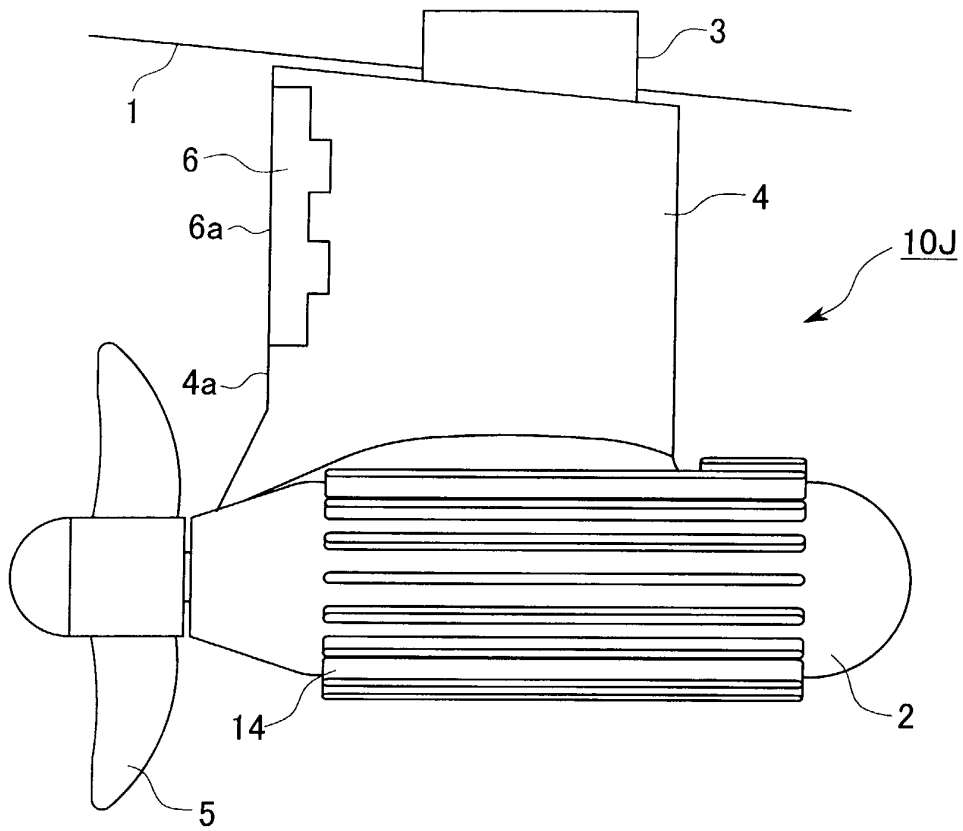


FIG. 10B

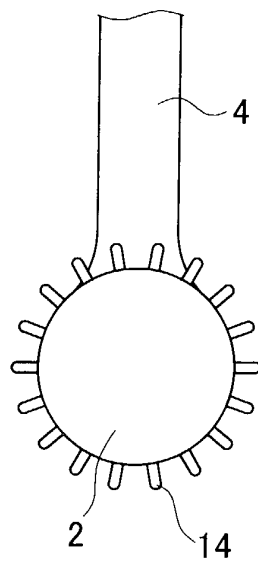


FIG. 11A

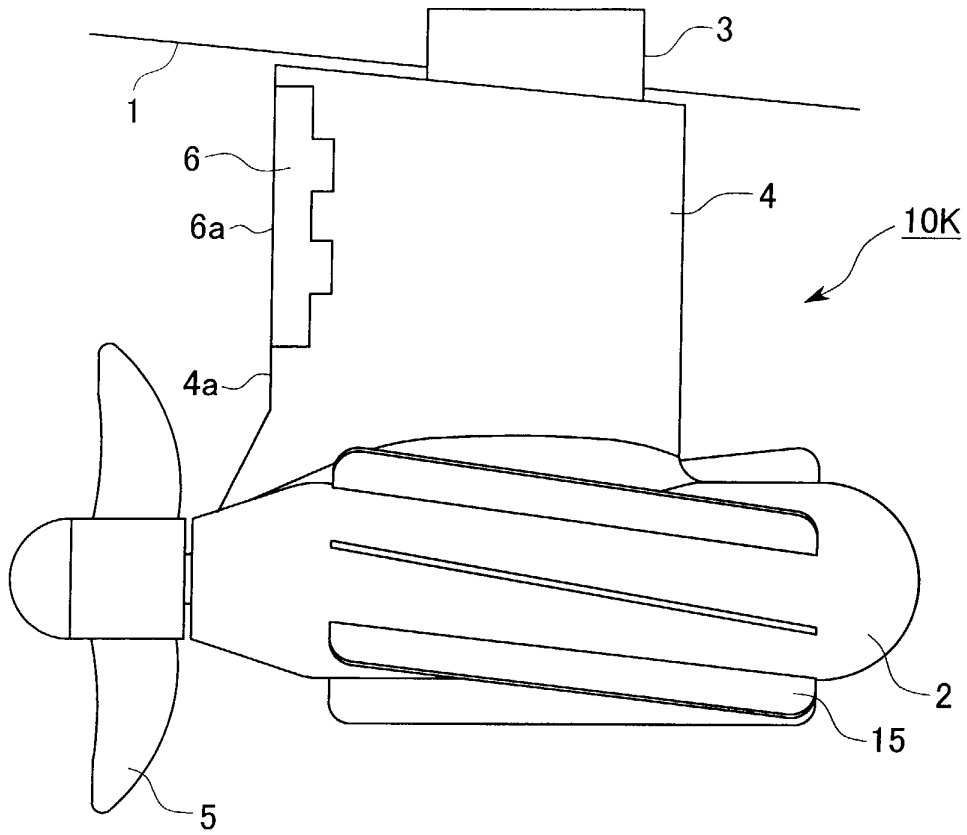


FIG. 11B

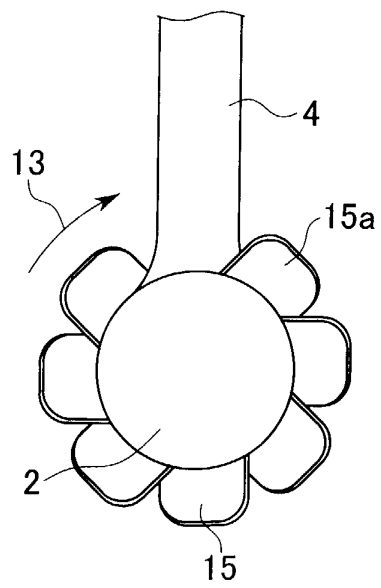


FIG. 12

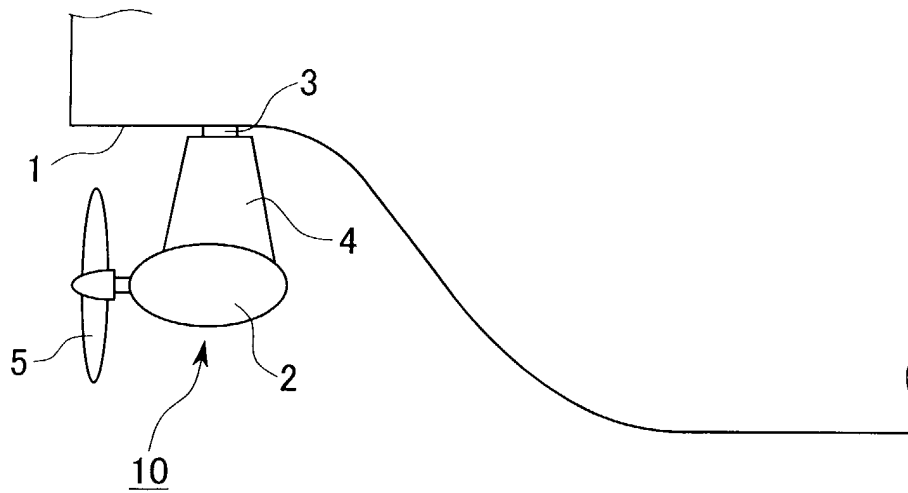


FIG. 13A

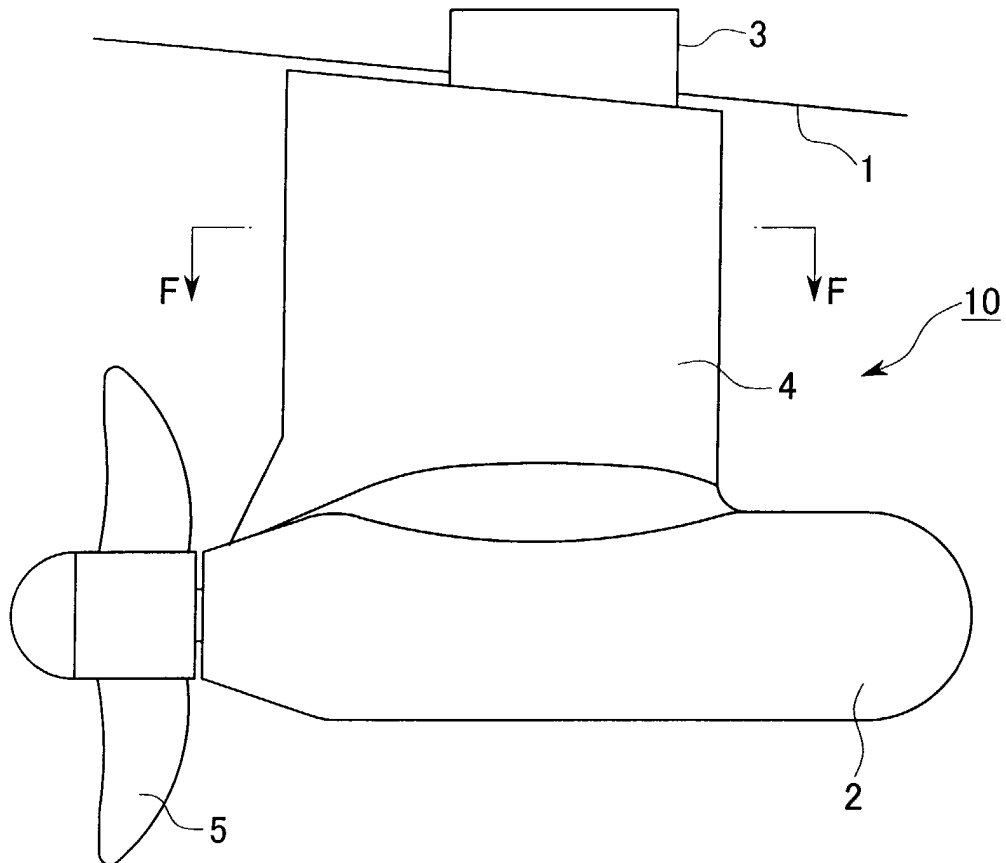


FIG. 13B





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 01 1481

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Place of search MUNICH		Date of completion of the search 9 October 2002	Examiner Moya, E
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