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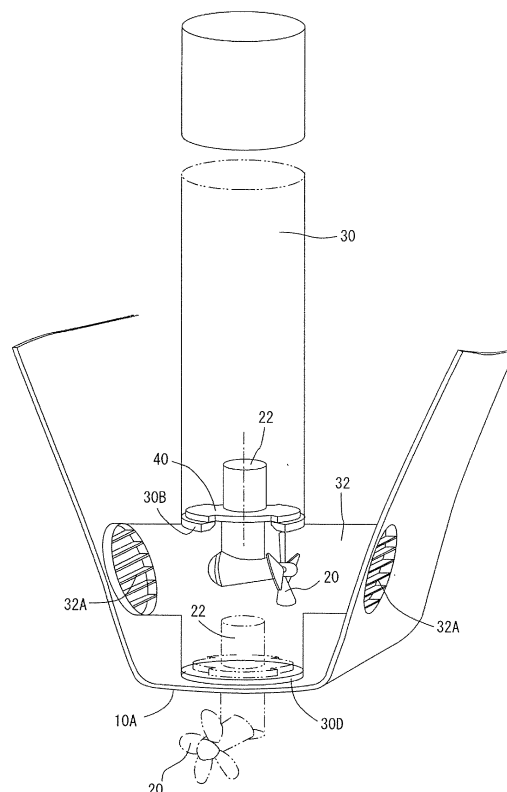
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(54) **BOAT EQUIPPED WITH ADDITIONAL PROPELLER**

(57) To reduce fuel consumption without impairing operational safety of a ship.

A ship 10 configured to obtain propelling force by driving a designed propeller 11 with a main engine 12, and including: a vertical tunnel 30 that is formed at a bow portion to pass through a ship bottom; a lateral tunnel 32 that is formed in communication with the vertical tunnel 30; and an additional propeller device 24 that is provided, which has an additional propeller 20 and a driving unit 22 for the propeller, wherein the additional propeller device 24 is configured such that the additional propeller 20 can turn around a vertical center line of the vertical tunnel 30, the additional propeller 20 is configured to be capable of vertically movable from below the ship bottom to a height position of the lateral tunnel 32, and when the additional propeller 20 is at the height position of the lateral tunnel 32, the additional propeller 20 is configured to follow the lateral tunnel 30.

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Description

Technical Field

[0001] The present invention relates to a ship equipped with an additional propeller such as a duct propeller and an operating method therefor.

Background Art

[0002] In the case of a ship, for example, a commercial ship, particularly a cargo ship, fluctuations of a draft line are very large between when cargo is loaded and when the cargo is unloaded.

[0003] Generally, in a case of cargo ship, the ship is operated with ballast draft or designed load draft. Particularly, the cargo ship is designed and constructed considering safety at the time of a bad sea state such that the draft can be kept even in the operation under heavy weather. Further, a draft depth is determined in consideration of propeller immersion to use a propulsion propeller effectively and safely.

[0004] However, to keep the draft depth deep is to increase fuel consumption caused by increase of a displacement, increase of contact area with water of a hull, and deterioration of a waterplane area coefficient.

[0005] Actually, after unloading the cargo, the cargo ship is operated with the ballast-designed draft, considering safety of the ship, although there is no freight revenue. Under such a situation, reducing the fuel consumption provides significant economic effects, and further contributes to environmental improvement effects on NO_x, SO_x, and so on.

[0006] Especially, in recent years, ballast water treatment is regarded as a problem from the viewpoint of environmental concerns in that sea creatures are mixed inside the ballast water.

[0007] It should be noted that there are the following related arts in relation to a duct propeller (nozzle propeller).

Citation List

Patent Literature

[0008]

Patent Literature 1: JP Patent Nos.3508811

Patent Literature 2: JP Patent Nos.5231878

Summary of Invention

Technical Problem

[0009] For a large ship and a medium ship, fuel consumption is larger than that of a small ship, and thus it is important to reduce fuel consumption.

[0010] In addition, the large ship and the medium ship

are inferior in fine movement performance, and often involve difficulty in maneuvering when docking at a pier or a port and leaving from the pier or the port.

[0011] Therefore, a main object of the present invention is to provide a ship that can reduce fuel consumption. Another object of the present invention is to provide a ship that is easy to maneuver when docking at a pier or a port and leaving from the pier or the port.

10 Solution to Problem

[0012] According to the present invention, which solves the above-mentioned problem, is provided a ship equipped with an additional propeller, the ship being configured to obtain propelling force by driving a designed propeller with a main engine, and comprising:

a vertical tunnel that is formed at a bow portion to pass through a ship bottom;

a lateral tunnel that is formed in communication with the vertical tunnel;

an additional propeller device that is provided, which has a propeller and a driving unit for the propeller, in the vertical tunnel; and

a hanging unit that is provided so as to hang the additional propeller device from above a water level inside the vertical tunnel,

wherein the additional propeller device is configured such that the additional propeller can be vertically movable from below the ship bottom to a height position of the lateral tunnel,

in a state with hanging by the hanging unit, the additional propeller device is provided so as to be capable of turning around a vertical center line of the vertical tunnel, and

when the additional propeller of the additional propeller device is at the lateral tunnel height position, the additional propeller is configured to follow the lateral tunnel.

[0013] According to the present invention, an additional propeller smaller than a designed propeller (main propeller) and a driving unit therefor are provided in addition to the designed propeller. The output of the driving unit for the additional propeller is 35% or less, more preferably, 25% or less than the output of a driving unit of the main engine. When cargo (freight) is loaded, the ship is operated by driving the designed propeller, having a state of draft close to designed load draft. If necessary, in addition to the designed propeller, the ship is operated also with the additional propeller in a combined manner.

[0014] When the ship navigates back to a port after unloading the cargo, the ship is mainly operated by the small additional propeller. Especially in days of calm and steady sea condition, there is little necessity to secure stability of the ship too severely during navigation. Accordingly, the ship is made to travel by means of the small additional propeller, keeping a draft line further lower.

[0015] As a result, apparent displacement is decreased and contact area with water of a shell is reduced because the draft line is lowered. Furthermore, a water-plane area coefficient can be improved, and significant reducing effects of fuel consumption can be obtained.

[0016] Additionally, since the small additional propeller is driven, small output of the driving device is enough (35% or less, more preferably, 25% or less of the output of the driving unit of the main engine). Also from this viewpoint, the significant reducing effects of fuel consumption can be obtained.

[0017] In the case where the ship leaves from a port after fully loaded with the cargo and then settles in a regular navigation mode, the ship navigates with the deep draft, driving the designed propeller. Further, in the case where the ship navigates using ballast after unloading the cargo, after settling in the navigation mode, the ship is operated with the additional propeller. However, in the case of bad weather, even when the ship is in an unload condition, the ship can travel using the small additional propeller or the designed propeller in a stabilized condition under draft adjustment by filling ballast water. Further, the additional propeller and the designed propeller can be used in a combined manner, if necessary.

[0018] Since the additional small duct propeller is mainly used at the time of ballast navigation, a propeller immersion ratio for the main propeller is not so largely limited so that a propeller diameter of the designed propeller can be made larger than the propeller diameter according to the relation between ship and propeller design in the related arts. This enables propeller efficiency to be upgraded, increasing the efficiency of about 5% to 7%. Thus, by adopting the designed propeller having the larger diameter, the propeller efficiency is increased, and the output required for the propulsion engine is reduced at the same speed of the ship. Thus, significant improvement of fuel efficiency can be obtained.

[0019] In the present invention, the additional propeller device is configured such that the additional propeller can be vertically movable from below the ship bottom to the lateral tunnel height position.

[0020] In the case of sailing using the small additional propeller, the additional propeller device causes the additional propeller to protrude downward from the ship bottom, and the ship is operated with energy saving.

[0021] On the other hand, when the ship navigates back to or leaves from the port, the additional propeller is raised to the lateral tunnel height position and is oriented in a direction along the lateral tunnel, and when the ship is made to dock at or leave from the port or a pier, maneuvering for docking at or leaving from the port or the pier is extremely easy by using the additional propeller as a side thruster.

[0022] When the additional propeller of the additional propeller device is at the lateral tunnel height position, the additional propeller device can be configured to be mountable on a support portion protruding inward in the vertical tunnel.

[0023] When the additional propeller is raised to the height position of the lateral tunnel and is oriented in a direction along the lateral tunnel in the case where the ship is made to dock at or leave from a port, since hydraulic fluctuation accompanying the rotation of the propeller and a vibration factor derived from the rotation are large, it is desirable that the additional propeller device is stably mounted.

[0024] For this mounting, in both cases where the additional propeller is at the lateral tunnel height position as well as where the additional propeller is located below the ship bottom as necessary, the support portion is formed so as to protrude inward in the vertical tunnel and the additional propeller device is mounted on the support portion so that the additional propeller device can be stably mounted.

[0025] In a structure where the additional propeller device is mounted on the support portion, when the additional propeller is at the lateral tunnel height position, a structure exhibits high stability in which the additional propeller device is pressed downwardly from above and mounted on the support portion. However, since the additional propeller device is configured such that the additional propeller can be vertically movable from below the ship bottom to the lateral tunnel height position, if the support portion were, for example, a flange over the entire circumference, the additional propeller device could not be vertically movable.

[0026] Accordingly, the flange as the support portion is divided into a plurality of parts in a circumferential direction, in the additional propeller device, a mounting portion is formed, which has a plurality of cutout portions circumferentially arranged in an outer circumferential portion and engaging portions formed so as to straddle the cutout portions, and in a state that the engaging portions are positioned to be able to pass through between the parts of the support portion, and then, the additional propeller device is pulled up and the additional propeller device is rotated around a vertical center line of the vertical tunnel so that the engaging portions are positioned at the flange position and the engaging portions can be pressed downwardly from above and mounted on the support portion by an appropriate mounting unit.

[0027] As a result, the additional propeller device can be vertically movable and also can be mounted.

[0028] Further, operating condition is selectable between regular operating condition in which propelling force is obtained by driving the designed propeller and the other operating condition in which propelling force is obtained by driving the additional propeller.

[0029] It is desirable that the additional propeller is a duct propeller for efficient propulsion. In the case of using the duct propeller as the additional propeller, relatively large thrust can be obtained even though the propeller size is small.

[0030] The additional propeller device has a driving unit that rotationally drives the propeller, and can be configured to be capable of turning around the vertical center

line of the vertical tunnel by a turning unit different from the additional propeller device.

[0031] A water level detecting unit may be provided that monitors or detects variation of the water level inside the vertical tunnel.

[0032] An operating method for a ship equipped with an additional propeller, the ship being configured to obtain propelling force by driving a designed propeller with a main engine, and comprising:

a vertical tunnel that is formed at a bow portion to pass through a ship bottom;

a lateral tunnel that is formed in communication with the vertical tunnel;

an additional propeller device that is provided, which has a propeller and a driving unit for the propeller, in the vertical tunnel; and

a hanging unit that is provided so as to hang the additional propeller device from above a water level inside the vertical tunnel,

wherein the additional propeller device is configured such that the additional propeller can be vertically movable from below the ship bottom to a height position of the lateral tunnel,

in a state with hanging by the hanging unit, the additional propeller device is provided so as to be capable of turning around a vertical center line of the vertical tunnel,

when the additional propeller of the additional propeller device is at the lateral tunnel height position, the additional propeller is configured to follow the lateral tunnel, and

the ship is propelled by driving the designed propeller in a load condition, and the ship is propelled by driving at least the additional propeller in an unload condition.

[0033] The operating method for a ship according to claim 8, wherein when the additional propeller is raised to the lateral tunnel height position, the additional propeller is oriented in a direction along the lateral tunnel, and the ship is made to dock at a pier or a port or leave from the pier or the port.

[0034] Incidentally, it is not economical to make the diameter of the vertical tunnel excessively large. However, when the turning unit is incorporated in the additional propeller device, the inner diameter of the vertical tunnel should be increased.

[0035] In this context, a hanging unit is provided to hang the additional propeller device from above a water level inside the vertical tunnel, and in a state with hanging by the hanging unit, the additional propeller device is provided so as to be capable of turning around a vertical center line of the vertical tunnel, and thus increase of the diameter of the vertical tunnel can be prevented.

Advantageous Effects of Invention

[0036] According to the present invention, the fuel consumption can be reduced without impairing operational safety of the ship. Further, the ship can be easy to maneuver when docking at a pier or a port and leaving from the pier or the port.

Brief Description of Drawings

[0037]

Fig. 1 is a schematic perspective view of an arrangement example of an additional propeller device according to the present invention.

Fig. 2 is a partial side view of the additional propeller device.

Fig. 3 is a bottom view from a ship bottom side.

Fig. 4 is a schematic view of an example of the additional propeller device.

Fig. 5 is a longitudinal sectional view of a structural example of the additional propeller device.

Figs. 6 (a) to (d) are explanatory views of an example of a mounting unit.

Fig. 7 is a schematic front view of a ship according to the present invention while operating in an unload condition.

Fig. 8 is a schematic front view of the ship in a load condition.

Fig. 9 is a partial longitudinal sectional view of an example of another mounting unit.

Description of Embodiments

[0038] An embodiment of the present invention will be described with reference to the attached drawings.

[0039] Figs. 7 and 8 are schematic front views of a ship according to the present invention, for example, a commercial ship 10 loaded with cargo, such as a cargo ship. The commercial ship 10 obtains propelling force by driving a designed propeller (main propeller) 11 by a main engine (propulsion engine) 12 such as a diesel engine.

[0040] As is referenced in Fig. 2, the ship is provided with a duct additional propeller device 24, which has an additional propeller 20 and a driving unit 22 therefor, in a manner where the duct additional propeller device 24 is provided along the vertical tunnel 30.

[0041] This additional propeller 20 is disposed at a position different from the designed propeller 11, more specifically, in an illustrated bow area.

[0042] Additionally, a bridge 13 is provided on the stern side, and a window 13A is formed therein so as to monitor not only the bow-side direction but also the stern-side direction.

[0043] An example of the additional propeller device 24 is illustrated mainly in Figs. 1, 4 and 5. The output of the driving unit 22 of the additional propeller 20, for example a motor, is small, which is 25% or less of the output

of a driving unit of the main engine 12.

[0044] Further, operating condition is selectable between regular operating condition in which propelling force is obtained by driving the designed propeller 11 and the other operating condition in which propelling force is obtained by driving the additional propeller 21.

[0045] Explaining an example of the additional propeller device 21, an electric motor or a hydraulic motor may be used as the driving unit 22, and further, if necessary, may be connected with the main engine (propulsion engine) 12 so as to obtain drive power. It is desirable that the driving unit 22 is made to have a watertight structure by a cover 22A.

[0046] The additional propeller 20 that includes a duct 21 around thereof is configured to be rotated when rotational drive force of an output shaft 23 by the driving unit 22 is transmitted to a transverse shaft 26 through a pair of bevel gears 25.

[0047] Further, a machine including the duct additional propeller device 24 disposed below a ship bottom 10A is assembled at the outside of the ship bottom 10A as illustrated in Fig. 7, but the machine is configured to be retractable to the inside of the ship because such assembly of the duct additional propeller device at the outside is to be an obstacle during normal navigation or navigation in a shallow sea.

[0048] With this configuration, when cargo (freight) R is loaded, the ship is operated by driving the designed propeller 11 with the main engine 12 in a state of draft close to designed load draft as illustrated in Fig. 7.

[0049] After the cargo is unloaded, especially in a day of calm weather or in a quiet sea, the ship is operated with the small additional propeller 20, keeping the draft line low as illustrated in Fig. 8, because there is little necessity to secure stability of the ship too severely at the time of navigating the ship. In this case, as indicated by an outlined arrow in Fig. 8, a moving direction of the ship can be suitably selected, and the bow and the stern are monitored by the bridge 13 depending on the moving direction of the ship.

[0050] As a result, apparent displacement is decreased and contact area with water of a hull is reduced because the draft line is lowered. Furthermore, a water-plane area coefficient can be improved, and significant reducing effects of fuel consumption can be obtained.

[0051] Moreover, since the small additional propeller 20 is driven, small output from the driving device 22 is enough, and the ship can be operated with the output of 35% or less, especially 25% or less, and best of all, about 10% to 5% of the output of the driving unit in the main engine 12. From this viewpoint, significant reducing effects of fuel consumption can be obtained. In a day of calm weather (when Beaufort scale is 0 to 3), travel speed of approximately 5 to 10 knots is enough.

[0052] In the case where the ship leaves from a port after fully loaded with the cargo R and then settles in the regular navigation mode, the ship navigates by driving the designed propeller 11 or by driving the additional pro-

PELLER 20 in addition to the designed propeller 11 in a combined manner with the deep draft.

[0053] Further, in the case of bad weather, ballast water BW (a reserve space for the ballast water is not illustrated) is filled even in an unload condition. This enables the ship to travel in a stabilized state by means of the small additional propeller 20 or the designed propeller 11.

[0054] The duct additional propeller device 24 is rotatable around a vertical shaft line, thus, in a required operating condition, propelling in the stern direction can be achieved by driving the duct additional propeller device 24 as illustrated in Fig. 8.

[0055] Moreover, a propulsion direction by the duct additional propeller device 24 can be set to the bow-side direction. For this reason, a propeller idling prevention device 11A for preventing the designed propeller 11 from rotating may be provided.

[0056] On the other hand, in the example of the present invention, as illustrated in Figs. 7 and 8, a vertical tunnel 30 is formed at a bow portion to pass through the ship bottom, and as illustrated in Fig. 1, a lateral tunnel 32 is formed in communication with the vertical tunnel 30. Reference numeral 32A is a protective cover of the lateral tunnel 32.

[0057] The additional propeller device 24, which has the propeller 20 and the driving unit 22 therefor, is provided in the vertical tunnel 30. Further, a hanging unit (not illustrated) is provided so as to hang the additional propeller device from above a water level inside the vertical tunnel, and the additional propeller device 24 is configured such that the additional propeller 20 can be vertically movable from below the ship bottom 10A to a height position of the lateral tunnel 32.

[0058] In a state with hanging by the hanging unit, the additional propeller device 24 is provided such that the additional propeller 20 can turn around a vertical center line of the vertical tunnel 30.

[0059] Further, when the additional propeller 20 of the additional propeller device 24 is at the height position of the lateral tunnel 32, the additional propeller 20 is configured to follow the lateral tunnel 32.

[0060] An appropriate unit can be used for vertical movement of the hanging unit of the additional propeller 20 or of the additional propeller device 24.

[0061] Conveniently, an elevator (not illustrated), such as a chain or a cylinder, can be used, which is provided on a deck 10C for maintenance above the vertical tunnel 30 or a turret (derrick: not illustrated) on an upper deck 10B and which is connected with the additional propeller device 24. In order to better understand this form, a part of a hanging tool 50 for vertical movement provided on a motor cover is illustrated in Fig. 9.

[0062] On the other hand, as disclosed in JP-A-2002-544028, a rack rail is provided on an inner surface of the vertical tunnel 30 or along a shaft connected to the inner surface, a pinion and a driving device for the pinion are provided on the additional propeller device 24-side, the pinion is meshed with the rack rail, and thus the ad-

ditional propeller device 24 may be vertically moved by the pinion driving device.

[0063] As described above, it is not economical to make the diameter of the vertical tunnel 30 excessively large. However, when a turning unit is incorporated in the additional propeller device, the diameter of the vertical tunnel 30 should be increased.

[0064] In this context, a turning unit, which is provided separately from the additional propeller device, is used for turning the additional propeller device around the vertical center line of the vertical tunnel 30. By doing so, increase of the diameter of the vertical tunnel 30 can be prevented.

[0065] As a turning unit for this purpose, a manner may be employed in which the elevator such as a chain or a cylinder can turn around the vertical center line of the vertical tunnel 30 in a state with hanging the additional propeller device 24.

[0066] Alternatively, for example, a support cylinder for turning (not illustrated) is provided to be fitted in the vertical tunnel 30, the support cylinder for turning is driven by a turning driving unit provided on an upper position of the cylinder, for example, via meshing gears arranged opposite to each other between the support cylinder for turning-side and the turning driving unit, and the support cylinder for turning can be configured to turn around the vertical center line of the vertical tunnel 30.

[0067] Further, as described above, the additional propeller 20 is raised to the height position of the lateral tunnel 32 and is oriented in a direction along the lateral tunnel 32 when the ship is made to dock at or leave from a port, and thus is used as a side thruster, that is, a bow thruster.

[0068] For mounting the additional propeller device 24, for example, as is referenced in Figs. 1, 5 and 6, support portions 30B and 30B protruding inward in the vertical tunnel 30 are formed and the additional propeller device 24 is mounted on the support portions 30B and 30B so that the additional propeller device 24 can be stably mounted.

[0069] In this configuration, in an arrangement where the additional propeller device 24 is mounted on the support portions 30B and 30B, a structure exhibits high mounting stability where the additional propeller device 24 is pressed downwardly from above and mounted on the support portions 30B and 30B. Since the additional propeller device 24 is configured such that the additional propeller 20 can be vertically movable from below the ship bottom 10A to the height position of the lateral tunnel 32, if the support portions 30B and 30B were, for example, a flange over the entire circumference, the additional propeller device 24 could not be vertically movable.

[0070] Accordingly, as the support portions 30B and 30B, the flange protruding inward in the vertical tunnel 30 is divided into a plurality of parts in a circumferential direction as illustrated in Fig. 6(c). In the additional propeller device 24, with respect to a mounting base 40 for the driving unit 22 and a motor case 22A, a mounting

portion is formed, which has a plurality of cutout portions 40A and 40A circumferentially arranged in an outer circumferential portion and engaging portions 40B and 40B formed so as to straddle the cutout portions 40A and 40A, as illustrated in Figs. 6(a) and 6(b). The engaging portions 40B and 40B are positioned to be able to pass through between the support portions 30B and 30B, and then, the additional propeller device 24 is pulled up and the additional propeller device 24 is rotated around the vertical center line of the vertical tunnel. By doing so, the engaging portions 40B and 40B are positioned at the flange position and the engaging portions 40B and 40B can be pressed downwardly from above and mounted on the support portions 30B and 30B by an appropriate mounting unit.

[0071] In such a configuration, when the additional propeller 20 is oriented in a direction along the lateral tunnel 32, a position of the vertical tunnel 30 around the vertical center line can be also determined as in the following example illustrated in Fig. 6. Precisely, by providing stoppers 30D and 30D at end portions of the support portions 30B and 30B, when the additional propeller device 24 is rotated around the vertical center line of the vertical tunnel, when the mounting base 40 is rotated, the engaging portions 40B and 40B can be brought into abutment with the stoppers 30D and 30D on the end portions of the support portions 30B and 30B.

[0072] Further, by providing conical pins 40C formed so as to project from under surfaces of the engaging portions 40B and 40B and so as to taper for fitting receiving holes 30E formed in the support portions 30B and 30B correspondingly, the conical pins 40C enter the fitting receivingholes 30E so that the mounting base 40 can be positioned in the circumferential direction.

[0073] As a mounting unit for pressing downwardly from above and mounting the engaging portions 40B and 40B on the support portions 30B and 30B, an appropriate manner can be applied.

[0074] In a first example of a mounting unit 60, as illustrated in Figs. 4 and 5, for example, an eccentric circular cam 61 is disposed on each engaging portion 40A so that for example, a rotational drive force of a driving motor 62 fixed to a support base 10D is transmitted as a rotational force to the eccentric circular cam 61 via a gear box 63.

[0075] After the engaging portions 40B and 40B are aligned with the support portions 30B and 30B, in order to apply a pressing force to the engaging portions 40B and 40B through the eccentric circular cam 61, the eccentric circular cam 61 is rotated so that point of the application is downward. In order to remove the engaging portions 40B and 40B, a reverse operation is performed.

[0076] In a second example of the mounting unit 60, as illustrated in Fig. 9, for example, a toggle mechanism is adopted.

[0077] That is, a pushing arm 65 is connected to a bracket 64 provided on the vertical tunnel 30 or the support portion 30B, on the other hand, a bracket 66 is pro-

vided on the vertical tunnel 30, and a distal end of an extension cylinder 67 is connected to the pushing arm 65 via a link 68, and is connected to the bracket 66 by a link 69.

[0078] In this example, after the engaging portions 40B and 40B are aligned with the support portions 30B and 30B, a piston rod of the extension cylinder 67 is extended, and the other endportion of the pushing arm 65 is strongly pressed against each engaging portion 40B via the toggle mechanism.

[0079] Further, when the additional propeller 20 of the additional propeller device 24 is located below the ship bottom, for example, as illustrated in Fig. 4, the mounting base 40 can be mounted on an inwardly protruding support portion 30F formed on a lower endportion of the vertical tunnel 30 as in the structure of the above examples.

[0080] If necessary, an additional propeller device 24A on the stern side can also be provided on left and right sides with respect to the center line of the ship as a border. The additional propeller devices 24A and 24A are provided on the left and right sides of the stern side, thereby improving the maneuverability. Further, when the propeller is utilized as the side thruster, the ship can be more easily docked at the port.

[0081] On the other hand, installation of the additional propeller device 24A on the stern side may not be performed. Instead, a stern side thruster can be provided. As for the stern side thruster, since there are an engine room and the like on the center axis of the ship on the stern side, the vertical tunnel 30 cannot be formed there. This results in that, in order to provide the stern side thrusters, as described above, two stern side thrusters are provided on the left and right sides of the center axis of the ship.

[0082] Further, as illustrated in Figs. 2 and 4, in the example of the present invention, water enters the vertical tunnel 30. Then, a (sea) water level WL inside the vertical tunnel 30 is hardly affected by waves. In view of this, the (sea) water level WL inside the vertical tunnel 30 can be detected by an appropriate detector (not illustrated), and the current draft can be grasped or monitored as outlined in Fig. 2.

Industrial Applicability

[0083] The present invention is applicable to a standard cargo ship, a container ship, a tanker, an LNG carrier, a car carrier, a bulk carrier, a cargo-passenger ship, and so on.

Reference Signs List

[0084]

10	ship
10A	ship bottom
11	designed propeller (main propeller)
12	main engine (propulsion engine: driving unit)

20	additional propeller
21	duct
22	driving unit
22A	cover
5 24	additional propeller device
30	vertical tunnel
30B	support portion
30D	stopper
30F	support portion
10 32	lateral tunnel
40	mounting base
40B	engaging portion
60	mounting unit
61	eccentric circular cam
15 67	extension cylinder
WL	(sea) water level

Claims

1. A ship equipped with an additional propeller, the ship being configured to obtain propelling force by driving a designed propeller with a main engine, and comprising:

a vertical tunnel that is formed at a bow portion to pass through a ship bottom;
a lateral tunnel that is formed in communication with the vertical tunnel;
an additional propeller device that is provided, which has a propeller and a driving unit for the propeller, in the vertical tunnel; and
a hanging unit that is provided to hang the additional propeller device from above a water level inside the vertical tunnel,
wherein the additional propeller device is configured such that the additional propeller can be vertically movable from below the ship bottom to a height position of the lateral tunnel,
in a state with hanging by the hanging unit, the additional propeller device is provided so as to be capable of turning around a vertical center line of the vertical tunnel, and
when the additional propeller of the additional propeller device is at the lateral tunnel height position, the additional propeller is configured to follow the lateral tunnel.

2. The ship equipped with an additional propeller according to claim 1, wherein when the additional propeller of the additional propeller device is at the lateral tunnel height position, the additional propeller device is configured so as to be mountable on a support portion protruding inward in the vertical tunnel.
3. The ship equipped with an additional propeller according to claim 1, wherein when the additional propeller of the additional propeller device is located

below the ship bottom, the additional propeller device is configured to be mountable on a support portion protruding inward in the vertical tunnel.

4. The ship equipped with an additional propeller, wherein operating condition is selectable between regular operating condition in which propelling force is obtained by driving the designed propeller and the other operating condition in which propelling force is obtained by driving the additional propeller.

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5. The ship equipped with an additional propeller according to claim 1, wherein the additional propeller is a duct propeller.

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6. The ship equipped with an additional propeller according to claim 1, comprising a water level detecting unit that monitors or detects variation of the water level inside the vertical tunnel.

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7. An operating method for a ship equipped with an additional propeller, the ship being configured to obtain propelling force by driving a designed propeller with a main engine, and comprising:

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a vertical tunnel that is formed at a bow portion to pass through a ship bottom;

a lateral tunnel that is formed in communication with the vertical tunnel;

an additional propeller device that is provided, which has a propeller and a driving unit for the propeller, in the vertical tunnel; and

a hanging unit that is provided to hang the additional propeller device from above a water level inside the vertical tunnel,

wherein the additional propeller device is configured such that the additional propeller can be vertically movable from below the ship bottom to a height position of the lateral tunnel,

in a state with hanging by the hanging unit, the additional propeller device is provided so as to be capable of turning around a vertical center line of the vertical tunnel,

when the additional propeller of the additional propeller device is at the lateral tunnel height position, the additional propeller is configured to follow the lateral tunnel, and

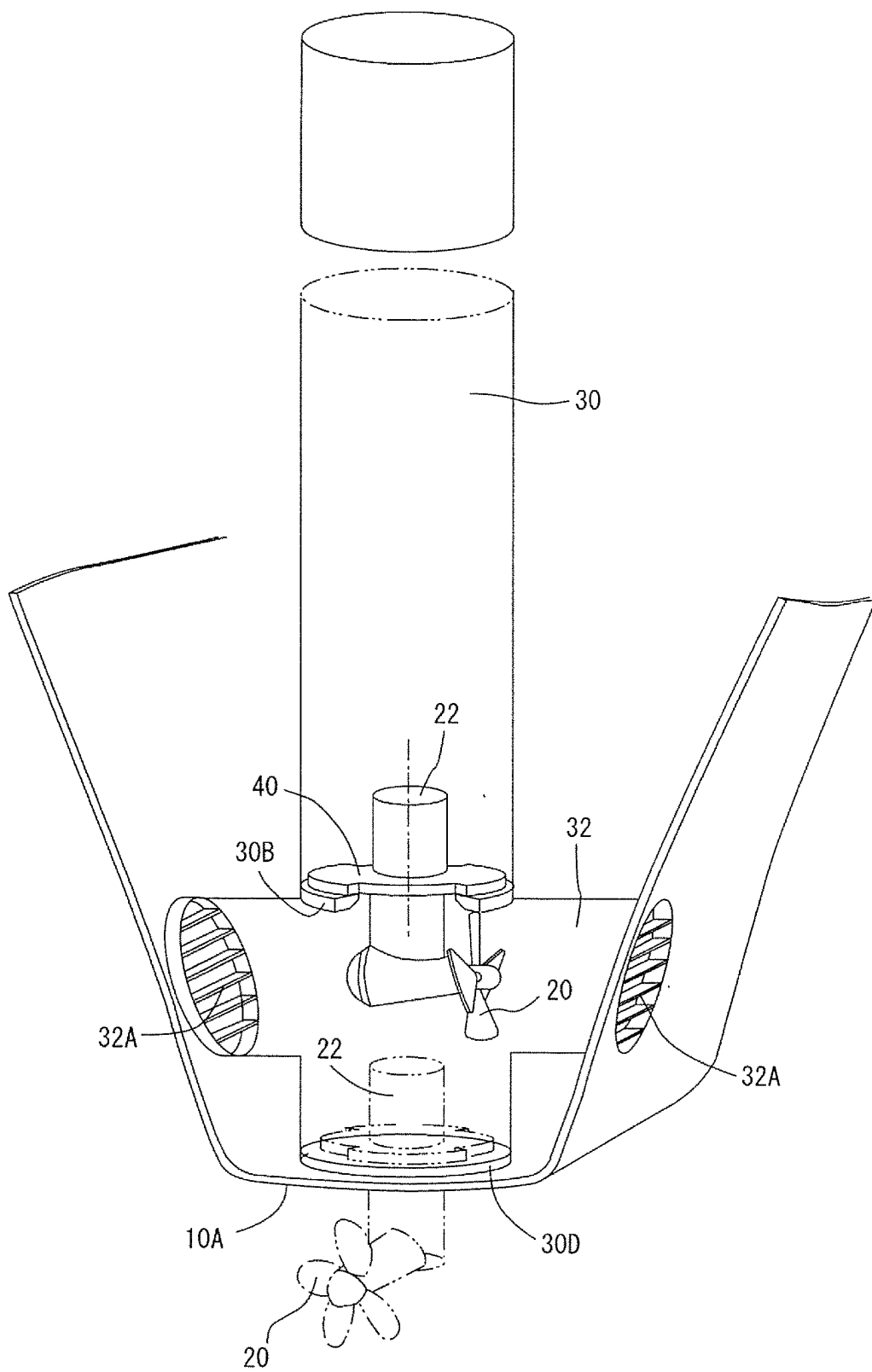
the ship is propelled by driving the designed propeller in a load condition, and the ship is propelled by driving at least the additional propeller in an unload condition.

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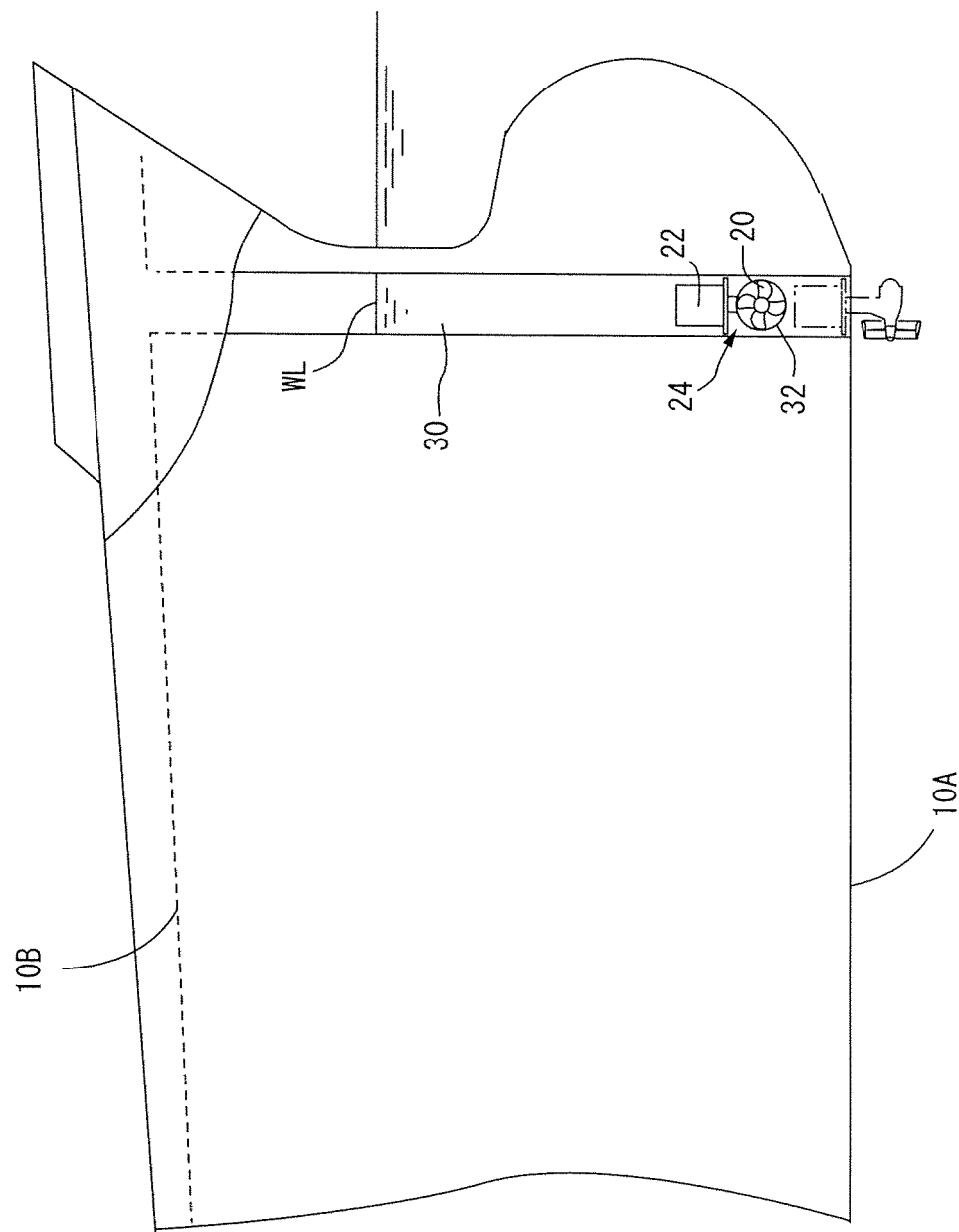
8. The operating method for a ship according to claim 7, wherein when the additional propeller is raised to the lateral tunnel height position, the additional propeller is oriented in a direction along the lateral tunnel, and the ship is made to dock at a pier or a port or leave from the pier or the port.

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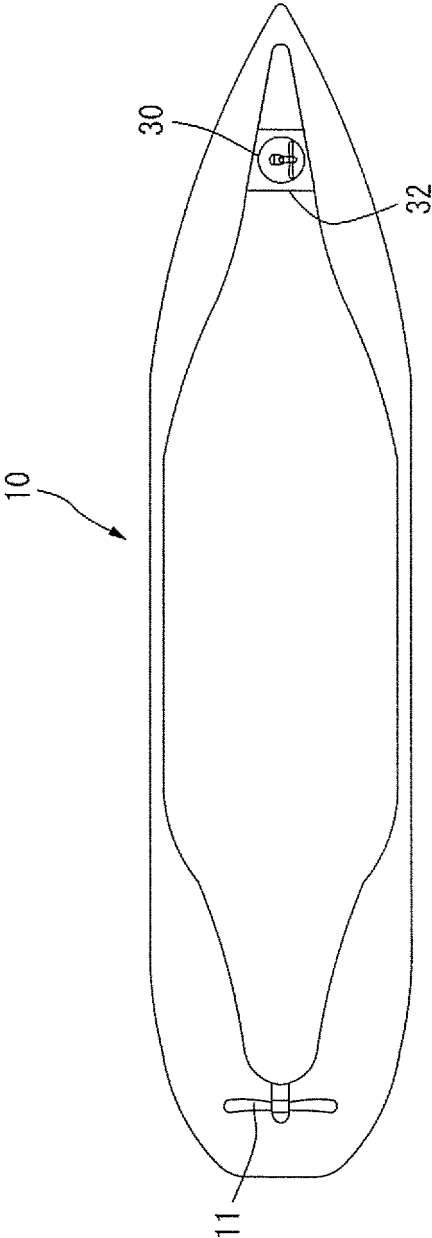
[FIG. 1]



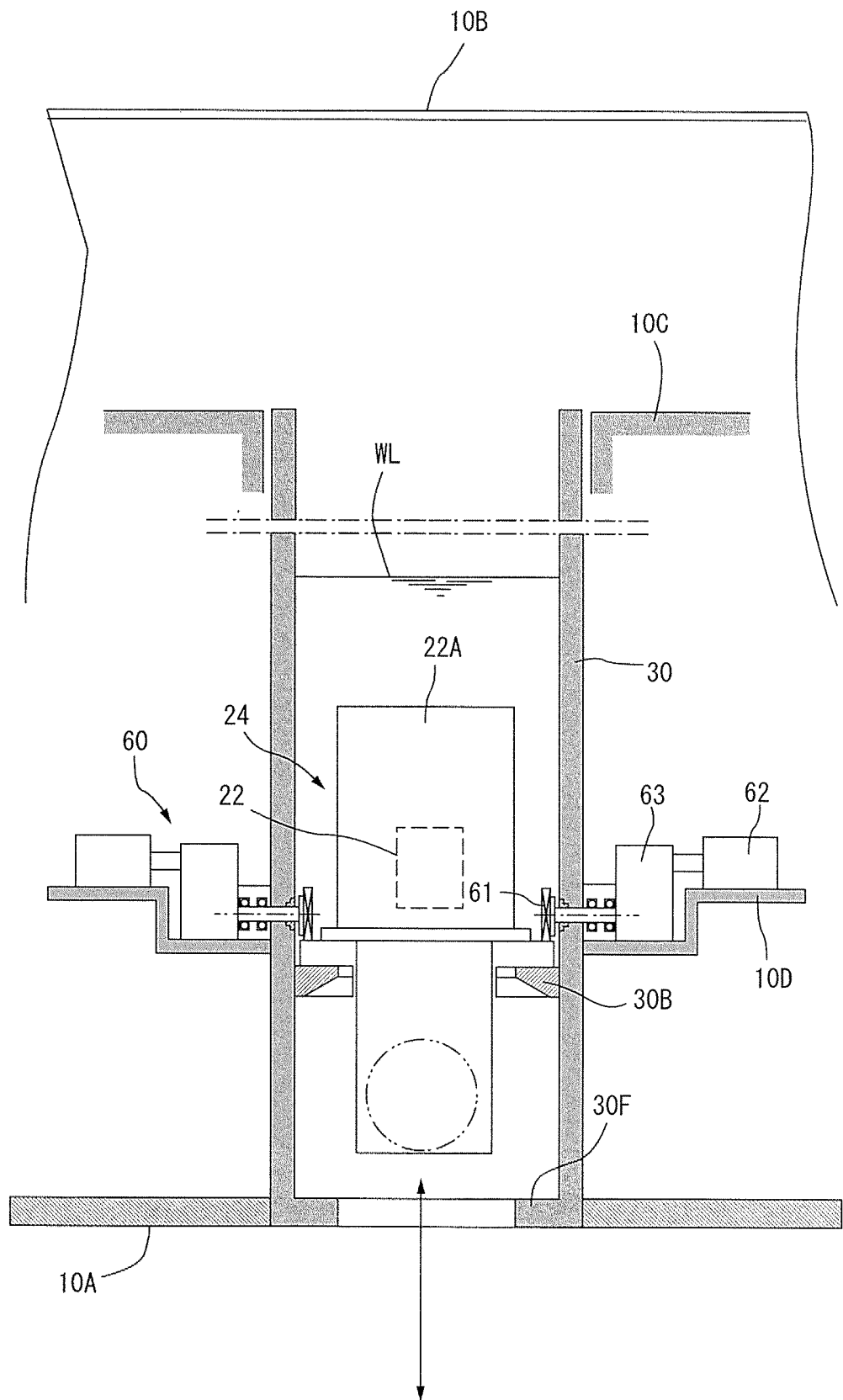
[FIG. 2]



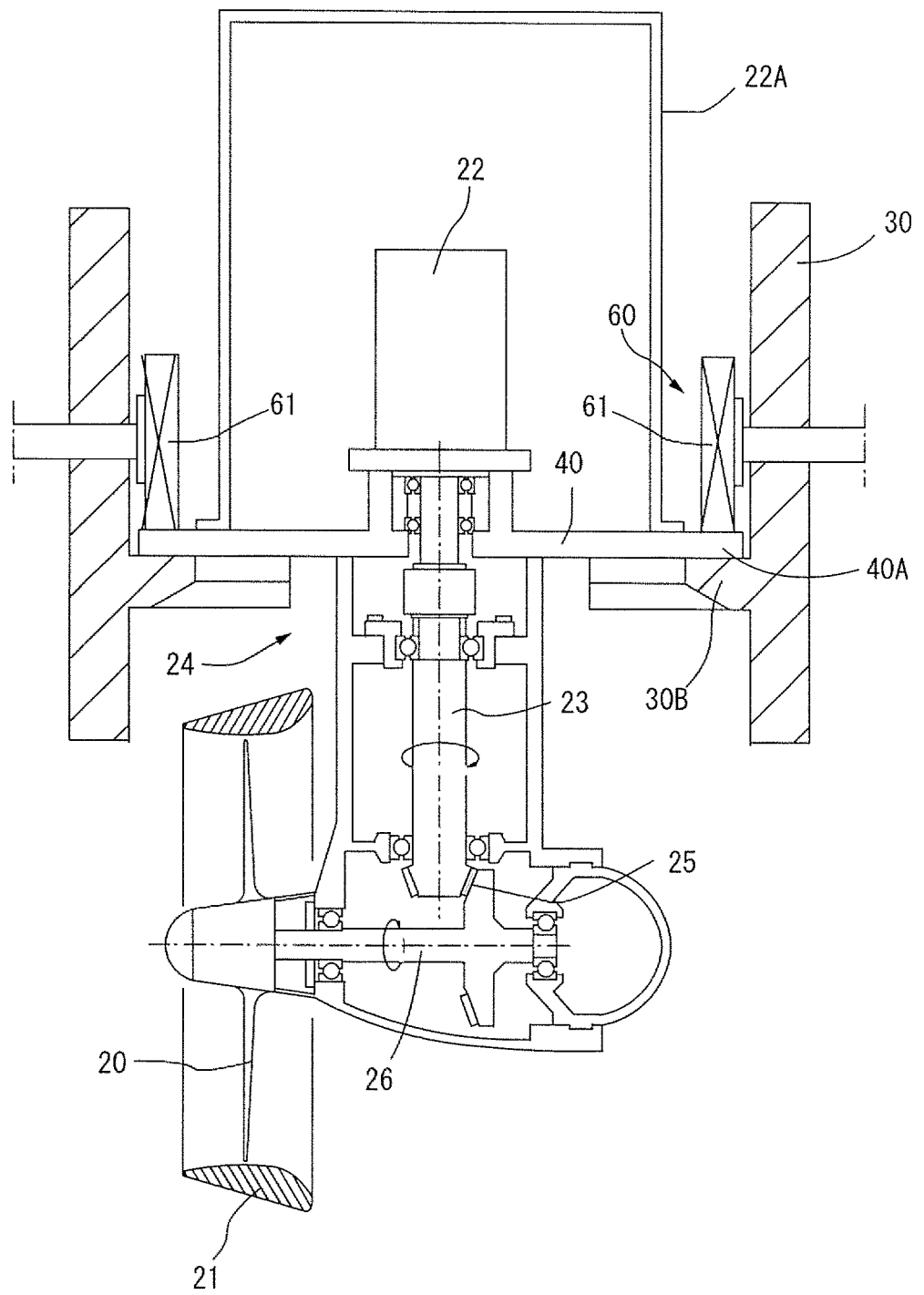
[FIG. 3]



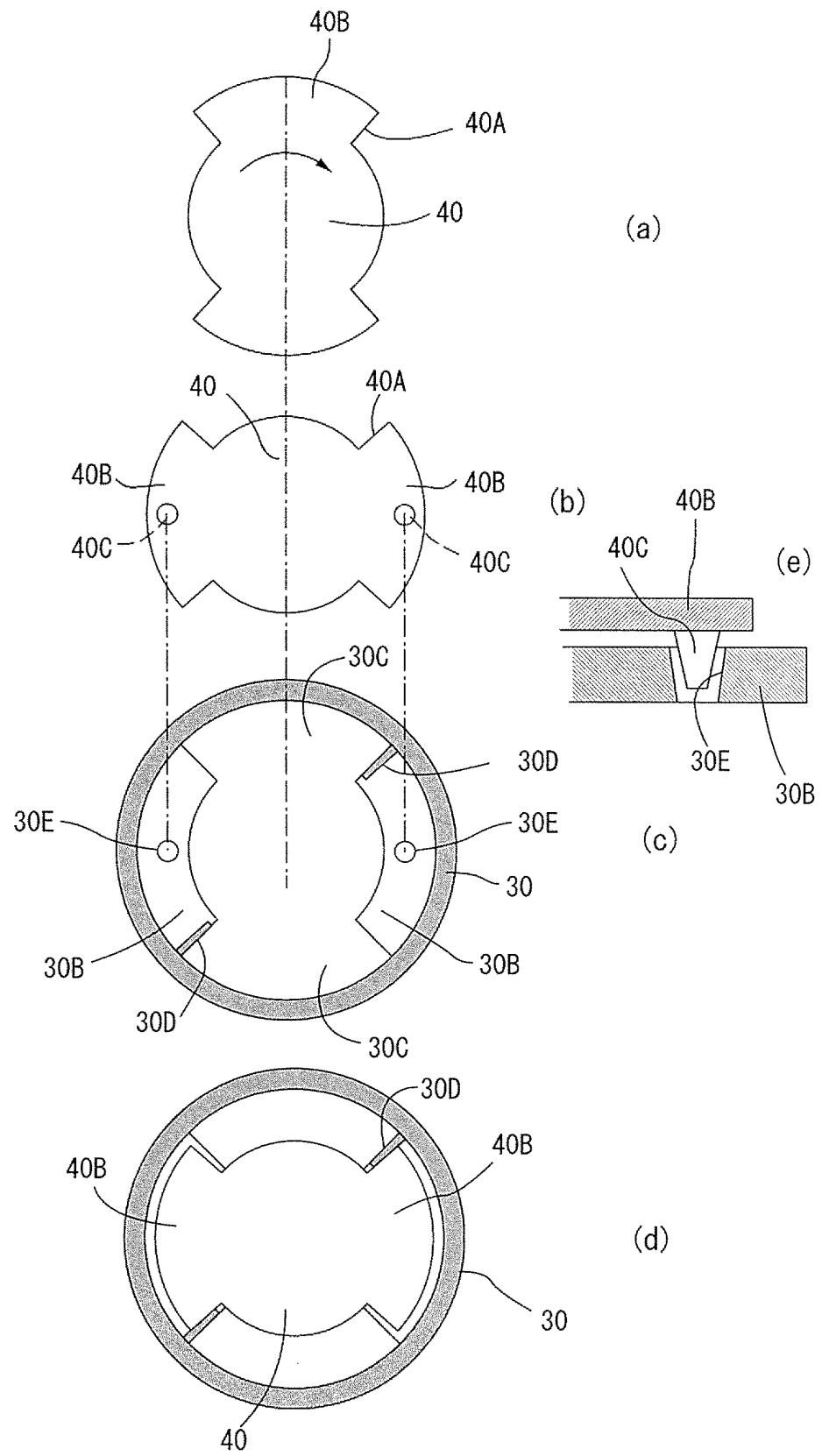
[FIG. 4]



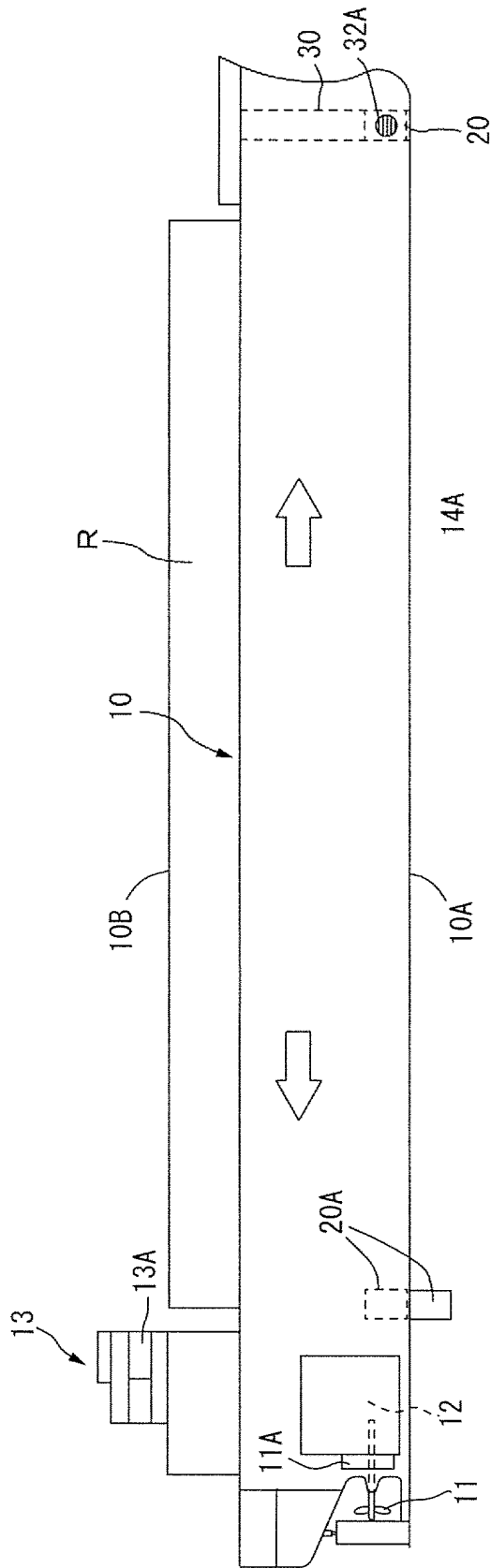
[FIG. 5]



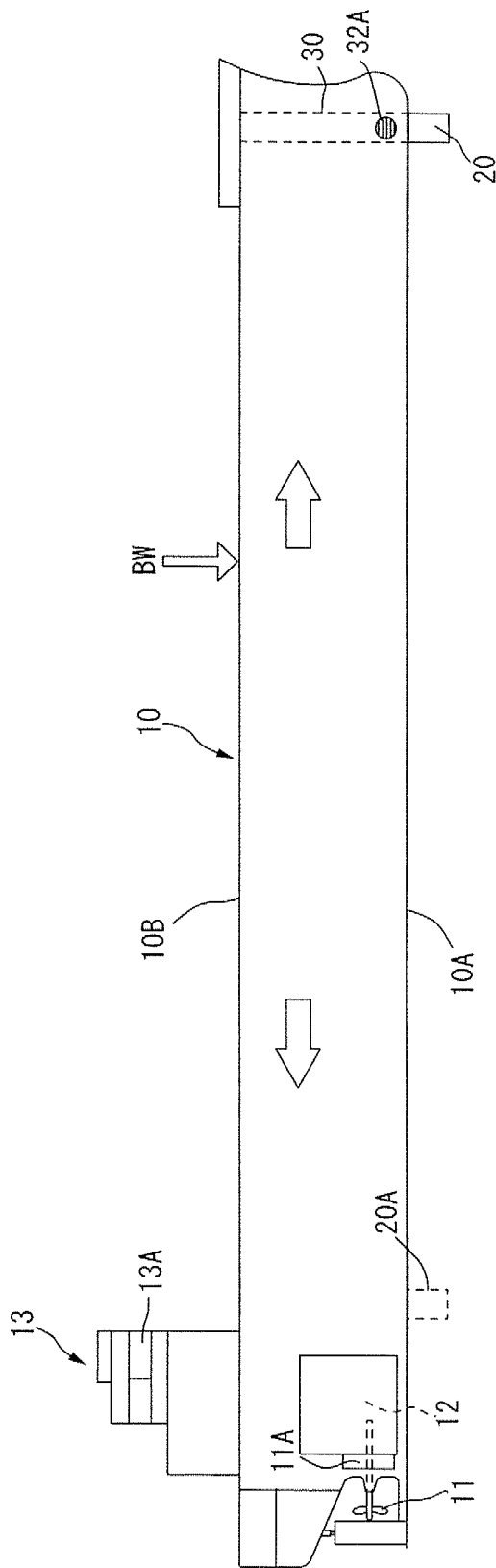
[FIG. 6]



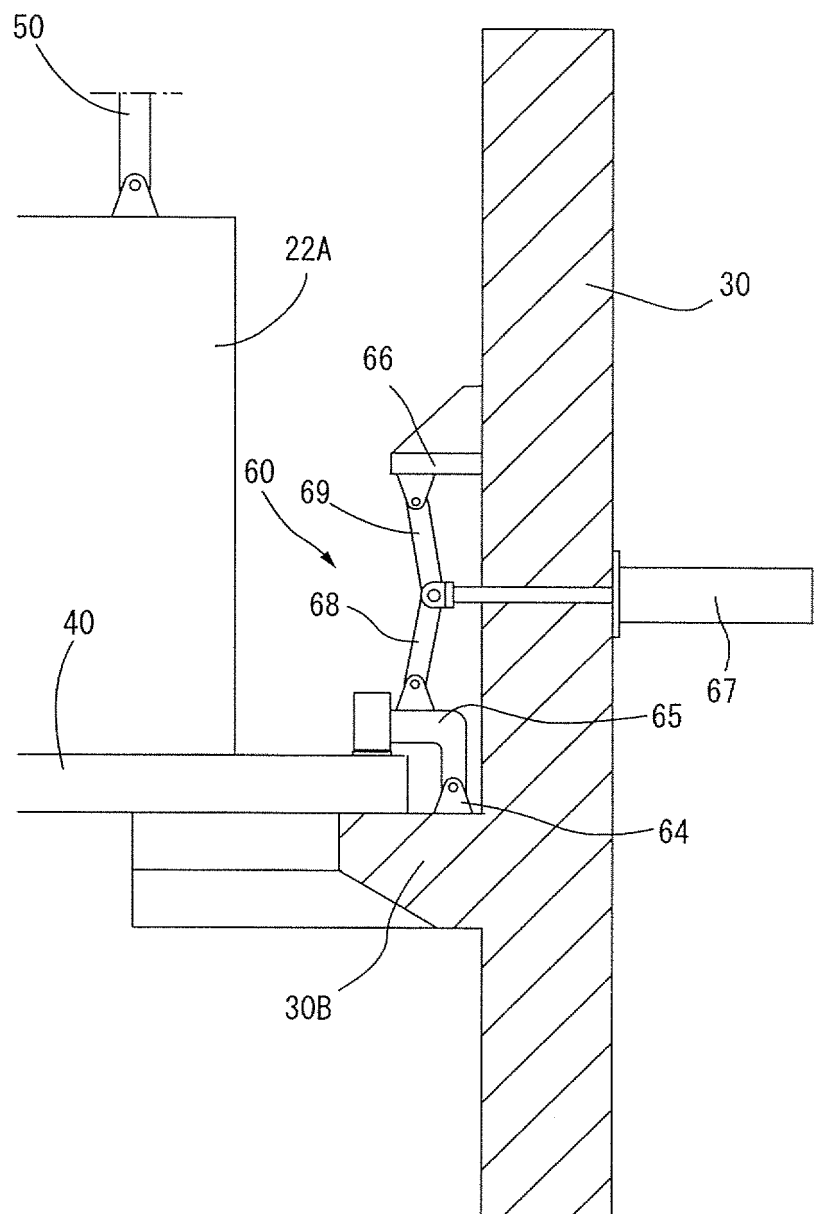
[FIG.7]



[FIG. 8]



[FIG. 9]



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/056835

A. CLASSIFICATION OF SUBJECT MATTER

B63H25/42(2006.01)i, B63B11/00(2006.01)i, B63H5/15(2006.01)i, B63H20/00(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)

B63H25/42, B63B11/00, B63H5/15, B63H20/00

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2016
Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2010/0175603 A1 (SAMSUNG HEAVY IND. CO., LTD.), 15 July 2010 (15.07.2010), paragraphs [0016] to [0022]; fig. 1 to 4 & WO 2009/014296 A1 & KR 10-2009-0011202 A & CA 2693328 A1 & RU 2010106622 A	1-8
Y	WO 2014/184968 A1 (Hiroshi UENO), 20 November 2014 (20.11.2014), paragraphs [0016] to [0024], [0042]; fig. 1 to 5 & JP 2014-221570 A	1-8

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

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Date of the actual completion of the international search
10 May 2016 (10.05.16)

Date of mailing of the international search report
24 May 2016 (24.05.16)

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/056835

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 61-261188 A (Kawasaki Heavy Industries, Ltd.), 19 November 1986 (19.11.1986), page 2, lower left column, line 16 to lower right column, line 6; page 3, upper left column, line 13 to lower right column, line 6; fig. 1 to 2 (Family: none)	2-3
Y	JP 2008-068796 A (IHI Marine United Inc.), 27 March 2008 (27.03.2008), paragraphs [0021] to [0023]; fig. 3 (Family: none)	7-8

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- JP 5231878 B [0008]
- JP 2002544028 A [0062]