

PROPELLER SHIP WITH FRONT POSITIONED TWIN RUDDERS

Technical Field

[0001]

The present invention relates to a propeller ship with front positioned twin rudders, having one propeller shaft and two rudders in a bow direction with respect to a propeller.

Background Art

[0002]

A ship is utilized as a means which can transport materials and person in large quantities and efficiently.

For that purpose, it is important for the ship to safely sail along a desired course and call at a port. As a result, a propulsion mechanism and a steering mechanism of the ship have been developed while being changed.

[0003]

Basic factors required for the rudder are a turning performance (a performance which indicates how quick a direction can be changed when keeping steering) and a course keeping performance (a course stability: a performance how straight the ship can travel), and these factors are frequently conflicting functions, however, there has been designed variously to make them compatible.

On the basis of a turning performance of the ship, in relation to a ship main body, and a water flow effect to the rudder, the rudder has been generally attached in tandem at a backward position with respect to the propeller, in a stern.

[0004]

The same airfoil theory as that of an airfoil of an airplane is applied to an effect of the rudder, and the rudder is well installed within a limited space in the stern.

[0005]

The turning performance of the rudder depends on thrust in lateral direction acting on a surface of the rudder. This is lift acting on the rudder surface. The lift is theoretically expressed as open water rudder performance in a uniform laminar flow by the following expression.

$$\text{Lift (F)} = 1/2\rho V^2 \cdot \sin\alpha \cdot A \cdot F_p$$

where, V: Inflow speed of water to rudder

α : Inflow angle of inflow water to rudder

A: Effective rudder area for the rudder lift

F_p : Gradient of rudder open water normal force coefficient

ρ : Density of seawater

[0006]

Meanwhile, in order to make the lift of the rudder larger, it has been known in Patent Document 1 that two rudders are provided in parallel at backward positions of a propeller for the single propeller, in a stern of a specifically designed ship.

Citation List

Patent Literature

[0007]

Patent Document 1: JP-A No. 2003-26096

Summary of Invention

Technical Problem

[0008]

The structure of the Patent Document 1 has an advantage that the lift can be enlarged, however, has no objects to achieve improvement of fuel consumption, reduce a ship construction cost, or enlarge an amount of cargo per ship total length.

[0009]

A main object of the present invention is to provide a structure of a propeller ship which can achieve improvement of fuel consumption, enlarge an amount of cargo per ship total length, and reduce a ship construction cost.

Solution to Problem

[0010]

The present invention achieving the object mentioned above is as follows.

<Invention described in claim 1>

A propeller ship with front positioned twin rudders wherein rudders are provided at laterally symmetrical positions of a ship center line in a front side of a propeller and in a rear side of a buttock line.

[0011]

(Operation and effect)

The rudders are provided at the laterally symmetrical positions of the ship center line. In a rudder area which is necessary for securing a turning performance and a course keeping performance (a course stability) which are necessary in a ship having a certain size, an area of each of the rudders in the case where two rudders are provided

can be made about 25 % to 50 % smaller per one rudder area than that in the case where one rudder is provided. A total area of two rudders is the same as or somewhat larger than that of a conventional case with one rudder. The rudder is desirably provided so as to make a clearance as small as possible with a ship bottom line.

Generally, the rudder necessarily goes under the seawater surface at the sailing time. Making it possible to reduce the rudder height according to the present invention means making it possible to reduce a draft depth at the sailing time. As a result, it is possible to reduce an output of a main engine on the same ship speed, and the fuel consumption is improved.

Meanwhile, an effect achieved by a stern thruster can be expected by provision of a stern thruster in the front side of the propeller.

The "buttock line" means a shape line of the stern obtained by cutting the stern by a vertical surface which is parallel to a central vertical cross sectional surface of a hull. It particularly refers to a line formed by a cross line to a parallel portion of the hull.

[0012]

<Invention described in claim 2>

The propeller ship with front positioned twin rudders described in claim 1, wherein a stern thruster is provided in the front side of the propeller and in the rear side of the buttock line, and a propeller axis of the stern thruster has a relationship that the center line of the propeller axis passes through a plate surface of each of the rudders.

[0013]

(Operation and effect)

It is possible to enhance maneuverability in correction of course in a narrow port or getting to or leaving the shore, by the provision of the stern thruster in the stern side.

Meanwhile, in the case where the ship sails at a low speed in the port, the rudder cannot work effectively at all. To cope with this, the maneuverability can be enhanced by starting the stern thruster and bringing the water flow thereof into the rudder plate surface.

[0014]

<Invention described in claim 3>

The propeller ship with front positioned twin rudders described in claim 2, wherein the stern thruster is positioned 3 to 25 m ahead of the propeller.

[0015]

(Operation and effect)

The stern thruster is preferably positioned 3 to 25 m ahead of the propeller. It has been known that the maneuverability by the stern thruster becomes appropriate in correction of course in the narrow port or in getting to and leaving the shore, in the case where the stern thruster is positioned 3 to 25 m ahead of the propeller.

[0016]

<Invention described in claim 4>

The propeller ship with front positioned twin rudders described in claim 1, wherein the rudder has laterally symmetrical rudder

surfaces.

[0017]

(Operation and effect)

The present invention is not characterized by the surface shape of the rudder, but takes into consideration use of the general rudder. In the case where the rudder has the laterally symmetrical rudder surfaces, it is possible to enhance the maneuverability by synchronously using two rudders, using only one rudder, or using in combination.

[0018]

<Invention described in claim 5>

The propeller ship with front positioned twin rudders described in claim 1, wherein a steering machine is provided within a hull in the front side of the propeller and the rear side of the buttock line.

[0019]

(Operation and effect)

In the case where the rudder and the steering machine are provided in the front side of the propeller, it is not necessary to arrange an after-peak tank, steering room and the like backward in the ship and it is possible to shorten the ship, for example, about 5 m to 20 m in comparison with a propeller ship having one rudder in the rear side of one propeller according to a conventional example.

As a result, since a volumetric capacity of a cargo tank can be increased about 5 % to 15 % per the same total length in the case of a cargo ship, a utility value of the ship is enhanced. Further, it is possible to shorten the total length of the ship and the ship

constructing cost is reduced.

[0020]

<Invention described in claim 6>

The propeller ship with front positioned twin rudders described in claim 1, wherein an additional propeller and a driving unit for the additional propeller are provided in addition to said propeller, one or a plurality of the additional propellers is disposed at a ship bottom or at a boot top of the ship bottom, in a position different from where said propeller is disposed, and operating condition is selectable between regular operating condition in which propelling force is obtained by driving said propeller and the other operating condition in which propelling force is obtained by driving the additional propeller.

[0021]

(Operation and effect)

A compact additional propeller and a driving unit therefor are provided in addition to said propeller, that is, the regularly used propeller. The output of the driving unit for the additional propeller can be 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 regularly used propeller, having a state of draft close to designed load draft. If necessary, the ship is operated also with the additional propeller in a combined manner.

When the ship navigates back to a port after unloading the cargo, the ship is mainly operated by the compact 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 compact additional propeller, keeping a draft line further lower.

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 waterplane area coefficient can be improved, and significant reducing effects of fuel consumption can be obtained.

Further, since the compact additional propeller is driven, small output of the driving unit is enough (35% or less, more preferably, 25% or less of the output of the driving unit of the main engine). From this viewpoint, the significant reducing effects of fuel consumption can be obtained.

In the case where the ship leaves a port after fully loaded with the cargo and then shifts to regular navigation, the ship navigates with the deep draft, driving the regularly used propeller. Further, in the case where the ship navigates using ballast after unloading the cargo, the ship is operated with the additional propeller after shifting to normal navigation. However, in the case of bad weather, ballast water is filled even in an unload condition. This enables the ship to travel in a stabilized state by means of the compact additional propeller or the regularly used propeller. Further, the additional propeller and the regularly used propeller can be used in a combined manner, if necessary.

Since the additional compact propeller is mainly used at the time of ballast navigation, a propeller immersion ratio for the

regularly used propeller is not so largely limited so that a propeller diameter of a 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 main engine is reduced at the same speed of the ship, thereby significantly improving fuel efficiency.

[0022]

<Invention described in claim 7>

The propeller ship with front positioned twin rudders described in claim 6, wherein a position of the additional propeller is selectable between a state of being assembled at the outside of the ship and the other state of being retracted to the inside of the ship.

[0023]

(Operation and effect)

In the case where the additional propeller is assembled at the outside of the ship and kept with unused condition under sailing, the propeller acts as resistance in the deep draft. Therefore, preferably the additional propeller is retracted to the inside of the ship.

Advantageous Effects of Invention

[0024]

As described above, according to the present invention, it is possible to achieve the improvement of the fuel consumption and it

is possible to enlarge the cargo amount per total length of the ship.

Brief Description of Drawings

[0025]

Fig. 1 is a side elevational view showing a stern portion in a front face of a propeller ship with front positioned twin rudders;

Fig. 2 is a plan view of the propeller ship with front positioned twin rudders;

Fig. 3 is a cross sectional view of the propeller ship with front positioned twin rudders as seen from a rear side;

Fig. 4 is a schematic side elevational view of a propeller ship in a load condition in the case where an additional propeller is provided;

Fig. 5 is a schematic side elevational view of the propeller ship while operating in an unload condition in the case where the additional propeller is provided;

Fig. 6 is an assembling drawing of an example of the additional propeller (a duct propeller);

Fig. 7 is a side elevational view showing a stern portion in a front face of a ship with single propeller and single rudder according to a conventional example; and

Fig. 8 is a plan view showing the stern portion in the front face of the ship with single propeller and single rudder according to the conventional example.

Description of Embodiments

[0026]

First of all, a description will be given of the conventional

example. A ship with single propeller and single rudder is provided as shown in Figs. 7 and 8 as an example of a tanker or a large cargo ship, an engine room 50 is arranged within a hull of a stern portion, and the ship is propelled by rotationally driving a propeller 51.
[0027]

A rudder 52 is provided in a rear side of the propeller 51, a steering room 53 is arranged above the propeller 51, a steering machine 54 is provided in the steering room 53, a rudder stock 55 is integrated with the rudder (a rudder plate) 52, and the ship can be turned by the steering machine 54. Reference numeral 56 denotes an after-peak tank.

A cargo space 57 is arranged in a front side of the engine room 50 so as to be connected to a bow side.
[0028]

Next, a description will be given of an embodiment according to the present invention with reference to the accompanying drawings.

Figs. 1 to 6 show an example of a propeller ship with front positioned twin rudders according to the present invention.
[0029]

The present invention is characterized in that rudders 12 and 12 are respectively provided at laterally symmetrical positions of a ship center line in a front side of a propeller 11 and in a rear side of a buttock line.
[0030]

The rudder 12 can employ both of a balance type and an unbalance type according to a relationship to a rudder stock 12a. Further,

it is desirable to have laterally symmetrical rudder surfaces as shown in Fig. 2. Two rudders 12 and 12 can appropriately select synchronous use, single use, and combined use.

[0031]

By arranging the rudders 12 and 12 in the front side of the propeller 11, the steering room 53 is also arranged in the front side of the propeller 11 and the steering machine 54 is provided in the steering room.

[0032]

A stern thruster 40 can be provided in the front side of the propeller 11 and in the rear side of the buttock line. Further, a propeller axis 40a of the stern thruster 40 is arranged so as to have a relationship that the propeller axis 40a passes through a rudder plate surface of each of the rudders 12 and 12.

It is possible to enhance maneuverability in course correction in a narrow port or getting to or leaving the shore by the provision of the stern thruster 40 in the stern side.

On the other hand, in the case where the ship sails at a low speed in the port or the like, the rudder cannot work effectively at all. Accordingly, by starting the stern thruster 40 and bringing the water flow thereof into the rudder plate surfaces, the rudder can work effectively and the maneuverability is enhanced.

[0033]

The stern thruster 40 is desirably positioned 3 to 25 m ahead of the propeller.

[0034]

According to the present invention, since the rudder and the steering machine are provided in the front side of the propeller, it is not necessary in the ship to arrange backward the after-peak tank 56, steering room 53 (see Fig. 7) and the like, as is different from the example shown in Figs. 7 and 8, and it is possible to shorten the ship, for example, about 5 m to 20 m in comparison with the propeller ship having one rudder in the rear side of one propeller according to the conventional example.

As a result, in the case of the cargo ship, since the volumetric capacity of the cargo tank can be about 5 % to 15 % increased per the same total length, a utility value of the ship is enhanced. Further, it is possible to reduce a ship construction cost.

[0035]

Said propeller 11 is the regularly used propeller. As shown in Figs. 4 to 6, a propeller ship with front positioned twin rudders can be provided, wherein an additional propeller and a driving unit for the additional propeller are provided in addition to the regularly used propeller 11, one or a plurality of the additional propellers is disposed at a ship bottom or at a boot top of the ship bottom, in a position different from where said propeller is disposed, and operating condition is selectable between regularly used operating condition in which propelling force is obtained by driving the regularly used propeller and the other operating condition in which propelling force is obtained by driving the additional propeller.

[0036]

FIG. 4 is a schematic side elevational view of a propeller ship,

for example, a commercial ship 10 loaded with cargo, such as a cargo ship. The commercial ship 10 obtains propelling force by driving a regularly used propeller (main propeller) 11 by a main engine (propulsion engine) 50 such as a diesel engine. The reference sign 14A represents a water line in an unload condition, indicating a state of trim by head in which the water line gradually becomes higher in a bow direction and intersects with a ship bottom line in a stern direction. In FIG. 5, the reference sign 14B represents a water line, indicating a state of trim by stern which is a reverse state of the state of trim by head.

[0037]

As is referenced in FIG. 6, the propeller ship is provided with an additional propeller 20 and a duct propeller 21, including a driving unit 22 for the additional propeller.

This additional propeller 20 is disposed at a position different from the regularly used propeller 11, more specifically, in a bow area, a stern area, or an intermediate position at a ship bottom or a boat top of the ship bottom. The case of disposing the additional propeller at the stern position is indicated by the reference sign 20A, and the case of disposing the same at the intermediate position is indicated by the reference sign 20B.

[0038]

The output of the driving unit 22 of the additional propeller 20 is small, which is 25% or less than the output of a driving unit of the main engine 50.

Further, operating condition is selectable between regular

operating condition in which propelling force is obtained by driving the regularly used propeller 11 and the other operating condition in which propelling force is obtained by driving the additional propeller 20.

[0039]

Explaining an example of the additional propeller 20, 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) 50 so as to obtain drive power.

[0040]

The duct propeller 21 that includes a duct 21A 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 vertical shaft 25 through a pair of bevel gears 24 and then transmitted, as rotational force of a propeller drive shaft 27, through a pair of bevel gears 26 provided at the vertical shaft 25.

On the other hand, the duct propeller 21 is configured to be rotatable around the vertical shaft 25 when rotational drive force of a transmission shaft 28 by the driving unit 22 is transmitted to a driving small gear 29 and a large gear 30 engaged therewith.

[0041]

Further, a device including the duct propeller 21 disposed below a ship bottom 10A is assembled at the outside of the ship bottom 10A as illustrated in FIG. 6, but preferably, the device is configured to be retractable to the inside of the ship because such assembly of the duct propeller at the outside is to be an obstacle during normal

navigation. The reference sign 10B indicates a shielding member that shuts after the device is retracted to the inside of the ship.

[0042]

With this configuration, when cargo R is loaded, the propeller ship is operated by driving the regularly used propeller 11 with the main engine 50 in a state of draft close to designed load draft.

After the cargo is unloaded, especially in a day of calm weather or in a quiet sea, the propeller ship is operated with the compact additional propeller 20, keeping the draft line low as illustrated in FIG. 5 because there is little necessity to secure stability of the ship too severely at the time of navigating the ship as shown in FIG. 5. In this case, as indicated by an outlined arrow in FIG. 5, a moving direction of the ship can be suitably selected, and the bow and the stern are monitored from the bridge 13 depending on the moving direction of the ship.

As a result, by lowering the draft line, apparent displacement is decreased and the contact area with the water of the shell is reduced. Further, a waterplane area coefficient can be improved and significant reducing effects of fuel consumption can be obtained.

Moreover, since the compact additional propeller 20 is driven, small output from the driving unit 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 50. 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.

[0043]

In the case where the propeller ship leaves a port after fully loaded with the cargo R and then shifts to regular navigation, the ship navigates with the deep draft, driving the regularly used propeller 11 mainly or in a combined manner with the additional propeller.

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

[0044]

On the assumption that the duct propeller 21 can rotate around a vertical axis, the propeller ship can propel in the stern direction by driving the duct propeller 21 as shown in Fig. 6 in a necessary driving state.

[0045]

If the duct propeller 21 is rotatable around a vertical shaft line 25 (the vertical axis), by appropriately rotating the additional propeller around the vertical axis in the combined driving state of the additional propeller and the regularly used propeller, a steering function can be added and maneuverability (directional property) can be improved. Further, when the ship is docked at a port, the duct propeller is oriented sideways so as to be utilized as a slide thruster.

[0046]

Further, a propeller idling prevention device for preventing the regularly used propeller 11 from rotating may be provided.

[0047]

If necessary, the duct propeller 21 may be provided on the right and left sides with respect to a center line of the ship. The duct propellers 21, 21 on the right and left sides rotate around the vertical shaft line, thereby improving the maneuverability. Further, when the propeller is utilized as the slide thruster, the propeller ship can be more easily get to the shore.

Industrial Applicability

[0048]

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

[0049]

- 10 Propeller ship
- 11 Regularly used propeller (main propeller)
- 12 Rudder
- 12a Rudder stock
- 20 Additional propeller
- 21 Duct propeller
- 22 Driving unit
- 40 Stern thruster
- 50 Main engine (propulsion engine: driving unit)
- 54 Steering machine

CLAIMS:

1. A propeller ship with front positioned twin rudders wherein rudders are provided at laterally symmetrical positions of a ship center line in a front side of a propeller and in a rear side of a buttock line.

2. The propeller ship with front positioned twin rudders described in claim 1, wherein a stern thruster is provided in the front side of the propeller and in the rear side of the buttock line, and a propeller axis of the stern thruster has a relationship that the center line of the propeller axis passes through a plate surface of each of the rudders.

3. The propeller ship with front positioned twin rudders described in claim 2, wherein the stern thruster is positioned 3 to 25 m ahead of the propeller.

4. The propeller ship with front positioned twin rudders described in claim 1, wherein the rudder has laterally symmetrical rudder surfaces.

5. The propeller ship with front positioned twin rudders described in claim 1, wherein a steering machine is provided within a hull in the front side of the propeller and the rear side of the buttock line.

6. The propeller ship with front positioned twin rudders described in claim 1, wherein an additional propeller and a driving unit for the additional propeller are provided in addition to said propeller, one or a plurality of the additional propellers is disposed at a ship bottom or at a boot top of the ship bottom, in a position

different from where said propeller is disposed, and operating condition is selectable between regular operating condition in which propelling force is obtained by driving said propeller and the other operating condition in which propelling force is obtained by driving the additional propeller.

7. The propeller ship with front positioned twin rudders described in claim 6, wherein a position of the additional propeller is selectable between a state of being assembled at the outside of the ship and the other state of being retracted to the inside of the ship.