

SHIP PROPULSION DEVICE AND SHIP WITH SAME
TECHNICAL FIELD

[0001]

The present invention relates to a ship propulsion device using a screw propeller and to a ship with the device, and relates specifically to a ship propulsion device in which fins are provided to a boss cap mounted to a boss of a screw propeller to improve the propulsion performance of the screw propeller, and to a ship with the device.

BACKGROUND ART

[0002]

Many ships use screw propellers as their propulsors. To improve propeller characteristics such as propeller efficiency contributes greatly to improvement in fuel economy. Thus, researches related to a propeller blade, such as the number of propeller blades, the shape, expanded area, pitch angle, and skew angle of the blades, have been made, and various blade shapes have been developed.

[0003]

For the purpose of improving the propeller characteristics, there has been developed a boss cap 5, for example, as described in Japanese Patent Application Kokoku Publication No. 1995-121716. Specifically, the boss cap 5 is equipped with rectification fins that increase the propeller efficiency by reducing hub vortexes in a slip stream of the propeller boss cap 5 near a propeller boss 2, as shown in Figs. 15 to 18.

[0004]

In this rectification-fin-equipped boss cap 5, the number of fins 6 (four in Fig. 15) mounted on the boss cap 5 is made

equal to the number of propeller blades 3 (four in Fig. 15). Moreover, as shown in Fig. 18, with respect to a geometric pitch angle ε of the roots of the propeller blades 3, an angle α of the fins 6 satisfies a relationship, " $-20^\circ \leq \alpha - \varepsilon \leq +30^\circ$." In the length direction of the fin 6, the front edge of the fin 6 is at the same position as the rear edge of the root of the propeller blade 3 or behind the rear edge in the propeller front-rear direction ($b \geq 0$). Moreover, the front edge of the fin 6 is provided at a position of a space between the roots of adjacent propeller blades 3 ($a > 0$). Furthermore, as shown in Figs. 16 and 17, the maximum diameter ($2r$) defined by the fins 6 and the axis of the main body of the cap 5 is larger than a diameter D_{ba} of a cap mounting end portion 2a of the boss 2 but not larger than 33% of the propeller diameter ($2R$).

[0005]

The operation and effect of the rectification-fin-equipped boss cap 5 are considered as follows. Specifically, the rectification fins themselves do not produce a thrust force but operate as rectification plates that reduce the amount of hub vortexes to be generated in a slip stream of the boss cap. By this rectification operation, the hub vortexes in the slip stream of the boss cap are diffused and an induced drag due to vortexes on the surfaces of the propeller blades is reduced. As a result, the propeller characteristics (propeller efficiency) are significantly improved with no increase in torque.

[0006]

In addition, the following technique has been proposed to a propeller of a ship provided with hub-vortex eliminators, such as the above rectification fins, to eliminate vortexes from

a propeller hub. Specifically, as described for example in Japanese Patent No. 3491890, the pitch or camber in a blade root portion in the propeller is larger than the pitch or camber in a middle portion in the propeller, for the purpose of improving the total efficiency of the propeller by enabling the hub-vortex eliminators to fully exhibit their functions and also of gaining an advantage in terms of strength thereof.

[0007]

Also, there has been proposed such a fin-equipped propeller boss as described for example in Japanese Utility Model Registration Application Kokai Publication No. 1993-7599 and Japanese Utility Model Registration Application Kokoku Publication No. 1995-34795. Specifically, no fins are provided to a boss cap, and instead multiple rectification fins, the number of which is equal to that of the blades of a screw propeller, are provided, at positions downstream of the blades, on a circumferential surface of the boss portion of the propeller boss except the boss cap.

[0008]

Meanwhile, the present inventors conducted tank experiments using various creative fin shapes based on various ideas, considering that the propeller efficiency may possibly be improved further by certain shapes of fins of a ship propulsion device using a rectification-fin-equipped boss cap. As a result, the present inventors came up with a ship propulsion device and a ship provided therewith which are capable of further improving the propeller efficiency, the ship propulsion device using the following screw propeller.

PRIOR ART DOCUMENT

PATENT DOCUMENTS

[0009]

Patent Document 1: Japanese Patent Application Kokoku
Publication No. 1995-121716

Patent Document 2: Japanese Patent No. 3491890

Patent Document 3: Japanese Utility Model Registration
Application Kokai Publication No. 1993-7599

Patent Document 4: Japanese Utility Model Registration
Application Kokoku Publication No. 1995-34795

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0010]

An object of the present invention is to provide a ship propulsion device and a ship provided therewith, the ship propulsion device formed of a screw propeller using a fin-equipped propeller boss cap and having a better workability and less weight than a ship propulsion device using a propeller boss cap equipped with fins having prior-art fin shapes and a ship provided with the ship propulsion device.

MEANS FOR SOLVING THE PROBLEM

[0011]

In a ship propulsion device to achieve the above object, according to a ship propulsion device in which a fin is provided to a propeller boss cap mounted on a rear side of a propeller boss of a screw propeller and the fin is disposed between but behind propeller blades, a diameter of a front end portion of the propeller boss cap is set as a reference diameter, and a rear half of the fin is formed into such a shape as to fall into a circular truncated cone having, as its bases, a circle that is situated at a middle position between a front end and a rear end of a root of the fin, that has a diameter 2.0 times, or more

preferably, 1.8 times as large as the reference diameter, and that is centered on a rotation center of the propeller, and a circle that is situated at a position of a rearmost end of the fin, that has a diameter 1.5 times, or more preferably, 1.3 times as large as the reference diameter, and that is centered on the rotation center of the propeller.

[0012]

Note that the wording, "at a middle position," means "to include the middle position and also to be in the plane of the fin that is perpendicular to a segment line connecting the front and rear ends of the root of the fin." Also, the wording, "at a position of a rearmost end" means "to include the position of the rearmost end and to be in the plane of the fin that is perpendicular to a segment line connecting the front and rear ends of the root of the fin."

[0013]

In the ship propulsion device to achieve the above object, according to the ship propulsion device, instead of providing the fin to the propeller boss cap, the fin is provided to each of portions on the propeller boss of the screw propeller which are behind the propeller blades, and the reference diameter is set as a diameter defined by a rear end of a root of each of the propeller blades on the propeller boss.

[0014]

In addition, according to the ship propulsion device, a front half of the fin is formed into such a shape that a distance from the front end of the root of the fin to a frontmost end of the fin in a direction along which the front and rear ends of the root are connected is set to be 0.0 to 0.3 times as large as the reference diameter, a diameter of a circle passing over

an outermost portion of the fin is set to be 1.0 to 2.5 times, or more preferably, 1.0 to 2.3 times as large as the reference diameter, and a diameter of a circle passing over an outermost portion of the fin at the middle position of the fin is set to be 1.0 to 2.0 times, or more preferably, 1.0 to 1.8 times as large as the reference diameter.

[0015]

Some prior-art fins are each formed into a shape in which front and rear halves thereof are substantially symmetrical about a center line. However, a flow behind propeller blades contracts rapidly. Thus, it is preferable for the rear half of the fin to have such a shape that a rear edge side thereof is cut off, as it can reduce the resistance of the fin while maintaining a fin effect on the contraction behind the propeller. Accordingly, as compared to the prior-art fin shapes, the machining is simple, thereby allowing lower manufacturing cost and also lighter weight. In addition, it is also effective for improving the propeller efficiency. From the finding of these facts through the tank experiments and so forth, the shape should be as above. Furthermore, as a result of an analysis of the flow over the fin surface based on a CFD (Computation Fluid Dynamics) computation, it was found that a rear edge side of an outer circumference of the fin produced resistance and that cutting such a portion led to an improvement in propeller efficiency.

[0016]

The ship for achieving the above object is designed to include the above ship propulsion device. Accordingly, it is possible to provide a ship including a ship propulsion device having a better workability and less weight than a ship

propulsion device of a ship that uses a propeller boss cap provided with fins having prior-art fin shapes.

EFFECTS OF THE INVENTION

[0017]

The ship propulsion device of the present invention is a propulsion device formed of a screw propeller using a fin-equipped propeller boss cap. The fin is formed into such a shape that a rear edge side of its rear half is cut off. Accordingly, a resistance of the fin is reduced while maintaining a fin effect on a contraction behind the propeller, so that the propeller efficiency is increased. In addition, the fin of the present invention is made smaller than prior-art fins, thereby facilitating the machining of the fin. The smaller size in turn allows the fin to be lighter accordingly.

[0018]

Also, according to the ship provided with the ship propulsion device of the present invention, it is possible to improve the propulsion efficiency as a ship propulsion device with a high propeller efficiency is used. For ships whose total operation period is over 10 years and which consume a large amount of fuel, only a slight improvement in propulsion efficiency allows the saving of a significantly large amount of fuel. Also, though only a small amount, the propulsion device is made lighter, and therefore a propeller shaft and a support structure for the propeller shaft can be made lighter accordingly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

[Fig. 1] Fig. 1 is a view showing the configuration of a ship propulsion device according to some embodiments of the present

invention and is seen from a rear side of the ship.

[Fig. 2] Fig. 2 is a side view of the ship propulsion device in Fig. 1.

[Fig. 3] Fig. 3 is a side view of a propeller boss cap.

[Fig. 4] Fig. 4 is a view showing the areas of the outlines of fins.

[Fig. 5] Fig. 5 is a view showing a first shape of each fin of the ship propulsion device according to one of the embodiments of the present invention.

[Fig. 6] Fig. 6 is a view showing a fin shape of a case where the propeller boss cap and the fins in Fig. 5 are rotated about the propeller rotation axis.

[Fig. 7] Fig. 7 is a view showing a second shape of each fin of the ship propulsion device according to one of the embodiments of the present invention.

[Fig. 8] Fig. 8 is a view showing a fin shape of a case where the propeller boss cap and the fins in Fig. 7 are rotated about the propeller rotation axis.

[Fig. 9] Fig. 9 is a view showing a third shape of each fin of the ship propulsion device according to one of the embodiments of the present invention.

[Fig. 10] Fig. 10 is a view showing a fin shape of a case where the propeller boss cap and the fins in Fig. 9 are rotated about the propeller rotation axis.

[Fig. 11] Fig. 11 is a view showing a fourth shape of each fin of the ship propulsion device according to one of the embodiments of the present invention.

[Fig. 12] Fig. 12 is a view showing a fin shape of a case where the propeller boss cap and the fins in Fig. 11 are rotated about the propeller rotation axis.

[Fig. 13] Fig. 13 is a view showing a fifth shape of each fin of the ship propulsion device according to one of the embodiments of the present invention.

[Fig. 14] Fig. 14 is a view showing a fin shape of a case where the propeller boss cap and the fins in Fig. 13 are rotated about the propeller rotation axis.

[Fig. 15] Fig. 15 is a view showing the configuration of a ship propulsion device according to a prior art and is seen from the rear side of the ship.

[Fig. 16] Fig. 16 is a side view of the ship propulsion device in Fig. 15.

[Fig. 17] Fig. 17 is a side view showing the shape of a propeller boss cap according to a prior art.

[Fig. 18] Fig. 18 is side view showing the positional relationship between each propeller blade and its corresponding fin according to the prior art.

[Fig. 19] Fig. 19 is a side view showing the mounting angle of the fin.

[Fig. 20] Fig. 20 is a cross-sectional view showing the rake angle of the fin, taken along the A-A line of Fig. 19, and seen from the rear side.

BEST MODES FOR CARRYING OUT THE INVENTION

[0020]

Hereinbelow, embodiments of a ship propulsion device and a ship provided therewith according to the present invention will be described by referring to the drawings. The description will be given herein by using an example where fins to be arranged behind propeller blades are disposed on a propeller boss cap; however, the present invention is also applicable to a case where fins are provided to portions on a propeller boss which

are behind propeller blades. In the case of providing fins to the portions behind propeller blades, a reference diameter is set to be the diameter defined by the roots of the rear ends of the propeller blades on the propeller boss.

[0021]

Note that Figs. 1 to 20 show a propeller boss, propeller blades, a propeller boss cap, fins and/or the like with different shapes and dimensions to facilitate the understanding thereof. The shapes and dimensions may differ from the actual ones. In addition, in the illustrations of Figs. 3 to 14 and 15 to 20, propeller blades and fins, which should be seen in normal cases, are omitted for the sake of simplicity and also due to some reasons regarding drawing and explanation.

[0022]

As shown in Figs. 1 to 14, each of ship propulsion devices 1A, 1B, 1C, 1D, and 1E (hereinafter, 1A to 1E) of embodiments of the present invention is formed of a screw propeller constituted of: a propeller boss (propeller hub) 2; propeller blades 3 mounted on the propeller boss 2; a propeller boss cap (propeller hub cap) 5A connected to the rear end of the propeller boss 2; and a corresponding one of sets of fins 6A, 6B, 6C, 6D and 6E (hereinafter, 6A to 6E) provided to the propeller boss cap 5A.

[0023]

The propeller boss cap 5A is formed as a rotor using a propeller rotation axis P_c as its rotation axis. A rear end portion 5a of the propeller boss cap 5A is formed as a flat surface. The rotor is so formed that each generating line of its rotation is a gently-curved or linear line, and is shaped to taper toward the rear side.

[0024]

Here, a diameter D_{cf} of a front end portion of the propeller boss cap 5A is set as a reference diameter D_s . In addition to that, an entire length L_c of the propeller boss cap 5A is set to be 0.28 to 0.76 times as large as the reference diameter D_s , preferably. Moreover, a diameter D_{ca} of a rear end portion 5a of the propeller boss cap 5A is set to be 0.35 to 0.95 times as large as the reference diameter D_s , preferably. Note that the diameter D_{cf} of the front end portion 5f is equivalent to the diameter of a flange of the propeller boss cap 5A.

[0025]

If each generating line of the rotor, which forms an outer circumferential surface 5b of the propeller boss cap 5A, is a linear line as shown in Fig. 3, the propeller boss cap 5A is in the shape of a circular truncated cone, which significantly facilitates the manufacturing thereof. Though not illustrated, even if the generating line of the rotor is a gently-curved line, the propeller boss cap 5A is in a shape tapering gently from the front side to the rear side. Preferably, in cross sections perpendicular to the propeller rotation axis P_c , the shape of the rear end portion 5a of this propeller boss cap 5A is such that the deviation from the shape of the circular truncated cone stays at or below 20% of the entire length L_c of the propeller boss cap 5A.

[0026]

Also, an end surface of the front end portion 5f of the propeller boss cap 5A is formed into a flat shape as it is joined to a rear end surface 2a of the propeller boss 2. In contrast, the end surface of the rear end portion 5a of the propeller boss

cap 5A is preferably formed as a flat surface as shown in Fig. 3 in view of machining thereof, but may be formed as a nearly-flat circular cone, rotor, or the like. In such a case too, the shape of the rear end portion 5a is so designed that the distance from the periphery to the center thereof in the front-rear direction would stay within a range not greater than 20% of the entire length L_c of the propeller boss cap 5A.

[0027]

The set of fins 6A to 6E are provided to the propeller boss cap 5A mounted on the rear side of the propeller boss 2 of the corresponding screw propellers 1A to 1E. The fins 6A to 6E are arranged between but behind the propeller blades 3. That is, when viewed from the rear side along the propeller axis P_c , a front end 6f of the root of each of the fins 6A to 6E is disposed between the rear ends of the roots of a pair of propeller blades 3. In addition, when viewed from a lateral side, the front end 6f of the root of each of the fins 6A to 6E is disposed behind the rear end of the root of the propeller blade 3. The fins 6A to 6E may be each formed to have a positive or negative camber, but a flat-plate shape is suitable for the sake of simplicity in machining thereof and reduction in manufacturing cost. Moreover, the fins 6A to 6E may be each mounted at a positive or negative rake angle.

[0028]

In the present invention, the fins 6A to 6E are formed into the following shape, as shown in Figs. 4 and 5 being views seen from a lateral side of the ship's body and Fig. 6 showing a case where the propeller boss cap 5A and the fins 6A to 6E are rotated about the propeller rotation axis. Incidentally, the shape of a prior-art fin 6, which is substantially

symmetrical in the front-rear direction, is illustrated in Fig. 4 with a thin line for the purpose of comparison with the fins 6A to 6E of the embodiments. To describe this in a very rough manner, in the present invention, the fins 6A or the like shown in Fig. 4 are each smaller by the fin area (shaded portion) of the rear half of the prior-art fin 6.

[0029]

The shape of the front half of each of the fins 6A to 6E is as follows. Specifically, as shown in Figs. 6 to 14, in the length direction of each of the fins 6A to 6E, i.e., in the direction of a line segment connecting the front end 6f and the rear end 6a of the root of each of the fins 6A to 6E, a distance L_f from the front end 6f of the root of the each of the fins 6A to 6E to the frontmost end of the each of the fins 6A to 6E is set to be 0.0 to 0.3 times as large as the reference diameter $D_s (=D_{cf})$. In other words, a maximum value L_{fmax} of the distance L_f is $0.3 \times D_s$.

[0030]

Moreover, as shown in Fig. 6, in the height direction of each of the fins 6A to 6E (a direction perpendicular to the propeller rotation axis P_c), a diameter D_1 of a first circle C_1 passing over outermost portions of the fins 6A to 6E is set to be 1.0 to 2.5 times, or more preferably, 1.0 to 2.3 times as large as the reference diameter D_s . A diameter D_2 of a second circle C_2 passing over outermost portions of the fins 6A to 6E at a middle position X_m between the front end 6f and the rear end 6a of each of the roots of the fins 6A to 6E is set to be 1.0 to 2.0 times, or more preferably, 1.0 to 1.8 times as large as the reference diameter D_s .

[0031]

Meanwhile, as shown in Figs. 5 and 6, the rear half of each of the fins 6A and 6E is formed into such a shape as to fall into a circular truncated cone having a third circle C3 and a fourth circle C4 as its bases, the third circle C3 situated at the middle position X_m between the front and rear ends 6f and 6a of each of the roots of the fins 6A to 6E and having a diameter D_3 that is 2.0, or preferably, 1.8 times as large as the reference diameter D_s , the fourth circle C4 situated at a position X_e of the rearmost end of each of the fins 6A to 6E and having a diameter D_4 that is 1.5, or preferably, 1.3 times as large as the reference diameter D_s .

[0032]

Note that the wording, "at the middle position X_m ," means "to include the middle position X_m and also to be in the plane of the fin that is perpendicular to a segment line connecting the front and rear ends 6f and 6a of each of the roots of the fins 6A to 6E." Also, the wording, "at the position X_e of the rearmost end" means "to include the position X_e of the rearmost end and to be in the plane of the fin that is perpendicular to a segment line connecting the front and rear ends 6f and 6a of each of the roots of the fins 6A to 6E."

[0033]

There are naturally limitations on the lengths of the fins 6A to 6E due to the fact that the front end 6f and the rear end 6a of the root of each of these fins 6A to 6E need to be disposed on the propeller boss cap 5A and also due to the mounting angle of each of the fins 6A to 6E with respect to the rotation center line of the propeller boss cap 5A. For example, the front edges of the fins 6A to 6E are at the same positions as or behind the rear edges of the roots of the propeller blades 3 in the

front-rear direction of the propeller 2.

[0034]

In addition, mounting angles α of the fins 6A to 6E are similar to those in the prior art as shown in Fig. 18. Specifically, relative to the geometric pitch angles ε of the roots of the propeller blades 3, the fins 6A to 6E are so mounted as to satisfy the relationship, " $(-20^\circ \leq \alpha - \varepsilon \leq +30^\circ)$." Also, the fins 6A to 6E are each provided at a position of a space between the roots of the corresponding pair of adjacent propeller blades 3. As the mounting angles of the fins 6A to 6E, a rake angle γ as shown in Figs. 19 and 20 may be given as in the case of the fin-equipped propeller boss cap 5 of the prior art. Fig. 20 is showing a case where the fins 6A to 6E are mounted at a rake angle γ of 0° and also cases where they are mounted at a positive angle $(+\gamma)$ and a negative rake angle $(-\gamma)$.

[0035]

With the above limitations, the shapes of the fins 6A to 6E are such that the rear halves of the fins 6A to 6E fall into shaded areas as shown in Figs. 5 to 14.

[0036]

Each fin 6A shown in Figs. 5 and 6 is characterized in that: an amount of projection L_f of the frontmost end is larger than zero; a position X_s of the front end is slightly forward of the front end $6f$ of the root; and a position X_e of the rearmost end coincides with the rear end $6a$ of the root. Fig. 5 is a schematic view of the fin 6A seen from a lateral side of the ship's body, whereas Fig. 6 shows a schematic lateral projection view in a case where the propeller boss cap 5A and the fin 6A are rotated about the propeller rotation axis. A line L_{xm} is depicted as a line being located at the middle position X_m

between the front and rear ends 6f and 6a of the root of the fin 6A, and being situated in the plane of the fin that is perpendicular to the line of the root.

[0037]

Each fin 6B shown in Figs. 7 and 8 is characterized in that: an outermost portion is located considerably forward of the front end 6f of the root; and the position Xe of the rearmost end coincides with the rear end 6a of the root. Fig. 7 is a schematic view of the fin 6B seen from a lateral side of the ship's body, whereas Fig. 8 shows a schematic lateral projection view in a case where the propeller boss cap 5A and the fin 6B are rotated about the propeller rotation axis.

[0038]

Each fin 6C shown in Figs. 9 and 10 is characterized in that: the outermost portion is located slightly forward of the front end 6f of the root; and the position Xe of the rearmost end coincides with the rear end 6a of the root. Fig. 9 is a schematic view of the fin 6C seen from a lateral side of the ship's body, whereas Fig. 10 shows a schematic lateral projection view in a case where the propeller boss cap 5A and the fin 6C are rotated about the propeller rotation axis.

[0039]

Each fin 6D shown in Figs. 11 and 12 is characterized in that: an amount of projection Lf of the frontmost end is zero; a position Xs of the front end coincides with the front end 6f of the root; and the position Xe of the rearmost end is rearward of the rear end 6a of the root. Fig. 11 is a schematic view of the fin 6D seen from a lateral side of the ship's body, whereas Fig. 12 shows a schematic lateral projection view in a case where the propeller boss cap 5A and the fin 6D are rotated about the

propeller rotation axis.

[0040]

Each fin 6E shown in Figs. 13 and 14 is characterized in that: an amount of projection L_f of the frontmost end is zero; the position X_s of the front end coincides with the front end 6f of the root; an amount of projection L_e of the rearmost end is zero; and the position X_e of the rear end coincides with the rear end 6a of the root. Fig. 13 is a schematic view of the fin 6E seen from a lateral side of the ship's body, whereas Fig. 14 shows a schematic lateral projection view in a case where the propeller boss cap 5A and the fin 6E are rotated about the propeller rotation axis.

[0041]

Also, as to the thickness direction of the fins 6A to 6E, a flat plate with an even thickness facilitates the machining thereof. However, if performance improvement is to be pursued even slightly, the fins 6A to 6E may be formed into a blade shape. In addition, a flat plate may be bent to have a camber, or a blade-shaped fin with a camber may be provided. If a camber is to be given, the root of each of the fins 6A to 6E should preferably be given a camber in a direction different from the camber of each propeller blade 3 in consideration of the relationship with the shape of the propeller boss cap 5 so that a torque Q_f can be generated in a direction opposite to a torque Q_p generated by the propeller blade 3.

[0042]

According to the above-described ship propulsion devices 1A to 1E, the fins 6A to 6E are formed into such shapes that rear edge sides of their rear halves are cut off. Accordingly, resistances of the fins 6A to 6E are reduced while maintaining

fin effects on contractions behind the propellers, so that the propeller efficiency is increased. In addition, the fins 6A to 6E are made smaller than prior-art fins, thereby facilitating the machining of the fins 6A to 6E. The smaller sizes in turn allow the fins 6A to 6E to be lighter accordingly.

[0043]

Moreover, the present invention is applicable to a case where fins are provided to portions on a propeller boss which are behind propeller blades. If fins are to be provided to the portions behind propeller blades, the reference diameter is set as the diameter defined by the rear ends of the roots of the propeller blades on the propeller boss. In the case where the fins 6A to 6E are to be mounted on the boss cap 5, the front edge of each fin 6 coincides with the rear edge of the root of the propeller blade 3 or is behind the rear edge ($b \geq 0$) in the propeller front-rear direction due to a physical limitation that the cap is installed behind the propeller. In the case where the fins 6 are to be provided to portions on a propeller boss 2 which are rear of propeller blades 3, the front end of each fin 6 may be disposed between the adjacent propeller blades. In this case, b may be a negative value, and preferably satisfy $-0.5 \times D_{cf} < b < 0$. With such a configuration, the propeller boss can be made as short as possible and therefore become lighter.

[0044]

A ship including the ship propulsion device of the present invention is designed to include any of the aforementioned ship propulsion devices 1A to 1E. Using any of the ship propulsion devices 1A to 1E, the ship can improve its propulsion efficiency. In addition, though only a small amount, the propulsion devices

1A to 1E are made lighter, and therefore a propeller shaft and a support structure for the propeller shaft can be made lighter accordingly.

INDUSTRIAL APPLICABILITY

[0045]

In the ship propulsion device of the present invention, each fin is formed into such a shape that a rear edge side of its rear half is cut off. Accordingly, a resistance of the fin is reduced while maintaining a fin effect on a contraction behind the propeller, so that the propeller efficiency is increased. Moreover, the fin is made smaller than prior-art fins, thereby facilitating the machining of the fin. The smaller size in turn allows the fin to be lighter accordingly. For this reason, the ship propulsion device can be utilized as a ship propulsion device.

[0046]

In addition, a ship including the ship propulsion device of the present invention can achieve improvement in propulsion efficiency and thus fuel consumption. Moreover, the ship can achieve weight reduction of its propulsion device and thus weight reduction of a propeller shaft and of a support structure of the propeller shaft. For this reason, the ship can be utilized as various types of ships.

EXPLANATION OF REFERENCE NUMERALS

[0047]

- 1, 1A, 1B, 1C, 1D, 1E ship propulsion device
- 2 propeller boss
- 2a rear end surface of propeller boss
- 3 propeller blade
- 4 propeller rotation axis

5, 5A propeller boss cap
 5a rear end portion of propeller boss cap
 5b outer circumferential surface of propeller boss cap
 5f front end portion of propeller boss cap
 6, 6A, 6B, 6C, 6D, 6E fin
 6a rear end of root of fin
 6f front end of root of fin
 a distance from front end of fin to propeller blade in rotation direction
 b distance from rear end of propeller blade to front end of fin in propeller front-rear direction
 C1 first circle
 C2 second circle
 C3 third circle
 C4 fourth circle
 Dca diameter of rear end portion of propeller boss cap
 Dcf diameter of front end portion of propeller boss cap
 Dp diameter of propeller
 Ds reference diameter
 D1 diameter of first circle
 D2 diameter of second circle
 D3 diameter of third circle
 D4 diameter of fourth circle
 Lc length of propeller boss cap
 Le horizontal distance from rear end of root of fin to rearmost end of fin regarding outline of fin
 Lf horizontal distance from front end of root of fin to frontmost end of fin regarding outline of fin
 Lfmax maximum value of Lf
 Lxm line being located at middle position between front and

rear ends of root of fin and being situated in plane of fin perpendicular to line of root

Xs position of frontmost end of fin

Xm middle position between front and rear ends of root of fin

Xe position of rearmost end of fin

α mounting angle of fin

ε geometric pitch angle of root of propeller blade

γ mounting rake angle of fin

CLAIMS

[Claim 1]

A ship propulsion device in which a fin is provided to a propeller boss cap mounted on a rear side of a propeller boss of a screw propeller and the fin is disposed between but behind propeller blades, characterized in that

a diameter of a front end portion of the propeller boss cap is set as a reference diameter, and

a rear half of the fin is formed into such a shape as to fall into a circular truncated cone having, as its bases, a circle that is situated at a middle position between a front end and a rear end of a root of the fin, that has a diameter 2.0 times as large as the reference diameter, and that is centered on a rotation center of the propeller, and a circle that is situated at a position of a rearmost end of the fin, that has a diameter 1.5 times as large as the reference diameter, and that is centered on the rotation center of the propeller.

[Claim 2]

The ship propulsion device according to claim 1, characterized in that

instead of providing the fin to the propeller boss cap, the fin is provided to each of portions on the propeller boss of the screw propeller which are behind the propeller blades, and

the reference diameter is set as a diameter defined by a rear end of a root of each of the propeller blades on the propeller boss.

[Claim 3]

The ship propulsion device according to claim 1, characterized in that

a front half of the fin is formed into such a shape that
a distance from the front end of the root of the
fin to a frontmost end of the fin in a direction along which
the front and rear ends of the root are connected is set to be
0.0 to 0.3 times as large as the reference diameter,

a diameter of a circle passing over an outermost
portion of the fin is set to be 1.0 to 2.5 times as large as
the reference diameter, and

a diameter of a circle passing over an outermost
portion of the fin at the middle position of the fin is set to
be 1.0 to 2.0 times as large as the reference diameter.

[Claim 4]

A ship characterized by comprising the ship propulsion
device according to any one of claims 1, 2 and 3.