

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 propeller 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 a blade, 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 a hub vortex in a slip stream of the propeller boss cap 5 near a propeller boss 2, as shown in Figs. 12 to 15.

[0004]

In this rectification-fin-equipped boss cap 5, the number of fins 6 (four in Fig. 12) mounted on the boss cap 5 is made

equal to the number of propeller blades 3 (four in Fig. 12). Moreover, as shown in Fig. 15, with respect to a geometric pitch angle  $\varepsilon$  of the roots of the propeller blades 3, an angle  $\alpha$  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. 13 and 14, 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 which are 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 (propeller boss). 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]

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

PRIOR ART DOCUMENT

PATENT DOCUMENTS

[0008]

Patent Document 1: Japanese Patent Application Kokoku Publication No. Hei 7-121716

Patent Document 2: Japanese Patent No. 3491890

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0009]

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 propeller

efficiency, a better workability, and less weight than a ship propulsion device using a propeller boss cap equipped with prior-art fin and a ship provided with the ship propulsion device.

#### MEANS FOR SOLVING THE PROBLEM

[0010]

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 rear end portion of the propeller boss cap is formed as a flat surface, or the rear end portion of the propeller boss cap is formed into such a shape as to extend from a periphery thereof by a distance not greater than 20% of an entire length of the propeller boss cap, the entire length of the propeller boss cap is set to be 0.28 to 0.76 times as large as a diameter of a cap front end portion, and a diameter of the cap rear end portion of the propeller boss cap is set to be 0.35 to 0.95 times as large as the diameter of the cap front end portion.

[0011]

The propulsion efficiency of the propeller is good when the entire length of the propeller boss cap is 0.28 to 0.76 times, preferably 0.34 to 0.68 times, and most preferably 0.50 times as large as the diameter of the cap front end portion, and also when the diameter of the cap rear end portion is 0.35 to 0.95 times, preferably 0.42 to 0.85 times, and most preferably 0.65 times as large as the diameter of the cap front end portion. Using this configuration, the cap main body of the propeller boss cap can be formed into an optimum shape, whereby the

propeller efficiency can be improved. In addition, since the rear end portion of the propeller boss cap is formed as a flat surface, the workability of the propeller boss cap can be improved. Moreover, since the rotor tapering toward its rear end has no pointed tip, weight reduction can be achieved accordingly.

[0012]

In the ship propulsion device to achieve the above object, according to the ship propulsion device in which a fin is provided to a portion, on a propeller boss of a screw propeller, which is behind each of propeller blades and the fin is disposed between but behind the propeller blades, a rear end portion of the propeller boss cap is formed as a flat surface, or the rear end portion of the propeller boss cap is formed into such a shape as to extend from a periphery thereof by a distance not greater than 20% of an entire length of the propeller boss cap, a distance from a front end of a root of the fin to a rear end of the root of the fin is set to be 0.28 to 0.76 times as large as the diameter of the propeller boss at a position of the rear end of each of the propeller blades, and a diameter behind the root of the fin is set to be 0.35 to 0.95 times as large as the diameter of the propeller boss at the position of the rear end of each of the propeller blades. This configuration enables obtaining the same effects as described above.

[0013]

In addition, according to the ship propulsion device, the propeller boss cap is formed as a rotor using a rotation axis of the propeller as its rotation axis, and each generating line of the rotor is a linear line so that the propeller boss cap is formed into a shape of a circular truncated cone. Using this

configuration, the propeller boss cap is formed into a simple shape, whereby the workability can be improved and the manufacturing cost can be reduced.

[0014]

The ship for achieving the above object is designed to include the above ship propulsion device. Accordingly, the propulsion efficiency can be improved.

#### EFFECTS OF THE INVENTION

[0015]

According to the ship propulsion device of the present invention, in a propulsion device formed of a screw propeller using a fin-equipped propeller boss cap, the cap main body of the propeller boss cap is formed into an optimum shape, whereby the propeller efficiency can be improved. In addition, since a rear end portion of the propeller boss cap is formed as a flat surface, the workability of the propeller boss cap can be improved. Moreover, since the rotor tapering toward its rear end has no pointed tip, weight reduction can be achieved accordingly.

[0016]

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. 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

[0017]

[Fig. 1] Fig. 1 is a view showing the configuration of a ship

propulsion device according to an embodiment 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 schematic side view showing a propeller boss cap having a trapezoidal side cross-sectional shape.

[Fig. 4] Fig. 4 is a schematic side view showing a propeller boss cap having a gently-curved side cross-sectional shape.

[Fig. 5] Fig. 5 is a graph showing the relationship between "cap length/cap front end portion diameter" and "increase rate of propeller efficiency" in the case of the ship propulsion device.

[Fig. 6] Fig. 6 is a graph showing the relationship between "cap rear end portion diameter/cap front end portion diameter" and "increase rate of propeller efficiency" in the case of the ship propulsion device.

[Fig. 7] Fig. 7 is a diagram showing the arrangement of the root of a propeller blade on a surface of a propeller boss.

[Fig. 8] Fig. 8 is a diagram showing the arrangement of the root of a fin on a surface of the propeller boss cap having trapezoidal cross-sectional shape and on a surface of a prior-art propeller boss cap.

[Fig. 9] Fig. 9 is a diagram showing the arrangement of the root of a fin on a surface of a propeller boss cap having a cylindrical shape and on a surface of a propeller boss cap having an expanding shape.

[Fig. 10] Fig. 10 is a schematic side view showing a cylindrical propeller boss cap.

[Fig. 11] Fig. 11 is a schematic side view showing a propeller boss cap having an expanding shape.

[Fig. 12] Fig. 12 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. 13] Fig. 13 is a side view of the ship propulsion device in Fig. 12.

[Fig. 14] Fig. 14 is a side view showing the shape of a propeller boss cap according to a prior art.

[Fig. 15] Fig. 15 is side view showing the positional relationship between each propeller blade and its corresponding fin according to the prior art.

[Fig. 16] Fig. 16 is a side view showing the mounting angle of the fin.

[Fig. 17] Fig. 17 is a cross-sectional view showing the rake angle of the fin, taken along the A-A line of Fig. 16, and seen from the rear side.

#### BEST MODES FOR CARRYING OUT THE INVENTION

[0018]

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. Note that Figs. 1 to 4 and 10 to 17 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, 4, 10, 11 and 14 to 17, 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.

[0019]

As shown in Figs. 1 and 2, a ship propulsion device 1A

of an embodiment 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 fins 6 provided to the propeller boss cap 5A.

[0020]

The fins 6 are provided to the propeller boss cap 5A mounted on the rear side of the propeller boss 2 of the screw propeller 1A. The fins 6 are arranged between but behind the propeller blades 3. That is, when viewed from the rear side along a propeller axis  $P_c$ , the front end of the root of each fin 6 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 of the root of the fin 6 is disposed behind the rear end of the root of each propeller blade 3. The fin 6 may be formed to have a positive or negative camber, but a flat-plate shape is the most suitable for the sake of simplicity in machining thereof and reduction in manufacturing cost. Moreover, the fin 6 may be mounted at a positive or negative rake angle. For the shape and arrangement of the fin 6, a well-known technique is used.

[0021]

In this embodiment, the propeller boss cap 5A is formed as follows. Firstly, the propeller boss cap 5A is formed as a rotor using the propeller rotation axis  $P_c$  as its rotation axis. This rotor is such that its lateral surface 5b is formed of the rotor's generating lines which are gently curved or linear lines. In addition, the rotor is formed into a shape tapering toward the rear side. Moreover, a rear end portion 5a of the propeller boss cap 5A is formed as a flat surface.

If the rotor's generating lines, which form the outer circumferential surface 5b of the propeller boss cap 5A, are each 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.

[0022]

Alternatively, even if the rotor's generating lines are each a gently-curved line as shown in Fig. 4, the propeller boss cap 5A is also 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 propeller boss cap 5A is such that the deviation from the shape of the circular truncated cone stays within a range from 0% to 20% inclusive.

[0023]

Specifically, the propeller boss cap 5A is formed smaller than an area defined by line segments L1 each connecting a point on 1.2 Dcf at a front end portion 5f and a point on 1.2 Dca at the rear end portion 5a, but larger than an area defined by line segments L2 each connecting a point on 1.0 Dcf at the front end portion 5f and a point on 1.0 Dca at the rear end portion 5a. To put it differently, the propeller boss cap 5A is formed inside a circular truncated cone defined by the 1.2 Dcf at the front end portion 5f and the 1.2 Dca at the rear end portion 5a, but outside a circular truncated cone defined by the 1.0 Dcf at the front end portion 5f and the 1.0 Dca at the rear end portion 5a. That is, the propeller boss cap 5A is formed to have an outline that falls into a shaded area in Fig. 4. Further, the rear end portion 5a of the propeller boss cap 5A is formed as a flat surface.

[0024]

In addition, an entire length  $L_c$  of the propeller boss cap 5A is set to be 0.28 to 0.76 times, preferably 0.34 to 0.68 times, and most preferably 0.50 times as large as the diameter  $D_{cf}$  of the cap front end portion. Moreover, the diameter  $D_{ca}$  of the rear end portion 5a of the propeller boss cap 5A is set to be 0.35 to 0.95 times, preferably 0.42 to 0.85 times, and most preferably 0.65 times as large as the diameter  $D_{cf}$  of the front end portion 5f of the propeller boss cap 5A. Note that the diameter  $D_{cf}$  of the front end portion 5f is equivalent to the diameter of a flange of the cap.

[0025]

As shown in Figs. 3 and 4, 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, an 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 as shown in Fig. 4. Even in such a case, a distance  $L_{ca}$  from a periphery 5ao of the rear end portion 5a to a center 5ac thereof in the front-rear direction should be not greater than 20% of the entire length  $L_c$  of the propeller boss cap 5A.

[0026]

Next, in the present invention, the entire length  $L_c$  of the propeller boss cap 5A is set to be 0.28 to 0.76 times, preferably 0.34 to 0.68 times, and most preferably 0.50 times as large as the diameter  $D_{cf}$  of the cap front end portion, and this configuration will be described below.

[0027]

Fig. 5 shows results of tank experiments conducted on propellers with different cap lengths (entire lengths of propeller boss caps)  $L_c$ . The horizontal axis indicates "cap length/cap front end portion diameter ( $L_c/D_{cf}$ )" while the vertical axis indicates the increase rate of propeller efficiency.

[0028]

A control propeller boss cap 5A with no increase rate is formed as a normal rotor tapering toward its rear end so that the diameter diminishes gradually and reaches zero at the rearmost end.  $L_c/D_{cf}$  for the control propeller boss cap 5A is 0.80. With this set as a control increase rate (zero increase rate), Fig. 5 shows increase rates of the propeller efficiency regarding cases of mounting propeller boss caps 5A of the shape in Fig. 3, i.e., a circular cone with the truncated end surface of its rear end portion being formed as a flat surface. Note that fins 6 mounted on these propeller boss caps 5A are each formed into a flat-plate shape, and change in "cap length/cap front end portion diameter ( $L_c/D_{cf}$ )" allows the fin 6 to have a length proportional to the changed length of the cap.

[0029]

As is clear from Fig. 5, from the results of experiments using a propeller advance ratio  $J$  ( $= V/nD_p$ , where  $V$  is the advance speed,  $n$  is the number of propeller revolutions, and  $D_p$  is the diameter of the propeller) as the propeller advance ratio at a propeller design point, the increase rate is found to be 1.4% with the  $L_c/D_{cf}$  being 0.28 to 0.76, 1.8% with the  $L_c/D_{cf}$  being 0.34 to 0.68, and largest with the  $L_c/D_{cf}$  being 0.50. Based on these experimental results, the ratio  $L_c/D_{cf}$  is set within a range Z1 from 0.28 to 0.76 in the present invention.

[0030]

Next, the diameter  $D_{ca}$  of the rear end portion 5a of the propeller boss cap 5A is set to be 0.35 to 0.95 times, preferably 0.42 to 0.85 times, and most preferably 0.65 times as large as the diameter  $D_{cf}$  of the front end portion 5f, and this configuration will be described below.

[0031]

Fig. 6 shows results of experiments conducted using differently-shaped propeller boss caps 5A obtained by changing the diameter  $D_{ca}$  of the rear end portion 5a of the propeller boss cap 5A, with the cap length  $L_c$  maintaining a fixed ratio of  $L_c/D_{cf} = 0.71$ . The horizontal axis indicates "cap rear end portion diameter/cap front end portion diameter ( $D_{ca}/D_{cf}$ )" while the vertical axis indicates the increase rate of propeller efficiency.

[0032]

Fig. 6 shows that the shape of the propeller boss cap 5A is desirable when the diameter  $D_{ca}$  of the rear end portion 5a is smaller than the diameter  $D_{cf}$  of the front end portion and that there exists an optimum range as well for the ratio  $D_{ca}/D_{cf}$ . Specifically, from the results of experiments using the propeller advance ratio  $J$  as the propeller advance ratio at the propeller design point, the increase rate is found to be 1.0% with the  $D_{ca}/D_{cf}$  being 0.35 to 0.95, 1.2% with the  $D_{ca}/D_{cf}$  being 0.42 to 0.85, and largest, or 1.5%, with the  $D_{ca}/D_{cf}$  being 0.65. Based on these experimental results, the ratio  $D_{ca}/D_{cf}$  is set within a range  $Z_2$  from 0.35 to 0.95 in the present invention.

[0033]

Meanwhile, to study the influence of the fins 6 on the propeller characteristics, forces exerting on the fins 6 were

measured through an experiment. It was found that relative to a thrust force  $T_p$  and a torque  $Q_p$  exerted on the propeller blades 3, a thrust force  $T_f$  exerted on the fins 6 and the propeller boss cap 5A and also a small torque  $Q_f$  exerted on the fins 6, and that the entire thrust force  $T_t$  and torque  $Q_t$  showed improvements.

[0034]

Further, from a CFD (Computational Fluid Dynamics) calculation, it was found that, as a result of diffusion of hub vortexes and a raise in a static pressure behind the propeller boss cap 5A, the static pressure worked as a force pushing the end surface of the rear end portion 5a of the propeller boss cap 5A, helping improve the thrust force  $T_t$  as a whole. From the above finding, it is understood that the propeller boss cap 5A helps improve the thrust force  $T_t$  as a whole, as long as the end surface of the rear end portion 5a thereof is a flat shape or even a nearly flat shape.

[0035]

Now, consider the relationship between the shape of the propeller boss cap 5A and the propeller efficiency. A flow passing through the propeller blades 3 undergoes a contraction and moves rearward. This implies that, at a portion where the propeller boss cap 5A is located, the flow direction is not oriented along a cylindrical plane, which is the same as, i.e., parallel to the propeller axis  $P_c$ ; instead, the flow direction is so oriented that a flow moving rearward beyond a cap flange 2a becomes smaller gradually toward the propeller rotation axis  $P_c$ . Thus, a flow moving along the lateral surface 5b of the propeller boss cap 5A is subjected to the influence of that flow. Accordingly, it is suitable to form the lateral surface 5b of

the propeller boss cap 5A into such a shape that the diameter of the lateral surface 5b becomes smaller and smaller toward the rear end in parallel to the contraction.

[0036]

Consider also the mounting angle ( $\alpha$  in Fig. 15) and camber of the fin 6. Fig. 7 shows the blade shape and camber of the root of each propeller blade 3. For comparison with this, Fig. 8 shows the expanded shape of a trapezoidal cap and the shape of the root of each fin 6 on the surfaces of propeller boss caps 5A. A (circles) shows a case where a flat-plate-shaped fin 6 is mounted on a propeller boss cap 5A having a trapezoidal side cross-sectional shape as shown in Fig. 3. In addition, B (diamonds) shows a case where the fin 6 is mounted on a prior-art propeller boss cap 5A as shown in Fig. 14.

[0037]

See the shapes of the root of the fin 6 on the expanded diagram where the surfaces of the propeller boss caps 5A are expanded. On the expanded diagram shown in Fig. 8, the cambers in both cases A and B are given in an opposite direction to the blade camber of the root of the propeller blade 3 shown in Fig. 7. Note that a line  $\epsilon$  in Fig. 7 is a line showing the pitch angle ( $\epsilon$  in Fig. 15) of the propeller blade 3 at its root.

[0038]

A line  $\alpha$  in Fig. 8 is a line showing the mounting angle ( $\alpha$  in Fig. 15) of the fin 6. The shape of the root of the fin 6 is such that the most part of the root is on this line  $\alpha$  in Fig. 8. In a propeller slip stream, a flow over the fin surface moves along the line. As shown in Fig. 8, from the line  $\alpha$ , the flow along the fin 6 moves along the camber which is opposite to that of the propeller blade 3. In this case, the torque  $Q_f$

generated by the fin 6 is an opposite torque to the torque  $Q_p$  generated by the propeller blade 3. Thus, the torque  $Q_f$  is generated in a direction to cancel the torque  $Q_p$ .

[0039]

Meanwhile, the fin 6 generates a propulsive force in an opposite direction to the thrust force  $T_p$  generated by the propeller blade 3. The fin 6, however, diffuses hub vortexes to thereby raise a static pressure behind the cap. The static pressure then serves as a force pushing the end surface of the cap end portion 5a. As a result, the thrust force  $T_f$  generated by the cap 5A and the fin 6 acts in the direction of the thrust force  $T_p$  generated by the propeller blade 3 and brings about an improvement in propeller efficiency.

[0040]

In an expanded diagram shown in Fig. 9, C (circles) indicates a case of a propeller boss cap 5C having a cylindrical shape as shown in Fig. 10, and D (diamonds) indicates a case of a propeller boss cap 5D having an expanding shape expanding toward the rear end as shown in Fig. 11. As shown in Fig. 9, in these cases C and D, the pitch angles are larger than the line  $\alpha$ , and therefore the shapes are given cambers in the same direction as that of the propeller blade 3. In these cases, the fin 6 generates the torque  $Q_f$  in the same direction as the torque  $Q_p$  generated by the propeller blade 3, i.e., in a direction to increase the torque  $Q_t$  as a whole. Thus, the contribution to the improvement in propeller efficiency is small.

[0041]

As described above, it is understood that even if the mounting angle of the fin 6 is the same, the shape of the

propeller boss cap 5A influences the flow on the surface of the propeller boss cap 5A relative to the root of the fin 6.

[0042]

As the mounting angle of the fin 6, a rake angle  $\gamma$  as shown in Figs. 16 and 17 may be given as in the case of the fin-equipped propeller boss cap of the prior art. Fig. 17 is showing a case where the fin 6 is mounted at a rake angle  $\gamma$  of  $0^\circ$  and also cases where it is mounted at a positive angle  $(+\gamma)$  and a negative angle  $(-\gamma)$ .

[0043]

A ship including the ship propulsion device of the present invention is designed to include the aforementioned ship propulsion device 1A. Using the ship propulsion device 1A, the ship can improve its propulsion efficiency. In addition, though only a small amount, the propulsion device 1A is made lighter, and therefore a propeller shaft and a support structure for the propeller shaft can be made lighter accordingly.

#### INDUSTRIAL APPLICABILITY

[0044]

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 ship propulsion device is capable of improving the propeller efficiency, and also has a fine workability and a light weight. For this reason, the device can be utilized as a ship propulsion device.

[0045]

In addition, a ship including the ship propulsion device of the present invention can achieve improvement in propulsion efficiency. 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

[0046]

1, 1A ship propulsion device  
2 propeller boss  
2a rear end surface of propeller boss  
3 propeller blade  
4 propeller rotation axis  
5, 5A, 5C, 5D propeller boss cap  
5a rear end portion of propeller boss cap  
5ao periphery of rear end portion  
5ac center of rear end portion  
5b outer circumferential surface of propeller boss cap  
5f front end portion  
6 fin  
Dba diameter of cap mounting end portion of propeller boss  
Dca diameter of rear end portion of propeller boss cap  
Dcf diameter of front end portion of propeller boss cap  
Dp diameter of propeller  
Lc entire length of propeller boss cap (cap length)  
Lca distance from periphery to center of rear end portion in front-rear direction  
Pc propeller axis  
Qf torque generated by fin  
Qp torque generated by propeller blade  
Qt torque generated by propulsion device  
Tf thrust force generated by fin and cap  
Tp thrust force generated by propeller blade

$T_t$      thrust force generated by propulsion device  
 $\alpha$      mounting angle of fin  
 $\gamma$      mounting rake angle of fin  
 $\varepsilon$      pitch angle of root of propeller blade

## 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 rear end portion of the propeller boss cap is formed as a flat surface, or the rear end portion of the propeller boss cap is formed into such a shape as to extend from a periphery thereof by a distance not greater than 20% of an entire length of the propeller boss cap,

the entire length of the propeller boss cap is set to be 0.28 to 0.76 times as large as a diameter of a cap front end portion of the propeller boss cap, and

a diameter of the cap rear end portion of the propeller boss cap is set to be 0.35 to 0.95 times as large as the diameter of the cap front end portion.

### [Claim 2]

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

a rear end portion of the propeller boss cap is formed as a flat surface, or the rear end portion of the propeller boss cap is formed into such a shape as to extend from a periphery thereof by a distance not greater than 20% of an entire length of the propeller boss cap,

a distance from a front end of a root of the fin to a rear end of the root of the fin is set to be 0.28 to 0.76 times as large as the diameter of the propeller boss at a position of

the rear end of each of the propeller blades, and

a diameter behind the root of the fin is set to be 0.35 to 0.95 times as large as the diameter of the propeller boss at the position of the rear end of each of the propeller blades.

[Claim 3]

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

the propeller boss cap is formed as a rotor using a rotation axis of the propeller as its rotation axis, and

each generating line of the rotor is a linear line so that the propeller boss cap is formed into a shape of a circular truncated cone.

[Claim 4]

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