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(54) **Method for reducing wake making resistance at transom stern and transom stern form**

Verfahren zur Verringerung des in Heck entstanden Wellenwiderstands und Heckform

Procédé pour la réduction de la résistance à formation de vagues et forme du tableau d'arrière

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• **SCHMIDT W: "SPEZIELLE SCHIFFBAULICHE**
STRUKTUREN AM BEISPIEL DES FAST
MONOHULL" SCHIFF UND HAFEN, SEEHAFEN-
VERLAG ERIK BLUMENFELD. HAMBURG, DE,
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Description

Field of the Invention

[0001] The present invention relates to a transom stern structure capable of reducing the stern wave making resistance of conventional ships having a transom stern (displacement ships that voyage at a design speed substantially corresponding to a Froude's number (Fn) of 0.2 - 0.4). Referring to Fig. 12(b), a transom stern is a stern having a substantially vertical rearmost end face (stern end) 5. Fig. 12(a) shows a cruiser stern. Herein, the Fn is expressed as:

$$Fn = V/\sqrt{L_{WL} g}$$
, where V is ship speed (m/s), L_{WL} is waterline length on design draught (m), and g is the acceleration of gravity (m/s²). Here, the "waterline" means horizontal line parallel to the base line.

Description of the Related Art

[0002] Conventionally, there have been many examples of lightweight aluminium alloy constructed high speed craft or the like ($Fn \geq 0.4$), which have a movable plate (trim tab) protruding from the stern end or a wedge provided on the stern bottom in order to reduce resistance and motion of the craft (for example, see Japanese Laid-Open Patent Publication No. Hei. 9-52591 or Japanese Laid-Open Patent Publication No. Sho. 62-8891).

[0003] Because of its small displacement and high speed, the high speed craft is capable of greatly lifting the stern end by a lift generated by the trim tab and the wedge provided at the stern end. In the high speed craft, since the deeper transom immersion is, the larger the stern wave making resistance is, the stern wave making resistance could be reduced by lifting the stern end by the lift generated by the trim tab or the wedge.

[0004] However, in a so-called conventional ship, i.e., the displacement ship that voyages at a design speed substantially corresponding to a Fn of 0.2-0.4, since the ship speed is relatively low and the displacement is large as compared to the high speed craft, it is difficult to greatly lift the stern by means of a trim tab or wedge and, therefore, its running condition is hardly changed by these means. So, it has been considered that stern wave making cannot be reduced in this ship.

[0005] In addition, since the stern end of the high speed craft has a substantially rectangular cross section, a trim tab or wedge of two-dimensional shape can be mounted relatively easily, whereas since a stern end of the conventional ship has a convexly curved cross section, the mounting of the two-dimensional parts creates a discontinuity, which increases resistance. In the conventional displacement ship which has a transom stern and voyages at a design speed corresponding substantially to Fn of 0.2 - 0.4, the stern wave generated by the transom stern end is increased, and a wave crest of the stern wave sometimes causes disturbed surface, thereby producing dead water around the stern transom part. When

these phenomena are seen from the view point of propulsive performance, the stern wave with disturbed surface produces a large stern wave making resistance, causing the horse power requirement and fuel oil consumption (FOC) to be significantly increased. Under the circumstances, reduction of the stern wave has been a challenge to naval architects.

[0006] DE-A-3808859 discloses a displacement ship having a transom stern and a longitudinal hull centre line profile defining an inflection point, with a portion of the hull forward of said inflection point sloping upwardly to said inflection point. The inflection point is positioned substantially above the ship's propellers to allow clearance for the use of larger propellers and provide increased clearance above the propellers in order to enhance propeller efficiency and prevent vibration due to surface forces caused by rotation of the propellers.

SUMMARY OF THE INVENTION

[0007] The invention provides a method of reducing the wave making resistance of a displacement ship having a transom stern and a design speed corresponding substantially to a Froude Number of 0.2 to 0.4, the method comprising providing the hull of said ship with a longitudinal centre line profile having an inflection point at a longitudinal distance of 0.1 to 10% Lpp (length between perpendiculars) from the stern end of the ship, with the portion of the hull profile forward of said inflection point sloping upwardly to said inflection point and the portion of the hull profile rearward of the inflection point being horizontal or sloping downwardly, and positioning the lower end of the stern end relative to the design draught such that the ratio γ of the distance between the base line at the hull centre line and said lower end and the distance between said base line and the design draught at the hull centre line is 0.95 to 1.2 such that, in use, a first flow condition is generated forward of said inflection point and a second flow condition is generated between said inflection point and said stern end to provide accelerated flow rearwardly of said inflection point.

[0008] The hull centre line profile between said stern end and said inflection point may be provided by fitting an extension to the stern end of an existing ship.

[0009] The invention also includes a displacement ship having a transom stern and a longitudinal hull centre line profile defining an inflection point with a portion of the hull centre line profile forward of said inflection point sloping upwardly to said inflection point and the portion of the hull centre line profile rearwardly of the inflection point ceasing to slope upwardly, characterised in that the ship has a design speed corresponding substantially to a Froude Number of 0.2 to 0.4, in that the longitudinal distance between the stern end of the ship and said inflection point is 0.1 to 10% Lpp (length between perpendiculars) and in that the lower end of the stern end is positioned relative to the design draught such that the ratio γ of the distance between the base line at the hull centre line and

said lower end of the stern end and the distance between said base line and the design draught at the hull centre line is 0.95 to 1.2 such that, in use, a first flow condition is generated forward of said inflection point and a second flow condition is generated between said inflection point and said stern end to provide an accelerated flow rearwardly of said inflection point.

[0010] From the inflection point to the stern end, the longitudinal centre line profile may be flat or gently curved and a line connecting the inflection point to the lower end of the stern end may be horizontal or downwardly inclined with respect of the design load waterline such that an angle α made between said line and the design load waterline is 0 to 20 degrees.

[0011] The angle β at which tangential lines forward and rearward of the inflection point at the hull bottom may intersect at 140 to 180 degrees.

[0012] The distance of the lower end of the stern end from the base line may be constant, or increase, in the widthways direction of the hull on either side of the hull centreline.

[0013] The hull centre line profile between the stern end and the inflection point may be defined by an extension extending from the stern end of an existing ship.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] In order that the invention may be understood, some embodiments, which are given by way of example only, will be described with reference to the drawings, in which:

Figs. 1(a) - 1(b) are figures for explaining a technical principle of reduction of wave making resistance according to the present invention, wherein Fig. 1(a) shows the profile of a ship's stern and Fig. 1(b) shows the distribution of a relative pressure in flow field in the longitudinal direction between a ship having a conventional stern form and a ship having a stern form according to the present invention;

Figs. 2(a) - 2(c) show stern profiles;

Fig. 3(a) is a front view showing a stern part having a three-dimensional shape in which an angle of an arbitrary section of the stern part is equal to an angle α of the stern form sectioned parallel to a ship centreline, that is, the angle is fixed, and Fig. 3(b) is an explanatory figure showing change in the angle;

Fig. 4(a) is a front view showing a stern part having a three-dimensional shape in which an angle of an arbitrary section of the stern part is decreased with respect to the angle α in the breadth direction and the section of an inflection point conforms in shape to the stern end at a point, and Fig. 4(b) is an explanatory figure showing change in the angle;

Figs 5(a) is a front view showing a stern part having a three-dimensional shape in which an angle of an arbitrary section of the stern part is decreased with respect to the angle α in the breadth direction and

the angle is made on the opposite side from a point, and Fig. 5(b) is an explanatory figure showing change in the angle;

Fig. 6 is a view showing planar shapes of cross sections respectively taken along lines P1-P1, P2-P2, and P3-P3 of Fig. 3, Fig. 4, and Fig. 5;

Fig. 7 illustrates a stern profile showing a state in which an angle β at which tangential lines forward and rearward of the inflection point at the hull bottom intersect is set to 140 - 180 degrees;

Fig. 8 illustrates a stern profile showing a state in which a ratio γ (H_a/H_b) of a height H_a of a lower end of the stern end from a base line to a height H_b of a design draught is set to 0.95 - 1.2;

Figs. 9(a), (b) show embodiments of the present invention obtained by extending the stern end of an existing ship;

Fig. 10 shows the reduction effect of the stern wave making resistance coefficient according to the present invention based on a comparison with a conventional ship;

Fig. 11 shows a horse power reduction effect obtainable according to the present invention based on comparison with a conventional ship; and

Fig. 12(a) shows a cruiser stern form; Fig. 12(b) shows a transom stern; and Fig. 12(c) is a side view showing a conventional stern form of the transom stern of Fig. 12(b).

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] A ship according to the present invention is a so-called conventional displacement ship (a ship with Lpp more than 50m is suitable) which has a transom stern as shown in Fig. 12(b) and voyages at a design speed corresponding substantially to a Froude number (F_n) of 0.2 - 0.4. As mentioned previously, since such a ship generally has a relatively low speed and a large displacement as compared to the high speed craft, it is difficult to greatly lift the stern end thereof by the lift of the trim tab or the wedge.

[0016] Referring to Fig. 1(a), the shape of a hull bottom sectioned along the ship centre line has an inflection point 2 between 0.1 - 10% Lpp forward of the stern end 5 of the stern 1 ("Lpp" refers to length between perpendiculars). The bottom of the stern 1 has a forward hull portion 3 and a rearward hull portion 4. The forward hull portion 3 slopes gently up to the inflection point 2 and is gently curved or flat. The rearward hull portion 4 has a length sufficient to accelerate flow from the inflection point 2 to the stern end 5, i.e., a length of 0.1 - 10% Lpp forward of the stern end 5 and is horizontal or downwardly inclined from the inflection point 2 so as to generate a horizontal or downward flow. The lower end 5a of the stern end 5 is positioned in the vicinity of (on or above) the design draught. As should be understood from the later description, the "inflection point" refers to a shape changing point

at which the shape of the hull bottom of the stern part that is sectioned along the ship centre line is knuckle-shaped or knuckle-filletted to change the flow field at that point.

[0017] As can be seen from the graph of Fig. 1(b), with the above-described shape of hull bottom, the relative pressure in a region forward of the inflection point 2 is higher than that of a ship having the conventional stern form, and therefore, based on Bernoulli's theorem in which a sum of a static pressure and a dynamic pressure is constant, the region forward of the inflection point 2 has a flow velocity lower than that of the ship having the conventional stern form, while the pressure in a region from the inflection point 2 to the stern end 5 is lower than that of the ship having the conventional stern form and therefore, the region rearward of the inflection point 2 accelerates the flow.

[0018] In other words, the flow fields forward and rearward of the inflection point 2 differ from each other. In addition, since the lower end 5a of the stern end 5 is located in the vicinity of (on or above) the design draught, the accelerated flow prevents the stern wave. Besides, since the disturbed surface hardly occurs, the stern wave making resistance can be significantly reduced as a whole.

An angle β made between the forward hull portion 3 and the rearward hull portion 4 which are respectively located forwardly and rearwardly of the inflection point 2 is determined as mentioned later so that some increase in drag due to the downwardly inclined rear hull bottom does not negate the reduction effect of the stern wave making resistance.

[0019] Figs. 2(a) - 2(c) show stern profiles (hull side cross sections) sectioned along the ship centre line. The inflection point 2 is provided at a position L ($= 0.1 - 10\%L_{pp}$) forward of the stern end 5. The inflection point 2 shown in Fig. 2(a) is knuckle-shaped and the inflection point 2 shown in Fig. 2(b) is knuckle-filletted. The shape from the inflection point 2 to the stern end 5 is straight line as shown in Fig. 2(a), and the shape from the inflection point 2 to the stern end 5 is gently curved as shown in Fig. 2(c). When the shape is gently curved, it is a convex curve (as indicated by a solid line of Fig. 2(c)) or a concave curve (as indicated by an imaginary line of Fig. 2(c)).

[0020] Assuming that an angle made between a line (hull bottom line) connecting the inflection point 2 and the lower end 5a of the stern end 5 and the design load waterline DLWL is α , it is preferable that the hull bottom line is parallel to the design load waterline DLWL ($\alpha = 0$ degree), or downwardly inclined with respect to the design load waterline DLWL at an angle of 20 or less ($\alpha \leq 20$ degrees). By horizontally or downwardly flowing the accelerated water flowing from the stern end 5, the disturbed surface or the stern wave is reduced.

[0021] The reason why the inflection point 2 is provided at the position L ($0.1 - 10\% L_{pp}$) forward of the stern end 5 is, as described above, that some distance is needed

for sufficiently accelerating the slow flow forward of the inflection point 2 from the inflection point 2 to the stern end 5, so that the flow fields forward and rearward of the inflection point 2 differ from each other.

[0022] Figs. 3(a), 3(b) show a hull shape in which the angle α of longitudinal sections taken on either side of the hull centreline is equal to the angle α of the section along the ship centre line. That is, the angle α is fixed in the widthways direction of the hull. A dotted line shows the shape of the section at the inflection point 2 (cross section of the inflection point).

[0023] Figs. 4(a), 4(b) show a hull shape in which the angle α of longitudinal sections taken on either side of the hull centreline gradually decreases with respect to the angle α of the section along the centreline such that at respective points on either side of the centreline, the angle α is 0° and at those points, the respective longitudinally extending lines connecting the inflection point 2 to the stern end 5 are horizontal.

[0024] Figs. 5(a), 5(b) show a hull shape in which angle α of longitudinal sections taken on either side of the hull centreline decreases with respect to the angle α of the section along the hull centreline to respective knuckle points at which the angle α is 0° and outwardly of the knuckle points, the waterline contour is smoothly curved.

[0025] Fig. 6 shows waterline sections respectively taken along lines P1-P1, P2-P2, and P3-P3 of Figs. 3 to 5. The waterline shape P1 in case of Fig. 3 has a width increased from the inflection point 2 to the stern end 5. The waterline shape P2 in case of Fig. 4 extends in parallel with the ship centre line from the inflection point 2 to the stern end 5. The waterline shape P3 in case of Fig. 5 is gently curved from the inflection point 2 to the stern end 5, thereby preventing the flow from going away from the hull.

[0026] As should be understood from the foregoing, it is preferable that in the stern profile form, the height of the lower end 5a of the stern end 5 from a base line of the hull sectioned along the ship centre line is constant or gradually increased, and the two-dimensional shape is gradually changed toward a gunwale according to a function and thereby made into a three-dimensional shape.

[0027] As shown in Fig. 7, it is preferable that an angle β made between a tangential line in the range of $0.1 - 10\% L_{pp}$ from the stern end 5 and a tangential line of a stern profile, i.e., an angle β at which tangential lines forward and rearward of the inflection point 2 at the hull bottom intersect is set to $140 - 180$ degrees. In this range, the reduction effect of the stern wave resistance is much greater than the drag.

[0028] As shown in Fig. 8, the ratio γ (H_a/H_b) of the height H_a of the lower end 5a of the stern end 5 from the base line to the height H_b of the design draught is set to $0.95 - 1.2$. The positioning of the lower end 5a of the stern end 5 at the vicinity of the design draught and the accelerated flow from the lower end 5a of the stern end 5 are capable of cooperatively smoothing the disturbed sur-

face breaking and the stern wave.

[0029] As indicated by oblique lines shown in Fig. 9(a), the stern end of an initially designed ship or running ship can be extended. Specifically, a transom stern hull extension 7 extends from an original stern end 5' of an existing ship for accelerating the flow from the original stern end 5' as the inflection point 2. Alternatively, as shown in Fig. 9(b), an extension part 8 having a triangular cross section indicated by oblique lines, may be added to the transom stern end 5' of an existing design. In either case, α , β and the distance L required for accelerating the flow are the same and the beneficial effects described above are obtained.

[0030] As should be understood from the foregoing description, according to the present invention, by changing the flow field around the stern to reduce the disturbed surface and the stern wave, instead of lifting the stern end by the lift generated by the trim tab or the wedge like the conventional high speed craft, the stern wave making resistance can be significantly reduced.

[0031] The result will be described with reference to Figs. 10, 11. Fig. 10 shows wave making resistance coefficient on the vertical axis and Froude number (Fn) on the horizontal axis. As shown in Fig. 10, the coefficient of the stern of the present invention is lower than that of the conventional stern and the degree at which the wave making resistance is lowered increases with an increase in the Fn.

[0032] Fig. 11 shows horse power on the vertical axis and ship speed on the horizontal axis. The reduction effect is 4 - 10% in terms of a horse power ratio.

[0033] It will be appreciated that this invention may be embodied in several forms without departing from the essential characteristics thereof and so the described embodiments are illustrative and not restrictive, the scope of the invention being defined by the appended claims rather than by the description of the embodiments.

Claims

1. A method of reducing the wave making resistance of a displacement ship having a transom stern and a design speed corresponding substantially to a Froude Number of 0.2 to 0.4, the method comprising providing the hull of said ship with a longitudinal centre line profile (3, 4) having an inflection point (2) at a longitudinal distance of 0.1 to 10% Lpp (length between perpendiculars) from the stern end (5) of the ship, with the portion (3) of the hull profile forward of said inflection point sloping upwardly to said inflection point and the portion (4) of the hull profile rearward of the inflection point being horizontal or sloping downwardly, and positioning the lower end (5a) of the stern end relative to the design draught such that the ratio γ (Ha/Hb) of the distance (Ha) between the base line at the hull centre line and said lower end (5a) and the distance (Hb) between said base line and the design draught at the hull centre line is 0.95 to 1.2 such that, in use, a first flow condition is generated forward of said inflection point and a second flow condition is generated between said inflection point and said stern end to provide accelerated flow rearwardly of said inflection point.
2. A method as claimed in claim 1, wherein said hull centre line profile (4) between said stern end (5) and said inflection point (2) is provided by fitting an extension (7; 8) to the stern end (5') of an existing ship.
3. A displacement ship having a transom stern (5) and a longitudinal hull centre line profile (3, 4) defining an inflection point (2), with a portion (3) of the hull centre line profile forward of said inflection point sloping upwardly to said inflection point and the portion (4) of the hull centre line profile rearwardly of the inflection point ceasing to slope upwardly, **characterised in that** the ship has a design speed corresponding substantially to a Froude Number of 0.2 to 0.4, **in that** the longitudinal distance between the stern end (5) of the ship and said inflection point (2) is 0.1 to 10% Lpp (length between perpendiculars) and **in that** the lower end (5a) of the stern end (5) is positioned relative to the design draught such that the ratio γ (Ha/Hb) of the distance (Ha) between the base line at the hull centre line and said lower end (5a) of the stern end and the distance (Hb) between said base line and the design draught at the hull centre line is 0.95 to 1.2 such that, in use, a first flow condition is generated forward of said inflection point and a second flow condition is generated between said inflection point and said stern end to provide an accelerated flow rearwardly of said inflection point.
4. A ship as claimed in claim 3, wherein from the inflection point (2) to the stern end (5), the longitudinal centre line profile is flat or gently curved and a line connecting the inflection point (2) to the lower end (5a) of the stern end (5) is horizontal or downwardly inclined with respect to the design load waterline (DLWL) such that an angle α made between said line and the design load waterline is 0 to 20 degrees.
5. A ship as claimed in claim 3 or 4, wherein an angle β at which tangential lines forward and rearward of the inflection point (2) at the hull bottom intersect is 140 to 180 degrees.
6. A ship as claimed in claim 3, 4 or 5, wherein the distance of the lower end of the stern end (5) from the base line is constant or increases in the widthways direction of the hull on either side of the hull centreline.
7. A ship as claimed in any one of claims 3 to 6, wherein said hull centre line profile (4) between said stern

end (5) and said inflection point is defined by an extension (7; 8) extending from the stern end (5') of an existing ship.

Patentansprüche

1. Verfahren zum Verringern des Wellenwiderstandes eines Verdrängungsschiffes mit einem Transom-Heck und einer Sollgeschwindigkeit, die im Wesentlichen einer Froude-Zahl von 0,2 bis 0,4 entspricht, wobei das Verfahren umfasst: Versehen des Schiffsrumpfes mit einem longitudinalen Mittschiffsprofil (3, 4), das in einem longitudinalen Abstand von 0,1 bis 10 % Lpp (Baulänge) vom Heck (5) des Schiffes einen Wendepunkt (2) besitzt, wobei der Abschnitt (3) des Schiffsrumpfprofils vor dem Wendepunkt nach oben zu dem Wendepunkt geneigt ist und der Abschnitt (4) des Schiffsrumpfprofils hinter dem Wendepunkt horizontal ist oder nach unten geneigt ist, und Positionieren des unteren Endes (5a) des Hecks in Bezug auf den Solltiefgang in der Weise, dass das Verhältnis γ (Ha/Hb) des Abstandes (Ha) zwischen der Basislinie der Rumpf-Mittschiffslinie und dem unteren Ende (5a) zu dem Abstand (Hb) zwischen der Basislinie und dem Solltiefgang bei der Rumpf-Mittschiffslinie im Bereich von 0,95 bis 1,2 liegt, so dass im Betrieb vor dem Wendepunkt ein erster Strömungszustand erzeugt wird und zwischen dem Wendepunkt und dem Heck ein zweiter Strömungszustand erzeugt wird, um hinter dem Wendepunkt eine beschleunigte Strömung zu schaffen.
2. Verfahren nach Anspruch 1, bei dem das Mittschiffsprofil (4) des Schiffsrumpfes zwischen dem Heck (5) und dem Wendepunkt (2) durch Anbringen einer Verlängerung (7-8) an das Heck (5') eines vorhandenen Schiffes geschaffen wird.
3. Verdrängungsschiff mit einem Transom-Heck (5) und einem longitudinalen Schiffsrumpf-Mittschiffsprofil (3, 4), das einen Wendepunkt (2) definiert, wobei ein Abschnitt (3) des Schiffsrumpf-Mittschiffsprofils vor dem Wendepunkt nach oben zu dem Wendepunkt geneigt ist und der Abschnitt (4) des Schiffsrumpfs-Mittschiffsprofils hinter dem Wendepunkt nicht mehr nach oben geneigt ist, **dadurch gekennzeichnet, dass** das Schiff eine Sollgeschwindigkeit besitzt, die im Wesentlichen einer Froude-Zahl im Bereich von 0,2 bis 0,4 entspricht, dass der longitudinale Abstand zwischen dem Heck (5) des Schiffes und dem Wendepunkt (2) im Bereich von 0,1 bis 10 % Lpp (Baulänge) liegt und dass das untere Ende (5a) des Hecks (5) in Bezug auf den Solltiefgang in der Weise positioniert ist, dass das Verhältnis γ (Ha/Hb) des Abstandes (Ha) zwischen der Basislinie bei der Schiffsrumpf-Mittschiffslinie und dem unteren Ende (5a) des Hecks zu dem Abstand (Hb) zwi-

schen der Basislinie und dem Solltiefgang bei der Schiffsrumpf-Mittschiffslinie im Bereich von 0,95 bis 1,2 liegt, derart, dass im Betrieb vor dem Wendepunkt ein erster Strömungszustand erzeugt wird und zwischen dem Wendepunkt und dem Heck ein zweiter Strömungszustand erzeugt wird, um hinter dem Wendepunkt eine beschleunigte Strömung zu schaffen.

4. Schiff nach Anspruch 3, bei dem das longitudinale Mittschiffsprofil zwischen Wendepunkt (2) und Heck (5) eben oder leicht gekrümmt ist und eine den Wendepunkt (2) mit dem unteren Ende (5a) des Hecks (5) verbindende Linie in Bezug auf die Solllast-Wasserlinie (DLWL) horizontal oder nach unten geneigt ist, derart, dass ein Winkel α , der zwischen dieser Linie und der Solllast-Wasserlinie gebildet wird, im Bereich von 0 bis 20 Grad liegt.
5. Schiff nach Anspruch 3 oder 4, bei dem ein Winkel β , unter dem sich Tangentiallinien vor und hinter dem Wendepunkt (2) an dem Schiffsrumpfboden schneiden, im Bereich von 140 bis 180 Grad liegt.
6. Schiff nach Anspruch 3, 4 oder 5, bei dem der Abstand des unteren Endes des Hecks (5) von der Basislinie in Breitenrichtung des Schiffsrumpfes konstant ist oder auf jeder Seite der Schiffsrumpf-Mittschiffslinie zunimmt.
7. Schiff nach einem der Ansprüche 3 bis 6, bei dem das Schiffsrumpf-Mittschiffsprofil (4) zwischen dem Heck (5) und dem Wendepunkt durch eine Verlängerung (7; 8) definiert ist, die sich von dem Heck (5') eines vorhandenen Schiffes erstreckt.

Revendications

1. Procédé de réduction de la résistance à la formation de vagues d'un navire à tirant d'eau muni d'un tableau arrière et ayant une vitesse nominale correspondant pratiquement à un nombre de Froude compris entre 0,2 et 0,4, le procédé comprenant la mise en oeuvre de la coque dudit navire avec un profil selon la ligne centrale longitudinale (3, 4) ayant un point d'inflexion (2) situé à une distance longitudinale comprise entre 0,1 et 10 % de la longueur entre perpendiculaires (lpp) à partir de l'extrémité de poupe (5) du navire, la partie (3) du profil de coque située en avant dudit point d'inflexion étant inclinée vers le haut en direction dudit point d'inflexion et la partie (4) du profil de coque située vers l'arrière du point d'inflexion étant horizontale ou inclinée vers le bas, et le positionnement de l'extrémité inférieure (5a) de l'extrémité de poupe relative au tirant d'eau nominal de telle sorte que le rapport γ (Ha/Hb) de la distance (Ha) entre la ligne de base au niveau de la ligne

- centrale de la coque et ladite extrémité inférieure (5a) à la distance (Hb) entre ladite ligne de base et le tirant d'eau nominal au niveau de la ligne centrale de la coque soit compris entre 0,95 et 1,2 de telle sorte que, en cours d'utilisation, une première condition d'écoulement soit générée en avant dudit point d'inflexion et une seconde condition d'écoulement soit générée entre ledit point d'inflexion et ladite extrémité de poupe pour assurer un écoulement accéléré vers l'arrière dudit point d'inflexion.
2. Procédé selon la revendication 1, dans lequel ledit profil de ligne centrale de la coque (4) entre ladite extrémité de poupe (5) et ledit point d'inflexion (2) est obtenu en implantant une extension (7 ; 8) à l'extrémité de poupe (5') d'un navire existant.
3. Navire à tirant d'eau muni d'un tableau arrière (5) et ayant un profil longitudinal de ligne centrale de coque (3, 4) définissant un point d'inflexion (2), une partie (3) de la ligne centrale de la coque située en avant dudit point d'inflexion étant inclinée vers le haut vers ledit point d'inflexion et la partie (4) du profil de la ligne centrale de la coque située vers l'arrière du point d'inflexion cessant d'être inclinée vers le haut, **caractérisé en ce que** le navire a une vitesse nominale correspondant pratiquement à un nombre de Froude compris entre 0,2 et 0,4, **en ce que** la distance longitudinale entre l'extrémité de poupe (5) du navire et ledit point d'inflexion (2) est comprise entre 0,1 et 10 % de la longueur entre perpendiculaires (lpp) et **en ce que** l'extrémité inférieure (5a) de l'extrémité de poupe (5) est positionnée relativement au tirant d'eau nominal de telle sorte que le rapport γ (Ha/Hb) de la distance (Ha) entre la ligne de base au niveau de la ligne centrale de la coque et ladite extrémité inférieure (5a) à la distance (Hb) entre ladite ligne de base et le tirant d'eau au niveau de la ligne centrale de la coque soit compris entre 0,95 et 1,2 de telle sorte que, en cours d'utilisation, une première condition d'écoulement soit générée en avant dudit point d'inflexion et une seconde condition d'écoulement soit générée entre ledit point d'inflexion et ladite extrémité de poupe pour assurer un écoulement accéléré vers l'arrière dudit point d'inflexion.
4. Navire selon la revendication 3, dans lequel, entre le point d'inflexion (2) et l'extrémité de poupe (5), le profil de la ligne centrale longitudinale est plat ou légèrement courbé et une ligne reliant le point d'inflexion (2) et l'extrémité inférieure (5a) de l'extrémité de poupe (5) est horizontale ou inclinée vers le bas par rapport à la ligne de flottaison de charge théorique (DLWL) de telle sorte qu'un angle α existant entre ladite ligne et la ligne de flottaison de charge théorique soit compris entre 0 et 20 degrés.
5. Navire selon la revendication 3 ou 4, dans lequel un angle β selon lequel se coupent les lignes tangentielles situées en avant et en arrière du point d'inflexion (2) dans la partie inférieure de la coque est compris entre 140 et 180 degrés.
6. Navire selon la revendication 3, 4 ou 5, dans lequel la distance entre l'extrémité inférieure de l'extrémité de poupe (5) et la ligne de base est constante ou augmente dans la direction de la largeur de la coque de part et d'autre de la ligne centrale de la coque.
7. Navire selon l'une quelconque des revendications 3 à 6, dans lequel ledit profil de la ligne centrale de la coque (4) situé entre ladite extrémité de poupe (5) et ledit point d'inflexion est défini par une extension (7 ; 8) se prolongeant depuis l'extrémité de poupe (5') d'un navire existant.

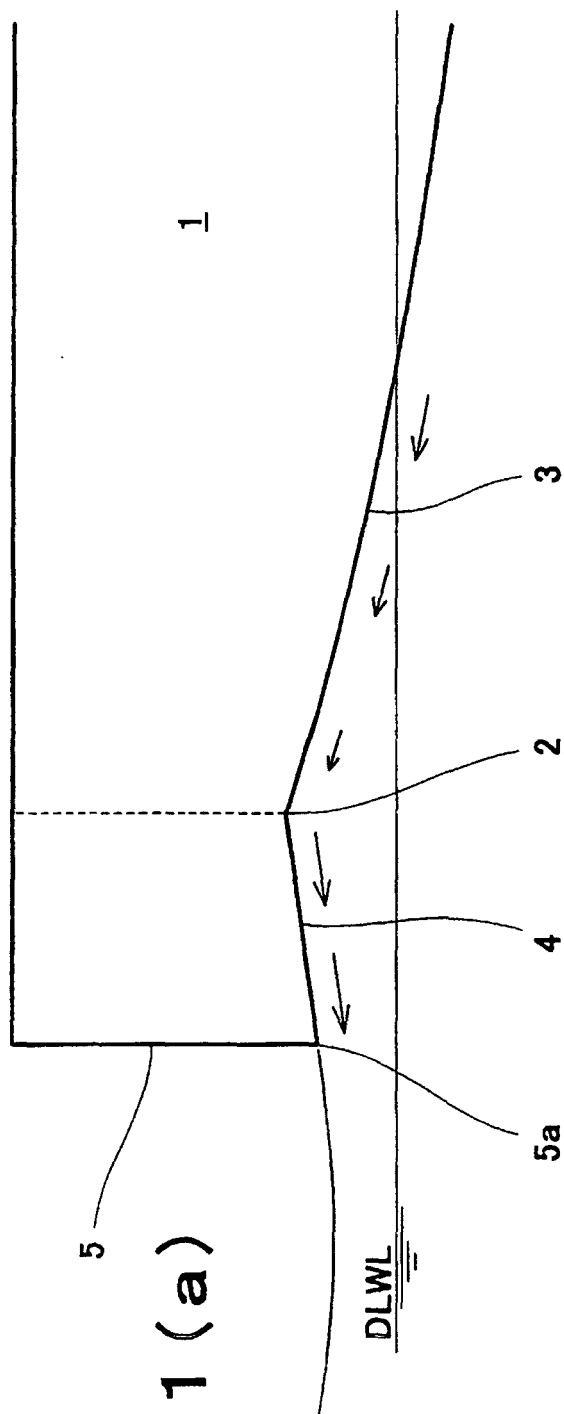


Fig. 1(a)

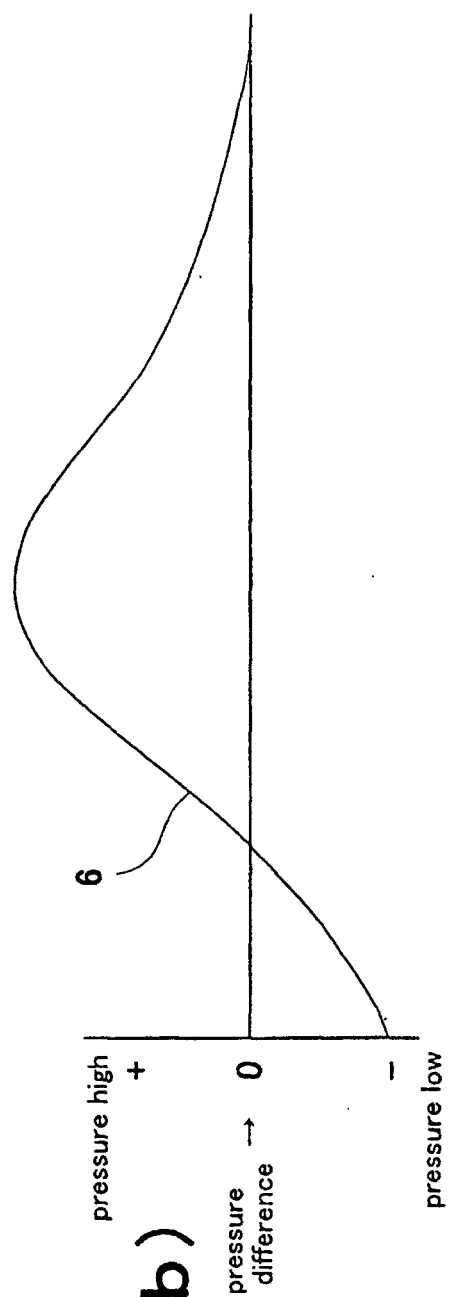


Fig. 1(b)

Fig.2(a)

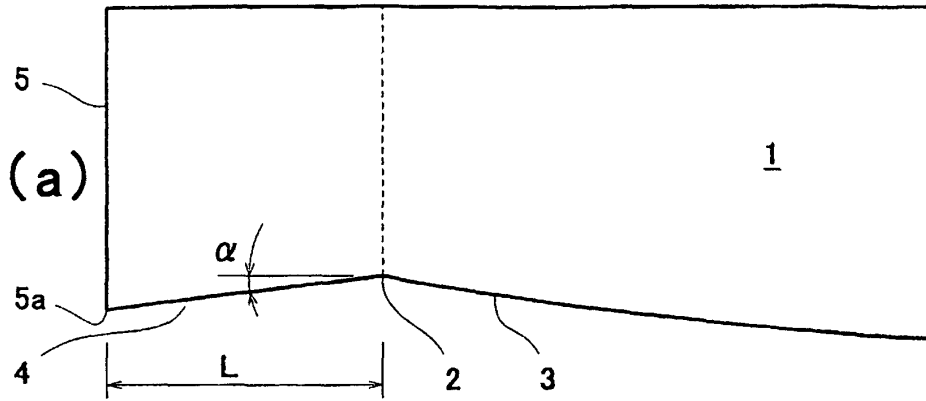


Fig.2(b)

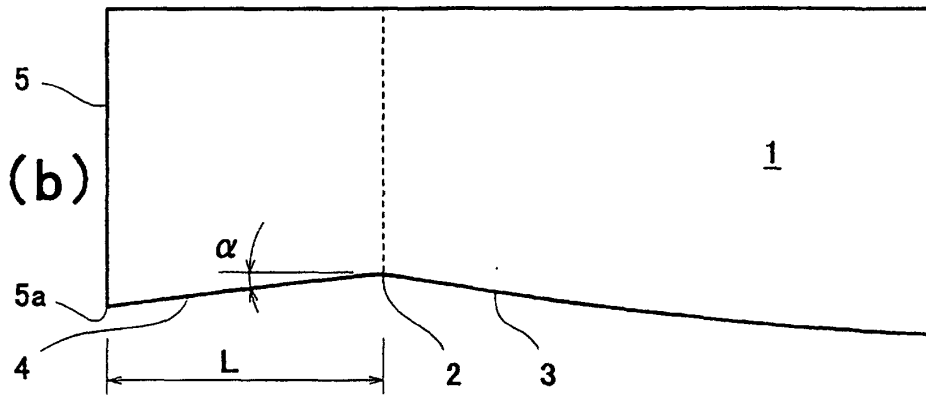
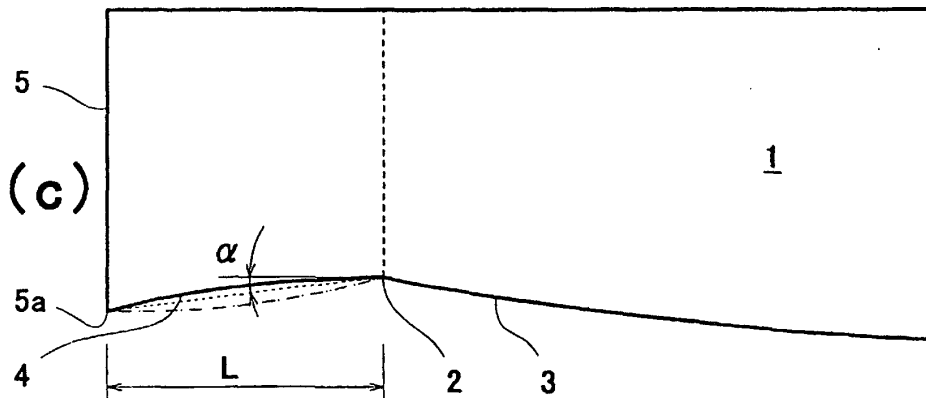


Fig.2(c)



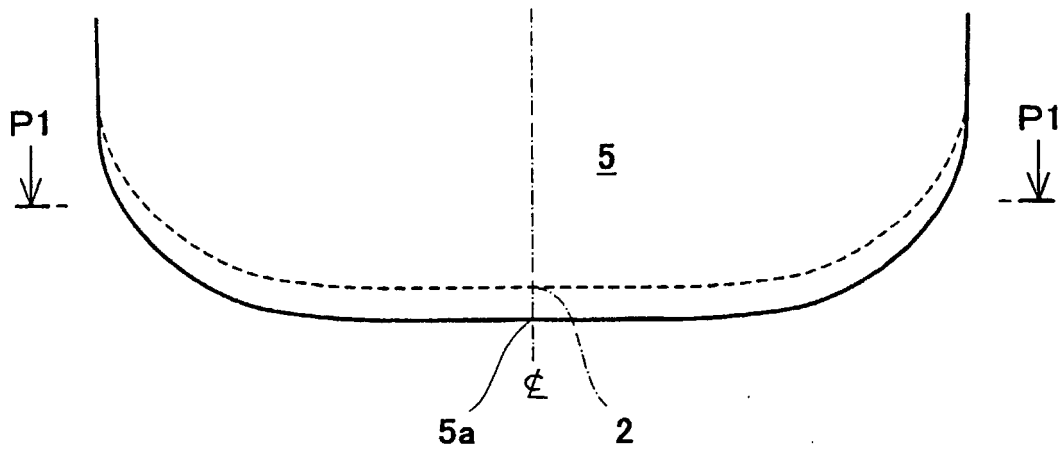


Fig. 3(a)

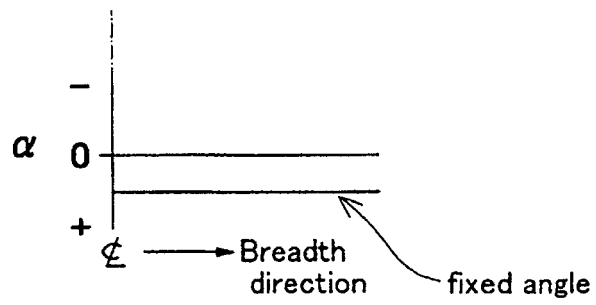


Fig. 3(b)

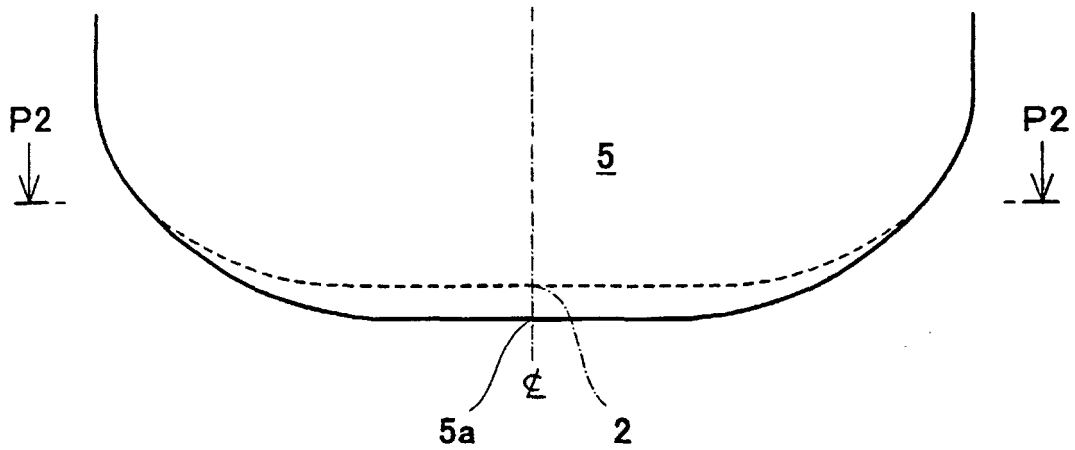


Fig. 4(a)

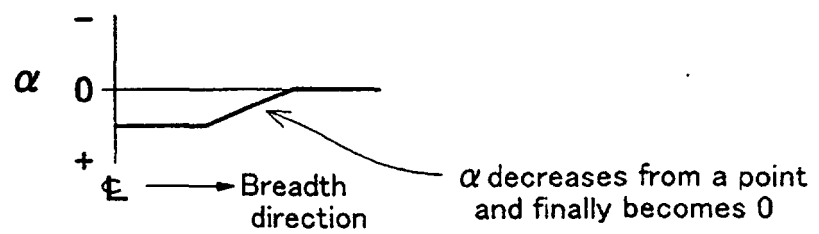


Fig. 4(b)

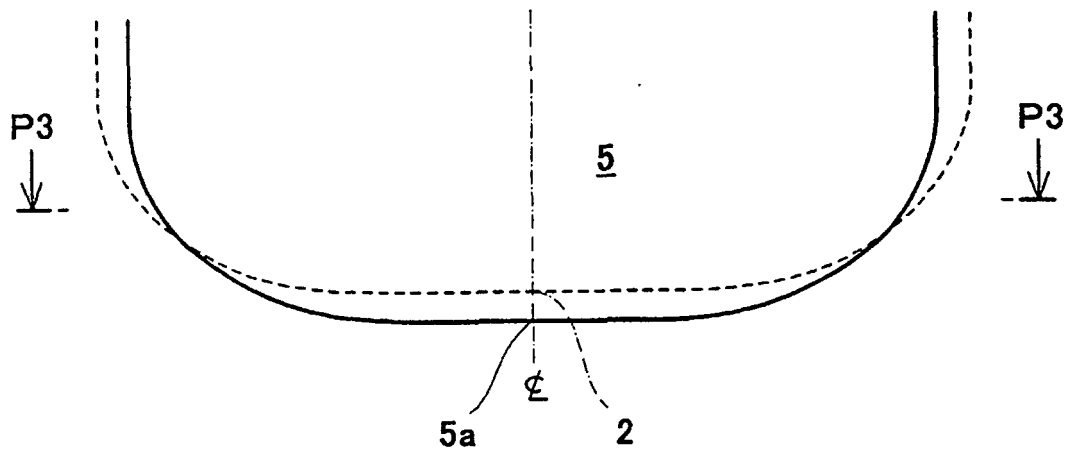


Fig. 5(a)

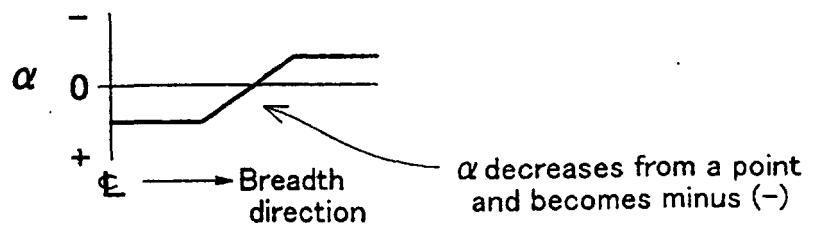


Fig. 5(b)

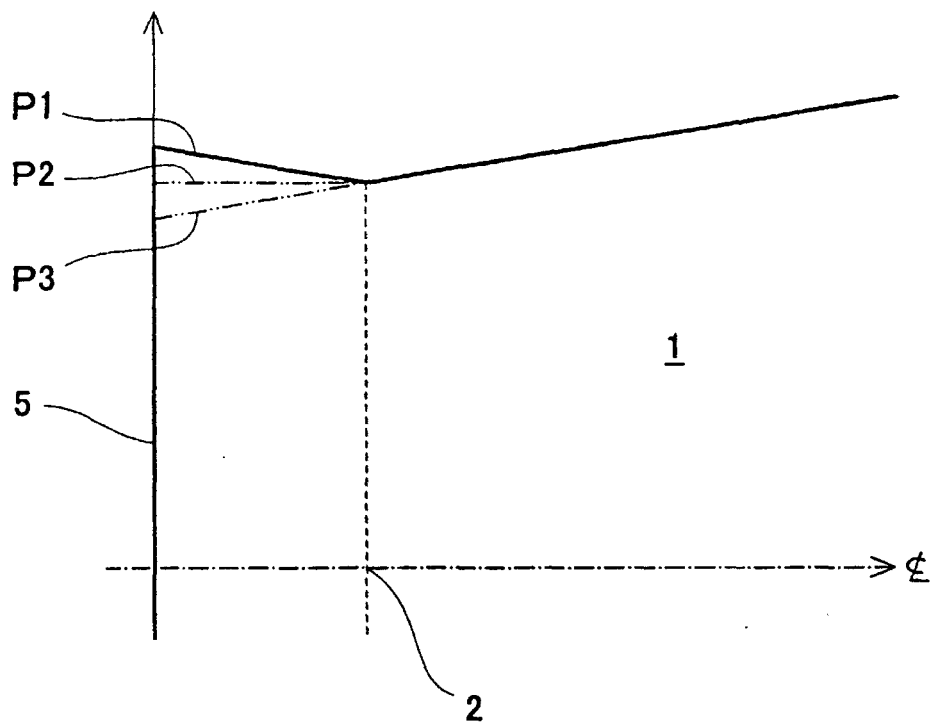


Fig. 6

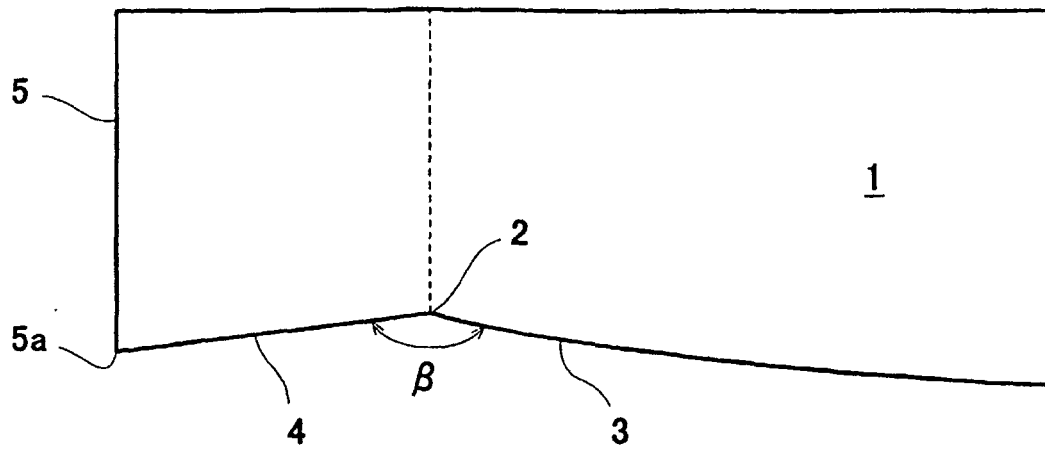


Fig. 7

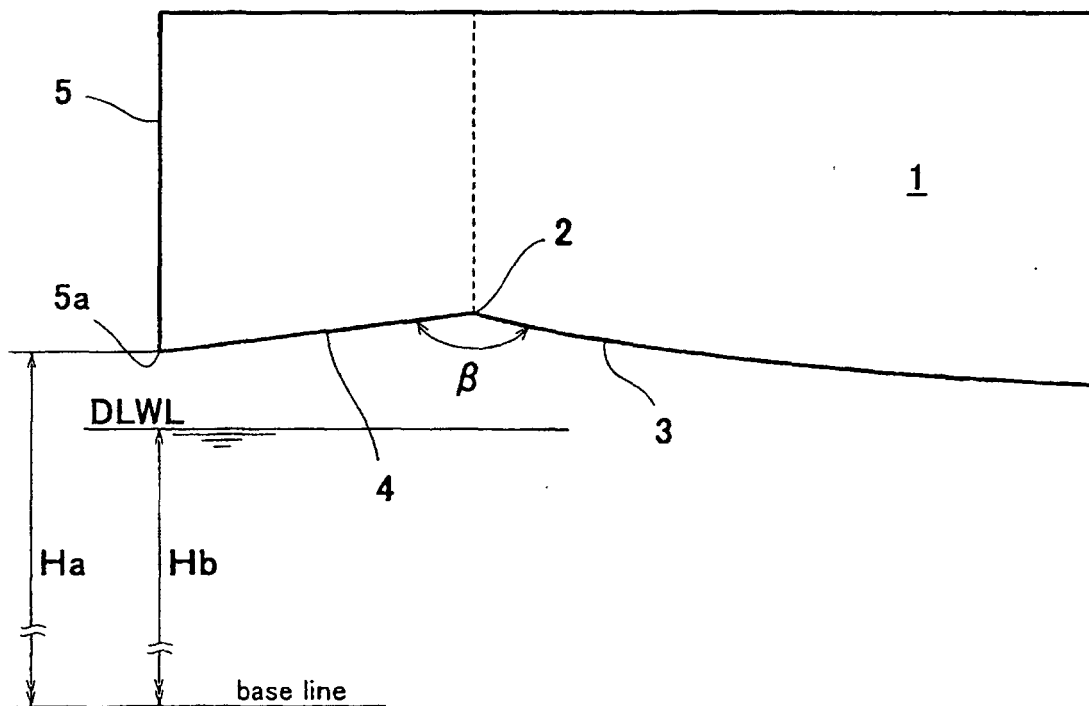


Fig. 8

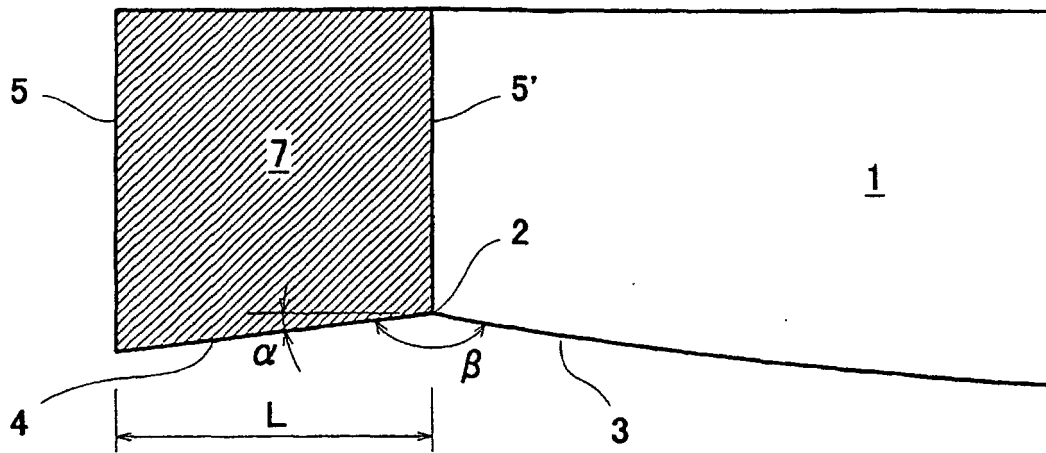


Fig. 9(a)

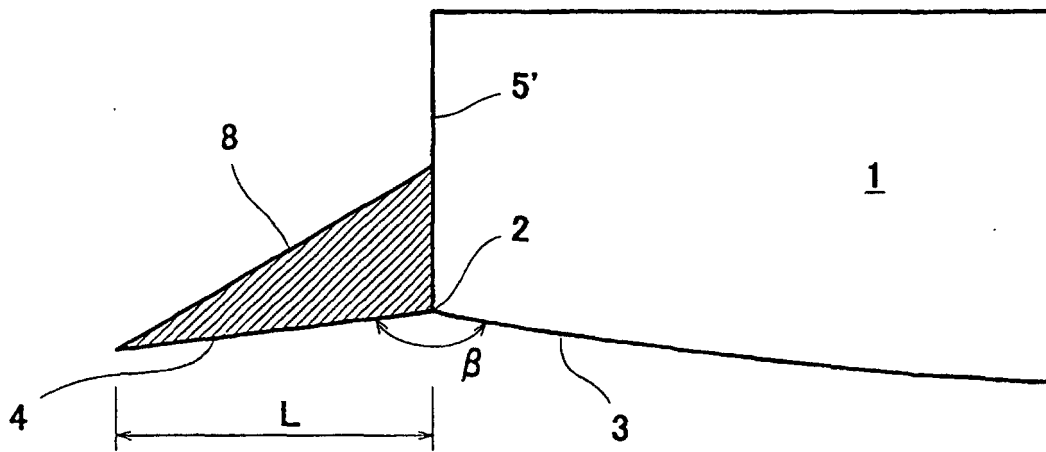


Fig. 9(b)

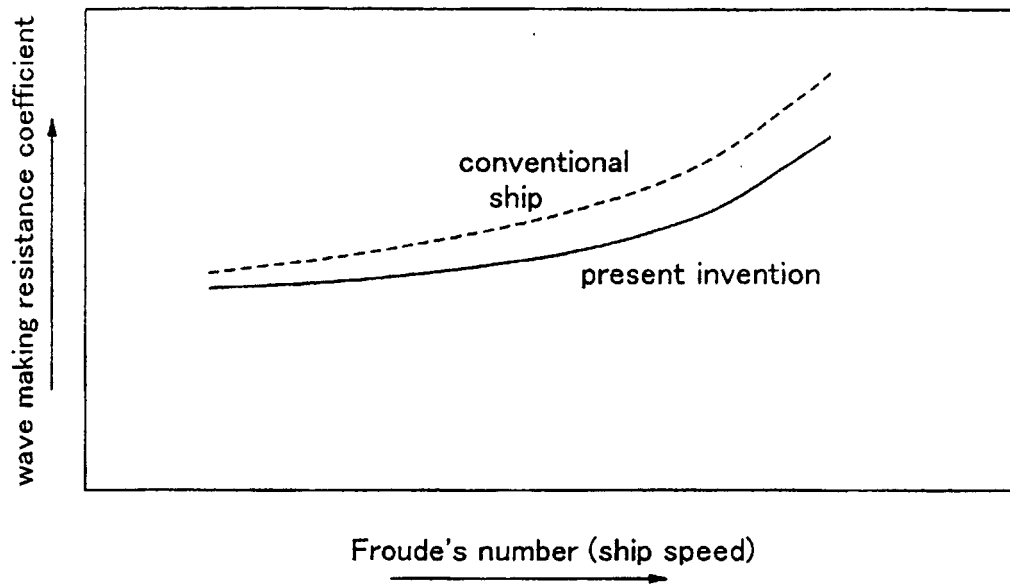


Fig. 10

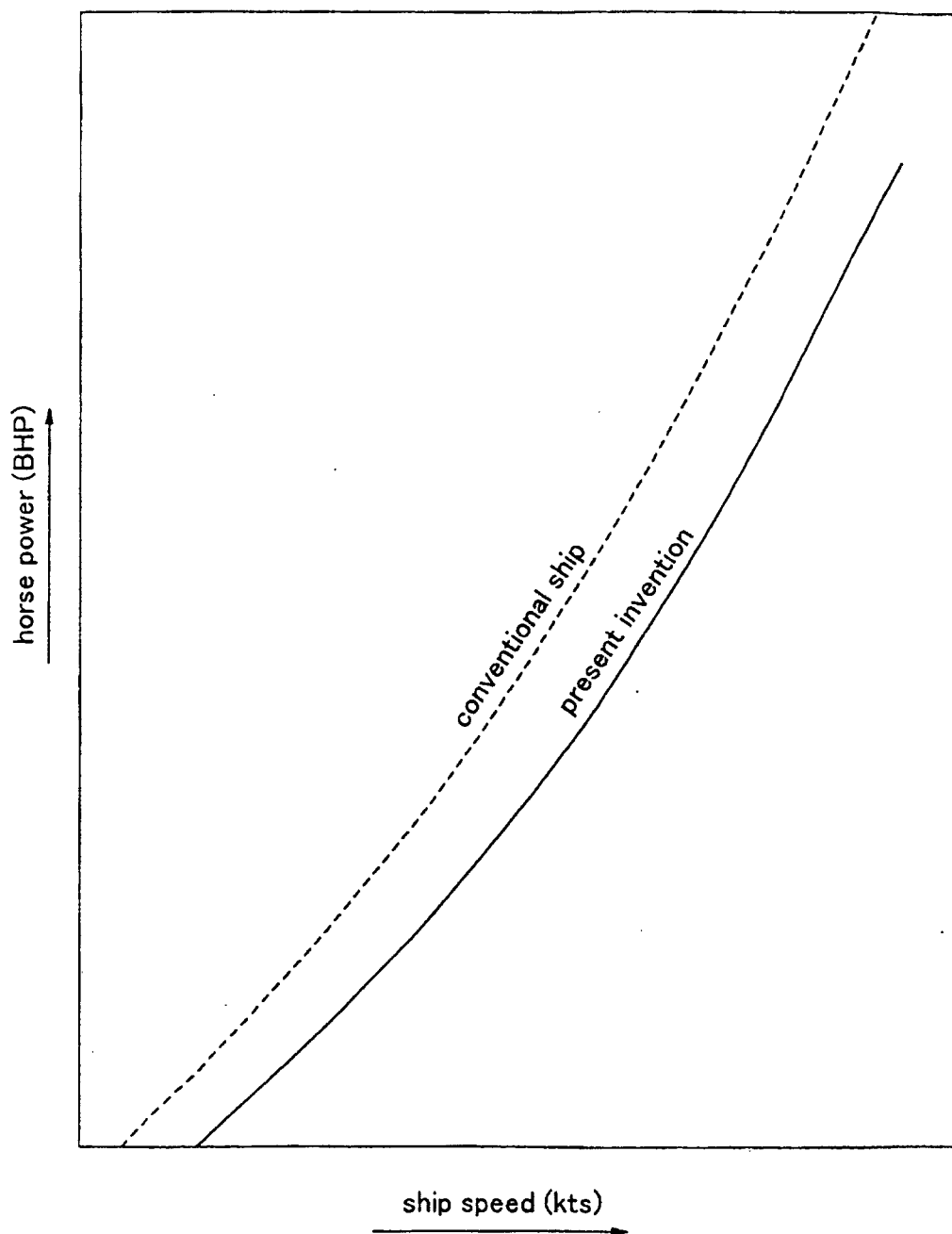


Fig. 11

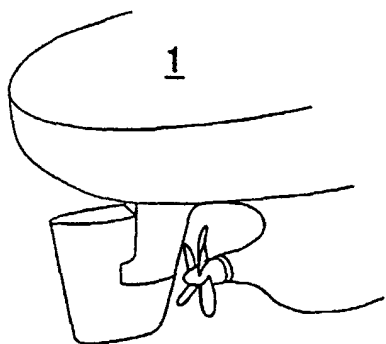


Fig. 12(a)

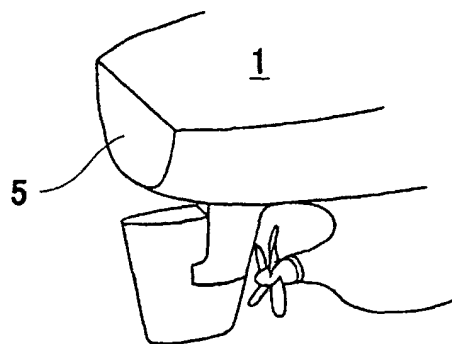


Fig. 12(b)

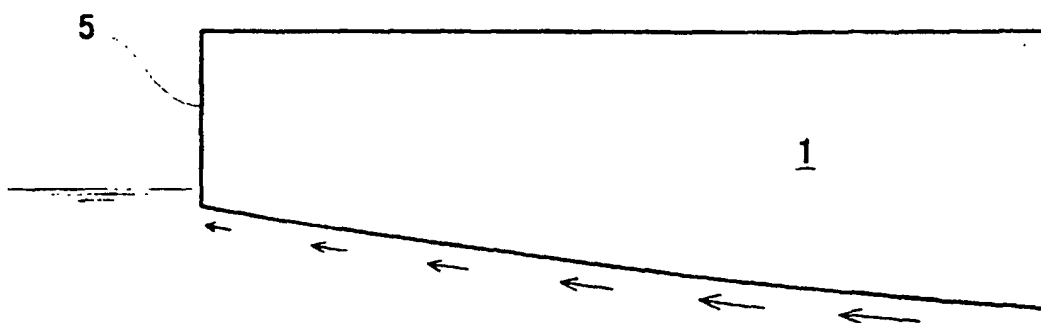


Fig. 12(c)

REFERENCES CITED IN THE DESCRIPTION

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