(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 873 934 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
28.10.1998 Bulletin 1998/44

(51) Int Cl.6: **B63B 1/10**

(21) Application number: **98302988.5**

(22) Date of filing: **17.04.1998**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **21.04.1997 AR 10160097**

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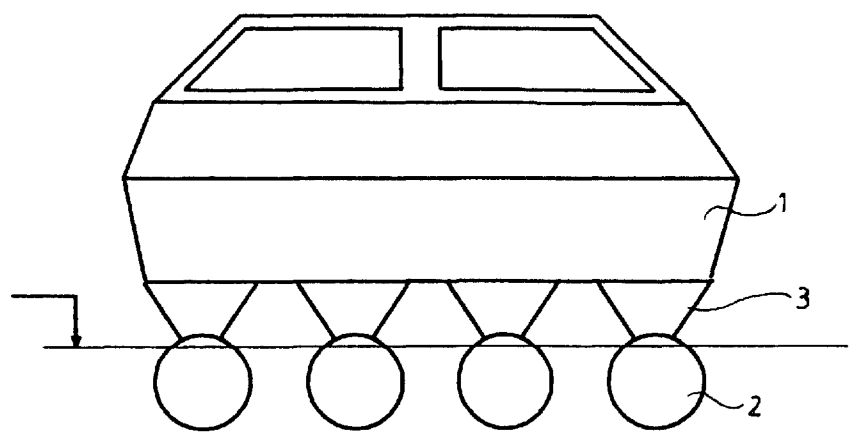
(54) A vessel with a hull supported by totally submerged ellipsoidal floats

(57) This invention relates to a vessel whose hull (1) is above the surface of the water, and whose submerged and semi-submerged parts are oblong antirolling propelling floats (2,3) whose axes are parallel to the longitudinal axis of the vessel. There are at least two floats (2,3) designed in such a way that driving resistance is minimum, righting moment is increased, and the vessel is more stable and easier to manoeuvre (Fig. 1).

FIG. 1



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Description

This invention is a solution to a usual problem in the field of navigation: how to reduce water resistance and at the same time how to navigate stably at high speeds both in calm and rough waters.

BACKGROUND OF THE INVENTION.

Attempts have been made to solve this problem, but for different reasons none of them has been a real solution as they lack stability or describe a structure which considerably reduces the effect to be achieved.

The Argentine patent number 213.661 discloses submerged floats which have the shape of an ellipsoid-of-revolution. However, it fails to mention stabilizing means such as the ones mentioned in this invention.

The Japanese patent application Kokai 52-31486 includes submerged floats; however, it does not disclose their shape, and includes perpendicular levelling means between two floats (at the rear end of said floats) joined to them, as well as a horizontal and vertical rudder system, also positioned between the two floats (at the front end of said floats) and joined to them. Both this levelling system and the rudder system, increase the navigation surface because of their features, and because their shape is incompatible with the design characteristics required to reduce shape resistance, they cause a significant increase in driving resistance.

The EP-A-0080308 includes removable semisubmerged floats, fixed both at their front and rear ends to partially submerged columns which are perpendicular to the water surface.

The submerged ends of said columns include pairs of quarters which function as stabilizing means. As indicated in the previous specifications, this vessel has been designed for low speeds and to be at rest. This is apparent because the columns which are located near the ends of the floats dramatically reduce the shape effect achieved by said floats; at the same time these columns produce wave resistance, increase driving resistance and require a solid structure to drive the float removing means.

Now that the background has been reviewed, it will be noted that no appropriate stabilizing means have been found that can be combined with the floats supporting a vessel, and that said vessel cannot navigate stably in either rough or calm waters.

SUMMARY OF THE INVENTION

According to a preferred embodiment of this invention, there is provided a vessel or boat whose hull or useful volume (1) is above the surface of the water, and whose submerged part (2) and semi-submerged part (3) comprises anti-rolling floats (2,3), basically oblong, the axis of which is parallel to the longitudinal axis of the whole set, supporting columns which are a series of ellipses, and at least two, designed in such a way that they minimize the driving resistance, increase righting moment and make manoeuverability and stability easier.

DESCRIPTION OF THE INVENTION

A vessel according to the present invention, as basically designed, offers a plurality of advantages compared to conventional vessels, as it reduces wave formation resistance significantly; reduces driving resistance; makes it possible to use propelling power better; saves fuel; makes transport at higher speeds possible; has a limited draught and a greater breath; achieves optimum balance between surface resistance and shape resistance in order to achieve the least driving resistance and the maximum stability and manoeuverability; solves stability problems as it produces righting moment (response to the vessel rolling) with a minimum of undulating movement; it does not use energy to produce "gliding effect" as the vessel buoyancy is basically is static instead of dynamic; and moreover it can transport heavy loads.

The performance of a vessel using this invention under variable conditions of speed and in both rough and calm waters will now be analysed.
There are basically three kinds of resistances that use propelling power, that is: surface resistance, shape resistance and wave formation resistance. At relatively low speeds (between 0 and 1.5 according to a unitless standard related to Froude number), friction forces comprising between 80 % and 85% of total resistance are more commonly observed. At relatively high speeds without gliding (from 1.5 to 3), friction forces comprise 50% of the total resistance, and said resistance (from 1.5) increases much more rapidly than at low speeds, especially because of wave formation.

As a reference for relative speeds, it can be said that a cargo boat sails at 0.8; a warship at 2.0; and an off-shore power boat at 7.0 or more. As practically the entire anti-rolling floats (2,3) are submerged (80% - 100% of their volume), and considering the way they are arranged - as described in the Argentine patent number 213.661, the only patent in which the shape of the floats is totally used - flow is almost perfect and complete, the air/water contact surface is much smaller than in conventional vessels and boats because of the floats, and the corresponding resistances are much lower, which consequently makes it possible to use propelling power better, especially at high speeds.

In order to achieve the required level of stability in calm waters, the floats may be equipped with stabilizers, both in the bow and in the stern. Said stabilizers may be controlled by any known means, e.g. manually or by hydraulic drives or drives controlled by microprocessors, and offset both pitch and roll of the vessel.

At high speeds and as the waters become rough, the stabilizers are not enough to achieve the desired level of stability of the boat. This invention makes the best out of the floats' shape in order to minimize shape resistance as well as wave formation resistance, and however increase stability gradually as the boat requires it.

The conformation of each antirolling float (2,3) according to an ellispsoid of revolution, is an excellent condition to make the best of propelling power, as it has been proved that the higher the ratio between the major and the minor axis, or in other words, the more oblong the float, the higher the speed the boat can reach.

It is known that the body that has the smallest surface area for a certain volume is a sphere. This is the case of a bubble. So as to know what shape a bubble would adopt when affected by a field of external and uniform forces, we can compare a bubble to the electron cloud of a hydrogen atom. When this cloud is under the effect of a field of force that can deform it in a given direction, for example a uniform external electrical field, said cloud will deform, and give way to an induced electrical dipole. The shape this cloud will adopt in space is an ellipsoid of revolution.

Apart from the above mentioned, when a body moves in fluid, it produces an undulating disturbance. If a particle is placed under the effect of the first whirl of said disturbance, its path equation is sine or cosine.

When said particle defines a semiwave, the points reached during the corresponding path, for example corresponding to the sine, coincide with one of the points given by the equation of a semiellipse. If instead of taking a particle, a group of particles is selected, so that the plane they are contained in is normal with respect to the direction of the forces of the field, and the centre of symmetry coincides with the intersection of said plane with the path direction, we will obtain the equation corresponding to an ellipsoid of revolution in space.

According to the above-mentioned, we conclude that for our case in particular, the best shape of a body having a given volume, and that moves in water at regular speed and that produces the least disturbance is an ellipsoid of revolution.

Moreover, if we cut this ellipsoid of revolution with a horizontal plane, so that it contains the main axis of the ellipsoid, we can see that the fluid drains not only in the lower part, but also in all of the top part. This means that the fluid flows all around the body. In order to provide the boat with an adequate righting moment, the antirolling floats (2,3) are not totally ellipsoids of revolution, as they would be in the boat described in the Argentine patent 213.661. If we cut the antirolling float (2,3) according to a plane normal to its longitudinal axis, the latter will be shaped as shown in Fig. 3, and if we cut the float at any horizontal plane we will find an elliptical shape, which means shapes similar to an ellipse and not exclusively a geometrical ellipse, which preferably will keep the radius ratio both in its propelling section and its anti-rolling section. When the vessel rocks (Figs. 5 and 6), the floating plane changes and grows larger, and consequently the moment of inertia opposing the rolling increases too. In the same way, the submerged volume increases as much as V' (Fig. 6) so that this extra volume produces a push at a distance L from the centre of the vessel, generating a moment opposing the movement. The exact shape and dimensions of the unsubmerged region (2) of the antirolling float (2,3) will depend on the antirolling characteristics the vessel may require; the response can be either slow or sudden, and the section which is horizontal to the longitudinal axis of the unsubmerged volume (3) will be ovoid or ellipsoidal.

After designing the floats in this way and after selecting the measures of the axes of the ellipses that generate the former, it is possible to reduce driving resistance and undulating movements. In fact, if we call the larger semiaxis of the generating ellipse "R" and if we call the semiaxis of the same ellipse "r", the quotient R/r will determine in each case a value having a corresponding speed for which said driving resistance and undulating movement are slight.

Given a supporting volume "T", there will be a large number of ratios between "R" and "r", and an optimum speed "V" will correspond to each of them. If the quotient R/r increases, so will "V". Therefore, if "T" is kept constant, "V" will be increased by only increasing "R" with respect to "r" for the same number of floats; or given a "R" determined by the length of a vessel, the optimum speed will be successfully increased if the number of floats is increased for the same volume. If the floats are longer, or if the number of floats is increased, their external surface will be increased too, which will lead to more contact with water, and therefore, a decrease in speed. If motive power is always constant, speed will reach a maximum value for each volume "T", and then will decrease if the surface is larger. Said maximum speed will be useful to determine the number of and the size of floats for a volume "T" which will support a given weight, for which the motive power required will be the least. Therefore, it is possible that once the cargo and speed are fixed, a vessel according to this invention will use less motive power for said cargo at that given speed.

The antirolling float (2,3) used in this invention can be designed without taking into account the shape restrictions that a conventional hull or the previous models have; in this way the undulating movement generated by the part of the float that is in contact with the air-water surface can be minimized; it is possible to provide the necessary righting moment and achieve lateral resistance for a better manoeuverability of the vessel. The floats can be totally hollow and/or divided into watertight compartments, which is advantageous in case of accident or damage. Said compartments can be made by means of cross-sectional supports. Also, they can be divided into compartments where loads or fuel can be stored, or else they can be used to place the propelling engines. They can be provided with propellers, directional rudders, rolling stabilizers, etc.

In another embodiment, the anti-rolling floats (2,3) can be provided with supports so as to minimize resistance. Therefore, the supports of the floats that are not external can be oblong, or else a series of curves of elliptical shape, but the side walls are separated forming an angle which is smaller than that of the external floats, or a slight angle. In this way, a new embodiment of the antirolling float divides it into two sections: the inside antirolling section and the distal closed. Said examples are neither limiting nor protected exclusively by the scope of this specification.

DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a front view of the vessel;
Fig. 2 shows a side, schematic view in elevation of the same vessel shown in Fig. 1;
Figs. 3 and 4 correspond to a longitudinal section and a cross-section of a generic antirolling float, according to a preferred embodiment of the invention; and
Figs. 5 and 6 show the effect of the floats when the vessel rocks, in relation to the changes in the floating area of the float and the submerged volume.

In all the drawings, same numerals correspond to the same or equivalent parts of, according to the examples chosen for this explanation of the vessel object of the invention.

As it can be seen in Fig. 1, the vessel illustrated is provided with a superior set corresponding to the hull (1) and at least two floats (2) which are connected to the hull by antirolling means (3). The antirolling means (3) are oblong inverted frusto-conical bodies whose bases are fixed to the lower part of the hull (1) and whose frusta are joined respectively to the upper parts of the floats (2), preferably so that each float (2) and associated antirolling means (3) forms a single anti-rolling float body (2,3).

The front end (7) and the rear end (6) of each said antirolling means (3) comprise tapered ends defining sharp edges (8 and 9) of hydrodynamic profile for a better displacement. The total volume of the floats (2) is such that it supports the hull (1) and its cargo, above the surface of the water.

Figs. 3 and 4 show a longitudinal section and a cross-section of an antirolling float body (2,3) which is formed by a lower revolution body (2) with a top longitudinal opening (a-a) from whose opposing ends two upwardly diverging walls (12 and 13) extend. At their upper ends, the walls (12 and 13) bend inwardly towards one another over horizontal sections (10 and 11), which are useful to join said body to the hull (1), and furthermore the structure of the truncated-conical section they define is an antirolling means.

Having described this vessel and the examples, modifications and improvements will occur to those skilled in the art, all of which must be considered within the scope of this letter patent; this scope is limited only by the claims that follow.

Claims

1. A vessel whose hull (1) or other useful volume is above the surface of the water in use and is provided with float means (2,3) joined to said hull (1), characterized in that said float means (2,3) comprise at least two oblong float bodies (2) arranged in parallel fashion to the longitudinal axis of the vessel, and antirolling means (3) in an upper part of said float means (2,3).

2. A vessel according to claim 1, characterized in that each antirolling means (3) comprises an oblong body having a longer base connected to the hull and a shorter base connected to the floating body (2).

3. A vessel according to claim 1, characterized in that each antirolling means (3) comprises an inverted frusto-conical body whose base is joined to the hull and whose frustum is joined to the float body (2).

4. A vessel according to claim 1, characterized in that the antirolling means (3) serve as joining means between the float bodies (2) and the hull (1).

5. A vessel according to claim 1, characterized in that fore and aft ends of the antirolling means (3) form an air dynamic edge for water displacement.

6. A vessel according to claim 2, characterized in that when the float body (2) is cut by a horizontal plane an elliptical area is defined.

7. A vessel according to claim 1, characterized in that the float volume that is submerged is about 80 - 100% of its total volume.

8. A vessel according to claim 1, characterized in that the radius ratio between ellipsoids of revolution of the float propelling section and elliptical forms of the antirolling means is the same.

9. A vessel according to claim 1, characterized in that ends of the propelling section of the antirolling float means form a hydrodynamic edge for water displacement.

10. A vessel according to claim 1, characterized in that the float means (2,3) comprise watertight compartments.

11. A vessel according to claim 1, characterized in that it comprises means that modify the waterline and fix it at the hull of said vessel.

12. A vessel according to claim 1, characterized in that the antirolling means (3) comprise stabilizing means.

13. A vessel according to claim 1, characterized in that it comprises means for filling and emptying the float means (2,3).

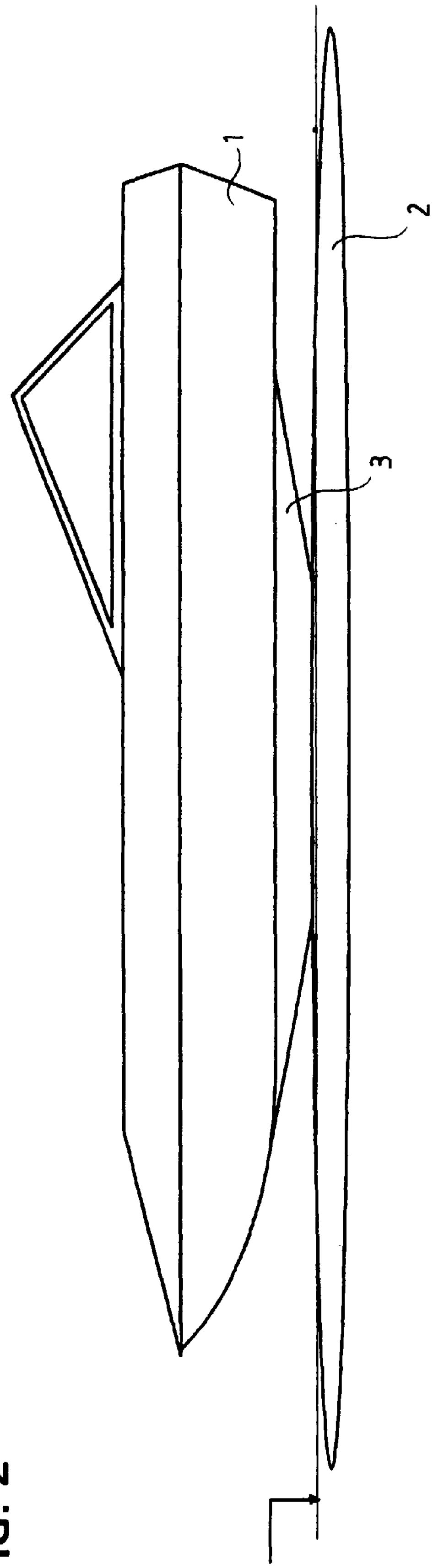

FIG. 2

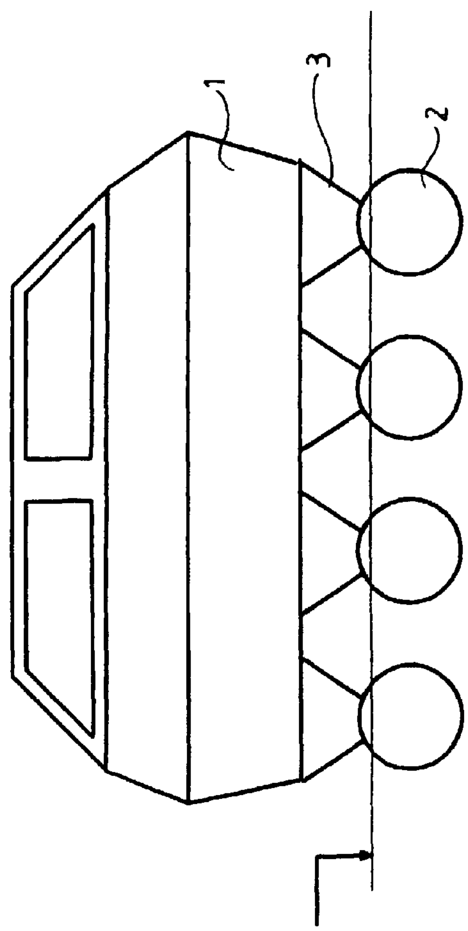

FIG. 1

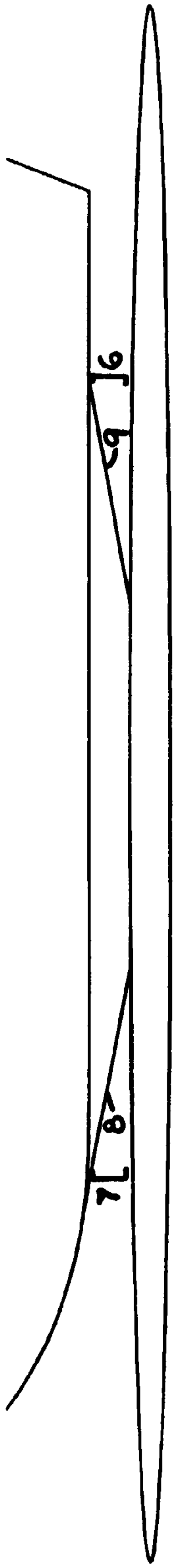

FIG. 3

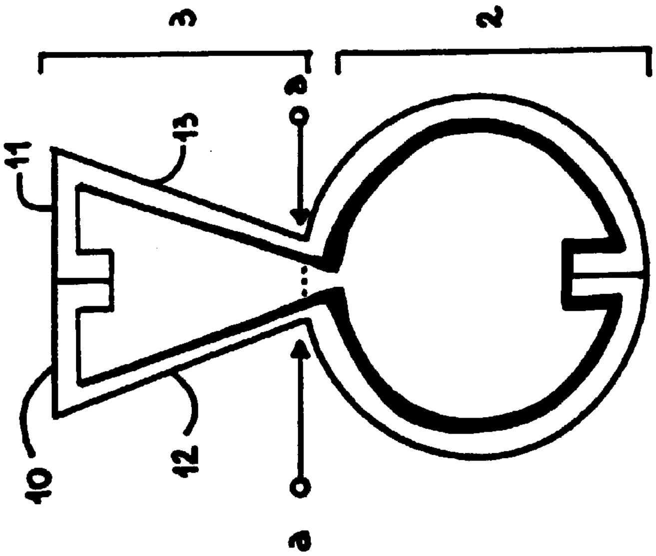

FIG. 4

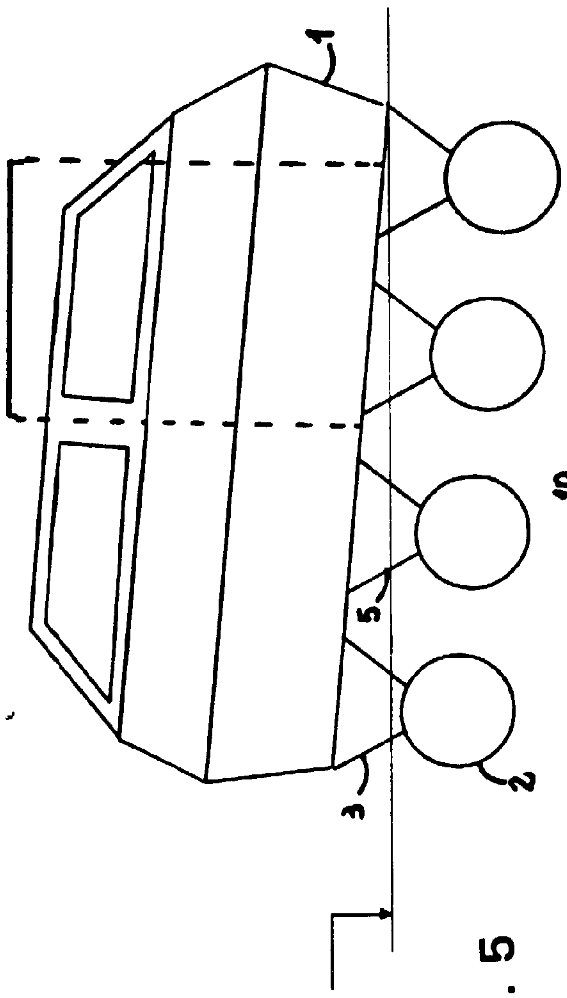

FIG. 5

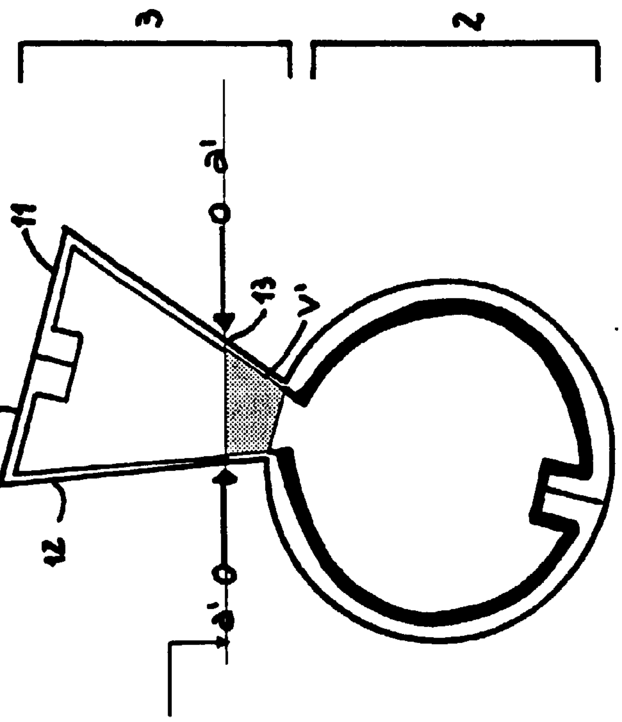

FIG. 6