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(54) Propulsion apparatus for marine craft and method for the manufacture of such apparatus.

(57) Propulsion apparatus for high speed, planing marine craft and especially useful for so called surface piercing propellers (3) and comprising a fixed drive body (1) which is non-steerable or which can not be tilted up and down in the vertical direction, and which drive body is adapted to be mounted directly to the stern (17) of a boat, and a method for the manufacture of such a propulsion apparatus, whereby the drive body (1) is made from two flat pieces of plate, namely a boomerang-like superwater body portion (4) having the convexly curved boomerang point facing the propeller (3), and an arrow-point like subwater plate piece having the point (11) thereof facing the boat hull, and whereby the two pieces of plates, after having been folded round, the superwater plate (4) downwards from a central longitudinal axis (6) and the subwater plate (5) upwards from a central longitudinal axis and after having been joined along the meeting edges (9,12) form a superwater body part (4) and a subwater body part (5), whereby the superwater body part provides a drive body portion which is tapering rearwardly towards the propeller (3) and which has a strong and stable mounting means (2) at the opposite end for mounting of the drive body to the stern (17) of the boat, whereas the subwater drive body part (5) is widened rearwardly towards the propeller (3) to meet the water like the stem of a canoe.

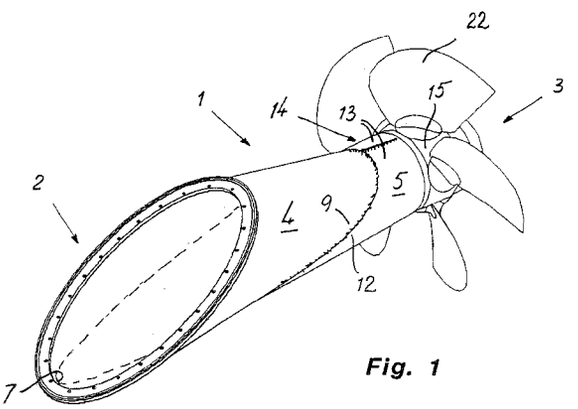

Fig. 1

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The present invention relates to a propulsion apparatus for high speed, planing marine craft, and more particularly the invention relates to such a propulsion apparatus which is adapted to be used in combination with surface water driving propellers, by which is meant a propeller for large size, high speed marine craft, and which propeller while driving the boat at high speed dips into the water with only a little portion thereof, for instance with 30-50% thereof, whereas the remaining part of the propeller runs in the air above the water level.

A propulsion apparatus of this type are known, for instance by the so called "Arneson-drive" which is shown in the European patent EP-A-37.690 and which comprises a drive body having a substantially circular cross section and a diameter which decreases in the direction towards the propeller, and in which the drive body via a ball joint is connected to a mounting means at the transom of the boat, and which is stablized by a pair of steering cylinders and a tilt cylinder.

Marine propulsion drives having surface driving propellers and formed for being steered and for being tilted in the vertical direction are complicateed and expensive, and they mostly have a drive body shape which is not ideal from water flow viewpoint, for instance since the shape of the drive body is at least to some extent necessarily adapted to the mounting means at the boat's stern and to the steering and tilting means.

It is very well possible to form a propulsion apparatus of the said type having a surface driving propeller without steering means and without tilting means. Such a "fixed" propulsion apparatus is considered advantageous from some viewpoints as compared with the above mentioned known apparatus.

The inventions is based on the idea of providing a fixed type of marine propulsion apparatus having a surface driving propeller, in other words a marine propulsing apparatus not having any steering of tilting facilities for the drive body. In many cases the drive body of a fixed propulsion apparatus can be made more stable than the apparatus having steering and tilting means; for many purposes conventional, separate steering means in the form of rudders mounted in the boat hull are both cheaper and more easy to handle and maintain than steerable drives; at least in the open see a boat can be easier to manage by means of such separate rudder systems; it is possible to form the fixed drive body with a profile which from water flow viewpoint is improved or nearly ideal since it is not necessary to consider any steering and tilting means in the design of the drive body; it is easier to mount the drive body at the boat hull; and the connection of the drive to the drive engines can be made by means of simple, straight and stably beared shafts, etc.

Since boats having surface driving propellers are generally intended to run at very high speeds the water resistance against the drive body is critical, and only a slight water flow restricting part included in the drive body may create turbulent water flows and even cavitation, and this, in turn, leads to power losses, wear of the drive body and the propeller blades, impaired steering capacity and water cascades and splashing water round the propulsion apparatus and even round the entire stern of the boat.

The object of the invention is to solve at least the majority of the above mentioned problems and lacks of the previously known propulsion apparatus of the above mentioned type having surface water driving propellers, and the invention is intended to provide a marine propulsion apparatus of a fixed type, that is a non-steerable and non-tiltable type, which is designed to give the flow of passing water an optimum good, laminary flow without the risque of turbulence and cavitation.

The optimum shape of a body which is moving at high speed in the water is supposed to be an acute or arrow-like shape having the point of the body in the moving direction of the marine craft. For strength technical reasons a drive body of said known type, however, can not be formed conically widened towards the propeller like an arrow, since in such case the entire drive body should be too weak, and in front of all the mounting surface of the drive body at the stern of the marine craft should bee too little and too weak.

Basis of the invention therefore is the idea of formning only the part of the drive body which at high speed is dipped into the water with a spool-shaped surface which is conically widened towards the propeller, like the stem of a canoe, and to form the remaining parts of the drive body, which parts are at high speed driving located above the water with an inversely widened drive body surface, meaning a drive body portion which is tapering towards the propeller. A drive body having such a combined drive body shape is advantageous in providing a canoe-like subwater-body part providing a laminary water flow along the water dipped part of the drive, and a large and stable superwater body part above the water surface and a large mounting surface for the drive body at the stern of the boat.

It is not possible by a simple method to form a drive body of the said type in one piece of material, since it comprises a complicated combination of convex and concave surfaces. Therefore the object of the invention also has been to solve the problem of manufacturing a drive body having said complicated shape comprising a subwater body portion converging in the moving direction of the boat and of the drive and a superwater body portion which is diverging is same direction.

According to the invention this object is fulfilled by means of two specially formed pieces of plates,

whereby both plates are fold to a round form and are joined edge to edge to each other by means of a substantially longitudinal joint. The joining preferably is made by welding but alternatively the plates can be joined by rivetting.

The substantially longitudinal joint between the subwater and superwater portions of the drive body provides a concave fold or flute at opposite sides of the drive body, which flutes, in an ideally designed drive body, form a type of water guiding groove or channel along which the water is guided in a laminary flow along the drive body towards the center and slightly below the center of the propeller.

Further characteristics and advantages of the invention will be evident from the following detailed specification in which reference will be made to the accompanying drawings.

In the drawings figure 1 shows a propulsion apparatus according to the invention seen from above and from the end thereof which is to be mounted at the boat. For the sake of clearness the drive shaft is excluded in figure 1. Figure 2 shows the apparatus of figure 1 straight from above. Figure 3 diagrammatically shows a vertical cross section through the rear part of a boat equipped with the propulsion apparatus according to the invention. Figure 4 shows a boat having a twin arrangment of propulsion apparatus as seen from behind the boat, figure 5 is a perspective view from behind and from underneath the same boat, and figure 6 shows the same boat straight from underneath. Figure 7 diagrammatically illustrates the angles of the drive body and the stern of the boat, "alfa", "beta", "gamma", which are of great importance for the good function of the propulsion apparatus. Figure 8 shows a ready punched out plate for the manufacture of the "superwater" part of the drive body, figure 9 shows a ready punched out plate for the manufacture of the "subwater" part of the drive body, and figure 10 diagrammatically shows how the plates of figures 8 and 9 are being formed and joined to a combined drive body.

The propulsion apparatus shown in the drawings comprises a composed drive body 1 having means, prefably a mounting ring 2 for mounting of the propulsion apparatus on a inclined stern of a boat, and at the opposite end of the drive body there is a propeller means.

The drive body 1 is composed of two different parts, in the following referred to as the "superwater" body 4 and the "subwater" body 5, named considering the fact that the two parts 4 and 5 upon driving the boat at high speed, meaning a speed which is substantially higher than the so called planing limit dprrf, mainly lie above and under the water surface respectively. When the boat is not moving or it is driven at low speed the entire propulsion apparatus, however, is under water.

As best evident from figures 8 and 9 both the superwater body 4 and the subwater body 5 are made from a flat, punched out plate blank of for instance stainless steel or aluminum. The plate blanks are illustrated in figure 8 and 9 respectively. The plate blank for the superwater body 4 has a shape which is similar to a boomerang, which is symmetrical about a central longitudinal axis 6 and which has the convexly bow-formed boomerang point facing the propeller. The boomerang wings end in points 7 which form the lowermost part 7-7 of the drive body adjacent the mounting ring and which in the ready drive body are joined meeting point 7 to point 7. The mainly concave plate edge 8 between the wing points 7 is shaped to form an even surface in the ready drive body, against which surface the mounting ring 2 can be welded, whereby the mounting ring will be inclined a certain angle corresponding to a calculated best mounting angle, "gamma"of figure 7, at the stern of the boat. In the ready drive body the mainly convex edge 9 of the superwater body part 4 sweeps from the lowermost part 7-7 backwards-uppwards and thereafter downwards-forwards round the entire drive body and ends at the points 7-7.

The plate blank for the subwater body part 5, which is likewise symmetrical about a central longitudinal axis 10 forms a convex point 11 adapted to be joined to the front-bottom end part 7-7 of the superwater body 4, and from said point 11 the blank has two diverging edges 12 and a T-shaped transversal rear end 13 adapted to form a substantially cylindrical mounting means 14 for the propeller housing 15. The edges 12 of the subwater body part 5 are joined, preferably welded, to the edges 9 of the superwater body 4, and the transversal end parts 13 are weld connected edge to edge at the top of the drive body.

The drive body part thereby formed provides a subwater body 5 which, as seen rearwardly from the boat stern, is diverging like the stem of a canoe, especially so that each point along the subwater body forms a tangent "alfa" (see figure 7) to the longitudinal direction of the drive body which is 0-4° or preferably 1-2°, corresponding to a diverging angle, as seen in the flow direction of the water of up to 8° or preferable 2-4°. The superwater body part 4 of the drive body is, contrary to the subwater body part 5, converging in the direction towards the propeller 3. For giving give the superwater body part 4 a sufficient strength and stability it may form an angle "beta" (see figure 7) to the central axis of the drive body of about 5-10° or preferably 7-8°, corresponding to a convergence angle, as seen in the flow direction of the water, of 10-20° or preferably 14-16°. As also best shown in figure 7 the stern of the boat is significantly slowly inclined, and it may form an angle "gamma" of 20-30° to the bottom of the boat, which bottom plane, at full speed driving - over planing speed - is supposed to be identical to the horizontal plane. In the case illustrated in figure 3 said angle "gamma" is about 25°, but this is

not a critical angle. Figures 4-7 show that the boat preferably has some overhang.

Figure 4 illustrates a twin mounting in which the two propulsion apparatus are mounted so close to the the V-shaped bottom 16 of the boat that one or two of the shown five propeller blades dip into the water when the boat is driven at a speed over the planing speed, whereas the remaining 4-3 propeller blades appear in the air above the water surface.

It is shown most clearly in figures 3 and 7 that the mounting ring 2 for the drive body should have such an angle in relation to the stern 17 of the boat, that the bottom edge of the subwater body 5 and the above mentioned parts of the superwater body form an angle downwards "alfa" of 0-4° or preferably 1-2° in relation to the water surface. A larger angle than 4° gives,or at least tends to give, a turbulent water flow, and a negative angle, in turn, gives a too little dipping of the propeller blades into the water.

The mounting ring 2 can be screwed of bolted directly to the stern 17 of the boat, and this gives a stable and safe mounting thereof.

As shown in figure 3 the propulsion apparatus is connected to a drive-engine, for to instance a gas turbine 18 having an assisting diesel engine 19, over a straight shaft 20 which can be very stably beared on several places of the boat. Figure 3 also shows how the boat can be formed with a conventionsl rudder 21 having a separate steering means.

The propeller is of a known type having propeller blades 22 which are warpable for front and rear driving of boat and which are specially adapted to surface water driving conditions, and which for this purpose are much larger than convention subwater propeller blades and have a shape and pitch which significantly differ from those of said conventional propeller blades.

Figure 10 diagramatically illustrates how a propulsion apparatus is manufactured. The boomerang-like plate for the superwater body 4 is placed with the rounded boomerang point facing the propeller 3, and the plate for the subwater body 5 is placed with the point 11 thereof facing the mounting means 2. In figure 10 is indicated that the folding round of the superwater plate 4 starts from the lower point 7 at the underside of the drive body, whereas the folding round of the subwater body 5 starts at the upper part thereof located closest to the propeller means 3. It is of course possible to start the folding round of the plates at other points of the drive body. In the illustrated case the superwater plate 4 is now folded up, round the upper side of the drive body and down again on the opposite side of the drive body, so that the points 7-7 meet each other. The subwater plate 5, on the contrary, is fold down, round the underside of the drive body and up again, so that the transversal ends 13-13 form a butt joint. The drive body parts now are welded together along the edges 9 and 12 and along the meeting edges of the transversal ends 13-13. The propeller housing 15 is thereafter put into place and is weld connected to the drive body, and a mounting ring 2 is welded to the end of the drive body to be mounted at the stern of the boat.

Reference numerals

1	drive body
2	mounting ring
3	propeller means
4	superwater body part
5	subwater body part
6	axis (of 4)
7	point (of 4)
8	plate edge
9	plate edge
10	axis (of 5)
11	point
12	plate edge
13	transversal end
14	mounting means
15	propeller housing
16	bottom of boat
17	stern
18	gas turbine
19	diesel engine
20	drive shaft
21	rudder

Claims

1. Propulsion apparatus for high speed, planing marine craft and especially useful for so called surface water driving propellers (3) which with only 30-50% thereof dip into the water, whereas the remaining parts of the propellers are present in the air above the water surface, and comprising a fixed drive body (1) which is non-steerable or which can not be tilted up and down in the vertical direction, and which drive body is adapted to be mounted directly at the stern (17) of a boat, **characterized** in that the drive body is composed by two body parts, which parts respectively form a superwater body part (4) and a subwater body part (5), and in which the superwater body part (4) is formed converging rearwardly towards the propeller (3), and is formed with strong and stable mounting means (2) for mounting of the drive body at the stern (17) of a boat, whereas the subwater body part (5) is formed diverging rearwardly towards the propeller (3).

2. Propulsion apparatus according to claim 1, **characterized** in that the subwater part (5) of the drive body has a point (11) located at the lowermost part of the drive body and closest to the

mounting means (2), and from which point (11) said subwater part (5) extends rearwardly-upwardly along a line (12) on both sides of the drive body and meet edge to edge with the two sides (13-13) thereof close to the propeller (3), whereas the-superwater body part (4) with two points (7-7) thereof extend from a point at the underside of the drive body located at or close to the mounting means (2), and which along the two sides-of the drive body extend rearwardly-upwardly forming the upper side of the drive body (1).

3. Propulsion apparatus according to claim 2, **characterized** in that the subwater body part (5) is widened in the direction towards the propeller (3) with an angle of divergence of up to 8° or preferably of 2-4°.

4. Propulsion apparatus according to claim 1, 2 or 3, **characterized** in that the superwater body part (4) tapers in the direction towards the propeller (3) with an angle of convergence of 10-20° of preferably of 14-16°.

5. Propulsion apparatus according to any of the preceding claims, **characterized** in that the superwater body part (4) and the subwater body (5) part are joined to each other along a joining line (9, 12) which forms a V-shaped flute guiding the water in a laminary flow mainly towards the centre of the propeller (3).

6. Propulsion apparatus according to any of the preceding claims, **characterized** in that the propulsion apparatus is mounted at such angle at the stern (17) of a boat, that the underside of the subwater body (5) at a speed of the boat exceeding the planing speed forms an angle to the water surface of 0-4° or preferably 1-2°.

7. Method for the manufacture of a propulsion apparatus according to any of the preceding claims for high speed, planing marine craft and especially useful for so called surface water driving propellers (3) which with only 30-50% thereof dip into the water, whereas the remaining parts of the propeller are present in the air above the water surface, and comprising a fixed drive body (1) which is non-steerable or which can not be tilted up and down in the vertical direction, and which drive body is adapted to be mounted directly to the stern (17) of a boat, **characterized** in that the drive body is manufactured in the form of a superwater body part (4) and a subwater body part (5) which are joined to each other, and in that said two drive body parts (4, 5) are made from two flat pieces of plate, namely a boomerang-like superwater body part (figure 8) having the convexly curved boomerang point facing the propeller (3), and an arrow-point like subwater plate piece (figure 9) having the point (11) thereof directed to the boat hull, and whereby the two pieces of plate, after having been folded round, the superwater plate (4) downwards from a central longitudinal axis (6) and the subwater plate (5) upwards from a central longitudinal axis (10) and after having been joined along the meeting edges (9, 12) thereof, form a superwater body part (4) and a subwater body part (5), whereby the superwater body part (4) provides a drive body portion which is tapering rearwardly to the propeller (3) and which has a strong and stable mounting means (2) at the opposite end for mounting of the drive body at the stern (17) of the boat, whereas the subwater drive body portion (5) is widened rearwardly towards the propeller (3) to meet the water like the stem of a canoe.

8. Method according to claim 7, **characterized** in that the piece of plate (figure 9) for the subwater body portion (5) of the drive body is designed so that said portion (5) forms, after having been folded round and joined, an angle of divergence, as seen in the flow direction of the water, of 0-8° or preferably 2-4°, and in that the superwater body portion (4) of the drive body (1) forms, after having been folded round and joined to the subwater body portion (5) an angle of convergence, as seen in the flow direction of the water, of 10-20° or preferably 14-16°.

9. Method according to claim 7 or 8, **characterized** in that the superwater body portion (4) and the subwater body portion (5) of the drive body (1) are shaped and joined so that the joining edges (9, 12) of saud two body portions (4, 5) form a concave V-shaped groove which upon driving the boat at a speed exceeding the planing speed guides a laminary flow of water substantially towards the propeller (3).

10. Method according to claim 7, 8 or 9, **characterized** in that the superwater body portion (figure 8), at the end thereof facing the boat hull, is formed with an inclined end surface against which a mounting ring (2) is welded or rivetted, and in that the subwater body portion at the end located adjacent the propeller (3) is formed to a cylinder (14) in or at which a propeller housing (15) is mounted.

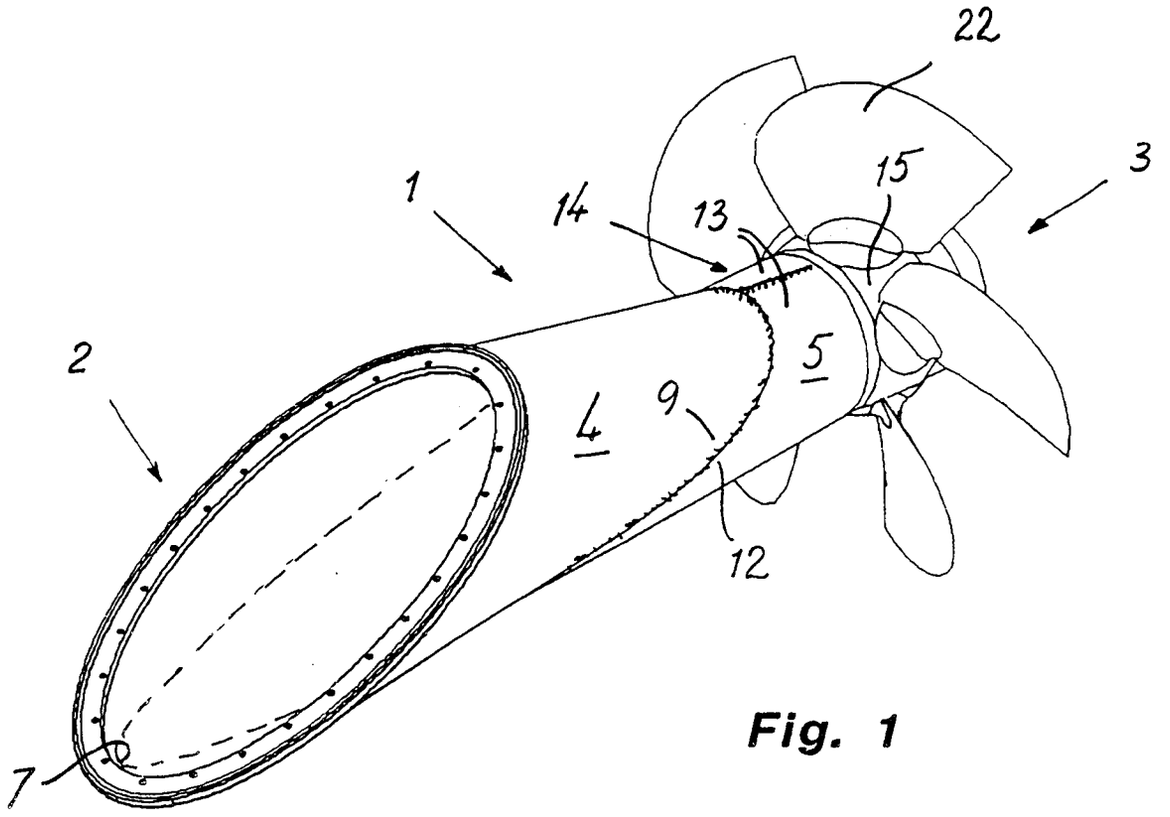

Fig. 1

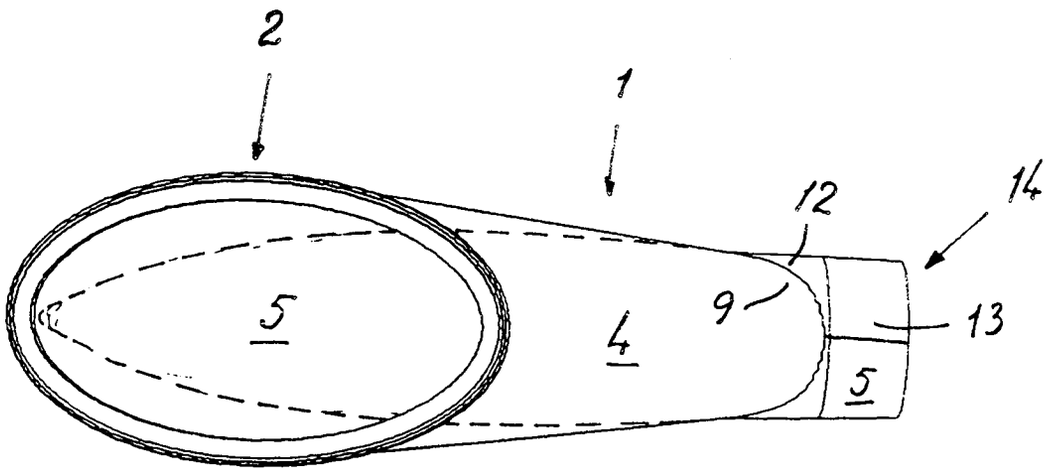

Fig. 2

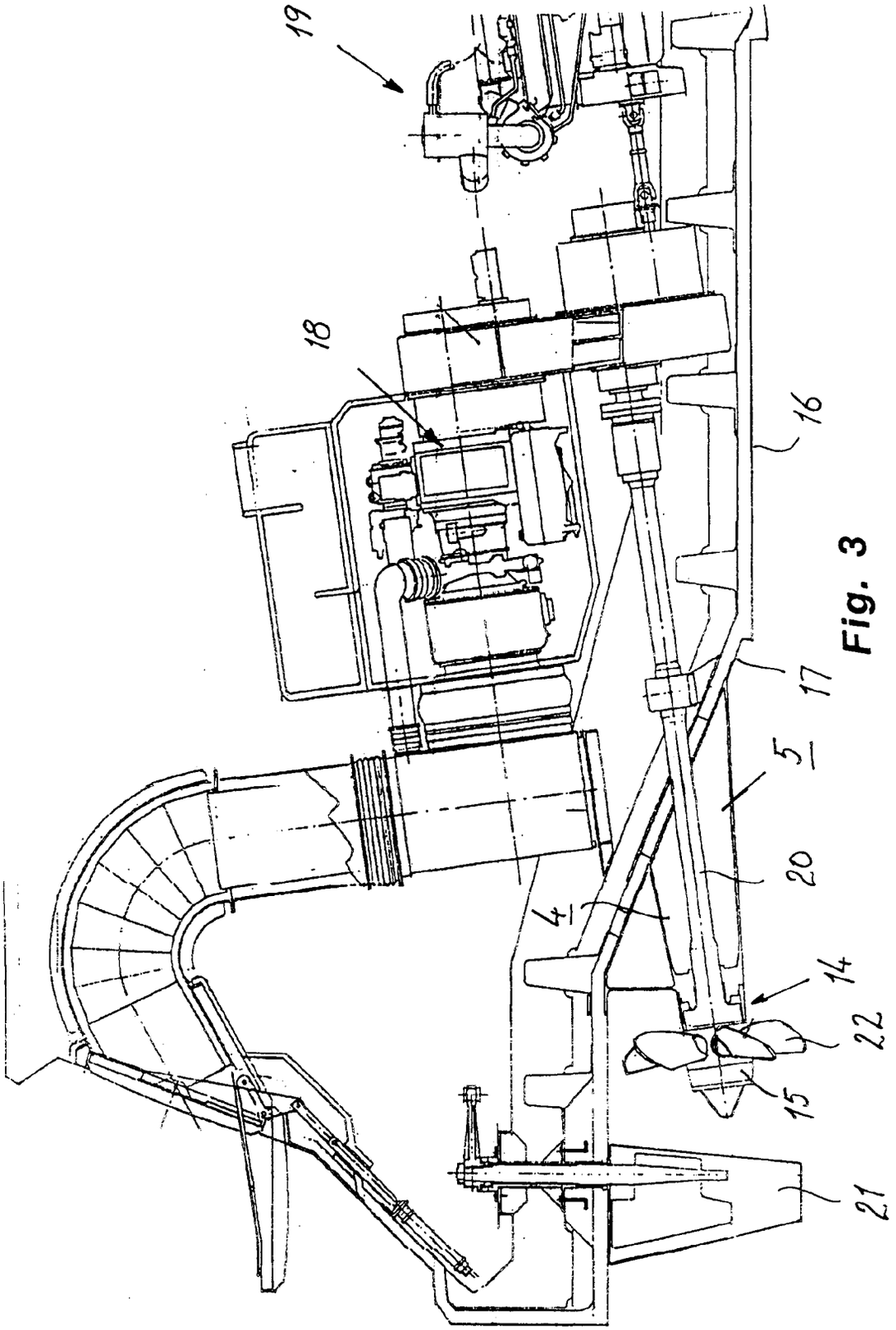

Fig. 3

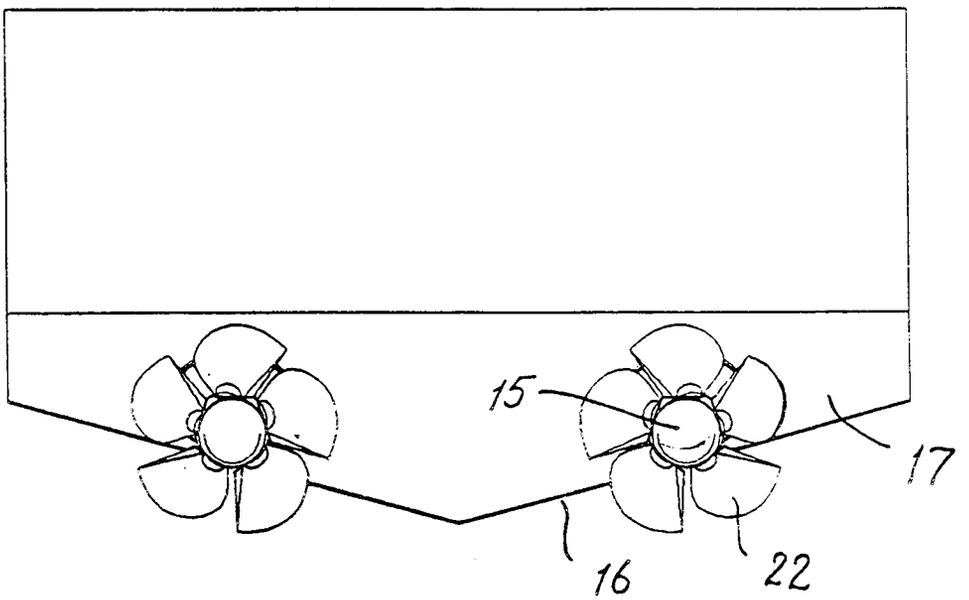

Fig. 4

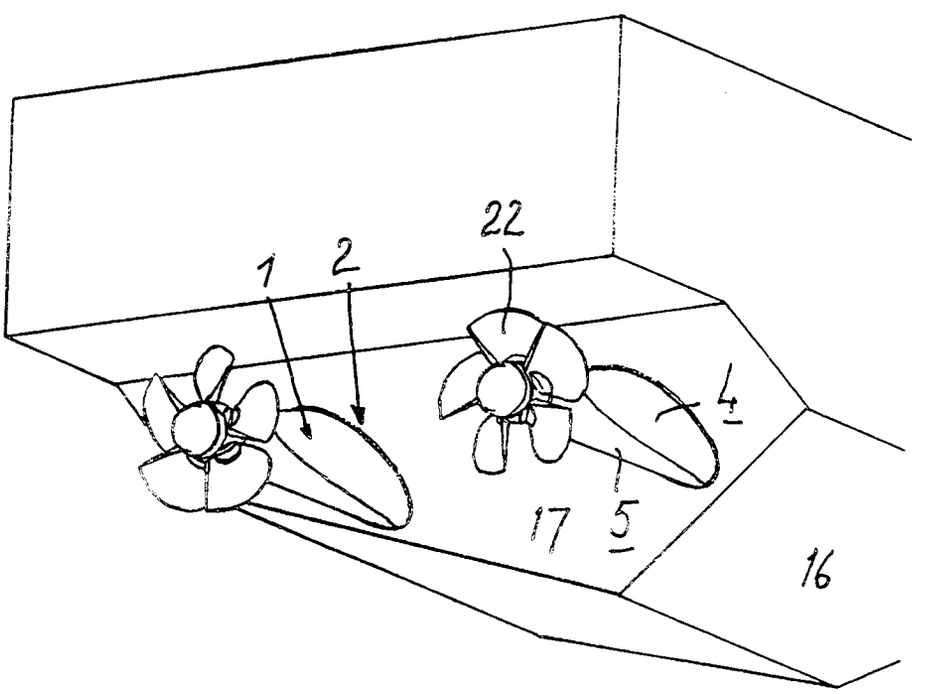

Fig. 5

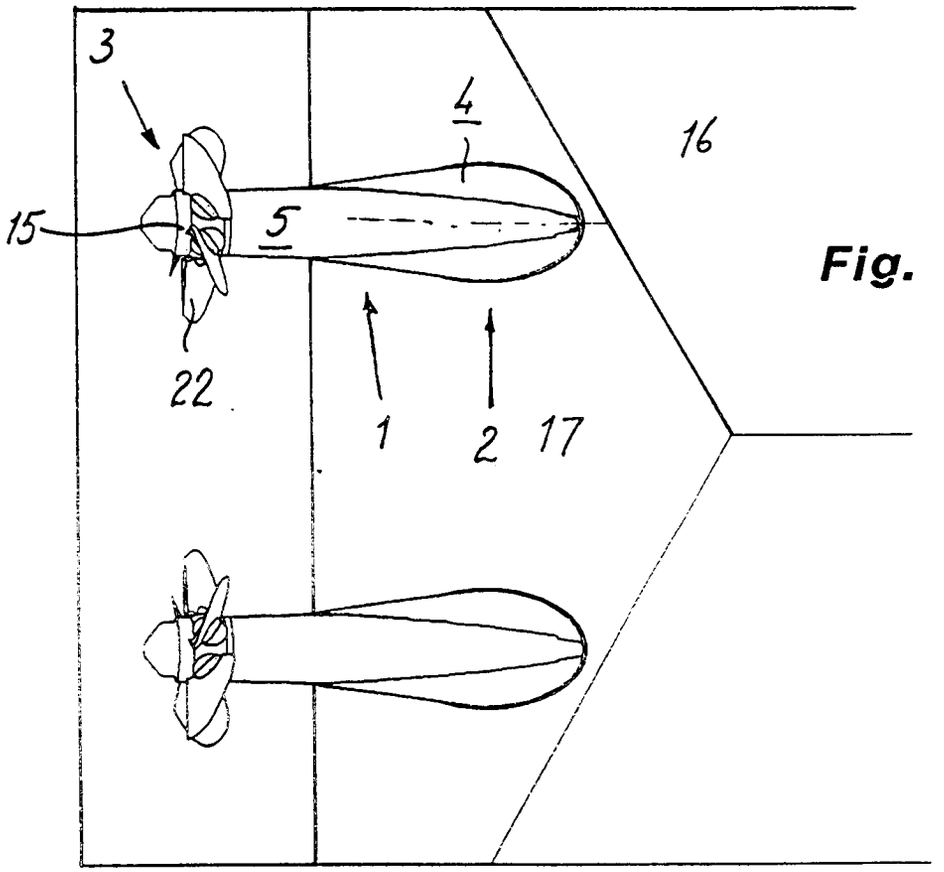

Fig. 6

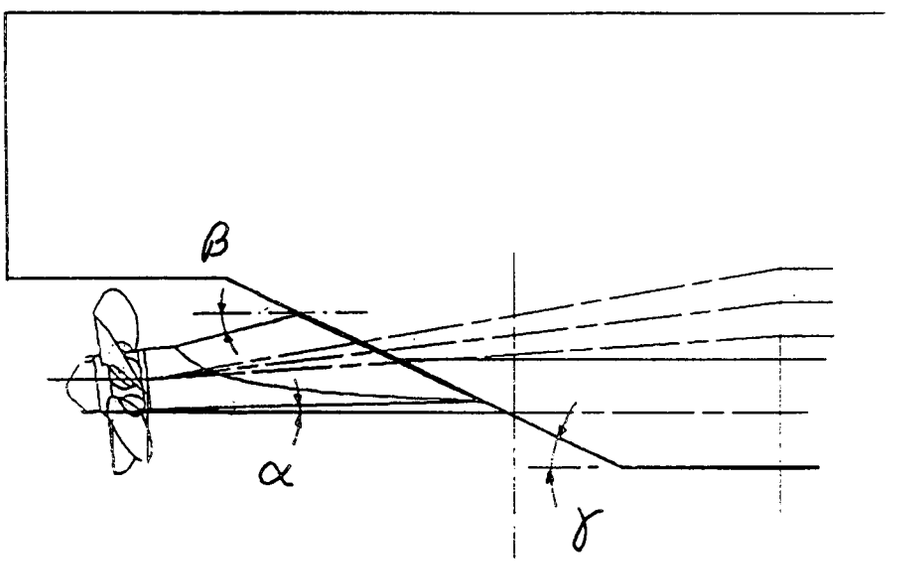

Fig. 7

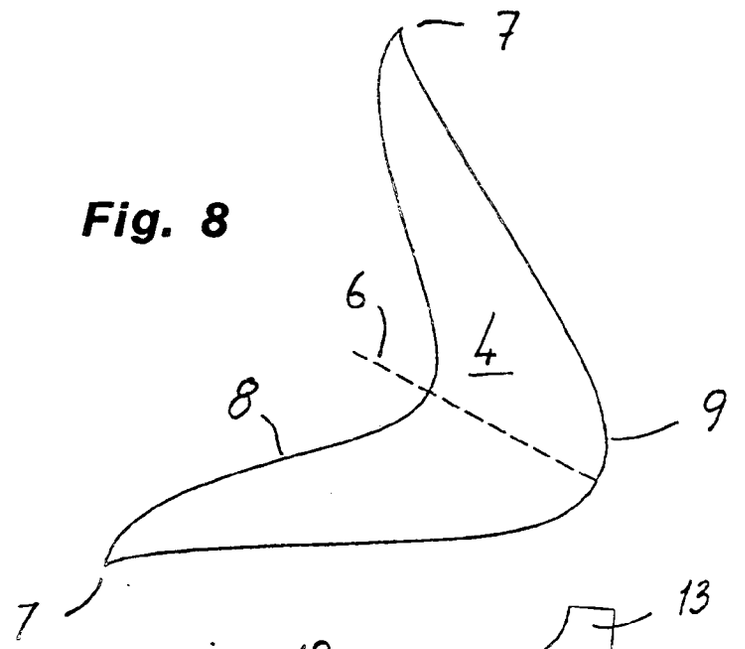

Fig. 8

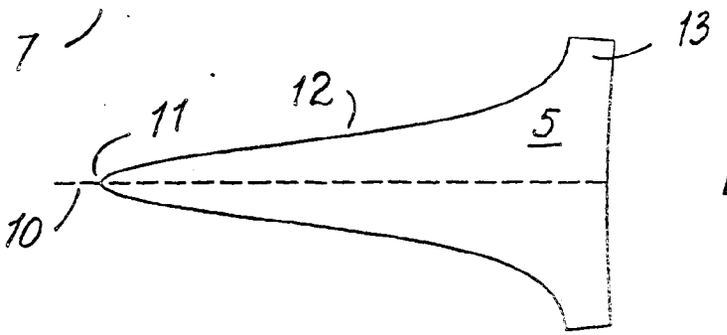

Fig. 9

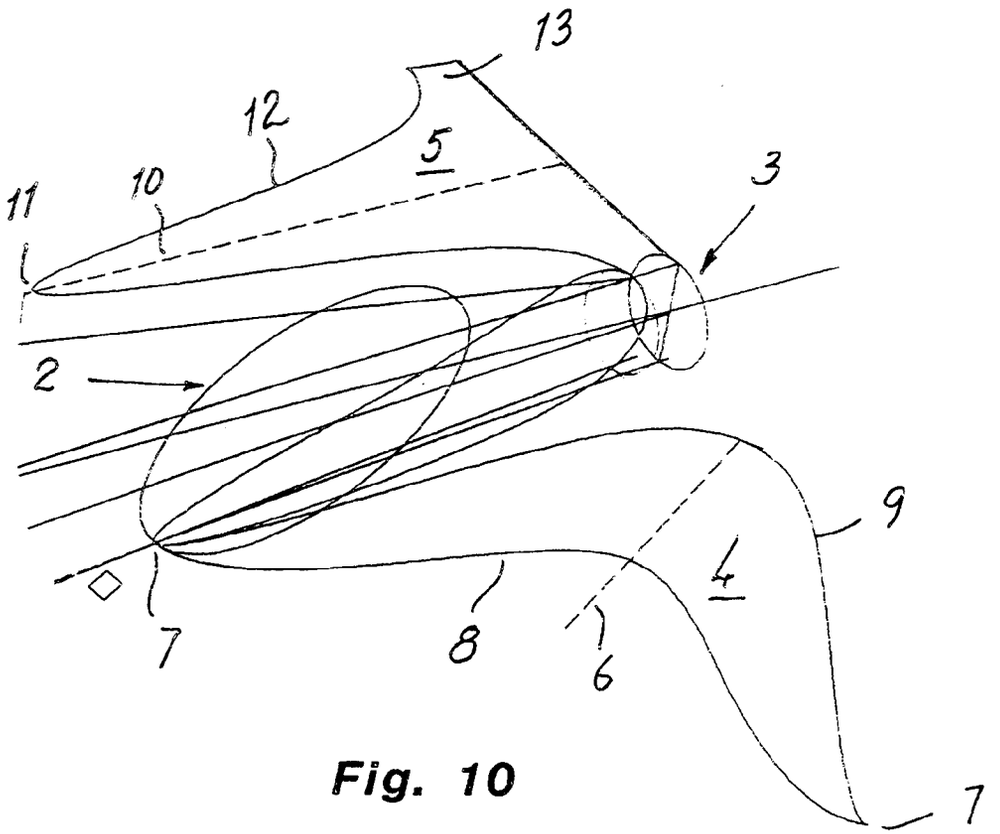

Fig. 10

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 85 0048

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	FR-A-2 431 424 (FIRMA CARL HURTH MASCHINEN- UND ZAHNRADFABRIK) * page 1, line 1 - line 4 * * page 6, line 8 - line 30 * * figures 1,4 * ---	1,7	B63H5/16 B63H23/36
A	GB-A-389 643 (E. VAN DER MOLEN) * claim 1; figures * -----	1,7	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B63H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26 MAY 1992	STIERMAN E.J.

CATEGORY OF CITED DOCUMENTS

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