PRE-NOZZLE FOR A DRIVE SYSTEM OF A WATERCRAFT TO IMPROVE THE ENERGY EFFICIENCY

The invention relates to a pre-nozzle for a drive system of a watercraft to improve the energy efficiency.

Drive systems for different types of ships to improve the drive power requirements are known from the prior art. Known from EP 2 100 808 A1 is, for example, a drive system for a ship, based on a pre-nozzle. The drive system consists of a propeller and a pre-nozzle which is mounted directly upstream of the propeller and comprises fins or hydrofoils integrated in the pre-nozzle. The pre-nozzle substantially has the shape of a flat conical cut-out, where both openings, both the water inlet and the water outlet opening, are configured as circular openings and the water inlet openings has a larger diameter than the water outlet opening. It is thereby possible to improve the propeller afflux and to reduce the losses on the propeller stream due to pre-swirl generation by means of the fins or hydrofoils integrated in the pre-nozzle.

Embodiments of the present invention seek to provide a pre-nozzle for a drive system of a watercraft for further improvement of the drive efficiency, in particular for slow, large-volume ships.

According to a first aspect of the present invention, there is provided a pre-nozzle for a drive system of a watercraft, wherein a jacket of the pre-nozzle comprises a water inlet opening and a water outlet opening, wherein a fin system is disposed inside the jacket of the pre-nozzle, wherein the fin system is not arranged in an inlet region of the pre-nozzle, wherein no propeller is disposed inside the pre-nozzle, wherein the jacket of the pre-nozzle is configured to be rotationally asymmetrical, wherein the jacket of the pre-nozzle when viewed in cross-section comprises rectilinear sections, said rectilinear sections extending over an entire length of the pre-nozzle.

Accordingly, the pre-nozzle for a drive system of a watercraft, in particular a ship of the type described initially, is configured in such a manner that a fin system is disposed inside the pre-nozzle. In this case, the pre-nozzle is located upstream of a propeller in the direction of travel of the ship. "In the direction of travel of the ship" is to be understood here as the forward direction of travel of a ship. No propeller is located inside the pre-nozzle as for example, in Kort nozzles. Furthermore, the pre-nozzle is located at a distance from the propeller. The fin system located inside the pre-nozzle consists of a plurality of, for

CLAIMS

1. Pre-nozzle for a drive system of a watercraft, wherein a jacket of the pre-nozzle comprises a water inlet opening and a water outlet opening, wherein a fin system is disposed inside the jacket of the pre-nozzle, wherein the fin system is not arranged in an inlet region of the pre-nozzle, wherein no propeller is disposed inside the pre-nozzle, wherein the jacket of the pre-nozzle is configured to be rotationally asymmetrical, wherein the jacket of the pre-nozzle when viewed in cross-section comprises rectilinear sections, said rectilinear sections extending over an entire length of the pre-nozzle.

2. The pre-nozzle according to claim 1, wherein the water inlet opening of the jacket of the pre-nozzle is expanded in particular downwards and/or upwards to improve the water inflow.

3. The pre-nozzle according to any one of claims 1 or 2, wherein opening planes of the water inlet opening and the water outlet opening of the jacket of pre-nozzle are each enclosed by a front-end edge of the jacket of the pre-nozzle, wherein at least one of the two enclosed opening planes has a greater length between an upper profile line and a lower profile line than in the horizontal direction.

4. The pre-nozzle according to claim 3, wherein the water-inlet-side opening plane of the jacket of the pre-nozzle is greater than the water-inlet-side opening area of a rotationally symmetrical jacket of a pre-nozzle having the same central radius.

5. The pre-nozzle according to any one of the preceding claims, wherein the pre-nozzle at least partially encloses a propeller axis of a watercraft.

6. The pre-nozzle according to any one of the preceding claims, wherein an opening plane of the water inlet opening and an opening plane of the water outlet opening of the pre-nozzle are each enclosed by a front-end edge of a nozzle body of the pre-nozzle, wherein the two opening planes of the pre-nozzle are at least partially not parallel to one another.

7. The pre-nozzle according to any one of the preceding claims, wherein the jacket of the pre-nozzle has a profile length, wherein the profile length is not constant around the circumference of the jacket in each area of the pre-nozzle.

8. The pre-nozzle of a ship according to claim 7, wherein the profile length of the jacket of the pre-nozzle decreases continuously within a lower region of the jacket of the pre-nozzle when viewed from top to bottom.

9. The pre-nozzle according to any one of the preceding claims, wherein the opening plane of the water inlet opening and the opening plane of the water outlet opening of the pre-nozzle are each enclosed by a front-end edge of the jacket of the pre-nozzle, wherein the water-inlet-side opening plane of the jacket of the pre-nozzle has at least one angle of intersection with the cross-sectional area of the jacket of the pre-nozzle.

10. The pre-nozzle of a ship according to claim 9, wherein the angle of intersection is constant and greater than 0°.

11. The pre-nozzle according to claim 3, wherein the jacket of the pre-nozzle has an upper profile angle between the upper profile line and the axis of rotation of the pre-nozzle and/or that the jacket of the pre-nozzle has a lower profile angle between the axis of rotation and the lower profile line of the jacket of the pre-nozzle, wherein the opening angle of the pre-nozzle between upper and lower profile line of the jacket of the pre-nozzle is greater than twice the upper profile angle or greater than twice the lower profile angle.

12. The pre-nozzle according to claim 11, wherein the opening angle of jacket of the the pre-nozzle between upper and lower profile line of the jacket of the pre-nozzle corresponds to the sum of twice the upper profile angle and the angle of intersection or the sum of twice the lower profile angle and the angle intersection.

13. The pre-nozzle according to claim 11 or 12, wherein the lower profile angle is greater than the upper profile angle.

14. The pre-nozzle according to any one of the preceding claims, wherein the water-inlet-side opening plane of the jacket of the pre-nozzle is bent or curved and in particular is formed over at least two planes, which are at an angle to one another, wherein the angle is greater than 90° and smaller than 180°.

15. The pre-nozzle according to any one of the preceding claims, wherein the profile length of the jacket of the pre-nozzle between upper and lower profile line of the jacket of the pre-nozzle decreases continuously from top to bottom.

16. The pre-nozzle according to any one of claims 9 to 15, wherein the value of the angle of intersection is constant.

17. The pre-nozzle according to any one of claims 1 to 5, wherein the jacket of the pre-nozzle has a constant profile length, so that the profile length is the same in the entire region of the jacket of the pre-nozzle.

18. The pre-nozzle according to any of the preceding claims, wherein the rectilinear sections in a cross-sectional view interconnect a plurality of arcuate sections.

19. The pre-nozzle according to any one of the preceding claims, wherein the rectilinear sections are disposed at the side region of the jacket of the pre-nozzle.

20. The pre-nozzle according to any one of the preceding claims, wherein the ratio of the greatest length of at least one opening plane of the jacket of the pre-nozzle in the vertical direction to the average profile length of the jacket of the pre-nozzle is between 1.5 : 1 and 4 : 1.