

A ship propulsion system with a nozzle and a propeller

The invention relates to a ship propulsion system according to the preamble of claim 1.

5

Such ship propulsion systems are well known (see DE 28 48 785 C2). Such propulsion systems can be arranged in the stern region of a ship. They can be fixed or pivotable. The inner surface of the nozzle forms a flow channel whose longitudinal axis extends coaxially to the propeller. The channel width generally changes over the length of the nozzle. The channel may comprise a converging and a diverging section. Cylindrical sections are also provided. The nozzle body has a certain thickness. Water can flow about the outer surface.

10

An important parameter is the ratio of the produced thrust of the propulsion system in relation to the power absorbed. The ratio of the nozzle thrust in relation to the propeller thrust is also very important. This ratio lies in practice close to 1, e.g. at 0.7 to 0.8.

15

Both numbers are important parameters of the specific power demand. Efforts are undertaken to improve these values.

20

The invention is based on the object of providing a ship propulsion system of the kind mentioned above in which the ratio of nozzle thrust to propeller thrust is as large as possible.

25

This object is achieved by the features of the independent claims.

The inventors have accordingly found that at least one of the three following conditions needs to be fulfilled in order to achieve this object.

30

- The propeller is located downstream of the constriction of the flow channel or
- the constriction of the flow channel is situated at a specific point in the length of the nozzle body.

5

The advantage to be achieved by the invention is virtually spectacular. During the tests, the invention led to such a ratio of nozzle thrust to propeller thrust that the inventor interrupted the tests at first because they believed the measuring instruments to be defective. The ratio of nozzle thrust to propeller thrust led to a value which far exceeded 1, namely approximately 1.5.

10

The invention is explained in closer detail by reference to the drawing, which shows the following in detail:

15

Fig. 1 shows an axial sectional view of a ship propulsion system with a nozzle body and a propeller;

Fig. 2 shows a highly schematic view of an axial section of a second propulsion system;

20

Fig. 3 again shows a highly schematic view of a further propulsion system;

Figs. 4 – 7 show further nozzle bodies in axial sectional views;

25

Fig. 8 shows an axial section in a highly schematic view of a third ship propulsion system with two different axial propeller positions.

30

The ship propulsion system shown in Fig. 1 comprises a nozzle body 1 and a propeller 2 which is enclosed by said nozzle body. The propeller 2 comprises a propeller shaft 2.1 and four propeller blades 2.2.

The nozzle body 1 comprises an inner surface 1.1 and an outer surface 1.2. The inner surface 1.1 forms a flow channel through which the flow passes in the direction of the arrow. The channel comprises a constriction 3. The apex of each propeller blade 2.2 in the radially outer region is situated downstream of the constriction 3, which is precisely shown in Fig. 2 and also in Fig. 8. This axial sectional view shows a hydrofoil profile.

Figs. 2 and 3 show the hydrofoil profile of the nozzle body 1 again. In the embodiment according to Fig. 2, the propeller 2 is clearly displaced in relation to the constriction in the downstream direction, which is in the direction of the flow.

The inner surface 1.1 of the nozzle body 1 which forms the flow channel has a first contour I which forms the inlet section of the flow channel. Contour I is situated between the entrance plane 4 and the constriction 3. Contour I obeys a specific quadratic function with a deviation of ± 5 percent of the length 1.2 of the nozzle body 1. The inner surface 1.1 has a second contour II. Contour II is situated between the constriction 3 and the outlet plane 5. Contour II obeys a specific rational function, which again occurs with a deviation of ± 5 percent of the length 1.2 of the nozzle body 1. The constriction 3 is situated at the location where the contours I and II meet each other.

The contour III of the outer surface 1.2 of the nozzle body 1 belongs to a polynomial of sixth order, again with the aforementioned possible deviation of ± 5 percent of the length 1.3 of the nozzle body 1.

In the embodiment according to Fig. 3, the propeller 2 is situated at the constriction 3 of the flow channel. Everything else is similar to the embodiment according to Fig. 2.

Figs. 4 to 7 show further embodiments of nozzle bodies 1, which all include a hydrofoil profile.

- 5 Axial propeller positions are shown in the embodiment according to Fig. 8. In the illustration with the unbroken line the propeller is situated downstream of the constriction 3 and in the illustration with the dashed line it is located at the constriction 3.

List of reference numerals

	1	Nozzle body
	1.1	Inner surface
5	1.2	Outer surface
	1.3	Length of nozzle body 1
	2	Propeller
	2.1	Propeller shaft
	2.2	Propeller blade
10	3	Constriction

CLAIMS:

1. A ship propulsion system;
 - 1.1 comprising a nozzle body (1) and a propeller (2) enclosed by said nozzle body;
 - 1.2 the nozzle body (1) has an inner surface (1.1) which forms a flow channel, and further an outer surface (1.2);
 - 1.3 a constriction (3) is situated between the inlet plane and the outlet plane of the flow channel;
 - 1.4 as seen in an axial sectional view, the inner boundary surface of the flow channel has a first contour (I) between the inlet plane and the constriction (3), and a second contour (II) between the constriction (3) and the outlet plane;
 - 1.5 the constriction (3) is situated at a distance of 0.25 to 0.55 of the length of the nozzle body (1) as measured from the inlet plane, preferably 0.3 to 0.4.
2. A ship propulsion system according to claim 1, characterized in that the propeller (2) is situated downstream of the constriction (2).
3. A ship propulsion system according to claim 1 or 2, characterized in that the first contour is at least approximately a hyperbola.
4. A ship propulsion system according to one of the claims 1 to 3, characterized by the following features:
 - 4.1 the second contour (II) is at least approximately rectilinear;
 - 4.2 the flow channel expands between the constriction (3) and the outlet plane;
 - 4.3 the opening angle between the second contour (II) and the longitudinal axis of the flow channel lies between 5 and 15°, preferably between 8 and 11°.

5. A ship propulsion system according to one of the claims 1 to 4, characterized by the following features:

the contour (I) follows the following rational function:

$$y = (a + bx) / (1 + cx + dx^2)$$

with the following coefficients

$$a = 0.21480055$$

$$b = -0.6380295$$

$$c = 22.43205$$

$$d = -23.304763,$$

namely for a length of one meter of the nozzle body (1), wherein the coefficients need to be scaled accordingly in the case of deviating lengths of the nozzle body (1).

6. A ship propulsion system according to one of the claims 1 to 5, characterized by the following features:

the second contour (II) follows the following quadratic function

$$y = a + bx^2$$

with the following coefficients:

$$a = -0.01965953$$

$$b = 0.01381632$$

$$c = 0.09219007,$$

namely for a length of one meter of the nozzle body (1), wherein the coefficients need to be scaled accordingly in the case of deviating lengths of the nozzle body (1).

- 5 7. A ship propulsion system according to one of the claims 1 to 6,
characterized by the following features:
- 7.1 the outer surface (1,2) of the nozzle body (1) has a contour (II) as a
polynomial of sixth order according to the following function:

10
$$y = a + bx + cx^2 + dx^3$$

with the following coefficients:

15
$$\begin{aligned} a &= 0.24418034 \\ b &= 0.919041095 \\ c &= -8.7136152 \\ d &= 29.591049 \\ e &= -51.371726 \\ f &= 43.581168 \\ g &= -14.141404, \end{aligned}$$

20

namely for a length of one meter of the nozzle body (1), wherein the coefficients need to be scaled accordingly in the case of deviating lengths of the nozzle body (1).

25

8. A ship propulsion system according to one of the claims 4 to 7,
characterized by a deviation of the aforementioned numbers by ± 10
percent, at least by ± 5 percent.

9. A ship with a ship propulsion system, characterized in that the ship propulsion system is arranged according to one of the claims 1 to 8.