

Ship Provided With At Least One Shaft Line Equipped With A Helical Pump Propeller

5 The present invention relates to a ship, especially a passenger ship,
which is provided with at least one shaft line equipped with a propeller consisting
of a sub-nozzle helix fitted with a stator, the whole being called "helical pump"
hereinbelow and described more precisely hereinbelow.

 The use of a helical pump as propeller in a propulsion installation of a ship
has multiple advantages.

10 In fact, the installation is mechanically simple relative to other propulsion
systems used, especially for liners, such as "pods", and provides high-output
thrust with a minimum of acoustic noise and vibration.

A helical pump generally comprises a stator (constituted by several flow-directing
fins), a rotor (in this case a helix) and a nozzle enclosing the assembly.

15 The forms of the nozzle, the vanes of the rotor and of the stator are
designed as is known to get the best output and attain a given speed with the
lowest possible mechanical power.

 The helical pump is connected to the ship by means of a shaft line which
drives the rotor in rotation. This drive can be accomplished by any type of known
20 process (by crank, enclosed electric motor, etc.).

 When it is operating, the stator, generally located upstream of the rotor,
communicates a rotational component to the flow about the axis of the nozzle in a
direction of rotation opposite the direction of rotation of the rotor. Generating this
rotation creates hydrodynamic torque on the stator via reaction.

25 This arrangement aims to compensate the rotational effect caused by the
rotor on the fluid and improve output of the installation. In an optimised design,
torque on the stator is equal and opposite the torque on the rotor, the result of
which is to cancel the quantity of angular movement in the wake of the propeller
assembly.

30 Also, criteria for distancing the propeller relative to the hull of the ship are
used to reduce interactions between the hull and the hull.

 Embodiments of the present invention seek to further improve the
propulsive output of a helical pump on board a ship; more particularly, to provide

a hydrodynamic hull form for optimising the overall propulsive output of a ship propelled by one or more helical pumps.

An aspect of the present invention provides a ship, especially a passenger ship, which is provided with at least one shaft line equipped with a propeller consisting of a helical pump comprising a rotor, one or more stators and a nozzle, characterised in that its hull has, substantially opposite said helical pump, a concave form and the curve delimiting this concave form, according to a longitudinal and vertical cut plane passing through the axis of rotation of the rotor, has two points of inflexion, one located upstream and the other downstream of said helical pump, and a tangent parallel to the axis of the shaft line, said tangent located upstream of said helical pump.

According to other advantageous and non-limiting characteristics of this ship:

- said tangent upstream of said helical pump is located at an axial distance L from the leading edge of the nozzle, this distance being less than $D/4$, D being the diameter of said rotor;
- said hull is distant from said nozzle by a constant gap, according to a direction perpendicular to the axis of said shaft line;
- the median longitudinal plane of the ship constitutes a plane of symmetry of said hull, this plane passing through the thin plane of the ship;
- in a horizontal plane, and/or in intermediate planes located between the vertical plane and said horizontal plane and passing through the axis of the shaft line, substantially opposite the helical pump the surface of said thin plane has a concave form and the curve delimiting this concave form, according to this horizontal and/or intermediate plane passing through the axis of rotation of the rotor has two points of inflexion, one located upstream and the other downstream of said helical pump, and a tangent parallel to the axis of the shaft line, a tangent located upstream of said helical pump.
- the distance H1 between the axis of the shaft line and said hull, measured perpendicularly to the axis of the shaft line and at said distance L from said leading edge of the nozzle is greater than the distance H2 between the axis of the shaft line and said hull,

measured perpendicularly to the axis of the shaft line and just downstream of the nozzle;

- in a cut plane transversal and vertical to said nozzle, said hull is distant from said nozzle by said constant gap, over an angular sector of at least 45°.

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Other characteristics and advantages of the present invention will emerge from the following detailed description.

This description will be given in reference to the attached diagrams, in which:

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- figure 1 is a view in longitudinal section of the hull of a ship with a propulsion installation with helical pump, this cut plane I-I passing through the axis of rotation of the helix of the pump;

- figure 2 is a view according to the plane II-II of the figure 1, more particularly showing the structure of the helical pump.

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- figure 3 finally is a schematic view in transversal section of a hull provided with two helical pumps.

The ship 1 illustrated very partially in the attached figures comprises a hull designated 2.

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It comprises a thin plane PM located in the plane of symmetry of the ship, integrated into the rear part of the hull.

On both sides of this thin plane, extending parallel to the longitudinal axis of the ship is a shaft line 3 which can be attached to the hull by one or more arms 30 and at the end of which is mounted the rotor of the helical pump 4 (clearly, because of the cut shown here only one line 3 is visible. However, the details specified hereinbelow apply to each of them).

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It is evident especially in figure 1 that this helical pump is placed slightly upstream of the trailing edge of the thin plane PM.

In the figures, AM corresponds to upstream, while AV corresponds to downstream, which decides direction of flow of the fluid through the installation.

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In reference to the helical pump 4, its stators are designated 40, its helix or rotor 42, and its nozzle 41.

It is noted that the latter complies so as to be convergent from upstream to downstream.

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According to the invention, substantially opposite the helical pump 4 the hull 2 has a concave form C and the curve I which delimits this concave form,

according to the vertical longitudinal cut plane I-I which passes through the axis of rotation of the rotor 42 of the helical pump, has two points of inflexion designated respectively PI1 and PI2, one PI1 being located upstream of the helical pump 4, whereas the other PI2 is located downstream.

5 This line I also has a tangent T which is parallel to the axis X-X' of shaft line 3, this tangent being located upstream of the pump.

It is preferably located at an axial distance L from the leading edge 410 of the nozzle 41, this distance L being less than $D/4$, D being the diameter of the rotor.

10 Because of this combination of characteristics, the propulsion system comprising the helical pump is arranged partially in the concavity C, such that it benefits from the combined effect of the viscous slowdown associated with the proximity of the largest possible layer surface, and of the slowdown of the fluid in this cavity. The helical pump is fed by a slowed flow, which improves the
15 propulsive output.

Also, and as indicated earlier, according to an advantageous characteristic of the invention, the hull 2 is distant from the nozzle 41 by a constant gap G according to a direction perpendicular to the axis X-X' of the shaft line 3.

20 This arrangement both avoids creating divergent sections and especially separation of the flow in this channel, and also makes the flow external to the propeller parallel to the axis of the propeller so as not to create drag additional on the hull when the propeller is running.

The suction effect is limited.

25 The best results are obtained when the distance H1 between the axis X-X' of the shaft line 3 and the hull 2, measured perpendicularly to this axis X-X' of the shaft line and the distance L of the leading edge 410 of the nozzle 41, is greater than the distance H2 between the axis X-X' of the shaft line 3 and the hull 2, measured perpendicularly to the axis of the shaft line 3 and just downstream 1
30 of the nozzle 41.

In a more preferred embodiment, in the cut plane II-II transversal and vertical to said nozzle 31, the hull 2 is distant from the nozzle 31 by a constant gap G over an angular sector by at least 45° .

Clearly, in this configuration in which the ship has two shaft lines
35 equipped with a helical pump (as is particularly evident in figure 3) the

longitudinal and vertical plane P which passes through the thin plane PM of the ship and which comprises a plane of symmetry of the hull, also comprises a plane of symmetry for said helical pumps.

5 The surface of the thin plane PM can be designed to reproduce geometric characteristics of the hull identical to that described earlier in the vertical plane in the horizontal plane HO, or in an intermediate plane IN extending between the horizontal plane HO and the vertical plane.

10 In other terms, in these directions, the hull also has a concave form, with a curve I having two points of inflexion and a tangent such as described earlier.

CLAIMS

1. A ship, especially a passenger ship, which is provided with at least one shaft line equipped with a propeller consisting of a helical pump comprising a rotor, one or more stators and a nozzle, characterised in that its hull has, substantially opposite said helical pump, a concave form and the curve delimiting this concave form, according to a cut plane longitudinal and vertical passing through the axis of rotation of the rotor, has two points of inflexion, one located upstream and the other downstream of said helical pump, and a tangent parallel to the axis of the shaft line, said tangent located upstream of said helical pump.

2. The ship according to Claim 1, characterised in that said tangent upstream of said helical pump is located at an axial distance from the leading edge of the nozzle, this distance being less than $D/4$, D being the diameter of said rotor.

3. The ship according to Claim 1 or 2, characterised in that said hull is distant from said nozzle by a constant gap, according to a direction perpendicular to the axis of said shaft line.

4. The ship according to any one of Claims 1 to 3, which comprises two parallel shaft lines, characterised in that the median longitudinal plane of said hull constitutes a plane of symmetry for said helical pumps, this plane passing through the thin plane of the ship.

5. The ship according to Claim 4, characterised in that the surface of said thin plane has, in a horizontal plane and/or in intermediate planes located between the vertical plane and said horizontal plane and passing through the axis of the shaft line, substantially opposite the helical pump, a concave form and the curve delimiting this concave form according to this horizontal and/or intermediate plane passing through the axis of rotation of the rotor has two points of inflexion, one located upstream and the other downstream of said helical pump,

and a tangent parallel to the axis of the shaft line, said tangent located upstream of said helical pump.

5 6. The ship according to any one of Claims 1 to 4, characterised in that the distance between the axis of the shaft line and said hull, measured perpendicularly to the axis of the shaft line and at said distance from said leading edge of the nozzle, is greater than the distance between the axis of the shaft line and said hull, measured perpendicularly to the axis of the shaft line and the trailing edge of the nozzle.

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 7. The ship according to any one of Claims 3 to 6, characterised in that, in a cut plane transversal and vertical to said nozzle, said hull is distant from said nozzle by said constant gap over an angular sector by at least 45°.

ABSTRACT**Ship provided with at least one shaft line
equipped with a helical pump propeller**

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The present invention relates to a ship, especially a passenger ship, which is provided with at least one shaft line (3) equipped with a propeller consisting of a helical pump (4) comprising a rotor (42), one or more stators (40) and a nozzle (41), characterised in that its hull (2) has, substantially opposite said
10 helical pump (4), a concave form (C) and the curve (I) delimiting this concave form, according to a longitudinal and vertical cut plane (I-I) passing through the centre of rotation of the rotor (42), has two points of inflexion (PI1, PI2), one (PI1) located upstream and the other (PI2) downstream of said helical pump (4), and a
15 tangent (T) parallel to the axis (X-X') of the shaft line (3), a tangent located upstream of said helical pump (4).

Figure 1