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Wind Drive for a Ship

The invention relates to a wind drive for a ship comprising
5 a Flettner-rotor and a surface which is influenced by the
flow conditions at the periphery of the rotor, said sur-
face being swivellable about the rotor axis and being rot-
atable about a pitch axis of its own.

10 In drives of the above described kind the surface is
arranged approximately in the form of a rudder in order to
bring about a control effect and in order to improve the
working efficiency of the rotor.

15 In addition to ships drives in which a rotating cylinder
with end discs develops a propulsive force when acted on
by the wind (Flettner-rotor), it is also known to use
sails (principle of the Rah-sail) for the propulsion of
ships.

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The problem underlying the invention is to provide a wind
drive, or auxiliary wind drive, for ships which has better
efficiency than the known wind exploiting devices. This
means that the performance of the wind drive in accordance
25 with the invention should be significantly better, related
to its constructional size, than that of the known devices
consisting of sail or rotor.

Starting from the initially described known wind drive
30 this problem is solved by an arrangement in which the
surface is formed by a sail which is symmetrical about a
plane through its pitch axis and rotatable through 360°
about this pitch axis, with the sail also being acted on,
in part, by the undisturbed wind flow.

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1 The technical flow processes occurring at a cylinder
against which the wind blows are exploited in this way
for propulsion or thrust generation by an accurately
spaced and pitched symmetrical sail.

5 Further developments of the invention are to be found in
the subclaims. Of these developments the jointly swivel-
lable rotor and sail (see Fig. 3) serve to facilitate
more rapid and better matching of changes in the wind
10 direction to the desired course of the ship.

The thrust or propulsion generated by a rotating cylinder
against which the wind blows arises, in accordance with
the "Magnus-effect", in known manner from the circulatory
15 flow (at the surface of the cylinder jacket) and the
parallel air flow (wind) superimposed thereon. This results
in a large flow velocity and an area of low pressure on
that side of the cylinder where the direction of rotation
of the cylinder and the wind direction are the same.

20 A smaller flow velocity and an area of excess pressure
arise at the opposite side of the cylinder where the
cylindrical jacket runs counter to the wind flow. If now
a symmetrical sail is arranged in the low pressure area
25 of the rotor so that, on the one hand, it does not negat-
ively influence the flow processes at the rotor but, on
the other hand, just profits from the higher flow velocit-
ies, then advantageous flow conditions exist for the sail.
The total thrust of the wind drive of the invention
30 results from the joint propulsive effects, i.e. thrust
from the rotor and from the sail.

The dimensions of the rotor and the sail surface have a
specific ratio one to the other. It is assumed that the
35 rotor diameter and the rotor length are proportioned
approximately in the ratio 1 : 4. The sail surface is so
dimensioned that its height exactly matches the height

- 1 between the two end discs of the rotor. The width of the sail surface should correspond approximately to the diameter of the rotor, can however also be broader or narrower.
- 5 In order to avoid influencing the flow processes at the rotor the space between the sail surface and the rotor jacket should not be less than $0.7 D_r$ (D_r = rotor diameter). In operation the sail is first set parallel to the surface of the rotor jacket, i.e. the wind inlet edge and the wind
- 10 outlet edge of the sail surface are set at the same distance from the axis of rotation of the rotor. In order to achieve the most favourable pitch angle the sail is made rotatable. This rotational movement is achieved by
- 15 arranging a rotational joint and a remotely actuated hydraulic turning motor in the support mast for the sail surface. In order to exploit winds from different directions relative to the ship's course using the wind drive of the invention the rotor carrier is fixedly arranged on the ship's deck while the sail can be guided around the
- 20 longitudinal axis of the rotor.

For this purpose a foundation plate on which the support mast for the sail surface is mounted is arranged on the rotor carrier by means of a rotational joint.

- 25 An electrical or hydraulically actuated positioning device which is automatically controlled by a wind direction measuring system, turns the foundation plate with the sail to the correct pitch angle appropriate to the
- 30 particular wind direction. The foundation plate can be rotated through 360° .

- In order to be able to exploit wind from both the starboard and the port directions relative to the ship's
- 35 course the profile of the sail surface is made absolutely symmetrical and the direction of rotation of the drive for

- 1 the rotor is made reversible. In order to be able to exploit winds from different directions relative to the ship's course the rotor together with its drive and the associated sail can alternatively be mounted on a common
5 base plate which is rotatably arranged on a column or a similar type of substructure.

For this purpose a rotational joint (for example a roller bearing) is incorporated between the common base plate
10 and the substructure. An electric or hydraulically actuated positioning device, which is automatically controlled by a wind direction measuring system, rotates the common base plate and the wind drive mounted thereon to the correct pitch angle appropriate to the particular wind direction.

- 15 In order to be able to set the wind drive out of operation at any time the rotor is brought to a standstill by stopping its drive member. The sail is then rotated about its central longitudinal axis until one of the two entry
20 edges has reached its position of smallest separation from the rotor jacket. The foundation plate with the sail mounted thereon is then turned until the sail surface is located in the lee of the stationary rotor (see Fig. 2c).

- 25 A number of embodiments of the invention are illustrated in the accompanying drawings in which:

Fig. 1 shows a perspective view of the invention,

- 30 Figs. 2a show schematic illustrations with different wind to 2c flow directions,

- Fig. 3 shows a view similar to that of Fig. 1 but with a common base plate for the rotor and sail, with
35 the base plate being rotatable about its own axis, and

- 1 Fig. 4 shows a view similar to that of Fig. 1 but with
a sail of sail cloth.

A wind drive or wind auxiliary drive for ships in
5 accordance with Fig. 1 consists of a rotor 1 with end discs
11, 12 which generates propulsion when blown on by a wind
and when set in rotation. The direction of rotation of the
rotor can be selectively controlled in correspondence with
the wind direction. The bearings and drive for the rotor 1
10 are located in the rotor carrier 14 which is fixedly
connected with the ship's structure, which is not shown
in any further detail.

A foundation plate 15 is mounted on the rotor carrier 14
15 by means of a rotational joint 13 and can be swivelled
(double arrow 7/8) through 360° about the longitudinal
axis 2 of the rotor. The swivel drive is housed in the
rotor carrier 14. A sail 3 of aerofoil shape which like-
wise generates propulsion when blown on by the wind is
20 mounted on the foundation plate 15. A rotational joint 16
which makes it possible to rotate the sail 3 through
 360° about its pitch axis 4 is located in the said support
mast. The rotational movement (double arrow 9/10) of the
sail can be selected clockwise or counterclockwise with
25 the aid of a turning motor which is integrated in the
rotational joint 16 in the sail support mast.

Figs. 2a and 2b schematically illustrate a ship 20, and
also the position of the sail 3 and the direction of
30 rotation of the rotor 1, with the wind blowing from the
starboard direction 17 and from the port direction 18
respectively.

Furthermore, Fig. 2c shows the wind drive set out of
35 operation when the wind flow is from the front 19. In
this condition the rotor 1 is brought to a standstill and
the sail is positioned in the longitudinal direction of
the ship in the lee of the rotor.

1 Fig. 3 shows a rotor 1 rotating about its axis 2 and
a sail 3 which is rotatable about its pitch axis 4, with
the rotor 1 and the sail 3 being mounted on a common base
plate 21 which is in turn swivellable about the axis 22.

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Fig. 4 corresponds to Fig. 1 the only difference being
that a non-rigid sail 23 of sail cloth is provided on a
Rah-mast 24 in place of the rigid sail 3.

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1 CLAIMS

1. A wind drive for a ship comprising : a Flettner-rotor and a surface which is influenced by the flow conditions at the periphery of the rotor, said surface being swivellable about the rotor axis and being rotatable about a pitch axis of its own, characterised in that the surface is formed by a sail (3; 23) which is symmetrical about a plane through its pitch axis (4) and rotatable through 360° about this pitch axis (4), with the sail also being acted on, in part, by the undisturbed wind flow.
2. A wind drive in accordance with claim 1 and characterised in that the direction of rotation (5,6) of the rotor (1) can be reversed in manner known per se and in that the rotor can be stopped.
3. A wind drive in accordance with claims 1 or 2 and characterised in that the rotor (1) is provided with end discs (11, 12) in manner known per se and in that the height of the sail (3; 23) matches the height of the rotor (1) between these end discs (11, 12).
4. A wind drive in accordance with any one of the previous claims and characterised in that the width of the sail corresponds approximately to the diameter (D_r) of the rotor (1).
5. A wind drive in accordance with any one of the preceding claims wherein the space between the sail surface and the rotor (1) is not less than 0.7 times the diameter (D_r) of the rotor (1).
6. A wind drive in accordance with one of the claims 1 to 5 and characterised in that the rotor (1) and the sail (3; 23) are arranged on a common base plate (21) which is rotatable through 360° and about a swivel axis (22)



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- 1 disposed parallel to and between the pitch axis (4) and
the rotor axis (2).
7. A wind drive in accordance with one of the claims 1 to 6
5 and characterised in that the symmetrical sail (3; 23)
is either rigid (3) or a symmetrically constructed
sail (23) of known construction, e.g. of sail cloth.
8. A wind drive or auxiliary wind drive for a ship, or other
10 boat, substantially as herein described and as
illustrated in the accompanying drawings.
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