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(54) **A VESSEL**

(57) A vessel (1) comprises a hull (2) and a Magnus rotor (4) which is mounted to the hull (2) and rotatable with respect to the hull (2) about an upwardly directed axis of rotation (5). The Magnus rotor (4) has a lower rotor part (4b) and an upper rotor part (4a). The upper rotor part (4a) and the lower rotor part (4b) are drivable with respect to the hull (2) at different rotational velocities and/or in opposite rotational directions about the axis of rotation (5).

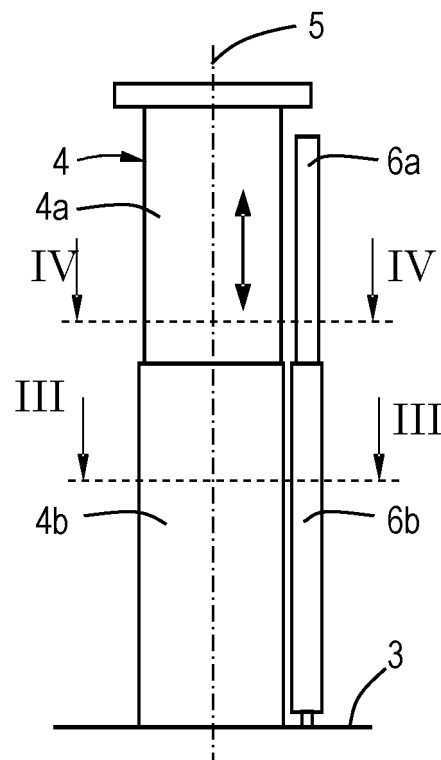


Fig.2

Description

[0001] The present invention relates to a vessel, comprising a hull and a Magnus rotor which is mounted to the hull and rotatable with respect to the hull about an upwardly directed axis of rotation, wherein the Magnus rotor has a lower rotor part and an upper rotor part.

[0002] Such a vessel is known from FR 2 948 094. An advantage of the known vessel is that the upper rotor part can be extended and lowered with respect to the lower rotor part such that the total height of the Magnus rotor can be varied. This provides the opportunity to increase the generated propulsion force in case of a weak wind and to decrease propulsion force in case of heavy wind.

[0003] An object of the invention is to provide an improved vessel.

[0004] This object is accomplished with the vessel according to the invention which is characterized in that the upper rotor part and the lower rotor part are drivable with respect to the hull at different rotational velocities and/or in opposite rotational directions about the axis of rotation.

[0005] The invention provides the opportunity to control the torque on the hull caused by the Magnus rotor under operating conditions. For example, the torque caused by the lower rotor part can be compensated by a counter torque caused by the upper rotor part by means of rotating the upper rotor part in opposite direction of the lower rotor part. In that case the propulsion force generated by the lower rotor part is counteracted by a counter force generated by the upper rotor part, but the counter force may be relatively low to create a relatively high counter torque since the distance from the hull where the counter force is exerted is relatively large.

[0006] The upper rotor part and the lower rotor part may be drivable independently from each other.

[0007] Preferably, the upper rotor part and the lower rotor part are moveable with respect to each other along the axis of rotation, since this provides the opportunity to control the height from the hull where a counter force generated by the upper rotor part acts, hence affecting the level of a counter torque on the hull.

[0008] The upper rotor part and the lower rotor part may be telescopically connected to each other.

[0009] The upper rotor part may have a smaller diameter than the lower rotor part.

[0010] In an embodiment, next to the lower rotor part and the upper rotor part an oblong lower vane and an oblong upper vane, respectively, are located, which lower and upper vanes extend parallel to the axis of rotation. The upper and lower vanes define a location where streamlines detach from rotor surfaces of the respective upper and lower rotor parts.

[0011] The lower and upper vanes may be movable in circumferential direction about the upper and lower rotor parts, respectively, in order to adapt desired locations of streamline detachments under operating conditions.

[0012] It is conceivable that the Magnus rotor has one

or more additional rotor parts which extend or are extendable above the upper rotor part and are drivable with respect to the upper rotor part at different rotational velocities and/or in opposite rotational directions about the axis of rotation. This provides more flexibility to control the propulsion force of the vessel.

[0013] The invention will hereafter be elucidated with reference to very schematic drawings showing an embodiment of the invention by way of example.

Fig. 1 is a perspective view of an embodiment of a vessel according to the invention.

Fig. 2 is a side view of a part of the vessel of Fig. 1 on a larger scale, showing one Magnus rotor.

Fig. 3 is a cross-sectional view along the line III-III in Fig. 2.

Fig. 4 is a cross-sectional view along the line IV-IV in Fig. 2.

[0014] Fig. 1 shows an embodiment of a vessel 1 according to the invention. The vessel 1 comprises a hull 2 including a deck 3 and four Magnus rotors 4 which are mounted to the hull 2 at four corners thereof. The Magnus rotors 4 are rotatable with respect to the hull 2 about respective axes of rotation 5 which extend upwardly from the hull 2. Under operating conditions the Magnus rotors 4 provide additional drive force on the vessel 1 by using the Magnus effect.

[0015] Referring to Figs. 2-4, each of the Magnus rotors 4 has an upper rotor part 4a and a lower rotor part 4b. The upper rotor part 4a has a smaller diameter than the lower rotor part 4b. They are telescopically connected to each other, such that the upper rotor part 4a is moveable with respect to the lower rotor part 4b along the axis of rotation 5. This is indicated by the double-headed arrow in Fig. 2.

[0016] In the embodiment as shown in the figures the upper rotor part 4a and the lower rotor part 4b are drivable with respect to the hull 2 independently from each other. They are drivable with respect to each other in opposite directions and/or at different rotational velocities about the axis of rotation. It is also conceivable that a common driving unit drives both the upper rotor part 4a and the lower rotor part 4b through a transmission.

[0017] Fig. 2 shows that next to the upper rotor part 4a and the lower rotor part 4b oblong upper and lower vanes 6a, 6b, respectively, are located. The upper and lower vanes 6a, 6b extend substantially parallel to the axis of rotation 5 and have more or less the same lengths as the upper and lower rotor parts 4a, 4b, respectively. The upper and lower vanes 6a, 6b are rotatable about the axis of rotation 5 of the Magnus rotor 4 such that an appropriate static position with respect to the hull 2 along the circumference of the Magnus rotor 4 can be selected, dependent on the actual wind direction under operating conditions. The upper and lower vanes 6a, 6b are also telescopically connected to each other; this means that they extend at the same rotational position about the axis

of rotation 5. In an alternative configuration (not shown) the upper and lower vanes 6a, 6b may be separate from each other such that they may have different rotational positions about the axis of rotation 5.

[0018] Under operating conditions the location of the upper and lower vanes 6a, 6b with respect to the hull 2 is selected on the basis of the actual wind direction. This position can be adjusted automatically such that the upper and lower vanes 6a, 6b are positioned at a side of the upper and lower rotor parts 4a, 4b which is directed in substantially the same direction as the wind direction. The presence of the upper and lower vanes 6a, 6b define a fixed location where streamlines become detached from the rotor surfaces of the upper and lower rotor parts 4a, 4b. This appears to minimize undesired vibrations of the Magnus rotor 4 and improve the ratio between lift and drag coefficient of the Magnus rotor 4.

[0019] Rotating the upper and lower rotor parts 4a, 4b in opposite directions, as illustrated by arrows in Figs. 3 and 4, leads to the following effect under operating conditions. Rotation of the lower rotor part 4b generates a propulsion force which also generates a torque on the hull 2 of the vessel 1. The torque can be reduced by a counter force which is generated by the upper rotor part 4a which counter force acts on the upper rotor part 4a at a larger distance from the hull 2 than the propulsion force on the lower rotor part 4b. The counter force generated by the upper rotor part 4a which is lower than the propulsion force generated by the lower rotor part 4b may create a relatively large counter torque due to the larger distance from the hull 2 where the counter force acts. Consequently, a counter torque can be generated without significantly limiting the propulsion force.

[0020] The invention is not limited to the embodiment shown in the drawings and described hereinbefore, which may be varied in different manners within the scope of the claims and their technical equivalents. For example, the upper and lower vanes may be omitted. It is also conceivable that the Magnus rotor has one or more additional rotor parts which extend or are extendable above the upper rotor part and are drivable with respect to the upper rotor part at different rotational velocities and/or in opposite rotational directions about the axis of rotation.

Claims

1. A vessel (1), comprising a hull (2) and a Magnus rotor (4) which is mounted to the hull (2) and rotatable with respect to the hull (2) about an upwardly directed axis of rotation (5), wherein the Magnus rotor (4) has a lower rotor part (4b) and an upper rotor part (4a), **characterized in that** the upper rotor part (4a) and the lower rotor part (4b) are drivable with respect to the hull (2) at different rotational velocities and/or in opposite rotational directions about the axis of rotation (5).

2. A vessel (1) according to claim 1, wherein the upper rotor part (4a) and the lower rotor part (4b) are drivable independently from each other.
3. A vessel (1) according to claim 1 or 2, wherein the upper rotor part (4a) and the lower rotor (4b) part are moveable with respect to each other along the axis of rotation (5).
4. A vessel (1) according to claim 3, wherein the upper rotor part (4a) and the lower rotor part (4b) are telescopically connected to each other.
5. A vessel (1) according to any one of the preceding claims, wherein the upper rotor part (4a) has a smaller diameter than the lower rotor part (4b).
6. A vessel (1) according to any one of the preceding claims, wherein next to the lower rotor part (4b) and the upper rotor part (4a) an oblong lower vane (6b) and an oblong upper vane (6a), respectively, are located, which lower and upper vanes (6a, 6b) extend parallel to the axis of rotation (5).
7. A vessel (1) according to claim 6, wherein the lower and upper vanes (6a, 6b) are movable in circumferential direction about the upper and lower rotor parts (4a, 4b), respectively.
8. A vessel (1) according to any one of the preceding claims, wherein the Magnus rotor (4) has one or more additional rotor parts which extend or are extendable above the upper rotor part (4a) and are drivable with respect to the upper rotor part (4a) at different rotational velocities and/or in opposite rotational directions about the axis of rotation (5).

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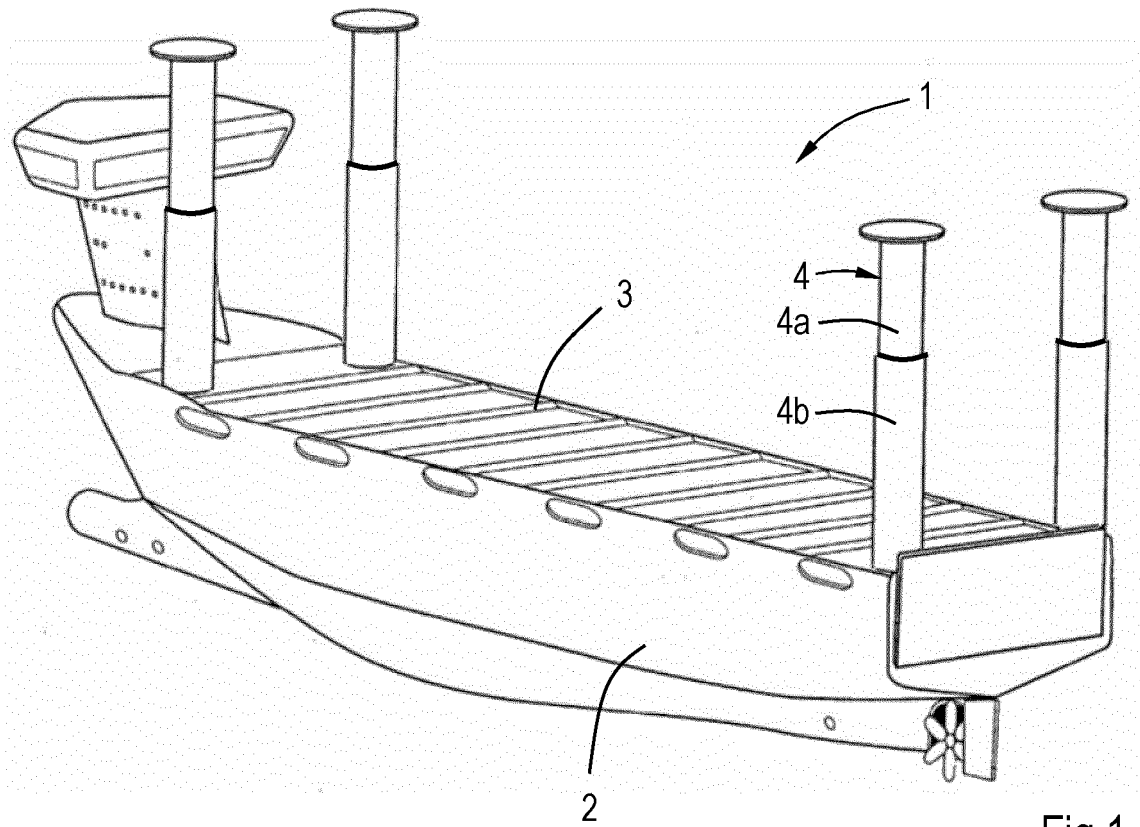


Fig.1

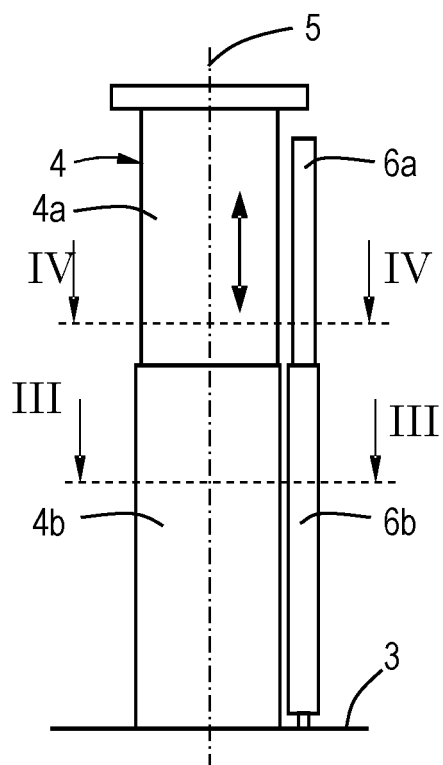


Fig.2

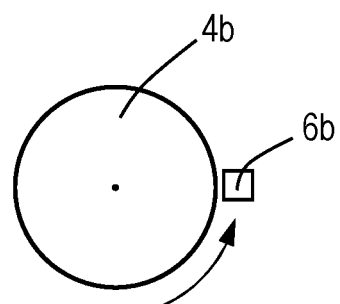


Fig.3

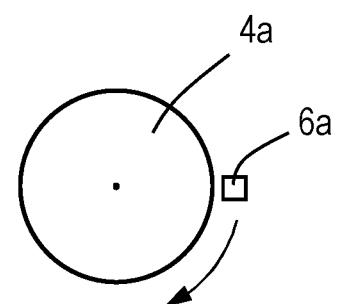


Fig.4



EUROPEAN SEARCH REPORT

Application Number

EP 22 19 2879

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			TECHNICAL FIELDS SEARCHED (IPC)
			B63H
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		15 February 2023	Freire Gomez, Jon
CATEGORY OF CITED DOCUMENTS			
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 22 19 2879

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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15-02-2023

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