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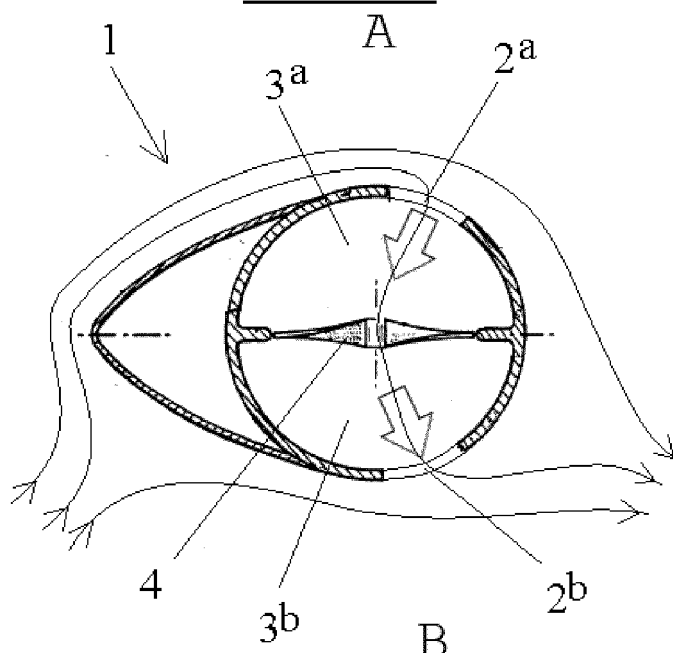
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(54) **A PROPULSION DEVICE**

(57) Propulsion device for a vessel, comprising an upright hollow wing (1) in which first and, respectively, second air passage openings (2a, 2b) connected to a first and, respectively, second air chamber (3a, 3b) are provided. The first and second air chamber are connected to one another via fans (4) configured to be able to pump air between the first and the second air chamber, either from the first to the second air chamber or vice versa, wherein then either the first air passage openings

(2a) serve for air infeed and the second air passage openings (2b) serve for air outfeed or vice versa. What is achieved by the invention is that, without using fragile mechanical components, the air flow around the one side of the vertical wing is deflected differently than the air flow around the other side, namely due to the fact that the air flow on the one side is in part sucked inwards and the air flow on the other side is, by contrast, blown outwards.

**FIG. 2**



## Description

**[0001]** The invention relates to a propulsion device in particular for a vessel, comprising a substantially upright hollow wing in which, as seen in a horizontal section plane, one or more first and, respectively, second air passage openings extending one above the other are provided at locations A and B which are mutually substantially separated from one another.

**[0002]** Such a propulsion device is known from, inter alia, the applicant's previous patent application NL1043560 and US4630997 in the name of Jacques Cousteau et al. The propulsion devices described therein, in particular for a vessel, comprise a substantially upright hollow wing which comprises a wall portion having a substantially circular profile, as seen transversely with respect to the length axis of the hollow wing (in other words, as seen in a horizontal section plane), in which air passage openings are provided at locations A and B in the wing wall which are mutually substantially separated from one another, while provision is also made of a closure element which can open and close the air passage openings by rotating about the centre of the circular wing wall portion, such that when the one air passage opening is open, the other is closed and vice versa. The present type of propulsion device is often referred to by the term "turbosail" (see for example <https://en.wikipedia.org/wiki/Turbosail>).

**[0003]** The present invention aims to provide a more or less equivalent propulsion device, in which, however, the air passage openings cannot be closed by means of a type of variable closure slide, but in which the same effect as is achieved by the closure slide, namely the control of the passage of the air flow ("air flow control"), which is of essential importance for "turbosail" applications (see the aforementioned patent US4630997 of Cousteau et al for a detailed discussion thereof), is achieved in a different way, namely by means of one or more internal fans.

**[0004]** The invention provides a propulsion device in particular for a vessel, comprising a substantially upright hollow wing in which, as seen in a horizontal section plane, one or more first and, respectively, second air passage openings extending one above the other are provided at locations A and B which are mutually substantially separated from one another,

wherein the first and second air passage openings are connected to a first and, respectively, second air chamber, which first and second air chamber are connected to one another via one or more fans which are configured to be able to pump air between the first and the second air chamber, either from the first to the second air chamber or vice versa, under the control of fan control means, all this being configured and designed in such a way that, under the control of the fan control means, the one or more fans generate an air flow between the

first and the second air passage openings, wherein then either the first air passage openings serve for air infeed and the second air passage openings serve for air outfeed or vice versa.

**[0005]** It should be noted that Figures 13 and 14 in patent US4630997 of Cousteau et al show an exemplary embodiment in which there is also mention of air passage openings which are connected to a first and, respectively, second air chamber, which air chambers are connected to one another via one or more fans which are configured to be able to pump air between the first and the second air chamber, either from the first to the second air chamber or vice versa, under the control of fan control means. However, in that embodiment of US4630997A, mention is made of distinct, geometrically separated air infeed openings (54) and air outfeed openings (68), which are provided with hinged panels operating as one-way air valves, such that, depending on the blowing direction of the fans (66), the air flow is either introduced via the air infeed openings provided in the first air chamber (63a) and is blown out via the air outfeed openings provided in the second air chamber (63b), or - in the case of the opposite blowing direction of the fans - is introduced via the air infeed openings provided in the second air chamber (63b) and is blown out via the air outfeed openings provided in the first air chamber (63a). In all, this configuration known from US4630997A mentions distinct air infeed valves (54) and air outfeed valves (68), in which case use still has to be made of an air flow deflector flap (14a) which plays a crucial role in the configuration of US4630997A (see, for example, Figure 2a of US4630997A) and, moreover, also in the configuration of NL1043560 of the applicant (which proposes an improvement to the operation of such a slidable air flow deflector flap (deflector 8) which - as is the case in an embodiment shown in Figures 6, 7a and 7b of US4630997A (Cousteau et al) - is of slidable design and, as a result, can be used as a closure flap (3) which is able to close a series of first air infeed openings and simultaneously open a series of second air infeed openings or vice versa.

**[0006]** In the configuration as shown in Figures 13 and 14 of US4630997A (Cousteau et al), use is therefore made of an air flow deflector flap 14a to achieve the desired/required deflection of the air flows anti-clockwise and clockwise and to thereby prevent undesired air vortices from being able to form locally (see US4630997A; Figure 2a). Furthermore, in this known configuration, the inlet openings (54) and outlet openings (68) occupy different locations, which is *not* the case in the configuration according to the present invention.

**[0007]** In the configuration known from US4630997A, the intake of the air and the blowing out thereof at different locations is realized by means of openings in the form of valves having, for example, lamellae, as a result of which the openings 54 can serve only as air inlet and the openings 68 only as outlet. In the configuration according to

the invention, the openings are not provided with such one-way "valves". Due to the fact that the distance between the inlet openings and the outlet openings is much greater (further apart) in the configuration according to the present invention, there will be no undesired vortices. The fact that the same openings are used as air inlet or air outlet in the configuration according to the present invention in itself affords the major advantage that said configuration is significantly more simple and more robust: no valve lamellae, etc., which are highly disadvantageous owing to the harsh environmental conditions (seawater, rust, ice formation, etc.).

**[0008]** What is achieved by the measures according to the present invention is that, *without* using mechanical components, which are always vulnerable due to the unfavourable environmental conditions, as slidable air flow deflection means, and closure elements as in the configurations known from US4630997A and NL1043560, the air flow around the one side of the vertical wing is deflected differently than the air flow around the other side, namely due to the fact that the air flow on the one side is in part sucked inwards and the air flow on the other side is, by contrast, blown outwards.

**[0009]** The invention will now be discussed in more detail by means of the following description of the figures.

**[0010]** Figure 1 schematically shows an exemplary embodiment of the propulsion device known from US4630997A;

**[0011]** Figure 2 schematically shows an exemplary embodiment of a propulsion device according to the invention.

**[0012]** Figure 1 schematically shows an exemplary embodiment of the propulsion device known from US4630997A, comprising a substantially upright hollow wing 1 in which, as seen in a horizontal section plane, one or more air passage openings 54a, 54b, 68a and 68b, respectively, extending one above the other are provided at locations A and B which are mutually substantially separated from one another (for convenience, approximately the same numbering as in US4630997A is used in the figure), which air passage openings are connected to a first and, respectively, second air chamber 63a and 63b, respectively, which first and second air chamber are connected to one another via one or more fans 66 which are configured to be able to pump air between the first and the second air chamber, either from the first to the second air chamber or vice versa, under the control of fan control means.

**[0013]** In the configuration known from Figures 13 and 14 of US4630997A, all this is configured and designed in such a way that, under the control of the fan control means, the one or more fans 66 can generate an air flow between the two air chambers 63a and 63b. Air infeed openings 54a and 54b and air outfeed openings 68a and 68b are provided in the outer walls of the air chambers.

**[0014]** Mounted in the air infeed openings 54a and 54b are valve lamellae which - under the influence of the suction/blowing direction of the fans - open when the air pres-

sure in the relevant air chamber is lower than the air pressure of the ambient air and which close when the air pressure in the relevant air chamber is higher than the air pressure of the ambient air.

**[0015]** Similarly, mounted in the air outfeed openings 68a and 68b are valve lamellae which - under the influence of the suction/blowing direction of the fans - open when the air pressure in the relevant air chamber is higher than the air pressure of the ambient air and which close when the air pressure in the relevant air chamber is lower than the air pressure of the ambient air.

**[0016]** According to US4630997A, all this is configured and designed in such a way that, under the control of fan control means, the fans 66 generate an air flow either (a) from the air passage openings 54a to the air passage openings 68b or (b) from the air passage openings 54b to the air passage openings 68a.

**[0017]** In the first case (a), shown in Figure 1b, the lamellae in these air passage openings 54a and 68b open as a result of the pressure differences, induced in the air chambers 63a and 63b by the fans 66 ("-" in air chamber 63a and "+" in air chamber 63b), with respect to the pressure of the outside air, whereas, at the same time, the lamellae in the air passage openings 54b and 68a close as a result of the same pressure differences with respect to the pressure of the outside air.

**[0018]** In the second case (b), the lamellae in the air passage openings 54b and 68a open as a result of the pressure differences, induced in the air chambers 63a and 63b by the fans 66 (in this case "-" in air chamber 63b and "+" in air chamber 63a), with respect to the pressure of the outside air, whereas, at the same time, the lamellae in the air passage openings 54a and 68b close as a result of the same pressure differences with respect to the pressure of the outside air.

**[0019]** Lastly, Figure 1b of the configuration known from US4630997A shows an air flow deflector flap 14a used to achieve the desired/required deflection of the air flows anti-clockwise and clockwise and to thereby prevent undesired air vortices from being able to form locally.

**[0020]** Figure 2 schematically shows an exemplary embodiment of a propulsion device according to the invention, comprising a substantially upright hollow wing 1 in which, as seen in a horizontal section plane, one or more first and, respectively, second air passage openings 2a and, respectively, 2b extending one above the other are provided at locations A and B which are mutually substantially separated from one another.

**[0021]** The first and second air passage openings 2a and 2b, respectively, are connected to a first and, respectively, second air chamber 3a and 3b, respectively, which first and second air chamber are connected to one another via one or more fans 4 which are configured to be able to pump air between the first and the second air chamber 3a and 3b, respectively, either from the first to the second air chamber or vice versa, under the control of fan control means (not shown).

**[0022]** According to the invention, all this is configured

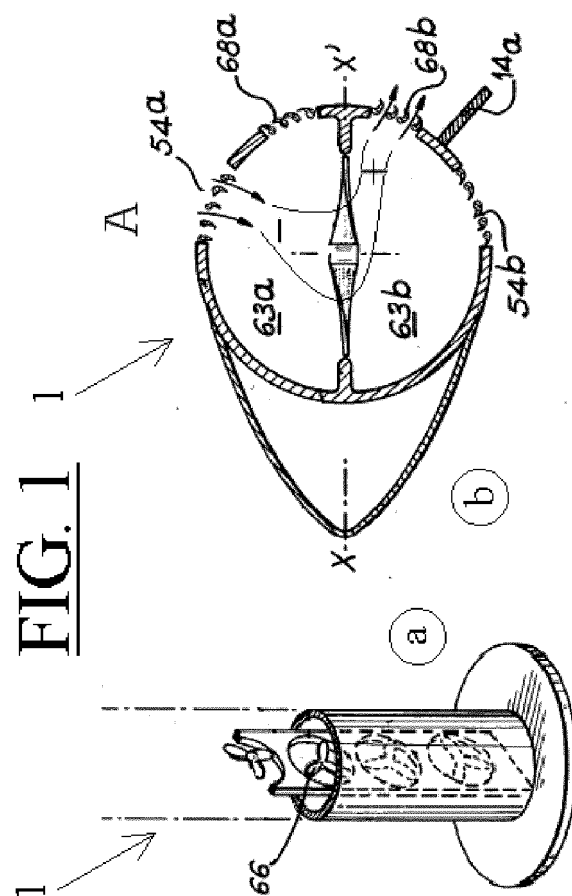
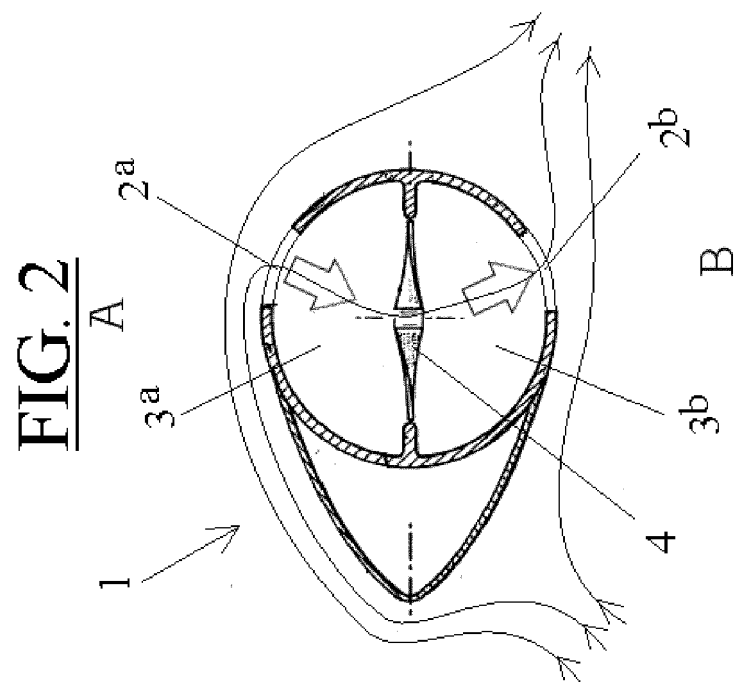
and designed in such a way that, under the control of the fan control means, the one or more fans 4 generate an air flow between the first and the second air passage openings 2a and 2b, respectively, wherein then - as shown in Figure 2 - either the first air passage openings 2a serve for air infeed and the second air passage openings 2b serve for air outfeed or vice versa, wherein then the second air passage openings 2b serve for air infeed and the first air passage openings 2a serve for air outfeed.

## Claims

1. Propulsion device in particular for a vessel, comprising a substantially upright hollow wing (1) in which, as seen in a horizontal section plane, one or more first and, respectively, second air passage openings (2a, 2b) extending one above the other are provided at locations A and B which are mutually substantially separated from one another,

wherein the first and second air passage openings are connected to a first and, respectively, second air chamber (3a, 3b), which first and second air chamber are connected to one another via one or more fans (4) which are configured to be able to pump air between the first and the second air chamber, either from the first to the second air chamber or vice versa, under the control of fan control means,

all this being configured and designed in such a way that, under the control of the fan control means, the one or more fans generate an air flow between the first and the second air passage openings, wherein then either the first air passage openings (2a) serve for air infeed and the second air passage openings (2b) serve for air outfeed or vice versa.





## EUROPEAN SEARCH REPORT

Application Number

EP 22 19 2921

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category   | Citation of document with indication, where appropriate, of relevant passages                                   | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|--|---|-------------------|---|
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|  |   |                   | TECHNICAL FIELDS SEARCHED (IPC)         |
|  |   |                   | B63H                                    |
| The present search report has been drawn up for all claims |   |                   |   |

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Place of search

The Hague

Date of completion of the search

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Examiner

Blazquez Lainez, R

## CATEGORY OF CITED DOCUMENTS

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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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**REFERENCES CITED IN THE DESCRIPTION**

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