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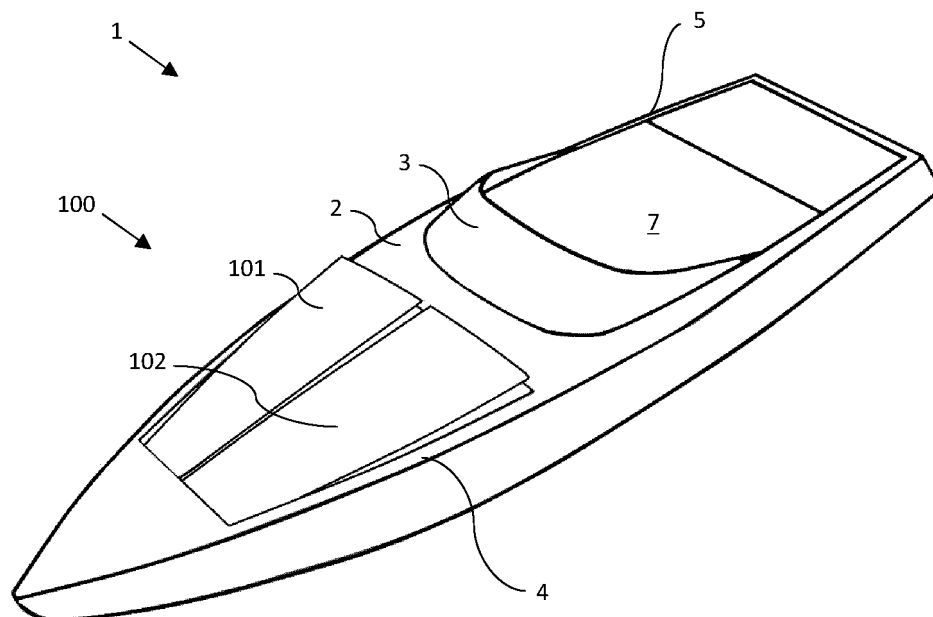
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(54) **CONVERTIBLE DECK SYSTEM FOR BOAT, BOAT EQUIPPED WITH SAME, AND METHOD**

(57) Convertible deck system for converting a front section of a boat between an open bow configuration and a flush deck configuration. The convertible deck system comprises at least one movable deck panel, movable between a first position in the open bow configuration wherein a user area in the front section of the boat is uncovered and a second position in the flush deck con-

figuration wherein the user area is covered and the at least one deck panel is flush with a deck level of the boat. A moving mechanism is provided for positioning the deck panels in a raised configuration, wherein the at least one deck panel is at least partially raised or tilted above the deck level for influencing aerodynamics of the boat during travelling on water, in particular during planing or foiling.



**FIG. 3**

## Description

### Field of the disclosure

**[0001]** The present disclosure relates to a convertible deck system for converting a front section of a boat between an open bow configuration and a flush deck configuration.

### Background art

**[0002]** US 6497192 B2 discloses a boat having a sunken seating area in the bow of the boat. This seating area is hidden by a panel. The panel is movable to expose and allow access to the bow seating area.

**[0003]** US 6945190 B1 discloses a known convertible deck system for a pleasure boat. The document discloses a seat back system that includes a pair of seat benches for mounting to the floor of an open front section of the pleasure boat that each include seat backs that are individually mounted to pivot from a vertical, seat back attitude, to a horizontal attitude covering over the open front section and includes an arrangement for pivoting the seat backs that can be hydraulic, pneumatic or mechanical, that each involve an extending piston between a boat floor and at a location along a brace that is secured to a seat back side, extending at a right angle therefrom, with piston extension to provide seat back travel, providing a load bearing deck.

### Summary of the disclosure

**[0004]** It may be an aim of the present disclosure to provide a convertible deck system for a boat with enhanced functionality and/or a method for controlling a convertible deck system to enhance its functionality.

**[0005]** A further aim of the present disclosure may be to provide a kit of parts for building such a convertible deck system on a boat and/or a boat comprising such a convertible deck system.

**[0006]** A further aim of the present disclosure may be to provide a convertible deck system capable of influencing the aerodynamics of a boat and/or a method for controlling a convertible deck system to influence the aerodynamics of a boat.

**[0007]** In a first aspect, which may be combined with other aspects and/or embodiments described herein, the present disclosure relates to a convertible deck system for converting a front section of a boat between an open bow configuration and a flush deck configuration, the convertible deck system comprising: at least one movable deck panel, movable between a first position in the open bow configuration wherein a user area in the front section of the boat is uncovered and a second position in the flush deck configuration wherein the user area is covered and the at least one deck panel is flush with a deck level of the boat, and a moving mechanism for moving the at least one deck panel.

**[0008]** In embodiments of the convertible deck system, the moving mechanism may be provided for positioning the deck panels in a raised configuration in the front section of the boat, wherein the at least one deck panel is at least partially raised or tilted above the deck level for influencing aerodynamics of the boat during travelling on water, in particular during planing or foiling. In this way, the convertible deck system may be used for influencing the aerodynamics of the boat to redirect the air around and over the vessel as aerodynamically efficient as possible, i.e. with the intent to reduce aerodynamic drag.

**[0009]** In embodiments of the convertible deck system, the moving mechanism may be provided for positioning the at least one deck panel in a range of third positions in the raised configuration.

**[0010]** In embodiments of the convertible deck system, the range of third positions may extend between the second position wherein the at least one deck panel is flush with the deck level and an extreme position wherein the downward pressure on the front section of the boat is maximum.

**[0011]** In embodiments of the convertible deck system, the moving mechanism may be provided for moving the at least one deck panel from the second position to the first position and vice versa.

**[0012]** In embodiments, the convertible deck system may further comprise a control unit for operating the moving mechanism and controlling the position of the at least one deck panel at least between the flush deck configuration and the raised configuration.

**[0013]** In embodiments, the convertible deck system may further comprise user controls for operating the moving mechanism and/or the control unit.

**[0014]** In embodiments of the convertible deck system, the control unit may be provided for receiving sensor input data from at least one of the following sensors or input units: at least one camera unit, a gyroscope unit, at least one force or pressure sensor provided for sensing or determining downward pressure on the at least one deck panel, a wind sensor unit, a sensor unit associated with an engine of the boat, or other.

**[0015]** In embodiments, the convertible deck system may further comprise a learning module, provided for collecting position data with respect to the position of the at least one deck panel in the raised configuration during travelling on water and sensor input data based on information or signals provided by at least one sensor or input unit.

**[0016]** In embodiments, the learning module may be provided for determining learned data, in particular optimized position data for the at least one deck panel in the raised configuration, on the basis of the collected position data and sensor input data and an inputted desired effect, wherein the desired effect is preferably one of the following: a reduced number or magnitude of shocks, improved orientation with respect to the water surface, a maximized speed, a reduced fuel consumption.

**[0017]** In embodiments of the convertible deck system,

the moving mechanism may be provided for tilting the at least one deck panel along a longitudinal axis between the first and second positions and tilting the at least one deck panel along a transverse axis between the second and third positions.

**[0018]** In another aspect, which may be combined with other aspects and/or embodiments described herein, the present disclosure provides a kit of parts for building a convertible deck system as disclosed herein on a boat or vessel. In this way, the present disclosure provides a kit of parts which may be used for retrofitting a boat with a convertible deck system as disclosed herein.

**[0019]** In another aspect, which may be combined with other aspects and/or embodiments described herein, the present disclosure provides a boat comprising a hull, a front section in front of a steering gear and a rear section rearward from the steering gear, and a convertible deck system as disclosed herein in the front section of the boat.

**[0020]** In another aspect, which may be combined with other aspects and/or embodiments described herein, the present disclosure provides a method for influencing aerodynamics of a boat during travelling on water, in particular during planing or foiling, comprising the steps of: (a) providing a convertible deck system according to any one of the preceding claims, and (b) operating the convertible deck system to raise the at least one deck panel at least partially above the deck level for influencing the aerodynamics of the boat, in particular for controlling a downward pressure on the front section of the boat.

**[0021]** In embodiments, the method may further comprise the step of operating the convertible deck system to control the position of the at least one deck panel in a range of positions between the second position wherein the at least one deck panel is flush with the deck level and a third position wherein the air resistance of the boat is maximum.

**[0022]** In embodiments, the method may further comprise the step of collecting data by means of a learning module, the collected data comprising position data with respect to the position of the at least one deck panel in the raised configuration during travelling on water and sensor input data based on information or signals provided by at least one sensor or input unit, the method preferably further comprising steps for determining learned data, in particular optimized position data for the at least one deck panel in the raised configuration, on the basis of the collected position data and sensor input data and an inputted desired effect, wherein the desired effect is preferably one of the following: a reduced number or magnitude of shocks, improved orientation with respect to the water surface, a maximized speed, a reduced fuel consumption.

### Brief description of the drawings

**[0023]** Embodiments of the present disclosure will be discussed in more detail below, with reference to the attached drawings.

Figs. 1-3 show an embodiment of a boat equipped with a convertible deck system according to the present disclosure, convertible between an open bow configuration (Fig. 1), a flush deck configuration (Fig. 2) and a raised configuration (Fig. 3).

Figs. 4-7 show views of an embodiment of a moving mechanism as part of a convertible deck system according to the present disclosure.

Figs. 8-10 schematically show other embodiments of convertible deck systems according to the present disclosure.

Fig. 11 schematically shows the operation of a control unit as part of convertible deck systems according to the present disclosure.

Fig. 12 schematically shows the operation of a learning module as part of convertible deck systems according to the present disclosure.

Fig. 13 shows an exploded view of the moving mechanism of Figs. 4-7 or a kit of parts for building such a moving mechanism.

### Description of embodiments

**[0024]** Below, particular embodiments according to the disclosure are described with reference to certain drawings but the disclosure is not limited thereto. The drawings described are only schematic and are non-limiting. In the drawings, the size of some of the elements may be exaggerated and not drawn on scale for illustrative purposes. The dimensions and the relative dimensions do not necessarily correspond to actual reductions to practice of the disclosure.

**[0025]** Furthermore, the terms first, second, third and the like in the description and in the claims, are used for distinguishing between similar elements and not necessarily for describing a sequential or chronological order. The terms are interchangeable under appropriate circumstances and the embodiments of the disclosure can operate in other sequences than described or illustrated herein.

**[0026]** Moreover, the terms top, bottom, over, under and the like in the description and the claims are used for descriptive purposes and not necessarily for describing relative positions. The terms so used are interchangeable under appropriate circumstances and the embodiments of the disclosure described herein can operate in other orientations than described or illustrated herein.

**[0027]** Furthermore, the various embodiments, although referred to as "preferred" are to be construed as exemplary manners in which the disclosure may be implemented rather than as limiting the scope of the disclosure.

**[0028]** The term "comprising", used in the claims, should not be interpreted as being restricted to the elements or steps listed thereafter; it does not exclude other elements or steps. It needs to be interpreted as specifying the presence of the stated features, integers, steps or components as referred to, but does not preclude the

presence or addition of one or more other features, integers, steps or components, or groups thereof. Thus, the scope of the expression "a device comprising A and B" should not be limited to devices consisting only of components A and B, rather with respect to the present disclosure, the only enumerated components of the device are A and B, and further the claim should be interpreted as including equivalents of those components.

#### Definitions

**[0029]** As used herein, with "convertible deck system" is intended to mean a system that is installed, or provided for being installed, in a frontal area of a boat, in particular in front of a main user area of the boat where the steering gear is provided. Other terminology that may be used for designating such a system is a convertible bow system or convertible front deck system.

#### Introduction

**[0030]** In the current market, consumers in the recreational fast-moving boat segment generally have to choose between a vessel with an open front section, with a user/seating area in the front, or a closed front section. There are no boats commercially available that allow sailing both with an open front section and closed front section. Boats with an open bow (also known as bowrider, console boat or deckboat) are currently the most popular. This is because a maximum surface can be used as a liveable space. The airflow over such vessels is greatly disrupted as a consequence of the open bow, giving the vessel considerably more air resistance and making travelling at high speeds dangerous.

**[0031]** Racing boats have a closed front section which creates optimal airflow. This is necessary to ensure the racing ability of the vessel. Unlike vessels with an open bow, these vessels have a lot less liveable space, which is only located at the steering gear of the vessel, behind the windshield (if present). This space is usually limited to 2 to 5 people. Depending on the size of the vessel, obtaining the possibility of an open front section may allow an additional 2 to 4 people on such a vessel.

**[0032]** In classic racing boats, the steering of the racing boat - all the more so at higher speeds - is controlled by the position of the propeller and the trim tabs. The position of the propeller determines the position of the vessel with respect to the water plane. When the propeller is directed upwards, the bow of the vessel will be directed upwards. Conversely, the bow of the vessel will be directed downwards when the propeller is directed downwards. In professional jargon, this is known as trimming the sterndrive.

**[0033]** The trim tabs control the boat's point of contact with the water surface. In addition, water can be pumped into the nose of the boat when required, especially in rough conditions and/or at higher speeds. This creates ballast which causes the boat's nose to be pushed down. This brings however an extra weight, which is suboptimal

for the vessel.

#### Convertible deck system

**[0034]** Figs. 1-3 show an embodiment of a convertible deck system 100 according to the present disclosure, convertible between an open bow configuration (Fig. 1), a flush deck configuration (Fig. 2) and a raised configuration (Fig. 3). The convertible deck system comprises two movable deck panels 101, 102 which are movable between a first position (Fig. 1), a second position (Fig. 2) and at least one third position (Fig. 3), by means of a moving mechanism, which is described further on.

**[0035]** The convertible deck system is fitted on a boat 1, comprising a hull 2, a windshield 3, a rear section 5 rearward from the windshield and/or the steering gear and a front section 4 in front of the windshield and/or steering gear. A first user area 6 is provided in the front section and a second user area 7 is provided in the rear section. The first user area 6 comprises a seating area. The second user area comprises a steering cabin 7 and may also be called a main user area.

**[0036]** Fig. 1 shows the open bow configuration with the deck panels 101, 102 in the first position. In this configuration, the user area 6 in the front section 4 of the boat (in front of the windshield and/or steering gear) is accessible for users. In particular, the user area may comprise a seating area for users which is uncovered by the deck panels 101, 102 in the first position. In the embodiment shown, the deck panels are moved into a generally vertical position sideways of the user area 6, for example behind the back seats of a seating area or generally between the back seats and the hull 2.

**[0037]** In alternative embodiments, there may be for example only a single deck panel which is moved to one side of the hull in the open bow configuration, or there may be more than two deck panels. Further, (one or more) of the back seats of the seating area may be attached to or form part of the (one or more) movable deck panels.

**[0038]** Fig. 2 shows the flush deck configuration wherein the user area 6 in the front section 4 is covered or closed off, and the deck panels 101, 102 are preferably generally flush with a deck level of the boat and preferably close off the user area in the front section on all sides. In this configuration, i.e. with the two deck panels in the second position, the deck panels are preferably interlocked, i.e. in engagement with each other or at least in a fixed relationship with each other. To this end, a locking mechanism may be provided, preferably as part of the moving mechanism, which is described further on. This fixed relationship is advantageous to ensure that the user area remains closed during travelling on water and may also achieve that the deck panels 101, 102 can be moved as a single unit to the raised configuration.

**[0039]** Fig. 3 shows the raised configuration in which the deck panels 101, 102 are in a third position. In this configuration, the deck panels are at least partially raised

above the deck level or top side of the hull. The purpose of this third position is to influence the aerodynamics of the boat during travelling on water, in particular during planing or foiling, in particular to apply a downwards pressure onto the front section 4 of the boat. This can be used as an alternative or in addition to pumping ballast into the nose of the boat with the advantage of avoiding or at least reducing the additional weight caused by the ballast.

**[0040]** Preferably, in the raised configuration, the convertible deck system provides a range of (third) positions for the deck panels 101, 102, so that the amount of influence on the aerodynamics can be adjusted or controlled, preferably by means of the moving mechanism of the deck panels. The range may for example extend from the second position, wherein the deck panels are flush with the deck level and an extreme position where the air resistance of the boat is maximum.

**[0041]** In the embodiment shown, about 75% of the area of the deck panels is raised above the deck level in the raised configuration. In embodiments, another portion of the area of the deck panels may be raised, preferably at least 50% of the surface area, for example 60%, 70%, 80%, 90% up to 100%.

**[0042]** In the embodiment shown in Figs. 1-3, the deck panels are tilted as a whole towards the raised configuration, with a front portion of the deck panels (about 25% in the embodiment shown) being lowered with respect to the deck level. In embodiments, each deck panel may be subdivided into partial deck panels of which some or all may be moveable to a raised position. For example, frontal parts of the deck panels may stay flush with the deck level while only rearward parts, closer to the windshield, are raised. The parts or partial deck panels may be connected to each other by means of hinges and/or have a hinge axis in generally transverse direction of the boat.

**[0043]** Preferably, means are provided to avoid or reduce the risk of water entering the front section 4 of the boat while the deck panel(s) are in the raised configuration. Such means may be provided in the form of sealing strips, drip rails or like means for evacuating water, a second level of panels below the (raised) deck panels which maintain the user area 6 closed or sealed, or other.

**[0044]** Figs. 8-10 schematically show alternative embodiments to the embodiment of Figs. 1-3. In the embodiment of Fig. 8, the convertible deck system 110 comprises a deck panel 111 (or a pair of deck panels similar to Figs. 1-3) which is completely tilted or raised above the deck level in the raised configuration. As indicated by the double arrow, the deck panel(s) 111 is/are moveable in a range of (third) positions. The extreme position with maximal air resistance is indicated in Fig. 8 by the full line. The second position flush with the deck level, which is indicated by the dotted line, forms another end of the range. At least one intermediate position, also shown in dotted line, may be predefined in a control unit of the convertible deck system, or the deck panel(s) 111

may be moveable to any (third) position in between the extreme position and the second position.

**[0045]** In the embodiment of Fig. 9, the convertible deck system 120 comprises a series of deck panels (or a series of pairs/rows of deck panels) 121, 122. The panels are shown in the extreme (third) position in which the air resistance is maximal and/or the downward pressure on the front section 4 during travelling on water is maximal. Similar to the embodiment of Fig. 8, the deck panels 121, 122 may be moveable to at least one (predefined) intermediate position or to any position within the range of (third) positions between the extreme position, shown in the figure, and the second position flush with the deck level. The control unit may be configured for controlling the moving means to move the deck panels 121, 122 in a synchronized way, i.e. the panels are always tilted to substantially the same angle. The control unit may also be configured for controlling the moving means to move the deck panels 121, 122 individually, i.e. each panel (or each pair/row of panels) can be individually or independently set to a desired angle or third position.

**[0046]** In the embodiment of Fig. 10, the convertible deck system 130 comprises a series of deck panels (or a series of pairs/rows of deck panels) 131, 132, 133, further including an anchor hatch or deck panel 131 covering a storage space for the boat's anchor located in front of the first user area 6. Like in the embodiment of Fig. 9, the panels are shown in the extreme (third) position in which the air resistance is maximal and/or the downward pressure on the front section 4 during travelling on water is maximal. Similar to the embodiments of Figs. 8 and 9, the deck panels 131, 132, 133 may be moveable to at least one (predefined) intermediate position or to any position within the range of (third) positions between the extreme position, shown in the figure, and the second position flush with the deck level. The control unit may be configured for controlling the moving means to move the deck panels 131, 132, 133 in a synchronized way, i.e. the panels are always tilted to substantially the same angle. The control unit may also be configured for controlling the moving means to move the deck panels 131, 132, 133 individually, i.e. each panel (or each pair/row of panels) can be individually or independently set to a desired angle or third position.

**[0047]** Embodiments wherein only the anchor hatch 131 or like panel at the front of the deck is moveable to a raised or tilted position for influencing aerodynamics are also envisaged within the scope of the present disclosure.

**[0048]** The convertible deck system 100, 110, 120, 130 preferably further comprise user controls and/or a control unit, possibly further provided with a learning unit, for controlling the moving mechanism by means of which the deck panel(s) are moved. These components are described more in detail below.

## Moving mechanism

**[0049]** An embodiment of a moving mechanism, as part of a convertible deck system according to the present disclosure, for example the convertible deck systems shown in the drawings, is shown schematically in Figs. 4-7 and in Fig. 13 in exploded view. The moving mechanism 200 is provided for moving the at least one deck panel 101, 102. The instructions or control signal for the movement may be achieved by means of the control unit and/or the user controls.

**[0050]** The moving mechanism 200 may be provided for tilting the deck panels along a generally longitudinal axis of the deck panels between the first and second positions (Figs. 1 and 2) and tilting the deck panels along a generally transverse axis between the second and third positions (Figs. 2-3 and 8-10). To this end, a number of hinge mechanisms 201, 202 as discussed below may be provided, on which the deck panel(s) are mounted.

**[0051]** In the embodiment shown, the hinge mechanism 201 is provided for moving a deck panel to the first position (open bow configuration), the second position (flush deck configuration) and at least one third position (raised configuration). To this end, the hinge mechanism 201 comprises a trolley 206 which can travel generally in vertical or height direction along or inside a profile 203 and a hinge arm 204 which is pivotably connected to the trolley 206. At the distal end of the arm, a locking pin 205 or mechanism may be provided for engaging with an opposing hinge arm 202 to which an opposite deck panel is mounted, so that the two deck panels can be raised as a unit. On the top side of the hinge arm 204, a further tiltable or raisable arm 207 may be mounted, by means of which the respective deck panel is moveable between the second position flush with the deck level to at least one third position, at least partially raised with respect to the deck level. In the embodiment shown, this tiltable arm 207 comprises a connector portion 208 at its distal end, which is hingeably mounted to both the tiltable arm 207 and the hinge arm 204 and secures the connection between the tiltable arm 207 and the hinge arm 204.

**[0052]** The movements of the parts of the hinge mechanism(s) 201, 202 are preferably driven by means of different motors or actuators, in order to move the parts and thereby move the deck panel to the various positions. The trolley 206 preferably comprises a trolley motor 210 arranged for moving the trolley up and down inside or along the profile 203. The hinge arm 204 may comprise a first linear motor 211 for pivoting the hinge arm 204 with respect to the trolley 206 and a second linear motor 209 for tilting the tiltable arm 207 with respect to the hinge arm 204. Each of the linear motors is preferably equipped with a force or pressure sensor, which may give a feedback to the control unit about the pressure experienced as a result by the airflow over the deck panel(s).

**[0053]** Preferably, a control unit is provided for controlling the various motors or actuators of the hinge mechanisms, such that the movement of the hinge arms and

trolleys can be accurately controlled and the movement of the deck panels can be synchronized. User controls (not shown) may be provided, in communication with the control unit, allowing the user to select the desired position of the deck panels and/or control the extent to which the deck panels are raised in the third configuration. Such user controls may for example comprise a number of push buttons on a dashboard in the steering cabin 7. Further, the control unit may be configured with a control programme for automated control of the position of the deck panels in the raised configuration, for example automated control within a range of third positions.

**[0054]** In Fig. 5 the hinge mechanism 201 is shown in the second position (flush deck configuration). In order to move the deck panel to the first position, the hinge arm 204 is lifted by operating the first linear motor and subsequently the trolley 206 is lowered along the profile by operating the trolley motor. The first position is shown in Fig. 4. In order to move the deck panel from the second to the third position, the second linear motor 209 is operated for raising the tiltable portion 207 above the hinge arm 204. The connector portion 208 ensures the connection between the tiltable arm 207 and the hinge arm 204, such that the deck panel mounted on the hinge mechanism 201 can stay interlocked with the opposing hinge mechanism 202, as shown in Figs. 6 and 7.

**[0055]** In embodiments, the moving mechanism may be provided for controlling only the position of the deck panels between the second position (the flush deck configuration) and at least one third position (the raised configuration). In such embodiments, the conversion between the flush deck configuration and the open bow configuration may be achieved by a manual operation, for example lifting the deck panels and moving them to the first position. Preferably, the moving mechanism is also provided for effecting the movement from the second position (flush deck configuration) to the first position (open bow configuration), preferably under instructions or a control signal provided by the control unit and/or the user controls.

**[0056]** Many other embodiments of moving mechanisms for moving the deck panels are envisaged within the scope of the present disclosure. For example, a moving mechanism may be provided within the scope, wherein only the movement between the second and (at least one) third positions is driven by a motor and controlled by means of a control unit and/or user controls and wherein the movement between the second and first positions, to open or close the user area 6, is performed manually. A possible embodiment like this may be similar to the one shown in Figs. 4-7, wherein only the position of the tiltable arm 207 is driven by means of a motor, preferably a linear motor and wherein the user can for example manually disconnect the locking mechanism 205, lift the deck panels (and the hinge arms 204 to which they are fixed) and once lifted, lower the deck panels into the first positions while the trolleys 206 are moved downwards along the profiles 203.

## Control unit

**[0057]** The control unit is described with reference to Fig. 11. The control unit 301 is provided for operating the moving mechanism and thereby controlling the position of the deck panels 111, at least between the flush deck configuration (dotted line) and the raised configuration (full line).

**[0058]** In embodiments, the control of the position of the deck panels may be entirely left to the user, i.e. by means of user controls which are preferably provided in the steering cabin 7 of the boat. For example, these controls may be provided in the form of push buttons, for example an "up" button for raising the panel(s) 111 and a "down" button for lowering the panel(s) 111. In embodiments where the moving mechanism is further provided for moving the panel(s) 111 to the first position (open configuration), this may be provided in the form of an "open" button for opening the user area 6 and "close" button for closing the user area 6. As mentioned elsewhere herein, the movement between the first and second positions may also be provided manually.

**[0059]** In embodiments, the control of the position of the deck panels in the raised configuration, i.e. in a range of third positions, may also be (partially) automated. For example, the control unit 301 may be configured for controlling the position of the deck panel(s) depending on the speed, a measured air resistance and/or any sensor input which give feedback to the control unit 301. In embodiments, the user controls may be combined with a (partially) automated control by means of the control unit 301. For example, the control unit may be provided for automated control of the position of the deck panels based on sensory feedback with an override function when the user operates the user controls. In another example, the control unit 301 may be configured such that the user sets, by means of the user controls, one or more predefined third positions for the deck panel(s) 111 and that the control unit 301 subsequently fine-tunes the position of the deck panel(s) in a subrange around the selected third position based on the sensor feedback.

**[0060]** In Fig. 11, a number of sensors and/or input units which may provide information to the control unit 301 are shown. The sensors may comprise one or more of the following:

- one or more (thermal) camera unit(s) 10 mounted at the front of the boat and provided for determination of a height with respect to the water surface and/or distance with respect to the vessel, a wave frequency and the like;
- a gyroscope unit 11 comprising sensors (gyroscopes, accelerometers, a compass and/or a gps module) enabling detection or measurement of an orientation with respect to the water surface, speed, acceleration, shocks, and/or position coordinates with indication of time;
- one or more force or pressure sensors 12, possible

associated with one or more of the motors or actuators of the deck panel moving mechanism, for sensing or determining downward force or pressure on the deck panel(s) 111;

- a wind sensor unit 13 for sensing or determining wind speed and/or direction;
- a sensor unit 9 associated with the boat engine which may for example give feedback about the rpm or the propellor, fuel consumption and the like.

**[0061]** Each of these sensors or input units 9-13 may comprise its own, local intelligence and thus provide processed data to the control unit, or may simply provide raw data for being processed by the control unit 301. In other words, data processing may be localized and/or centralized.

**[0062]** The convertible deck system may further comprise a learning module 302. The learning module may be provided for collecting data with respect to the position of the at least one deck panel in the raised configuration during travelling on water and data based on information or signals provided by at least one of the sensors or input units, possibly after some processing (further referred to as "sensor input data"). The learning module 302 may be configured for learning optimised positions for the at least one deck panel based on the collected deck panel position data and sensor input data. Such a learning module may for example be used to learn or gain feedback on the position (in the raised configuration) that is set by the user by means of the user controls and/or by the control unit in correlation with at least some of the collected sensor input data. For example, the learning module 302 may be configured for correlating the deck panel position with one or more of: the speed of the boat, the orientation with respect to the water surface, detected weather conditions and/or any other sensor input described herein. Once the learning module is provided with a relevant, large enough dataset, the learning module may be capable of determining an optimized position for the deck panel(s) in the raised configuration depending on the sensor input and a "desired effect". Desired effects can for example be: a reduced number or magnitude of shocks, improved orientation with respect to the water surface (optimized tilt of the boat), maximizing speed, reducing fuel consumption, or other. This is shown schematically in Fig. 12. The learning module 302 may be embodied in the form of a separate unit or as a module within the control unit 301.

**[0063]** The output or results of the learning module (the "learned data") can be used to advise users of the boat on an optimized deck panel position to obtain the desired effect, or can be used as a feedback signal to the control unit 301 for automated optimization of the deck panel position in the raised configuration. In embodiment, the desired effect may be a user setting, i.e. may be selectable by the user.

**[0064]** The learned data can further be used as training data for other boats or vessels on which a convertible

deck system according to the present disclosure is installed. To this end, the control unit 301 may be provided with telecommunication means for connecting with a cloud server and uploading the learned data and/or downloading training data which has been obtained on the basis of learned data from other boats or vessels, for example boats or vessels of the same type. In an initial, training stage, the control unit 301 and learning module 302 on one or more boats or vessels may be provided for (mainly) collecting and determining learned data while the positioning of the deck panels in the raised configuration is (mainly) left to the user(s) by means of the user controls and while the position data is correlated with the sensor input data. In this way, a large data set of learned data can be obtained in a relatively short term on the cloud server, so that some useful correlations between the deck panel position data and sensor input data can be determined in order to be able to optimize the deck panel positions in view of desired effects to be achieved. In subsequent stages, the cloud server can thus supply training data to the control unit(s) 301, possibly to supplement learned data which is determined on board the respective boat(s) or vessel(s).

**[0065]** In embodiments, the following "desired effects" may be achievable by means of the control unit 301 and/or learning module 302, alone or in combination, using the following implementation.

**[0066]** Reducing shocks: controlling the front deck may be done using data collected from the thermal camera, gyroscope, pressure sensors on the deck panels and wind sensor. With the aim of reducing shocks at planing speed, the learning module 302 may be configured to learn about the causal relationship between the roughness of the fairway, how many shocks the vessel endures and how the wind affects it. The objective is to use aerodynamic force to weigh down the front deck to make the bow cleave better through rough water, so that the vessel moves less up and down and thus experiences less shocks. The learning module 302 may use a reinforcement learning AI model to continuously optimise the movements of the deck panels in order to reduce shocks.

**[0067]** Levelling the vessel: controlling the front deck may be done using data collected from the gyroscope, pressure sensors on the deck panels and wind sensor. With the aim of levelling the vessel (front to back and starboard to portside) at planing speed. The objective is to use aerodynamic force of each moving deck panel to level pitch and roll (front to back and starboard to portside). The learning module 302 may use a reinforcement learning AI model to continuously optimise the movements of the deck panels in order to better level the vessel.

**[0068]** Reducing energy consumption for propulsion: at planing speed, a comparison may be made between the vessel's pitch, any propeller position, wind impact and acute energy consumption (for propulsion). The objective here is to reduce aerodynamic drag around and behind the vessel at any speed as the moving front deck

re-directs the wind around the vessel as efficiently as possible. Engine RPM and especially acute energy consumption are metrics to measure and demonstrate aerodynamic optimisation. The learning module 302 may use a reinforcement learning AI model to continuously optimise the movements of the deck panels in view of reducing energy consumption.

#### Control programme

**[0069]** A method according to the present disclosure may be provided for influencing aerodynamics of a boat during travelling on water, in particular during planing or foiling. The method may take the form of a control programme, provided in or with the control unit 301 of the convertible deck system described herein and comprising at least steps for controlling the position of the deck panels between the second position (flush deck configuration) and at least one third or raised position (raised configuration), wherein the deck panels are at least partially raised above the deck level.

**[0070]** The method / control programme may comprise steps for controlling the moving mechanism and thereby controlling the position of the deck panels, at least between the flush deck configuration and the raised configuration. The method / control programme may comprise steps for controlling the position of the at least one deck panel in a range of positions between the second position wherein the at least one deck panel is flush with the deck level and an extreme position wherein the air resistance of the boat is maximum. The range of position may comprise a number of discrete, predefined positions between the second position and the extreme position or a continuous range of positions.

**[0071]** The method / control programme may comprise steps for collecting data by means of the control unit 301 and/or a learning module 302 and learning optimized positions for the deck panels, based on a desired effect to be achieved (as described elsewhere herein).

**[0072]** The method / control programme may be configured for instructing the control unit 301 to control, by means of the moving mechanism 200, the position of the deck panel(s) depending on sensor input such as for example the speed, a measured air resistance and/or any sensor input which give feedback to the control unit 301. In embodiments, method / control programme may comprise steps for enabling user control in combination with automated control by means of the control unit 301. For example, steps may be provided for automated control of the position of the deck panels based on sensor feedback with an override function when the user operates the user controls. In another example, the method / control programme may comprise steps allowing the user to set, by means of the user controls, one or more predefined third positions for the deck panel(s) and further steps for subsequently fine-tuning the position of the deck panel(s) in a subrange around the selected third position based on the sensor feedback.

**[0073]** The method / control programme may comprise steps for processing feedback information received from one or more sensors and/or input units. The sensors and/or input units which may provide feedback information to the control programme have been described elsewhere herein and may comprise one or more of the following: one or more (thermal) camera unit 10; a gyroscope unit 11; one or more force or pressure sensors 12, possible associated with one or more of the motors or actuators of the deck panel moving mechanism; a wind sensor unit 13 for sensing or determining wind speed and/or direction; a sensor unit 9 associated with the boat engine; or other.

**[0074]** The method / control programme may comprise steps for instructing the learning module to collect data with respect to the position of the at least one deck panel in the raised configuration during travelling on water and data based on information or signals provided by at least one of the sensors or input units, possibly after some processing (further referred to as "sensor input data"). The method / control programme may comprise steps for instructing the learning module to determine or learn optimised positions for the at least one deck panel based on the collected deck panel position data and sensor input data. Such steps may for example comprise learning from the position(s) (in the raised configuration) that is/are set by the user by means of the user controls and/or by the control unit in correlation with at least some of the collected sensor input data. For example, the learning module 302 may be instructed for correlating the deck panel position with one or more of: the speed of the boat, the orientation with respect to the water surface, detected weather conditions and/or any other sensor input described herein. Once the learning module has collected a relevant, large enough dataset, the learning module may determine an optimized position for the deck panel(s) in the raised configuration depending on the sensor input and a "desired effect". Desired effects can for example be: a reduced number or magnitude of shocks, improved orientation with respect to the water surface (optimized tilt of the boat), maximizing speed, reducing fuel consumption, or other, as described elsewhere herein. In embodiments, the desired effect may be a user setting, i.e. may be selectable by the user.

**[0075]** The method / control programme may comprise steps to control the learning module 302 by means of a reinforcement learning AI model to continuously determine optimised positions and/or movements for the deck panels in view the desired effect(s).

**[0076]** The method / control programme may comprise steps for using the output or results of the learning module (the "learned data"), for example to advise users of the boat on an optimized deck panel position to obtain the desired effect, or to provide a feedback signal to the control unit 301 for automated optimization of the deck panel position in the raised configuration. In embodiments, the desired effect may be a user setting, i.e. may be selectable by the user.

**[0077]** The method / control programme may comprise steps for providing the learned data as training data for other boats or vessels on which a convertible deck system according to the present disclosure is installed. To this end, method / control programme may comprise steps for connecting the control unit 301 through telecommunication means with a cloud server and uploading the learned data and/or downloading training data which has been obtained on the basis of learned data from other boats or vessels, for example boats or vessels of the same type.

**[0078]** The method / control programme may comprise an initial, training stage, wherein the control unit 301 and learning module 302 on one or more boats or vessels are controlled to (mainly) collect and determine learned data while the positioning of the deck panels in the raised configuration is (mainly) left to the user(s) by means of the user controls and while the position data is correlated with the sensor input data. In this way, a large data set of learned data can be obtained in a relatively short term on the cloud server, so that some useful correlations between the deck panel position data and sensor input data can be determined in order to be able to optimize the deck panel positions in view of desired effects to be achieved. In subsequent stages, method / control programme may comprise steps for controlling the control unit 301 to receive training data from the cloud server, possibly to supplement learned data which is determined on board the boat itself.

## Claims

1. A convertible deck system for converting a front section of a boat between an open bow configuration and a flush deck configuration, the convertible deck system comprising

at least one movable deck panel, movable between a first position in the open bow configuration wherein a user area in the front section of the boat is uncovered and a second position in the flush deck configuration wherein the user area is covered and the at least one deck panel is flush with a deck level of the boat, and a moving mechanism for moving the at least one deck panel,

**characterized in that** the moving mechanism is provided for positioning the deck panels in a raised configuration in the front section of the boat, wherein the at least one deck panel is at least partially raised or tilted above the deck level for influencing aerodynamics of the boat during travelling on water, in particular during planing or foiling.

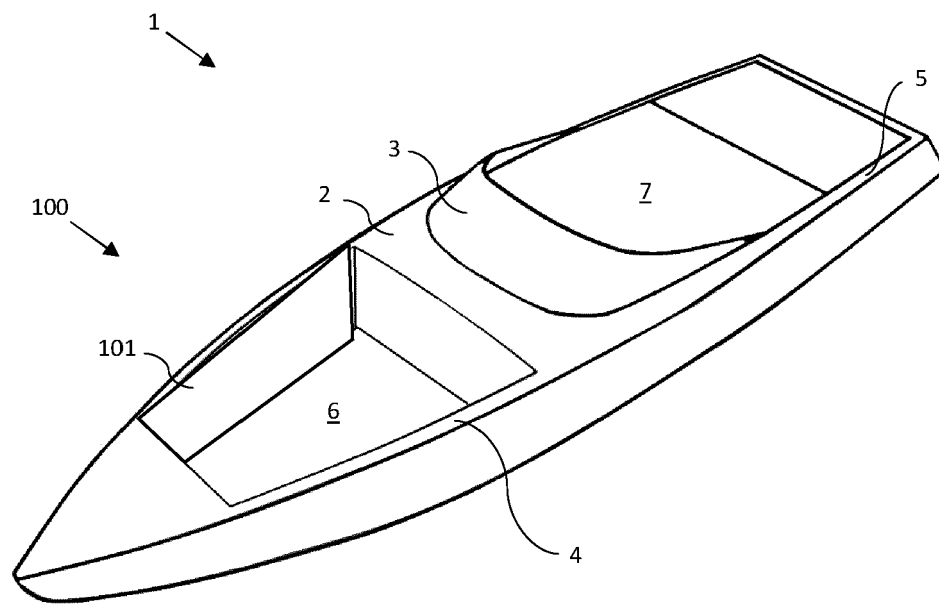
2. The convertible deck system according to claim 1, wherein the moving mechanism is provided for po-

sitioning the at least one deck panel in a range of third positions in the raised configuration.

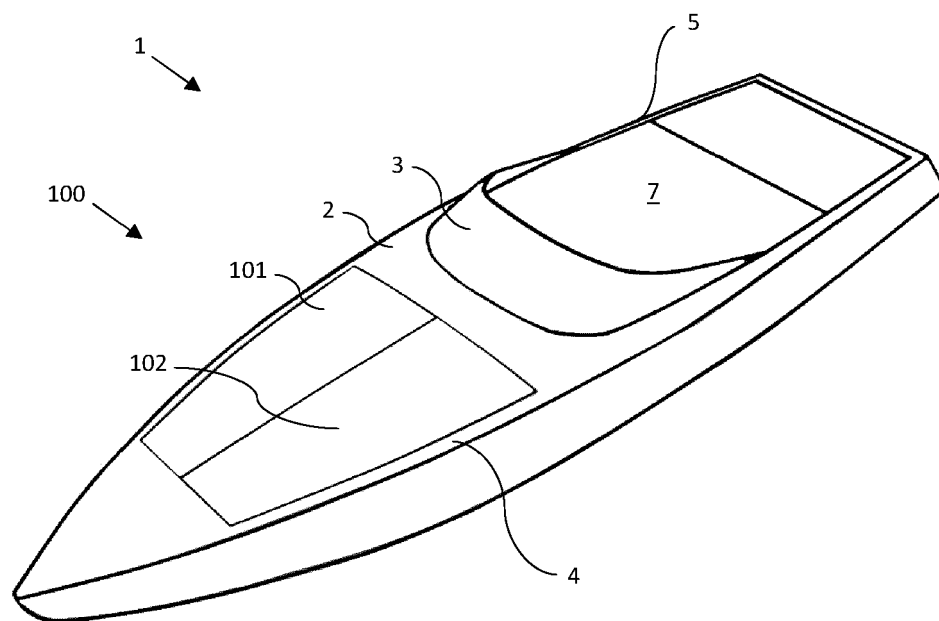
3. The convertible deck system according to claim 2, wherein the range of third positions extends between the second position wherein the at least one deck panel is flush with the deck level and an extreme position wherein the downward pressure on the front section of the boat is maximum. 5
4. The convertible deck system according to any one of the preceding claims, wherein the moving mechanism is provided for moving the at least one deck panel from the second position to the first position and vice versa. 10
5. The convertible deck system according to any one of the preceding claims, wherein the convertible deck system further comprises a control unit for operating the moving mechanism and controlling the position of the at least one deck panel at least between the flush deck configuration and the raised configuration. 15
6. The convertible deck system according to any one of the preceding claims, wherein the convertible deck system further comprises user controls for operating the moving mechanism and/or the control unit. 20
7. The convertible deck system according to claim 6, wherein the control unit is provided for receiving sensor input data from at least one of the following sensors or input units: at least one camera unit, a gyroscope unit, at least one force or pressure sensor provided for sensing or determining downward pressure on the at least one deck panel, a wind sensor unit, a sensor unit associated with an engine of the boat, or other. 25
8. The convertible deck system according to any one of the preceding claims, wherein the convertible deck system further comprises a learning module, provided for collecting position data with respect to the position of the at least one deck panel in the raised configuration during travelling on water and sensor input data based on information or signals provided by at least one sensor or input unit. 30
9. The convertible deck system according to claim 8, wherein the learning module is provided for determining learned data, in particular optimized position data for the at least one deck panel in the raised configuration, on the basis of the collected position data and sensor input data and an inputted desired effect, wherein the desired effect is preferably one of the following: a reduced number or magnitude of shocks, improved orientation with respect to the water surface, a maximized speed, a reduced fuel consumption. 35

sumption.

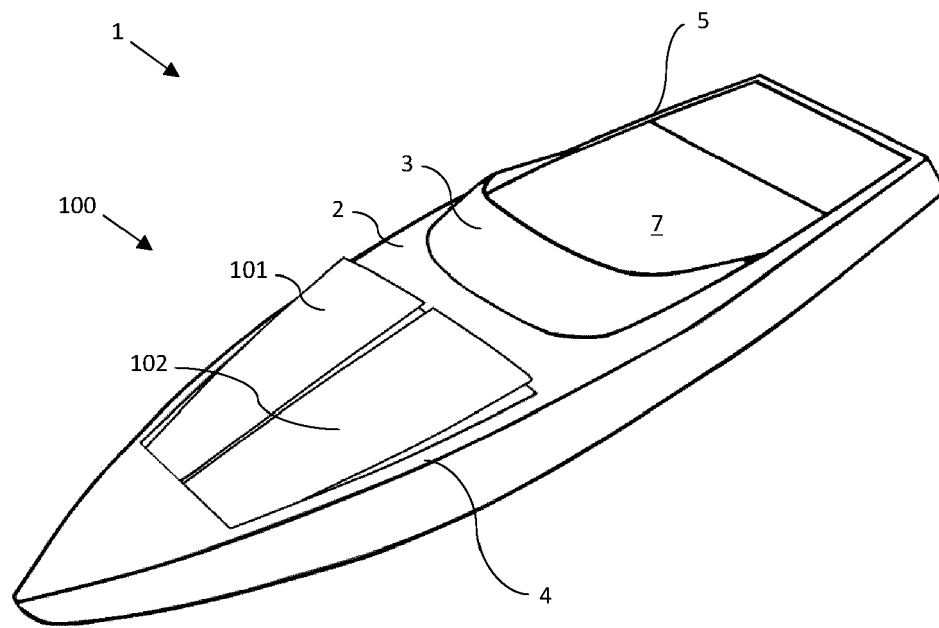
10. The convertible deck system according to any one of the preceding claims, wherein the moving mechanism is provided for tilting the at least one deck panel along a longitudinal axis between the first and second positions and tilting the at least one deck panel along a transverse axis between the second and third positions. 40
11. A kit of parts for building a convertible deck system according to any one of the preceding claims on a boat. 45
12. A boat comprising a hull, a front section in front of a steering gear and a rear section rearward from the steering gear, and a convertible deck system according to any one of the preceding claims in the front section of the boat. 50
13. A method for influencing aerodynamics of a boat during travelling on water, in particular during planing or foiling, comprising the steps of:
  - a) providing a convertible deck system according to any one of the preceding claims, and
  - b) operating the convertible deck system to raise the at least one deck panel at least partially above the deck level for influencing the aerodynamics of the boat, in particular for controlling a downward pressure on the front section of the boat. 55
14. The method according to claim 13, further comprising the step of operating the convertible deck system to control the position of the at least one deck panel in a range of positions between the second position wherein the at least one deck panel is flush with the deck level and a third position wherein the air resistance of the boat is maximum. 60
15. The method according to claim 13 or 14, further comprising the step of collecting data by means of a learning module, the collected data comprising position data with respect to the position of the at least one deck panel in the raised configuration during travelling on water and sensor input data based on information or signals provided by at least one sensor or input unit, the method preferably further comprising steps for determining learned data, in particular optimized position data for the at least one deck panel in the raised configuration, on the basis of the collected position data and sensor input data and an inputted desired effect, wherein the desired effect is preferably one of the following: a reduced number or magnitude of shocks, improved orientation with respect to the water surface, a maximized speed, a reduced fuel consumption. 65



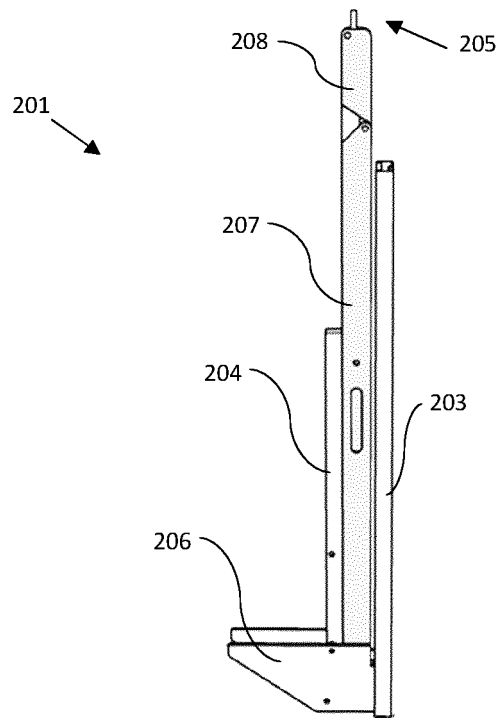
**FIG. 1**



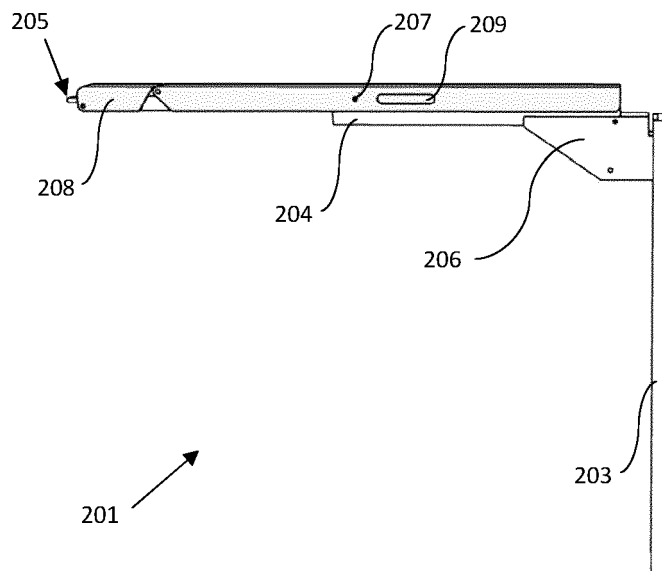
**FIG. 2**



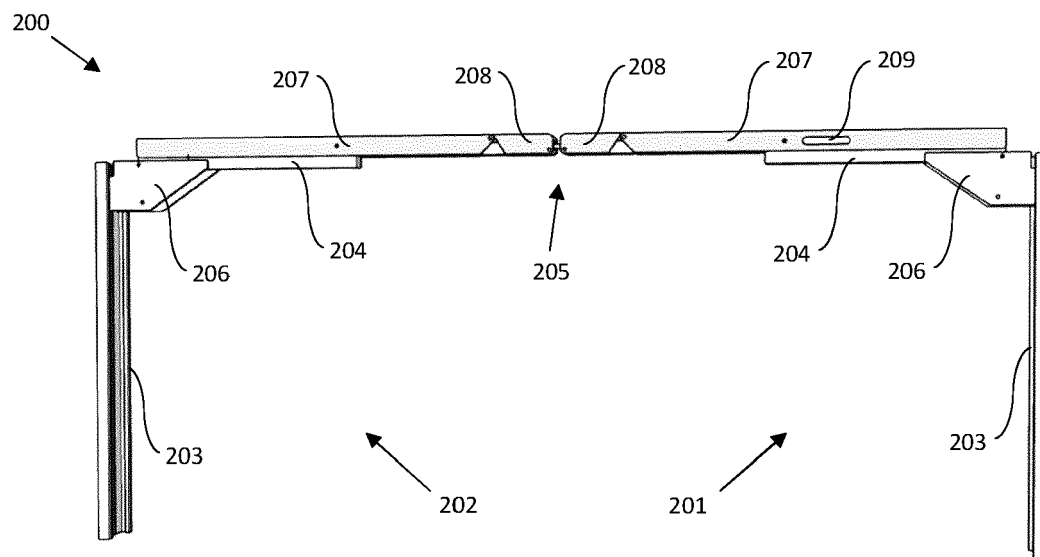
**FIG. 3**



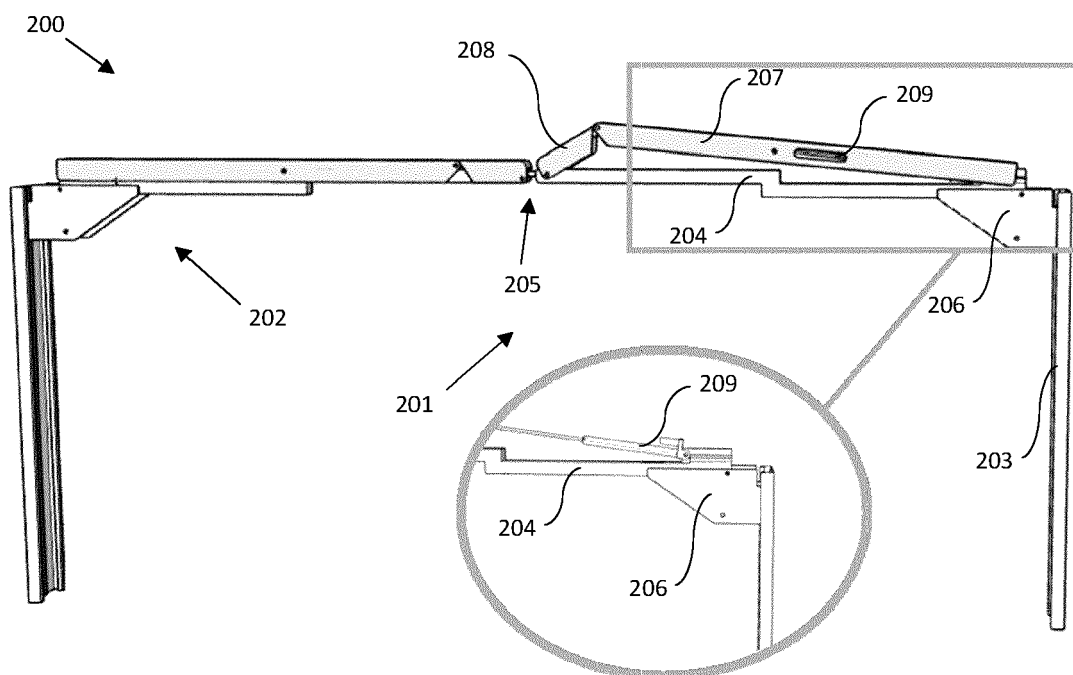
**FIG. 4**



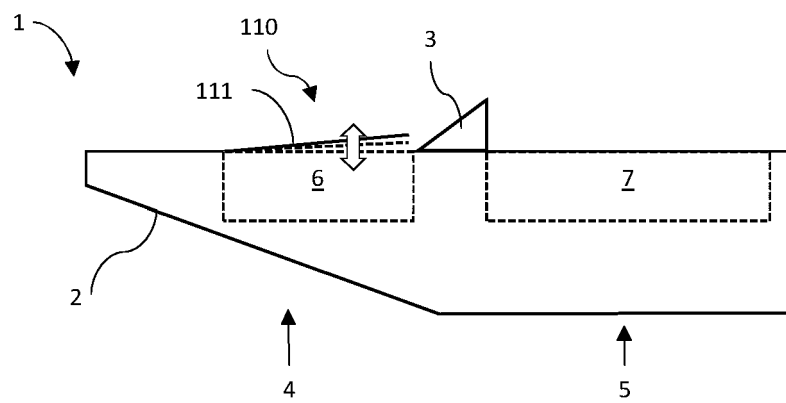
**FIG. 5**



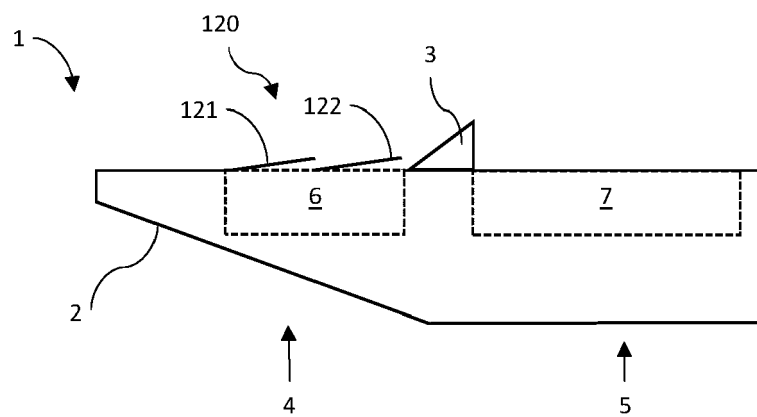
**FIG. 6**



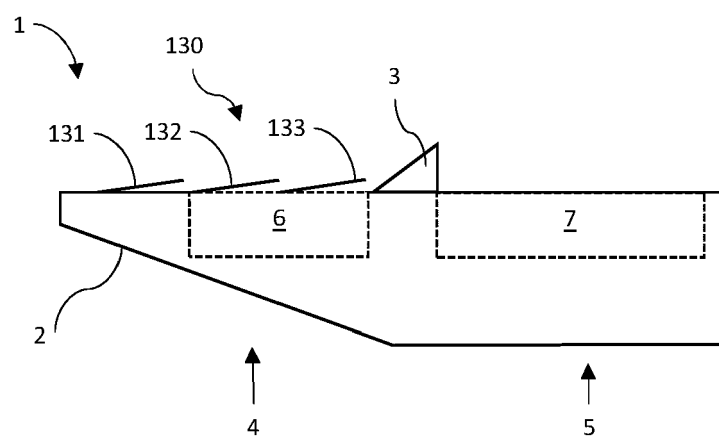
**FIG. 7**



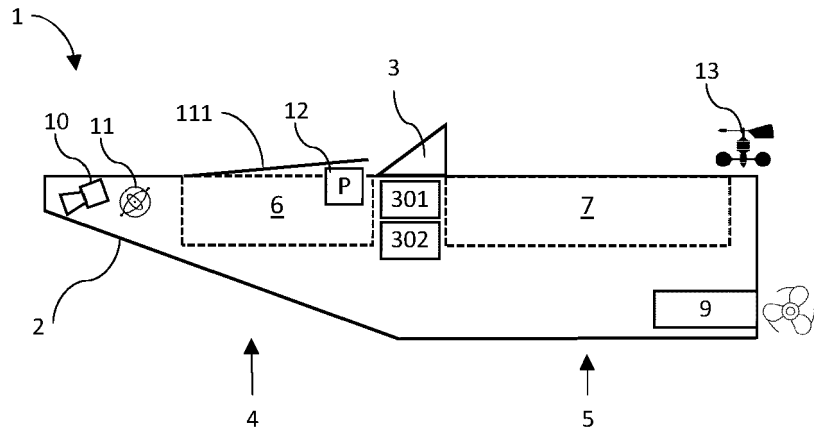
**FIG. 8**



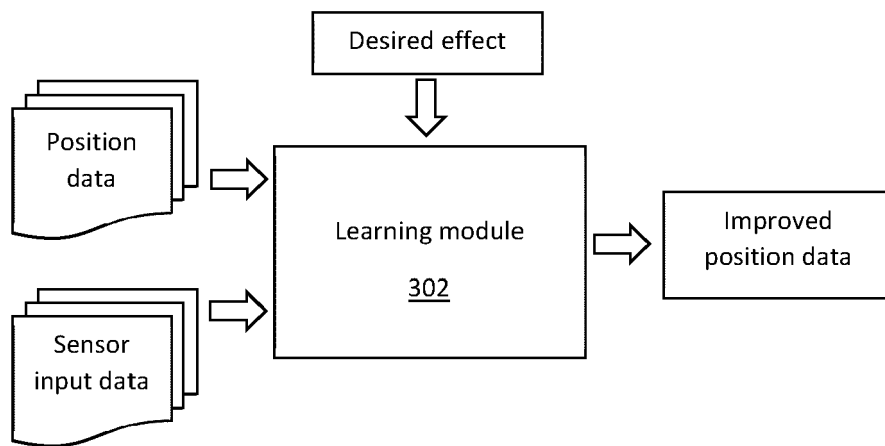
**FIG. 9**



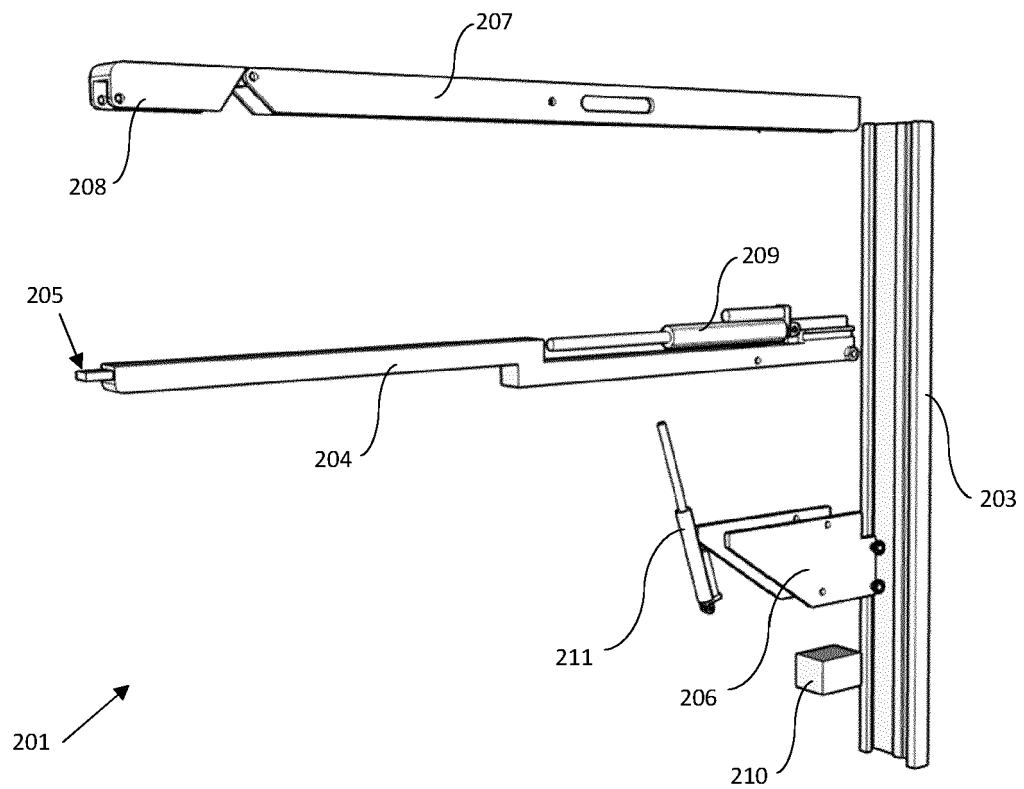
**FIG. 10**



**FIG. 11**



**FIG. 12**



**FIG. 13**



## EUROPEAN SEARCH REPORT

Application Number

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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                    |                                                                                                                             |                                                                                                                                                                                                                                                                                       |                                                        |
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|                                                                                                                                                                                                                                                        |                                                                                                                             |                                                                                                                                                                                                                                                                                       | B63B                                                   |
| The present search report has been drawn up for all claims                                                                                                                                                                                             |                                                                                                                             |                                                                                                                                                                                                                                                                                       |                                                        |
| Place of search<br><b>The Hague</b>                                                                                                                                                                                                                    |                                                                                                                             | Date of completion of the search<br><b>22 August 2023</b>                                                                                                                                                                                                                             | Examiner<br><b>Harder, Sebastian</b>                   |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document |                                                                                                                             | T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>.....<br>& : member of the same patent family, corresponding document |                                                        |

**ANNEX TO THE EUROPEAN SEARCH REPORT  
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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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22-08-2023

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