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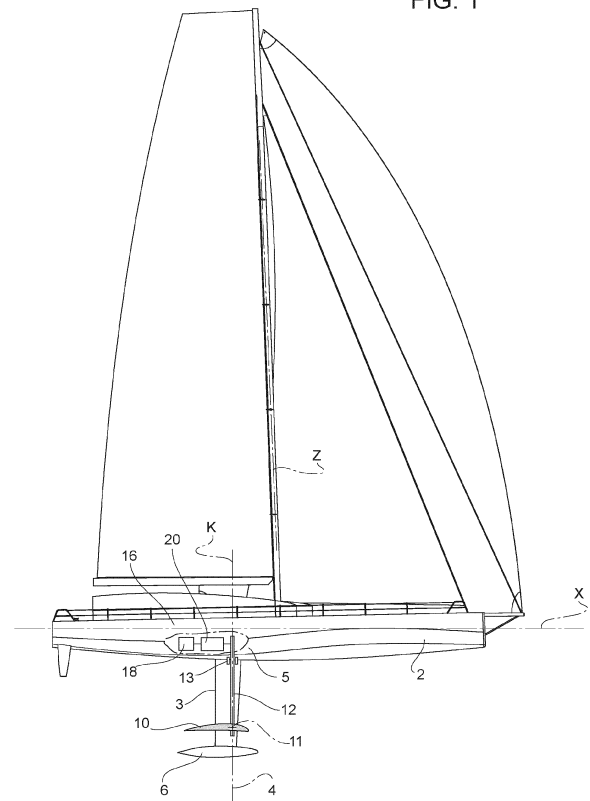
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(54) **BOAT WITH AN ENERGY RECOVERING APPARATUS**

(57) A boat (1) has a hull (2) and an apparatus (16) with an electric generator (18) for electric energy recovery; the apparatus (16) has a support (12), which is movable with respect to the hull (2) with a reciprocating motion along a trajectory (K), is coupled to the electric generator (18) so as to generate electric energy due to the movement between a top dead centre and a bottom dead centre along said trajectory (K) and carries a blade (10), arranged below the hull (2) so as to be permanently and completely arranged in the water during the use of the electric generator (18); the apparatus (16) has an actuator (14), which is operated by an electronic control unit (15) to vary an external configuration of the blade (10) and, hence, change a hydrodynamic lift or a hydrodynamic resistance along said trajectory (K) when the support (12) and the blade (10) reach the top and bottom dead centres.

FIG. 1



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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This patent application claims priority from Italian patent application no. 102023000017688 filed on August 29, 2023, the entire disclosure of which is incorporated herein by reference.

TECHNICAL FIELD

[0002] The invention relates to a boat, in particular a sailing boat, more in particular a racing boat, with an apparatus for recovering energy.

PRIOR ART

[0003] Some racing boats are provided with a plurality of energy-consuming devices, such as hydraulic actuators, charging devices for charging batteries and the like.

[0004] Usually, these devices are powered by energy produced by an internal combustion engine on board the boat.

[0005] The engine, in turn, is powered by fossil fuels.

[0006] This aspect leads to some drawbacks, including the emission of pollutants produced by the combustion of fossil fuel and the sizing of the devices closely related to the amount of fuel on board the boat.

[0007] Therefore, the aforementioned drawbacks need to be eliminated, preferably in a simple and reliable manner.

[0008] More specifically, there is a need to identify alternative energy sources, without the emission of polluting combustion products.

[0009] Aim of the invention is to fulfil at least one of the needs discussed above.

DESCRIPTION OF THE INVENTION

[0010] Said aim is achieved by a boat as defined in claim 1.

[0011] The dependent claims define special embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Hereinafter, an embodiment of the invention will be described, in order to allow the latter to be better understood, by way of non-limiting example and with reference to the accompanying drawings, wherein:

- figure 1 is a side view of a boat according to a preferred embodiment of the invention;
- figure 2 is a schematic plan view from the top of an apparatus for energy recovery provided on the boat of figure 1;
- figure 3 is a schematic front view of a detail of the apparatus for energy recovery of figure 2;

- figure 4 shows a detail of figure 1, on a larger scale and with more details; and
- figures 5 to 10 are similar to figures 1 and 4 and show a sequence of movements of a blade that is part of the apparatus for energy recovery.

EMBODIMENTS OF THE INVENTION

[0013] In figure 1, reference number 1 is used to indicate, as a whole, a boat.

[0014] The boat has a hull 2 extending longitudinally along an axis X, which coincides with the normal sailing direction of the boat.

[0015] In addition, the hull 2 extends in width and height according to a transverse axis, not shown, and according to an axis Z, which are perpendicular to one another and relative to the axis X, so as to form a (in particular, right-handed) Cartesian coordinate system of orthogonal axes, which is fixed relative to the hull 2. The X axis, the transverse axis and the axis Z are commonly referred to as roll axis, pitch axis and yaw axis, respectively.

[0016] The boat 1 preferably comprises a keel 3, which projects downwards along an axis 4 starting from a portion 5 of the hull 2, arranged in an intermediate position between the bow and the stern and at the centre between the sides of the hull 2. In particular, the portion 5 is the lowest part of the hull 2. Preferably, the axis 4 is orthogonal to the axis X. Preferably, the keel 3 has a lower end that supports or defines a bulb 6, having a mass (for example of about 8-10 tons) such as to place the centre of gravity of the boat 1 in a relatively low position, in particular in order to enable a self-righting of the boat 1 even in case of a possible total capsizing.

[0017] According to a variant which is not shown herein, the keel 3 is coupled to the hull 2 at its upper end so as to be able to rotate relative to the Z axis, due to the action of an actuator, about an axis which is parallel to the X axis, in particular to move the bulb 6 to the right or left.

[0018] The boat 1 comprises a blade 10, which is arranged below the hull 2 so as to be permanently and completely immersed in water and has a shape and/or structure and/or dimensions such as to define a hydrodynamic lift and/or a hydrodynamic resistance as a result of a relative speed in relation to the water in which it is immersed.

[0019] Preferably, the blade 10 is supported by the keel 3 and protrudes with respect to the keel 3 in a way that is not shown, along an axis 11 transverse to the axes X and Z.

[0020] According to an aspect of the invention, the blade 10 is mounted on a support 12, for example defined by a shaft or a rod, sliding together with the blade 10 relative to the keel 3 and the hull 2 along a trajectory K defined by a guide 13 (schematically shown). For example, the trajectory K is straight and coincides with the axis 4. The guide 13 can be part of the keel 3 or is arranged inside the hull 2.

[0021] Preferably, two blades 10 are provided, on op-

posite sides of the support 12.

[0022] According to variants which are not shown herein, the keel 3 lacks the bulb 6; or the blade 10 is arranged on a keel other than the keel 3 that supports the bulb 6; or the support 12 with the blade 10 projects downwards from the hull 2 without being supported by, or associated with, any keel; and/or the support 12 with the blade 10 is arranged in a longitudinal position other than the one shown herein (for example, it can be arranged at the bow).

[0023] According to another aspect of the invention, the blade 10 has an external configuration that can be changed to vary its hydrodynamic lift and/or its hydrodynamic resistance along the trajectory K. The way in which to change the external configuration is not essential and, for example, it can consist of:

- changing the angle of inclination of the entire blade 10 about the axis 11 relative to the support 12 (and, therefore, relative to the keel 3, in the case shown herein), and/or
- changing the external shape of the blade 10; this change in shape, in turn, can be obtained by
 - o deforming flexible walls that define the outer surface of the blade 10; for example, according to a known technique, this deformation can be caused by moving a cam (not shown) located inside the blade 10, or
 - o rotating, about the axis 11, a front or rear end of the blade 10, movable relative to the remaining part, which remains fixed with respect to the support 12.

[0024] The images shown in the accompanying figures are to be understood as functional diagrams and do not constructively show the specific way in which the external configuration of the blade 10 is varied.

[0025] As schematically shown in figure 4, the external configuration of the blade 10 is changed by operating an actuator 14, of the linear or rotary type, preferably powered by electric energy. The actuator 14 is carried by the support 12 and, hence, is movable together with the blade 10 and the support 12 along the trajectory K defined by the guide 13.

[0026] Preferably, the actuator 14 and the lower part of the support 12 are housed in the keel 3 and the latter has a lateral slit (not shown), which is parallel to the trajectory K and allows the blade 10 (which is external to the keel 3) and the lower part of the support 12 (which is internal to the keel 3) to be coupled to one another.

[0027] If necessary, a transmission, which is not shown, can be provided between the actuator 14 and the blade 10. In turn, the activation of the actuator 14 is controlled by an electronic control unit 15 (schematically shown), whose functions will be described more in detail below.

[0028] The blade 10, the support 12, the actuator 14

and the electronic control unit 15 are part of an apparatus 16 for energy recovery, which exploits the hydrodynamic lift and/or the hydrodynamic resistance generated by the blade 10 in response to a movement of the boat 1 relative to the water and, therefore, in response to a relative movement between the water and the blade 10.

[0029] Specifically, the apparatus 16 can be configured according to two preferred embodiments, one exploiting the movement of the boat 1 during navigation to generate hydrodynamic lift along the trajectory K and the other exploiting the natural oscillatory pitching movement of the bow of the boat 1, triggered by the wave motion of the sea, to generate hydrodynamic resistance along the trajectory K. The support 12 moves with a reciprocating motion along the direction K due to the effect of the hydrodynamic lift of the blade 10 (as also described below with reference to figures 5 to 10) or due to the effect of the hydrodynamic resistance of the blade 10.

[0030] This reciprocating motion can take place, at most, between an upper end-of-stroke position and a lower end-of-stroke position, defined for example by reference elements and/or stop elements that are not shown herein.

[0031] The reciprocating motion actually takes place between a top dead centre and a bottom dead centre, which could coincide with the aforementioned end-of-stroke positions.

[0032] With reference to figures 1 and 2, the apparatus 16 further comprises at least one electric generator 18. The generator 18 comprises a rotor 19, which can rotate about an axis R. The generator 18 is configured to convert a kinetic energy associated with a rotation of the rotor 19 (in fact, the kinetic energy of the rotation of the rotor 19) into electric energy.

[0033] The electric energy produced by the generator 18 can be stored in a power storage device, on board the boat 1, such as a battery (not shown), used to power the electric utilities of the boat 1.

[0034] The rotor 19 is coupled to the support 12 by means of a transmission mechanism 20 so as to rotate in response to the translation of the support 12.

[0035] In other words, the mechanism 20 transforms the reciprocating translatory motion of the support 12 along the trajectory K into a corresponding rotation of the rotor 19 about the axis R, in particular a continuous rotation according to a single direction of rotation, for example clockwise or counterclockwise.

[0036] In other words, thanks to the mechanism 20, a first translation of the support 12, followed by a second translation of the support 12 in the opposite direction relative to the first translation, causes, as a whole, a rotation, for example clockwise or counterclockwise, of the rotor 19 according to the single direction of rotation, namely without the latter changing with the shift from the first translation to the second translation.

[0037] In this sense, the term "continuous" refers precisely to the absence of a reversal of the direction of rotation of the rotor 19 due to the reversal of the direction

of translation of the support 12 shifting from the first translation to the second translation. Therefore, the term "continuous" should not be understood in the restrictive sense that the angular speed of the rotor 19 cannot in any case be zero at one or more moments of time.

[0038] With reference to figure 2, preferably, the mechanism 20 comprises two transmissions 21, 22 arranged in parallel and configured to transmit respective rotations to the rotor 19.

[0039] The transmissions 21, 22 are configured to convert the first translation and the second translation, respectively, of the support 12 into rotary motions and then selectively transmit such rotary motions so as to cause the rotor 19 to rotate about the axis R according to the single rotation direction. In other words, when the transmission 21 converts the first translation into a rotary motion and transmits the latter to the rotor 19, the transmission 22 does not transmit any rotation torque to the rotor 19; vice versa, when the transmission 22 converts the second translation into a rotary motion and transmits the latter to the rotor 19, the transmission 21 does not transmit any rotation torque to the rotor 19.

[0040] More in detail, the transmissions 21, 22 comprise respective decoupling devices 23, 24 configured to decouple the rotation of the rotor 19 from the translation of the support 12 and/or to interrupt the respective couplings between the rotor 19 and the support 12.

[0041] Each one of the decoupling devices 23, 24, independently of the other one, can be defined by:

- an automatic decoupling device, such as a freewheel device, or
- a clutch device, for example a tooth coupling or a friction clutch, operated by an actuator (not shown) that is controlled by the control unit 15 so as to engage and disengage the corresponding device 23, 24 as a function of the direction of translation of the support 12 (or, indirectly, as a function of a rotation that is indicative of the direction of translation) and, if necessary, also as a function of the speed of translation/rotation.

[0042] It could be advantageous to also take into consideration a speed threshold below which the devices 23 and 24 are both disengaged, as it can prevent the rotor 19 from being slowed down by a slowing down of the support 12, when, instead, the same rotor 19 could have an inertia that is sufficient to rotate faster.

[0043] In case of disengagement, the coupling between the rotor 19 and the support 12 is interrupted. On the other hand, when the device 23,24 is engaged again by a command of the control unit 15, the coupling is restored.

[0044] As mentioned above, the control unit 15 controls the activation of the clutch device as a function of one or more quantities corresponding to or indicative of the direction of translation and, preferably, of the speed of translation of the support 12. These quantities are ac-

quired by the control unit 15 by means of dedicated transducers (not shown) configured to detect the quantities.

[0045] According to the specific embodiment shown in figures 3 and 4, the transmissions 21, 22 comprise respective racks 25 and 26, on opposite sides of the support 12, meshing with respective pinions 27 and 28, which can rotate about fixed axes, parallel to one another and orthogonal to the direction K.

[0046] Therefore, the pinions 27, 28 rotate in opposite directions in response to a same translation of the support 12.

[0047] With reference to figure 2, preferably, the transmissions 21, 22 further comprise respective toothed wheels 29, 30, which are respectively coupled to the pinions 27,28 by means of the corresponding devices 23, 24 and rotate in the same direction as the pinions 27, 28, when the respective devices 23, 24 transmit rotation torque. Preferably, the wheels 29 and 30 are coaxial to the pinions 27 and 28, respectively.

[0048] The wheels 29, 30 both mesh with a toothed wheel 31, which operates the rotor 19 of the generator 18. In particular, the wheel 31 is coaxial and fixed relative to the rotor 19.

[0049] The devices 23, 24 are both configured to decouple the rotor 19 when the pinions 27, 28 rotate according to a same specific direction of rotation, for example clockwise or counterclockwise, so as to transmit torque only in the opposite direction of rotation.

[0050] Therefore, thanks to the devices 23, 24, to the engagement of the wheels 29, 30 with the wheel 31 and to the fact that the pinions 27, 28 always rotate in opposite directions, the wheel 31 and, hence, the rotor 19 can only rotate by means of a single one of the transmissions 21, 22 and according to one single direction of rotation.

[0051] As a matter of fact, the devices 23, 24 allow only one of the wheels 29, 30 to rotate and only in the direction contrary to the specific one, mentioned above, in which the wheels 29,30 are decoupled from the support 12.

[0052] When they are decoupled from the support 12, the wheels 29 and 30 continue to rotate always in the same direction of rotation, but idle, dragged by the meshing with the wheel 31.

[0053] The mechanism 20 schematically represented in figure 3 is one of the possible mechanisms conceivable for transforming the reciprocating translatory motion of the support 12 into a rotation of the rotor 19 according to a single rotation direction. For instance, the mechanism 20 could for example comprise a typical connecting rod-crank mechanism, whose properties are well known and do not need to be described in detail.

[0054] According to a variant that is not shown herein, the mechanism 20 comprises one single transmission (for example defined by the pinion 27 or 28), which converts the translatory motion of the support 12 into a rotary motion and transfers the latter to the rotor 19, which, hence, rotates with a reciprocating rotary motion about the axis R (without a decoupling device interposed

between the rotor 19 and the support 12): suitable electric/electronic devices are then provided to process and store the generated electric energy (which has an oscillating intensity and also reaches zero values at the top and bottom dead centres of the translation of the blade 10).

[0055] According to a different embodiment, the generator 18, of the rotary type, is replaced by a generator of electric energy of the linear type, for example by a linear alternator: in this case, the mechanism 20 could be absent, namely said generator could be directly coupled to the support 12.

[0056] The apparatus 16 of the boat 1 works as follows, with reference to figures 5 to 10, where the boat 1 is navigating, for example due to the thrust of the wind (sailing).

[0057] Starting from figure 5, at the bottom dead centre of the translation stroke of the support 12, the external configuration of the blade 10 defines a hydrodynamic airfoil that is set/adjusted by operating the actuator 14, so as to have a first hydrodynamic lift directed upwards, namely towards the hull 2, due to the effect of the relative movement between the airfoil 10 and the water along the navigation direction.

[0058] This first hydrodynamic lift corresponds to a thrust that causes the blade 10 to translate along the trajectory K towards the hull 2 (figure 6) until it reaches the top dead centre (figure 7).

[0059] At the latter (figure 8), the external configuration (i.e. the airfoil) of the blade 10 is automatically changed by the control unit 15: the latter operates the actuator 14 so as to reverse the direction of thrust of the hydrodynamic lift, namely so as to have a second hydrodynamic lift directed in the opposite direction relative to the hull 2 (always considering the hydrodynamic effects caused by the movement along the navigation direction).

[0060] Therefore, the blade 10 reverses the direction of translation, as the hydrodynamic thrust is now directed downwards (figure 9). When the blade 10 reaches the bottom dead centre (figure 10), the actuator 14 is automatically actuated by the control unit 15 to reverse again the direction in which the hydrodynamic lift is directed and, hence, obtain again a hydrodynamic lift and a translation facing upwards along the direction K.

[0061] It is evident that the automatic switching of the external configuration of the blade 10 (namely, the automatic reversal of the direction in which the hydrodynamic lift is directed) occurs in response to the attainment of the top and bottom dead centres.

[0062] In this embodiment, where the movement of the boat 1 in the navigation direction is exploited (possibly in combination with ocean currents), the top and bottom dead centres are located along the trajectory K in respective positions that are predefined and fixed (if necessary, adjustable during the initial setting of the apparatus 16, but anyway stable after said initial setting). In particular, the top and bottom dead centres respectively correspond to the end-of-travel positions provided for the

translation, so as to take advantage of the maximum stroke available in each one of the two directions of translation.

[0063] In particular, the control unit 15 is connected to suitable sensors, for example proximity sensors or position sensors (not shown), for these two positions, to detect the reaching of the top and bottom dead centres by the support 12 and/or the blade 10 and then supply corresponding consent signals to the control unit 15. The latter controls the actuator 14 in response to said consent signals, namely exactly when the blade and the support 12 have reached the top and bottom dead centres.

[0064] As mentioned above, according to another embodiment, it is possible to exploit the natural pitching movement of the boat 1 in order to cause a translation of the blade 10 and of the support 12 relative to the hull 2. In this case, the external configuration of the blade 10 is set/adjusted by the control unit 15 through the actuator 14 at the top and bottom dead centres so as to have a first and a second hydrodynamic resistance, which are directed along the trajectory K in directions contrary to the lifting and to the lowering, respectively, of the boat 1, namely in counter-phase with respect to the pitching movement. In other words, when the wave motion causes a lifting of the hull 2, a first hydrodynamic resistance of the blade 10 is set so as to hold blade 10 down, whereby the support 12 slides in the guide 13 which, in the meantime, is rising together with the hull 2; similarly, when the wave motion causes a lowering of the hull 2, the external configuration of the blade 10 is reversed, namely a second hydrodynamic resistance is set so as to hold the blade 10 up, whereby the support 12 slides in the opposite direction in the guide 13, which, in the meantime, is lowering itself together with the hull 2.

[0065] Preferably, though not necessarily, the control unit 15 is configured so as to have, as its objective or target, maintaining the blade 10 in the vicinity of a fixed depth with respect to the free surface of the water, while the hull 2 pitches naturally.

[0066] In this case, the top and bottom dead centres, where the switching of the external configuration of the blade 10 must take place, are not located in fixed positions, but depend on the actual range of the hull 2 during the pitching (and, hence, on the extent of the wave motion). In other words, the top dead centre and the bottom dead centre of the translation of the blade 10 and of the support 12 correspond to the bottom dead centre and to the top dead centre, respectively, of the oscillation of the hull 2 during pitching.

[0067] To this regard, the electronic control unit 15 is configured so as to synchronize the activation of the actuator 14 and, hence, the switching of the external configuration of the blade 10 with the pitching oscillation motion of the hull 2. In particular, the control unit 15 is connected to suitable sensors, for example inertial sensors or IMUs (not shown), located on the hull 2 and configured so as to detect the angle of orientation of the hull 2 about the transverse pitch axis. The control

unit 15 receives the signals emitted by these sensors and is configured so as to

- determine the top and bottom dead centres of the oscillation of the hull 2 based on the measurements carried out,
- control the actuator 15 at the top and bottom dead centres that were determined.

[0068] The result is similar to the one described above with reference to figures 5 to 10 for the previous embodiment, although the external shape and/or the inclination of the blade 10 are preferably different from the ones shown in said figures, to guarantee the desired hydrodynamic resistance along the trajectory K.

[0069] The generation of electric energy in the generator 18 causes a mechanical resistance that counters the translation of the support 12: the dimensions and shapes in the various configurations of the blade 10 are established by design so as to guarantee a sufficient hydrodynamic lift (when exploiting the navigation of the boat 1) or a sufficient hydrodynamic resistance (when exploiting the pitch of the hull 2) to overcome the mechanical resistance exerted by the generator 18 during the production of electric energy (in addition to overcoming the resistance caused by frictions in the coupling to the guide 13, frictions and inertias of the mechanism 20, inertia of the rotor 19, etc.).

[0070] Owing to the above, the advantages of the apparatus 16 mounted on the boat 1 are evident.

[0071] Thanks to the blade 10 immersed in the water and thanks to normal movements that are typical of the boat 1 (navigation or pitching), the simple use of the boat 1 allows for the generation of an alternative movement of the blade 10 and of the support 12, which, in turn, can be exploited to generate electric energy through the generator 18.

[0072] The electric energy can be directly used to power the electric utilities of the boat 1 or stored in one or more electric energy storage devices, such as batteries, capacitors and the like.

[0073] Other advantages are then obtained through the detailed features described above.

[0074] Finally, the boat 1 disclosed above with reference to the accompanying figures can be subject to changes and variants, which, though, do not go beyond the scope of protection defined by the appended claims.

[0075] In particular, as mentioned above, the external shape of the blade 10 and the dimensional proportions relative to the other components of the boat 1 can be different from the ones schematically shown herein by way of non-limiting example.

[0076] Furthermore, at least in principle, the support 12 could be provided with a rotary motion, instead of having translatory motion, so that the trajectory K could be curved, instead of being straight.

[0077] Finally, a system could be provided to retract the blade 10 and the lower part of the support 12, to bring

them out of the water (for example into the hull 2), when the generator 18 is not in use.

5 Claims

1. Boat (1) comprising:

- a hull (2),
- an apparatus (16) for electric energy recovery, the apparatus comprising an electric generator (18);

characterised in that said apparatus (16) further comprises:

- a support (12) movable with respect to said hull (2) with a reciprocating motion along a trajectory (K), and coupled to said electric generator (18) so as to generate electric energy due to the displacement of the support (12) between a top dead center and a lower dead center along said trajectory (K);
- a blade (10) carried by said support (12) and arranged below said hull (2) so as to be permanently and completely arranged in the water during the use of said electric generator (18);
- actuator means (14) operable to vary an external configuration of said blade (10) so as to set a hydrodynamic lift and/or a hydrodynamic resistance defined by said blade (10) along said trajectory (K);
- an electronic control unit (15) configured to operate said actuators (14) and change said hydrodynamic lift and/or said hydrodynamic resistance when said support (12) and said blade (10) reach said top dead centre and said bottom dead centre.

2. The boat according to claim 1, wherein said trajectory (K) is rectilinear.

3. The boat according to claim 1 or 2, wherein said apparatus (16) comprises a guide (13), which is arranged in a fixed position relative to said hull (2), defines said trajectory (K) and is engaged by said support (12) in a sliding manner.

4. The boat according to claim 3, wherein said electric generator (18) comprises a rotor (19), and wherein said apparatus (16) comprises a transmission mechanism (20), which couples said support (12) to said rotor (19) and is configured to convert the reciprocating translatory motion of said support (12) into a rotary motion for said rotor (19) .

5. The boat according to claim 4, wherein said transmission mechanism (20) comprises a first and a

second transmission (21,22), which are arranged in parallel between said support (12) and said rotor (19), are configured, each, so as to convert the reciprocating translatory motion of said support (12) into a rotary motion for said rotor (19), and comprise respective decoupling devices (23, 24) for transmitting rotational torque to said rotor (19) only in one of the two rotation directions. 5

6. The boat according to claim 5, wherein said decoupling devices (23, 24) are defined by freewheeling devices or by clutch devices controllable to be selectively disengaged depending on the translation direction of said support (12). 10

7. The boat according to any one of the preceding claims, wherein said top and lower dead centers are arranged in fixed positions along said trajectory (K); and wherein said actuator means (14) are operated so as to set a first and a second hydrodynamic lift, which are opposed to each other and tend to push said blade (10) along said trajectory (K) downwards and, respectively, upwards when said hull (2) is under navigation. 15 20

8. The boat according to claim 7, wherein said apparatus (16) further comprises sensor means connected to said electronic control unit (15) and configured to detect the attainment of said fixed positions by said support (12) and/or said blade (10); said electronic control unit (15) being configured to operate said actuator means (14) in response to detections of said sensor means. 25 30

9. The boat according to any one of claims 1 to 6, wherein said top and lower dead centers of said support (12) correspond, respectively, to a lower dead center and a top dead center of said hull (2) during an oscillatory pitching movement of said hull (2); and wherein said actuator means (14) are operated in such a way to set a first and a second hydrodynamic resistance which are opposed to each other and tend to hold said blade (10) along said trajectory (K) downwardly and, respectively, upwardly when said hull (2) raises and, respectively, lowers during pitching. 35 40 45

10. The boat according to claim 9, wherein said apparatus (16) further comprises sensor means connected to said electronic control unit (15) and configured to detect a pitch angle of said hull (2), said electronic control unit (15) being configured to operate said actuator means (14) in response to detections of said sensor means. 50 55

FIG. 1

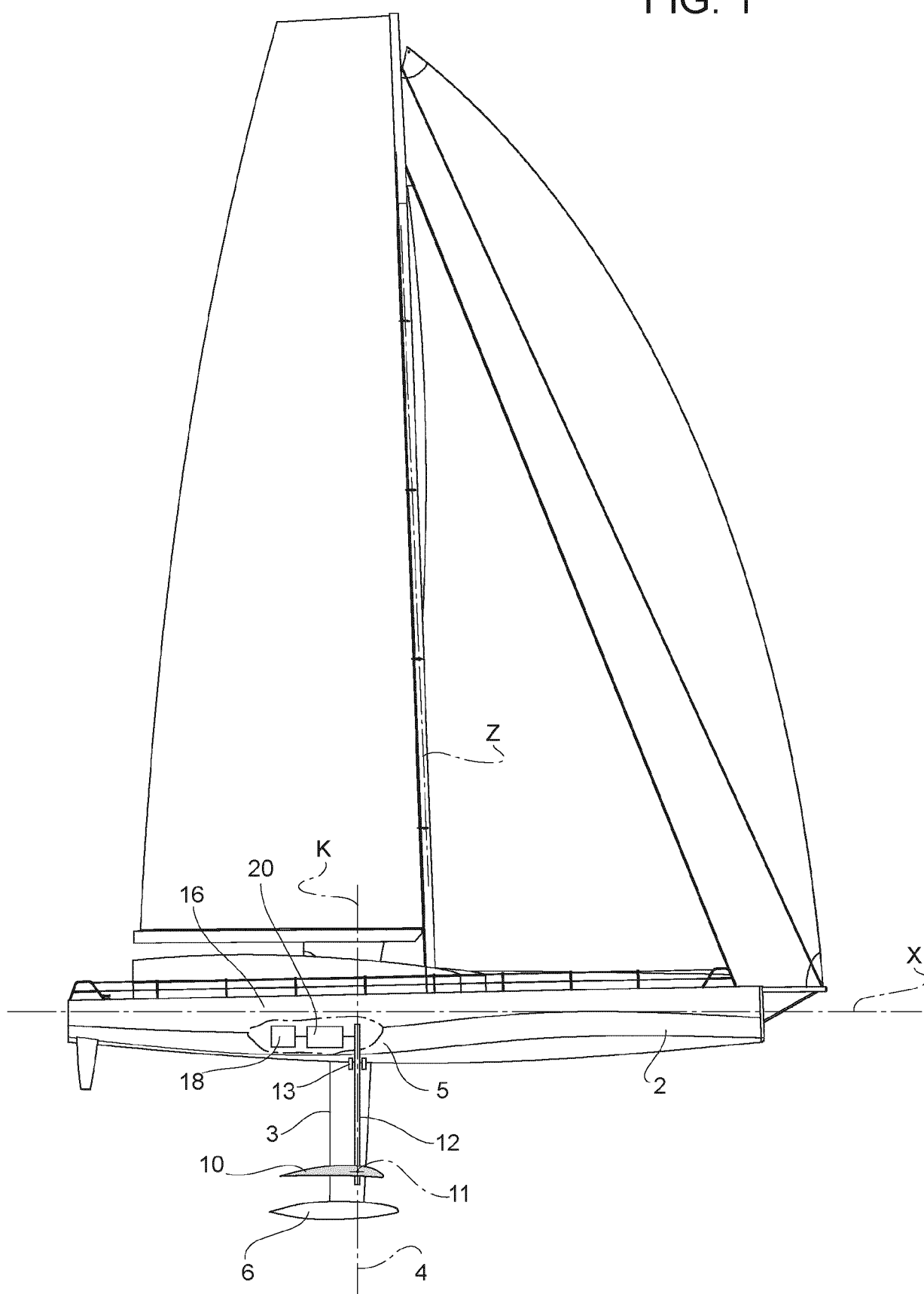


FIG. 2

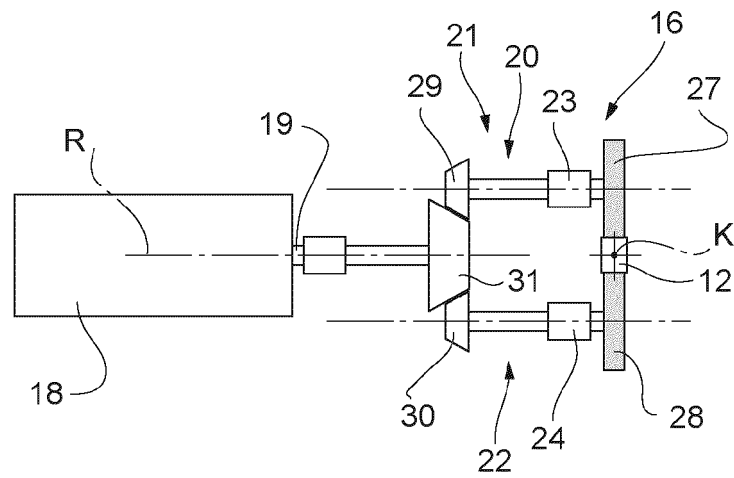


FIG. 3

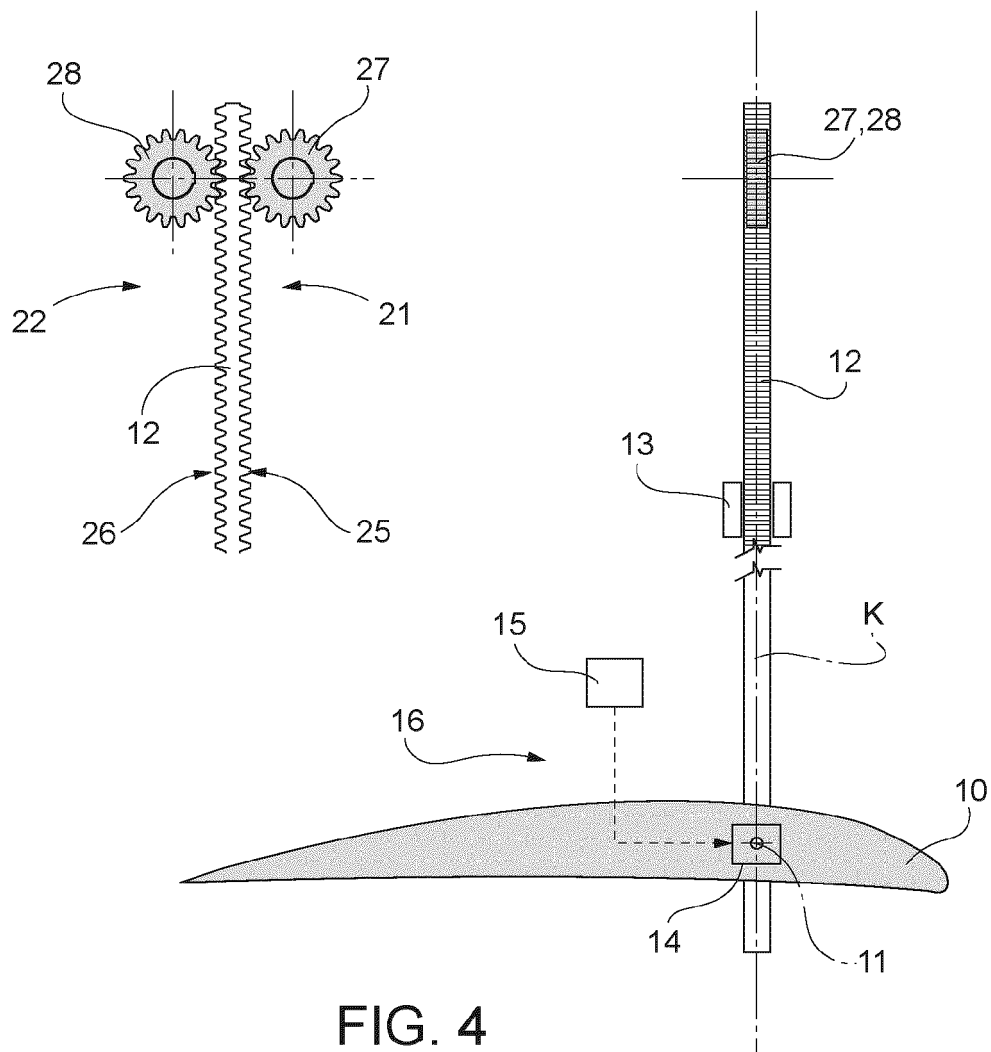


FIG. 4

FIG. 7

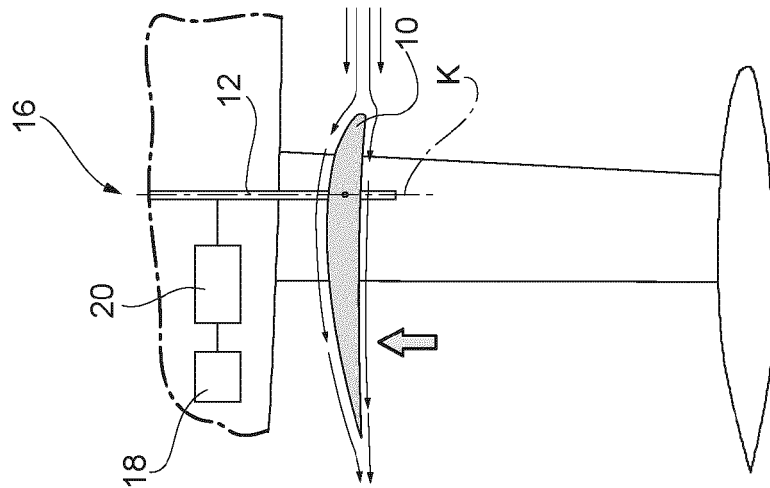


FIG. 6

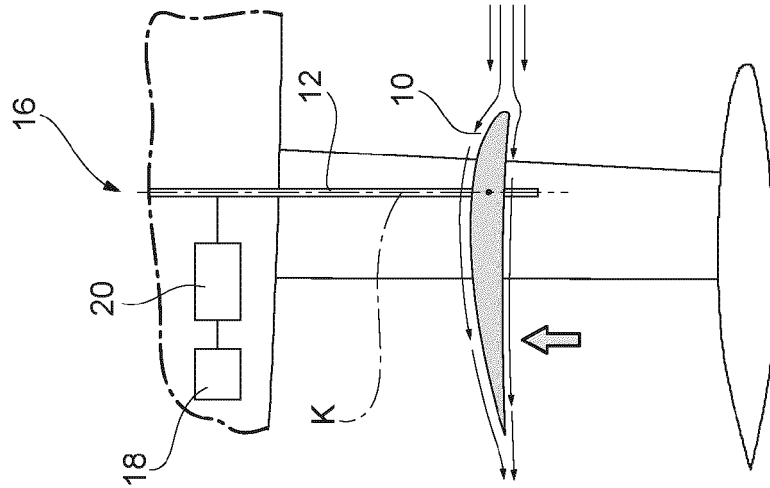


FIG. 5

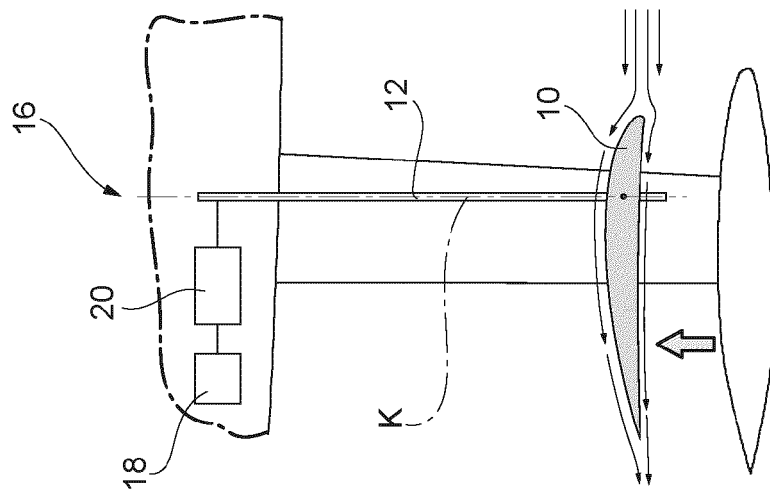


FIG. 8

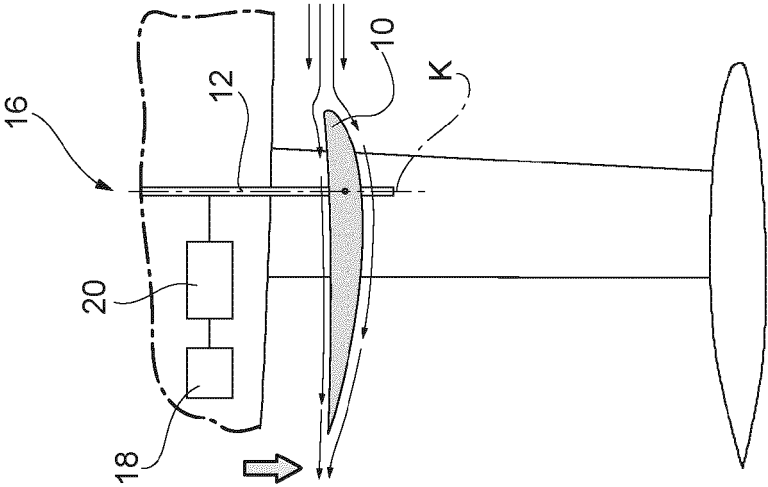


FIG. 9

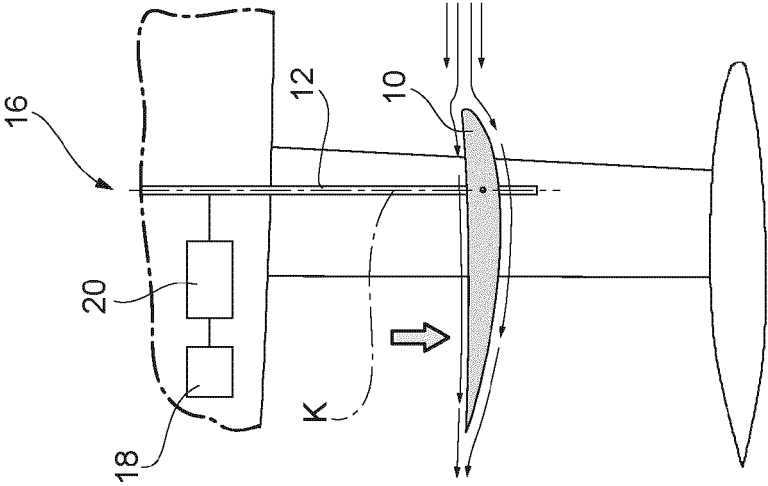
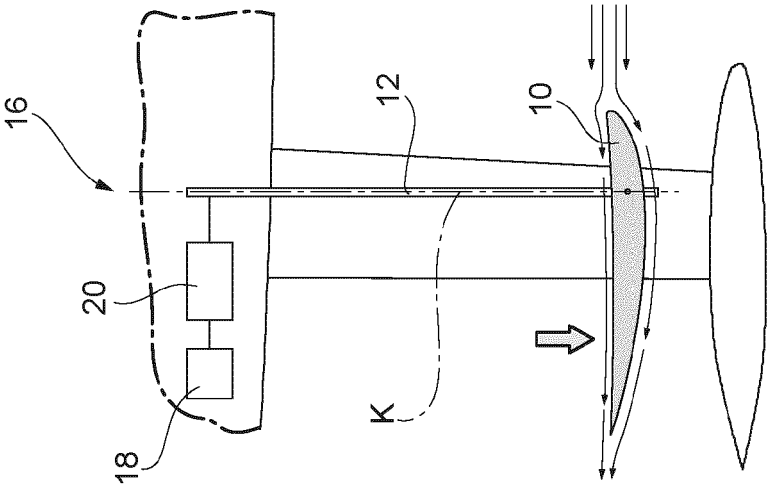


FIG. 10





EUROPEAN SEARCH REPORT

Application Number

EP 24 19 5822

DOCUMENTS CONSIDERED TO BE RELEVANT

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