SAIL BOAT PROPULSION AND STABILISATION SYSTEM AND DEVICE

[01] The present patent application refers to a sail boat propulsion and stabilisation system that belongs to the nautical sector, and refers particularly to a system which, by means of a device developed for this end, extends substantially the performance of one-hull and multi-hull boats, and shall be used for increasing the final speed of the existing and to be designed sailboats, thus making it possible for the boat to reduce its light and dynamic displacement, therefore increasing the speed and comfort when sailing.

STATE OF THE ART

[02] Over the centuries, the sail navigation has always been faced with stability problems due to the generation of more ballast and low weight (in the bottom or at the keel) in order to support strains of the sailing plan thereof.

[03] Over the years, sailboats have evolved to deeper keels and weights with hydrodynamic bodies in the form of bulbs. In parallel, salty water ballast tanks and fresh water ballast tanks have also been used, and more recently tilting rebounding keels having bulbs in the ends thereof (VOLVO OCEAN RACE designs - http://www.volvooceanrace.com/enlboat.html) in the last decade boats.

[04] There are a number of types of sailboats in the market, among which the ones shown below will be described.

[05] <u>A sailboat with a casting steel keel or lead ballast</u>:

- It is the more conventional sailboat, mostly manufactured in series, that is more consumed in the market;

- It consists of a hull provided with two main appendices: one appendix is the keel, that extends downward and comprises cast iron or lead ballast, and the other appendix is the helm (usually only a central helm);

- The keel having a symmetrical hydrodynamic profile in relation to the boat center line, when sailing, provides side sustentation so that the boat does not lean due to the side pressure on the sails. Similarly, to compensate the boat overturn moment, said keel is filled internally or manufactured with cast steel or lead, thus generating ballast and increasing the Metacentric Height;

- The use of lead is more efficient, since it provides higher weights for the same volume of the keel or even makes it possible to reduce the section of the keel due to its higher density;
- Most of said boats have only one helm in the conventional designs; and
- To make it easy to position the boat vertically or at the plum line, the crew normally seats windward, using the weight of the sailors, thus generating a careening moment in relation to the center of the boat.

[06] This type of sailboat has a number of inconveniences such as:

- Its construction is simple, but its performance is quite below what is presently considered as efficient;
- The keel must be heavy in order to generate a reasonable metacentric height, thus reducing the slope angle of the boat. This weight provides the hull with a higher hydrodynamic resistance that reduces the efficiency of the system;
- When sailing under a weak wind, all that weight added to the keel sinks the hull even more, generates a larger surface area of the craft actively engaged with the water and is good for nothing, since the weak wind does not heel over the boat. The weight that reduces the speed and response of the boat when the wind is weak almost always compels the commander to start the engine of the sailboat, lower the sails and navigate without sailing;
- Deep keels have a large wet surface (requiring internal volume to fill same with ballast), thus generating friction and reducing the speed even more;
- The hull also sinks with the weight of the keel on its bulge, thus extending the wet surface and holding the boat, thus reducing its performance;
- When the boat starts to heel over, the hydrodynamic profile of the

conventional keel starts to work outside the perpendicular of the water line plan, thus substantially reducing its side sustentation efficiency, so that the boat stalls in the wind and generates vortices in the water, which vortices dissipate the power, thus reducing the boat speed;

- When the boat approaches a port, cove or marina, the depth of the keel makes it difficult to dock because the draught of the boat is extended to three or more times the draught of the hull. Thus, many ports cannot be accessed, and the commanders cannot seek shelter under adverse climatic conditions because they cannot approach such ports;

- Another problem of the conventional keel is that its hydrodynamic profile is symmetrical to the center line. This cannot be different, since it is used to provide side sustentation when the wind blows starboard (starboard windward) or blows larboard (larboard windward), and then it only generates side sustentation to balance the side forces of the sail plan, if the boat navigates at an angle of attack in relation to the water (obliquely in relation to the sea). Thus, the hull of a sailboat having a fixed keel does not travel lined up with the sea flow lines;

- A certain angle of attack of the hull and keel in relation to the sea becomes necessary. If the boat hull is also symmetrical, its water lines do not need to be duly lined up with the sea water flow, thus generating more turbulence, mainly in the stern;

- In the fixed keel and center helm system, when the boat heels over, the vector center of all aerodynamic forces of the sails that promote the propulsion of the hull (sum of all forces that push the sailboat ahead) and the center of hydrodynamic resistance of the hull (sum of all the forces that hold the sailboat so that it does not increase its speed), are well unbalanced in relation to the boat center line. Thus, the center of the sail pressures with the direction of the forward component is positioned leeward. On the other hand, the hydrodynamic resistance center of the hull is unbalanced windward due to the inclination of the hull and the large resistance of the keel. The stronger the wind, more the boat heels over, extending the transversal distance between such forces, so that a moment (binary) is created to lead the boat prow to the course of the wind, against the wind (get into the wind);

- In order to counterbalance this trend, that occurs when the force of the wind increases and the boat inclines, with the helm located in the center line, needs to be turned at a sharp angle, thus generating a higher resistance to the movement of the boat and reducing its speed; and

- When the boat is heeled over by the wind, the helm must be used all the time and, since its axis is not perpendicular to the water line plan, the performance of the helm is awfully bad, thus decreasing the speed of the boat.

[07] Sailboats with keels of cast steel or lead ballast having two helms:

- In the last decade, the weight of sailboats with the above mentioned ballast system has been reduced little by little (reduction of the hull structural weight, mast and sail weight) so that they would navigate at higher speeds even with a heavy keel;

- Two helms in the stern are more efficient with a careened boat than with only one central helm. Practically all the modern boats (in the last ten years) have started to adopt a classic keel made of cast iron or lead when two helms are installed;

- As soon as the boat inclines a few degrees, the leeward helm (wind exit board) is positioned so that its command gauntlet (actuation shaft) is perpendicular to the water line plan (higher efficiency) in said condition; and

- When the windward helm (wind entrance board) is conveniently positioned by the designer it leaves the water, thus eliminating the shaping resistance, friction resistance and drag thereof.

[08] This type of sailboat still has some inconveniences as compared to those reported in the previous case. The only good advantage is that a helm (the one windward) is raised from the water (removing its wet surface and drag) when the boat is inclined in the boat displacement process, while the axis (helm command gauntlet) of the effectively submerged helm (leeward) is vertical to the fluctuation plan, thus assuring greater efficiency.

[09] Sailboats with a keel of cast steel or lead ballast, two helms and ballast tanks:

- The evolution of the sailboats has continued, as it is the natural way of things and also associated to the lead or cast iron keel and to the two helms shown herein above, when a higher sustentation to the overturn moment of the sails, the designs started to provide the boards with ballast tanks;
- The windward tanks were filled with a liquid, while the leeward tanks were emptied; and
- Depending on the design, even with this fluid extra-weight on board inside the windward tanks (increasing the full weight of the boat and increasing the hydrodynamic resistance thereof), due to the possibility of installing a larger sail area, the boat had a higher final speed at the same apparent wind intensity.

[10] This type of sailboat also has some inconveniences shown in the designs above. Thus, under stronger wind conditions:

- It is necessary to use moving weights among the tanks so that the boat is less heeled over and thus reduces the keel and helm inefficiencies for large overturn angles so that it can support a larger sail area;
- When the wind is weak, it is also necessary to discard the whole ballast, thus reducing the weight of the boat and consequently attaining higher speeds;
- The task of changing the fluid of a board with another fluid can be delayed, thus complicating the application of the system;
- The inner volume of the boat arrangement, the inhabitable space, is

obviously reduced and hindered by the volume of the tanks;

- The tank bulkheads, even when are not being used as the ballast, have their own weight, thus hindering the displacement of the boat. More weight is almost always not a good measure.

[11] Sailboats with a cast steel or lead keel, two helms and a tilting keel:

- In the continuous search for higher efficiency and speed, the next step related to boats was to generate a tilting keel that can pivot over a longitudinal shaft attached to the bottom of the boat;
- When sailing under more intense winds, the keel starts to be pivoted windward and the counterbalance due to this movement forces the boat to the plum line by exerting a substantial halyard moment;
- Obviously, when the keel is raised by being pivoted windward, the projection of the side area that sustained the force of the sail plan fades away. To compensate this negative effect, the members of the crew of these boats install a bowline keel without counterbalancing beyond the leeward mast;
- The exclusive function of said bowline keel is to prevent the boat from declining, supporting the side pressure of the wind. In stern winds, the bowline keels are hoisted so that they do not prevent the boat from moving;
- The bowline keels are not symmetrical like the hydrodynamic profile of usual keels and pivoting/tilting keels, thus generating a substantial efficiency gain. Technical faults in the tilting mechanism of said keels bring about a higher cost for installing same, and also broken devices have generated and continue to generate serious accidents when navigating in the open sea;
- Currently this system is known as the fastest and efficient available in the market for one-hull boats, but unfortunately the cost for acquiring and installing same is high; and
- Another complex matter is the (excessively high) draught of said boats,

as well as the need to place same in huge cradles when they are taken out of the water.

[12] Said types of sailboats have other inconveniences such as:

- When the boat is in the port, its draught is huge. Many times the sailboat is forced to stay outdoors without being sheltered against winds and waves;
- A high draught is a serious problem, since small ports and marinas are faced with environment issues and huge dragging cost when the depths thereof are increased;
- Tilting or pivoting the keel generates an optimum halyard moment that makes it possible to have large sail areas, but even here there is a huge amount of lead weight that the boat needs to carry, thus generating an increased propulsion resistance;
- Said rebounding, pivoting or tilting keels have a wet surface and drag resistance, but they do not cooperate to laterally sustain the boat for supporting the side pressure of the sail plan, and therefore bowline keels to be handled by the crew need to be installed ahead of the mast bowline;
- The bowline keels represent more wet surfaces and conflicting appendices;
- The system for pivoting or tilting system the keel is too expensive and requires strength no matter how hard the engineers work. The strains in said appendices in the open sea are enormous and the tilting maneuvers are slow;
- Briefly, the result is too much weight, a moving dead load, a high draught, and bowline keels that need to be lowered and lifted.

[13] Sailboats having a fixed cast steel or lead heel, two helms and a DSS (Dynamics Stability System) system:

- Some years ago, a group of naval architects started testing the DSS system. In this configuration the sailboat started receiving a fixed keel with a weight a little lighter than conventional ones as the hull appendices, two helms and a wing-shaped profile telescopically used in the bottom of the boat transversal to the center line;

- With such an arrangement, an efficiency gain in the small reduction of the weight of the keel was attained, as well as sailing in a regatta with less crew members;
- The hydrodynamic profile of the DSS wing replaces the original counterbalance of the crew seated on the wall of the boat windward; and
- Currently it is the most modern system available in the market and some sailboats around the world are already provide with said system.

[14] However, this type of sailboat still presents some inconveniences such as:

- The DSS system does not provide any sustentation to compensate the sail plan pressures. Thus, the hydrodynamic profile of the keel is still necessary;
- The draught of the boat is still very large, thus complicating the access to marinas as well as to park the boat out of water;
- In view of the design of the system, the DSS sustentation wing is too close to the water surface, thus generating cavitation on its back (upper face) what decreases a lot the output and sustentation ability thereof;
- Another serious problem in the DSS is that it is not possible to change the angle of attack of the profile. The way to increase the stability is directly connected to the use of more leeward wings. The response of the process is slow and its dynamic control is not efficacious;
- The DSS wing profile, by virtue of a problem in the concept of the design, because it is not deep (it cannot be deeper, since it does not allow to arrange the installation on the bulge of boat hulls) sometimes it arises partly or wholly in the surface, thus causing waves and turbulence that reduce the speed of the boat as well as diminish the sustentation of the wing;
- Briefly, its installation occupies a lot of inner space in the boat, and is difficult to be installed in the already existing boats;
- Although it has been named as a dynamic stability system, it is useless

when one navigates in widely spread winds or stern winds;

- The dynamic stability is an objective and not a result of the design;
- Due to the fact that the wing is flush with the surface (close to the surface) there is a problem of cavitation on the back thereof. When low immersed, the cavitation is difficult to control;
- Similarly, when the boat has the sails furled and is powered by the engine, there is no improvement in the stability and the rocking is not attenuated, thus causing discomfort to the passengers and members of the crew.

[15] In order to correct the faults found in several systems, a new system and device was developed for propelling and stabilizing a sailboat, which is extremely efficient for improving the performance related to the speed, generates much more comfort in the sea, makes it possible to get into low draught places, decreases substantially the displacement (weight) of the boat when it departs, and also decreases the displacement (weight) of the boat during the navigation, besides generating comfort when the navigation is engine powered, decreases the wet surface of the live works, and the integrated installation or design thereof is relatively simple.

[16] When navigating under stern winds, the invention will generate a stability with a rocking reduction in the order of 95%, thus also making it possible to attain a much more comfortable navigation when it is powered by an engine.

[17] The invention also provides an extraordinary reduction in the fuel consumption (compared to a traditional sailboat) when the navigation is powered by an engine.

OBJECT OF THE INVENTION

[18] In order to correct the imperfections of several systems, a new system and device was developed for propelling and stabilizing a sailboat, that is extremely efficient in improving the speed performance, generates a much higher comfort in the sea, makes it possible to get into low draught places, decreases substantially the displacement (weight) of the boat when it departs, decreases even more the displacement (weight) of the boat during the navigation, generates comfort even when the navigation is powered by an engine, decreases the wet surface of the live works, improves a lot the behavior and rocking of the boat when it is anchored, and the integrated installation or design thereof is relatively simple.

[19] When navigating under stern winds, the invention will generate a stability with a rocking reduction in the order of 95%, thus also making it possible to have a much more comfortable engine-powered navigation.

[20] The invention also provides an extraordinary reduction in the fuel consumption (compared to a traditional sailboat) when the navigation is powered by an engine.

BRIEF DESCRIPTION OF THE INVENTION

[21] The system and device for propelling and stabilizing a sailboat comprises a control panel actuated by a battery and connected to a hydraulic aggregate that is connected to directional valves and solenoids and are altogether responsible for the functioning of the device for propelling and stabilizing a sailboat which is provided with a wing keel, a counterbalance or "lift" wing, a cylindrical actuator of the counterbalance and "lift wing", a rotary hydraulic actuator for hoisting the assembly, a counterbalance wing shaft a tilting shaft of the set that is coupled to the broadside or mounting base provided for the broadside of already existing boats, in addition to sensors to detect the angle of attack of the counterbalance or "lift" wing. Optionally, for smaller boats, the hydraulic aggregate and the cylindrical hydraulic actuator can be replaced with cylindrical electric actuators directly connected to the control panel.

[22] Optionally, the system and device for propelling and stabilizing a sailboat will be assembled in a design integrated into a sail or motor boat that makes it possible to lower and lift the assembly quickly, a total efficiency in the operation, compatibility in the configuration (curvature) of the hull, thus contributing to greatly reduce the resistance to the navigation and generating low surface turbulence in the appendices. Additionally, the control panel provided will be actuated or accessed via a "tablet" or "smartphone", via "bluetooth" and/or wire, that will emit a signal in the control panel when the wing is locked, thus preventing the device from being raised without having released the locks thereof.

DESCRIPTION OF THE FIGURES

[23] The system and device for propelling and stabilizing a sailboat will be better understood through the figures that represent schematically:

Figure 1: a perspective view of the system and device for propelling and stabilizing a sailboat, showing one of the devices lowered and the other one raised;

Figure 2: a perspective view of the system and device for propelling and stabilizing a sailboat, showing one of the devices raised;

Figure 3: an exploded perspective view of the device for propelling and stabilizing a sailboat;

Figure 4: an exploded perspective view of the device for propelling and stabilizing a sailboat, partially assembled;

Figure 5: a perspective view of the device for propelling and stabilizing a sailboat with the inspection cover of the counterbalance wing exploded, showing the pivoting shaft;

Figure 6: a perspective view of the device for propelling and stabilizing a sailboat;

Figure 7: a schematic perspective view of a boat provided with the device for propelling and stabilizing a sailboat, illustrating the two positions, when raised and when lowered;

Figure 8: an exploded perspective view of the device for propelling and stabilizing a sailboat;

Figure 9: a partial front view of the pivoting system with an extended detail of the lock; and

Figure 10: a perspective view of an option of the counterbalance or "lift"

wing attached to the wing keel and provided with two "ALEIRONS".

DESCRIPTION DETAILED OF THE INVENTION

[24] In accordance with Figures 1 and 2, the system comprises a control panel (1), actuated by a battery (2), connected to a hydraulic aggregate (3) that is connected to directional valves (4) and solenoids (4') through which each device of a pair of devices (5) for propelling and stabilizing which is independently actuated respectively to larboard and starboard, and each device is provided with a wing keel (51), a counterweight or "lift" wing (52) joined by a bulb (56), a cylindrical actuator (54) for the counterweight or “lift” wing (52), a rotary hydraulic actuator (55) for hoisting the assembly, an articulation shaft (58), which running in the direction of the counterweight or “lift” wing (52) and transverse to the keel (51), and a tilting shaft (57) for the assembly, which is coupled to the boat broadside or to a mounting base (53) provided for the boat broadside of already existing boats, besides sensors of the angle of attack of the counterweight or "lift" wing (52).

[25] There are two options for the control panel (1) with regard to its electro-electronic sophistication: Standard or electronic stabilization, wherein:

1. <u>Standard option</u>: in this option the panel is that of a command for lowering the device (5) onto the water larboard, a command for lowering the device (5) starboard, a command for lifting the device (5) to its vertical position on the deck larboard, a command for lifting the device (5) to its vertical position on the deck starboard, a command that increases the angle of attack of the counterweight or “lift” wings (52) of the two devices when pressured down, and a command that decreases the angle of attack of the counterweight or “lift” wings (52) of the two devices when pressured down, said command being through a button or "touch screen". The panel (1) is also provided with a small digital display that indicates the actual slope angle of the boat, an on/off switch and a pilot lamp that indicates

when the oil level in the reservoir of the hydraulic aggregate (3) is low.

2. Electronic stabilization option: In this option the panel (1) has the same commands referred to in the Standard option for lifting and lowering the devices (5) larboard and starboard, a pilot lamp that indicates when the oil level in the reservoir of the hydraulic aggregate (3) is low, and has the following complementary controls in addition to said commands:

- a three-position electric switch: deactivation, automatic activation, and manual activation;
- a button that while pressured down increases the angle of attack of the larboard counterweight or “lift” wing (52) (manual electric/hydraulic control);
- a button that while pressured down decreases the angle of attack of the larboard counterweight or “lift” wing (52) (manual electric/hydraulic control);
- a button that while pressured down generates increases the angle of attack of the starboard counterweight or “lift” wing (52) (manual electric/hydraulic control);
- a button that while pressured down decreases the angle of attack of the starboard counterweight or “lift” wing (52) (manual electric/hydraulic control);
- a digital display that indicates the current slope angle of the boat;
- a digital display that indicates the requested slope angle set by the commander so that the boat can navigate.

[26] When there is not wind enough to keep the boat inclined or if the angle is higher than the recommended one for operating the system, the control panel (1) will sound an alarm so that the wing unit (excessive wind) is reduced or the system is disconnected (in the case of no wind at all).

[27] Said hydraulic aggregate (3) is fed through a 12 or 24 V DC battery (2) and comprises a pump, a hydraulic fluid reservoir, and is connected to a set of directional valves (4) at suitable gauges for operating the sets and solenoids (4') by supplying a hydraulic flow to the rotary hydraulic actuator (55) and the cylindrical actuator (54).

[28] Linear sensors (6) are housed close to the cylindrical actuator (54) of the rod that changes the angle of attack of the counterweight or “lift” wing (52) and sends signals to the control panel (1) informing the indication of angle of attack of the counterweight or “lift” wing (52), and in the event it is a government system and also an electronic stabilization, said signals are used for the instant positioning of the counterweight or “lift” wing (52) lift and variations thereof.

[29] The function of said sensors (6) of the angle of attack of the counterweight or "lift" wing (52) is to send the control panel:

- in the manual system (Standard system): a signal indicating the angle of attack of the counterweight or “lift” wing (52);
- in the electronic system: a signal of the instant angle of attack of the counterweight or “lift” wing (52) so that the electronic system may act in two situations;
- the first one, if it is the chosen option, will keep the boat inclined at a certain preset angle whenever the wind increases or decreases; and
- the second one, for stern or engine-powered navigation, will reduce the rocking of the boat by 95%.

[30] Optionally, for smaller boats, the hydraulic aggregate (3) and the cylindrical hydraulic actuator (54) will be replaced with by a cylindrical electric actuator (10) directly connected to the control panel (1) and acting directly on the counterweight or “lift” wing (52), in which case, without the need of sensors, it modifies the angle of attack of the counterweight or “lift” wing (52). Said cylindrical electric actuator (10) could be, for example, a LENCO 101 XD type actuator – part Number 15055-001.

[31] In accordance with Figures 3 the 6, the device (5) for propelling and stabilizing a sailboat comprises a mounting base (53) that is attached to the broadside of already existing boats, or already provided in new boats, on which the tilting shaft (57) that has the rotary hydraulic actuator (55) on one of the ends of the wing keel (51) and the other end coupled to the bulb (56) is mounted, that on its turn is coupled in one of the ends of the shaft (58) whose other is coupled to the housing (521) provided in the counterweight or "lift" wing (52), also coupled to the bulb (56) and that also receives one from the ends of the cylindrical hydraulic or electric actuator (54) that is coupled to the housing (511) provided in the wing keel (51).

[32] The mounting bases (53), in the larboard and starboard broadsides, are not needed in new boats under construction. Indeed, for boats under construction, the broadsides can already be designed for housing the keel wings (51) in accordance with the specifications of the design (see Figures 6 to 10).

[33] For the already existing boats provided with fixed or moving keels, with one or two helms, it is necessary to install the mounting base (53) in order to make the installation of the devices (5) quite easy. Usually, it is not necessary to reinforce the broadside region for the installation of said bases on boards by virtue of the distribution of strains resulting from the mounting part (53). However, it is convenient to consult a naval engineer or architect who, with the requested strains in hand, can analyze indeed if a local reinforcement is necessary or not, case by case.

[34] The mounting bases (53), one for each board, are made based on the shaped figure of the broadside in the vertical and horizontal plans. In said bases, a lowered and lifted operation lock of the wing keel (51), a rotary hydraulic actuator (55) for lifting the assembly, and a shaft for tilting the set (57) are prepared to be installed. Optionally, the rotary hydraulic actuator (55) for lifting the set can be manual.

[35] The mounting bases (53) are attached to the broadside by using screws and also adhered by using a bi-component polyurethane paste and an external finishing with a mono-component polyurethane paste. Some screws to help in the attachment and also in the adhesion operation are gauged. Hoses of the cylindrical actuator (54) of the counterweight or "lift" wing (52) are deployed, as well as cables of the sensors (6) of the angle of attack of the counterbalance wing (56). In the event a cylindrical electric actuator (10) is used, only the electric cable but not hydraulic hoses will be deployed.

[36] In the tilting shaft (57) line, the hydraulic pressure hoses that will supply the cylindrical actuator (54) of the counterweight or “lift” wing (52) or the electric cables of the electric cylindrical actuator (10) are installed when this option of the electric actuator is used. The rotary hydraulic actuators (55) that lift the device (5) from the water or rebound same in order to place them on the water are installed in one of the ends of the tilting shafts. Its displacement is provided by the hydraulic aggregate (3), with a rotation capacity higher than 180 degrees. This function of the rotary hydraulic actuators (55) in small sized boats could be carried out by rollers with nylon cords.

[37] The function of the wing keel (51) is to generate side sustentation, opposite the pressure of the sail plan. The geometry of the device (5) makes it possible to assemble the wing keel (51) with preset angles in relation to the vertical between 3 and 7 degrees (a 5 degree fall degree being advisable in relation to the vertical). During the navigation, by adjusting the stabilization control panel (1) or actuating same manually, when the boat careens by 5 degrees the wing keel (51) is fully perpendicular to the fluctuation plan (maximum efficiency) as well as the emerged windward helm without touching the surface in the case of boats provided with two helms.

[38] This perpendicularity arrangement in relation to the water line plan generates a perfect thrust in opposition to the attempt of the wing unit to displace the boat laterally. The conventional keels do not attain this geometry.

[39] In view of the design and height of the windward helm, when higher angles are needed, a compression should be checked so that the wing keel (51) is further raised (an angle higher than 5 degrees).

[40] Similarly, if desired, differently from conventional keels, this wing keel (51) can be designed with a wing profile. It generates a side sustentation thrust even when the boat is fully lined up with the flow of its movement. A fall/angle of attack is not necessary to generate sustentation strains. Thus, the hull flows lined up with the surrounding water flow. There is no flow oblique to the hull.

[41] The counterweight or "lift" wing (52) is assembled in the bottom, far from the surface of the sea, to the bulb (56), at the end of the wing keel (51).

[42] Due to its depth and surrounding water pressure, there is no cavitation in its back, thus generating an optimum thrust/lift/counterbalance in the vertical, lifting the leeward board of the boat in order to keep it halyarded and reducing at the same time the displacement of the boat in movement, since it finally lifts the whole boat assembly. In order to lift the boat, it also it reduces the resistance thereof to navigation.

[43] Since this counterweight or "lift" wing (52) is at a reasonable depth, it can have its angle of attack changed in order to generate more or less "lift" without cavitation of the back thereof. This angle of attack, that can be changed manually or electronically between 7.5 degrees downward and 5 degrees upward, generates an optimum band point for the navigation, thus placing the water line plan in a privileged condition for the hydrodynamic resistance. Further, the variation of the angle of attack of the counterweight or “lift” or "lift" wing (52) practically annuls the rocking of the boat, thus providing the members of the crew and passengers with more comfort.

[44] In stern navigation, when all sailboats are unstable, if one opts for placing one board or two boards of the device (5) on the water, the stability is highly enlarged, thus assuring that the sails are armed with efficiency and prediction in a safe way.

[45] Similarly, in any course with the boat powered by a motor and not the sails, a situation where sailboats are extremely discomforted in view of the side rocking, one or two devices (5) lowered generate rocking angles up to 95% lower than the boats not provided with said device (5) through the counterweight or “lift” and "lift" wings (52).

[46] The function of the metallic shaft (58) is to receive and transmit the vertical thrust/sustentation/lift of the counterweight or “lift” wing (52) to the wing keel (51). In a way similar to the one this shaft transmits the vertical thrust, it also responds with the attachment moment created by the counterweight or “lift” wing (52), conveying this attachment moment to the wing keel (51). This shaft is provided with bearings inside the housing (521) of the counterweight or “lift” wing (52) so that it can change its angle of attack, thus resulting more or less "lift" in accordance with the manual or electronic operation of the system.

[47] When said actuator (54) is hydraulic, it operates with a non-mineral hydraulic oil and its function is to extend to increase the angle of attack of the counterweight or “lift” wing (52), thus generating a higher sustentation or lift thereof. This actuator (54) can be directly electrically fed from the control panel (1), thus avoiding the need for hoses (in the case of smaller boats). When said cylinder (hydraulic or electric) extends, the sustentation or lift of the counterweight or “lift” wing (52) is increased. When the actuator retracts, the same sustentation decreases. This movement of the system can be manually controlled (in the most economic option) or governed by an electronic system that can manage a preset fixed band angle or, in stern wind navigation or motor-powered navigation when there is no wind, the system will try to compensate the rocking in order to minimize same as much as possible.

[48] For the sake of a practical maintenance and also aiming at extending the lifetime of the actuator (54), it is positioned above the water line in the housing (511) of the wing keel (51).

[49] With the function of activating the cylindrical actuator (54) with the counterweight or “lift” wing (52), a "L" shaped metallic rod (541) is provided, with a displacement when the cylinder is extended or contracted, thus promoting a change of about 7.5 degrees downward and 5 degrees upward in the counterweight or “lift” wing (52).

[50] The electric cables or hoses that supply the actuator (54) or the actuator (10) with power penetrate the wing keel (51) as far as the actuator (54) or the actuator (10), thus passing through the hull in a watertight way.

[51] In accordance with Figures 7 to 10, optionally the system for propelling and stabilizing a sailboat that comprises a control panel, actuated by a battery, connected to hydraulic aggregate(s) that is connected to directional valves and solenoids through which the device for propelling and stabilizing the sailboat is actuated and accessed via "tablet" or "smartphone" via "bluetooth" and/or wire, that will emit a signal in the control panel when the wing keel (l01) of the device is locked, thus preventing the device from being lifted without releasing a lock in advance.

[52] The device for propelling and stabilizing a sailboat, formed by a pair of side wings (100; 100') that are assembled in the niches (N) formed in the larboard and starboard broadsides in an integrated design in a sailboat or motor boat, will have each of the side wings (100; 100') comprising a wing keel (101) and a counterweight or "lift" wing (102) that are joined by the attachment (103) through its shaft that is connected to an attachment nut provided in the counterweight or "lift" wing (102) that is actuated by a linear piston (104) embedded in the wing keel (l01) that is provided with an arcuate region (105) that matches the configuration (curvature) of the hull (C), in the end of which the tilting shaft (106) that is actuated through two rotary pistons (107) that are embedded inside the hull (C) is provided, and the lowered operation lock (108) that serves to absorb the strains when navigating without transmitting same to the rotary pistons

(107) is provided more below. The set that makes out the device is actuated by an electronic control (109) while a hydraulic electric set supplies hydraulic power.

[53] In accordance with Figure 10, when the strain of the counterweight or "lift" wing (102) is too high, optionally the counterbalance or "lift" wing (102) is rigidly attached to the wing keel (101). In this situation, instead of rotary the counterweight or "lift" wing (102) about a shaft, the "lift" thereof is generated by "aileron(s)" (1021' and 1022') provided in regions (1021) and (1022), respectively. Said "ailerons(s)" (1021' and 1022') will be actuated by a hydraulic piston (104) that is then assembled to the counterbalance or "lift" wing (102). Thus, the linear hydraulic piston (104) that was installed in the wing keel in the systems having a moving "lift" wing, is then installed in the counterweight or "lift" wing (102), thus changing the angle of attack of the aileron(s) (1021' and 1022') so that the "lift" of said wing is changes in accordance with the need of the hydraulic electric system and sensors thereof.

[54] With the thus obtained device, in accordance with Figures 7 to 10, the side wings (100; 100') are assembled in the niche (N), where the region (105) of the wing keel (101) is formed based on the shaped figure of the broadside in the vertical and horizontal plans and is installed through tilting shafts (106) and rotary lifting pistons (107) of the assembly.

[55] Hoses of the linear pistons (104) of the counterweight or "lift" wing (102) and cables of the sensors of the angle of attack thereof are also provided.

[56] Hydraulic pressure hoses that will supply the linear piston (104) of the counterweight or "lift" wing (102) are installed on the line of the tilting shafts (106). The rotary pistons (107) that are used to lift device from the water or rebound same in order to place same on the water are installed in the ends of the tilting shafts (106). Its displacement has a rotation capacity higher than 180 degrees.

[57] In stern or fierce winds, as well as while the sailboat is motor-powered, the wings (100; 100') can be positioned horizontally or vertically, thus reducing the drag, increasing the speed, and also substantially improving the fuel economy.

[58] In order to improve the comfort, only the leeward assembly can be lowered onto the water, thus generating an exceptional stability and reducing the dynamic displacement of the boat.

[59] If the conditions of the sea so require or even if the priority is the comfort with relation to the performance, both wings (100; 100') can be lowered. The operational control of the system can be run through a "tablet" with an application via "bluetooth" or wire that manages the hydraulic and electronic systems of the device.

[60] When anchored, a regular boat rocks transversally and works sideways in an attempt to remove the anchor from its position. When a boat is anchored using the device object of the present invention, it is lined up with the chain and the anchor, thus preventing unnecessary efforts in anchoring same, and it is not affected by the side rocking caused by waves as well.

ADVANTAGES ATTAINED WITH THE INVENTION

[61] With the system and device for propelling and stabilizing a sailboat thus obtained, the following extraordinary advantages can be attained:

- Low or no draught appendix for entering any port or marina;
- Reduction of the wet surface of the boat, thus generating a consequent reduced resistance to the movement;
- Reduction of the displacement (weight) of the boat when navigating due to the removal of substantial weight of the keel (70%), thus generating a consequent reduced resistance to the movement;
- Reduction of the resistance of the boat due to navigation of the hull and the line plan thereof duly lined up with the flow of the water without the

need to fall or angle of attack of the submerged profile (old keel);

• Reduction of the displacement of the moving boat due to the appearance of a vertical dynamic thrust in the system (LIFT). There will be a higher speed gain;

• Reduction of the rocking due to the stabilizing effect and the possibility to install an electronic stability system when the sail is either in the luff, or in the traverse wind, or in the stern wind;

• Reduction of the rocking due to the stabilizing effect and the possibility of install an electronic stability system when the boat is not navigating using the sail but motor-powered in a calm sea;

• Lift of the prow of the boat to better face the waves when sailing at high speed and under strong winds, also making it possible for the boat to glide whenever possible;

• Lower compensation angles and leeward helm work due to the alignment of the wind thrust forces with the hydrodynamic resistance forces of the hull. This behavior will result in less drag in the helm, thus influencing positively the speed gain;

• The windward set, that will be lifted to the deck when luffed, will generate a positive traction force due to the wing effect on the wind;

• Possibility to keep the boat at a certain optimum preset slope angle when sailing transversely, luff or stern;

• Reduction of the number of the crew members for effecting the counterbalance in the windward broadside. The eventual lack of counterbalance with a reduction of crew members and weight on board, thus increasing the speed of the boat;

• Quick board luff change without the need of crew members working in the deck for lifting and lowering bowline keels or even for rebounding keels;

• Easy installation in already existing boats that are to generate a substantial performance increment;

- In most of the already existing boats there is no need to change the inner arrangement at all;
- There is no volume loss in the cabin or bowline;
- Simple and fast assembly on the broadside;
- For new boats already designed for the system, there will be a substantial cost reduction when the design and manufacture thereof are compared to retractable keels, DSS systems and the like;
- Higher speeds in all the wind directions and when the navigation is motor-powered with low consumption of fuel;
- Safer trips if the equipment is operated with due knowledge.
- More safety for the crew;
- Thrust gain in the prow, thus preventing the boat to pitch due to the actuation of the counterbalance wing or "lift" leeward, whenever there is an attempt to immerse the prow;
- Reduction of draught when approaching ports and marinas;
- With the boat out of water, the system allows for an easy maintenance of said boat in view of the fact that it can be kept dry in a substantially low position, thus making it possible to easily accessing in order to work in the bottom of the hull, helms, shafts, propellers, and the like;
- The system allows one to choose the slope angle of inclination so that the commander may have use the best water line adjustment, and also leave the windward helm emerged, thus reducing the friction resistances and turbulences of said helm;
- Perfect inclination and windward helm out of water; and
- The efficiency of the leeward helm, with its actuation plan perpendicular to the water line plan, is extremely extended.

[62] The scope of the present patent shall not be limited to the components used in the example, but to the terms defined in the claims and its equivalents.

CLAIMS

1. A SYSTEM FOR PROPELLING AND STABILIZING A SAIL BOAT, comprising a control panel, standard or electronic stabilization, actuated by a battery connected to a hydraulic aggregate that is connected to directional valves and solenoids through which each device of a pair of devices for propelling and stabilizing the sail boat is independently actuated respectively to larboard and starboard, and each device is provided with a wing keel, a counterweight or "lift" wing joined by a bulb, a cylindrical actuator of the counterweight or "lift" wing, a rotary hydraulic actuator for hoisting the assembly, an articulation shaft, which runs in the direction of the counterweight or “lift” wing and transverse to the keel, and a tilting shaft for the assembly, which is coupled to the boat broadside or to a mounting base provided for the boat broadside of already existing boats, beside sensors of the angle of attack of the counterweight or "lift" wing.

2. THE SYSTEM FOR PROPELLING AND STABILIZING A SAIL BOAT, according to claim 1, wherein the control panel has two options related to its electro/electronic sophistication: standard or electronic stabilization, where:

- in the standard option, the panel, which through operation of buttons or a touch screen performs a command for lowering the devices onto the water larboard, a command for lowering the device starboard, a command for lifting the device to its vertical position on the deck larboard, a command for lifting the device to its vertical position on the deck starboard, a command that increases the angle of attack of the counterweight or "lift" wings of the two devices, and a command that decreases the angle of attack of the counterweight or "lift" wings of the two devices; the panel is also provided with a small digital display that indicates the actual slope angle of the boat, an on/off switch and a pilot lamp that indicates when the oil level in the reservoir of the hydraulic aggregate is low;

- in the electronic stabilization option, the panel (1) which through the buttons or "touch screen" and software performs the same commands referred to in the standard option for lifting and lowering the larboard and starboard devices, a pilot lamp that indicates when the oil level in the reservoir of the hydraulic aggregate is low, and has the following complementary controls in addition to said commands:

- a three-position electric switch: deactivation, automatic activation, and manual activation;
- a button that when pressed increases the angle of attack of the larboard counterweight or "lift" wing via manual, electric or hydraulic control;
- a button that when pressed decreases the angle of attack of the larboard counterweight or "lift" wing via manual, electric or hydraulic control);
- a button that when pressed generates increases the angle of attack of the starboard counterweight or "lift" wing via manual, electric or hydraulic control);
- a button that when pressed decreases the angle of attack of the starboard counterweight or "lift" wing via manual, electric or hydraulic control);
- a digital display that indicates the current slope angle of the boat; and
- a digital display that indicates the requested slope angle set by the commander so that the boat can navigate.3. THE SYSTEM FOR PROPELLING AND STABILIZING A SAIL BOAT, according to claim 1, wherein the hydraulic aggregate is fed by a 12 or 24V DC battery and composed of a pump, a hydraulic fluid reservoir, and connected to a set of directional valves for the operation of the solenoids, thus supplying hydraulic flow to the rotary hydraulic actuator and the cylindrical actuator.

4. THE SYSTEM FOR PROPELLING AND STABILIZING

A SAIL BOAT, according to claim 1, wherein the linear sensors are housed close to cylindrical actuator of a rod, that changes the angle of attack of the counterweight or "lift" wing, which sensors that send signals to the control panel informing the indication of the angle of attack of the counterweight or "lift" wing and in the event it is a governing system and also an electronic stabilization said signals are used for the instant positioning of the counterweight or "lift" wing lift and variations thereof.

5. THE SYSTEM FOR PROPELLING AND STABILIZING A SAIL BOAT, according to claim 1, wherein in smaller boats the hydraulic aggregate and the cylindrical hydraulic actuator are optionally substituted with a cylindrical electric actuator connected directly to the control panel and acting directly on the counterweight or "lift" wing.

6. THE SYSTEM FOR PROPELLING AND STABILIZING A SAIL BOAT, according to claim 1, wherein the system is actuated or accessed via a "tablet" or "smartphone" via "bluetooth" or wire.

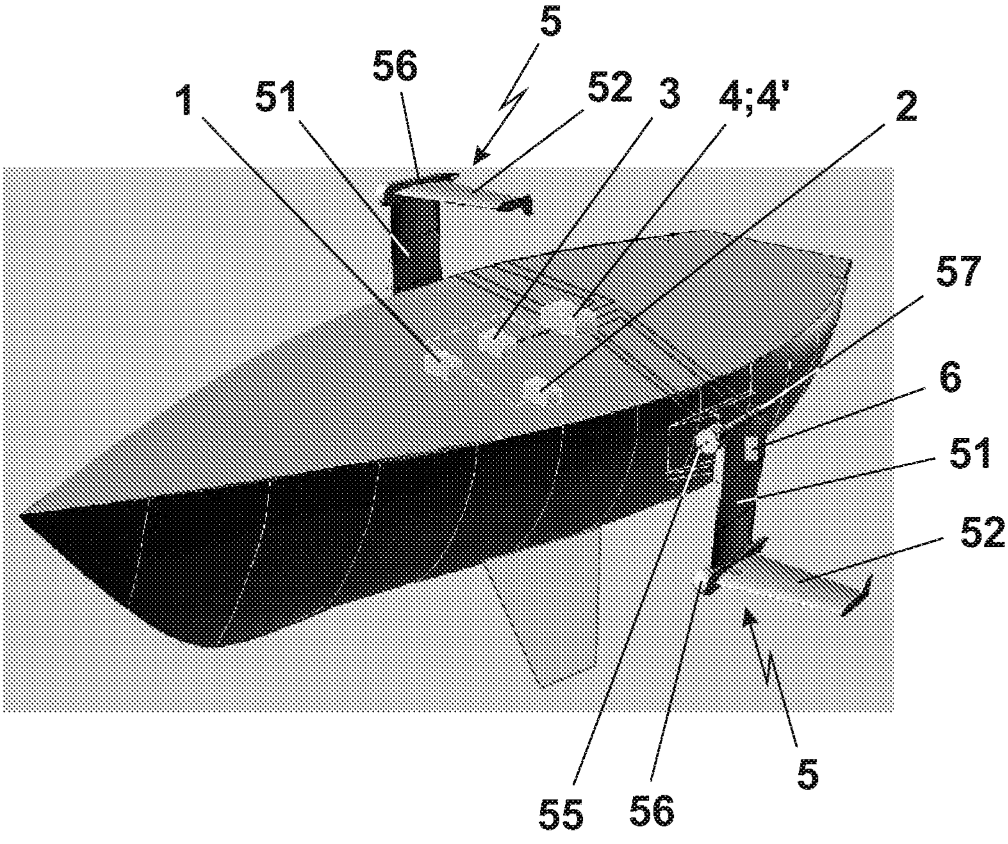

Fig. 1

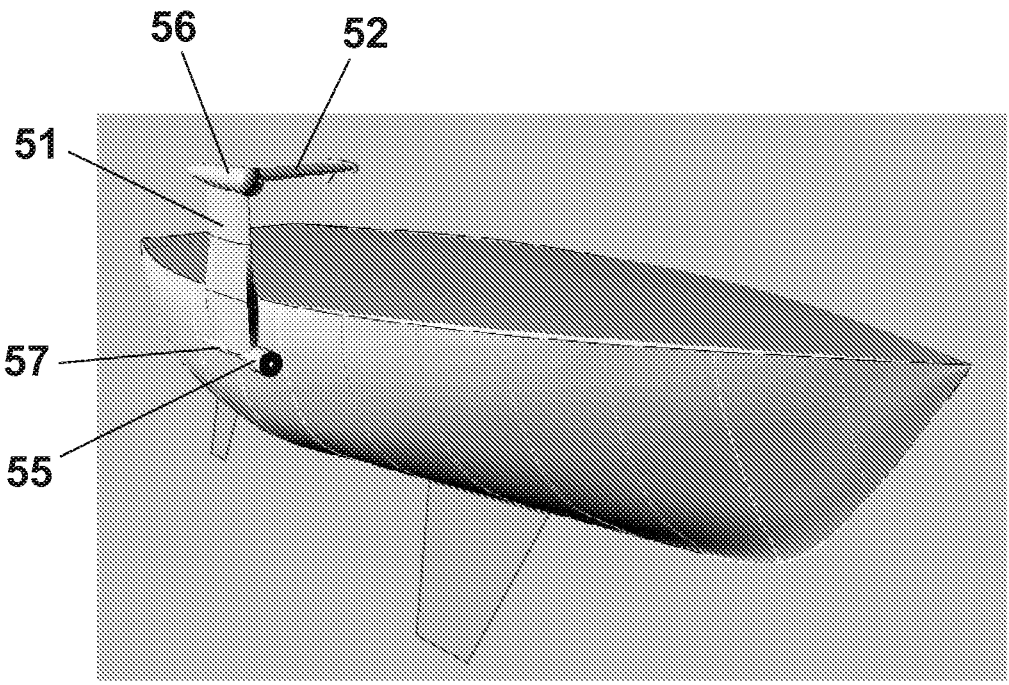

Fig. 2

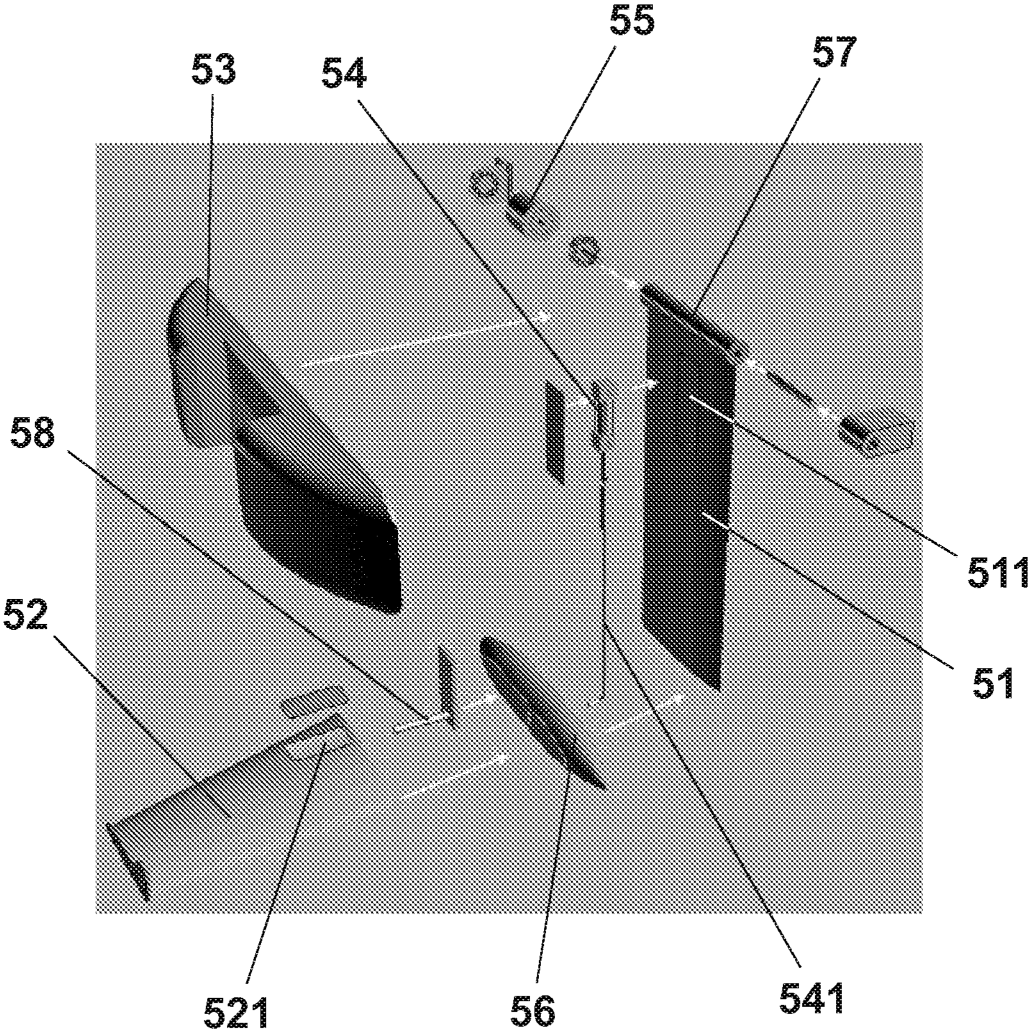

Fig. 3

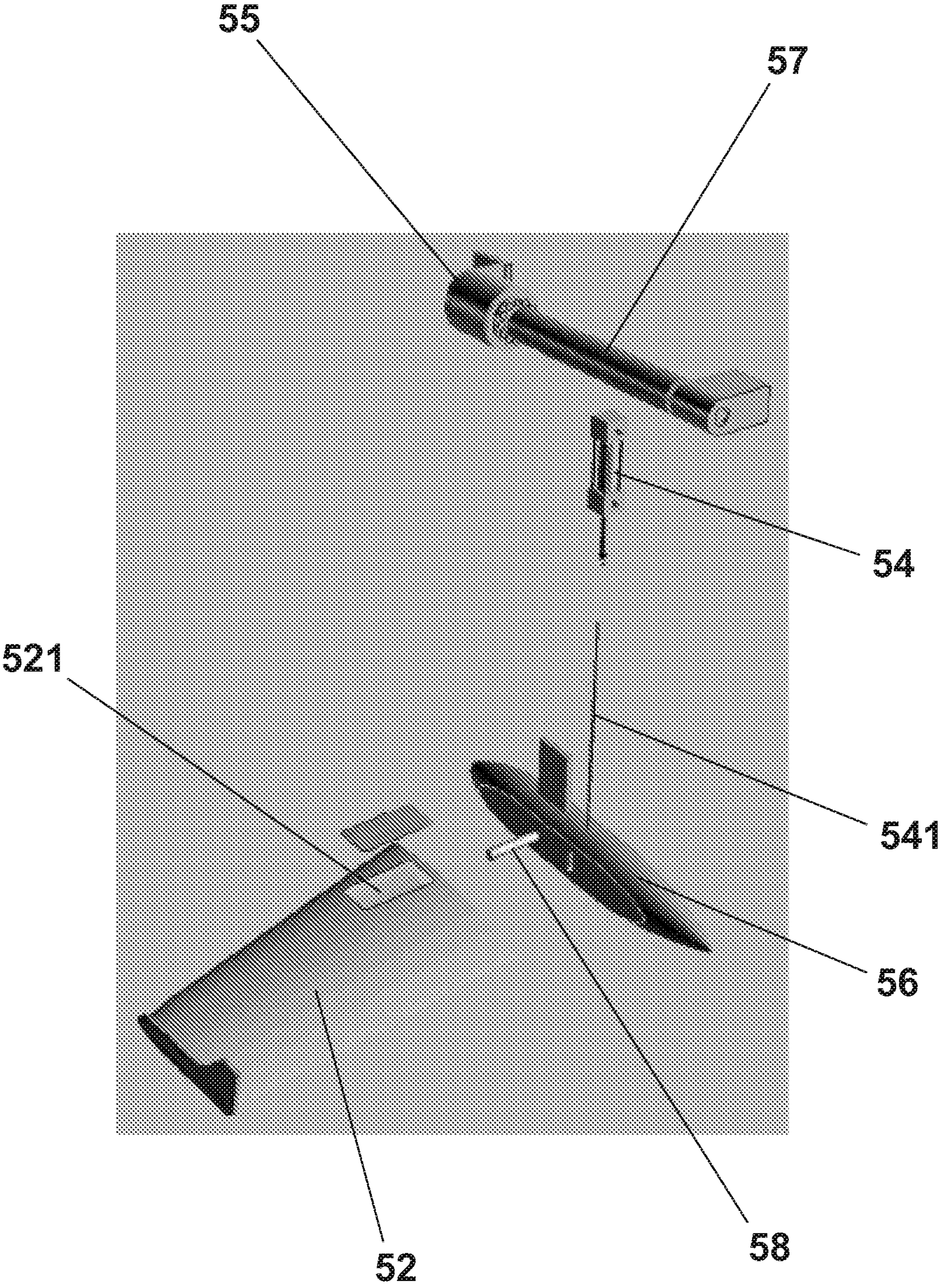

Fig. 4

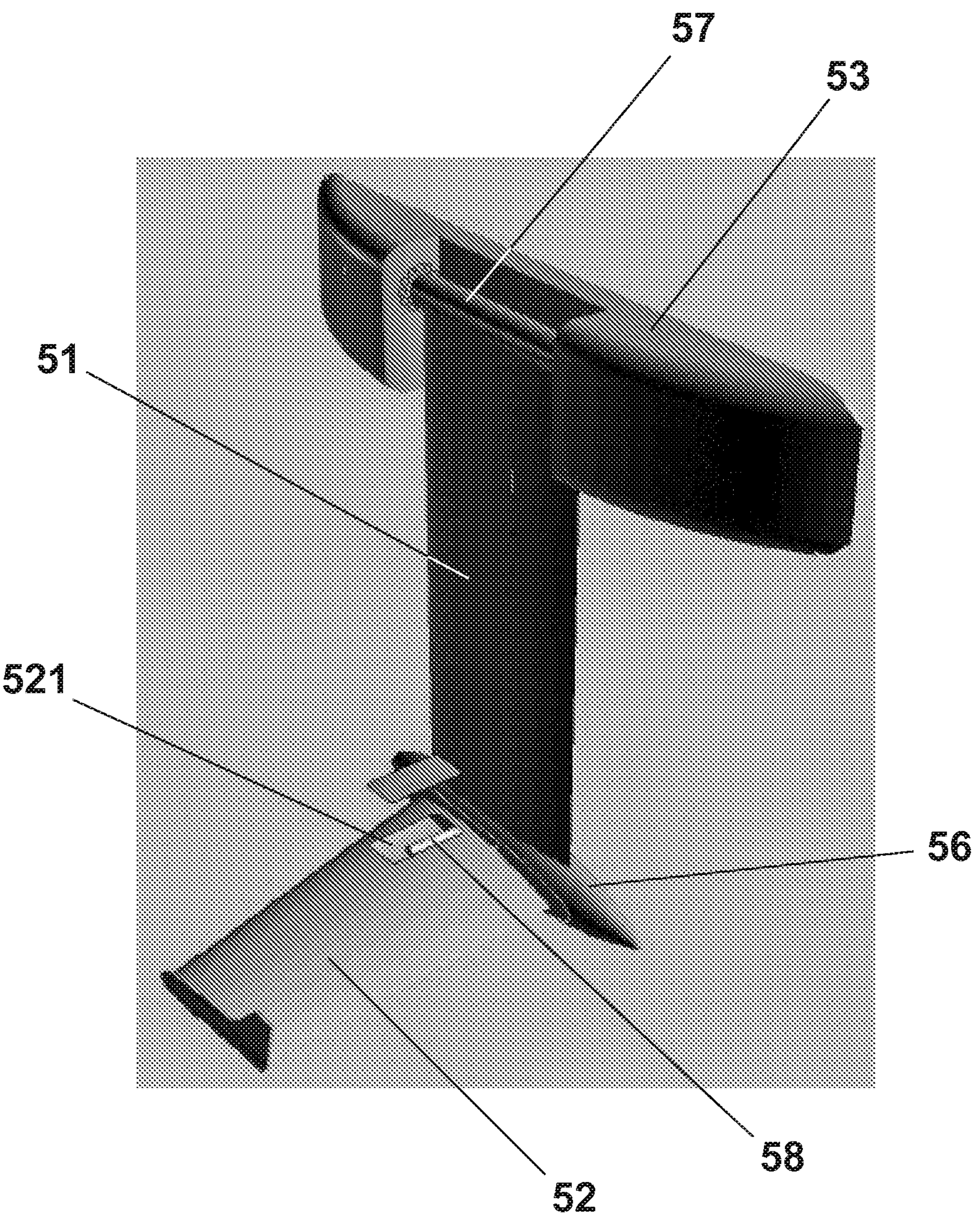

Fig. 5

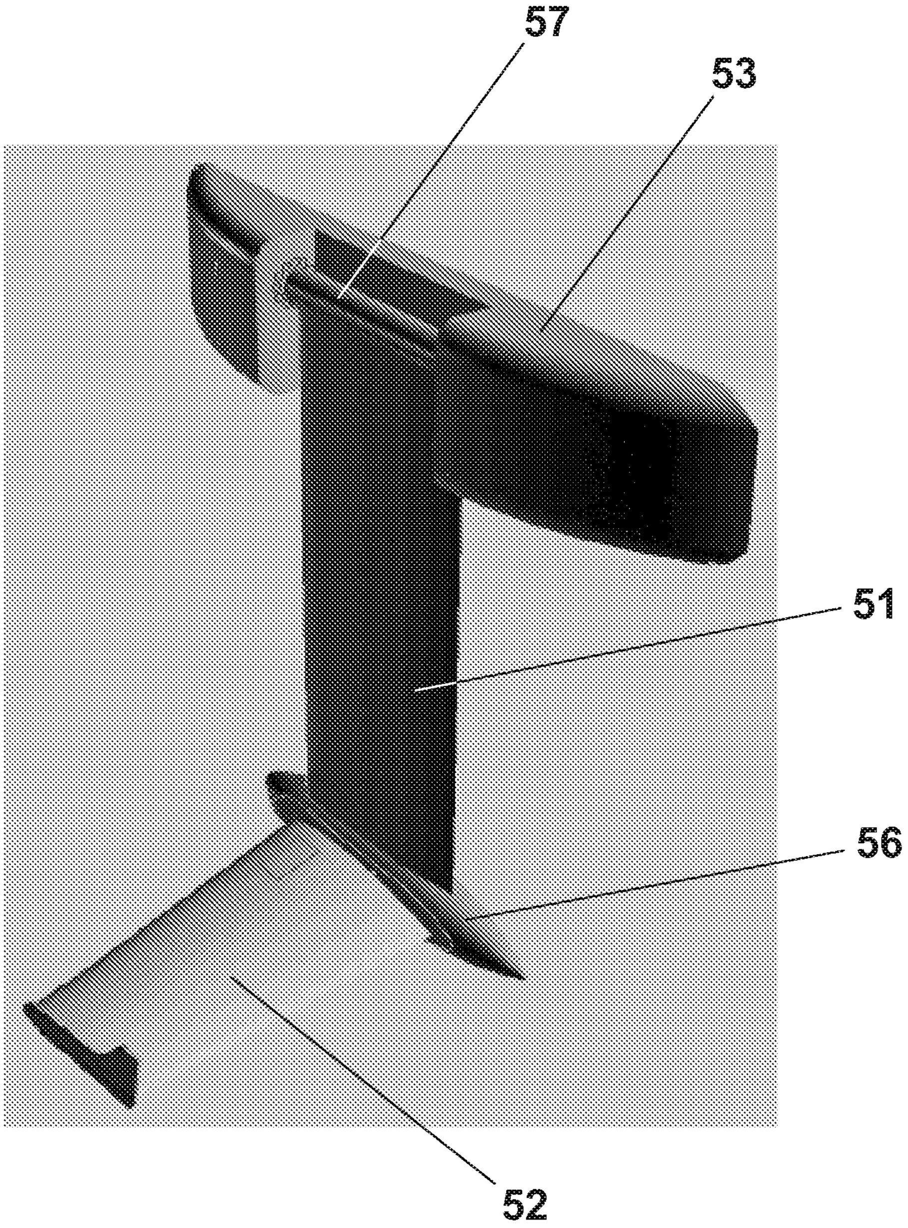

Fig. 6

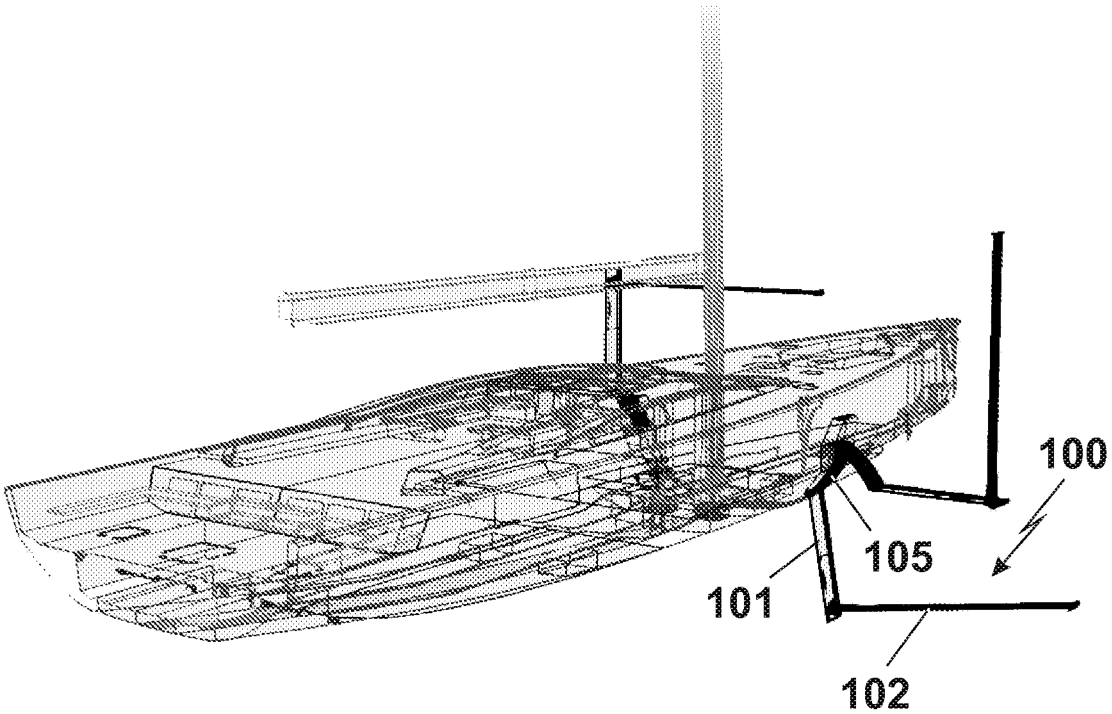

Fig. 7

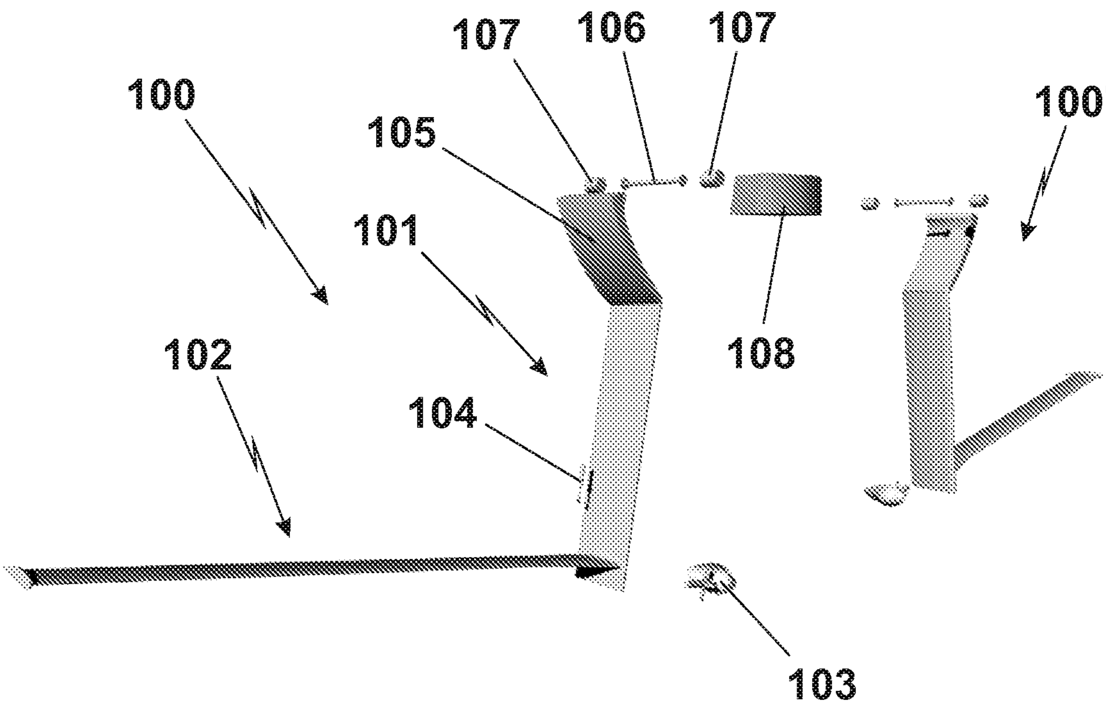

Fig. 8

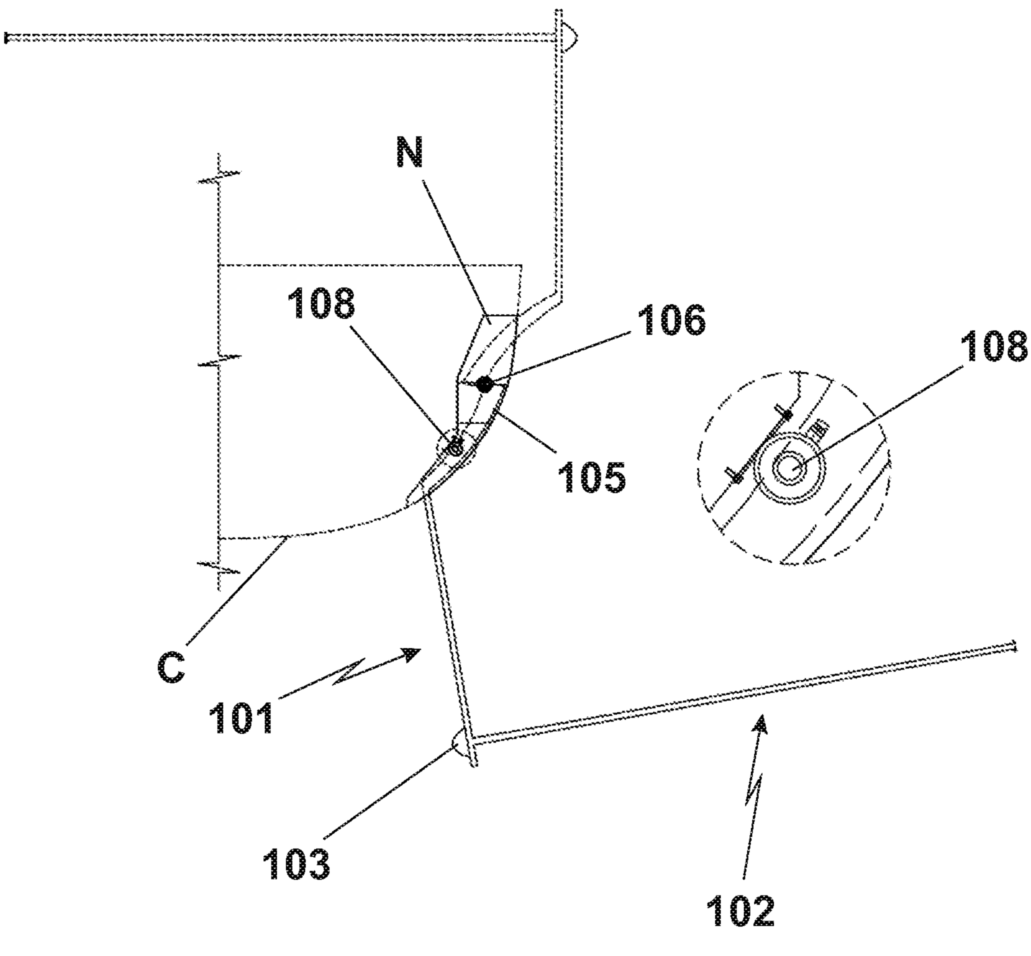

Fig. 9

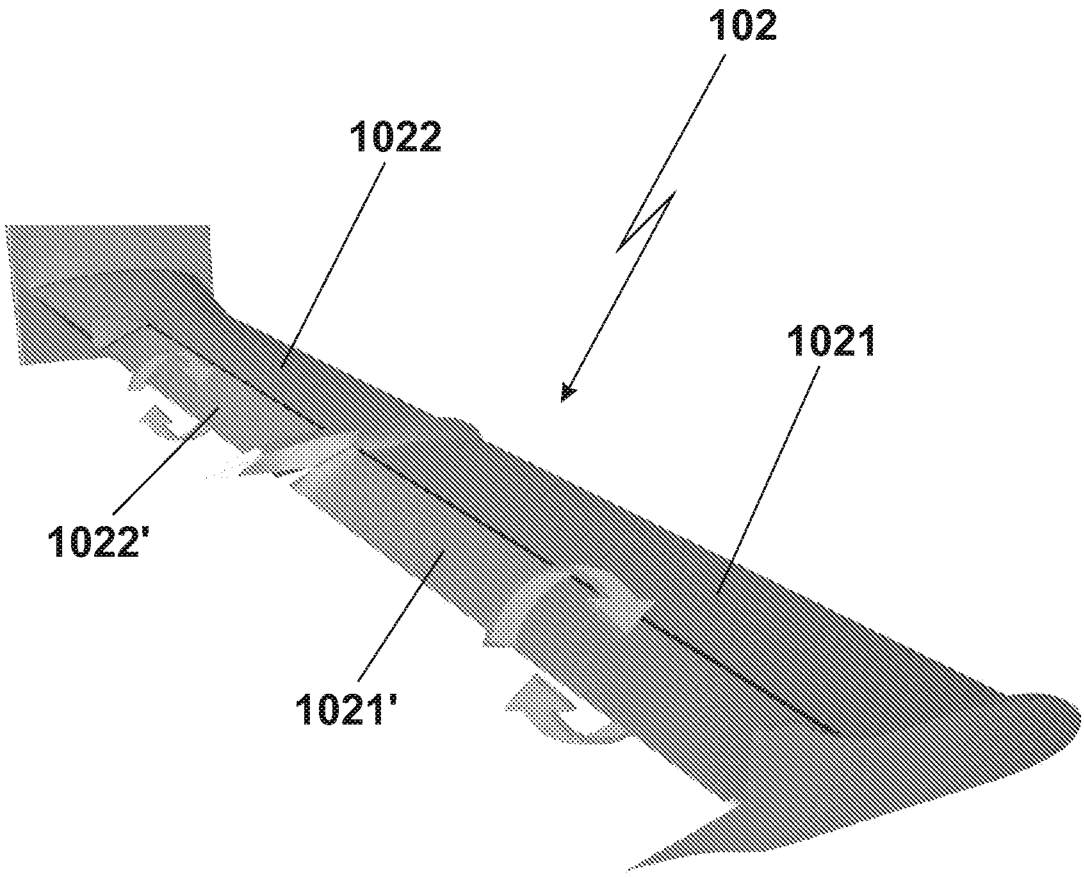

Fig. 10