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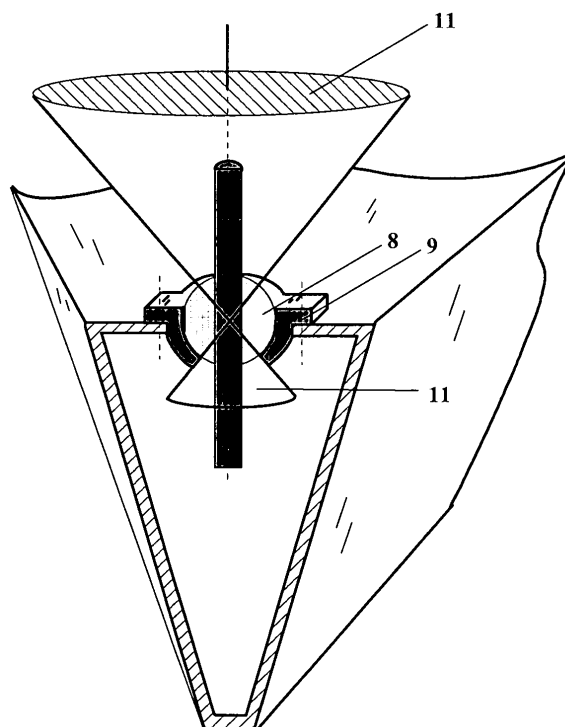
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(54) **Sailing boat with variable lift.**

(57) The present invention concerns a sailing boat 1 comprising a hull 2 and a supporting mast 3 for at least a sail and characterized in that the mast is pivoted to the hull in such a way as to be able to vary its inclination angle with respect to the surface of the hull. The connection between the mast and the hull is realized through a spherical joint 7 or connection stand 107. Moreover, adjustment means 12 connected from the hull to the mast allow to vary the inclination angle of the same when required. In such a manner, it is possible for the crew to vary the lift during all the sailing.

Fig. 11



Description

Technical Field

[0001] The present invention concerns the technical sector of sailing boats.

[0002] In particular, the invention refers to a type of sailing boat for regatta, races and the free time, on which the possibility of a control of the lift generated by the wind also during all the sailing is comprised.

Background Art

[0003] Sailing boats specifically designed for races and regatta in general have long been known. Considering the specific technical sector to which they are destined, it is fundamental that their design points at the realization of a profile (both of the sail and the hull) that optimizes on the whole the performances in all sea conditions, without damaging safety, though.

[0004] As it is well known, the wind force that acts on the sail is responsible for the advancement of the boat and can be decomposed into three main components.

[0005] A first component, called thrust **S**, results parallel to the advancement direction of the boat. Such a force is directly proportional to the projection of the sail with respect to a transversal plane with reference to the boat itself (this takes place by slack angles of up to 30-35 degrees), and in particular an orthogonal plane to the advancement direction of the boat. In that case, it is clear that an increase in the sail surface implies an increase in the sail surface projected on such a plane and therefore, on equal broad reach angle and wind, also a significant increase in the final thrust. On the other hand, as it is well known, the thrust creates a negative pitching effect that causes the sinking of the bow, especially in strongly wavy sea conditions. It is in fact known that the application point of the thrust component substantially corresponds to the sail's centre of gravity. An arm is therefore created that measures the distance between the force application point and the water line of the boat and, consequently, a pitching moment. Currently, such an undesired effect can be controlled by acting on the slack angle of the sail and varying it.

[0006] A second component of the wind force, completely undesired, results orthogonal to the longitudinal plane of the boat. It is called rolling **R** and it is the cause of the turnover of the boat on one side. Also this force component is approximately applied in the sail's centre of gravity and, as already described, a force application arm that determines the turnover is thus created.

[0007] Also this further undesired component of the force, currently, can be controlled only partially by acting on the slack angle and on the sheer or belly of the sail.

[0008] A third force component, extremely important and of substantially positive effects, is the lift **P**. The lift always acts on the sail's centre of gravity but is directed upwards. Such a force results substantially proportional

to the projection of the sailing surface on a parallel plane to the water plane. Also in this case it is therefore clear that an increase in the sailing surface (and therefore in the eventual projection) implies an increase of the lift.

[0009] As already said, the effects of such a force are extremely important to guarantee the boat high performances. In fact, a good lift determines a lifting of the boat with respect to its water line and therefore it allows the boat to plane easily, once pre-determined threshold speeds are overcome. The greater the lift, the inferior will be proportionally the necessary speed to allow the boat to plane. This translates in the concrete fact that, for high lift values, a lower thrust is enough to allow the boat to plane on water.

[0010] It is therefore clear that a control such as to allow an optimal exploitation of such a force component confers the boat the capacity to plane also in conditions of low intensity wind.

[0011] Lift control is important not only in terms of performances but also of safety. Excessive wind may imply such a high lift so as to cause a lifting of the boat such as to render its control difficult. It is clear that such a condition presents high risk for the crew. In normal conditions the solution is that of varying the slack angle in such a way as to diminish the trapped wind and with it all the force components (Thrust, Rolling and Lift). It is clear that such a solution determines an insurmountable limit to overcome predetermined performances. In extreme cases, the only solution to such a problem is to furl the sails definitely and bring the boat to port slowly.

[0012] Although, as per what has been described above, the control of the lift seems to be extremely important, currently there is no device or boat that allows, in any way, the control of the said lift. The mast is in fact substantially fixed and the whole is reflected on consequences that go from the loss of performances to risk conditions for the crew. Currently, the only practicable kinematic setup on the mast implies a minimal inclination of the same exclusively towards the stern or the bow. Such minimal inclinations are made possible thanks to the "step" used to realize the connection of the mast to the hull. This comprises a simple rectangular guide into which the base of the mast is inserted with interference. The tension rods then squash the base of the mast towards the base of the step, supporting it in the pre-chosen position. However, it is clear that such a connection implies exclusively a minimal inclination initial setup and that it cannot be changed anymore during sailing. Moreover, being such a setup limited to only the position towards stern or bow and not in lateral positions, this has substantially no control effect on the lift, which at present can thus be neither controlled nor modified during sailing.

Brief description of the invention

[0013] It is therefore the aim of the present invention to provide a sailing boat in general that solves at least in part the above-mentioned inconveniences.

[0014] In particular, it is the aim of the present invention to provide a sailing boat that allows to modify the lift value acting on the sail during sailing, thus allowing the control of the same.

[0015] It is therefore the aim of the present invention to provide a sailing boat that allows, on equal wind, to increase or diminish the lift value acting on the sail during sailing until rendering it even negative.

[0016] It is therefore the aim of the present invention to provide a sailing boat which mast results angularly adjustable with respect to the hull in such a way as to control the lift value.

[0017] These and other aims are obtained with the present sailing boat (1) according to claim 1.

[0018] In accordance with the invention, connection means (7; 107; 207) are provided, which connect the mast to the hull, comprising a pivoting element configured in such a way that the mast is capable of rotating so as to be able to generate cones (10) with vertex at the pivoting point and of variable amplitude.

[0019] In such a manner, when in use, it is possible to incline the mast with respect to the hull of any angle and direction, thus being possible to vary the lift at will.

[0020] The inclinations can be such as to allow a passage even from a negative camber position to a positive camber position and vice versa. In the case of positive camber, an inclination of the mast such as to generate a positive lift that lifts the boat is intended, while a negative camber indicates such an inclination as to determine negative lift. Such a control of the camber is extremely beneficial not only in terms of performances but also in terms of safety. In that case, it is therefore possible to annul the lift or even render it negative, allowing the boat to squash itself towards the water surface in the case it becomes necessary.

[0021] On the contrary, in scarce wind conditions, it is possible to incline the mast at positive camber so as to increase the surface projected with respect to the plane parallel to the water level and therefore increase the lift value. In that case, the boat will be able to plane also with scarce wind.

[0022] Moreover, the variation of the camber angle has a double positive effect. Apart from increasing or diminishing the lift, it has in fact a rolling reduction effect. The inclination of the mast consequently determines a reduction of the projected area with respect to the longitudinal plane and a lowering of the sail's centre of gravity. The whole translates in a reduction of the rolling effect. For example, in strong wind conditions it is possible to give negative camber to the sail in such a way as to generate negative lift and guarantee the controllability of the boat, reducing at the same time the rolling without precluding the thrust.

[0023] Advantageously, the pivoting element (7; 107) can comprise at least a spherical joint (8, 9).

[0024] Advantageously, the spherical joint comprises a concave seat (9) and a sphere (8), arranged inside in a rotating manner.

[0025] Advantageously, the mast (3) can be connected to the sphere (8) in such a way as to result rotatable in correspondence of the rotation of the sphere, the said spherical joint being connected to the hull (2).

[0026] Advantageously, the mast (3) can be passing through the entire diameter of the sphere.

[0027] Alternatively, the pivoting element (7; 107) can advantageously comprise a connection stand (107) of connection to the mast (3) comprising a flexible head (108) into which the mast (3) is inserted.

[0028] Advantageously, the connection stand (107) comprises a supporting base (110) on which the head (108) emerges, which is flexible with respect to the base (110).

[0029] Advantageously, the supporting base can be circular.

[0030] Advantageously, connection means (109) can be provided to fix the connection stand to the hull (2).

[0031] Advantageously, at least the head (108) can be realized of a rubber material.

[0032] The deformation in flexion of the joint in rubber allows to turn the mast as if it was indeed pivoted to the hull.

[0033] Alternatively, at least the head (108) can comprise partially rubber material and partially rigid material, with such materials arranged in such a way as to allow inclinations of the head (108) with respect to the supporting base (110) exclusively according to preferential directions.

[0034] Moreover, in an advantageous manner, the hinge (207) can alternatively comprise a pivot (210), rotatable around an axis **Y** and connected on one side with a cup support (220) on which a clamping block (230) is arranged in a rotatable manner around an axis **X**, orthogonal to the said axis **Y**, and wherein, further, a cylinder (240) is engaged with the clamping block (230), the said cylinder comprising a pivoting element (250') to which a support of the mast (250) is connected, rotatable around the axis **Z** orthogonal to the said axes **X** and **Y**.

[0035] With the aim of being able to control the camber angle during all the sailing, adjustment means (12) are further provided (12) to allow to control a lateral rotation of the mast with respect to the hull.

[0036] In fact, although the pivoting element theoretically allows angle adjustments at 360 degrees, traditional tension rods as per the background art that block the mast on the side of the stern and of the bow make the said means able to move the mast according to a substantially lateral inclination (towards right or left).

[0037] In particular, the said adjustment means (11, 12) comprise:

- At least two tension rods (13) connected to the mast so as to apply a draught action on the said mast contemporarily on two opposed directions;
- At least a tensioning device (15) to apply the said draught action on the mast through the two tension rods, the said tensioning device (15) comprising at

least a capstan or similar;

- At least two transmissions (14) respectively arranged each one on two opposed sides of the mast, the said transmissions guiding the tension rods from the mast towards the tensioning device.

[0038] Advantageously, the tensioning device (15) comprises a capstan.

[0039] The direction of the tension rods 13 and the positioning of the pulleys or transmissions 14 therefore allows a substantially lateral movement towards right or left.

[0040] Without moving apart from the present inventive concept, it is also possible to include a mast (3) for a sailing boat, configured in such a way as to allow rotations as to generate cones of variable amplitude when placed on a sailing boat.

Brief description of the drawings

[0041] Further features and advantages of the present sailing boat, according to the invention, will result clearer with the description that follows of one of its embodiments, made to illustrate but not to limit, with reference to the annexed drawings, wherein:

- Figure 1, figure 2 and figure 3 represent overall views of the boat and of the sail on which the force components of the wind act;
- Figure 4 represents a mast with null camber, as per the background art;
- Figure 5 represents an angle variation of the mast towards the stern or the bow, in accordance with the background art;
- Figure 6 represents a mast on which the camber angle is varied, in accordance with the present invention;
- Figures 7 and 8 represent the technical effects of a camber angle variation;
- Figures from 9 to 11 represent a first embodiment of connection of the mast to the hull in such a way as to vary the camber angle;
- Figure 12 represents a second embodiment of connection of the mast to the hull;
- Figure 13 represents a third embodiment for the mast/hull connection.
- Figures 14 and 15 represent the means to control the camber angle variation during sailing;
- Figure 16 represents a frontal view of a change of camber angle as to have a negative lift effect on the sail.

Description of one preferred embodiment

[0042] With reference to figure 1, a sailing boat 1 basically comprises a hull 2 and a mast 3 that serves as support for the sail (4, 5). The figure, in accordance with the background art, represents, for clarity purposes, the

said three force components that act on it, and already described in the preamble of the background art. It is represented the lift P, the rolling component R and the thrust S, all applied substantially in the sail's centre of gravity. The sail represented in figure comprises, for descriptive completeness reasons, a mainsail 4 and a jib 5. Figure 2, for greater clarity, further represents a frontal view of the sail and a lateral view with the lift applied in correspondence of the sail's centre of gravity, while figure 3 represents a top view. The top view of the boat, floating on the water surface, highlights the inclination of the sail and the component P, outgoing perpendicularly from the water line (represented with a dot). The intensity of the lift is therefore proportional to the area of the sail projected on a hypothetical horizontal plane 6 arranged above the boat.

[0043] For that purpose, figure 4 indicates the known configuration of the present boats wherein the mast 3 has an invariable camber angle initially arranged in such a way as to result null. As in fact shown in figure 5, currently, it is possible only a minimal adjustment of the mast towards stern or bow, that can be set up only before sailing and that then remains fixed. In that case, going back to figure 4, the area projected on the overlapped plane 6 will have a predetermined fixed value depending basically on the jib and on the belly of the mainsail, therefore on the pre-chosen sail configuration. Always figure 4 shows the plane 6 viewed from the top with the painted background projected area **A** and the lift P applied. Naturally, the length of the area extends for all the projected length of the sail.

[0044] In accordance with the present invention, as shown in figure 6, the hull and the mast are respectively combined between them in such a way that the mast results mobile in an angular manner so as to be able to adjust the camber. In particular, the mast results pivoted to the hull in such a way as to allow to incline it with respect to the surface of the hull, and in particular to incline it laterally with respect to the hull, as better explained below. Figure 6 gives a clear representation of such a lateral inclination. Once the position of the mast with respect to the stern and the bow is fixed, as indicated in figure 5, it is possible to incline the mast at will towards the side of the hull so as to vary the camber and therefore the lift during sailing. Just as a way of example, figure 6 shows a lateral inclination towards the right side of the sail. The technical effects of such an inclination are clarified by figure 7, wherein the ideal plane overlapped to the hull and on which the area of the sail is projected is represented. In that case, it is clear that an inclination in the direction of the arrow increases the projected area **A1** (see the painted background area), which is greater with respect to the preceding area **A** of figure 4. This inevitably implies a great increase of the lift value.

[0045] The figure therefore shows an inclination on one side that represents the increase of the camber angle.

[0046] Figure 8, for clarity purposes, further shows how the possibility of lateral inclination induces a further ben-

eficial effect of rolling reduction. The rotation of the mast 3 from the vertical position to a generic inclined position reduces the overall height of projection of the sail from a value h to a value h_1 . Such a height reduction implies a reduction of the area of the sail projected on the longitudinal plane, a lowering of the centre of gravity and therefore a reduction of undesired rolling effect.

[0047] The mobile connection between mast and hull is therefore realized through pivoting means (7; 107) schematically indicated in the figures from 9 to 12. In that case, the figures from 9 to 11 schematize a possible constructive solution with spherical joint connection 7. A sphere 8 is therefore fixed in a rotatable manner inside its concave seat 9. The seat 9 is fixed to the hull, for example with screws, gluing or similar methods anyway able to support the corrosive action of water. Figure 9 shows a section A-A for highlighting the section of the hull with the mast and the spherical joint. The sphere 8 is then connected to the base of the mast 3 in such a way as to realize the pivoting connection. In such a manner, as shown in figure 8, the mast is free to rotate practically at 360 degrees so as to be able to generate a cone 10 each time at variable amplitude and with vertex at the pivoting point.

[0048] The solutions of connection of the mast to the spherical joint can be multiple. Just as a way of example, figure 11 schematizes a further solution wherein the base of the mast 3 is passing through the sphere in such a way as to have greater stability. In that sense, also the concave seat will have to be hollow to allow the passage of the mast. In that case, the variable conic opening 11 is anyway limited by the passage hole realized in the support.

[0049] Alternatively, equivalent solutions can anyway be used.

[0050] For example (see figure 12), it is possible to include a connection stand 107 to the mast 3 having a head 108, flexible with respect to the supporting base 110 (for example, a head realized entirely of rubber) and into which the mast is inserted. The connection stand is then connected to the hull by means of an ordinary step, that is a longitudinal guide of quadrangular section into which it is fixed by means of a bolt with nut 109. The rubber head 108 is therefore dimensioned in such a way as to have enough rigidity to support the mast, but it can be inflexed by deformation so as to vary the angle. Always figure 12, for clarity purposes, shows in thin dotted line an inflexion of the junction 108 in rubber.

[0051] Also in this case any inclination can be obtained (in terms of angle and angle direction) but with vertex at the point of connection of the mast to the connection stand. Also this solution allows the generation of rotating cones.

[0052] Alternatively, the connection stand could also include a flexible head but partly made of rubber material and partly made of rigid material. In this manner, the rotations with vertex at the pivoting point are limited exclusively to preferential directions.

[0053] A third solution involves a pivoting element 207 comprising a pivot 210 rotatable around its own axis Y and connected with a cup support 220 (C-shaped), in such a way that the said cup support results rotatable around said axis (represented in thin dotted line). The cup element 220 presents holes 230' into which a clamping block 230 is inserted in a rotatable manner around the axis X and into which a cylinder 240 is placed. The cylinder is therefore rotatable according to, altogether, the directions X and Y . The cylinder comprises a further pivoting element 250' to connect in a rotatable manner a support 250 of the mast 3 to the cylinder. In such a manner, such a support results in turn rotatable with respect to the cylinder 240 around the axis Z outgoing from the plane of the drawing.

[0054] The angle adjustment can then be realized through adjustment means 12 combined with the said pivoting elements. As shown in figure 13, for example, two tension rods 13 are connected to the mast 3 and passing through at least two front transmissions 14 arranged laterally to the hull and in correspondence of the sides of the mast. Figure 13 limits itself to show only the section of the mast where the connection to the tension rods takes place and is generally arranged at about 3,5 metres from the hull. Other further transmissions (four in total, for example) conduct the tension rods up to a tensioning device 15. The transmissions 14 are generally pulleys, while the tensioning device is generally a capstan 15 of the winch type.

[0055] When in use, it is therefore possible, during sailing, to operate on the means 12 for passing, on the basis of the needs, from negative lift inclination conditions to positive lift inclination conditions and vice versa.

[0056] The crew can therefore act on the winch lever by draughting the mast through the pulleys on one side and releasing it on the opposed side and operating a lateral inclination of the mast in the direction indicated with the arrow 16 in figure 13.

[0057] Figure 14, just as a way of example, further shows the draught of the tension rod such as to incline the mast laterally in such a way as to render the sail of negative lift. Figure 15 clarifies the said inclination with a lateral view wherein such a rotation that inclines the mast towards left is highlighted (for the observer, placed on the stern). In that case, in accordance with the hypothetical direction of the wind, the negative lift effect is created.

Claims

1. A sailing boat (1) comprising:

- A hull (2);
 - A supporting mast (3) for a sail (4, 5);
 - Connection means (7; 107; 207) for connecting the mast to the hull and;
- characterized in that** the said connection

- means (7; 107; 207) comprise a pivoting element (7; 107; 207) configured in such a way as to allow the mast to rotate with respect to the hull so as to be able to make a conic rotation (10, 11) with vertex at the pivoting point at variable amplitude. 5
2. Sailing boat, according to claim 1, wherein the said pivoting element (7; 107) comprises at least a spherical joint (8, 9). 10
3. Sailing boat, according to claim 2, wherein the said spherical joint comprises a concave seat (9) and a sphere (8) arranged inside the concave seat in a rotatable manner. 15
4. Sailing boat, according to claim 3, wherein the mast (3) is connected to the said sphere (8) in such a way as to result rotatable in correspondence of the rotation of the sphere, the said spherical joint being connected to the hull (2). 20
5. Sailing boat, according to claim 4, wherein the mast (3) is passing through the entire diameter of the sphere. 25
6. Sailing boat, according to claim 1, wherein the said pivoting element (7; 107) comprises a connection stand (107) to the mast (3) comprising a flexible head (108) into which the mast (3) is inserted. 30
7. Sailing boat, according to claim 6, wherein the connection stand (107) comprises a supporting base (110), for supporting the connection stand (107) to the hull, on which the said head (108) emerges, flexible with respect to the base (110). 35
8. Sailing boat, according to claim 7, wherein the supporting base (110) is circular. 40
9. Sailing boat, according to one or more of the preceding claims from 6 to 8, wherein connection means (109) are provided to fix the connection stand to the hull (2). 45
10. Sailing boat, according to one or more of the preceding claims from 6 to 9, wherein at least the head (108) is realized of a rubber material. 50
11. Sailing boat, according to one or more of the preceding claims from 6 to 9, wherein at least the head (108) comprises partially rubber material and partially rigid material and are arranged in such a way as to allow inclinations of the head (108) with respect to the supporting base (110) exclusively according to preferential directions. 55
12. Sailing boat, according to claim 1, wherein the said pivoting element (207) comprises a pivot (210) rotatable around an axis **Y** and connected on one side with a cup support (220) on which a clamping block (230) is arranged in a rotatable manner around an axis **X**, orthogonal to the said axis **Y**, and wherein, further, a cylinder (240) is placed into the said clamping block (230), the said cylinder comprising a pivoting element (250') to which a support of the mast (250) is connected, rotatable around the axis **Z** orthogonal to the said axes **X** and **Y**.
13. Sailing boat, according to one or more of the preceding claims, wherein adjustment means (12) are further provided to allow to control the substantially lateral rotation of the mast with respect to the hull.
14. Sailing boat, according to claim 13, wherein the said adjustment means (12) comprise:
- At least two tension rods (13) connected to the mast in such a way as to apply a draught action on the said mast contemporarily on two opposed directions;
 - At least a tensioning device (15) to apply the said draught action on the mast through the said two tension rods, the said tensioning device (15) comprising at least a capstan or similar;
 - At least two transmissions (14) respectively placed each one on two opposed sides to the mast, the said transmissions guiding the said tension rods from the mast towards the tensioning device.

Fig. 1

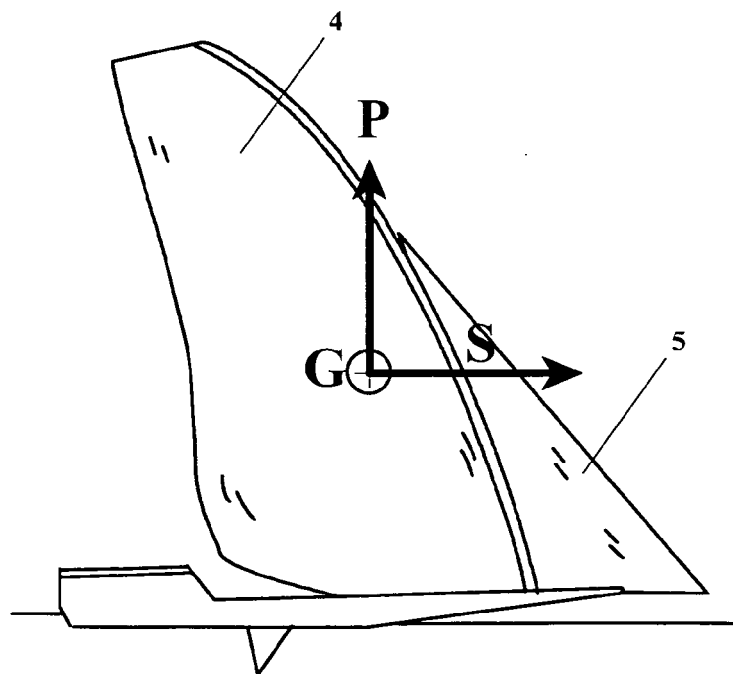
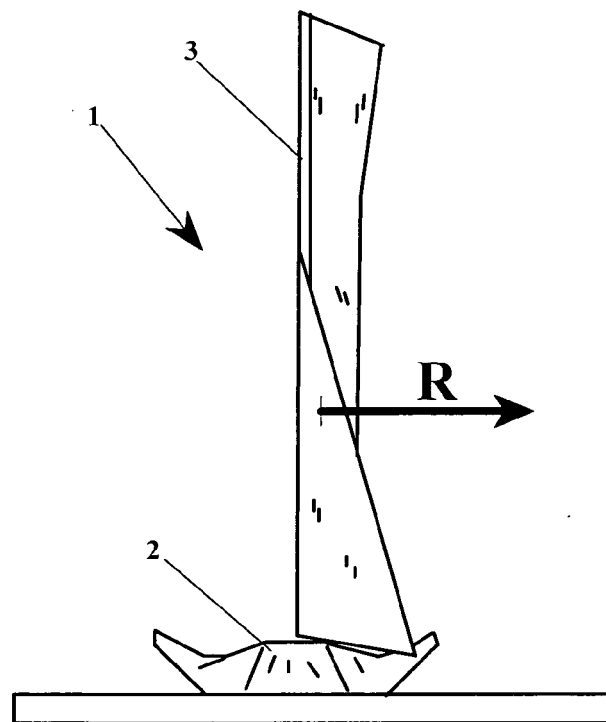


Fig. 2

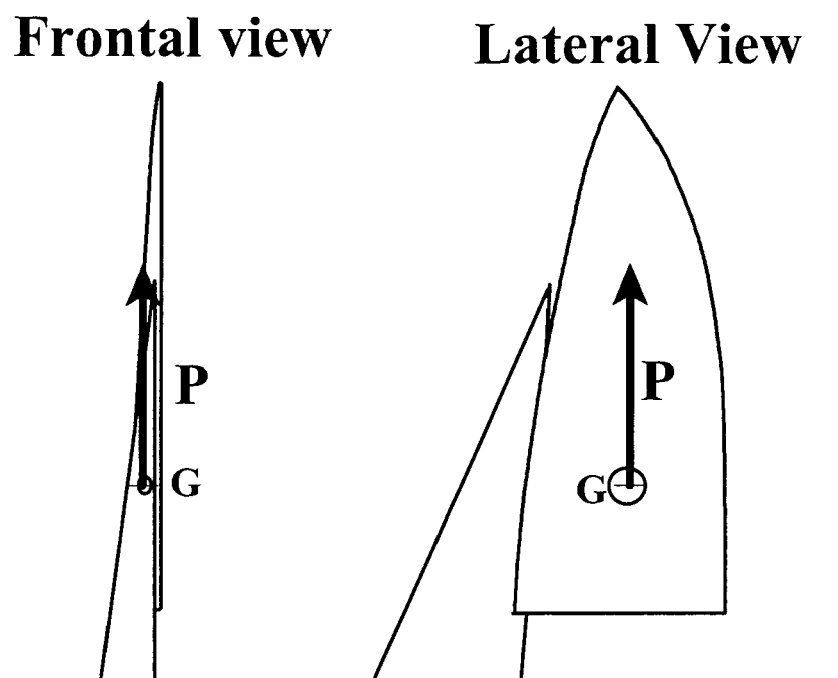


Fig. 3

Top View

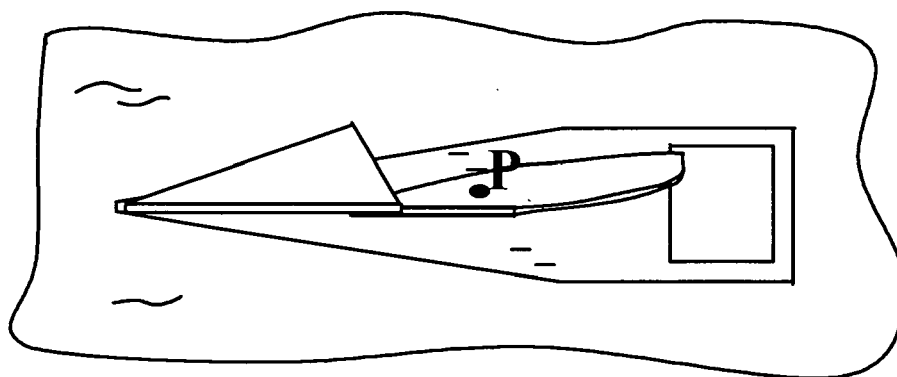


Fig. 4

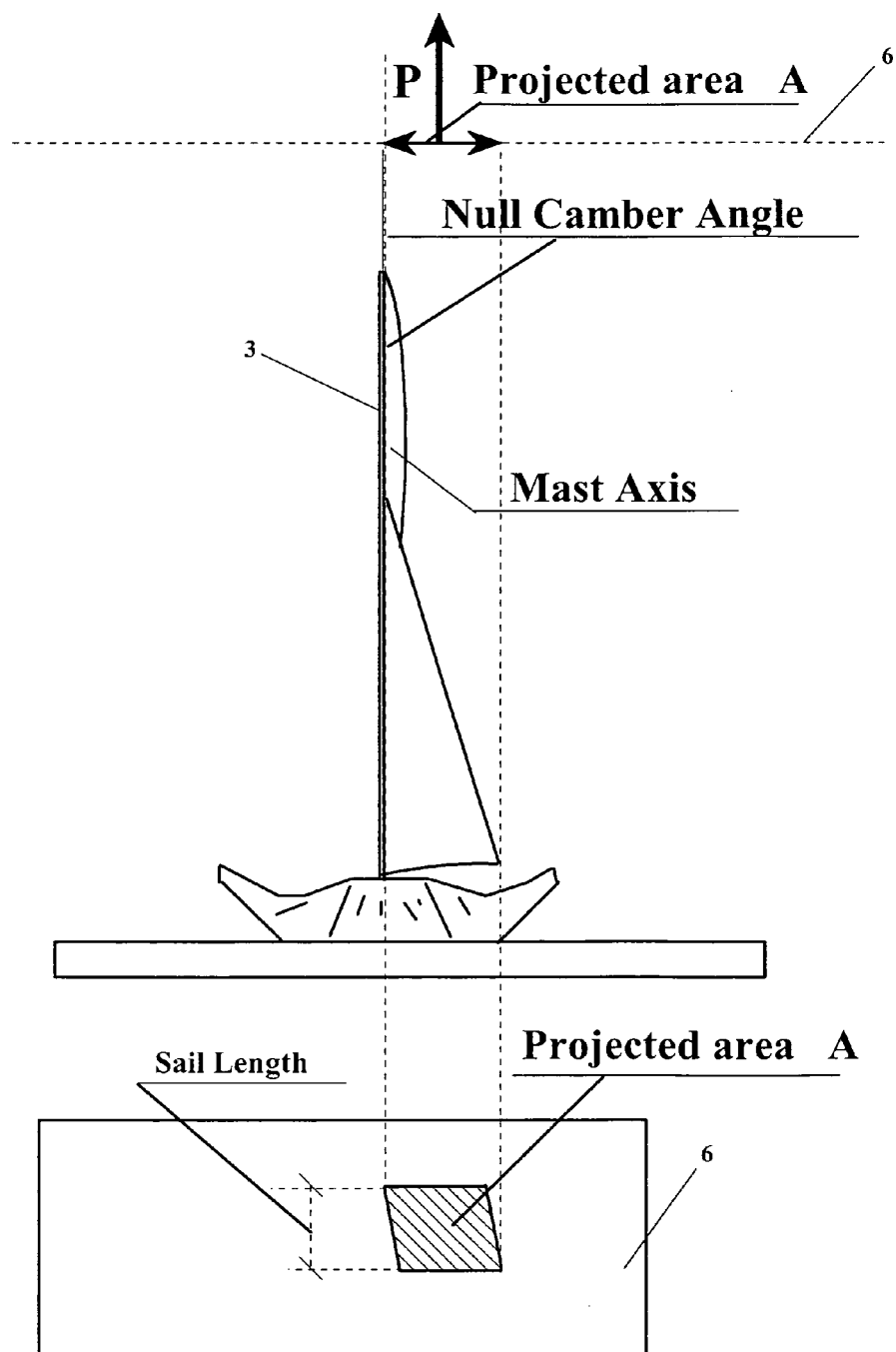


Fig. 5

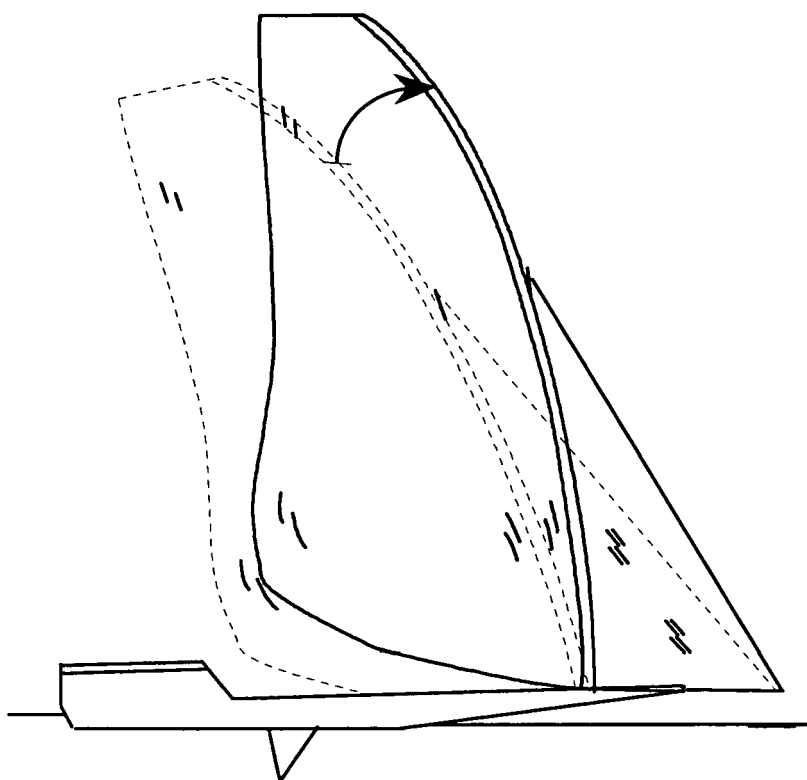


Fig. 6

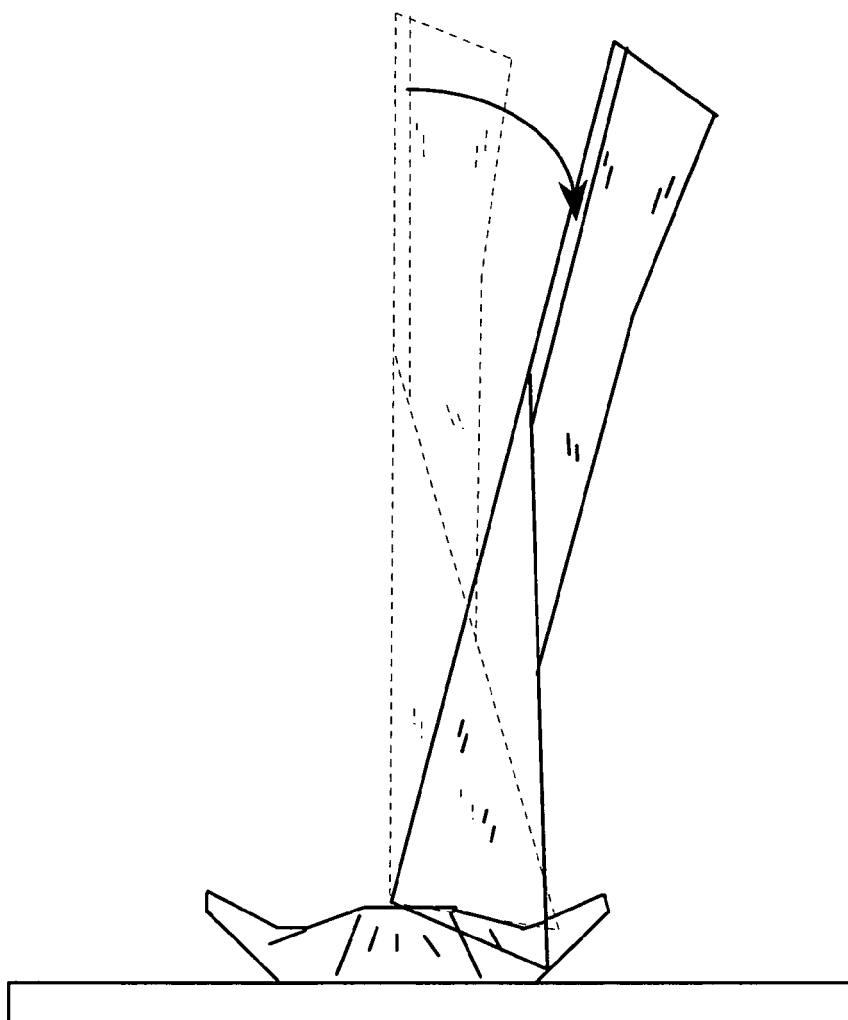


Fig. 7

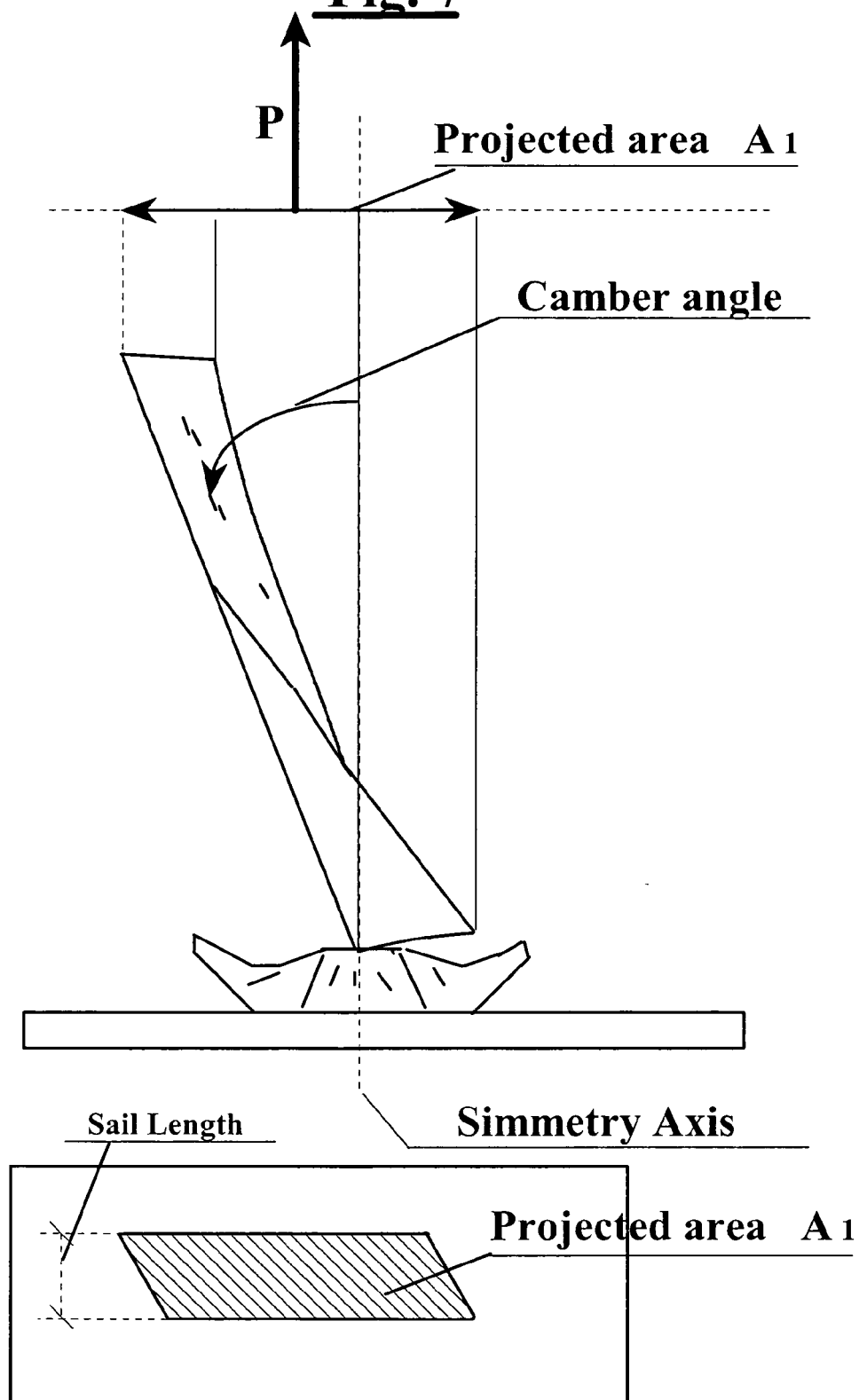


Fig. 8

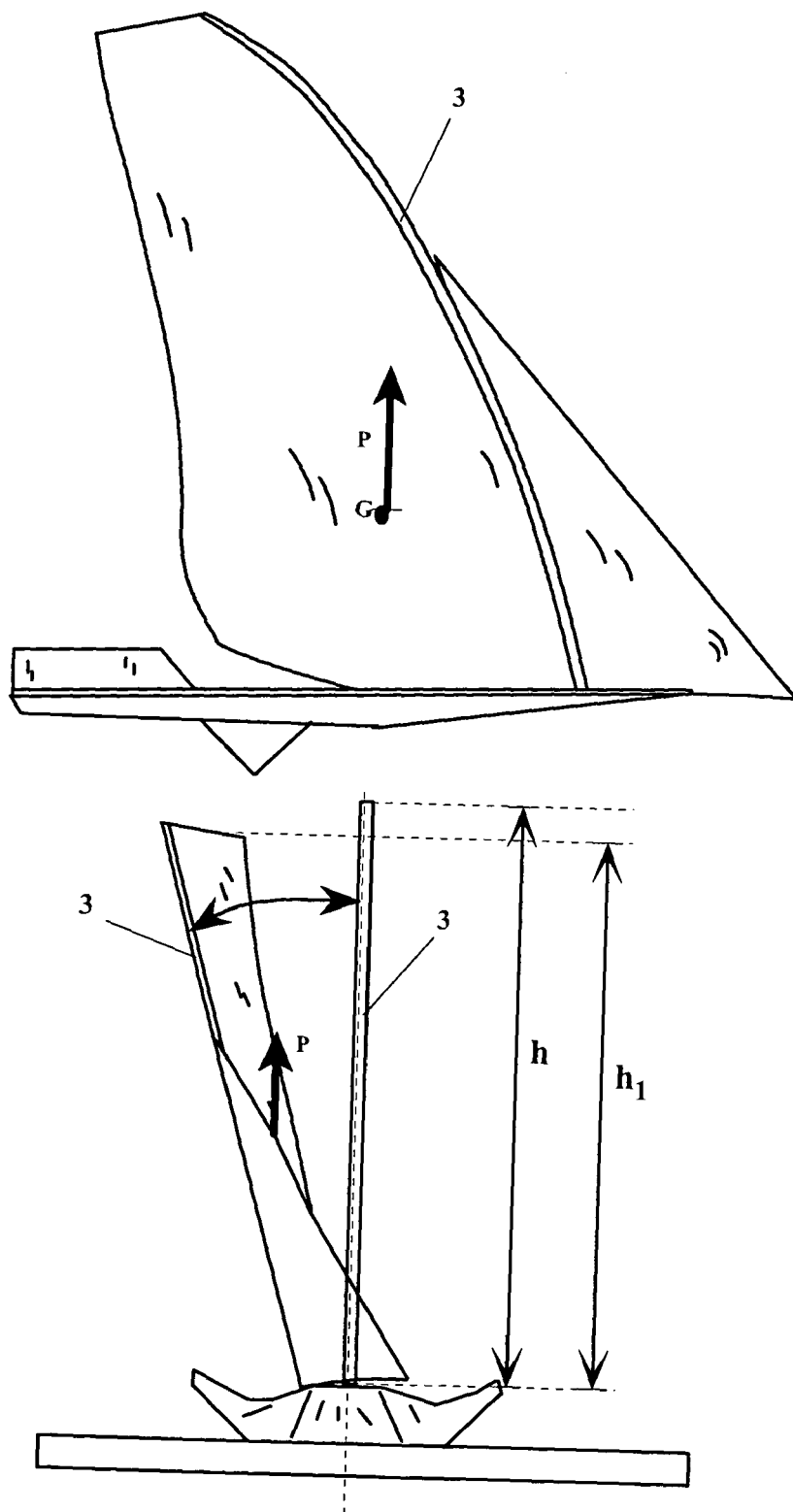


Fig. 9

Sec. A-A

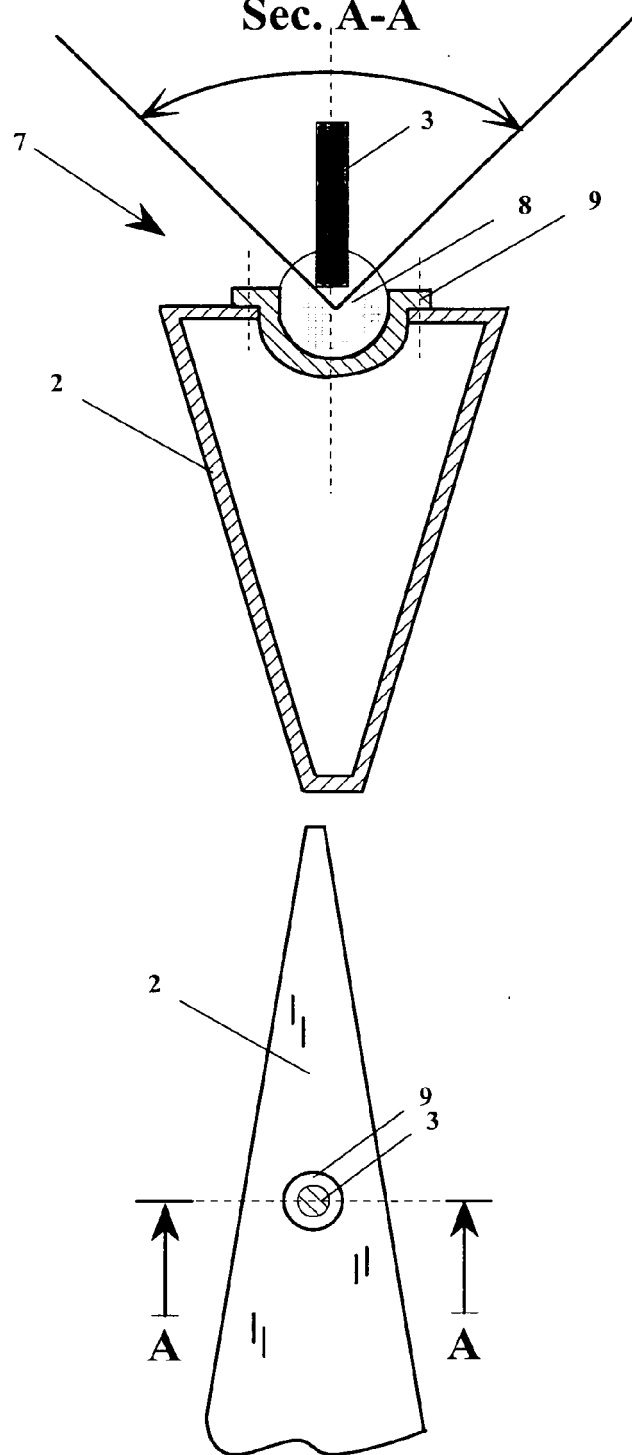


Fig. 10

Sec. A-A

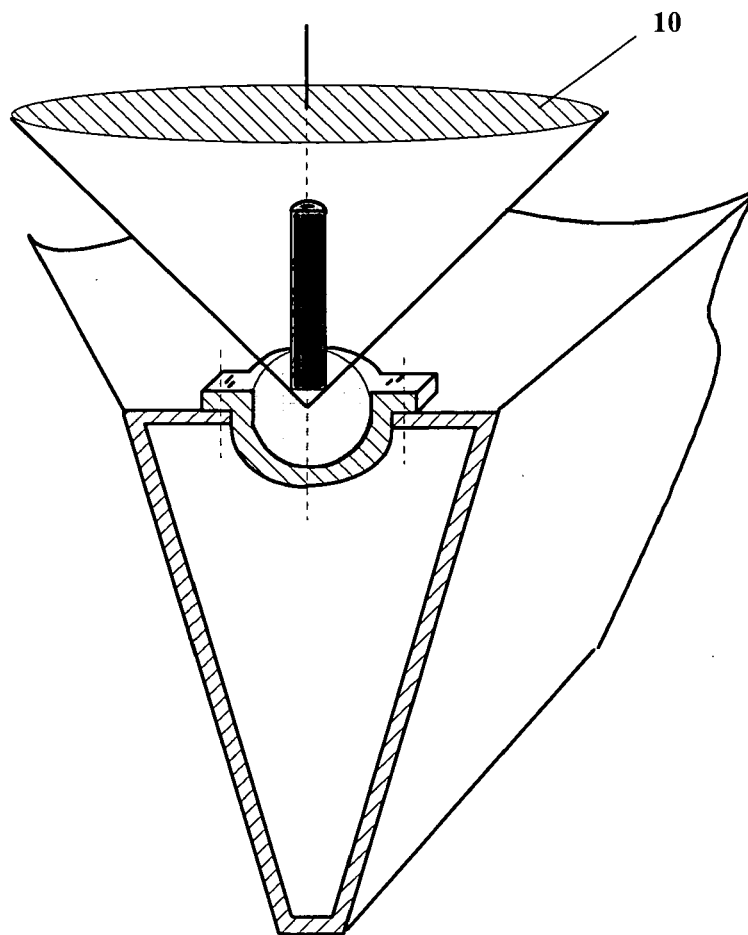


Fig. 11

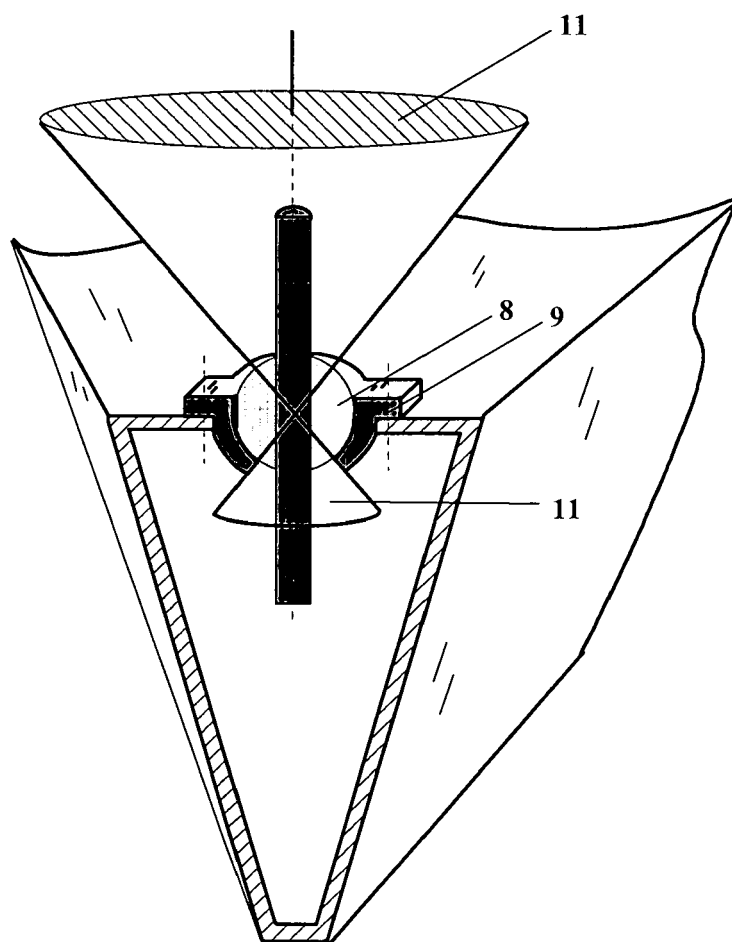


Fig. 12

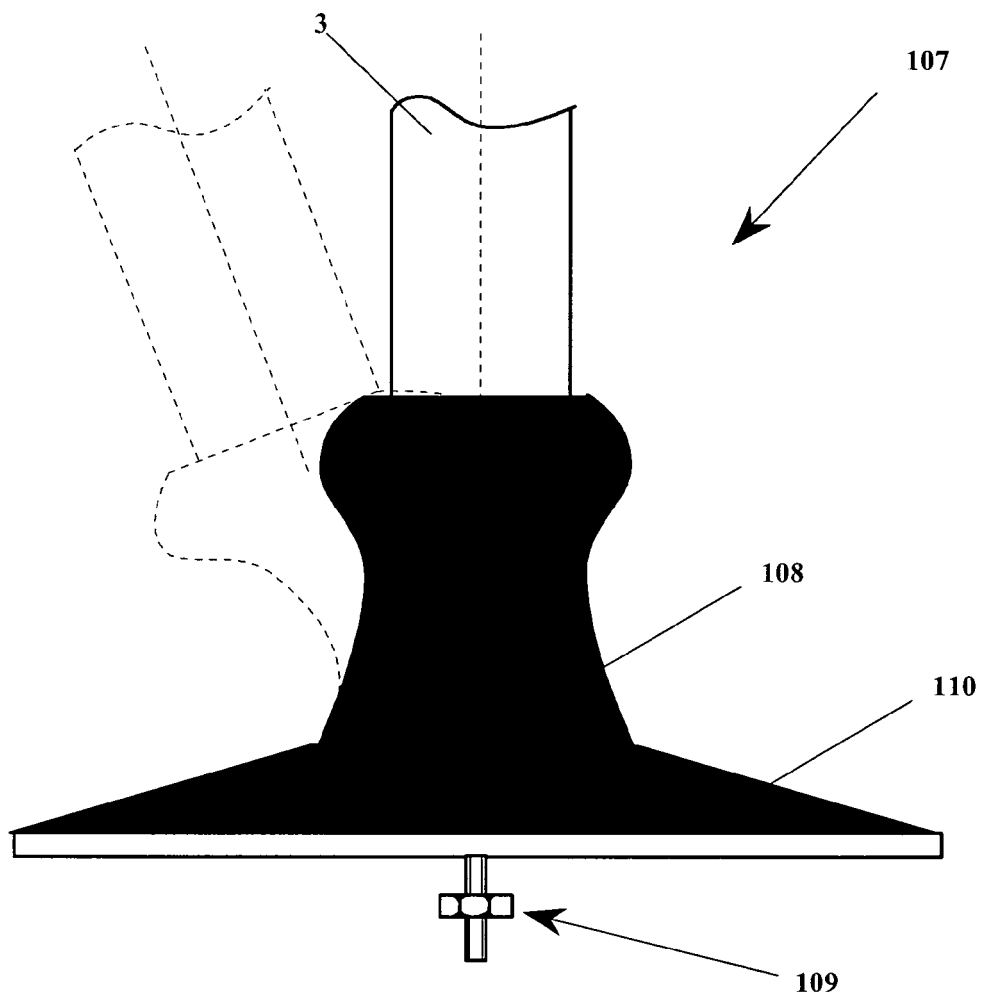


Fig. 13

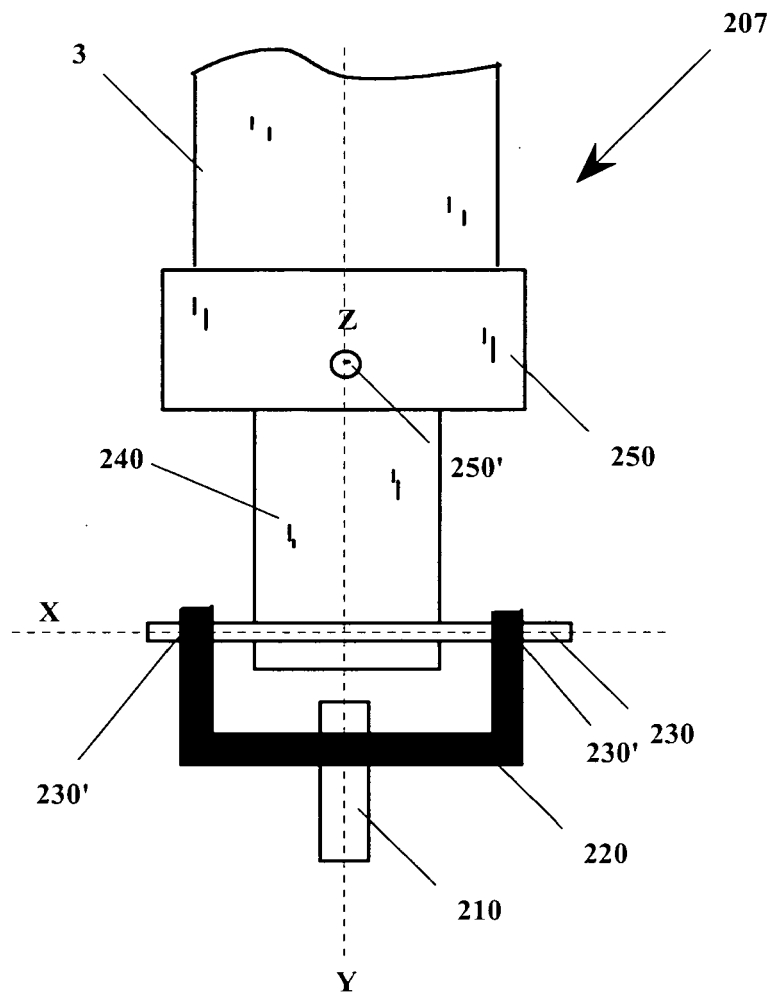


Fig. 14

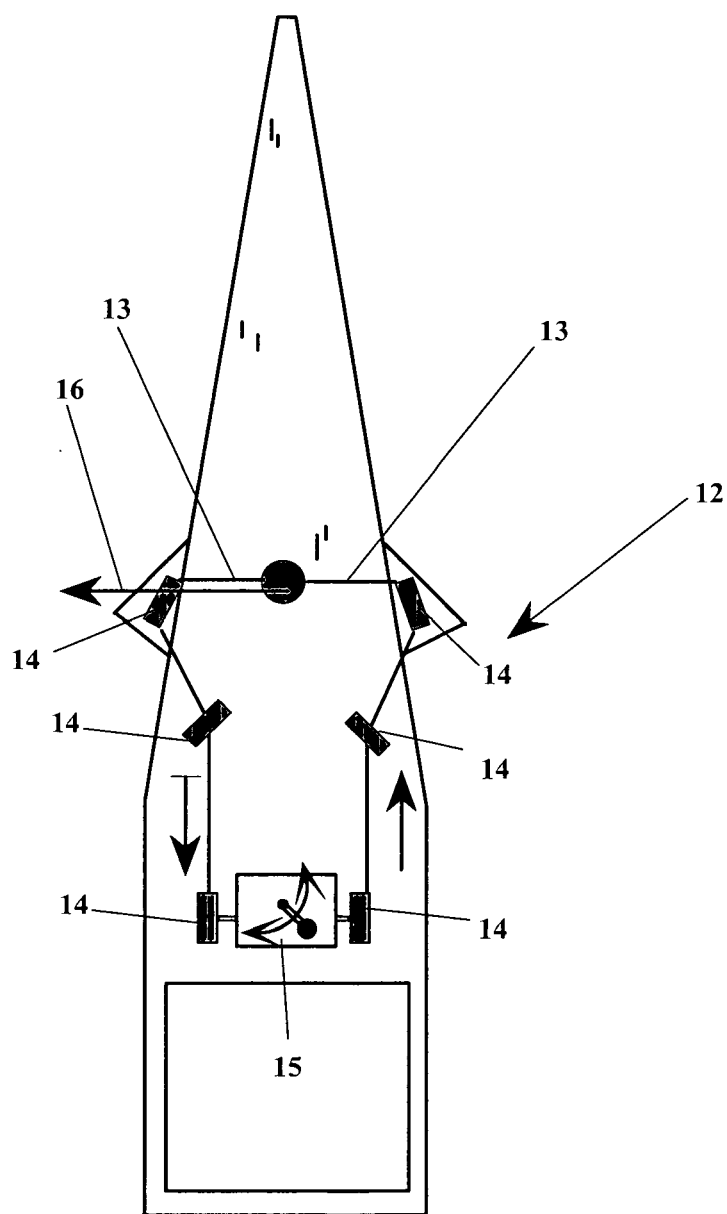


Fig. 15

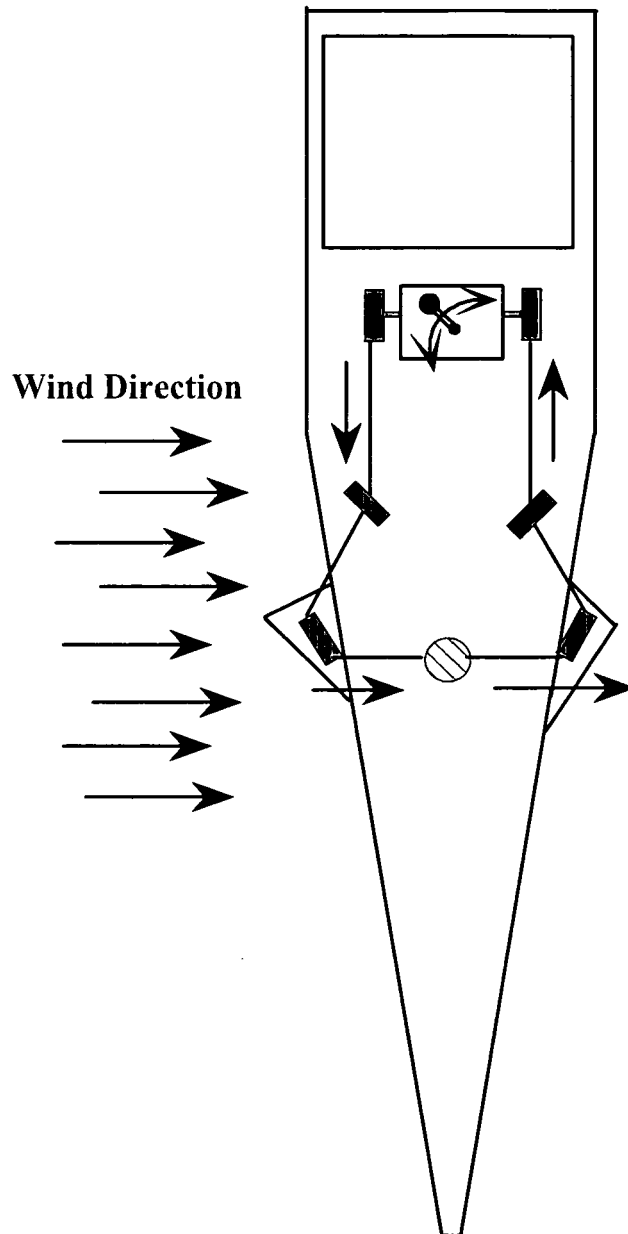
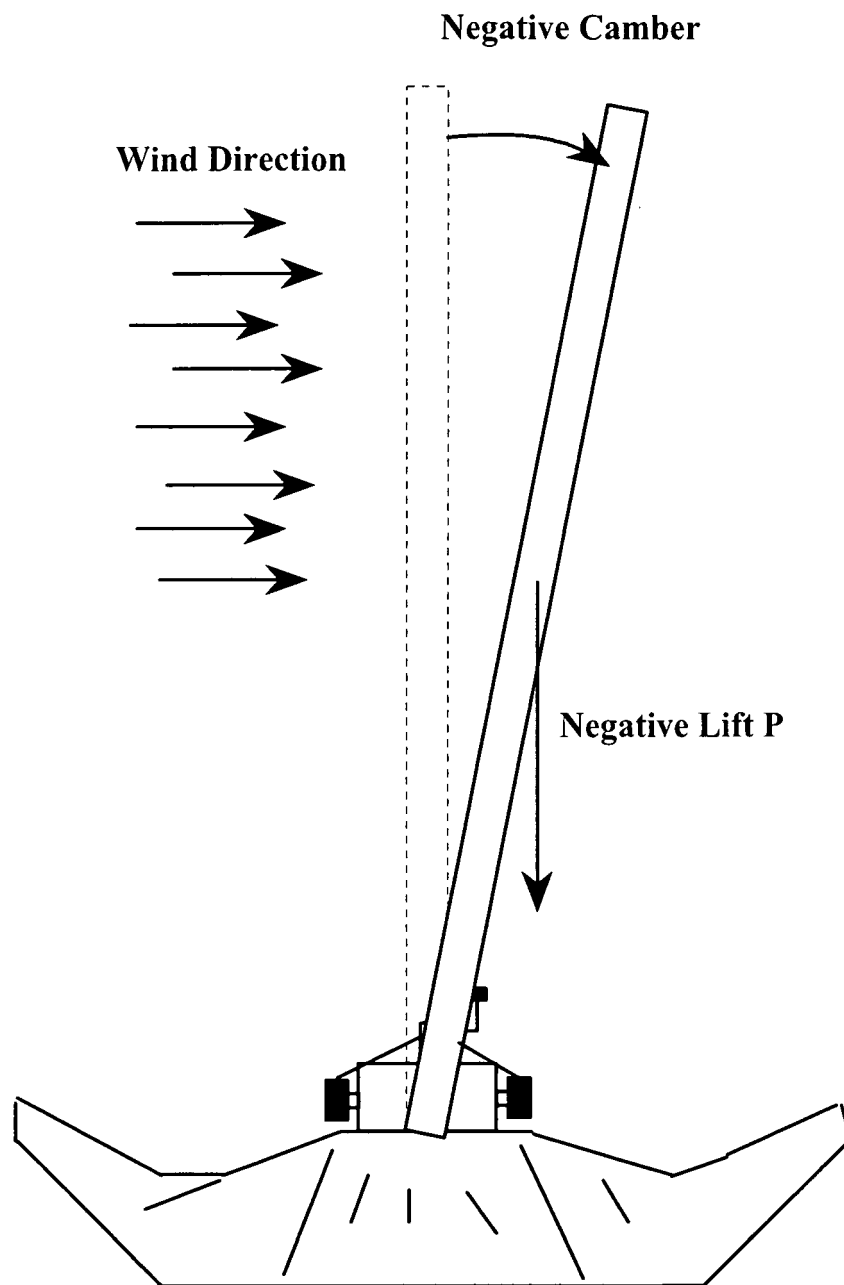


Fig. 16





EUROPEAN SEARCH REPORT

Application Number
EP 10 16 0928

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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