(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 184 225 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
12.05.2010 Bulletin 2010/19

(51) Int Cl.:
B63H 9/06 *(2006.01)*

(21) Application number: **09075174.4**

(22) Date of filing: **14.04.2009**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA RS

(30) Priority: **10.04.2008 US 43949 P**

(71) Applicant: **HART, Walter Willem Hubertus**
1054KX Amsterdam (NL)

(72) Inventor: **HART, Walter Willem Hubertus**
1054KX Amsterdam (NL)

(54) **Sailing vessel with sailing device pivotable and transversely movable with respect to the hull**

(57) The present invention relates to a sailing vessel (20), comprising:
- a hull assembly (21) comprising at least a left planing surface (22) positioned substantially on a left side of the vessel and a right planing surface (24) positioned substantially on a right side of the vessel, the left and right planing surface spaced apart from one another, the left and right planing surface being connected to one another via a frame or an intermediate hull part of the hull assembly;
- a mast assembly (43) connected to the hull assembly (21) and extending upwards from the hull assembly, the mast assembly being located at or near a rear part of the hull assembly; and
- a sail device (34) connected to the mast assembly (43) at an upper connection point located at or near an upper end of the mast assembly, the sail device further being connected to the hull assembly at a lower connection point, the sail device (34) being pivotable relative to the hull assembly (21) about a rotation axis (64) which is defined by the upper and lower connection point, wherein the lower connection point is movable relative to the hull assembly (21) from a position substantially on the left side of the hull assembly to a position substantially on the right side and vice versa such that the inclination of the rotation axis relative to the hull assembly is variable.

The invention also relates to a sail device, a sail, a planing surface, a hull assembly, a sail mast and a jib organ for use in the sailing vessel. The invention further relates to a method of sailing.

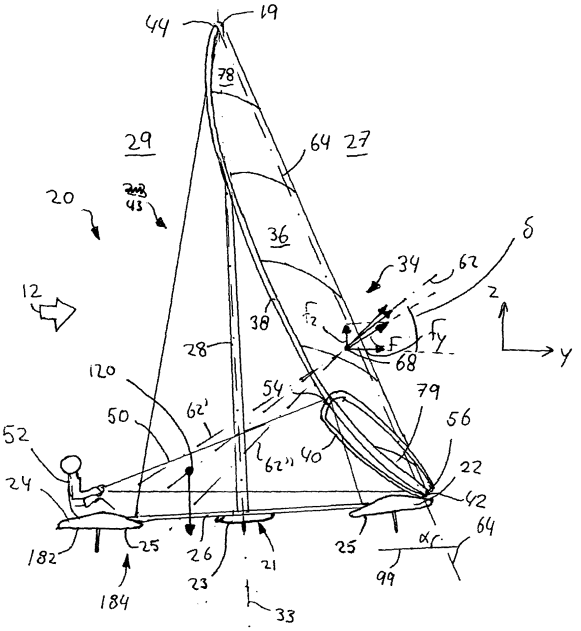


Fig. 4a

EP 2 184 225 A2

Description

[0001] The present invention relates to a sailing vessel. In another aspect, the present invention relates to a method of sailing. In a further aspect, the present invention relates to a sail device, a sail organ, a sail mast, a jib organ, a planing surface and a hull assembly for use in the sailing vessel.

FIELD OF THE INVENTION AND DESCRIPTION OF THE PRIOR ART

[0002] Sailing vessels are known in the field of the art. It is a general objective to construct sailing vessels in such a way that they can attain a high speed. Different types of sailing vessels exist. One known type of sailing vessel is the catamaran. The windsurfboard is another known type of sailing vessel. Both of these types of sailing vessels have disadvantages.

[0003] Known sailboats such as monohulls and catamarans and trimarans have a disadvantage in that in use, the wind force has a downward component, pressing the vessel into the water and thereby increasing the displacement. A further disadvantage of many known sailboats is that a large forward moment is exerted on the vessel by the wind force, pressing the bow of the vessel into the water. Another disadvantage of known vessels is that the wind force exerts a roll moment on the vessel, which roll moment is compensated by forces from the water exerting an upward force on the hull of the vessel on the leeside of the vessel, thereby keeping the vessel upright.

[0004] The downward wind force component, the forward moment and the roll moment slow the vessel down.

[0005] A windsurfboard has different mechanical characteristics. In a windsurfboard, the user supports the sail, and holds it in a position. An upwards vertical wind force is created, which lifts the windsurfer and the windsurfboard from the water. This decreases the buoyancy, and therefore the drag force, enabling the windsurfboard to attain high speeds.

[0006] Also, a windsurfboard has a substantially smaller forward moment due to the wind. The roll moment caused by the wind is compensated by the mass of the user instead of by an upward force from the water on the windsurfboard on the leeside of the vessel. These characteristics further contribute to the high speeds that a windsurfboard can attain. The current speed record exceeds 48,5 knots per hour i.e. exceeds 90 km/h.

[0007] However, the windsurfboard has disadvantages. A first disadvantage is eventual fatigue of the user. A substantial force must continuously be exerted by the body of the user on the sail in order to hold the sail in the required position. This causes fatigue of the user. These forces are dynamic an thus vary considerably in time, which accelerates the fatigue. The user has to stand up, which also causes fatigue.

[0008] A second disadvantage is that the size of a windsurfboard is limited. The windsurfboard is a one-person vessel, with a sail of limited size. Windsurfing is limited to a solo sport, and because of the small size, there is hardly any seaworthiness. Windsurfing is therefore generally limited to near-shore sailing. Longer trips, such as transatlantic voyages are not really possible in windsurfing

Summary of the invention

[0009] It is an object of the invention to provide a sailing vessel which suffers less from at least one of the above mentioned disadvantages.

[0010] It is a further object of the present invention to provide a fast sailing vessel.

[0011] It is a further object of the present invention to provide a fast sailing vessel that can be sailed with more than one person.

[0012] It is another object of the invention to provide a sailing vessel, which is substantially free of a downward vertical wind component during sailing.

[0013] It is another object of the present invention to provide a sailing vessel which has a substantially smaller forward bending moment than known vessels.

[0014] It is another object of the present invention to provide a sailing vessel which has a substantially smaller roll moment than known vessels.

[0015] It is yet another object of the invention to provide a sailing vessel which stays on course well.

[0016] It is a further object of the present invention to provide a sailing vessel which experiences a substantially smaller drag force from the water during sailing in comparison with known comparable sailing vessels.

[0017] It is a further object of the present invention to provide a sailing vessel that combines at least one advantage of a windsurfboard with at least one advantage of a catamaran.

[0018] It is yet a further object of the present invention to provide a sailing vessel that can jump out of the water, and make radical turns and spectacular moves.

[0019] At least one of the mentioned objects is reached in a sailing vessel according to the features of claim 1.

[0020] The sailing vessel according to the invention provides an advantage in that the rotation axis can be positioned in a predetermined orientation relative to the sailing vessel. In operation, the rotation axis can be positioned such that an upward vertical component of the wind force is created, pulling the sailing vessel upward from the water. Advantageously, good planing characteristics are provided, allowing the sailing vessel to plane on the water rather than to plow through the water, thereby decreasing and even minimising drag forces from the water.

[0021] The words "sail device" indicate the sail and the means to keep the sail in the required form.

[0022] The mast assembly is configured to support the sail device, and may have many different forms and generally comprises an A-frame when viewed from a side. Other mast assemblies are also possible. The hull as-

sembly may also have many different forms which are suitable for sailing.

[0023] The rotation axis may extend substantially through the upper end and lower end of the sail device.

[0024] In operation, a roll moment which is created by the lateral component of the wind force may be compensated by a mass which is positioned substantially on a weatherside of the sailing vessel, which mass creates a counter roll moment. This mass comprises the mass of the at least one user and the mass of the vessel itself.

[0025] The word user which is used herein may indicate that one user is present on the sailing vessel. However, it is preferable that the sailing vessel is sailed by more than one user. For instance, one user may operate the sail device while another user operates a rudder. Both users also provide mass in order to counter balance the wind force roll moment. Three or more users may be present as well. The present sailing vessel can be scaled up to substantial sizes.

[0026] In use, the wind roll moment exerted on the sail device may be varied by the user with relative ease by rotating the sail device about its rotation axis. This enables the user to keep the wind roll moment substantially equal to the counter roll moment, thereby keeping the sailing vessel in a dynamic roll equilibrium. Contrary to conventional sailing vessels, substantial water forces exerted on the leeside of the hull assembly for creating a compensating roll moment are not necessary.

[0027] The rotation axis may be positioned such, that an upward wind force component is created, which lifts the sailing vessel from the water.

[0028] The rotation axis may be inclined backwards.

[0029] The sail device thus leans to the weatherside and to the back and is positioned such, that a forward moment exerted by the wind on the sailing vessel is relatively small, increasing the speed of the vessel

[0030] In one aspect of the invention, the sail device has an upper end and a lower end, defining a height of the sail device. The rotation axis extends substantially between the upper and lower end of the sail device. The sail device may be rotatably connected at the upper end to an upper end of the mast assembly. In operation, a wind force axis along which a wind force acts on the sail device may extend approximately through the rotation axis.

Construction of the hull assembly

[0031] In one aspect, the hull assembly comprises a left planing surface and a right planing surface, in particular planing boards, connected to one another by a frame or an intermediate hull section. The intermediate section may be referred to as a frame or horizontal frame, but other embodiments are also conceivable.

[0032] The left and right planing surfaces are separated by a space. The left and right planing boards comprise respective longitudinal axes extending substantially parallel to one another. The sail device is configured such, that the pressure point of the sail device can be positioned substantially above the planing board on the leeside of the sailing vessel, while the user is positioned on the weatherside of the vessel. The mass of the user(s) and the mass of the vessel itself thus provide the counter roll moment to the roll moment created by the wind force.

[0033] The words "pressure point" indicate the position on the sail device where a resultant wind force acts on the sail device. This position may vary in dependence of the wind force, the spread of the wind load over the sail, and/or the angle of approach of the wind relative to the sail device.

[0034] Preferably, the left planing surface and the right planing surface are connected to one another via a frame which extends between the left and right planing surface and which in use is located substantially above the waterline or wherein the left planing surface and the right planing surface form part of an integrated hull of which an intermediate part which connects the left and right planing surface in use is located substantially above the water line. In this way a separating space between the left and right planing surfaces is created.

[0035] Preferably, a third planing surface is provided of which a forward part extends between an aft part of the first and second planing surface. The third planing surface is positioned at the rear side of the hull assembly.

[0036] Preferably, the left and right planing surface each have a substantially flat bottom surface which is substantially horizontal. This enables the sailing vessel to have good planing characteristics. In one aspect of the invention, the left and right planing surfaces have a windsurfboard-like form, i.e. are a planing board. The dimensions (length, width, height, volume) of the planing boards will generally be substantially greater than the dimensions of a regular windsurfboard. In particular, the length may be greater than 3 or 4 m.

[0037] Preferably, the planing boards have connection means or connection points via which the boards can be mounted to the frame or the intermediate hull part. Preferably, each board has at least four connection means or points which are spaced apart in order to allow substantial moments to be exerted by the boards on the frame or intermediate hull part. Two connection points are positioned forward, and two connection points are positioned a the rear of the first and second planning board.

[0038] Preferably, the mast assembly, in particular the upper end thereof is adjustable over some distance in a forward and backward direction relative to the hull assembly. This allows a good tuning of the sailing vessel to existing wind conditions at the time of sailing.

[0039] In one aspect, the sailing vessel comprises a third planing surface positioned at a central longitudinal plane of the sailing vessel, in particular substantially at the rear of the sailing vessel. The vessel may have an inclination to tilt backwards when no wind acts on the sail device. The third planing surface may compensate for this characteristic and avoid backwards capsizing of the

vessel. The third planing surface may have a bottom surface which is located somewhat higher, when viewed from the side, than the bottom surface of the first and second planing surface.

[0040] The rear end of the third planing surface is located further to the rear than the rear end of the first and second planing surface. A rear portion of the planing surface of the third planing surface is also located further to the rear than a rear portion of the planing surface of the first and second planing surface.

[0041] This feature allows the active part of the combined planing surface formed by the three individual planing surfaces of the vessel to move forward, when viewed from a side, when the vessel tilts about the planing surface on the leeside from a horizontal position to a tilted position in such a way that the planing surface on the weatherside and the third planing surface are lifted partially or completely from the water. When viewed from the side in a completely horizontal position, the third planing surface defines the rear end of the vessel. In the tilted position with the third planing surface out of the water, the rear end of the planing surface on the leeside defines the rear end of the vessel, at least the rearmost end which is in contact with the water. Due to the more forward position of the rear end of the leeside planing surface relative to the rear end of the third planing surface, the rear end of the vessel thus shifts forward relative to the sail device when the third planing surface is lifted above the water level.

[0042] The theoretical background of this feature is that a windsurfboard, when moving at an increasing speed, gradually comes out of the water in such a way that the portion of the board which is in contact with the water shifts to the rear of the board with an increasing speed. A sail of windsurfboard (in particular the pressure point thereof) is tilted backwards in use when the speed increases, in order to shift to the rear when the contact part of the board also shifts to the rear. In this way, the windsurfboard stays well balanced and maintains directional stability.

[0043] In the present invention, instead of moving the pressure point to the rear of the vessel, the rear boundary of the part of the hull which is in contact with the water is moved forward relative to the sailing vessel, as explained above with the tilting of the sailing vessel. At the same time, the forward boundary of the part of the planing surface which is in contact with the water moves to the rear.

[0044] In this way, when the speed increases, the portion of the hull which is in contact with the water stay at substantially the same position along the length of the vessel.

[0045] Simply put, instead of shifting the sail to the rear as happens in windsurfboards, the planing surface is shifted forwards. The net effect is substantially the same, i.e. the sailing vessel stays well balanced at increasing speed as windsurfboards also do.

Position and movement of the sail device relative to the hull assembly

[0046] Preferably, at least a part of the sail device, in particular a substantial part of the sail, is movable from the left to the right of the sailing vessel and vice versa. The sail device may thus be positioned alternately on the left and the right side of the sailing vessel.

[0047] The mast assembly projects upward from the hull assembly and is connected to the hull assembly. Preferably, the mast assembly is fixed to the hull assembly, and extends substantially vertically from the hull assembly at a substantially rear position thereof. The sail device, in particular the main longitudinal axis thereof is inclined backwards relative to the hull assembly, because the lower connection point of the sail device is positioned forward of the upper connection point. Further, the substantially rearward position of the mast assembly provides space on the forward side of the mast assembly for moving the sail device from left to right. The mast assembly may be straight, but may also be curved, extending upwards substantially vertically or inclined somewhat to the rear. Alternatively, the mast assembly may be curved at the upper end toward the forward end of the sailing vessel.

[0048] Preferably, the larger part of the sail device is configured to be positioned substantially at a leeside of the sailing vessel in use. In use, the sailing vessel may rotate about the planing surface on the leeside such that the planing surface on the weatherside and the auxiliary planing surface are lifted from the water. The water forces on the sailing will then be exerted on the sailing vessel for the most part on the planing surface situated on the leeside of the sailing vessel. The pressure point of the sail device can be positioned at or near a central vertical longitudinal plane of the planing board which is provided on the leeside of the sailing vessel, thus creating a good steering balance and a favourable position of the pressure point for compensating the roll moment..

[0049] When viewed from above, the pressure point thus is situated substantially above a point at which the drag force of the water acts on the sailing vessel, which improves directional stability of the sailing vessel. A substantial distance between the wind force axis and the drag force axis, when viewed from above, would lead to an eccentric wind force, which would disadvantageously create a steering moment, which would drive the sailing vessel off course. This effect is substantially avoided.

[0050] A second advantage is that because the pressure point can be situated at the leeside of the vessel, the counter mass can be positioned at the weatherside, thereby using the width of the vessel very efficiently. When the sailing vessel tilts (or roll) the planing surface on the leeside functions as a tilting point when viewed from the rear. A maximum lateral distance (or arm) between the planing surface on the leeside and the counter mass is thus created. This creates a large counter roll moment for a given mass, creating a large stability of the

vessel.

[0051] In one aspect of the invention, the part of the sail device which is movable from left to right is movable to a first position on a left side of a central longitudinal plane of the sailing vessel and movable to a second position on a right side of the central longitudinal plane. Advantageously, a substantial part of the rotation axis can be positioned on the leeside of the sailing vessel.

[0052] Preferably the lower connection point is movable along a curved trajectory from the left side of the vessel to the right side and vice versa. Preferably, when viewed from above the curved trajectory has a left end and a right end which form the rear parts of the trajectory and wherein a middle section of the curved trajectory is located more forward than the left and right end.

[0053] This shape of the trajectory allows the sail device to pass the mast assembly on the forward side and be positioned somewhat more to the rear when positioned on the left or right side.

[0054] Preferably, the sailing vessel comprises a rail or similar guiding device which extends substantially from the left side of the vessel to the right side of the vessel and which defines a trajectory along which the lower connection point is moveable, wherein a lower end of the sail device is movably connected via a slider or roller device to said rail or similar device, wherein the slider or roller device is movable from the left side of the vessel to the right side and vice versa.

[0055] This provides a very practical way of supporting the lower connection point while allowing the lower connection point to be moved from left to right and vice versa.

[0056] A diabolo coupling or a cardanian coupling may be provided between the lower end of the sail device and the slider or roller device.

[0057] Preferably, in said first position and said second position, the sail device is rotatable relative to the hull assembly about the rotation axis. This advantageously allows a user to position the sail device in a desired orientation relative to the wind in the first and second position.

[0058] In one aspect of the invention, the mast assembly comprises positioning means configured for positioning at least one part of the sail device in a first area located on the left side of the central longitudinal plane, and configured for positioning the at least one part of the sail device in a second area located on the right side of the central longitudinal plane.

[0059] The words first and second area indicate that in operation, the position of the pressure point may vary, for instance because of changing wind conditions which may necessitate a different orientation of the sail device about the rotation axis, and also because of some deformation of the sail device and/or the mast assembly due to the wind forces exerted on the sail device.

[0060] Preferably, the first area and the second area are located at an area distance from one another, the area distance being a substantial distance relative to a width of the hull assembly. The pressure point is thus movable over a lateral distance which is a substantial distance relative to the width of the sailing vessel.

[0061] This provides the advantage that efficient use is made of the available width of the vessel.

[0062] Preferably, the area distance is at least 40 % of the distance between a central vertical longitudinal plane of the left planing board and a central vertical longitudinal plane of a right planing board. If, in operation, the user is positioned at the central vertical longitudinal plane of the planing board on the weatherside, the pressure point will be at a horizontal distance of at least 70% of the distance between the central vertical longitudinal plane of the left planing board and the central vertical longitudinal plane of the right planing board from the user.

[0063] In one aspect of the invention, the left planing board has a left longitudinal plane, and the right planing board has a right longitudinal plane, and the first area is located nearer to the left longitudinal plane than to the central longitudinal plane of the sailing vessel, and the second area is located nearer to the right longitudinal plane than to the central longitudinal plane of the sailing vessel.

[0064] Fixing means may be provided which are configured for fixing the pressure point in said first and second area. These fixing means may not fix the pressure point in an exact location, but rather in a certain area.

[0065] Preferably, the pressure point of the sail device is movable from the left to the right area. If the pressure point can move from left to right, it can be positioned in a required position substantially above a part of the hull assembly where the drag force of the water acts on the sailing vessel, thereby reducing a possible steering moment.

[0066] Preferably, the sail device is rotatably connected at an upper end thereof to the mast assembly, in particular by a connection means which is connected to the upper end of the mast assembly.

[0067] Advantageously, this allows the sail device to be suspended from the mast assembly, such that the weight of the sail device is carried by the mast assembly. This allows the lower end of the sail device to easily be moved relative to the hull assembly by the user, in order to be moved from the left side of the sailing vessel to the right side and vice versa.

[0068] In one aspect of the invention, the mast assembly is configured for supporting the sail device in an inclined orientation relative to the hull assembly with an upper part of the sail device being located closer to the weatherside of the sailing vessel than a lower part of the sail device.

[0069] Advantageously, the inclined orientation of the sail device allows an upward vertical component of the wind force to be created during sailing, lifting the sailing vessel from the water and reducing the displacement and the drag force.

[0070] The upward wind force component also reduces the forward bending moment, leading to less nose dip behaviour.

[0071] Preferably, the lower end of the sail device is movable substantially from the left side of the hull assembly to the right side of the hull assembly and vice versa.

[0072] Advantageously, by moving the lower end, the pressure point is also moved from left to right, such that the pressure point can be positioned substantially in line with the drag force axis (when viewed from above), in particular above the planing board on the leeside of the sailing vessel. At the lower end of the sail device, a sail mast foot is provided which forms part of the lower connection point. The sail mast foot is connected to a slider or roller device which is movably mounted to the rail or similar guiding device.

[0073] In one aspect of the invention, the rotation axis is rotatable relative to the hull assembly about a pivot point. A rotation relative to the hull assembly about a pivot axis is a simple and effective way of moving at least one point of the rotation axis from left to right. The pivot point is generally located near the upper end of the mast assembly, at a distance above the planing boards.

[0074] Preferably, in the first position the rotation axis intersects the hull assembly at an intersection point located on the left side of the central longitudinal plane, and in the second position the rotation axis intersects the hull assembly at an intersection point located on the right side of the central longitudinal plane.

[0075] In one aspect, the rotation axis is rotatable about a pivot point which is located at a distance above the hull assembly. When the sail device is connected at the upper end thereof to an upper end of the mast assembly at a suspension point, the rotation axis can rotate about the suspension point at the upper end of the mast assembly.

[0076] Preferably, the sail device is supported with the rotation axis oriented in a backwards inclination over an angle (β) relative to the hull assembly. The backwards inclination of the rotation axis causes a backward inclination of the sail in use. When the sail is inclined backwards, an upwards component of the wind force is created, thereby lifting the sailing vessel from the water. Further, the forward roll moment is reduced.

[0077] In one aspect, the rotation axis can be oriented relative to the hull assembly in a left inclination over an angle α relative to the hull assembly and be oriented in a right inclination over an angle α' relative to the hull assembly. This also allows an upward vertical component of the wind force to be created during sailing, thereby reducing water displacement and reducing a forward roll moment.

[0078] Preferably, the sail device is configured to be in a substantial rotational equilibrium about the rotation axis in at least one sailing position. This allows a user to handle and/or rotate the sail device with relative ease, even when a substantial wind force is exerted on the sail device and even when the sail device has a substantial surface area. This may be achieved by constructing the sail device such, that at least a substantial part of the surface area of the sail is located forward of the rotation axis of the sail device, and at least a substantial part of the surface area of the sail device is located aft of the rotation axis of the sail device, when viewed from the side of the sailing vessel. The forward part and the rear part exert similar moments about the rotation axis, leading to the substantial equilibrium.

[0079] The words 'sailing position' indicate a position of the sail device relative to the hull assembly wherein the sail device can drive the sailing vessel forward.

[0080] Preferably, the sail device is configured to allow a wind force axis extending through a pressure point of the sail device to extend approximately through the rotation axis in at least one sailing position. This is effected by suitably choosing the surface areas of the forward part and the rear part of the sail.

[0081] In this configuration, the sail device is substantially in equilibrium about the rotation axis. The wind does not exert a moment on the sail device about the rotation axis, or only a small moment. This advantageously allows the at least one user to rotate the sail device about the rotation axis with relative ease. The user may rotate the sail device in order to catch more wind when the wind decreases. The user may rotate the sail device in order to let wind escape and thus catch less wind when the wind force increases. In this way, the balance of the sailing vessel about the roll axis may be maintained with only a relatively small effort. Thus, the sailing vessel can be kept in a substantial dynamic equilibrium about the roll axis.

[0082] Preferably, the pressure point of the sail device is movable from left to right, in particular along a curved trajectory.

[0083] The wind force acts on the sail at the pressure point along a wind force axis which extends through the pressure point. The wind force axis extends approximately through the rotation axis. The word approximately is used to indicate that the position of the pressure point may vary as described above, Therefore, the wind force axis does not necessarily extend exactly through the rotation axis. However, the wind force axis may extend through an area near the wind force axis, allowing a user of the sailing vessel to rotate the sail device about the rotation axis relatively easily.

[0084] Preferably, in at least one orientation relative to a wind direction, the sail device is in a substantial equilibrium about the rotation axis when a substantial wind force is exerted on the sail device. Again, the user may thus handle the sail device with ease.

[0085] In one aspect, the sail device has an elongate form, and the rotation axis extends substantially in the direction of the elongate form.

[0086] Preferably, the lower end of the sail device or the slider or roller is connected via a first operable line or other connection means to a left side of the hull assembly, and the sail device is connected via a second operable line or the connection means to a right side of the hull assembly. This allows the lower connection point

to be moved by the user from the left side to the right side and vice versa. The first and second operable line or other connection means may be connected to the lower end of the sail device.

[0087] In one embodiment, when viewed from above, the trajectory of movement of a lower part of the sail device from the left to the right and vice versa has a substantially circular shape, with the upper end of the sailing device forming the centre of the circle. The form of the trajectory may not be entirely circular when viewed from above, in particular because of the lower connection point of the sailing device not moving in an exact horizontal plane. For instance it is possible that in a central position of the lower connection point, the lower connection point is located somewhat higher than at the left and right positions.

[0088] In one aspect of the invention, the sail device is configured to move from the left to the right and vice versa forward of the mast assembly.

[0089] In one aspect of the invention, the mast assembly may be oriented to the rear when viewed in the intended direction of movement of the sailing vessel. This allows the suspension point of the sail device to be provided more to the rear relative to the vessel in comparison with a vertically extending mast assembly.

Construction of the sail device

[0090] In one aspect of the invention, the sail device comprises a frame and a sail, wherein the frame provides a substantial rigidity to the sail device. The frame may comprise a sail mast and a jib organ, wherein the jib organ is connected near one end to the sail mast. This configuration of the sail device resembles in part a sail of a windsurfboard (although the sail device may be larger), which has proven in practice to be a simple and effective design for a sail device.

[0091] The sail device may have a surface area larger than 10 m2. A substantial surface area enables at least two persons to be moved along at a relatively high speed, providing the possibility of sailing in a team. For instance, the sail device may have a surface area of 10, 12, 14 , 16, 18, 20, 22, 24, 30, 50, 70 or even 100 m2 or more, and any value in between.

[0092] In one aspect of the invention, the rotation axis extends substantially between a first end and a second opposite end of the sail device. The rotation axis thereby forms the main longitudinal axis of the sail device. This is a natural design of the sail device, allowing easy construction.

[0093] In another aspect of the invention, the sail device comprises a forward ridge which is substantially curved. The forward ridge may extend between the upper end and lower end of the sail device. The forward ridge may be defined by the sail mast. This enables the pressure point to be in such a location that the wind force axis also extends through or approximately through the rotation axis, which extends through an upper and lower end of the sail device. The forward ridge may be inclined substantially backwards over a substantial portion of the sail device. The forward ridge is preferably substantially rigid.

[0094] Preferably, the mast of the sail device is curved and forms the forward ridge of said sail device. Preferably, the curved mast has a nose-like form. This allows the sail to be wider near the bottom than at the top. The sail thus has a somewhat triangular shape with an upper corner, a lower rear corner and a lower forward corner. Preferably, the lower forward corner is substantially curved instead of being a sharp corner.

[0095] Preferably, the curved mast comprises an upper region which is substantially curved, a lower region which is substantially curved and an intermediate region which is substantially straight. In this way, the surface area of the sail is suitably shaped.

[0096] Preferably, when viewed from the side the intermediate section of the curved mast is inclined backwards relative to the hull assembly over an angle. The intermediate section may be slightly curved but is straighter than the upper and lower curved region. When the intermediate section is inclined backwards, this increases the upward component of the wind force.

[0097] Preferably, the sail has a corner located opposite to the curved forward ridge, wherein a lower ridge of the sail extends substantially straight from said corner to a lower end of said curved forward ridge, and wherein an aft ridge of the sail device extends substantially straight from said corner to an upper end of said curved forward ridge.

[0098] The lower ridge is constructed to extend substantially horizontally and to leave open only a small gap underneath the sail, thereby to a large extent preventing the wind to flow under the sail device. In this way, the wind is substantially 'trapped' by the sail in very much the same way as is customary in windsurfing.

[0099] Preferably, the sail device comprises a jib which extends between said corner of the sail and the curved mast and is connected to the curved mast at a location above said lower curved region. The jib may be a wishbone jib.

[0100] It is possible that the sail device is moved from left to right without being rotated.

[0101] In another aspect of the invention, the path along which the lower end of the sail device moves during the movement from left to right, extends at such a distance from the mast assembly that the jib of the sail device can pass the mast assembly and also move from the left to the right and vice versa.

[0102] In one aspect of the invention, in at least one position the sail device is rotatable over an angle of at least 180 degrees about the rotation axis. This allows a sail device to easily alternate between a left and a right position.

[0103] Rotation means may be provided for allowing the user to rotate the sail device about the rotation axis. The rotation means is connected to the sail device and is configured to be held by the user. The rotation means

may be a rope, a string, a cable or a line or other suitable means. Preferably, the rotation means has a predetermined length which allows the user to be positioned at a weatherside of the sailing vessel, while the pressure point location of the sail device is positioned substantially at a leeside of the vessel.

[0104] The rotation means may alternatively comprise a beam, connected at a first end thereof to the sail device, and configured to be held at a second, opposite end thereof by the user.

[0105] In one aspect, the rotation means provides a connection between the user and a substantially forward side of the sail device, and provides a connection between the user and a substantially rear side of the sail device, and is configured to be held by the user at a middle section thereof. In this way, a relatively small force is required for exerting a relatively large rotation moment on the sail device by the user.

[0106] The rotation means may comprise a rotation fixing means configured for fixing the sail device in a predetermined rotation angle about the rotation axis.

[0107] In one aspect of the invention, rotation means are provided on both sides of the sail device. This allows the user to operate the sail device both when it is positioned on the left side and when it is positioned on the right side of the sailing vessel.

[0108] In another aspect of the invention, the sail device has a substantial rigidity. The surface of the sail may adopt a first curved form in the first sailing mode and a second curved form in the second sailing mode, the first and second curved form being substantially opposite to one another. At least a part of the sail device has a substantially fixed form, determined by the sail mast and the jib organ.

[0109] The sail may have such a form that the pressure point is located below half of the height of the sail, i.e. in the lower half of the sail. The sail thus has a larger average width in the lower half as in the upper half of the sail. This form advantageously provides a low pressure point and thus a low forward moment.

[0110] The sail may be connected to the sail mast along one rim thereof, in particular a forward rim, and being connected to a second, opposite end of the jib organ.

[0111] The part of the sail extending between the upper end and the rearward end of the jib may be substantially straight.

[0112] In one aspect of the invention, the sail device comprises a trim organ comprising a trim surface area for catching wind, the trim surface area being positioned eccentrically from the rotation axis. The trim surface area is controllably variable by the user. The trim organ provides the advantage of allowing a user to vary the position of the wind force axis relative to a position of the rotation axis. A state of rotational equilibrium about the rotation axis may thus be easily obtained by varying the trim surface area.

[0113] Preferably, the position of the slider or roller device and the coupling between the slider or roller device and the sail mast is adjustable relative to the sail mast, for allowing the rotation axis to be adjusted relative to the sail device.

[0114] In one aspect a sail device is provided for use in the sailing vessel according to any of claims 1-32.

[0115] In one aspect, the sail device comprises:

- a sail;
- a frame for providing a substantial rigidity to the sail device

wherein the sail device is pivotably connectable about a rotation axis to a sailing vessel at a lower end and an upper end of the sail device, the sail comprising a forward part for in use urging the sail device in one rotation direction about the rotation axis and a rear part for in use urging the sail device in the opposite rotation direction.

[0116] Preferably, the sail has a forward part and a rear part and the forward part and the rear part have surface areas which are chosen such that in use a wind force axis along which a resulting wind force (F) acts on the combined surface area of the forward part and the rear part of the sail extends approximately through the rotation axis.

[0117] In another aspect, the invention relates to a hull assembly, a planing surface, a sail, a jib organ and/or a sail mast for use in the sailing vessel.

[0118] In another aspect, the present invention relates to a method of sailing, comprising:

- providing a sailing vessel according to any of claims 1-32,
- positioning the sail device such that the lower connection point is located on the leeside of the vessel, the sail device being oriented such that an upper part of the sail is located more to the weather side of the vessel than a lower part of the sail,
- rotating the sail device around the rotation axis in order to keep the sailing vessel in a substantial rotational equilibrium around a roll rotation axis extending approximately parallel to a central longitudinal plane.

[0119] The roll axis extends approximately parallel to a central longitudinal plane of the sailing vessel.

[0120] The invention is further explained in the accompanying, non-limiting drawing, wherein like reference numerals denote like parts, and wherein double arrows indicate directions of movement.

BRIEF DESCRIPTION OF THE DRAWINGS

[0121]

Figure 1 shows a diagrammatic axonometric view of a catamaran according to the prior art;
Figure 2 shows a diagrammatic axonometric view of

a wind surf board according to the prior art;
Figure 3 shows a diagrammatic top view of a sailing vessel according to the invention;
Figures 4a and 4b show a diagrammatic front view of a sailing vessel according to the invention;
Figures 5a and 5b show a diagrammatic side view of a sailing vessel according to the invention;
Figure 5c1 and 5c2 show side views comparing a windsurfboard with the present invention;
Figure 6a shows a view from above comparing a windsurfboard with the vessel of the invention;
Figure 6b shows a diagrammatic axonometric view of a hull assembly according to the invention;
Figure 6b shows a forward view of the vessel of the invention in use;
Figure 7 shows a diagrammatic side view of a sail device according to the invention;
Figures 8A, 8B, 8C and 8D show a diagrammatic top view of a sailing vessel according to the invention during a rotation relative to the wind;
Figures 9A, 9B and 9c show a schematic view of the sailing vessel when the sailing device is moved from right to left;
Figure 10 shows a diagrammatic front view of a hull assembly according to the invention;
Figure 11 shows details of a force acting on the sail device according to the invention;
Figure 12 shows a detailed side view of an upper end of a sail device according to the invention;
Figure 13 shows a front view of an embodiment of a hull assembly according to the invention;
Figure 14a shows a top view of a detail of a connection between the sail device and the hull assembly;
Figure 14b shows a cross-sectional view along the line A-A in figure 14a;
Figure 15 shows a side view of another embodiment of a sail device according to the invention
Figure 16A shows a partial rear view of a windsurfboard of the prior art
Figure 16A shows a partial rear view of a sailing vessel according to the invention.

[0122] Generally, sailing vessels are driven by the wind. In use, the wind exerts a force on the sail of the sailing vessel. The wind load is spread over the sail, and can be simplified as a single wind force acting on a virtual pressure point of the sail. The pressure point is located at a certain distance above the water level. The wind force can be decomposed in three components which are orthogonally oriented relative to one another. A longitudinal component is directed along a main longitudinal axis of the sailing vessel. A lateral component is directed perpendicular to the main longitudinal axis, in a horizontal direction. A vertical component is directed in a vertical direction.

[0123] The longitudinal component of the wind force is the cause of the forward speed of the sailing vessel. The movement of the vessel relative to the water creates a drag force exerted by the water on the sailing vessel.

[0124] The lateral component of the wind force exerts a roll moment on a hull of the sailing vessel. In a conventional sailing vessel, the roll moment causes the hull to roll over a certain roll angle about a longitudinal roll axis of the hull, such that the upper end of the sailing vessel rotates away from the direction from which the wind blows.

[0125] For a regular sailing vessel, this rotation causes a centre of buoyancy of the hull of the conventional sailing vessel to shift horizontally to a leeside of the sailing vessel. An upward buoyancy force acts on the centre of buoyancy and due to the shift, a counter roll moment is exerted on the hull, which increases with an increase in the roll angle of the hull. Conversely, the force which the wind exerts on the sail decreases with an increasing roll angle when the vessel rolls away from the wind. At a certain roll angle, the counter roll moment of the buoyancy force equals the roll moment of the wind force. The sailing vessel will sail in this roll angle in a dynamic equilibrium. When the wind force decreases, the vessel will turn more upright over a certain angle of rotation about the roll axis. When the wind force increases, the angle of inclination of the sailing vessel about the roll axis will increase.

[0126] The rolling movement of the hull has a disadvantage in that when the hull is rotated due to a roll moment of the wind, the mast and the sail are also rotated and oriented at a roll angle relative to a vertical axis, in which rotated orientation the wind force generally has a vertical component which is directed downwards, pushing the sailing vessel further into the water. This downward vertical component of the wind force increases the water displacement of the sailing vessel, and consequently increases the drag force, thereby slowing the sailing vessel down.

[0127] This is a known disadvantage of most monohulls, catamarans and trimarans. In operation, the wind causes the catamaran to roll and causes one hull section (the hull section on the weather side of the catamaran) to rise from the water. Due to the rolling, a downward vertical component of the wind force is created which pushes the catamaran into the water, in the same way as in a conventional sailboat.

[0128] Also, because the wind acts on the sail of the catamaran at a certain altitude above the hull and the water level, a forward roll moment is created by the longitudinal component of the wind force, pushing the forward end of the vessel into the water. This phenomenon of 'nose dip' also leads to more drag forces from the water and to a lower speed of the vessel.

[0129] With reference to Fig.1, a catamaran 1 according to the prior art is shown. It is shown that in operation, the catamaran 1 rotates about a longitudinal axis 4 due to a wind force F exerted on a sail 8 of the catamaran 1. This movement is known as rolling. A flotation body 2 on the weatherside is lifted from the water 9 , whereas the leeside flotation body 3 is pushed into the water 9. The wind force F may be decomposed in three components:

a longitudinal component Fx, a lateral component Fy and a vertical component Fz. The roll angle φ creates a downward wind component Fz on the sail 8, which pushes the catamaran 1 into the water. This downward wind force Fz slows the catamaran down.

[0130] The roll moment created by the wind force is in part compensated by an increased upward force by the water on the leeside floater. This increased upward force slows the catamaran down.

[0131] Further, the vertical distance between the pressure point P and the centre of mass of the catamaran creates a forward moment, which leads to 'nose dip' behaviour. This characteristic also slows the catamaran down.

[0132] Generally, in conventional sailboats such as a catamaran the resulting wind force on the vessel is eccentric to the center of gravity of the vessel. In other words, the wind force axis extends at a substantial distance from the centre of gravity of the vessel. This causes moments on the vessel which often act about the x-axis, the y-axis and the z-axis.. in order to prevent the vessel from rotating about any of these axes, the water has to exert a counter moment on the vessel. Often, a counter moment is required about the x-axis, about the y-axis and about the z-axis. The counter moments slow the vessel down.

[0133] Turning to Fig. 2, a windsurfing assembly 5 according to the prior art is shown. A user 6 who stands on the board 10 keeps a sail assembly 7 of the windsurf assembly 5 in position. The sail assembly 7 may be positioned such, that an upward wind force Fz is exerted on the sail 7, lifting the user 6 and/or windsurf assembly 5 from the water 9. The user 6 forms a structural part of the windsurfboard 5. Substantial forces are exerted on the arms and legs of the user 6, causing fatigue of the user 6. Also, the sail assembly 7 can generally only be handled by a single user 6. Windsurfing is a solo sport and generally cannot be sailed by a team of persons in the way sailboats such as catamarans can.

[0134] With reference to Figs. 3 through 7, a sailing vessel 20 according to the invention is shown. A hull assembly 21 comprises a left planing board 22 and a right planing board 24 connected to one another by an intermediate section 26. A third planing board 23 is provided at the rear of the hull assembly at the centre between the left and right planing board. It will be observed that in figure 3, the sailing vessel 20 is shown with the forward side pointing down.

[0135] The left and right planing boards 22, 24 comprise a substantially flat bottom side 182, which is configured for receiving an upward force from the water 9 during sailing. The bottom surface forms a planing surface 25 which allows the sailing vessel 20 to plane. In use, the hydrodynamic water force exerts an upward force an the planing surface. A space is defined between the planing boards 22, 24.

[0136] A function of the third planing board is to prevent the vessel from toppling backwards. A further function is to provide a forward shift of the planing surface when the vessel tilts about the leeside planing board, which is explained further below. The hull assembly 21 has a length 89 and a width 91.

[0137] Each planing board 22, 24 may comprise at least one respective dagger board 58 and/or at least one fin organ 60. The vessel comprises one or more rudders 63. The dagger board 58 prevents the sailing vessel from drifting too much in the lateral direction when a wind force F is exerted upon the sailing vessel 20. The fin organ 60 increases directional stability, and the rudder organ 63 allows a user 53 to control and change the course of the sailing vessel 20. The dagger board 58 may have a controllable, variable position in the longitudinal direction of the sailing vessel 20. Use can be made of experience and knowledge in windsurfboards. The dagger board 58 may also have a variable orientation relative to the respective planing boards 22;24, in the sense that it may be rotated about a horizontal axis (not shown) extending laterally. Alternatively, the dagger board 58 may not be present, in which case only a fin organ 60 is provided. This is also the case in many windsurfboards.

[0138] The hull assembly 21 is substantially symmetrical about a central longitudinal plane 33, dividing the hull assembly 21 in a left side 27 and a right side 29.

[0139] The left and right planing boards (or planing boards) 22, 24 have respective forward ends 166, 168 which point upward slightly. The planing boards 22,24 have a 'rocker' shape, known in the art of windsurfboards.

[0140] The intermediate section may be a frame, for instance composed of pipe sections. Other types of frames are also possible. The planing boards may be integrated with the frame. Aluminium or carbon are suitable materials for the frame. Preferably, the position and the orientation of the planing boards relative to the frame are adjustable in three directions and about three axes.

[0141] Sitting means may be provided for allowing the users 52 to sit on.

[0142] A mast assembly 43 is connected to the hull assembly 21, the mast assembly 43 comprising a mast assembly 28 which extends upward from the hull assembly 21 at the intermediate section 26 and which is supported by support lines 30, 31 so that the position of the mast assembly 28 is substantially fixed relative to the hull assembly 21. The mast assembly 28 is positioned somewhat to the aft side of the sailing vessel 20. The mast assembly 28 may have some lateral flexibility, allowing it to bend to the left and to the right when a lateral load is exerted on it. The mast assembly may be inclined backwards aver a small angle.

[0143] A rudder 63 is provided at the rear end of the third planing board 23. The rudder 63 may also be provided aft of the first and second planing board. Alternatively, three rudders may be provided.

[0144] A sail device 34 is connected at its upper end 44 to an upper end 19 of the mast assembly 28 at a suspension point 17. The sail device 34 is connected at its lower end 42 to the hull assembly 21.

[0145] The sail device 34 comprises a sail 36, a sail mast 38, and a jib organ 40. The sail device 34 has a rotation axis 64, which extends through the lower end 42 and the upper end 44. The rotation axis 64 is oriented in a sideways inclination over an angle α relative to a horizontal plane 99.

[0146] The sail device 34 comprises a mast foot coupling 141 provided at the lower end 42 of the sail device 34. The mast foot coupling 141 can be coupled to a left and right socket device 144, 145 provided at respective left and right mast foot positions 142, 143 on the left and right planing boards.

[0147] A rail 65 is provided along which the mast foot coupling 141 can move from left to right. The rail extends from the left side to the right side and has ends 181. The rail 65 defines a part of a circle.

[0148] The sail device 34 also comprises rotation means 50 in the form of a line, which is configured to be held by a first user 52. The sail device 34 is configured to be rotated relative to the hull assembly by the first user 52.

[0149] As can best be seen in Figs. 5a and 5b , the rotation axis 64 is inclined backwards relative to the hull assembly 21 over an angle β to a horizontal plane 99.

[0150] The sail device 34 comprises a forward point 54 and an aft point 56. The forward point 54 is located on a forward ridge, which is defined by a curved sail mast 38. The forward and aft points 54, 56 may be defined by the forward and aft end of the jib organ 40, but need not be. It is also possible that the sail mast 38 extends to a point which is located further forward than the most forward point of the jib organ 40.

[0151] The rotation means 50 is connected to the forward and aft point 54, 58 of the sail device 34 and extends from there to the user on the weather side.

[0152] Additionally, one or more elastic lines 250 may be provided for at least to some degree providing stability of the sail device 34. The elastic lines are also connected to the forward and aft points 54, 58 but extend from there to a suitable fixation point 251 on the vessel, see Fig. 3, which may be movable from left to right.

[0153] The sail device 34 has a sail mast 38 at the forward ridge thereof, which sail mast 38 is heavier than the rear part of the sail device. The sail device 34 will thus be inclined by the weight of the sail mast 38 to rotate. The elastic line 250 may compensate this bias and keep the sailing device 34 in a predetermined preferred position.

[0154] As can be seen best in Fig. 4b, the sail device 34 can be moved from a left position 162 to a right position 164 and back. The pressure point 68 is located in a left position 150 in a left area 200 or in a right position 152 in a right area 202.

[0155] In operation, due to the movement of the sail device 34 relative to the hull assembly 21, and due to the flexibility of the different parts of the sailing vessel 20, and due to the variability of the wind loads in time and space, the location of the pressure point 68 may vary in time relative to the sail 36.

[0156] The left area 200 and the right area 202 are located at a distance 204 from one another, which distance may be substantial. A virtual horizontal plane 99 extends through the hull assembly 21. The rotation axis 64 can adopt a left position 77 and a right position 77'. In the left position 77, the rotation axis 64 intersects the virtual horizontal plane 99 on the left side of the central longitudinal plane 33. In the right position 77', the rotation axis 64 intersects the horizontal virtual plane on the right side 29 of the central longitudinal plane.

[0157] The sail device 34 is rotatable about its rotation axis 64 relative to the hull assembly 21. Further, the inclination of the rotation axis 64 itself is variable. The rotation axis is pivotable about pivot axis 160 relative to the hull assembly 21. The pivot axis 160 extends substantially horizontally through the upper end of the mast 38. Therefore, the sail device 34 itself is also pivotable about pivot axis 160. It is also possible that the sail device 34 is pivotable about the upper suspension point 17 about a first pivot axis 160 and a second pivot axis 161. The second pivot axis 161 extends in a direction perpendicular to the first pivot axis 160. In this way, the sail device 34 can be rotated about pivot axis 161, wherein the lower end 42 of the sail device is moved away from the mast assembly 28.

[0158] A lower part 79 of the sail 38 can be positioned more to the leeside of the sailing vessel 20 than an upper part 78 of the sail device 34.

[0159] In certain aspects, the sail device 34 resembles a known sail of a windsurfboard. For instance, the basic setup of the sail mast 38, the jib organ 40 and the sail 36 is quite similar to a sail of a windsurfboard. In other aspects, the sail device 34 is also different from a sail of a windsurfboard.

[0160] One difference is that the sail mast 38 has a stronger curvature than the mast of a sail assembly of a windsurfboard. The function of the stronger curvature will be explained further hereinafter. Another difference is that the sail device 34 according to the invention will generally be larger than a sail of a windsurfboard, in general larger than 14 m2. Areas of 14,18, 20,25,30, 40, 50, 100, 150, 200 m2 or larger are conceivable

[0161] In use, the wind blows from a wind direction 12. A wind force F is exerted on the sail 36, pushing the sailing vessel 20 in a forward direction 7.

[0162] The sail device 34 is positioned substantially on the leeside of the sailing vessel 20, such that the pressure point 68 is substantially on the leeside, preferably above the planing board located on the leeside.

[0163] In use, the sailing vessel 20 is sailed by one or more persons 52, 53. The sail device 34 is rotated about the rotation axis 64. When the wind increases and the wind force F becomes too strong, causing a risk of capsizing of the sailing vessel 20, the user 52 rotates the sail device 34 such that it catches less wind, and consequently the wind force F on the sail is reduced. Conversely, when the wind decreases, the user 52 may rotate the sail

device 34 in order to catch more wind, thereby increasing the wind force F on the sail.

[0164] In use, the sailing vessel may rotate about the planing board on the leeside, causing the planing board on the weather side and the central planing board to rise from the water, so that only the planing board on the leeside is in contact with the water.

[0165] Figure 4a shows a lateral view, or a view in the y-z-plane. A centre of gravity 120 of the sailing vessel including the users is shown in Fig. 4a. The wind force F may extend along an axis 62 which extends through the centre of gravity 120, or close to the center of gravity. The wind force F has a vertical component Fz and a lateral component Fy and extends at an angle δ to the horizontal, when viewed in the y-z plane.

[0166] The wind force thus F only exerts a limited moment on the vessel, in contrast with many known sailing vessels.

[0167] In this way, the sailing vessel will only start to rotate about the planing board on the leeside if a substantial portion of the mass of the sailing vessel is carried by the sailing device, i.e. if the upward vertical component of the wind force F is substantial compared to the force of gravity on the sailing vessel.

[0168] If the wind force axis 62 'extends above the centre of gravity 120, the sailing vessel will have the tendency to rotate about the planing board 22 on the leeside. If the wind force axis 62" extends below the centre of gravity, the sailing vessel will have the tendency to rotate about the planing board 24 on the wind side.

[0169] The sail device 34 may also be rotated in dependence of a varying wind direction 12. When the sailing vessel 20 moves in a direction with the wind relatively head-on, the sail device 34 will have a different orientation than when the wind is directed more from the aft.

[0170] The users can vary their position on the vessel in dependence of the wind force and wind direction. Most likely, the users will position their bodies such that the vessel is in equilibrium with regard to the average wind force. Variations in the wind force can then be compensated by rotating the sail device 34.

[0171] Figure 5b shows a side view (in the x-z plane) of the sailing vessel with the wind force axis 62 shown to extend at a distance 77 from the centre of gravity 120. The wind force has an x-component and a z-component and extends at an angle ε to the horizontal, when viewed in the x-z plane.

[0172] Because the wind force has an upward component, and because the centre of gravity 120 is positioned relatively to the rear, the distance 77 is relatively small in comparison with for instance a catamaran, resulting in a small forward bending moment My on the vessel. Therefore, the water only needs to exert only a relatively small counter moment My on the vessel in order to compensate for the forward bending moment. This counter moment is created by an upward force 81 exerted on a forward portion of the planing surface. The upward water force 81 and the drag force are combined into a schematically indicated water force 194 extending along axis 195.

[0173] Axis 195 may extend at a distance from the center of gravity 120 at a forward side thereof. Thus, the water force 194 exerts a counter moment on the vessel which compensates the forward moment of the wind force. Because the distance between the wind force axis 62 and the center of gravity 120 is small, the nose dip effect is also small and the required counter moment of the water is also small. This leads to a high maximum speed. It is possible that the wind force axis extends through the center of gravity 120, resulting in no forward bending moment. In the same way the water force axis 195 may extend through the centre of gravity 120. Such a configuration completely takes away the nose dip effect.

[0174] Because the roll moment may be completely compensated by a counter moment created by the weight of the vessel and users, this would result in a sailing vessel which in use exerts no moments on the water at all. It is possible that the entire weight of the vessel and the users is carried by the upward component of the wind force.

[0175] The wind force on the vessel thus only results in a drag force and a lateral force of the water on the vessel.

[0176] Figures 5c1 and 5c2 show the effect of the lifting of the central planing board 23 from the water compared to the working of a windsurfboard. In a windsurfboard 5, at low speed a large part of the windsurfboard 400 contacts the water, defining a contact length 402. At high speed, only the rear portion 404 of the windsurfboard 400 contacts the water. The part of the windsurfboard that contacts the water thus in effect shifts to the rear, or at least the forward edge 406 of the water contact area 402 shifts to the rear. A schematised water force 194 would shift to the rear (194') when the speed increases. The user compensates this effect by pivoting the sail 7 backwards, thereby moving the pressure point 68 of the sail device backwards relative to the board. If the user would not pivot the sail 7 backward, the sail 7 would be positioned too far forward relative to the area of contact 404, resulting in a steering moment (when viewed in the x-y plane, i.e. from above) which would urge the windsurfboard 5 to turn away from the wind. In order to stay on course, the sail thus is pivoted to the back of the windsurfboard. An auxiliary effect is that the upward wind force on the sail increases due to the changed orientation of the sail.

[0177] As shown in Fig. 5c2, the present vessel 20 does not have this degree of freedom of the sail, because the upper end of the sail device is fixed to the upper end of the mast assembly 28. A different solution is applied.

[0178] When the vessel sails at low speed, all three planing boards 22, 23,24 are in contact with the water. when viewed from a side, the leeside planing board (22 or 24) and the central planing board 23 contribute to the part 408 of the vessel which is in contact with the water.

[0179] When the wind force increases, i.e. when the vessel sails at high speed, the part 410 of the planing board on the leeside that is in contact with the water shifts to the rear in the same way as in a windsurfboard. Due to the rolling of the vessel 20 about the longitudinal axis of the planing board on the leeside, the central planing board 23 is lifted from the water. This orientation is also shown in Fig. 6c. This rolling causes the rear of the vessel to 'shift' forward. Thus, the rear edge 412 which is in contact with the water shifts forward. The combined effect is that the portion of the hull which is contact with the water decreases in size relative to portion 408, but does not move substantially to the rear. This forward shift of the rear part of the contact area allows the vessel to do without the backward pivoting of the sail device at higher speeds. In effect, the schematised water force 194' stays substantially in the same place as the schematised water force 194, as is indicated in figure 5c2.

[0180] Thus, in a windsurfboard the pressure point 68 shifts to the rear at increasing speed together with the water force axis 195, whereas in the present invention the water force axis 195 stays more or less in the same place, and obviates a necessity of the pressure point 68 to shift to the rear at higher speeds.

[0181] It is further noted that this effect already takes place when the central planing board and the weatherside planing board are still partly in the water. Due to the increased wind force, the weatherside planing board and the central planing board exert a smaller downward force on the water and thus have a decreased 'footprint', although still in contact with the water.

[0182] Figure 6a shows a view from above comparing a windsurfboard and the present vessel. For the windsurfboard, the sail assembly 7 is shown in two positions, 7a and 7b. In a low-speed position 7a, the pressure point 68 is located more to the front of the board 10. In the high-speed position 7b, the sail assembly 7 is rotated to the rear of the board 10 and the pressure point 68 is located more to the rear of the windsurfboard 10.

[0183] In hatched lines, the part of the windsurfboard 10 that in use is in contact with the water is also shown. This part is called the footprint or planing area. At low speed, a large part of the windsurfboard is in contact with the water, resulting in a large footprint. This part is the total area of hatched area 333a and 333b. At high speed the forward part 333a of the windsurfboard rises from the water, resulting in only the rear part 333b being in contact with the water. This shift necessitates a corresponding shift of the pressure point 68 to the rear, reason why windsurfers rotate the sail to the rear at increasing speed. If the sail would not shift to the rear, the pressure point 68 would be too much forward relative to contact area 333b, resulting in a steering moment Mz which would steer the windsurfboard away from the wind 12.

[0184] The vessel according to the invention is also shown. The horizontal frame is not shown, for clarity purpose. The varying footprint (or planing area of contact area) is shown. Area 333a combined with area 333b shows the contact area at low speed. At low speed, all three planing boards 22, 23 and 24 are in contact with the water. At high speed, the weatherside planing board 22 and the central planing board 23 may rise from the water. Additionally, the contact area of the leeside planing board decreases, leaving only area 333b in contact with the water.

[0185] In use, the users have several means of controlling the vessel.

1. The user may vary the orientation of the rudder 63, thereby directly controlling the course of the vessel.
2. The user may vary the roll angle φ of the vessel, thereby partially or wholly lifting the weatherside planing board 22 and the central planing board 23 from the water.
3. The user may vary the position of the mast foot 141 on the guide rail 65, thereby shifting the pressure point 58 to the weatherside or to the leeside of the vessel. Also, in this way, the orientation of the rotation axis 64 relative to the vessel is changed.
4. The user may vary the orientation of the sail device 34 about the rotation axis 64. This leads to less or more wind being captured by the sail device 34.
5. The users may change their own position on the vessel, thereby shifting the location of the centre of gravity 120 of the vessel as a whole. For instance, at increased wind the users may move laterally toward the weatherside of the vessel, increasing the counter roll moment of their body weight. The users may also move to the front or the rear of the vessel, thereby shifting the centre of gravity forward or backward. The users may also stand up or sit down, thereby shifting the centre of gravity of the entire vessel upward or downward.

[0186] The shift of the contact area 333a and 333b to 333b may be compensated by the mentioned control options to a certain degree.

[0187] It will be clear to a person skilled in the art that, although only two footprints are shown, the shift in footprint is actually a gradual shift, with many in between situations. It is also clear that the footprint is also determined by the form and size of the dagger board or fin under the board.

[0188] In addition to controls which are available during sailing, many settings of the vessel may be adjustable. These settings include, position and orientation of the planing boards 22,23,24 in the x, y and z direction and about the x-axis, and y-axis. Also, the size of the sail, position and orientation of the mast 38 may be adjustable. Many other parameters of the vessel may be adjustable.

[0189] Additional control means may be provided, such as a fin with a variable position and orientation.

[0190] In Figure 6B the mast assembly 28 is shown to comprise a forward support beam 32 which prevents the mast 28 from falling forward under the influence of the

wind force. The lines 30, 31 support the mast 28 laterally.

[0191] Figure 6c shows the orientation of the vessel in use. The vessel is rolled about a longitudinal axis. The roll angle may vary from about 1 to 10 or 15 degrees. One planing board 22 planes on the water surface, while the other planing boards 23, 24 are lifted in the air.

[0192] In Fig. 7, it is shown that the sail device 34 comprises a curved sail mast 38, a jib organ 40 and a sail 36. The curved sail mast 38 defines a forward ridge of the sail device 34. The sail mast 38 and the jib organ 40 substantially keep the sail device 34 in a predetermined form, when viewed from the side.

[0193] The sail mast 38 has a section 301 with a strong curvature at a lower part of the sail mast and a section 302 with a relatively strong curvature at the top of the mast organ 38. The sail device 34 and the sail 36 thus have an aft section 303 which under the wind force urges the sail device in one direction of rotation about the rotation axis, and a forward section 304 which urges the sail device in the opposite direction of rotation. Preferably, the sections 303 and 304 exert a similar moment on the sail device 34 about the rotation axis 64, so that the sail device is substantially in equilibrium about the rotation axis 64. It is acceptable that the sail device is not completely in equilibrium, as long as it can be handled by a user.

[0194] The sail is broader at the bottom than at the top, which causes a relatively low position of the pressure point. The rear ridge of the sail is substantially straight in order to pass by the mast assembly.

[0195] In use, the wind force 68 extends along a wind force axis 62,which extends approximately through the pressure point 68. The curvature of the sail mast organ 38 causes a substantial part of the surface area of the sail 36 to be positioned forward of the rotation axis 64, which extends through the upper and lower end 44, 42 of the sail mast organ 38. Therefore, the pressure point 68 is located near the rotation axis 64. The wind force axis 62 intersects the rotation axis 64 at an intersection point 66, which is located at a substantial distance from the forward ridge of the sail device 34

[0196] The user 52 uses the rotation means 50 to rotate the sail device 34 about the rotation axis 64. The sail device 34 comprises a sail 36 which has two faces or sides. In use, a first side 171 may face the user 52 when the sail device 34 is positioned on the right side of the sailing vessel 20. A second side 172 may face the user 52 when the sail device 34 is positioned on a right side of the sailing vessel 34. In both situations, the user 52 will hold the rotation means 50. Therefore, rotation means 50 may be provided on both sides of the sail 36. It is also possible that the rotation means 50 can be switched from the first side 171 to the second side 172 and back.

[0197] The sail 36 may be connected to the mast 38 like a conventional surf sail, i.e. the sail 36 may have a tubular section at the forward ridge through which the mast 38 extends. Different connections between the sail and the mast 38 are also possible.

[0198] An alternative embodiment of the rotation means 50 is possible, comprising a bar 80 which is configured to be held by the user 52. The bar 80 is connected to an aft end 56 of the jib organ.

[0199] Turning to Figs. 8a through 8d, a turning operation of the sailing vessel 20 relative to the wind direction 12 is shown. In Fig. 8a, the sailing vessel 20 sails in a direction 7, substantially perpendicularly to the wind direction 12. The sail device 34 is positioned on the left side of the sailing vessel, which is the leeside. The user starts steering the rudder in order to turn the forward end of the sailing vessel 20 away from the wind direction 12 as shown by arrow 310. At the same time, the lower end 42 of the sail device 34 is moved from the left side to the right side as indicated by arrow 312.

[0200] Subsequently, as shown in Fig. 8c, the sail device 34 is rotated about the rotation axis 64 in a rotation direction 76. During the rotation of the sail device 34, the forward end of the sailing vessel 20 continues to turn away from the wind direction 12.

[0201] In Fig. 8D, the lower end 42 of the sail device 34 is moved from the left planing board 22 to the right planing board 24. This operation is performed by the user 52 by means of retractable connection means 74,75. As shown in Fig. 8D, the sailing vessel has completed a 180 degree turn relative to the wind direction 12 and is now sailing with the sail device 34 positioned on the right side of the sailing vessel 20.

[0202] It is also possible that there is enough space for the sail device 34 on the forward side of the mast assembly 28 to be moved from left to right without the sail device 34 having to be rotated.

[0203] Turning to Figs. 9a, 9b, 9c, a configuration is shown, wherein the sail device is movable from left to right without being rotated. The lower end of the sail device is moved from the mast foot position one side of the sailing vessel to a central forward location, thereby moving at least one point of the rotation axis forward relative to the mast assembly. From the central forward location, the lower end of the sail device is moved to the opposite mast foot position.

[0204] This embodiment has the particular advantage of a simple and effective design. Moving means for the sail device are shown.

[0205] Turning to Fig. 10, it is shown that the planing boards 22, 24 have a substantially flat bottom surface 182. The respective bottom surfaces of the left and right planing boards 22, 24 may be oriented at an angle γ relative to one another.

[0206] The bottom surface 183 of the central planing board may be positioned higher than the bottom surfaces 182 of the left and right planing boards, i.e. a distance 184 higher.

[0207] In operation, the hull assembly 21 may be rotated (rolled) slightly about a longitudinal axis (roll axis) of the sailing vessel 20. The larger part of the force of the water exerted on the sailing vessel 20 is exerted on

the planing board on the leeside. If the vessel 20 rolls, the entire water force is exerted on the leeside planing board, because the weatherside planing board and the central planing board are then lifted from the water. In this situation, the vessel 20 closely resembles a windsurfboard.

[0208] Due to the angle γ, the bottom surface 182 of the planing board which is located on the leeside of the sailing vessel 20, may be substantially horizontal when the hull assembly 21 is slightly rotated, i.e. rolled. The angle γ may be 1 degree to 15 degrees, and any value in between.

[0209] Turning to Fig.11, the variability of the location of the pressure point 68 is shown. The wind direction 12 and wind force F may vary in time. Also, the wind load may not be uniformly spread over the surface area of the sail. Therefore, the location of the pressure point 68 may move relative to the sail 36 both in a horizontal and vertical direction (or parallel to the rotation axis 64 and perpendicularly to the rotation axis 64). A movement of the pressure point location 68 parallel to the rotation axis 64 is not a substantial problem, since the state of equilibrium about the rotation axis will be maintained. A displacement of the pressure point 68 to the position indicated by 67 or 69 perpendicularly to the sail device 34 will cause the sail device 34 to loose its state of equilibrium about the rotation axis 64. A moment is created by the wind force F about the rotation axis 64, and the user will need to compensate this moment by exerting a force on the rotation means 50 of the sail device 34.

[0210] If the displacement of the pressure point 68 stays within a predetermined limit, the force that the user 52 will have to exert on the sail device 34 is also limited, enabling the sailing vessel 20 to be sailed without difficulty.

[0211] Turning to Fig. 12, it is shown that the upper end 44 of the sail device 34 may be connected by a connection means 46 to the upper end 19 of the mast assembly 28 at a suspension point 17. The connection means 46 may have a variable length, which allows the upper end 44 of the sail device to be positioned at a variable distance from the upper end 46 of the mast assembly 28.

[0212] In use, the sailing vessel 20 may capsize during sailing. In order to facilitate the turning upright of the sailing vessel 20, it may be easier to loosen the connection means 47 or to increase the length thereof, so that the sail 36 can remain substantially in the water while the sailing vessel 20 is turned upright. Subsequently, the connection means 47 may be retracted, for hoisting the sail device 34. The retractable connection means 47 may also be used for other purposes.

[0213] Turning to Fig. 13, an embodiment of the hull assembly 21 is shown wherein the left planing board, the right planing board and the intermediate section are integrated into a single hull assembly 21. The left and right part of the hull assembly have substantially flat bottom surfaces, oriented at an angle relative to one another.

[0214] Turning to Figs. 14a and 14b, the guide rail 65 is shown which allows the mast foot coupling 141 to be moved from left to right an vice versa. A line 320 extends through the guide rail 65 and is connected to the mast foot, so that the user can move the mast foot in a direction of choice 321 by pulling the line 320.

[0215] Figure 14b shows a way of supporting the mast foot in the guide rail 65.

[0216] Turning to Fig. 15, a stabilisation means 90 is shown with which a user 52 can vary the position of the pressure point 68 relative to the rotation axis 64. The stabilisation means 90 comprises a surface which is arranged pivotably about a rotation axis 96 relative to the sail device 34. The stabilisation means 90 is positioned eccentrically from the rotation axis 64,and can be pivoted by pivoting means 94. By pivoting the stabilisation means 90, the force exerted on it by the wind is varied in a controllable fashion. This enables the user 52 to control the position of the pressure point 68, 69 relative to the rotation axis 64, which enables the user 52 to relatively easy maintain the state of equilibrium of the sail device 34 about the rotation axis 64.

[0217] The sail mast 38 may be constructed from fibre glass. Other materials, such as aluminium, are also possible. The curvature of the sail mast may vary, depending on the dimensions and proportions of the sailing vessel 20.

[0218] Turning to Figures 16A and 16B, a comparison is shown of a windsurfboard and the present sailing vessel. In use, the water exerts a horizontal pressure Fh on the dagger board 58 and/or fin 60. This horizontal pressure Fh results in a bending moment 348 on the board 10 in the case of a windsurfboard. In order to prevent the board 10 from rotating about its longitudinal axis, the user 6 must use his feet 350 to create a counter bending moment 352 on the board 10. This counter moment 352 is created by pressing downwards on the board with feet 350 with force 354. Because the horizontal pressure rises with a higher speed, the downward force 354 also rises with higher speed. This downward force has a negative impact on the planing abilities of a windsurfer and slows the windsurfer down.

[0219] Although the sail of the windsurfboard creates lift on the combination of windsurfer, sail and board, the required downward force 354 prevents optimal use of this lifting capability of the wind. The lift force of the wind can not be transferred to the board.

[0220] In contrast, in the present invention the boards 22, 24 are fixed to the horizontal frame 26, as is shown in Figure 16A. The horizontal frame 26 is able to exert a counter moment 352 on the board without exerting a downward force on the board 22, 24 , because the board 22, 24 is fixated (or mounted) to the frame 26. Consequently, better use can be made of the lifting force of the wind on the vessel, and the lifting force of the wind on the sailing vessel can be transferred onto the boards 22,24 to lift the boards 22,24 from the water.

[0221] It will be clear to a person skilled in the art that

the sailing vessel described herein above uses known techniques from both windsurfboards and catamarans. A person skilled in the art may revert to existing publications for windsurfboards or catamarans for certain details of the sailing vessel not disclosed in the present document.

[0222] The present invention further relates to the following clauses:

1. Sailing vessel (20), comprising:

- a hull assembly (21) comprising at least a left planing surface (22) positioned substantially on a left side of the vessel and a right planing surface (24) positioned substantially on a right side of the vessel, the left and right planing surface spaced apart from one another, the left and right planing surface being connected to one another via a frame or an intermediate hull part of the hull assembly;
- a mast assembly (43) connected to the hull assembly (21) and extending upwards from the hull assembly, the mast assembly being located at or near a rear part of the hull assembly; and
- a sail device (34) connected to the mast assembly (43) at an upper connection point located at or near an upper end of the mast assembly, the sail device further being connected to the hull assembly at a lower connection point, the sail device (34) being pivotable relative to the hull assembly (21) about a rotation axis (64) which is defined by the upper and lower connection point, wherein the lower connection point is movable relative to the hull assembly (21) from a position substantially on the left side of the hull assembly to a position substantially on the right side and vice versa such that the inclination of the rotation axis relative to the hull assembly is variable.

2. Sailing vessel of clause 1, wherein the left planing surface (22) and the right planing surface (24) are connected to one another via a frame which extends between the left and right planing surface and which in use is located substantially above the waterline or wherein the left planing surface and the right planing surface form part of an integrated hull of which an intermediate part which connects the left and right planing surface in use is located substantially above the water line.

3. Sailing vessel of clause 1 or 2, wherein the lower connection point is movable along a curved trajectory from the left side of the vessel to the right side and vice versa.

4. Sailing vessel of any of clauses 1-3, wherein when viewed from above the curved trajectory has a left end and a right end which form the rear parts of the trajectory and wherein a middle section of the curved trajectory is located more forward than the left and right end.

5. Sailing vessel of any of clauses 1-4, comprising a rail or similar guiding device which extends substantially from the left side of the vessel to the right side of the vessel and which defines a trajectory along which the lower connection point is moveable, wherein a lower end of the sail device is movably connected via a slider or roller device to said rail or similar device, wherein the slider or roller device is movable from the left side of the vessel to the right side and vice versa.

6. Sailing vessel of clause 5, wherein the sail device is pivotably connected to said slider or roller.

7. Sailing vessel of any of clauses 1-6, wherein the curved trajectory defines a part of a circle and has the upper connection point as a centre point of the circle.

8. Sailing vessel of any of clauses 1-7, wherein at least one part (68), in particular a pressure point (58), of the sail device (34) is movable to a first area (200) located on the left side (27) of a central longitudinal plane (33) which extends substantially through and substantially parallel to the mast assembly, and movable to a second area (202) located on the right side (29) of the central longitudinal plane (33).

9. Sailing vessel of any of clauses 1-8, wherein the sail device is constructed such that in use, the larger part of the wind force acting on the sail is transferred from the sail device to the rest of the sailing vessel via the upper and lower connection point.

10. Sailing vessel of any of clauses 1-9, wherein the sail device (34) can be positioned in an inclined orientation relative to the hull assembly (21), an upper part (78) of the sail device (34) being located closer to a weatherside of the sailing vessel (20) than a lower part (79) of the sail device (34).

11. Sailing vessel of any of clauses 1-10, wherein the rotation axis (64) can be inclined to the left over an angle (α) relative to the hull assembly (21) and wherein the rotation axis (64) can be inclined to the right over an angle (α') relative to the hull assembly (21).

12. Sailing vessel of any of clauses 1-11, wherein the rotation axis (64) is rotatable about the upper connection point (46) relative to the hull assembly.

13. Sailing vessel of any of clauses 1-12, wherein the rotation axis (64) is oriented in a backwards inclination over an angle (β) relative to the hull assembly (21) both in a left orientation and a right orientation and any orientation which the rotation axis adopts when being shifted from the left orientation to the right orientation or vice versa.

14. Sailing vessel of any of clauses 1-13, wherein the sail device (34) comprises a sail (36) comprising a forward part which, when a wind force acts on the sail, urges the sail device in one rotation direction about the rotation axis and a rear part which urges

the sail device in the opposite rotation direction.

15. Sailing vessel of clause 14, wherein in use the forward part exerts a substantially same moment about the rotation axis as the rear part, resulting in a substantial equilibrium of the sail device about the rotation axis in one or more sailing situations which occur in use.

16. Sailing vessel of any of clauses 1-15, wherein the sail device (34) is configured to cause a wind force axis (62) extending through a pressure point (68) of the sail device (34) to extend approximately through the rotation axis (64).

17. Sailing vessel of any of clauses 1-16, wherein the sail device (34) comprises a frame (38, 40) and a sail (36), the frame comprising a mast and a jib, the frame providing a substantial rigidity to the sail device.

18. Sailing vessel of any of clauses 1-17, wherein the rotation axis (64) extends substantially through an upper end (42) and a lower end (44) of the sail device (34).

19. Sailing vessel of any of clauses 1-18, wherein a forward ridge (174) of the sail device (34) has a substantially curved form.

20. Sailing vessel of any of clauses 1-18, wherein the mast of the sail device is curved and forms the forward ridge (174) of said sail device (34).

21. Sailing vessel of any of clauses 1-20, wherein the curved mast has a nose-like form.

22. Sailing vessel of any of clauses 1-21, wherein the curved mast comprises an upper region which is substantially curved, a lower region which is substantially curved and an intermediate region which is substantially straight.

23. Sailing vessel of any of clauses 1-22, wherein when viewed from the side the intermediate section of the curved mast is inclined backwards relative to the hull assembly over an angle.

24. Sailing vessel of any of clauses 1-23, wherein the sail has a corner located opposite to the curved forward ridge, wherein a lower ridge of the sail extends substantially straight from said corner to a lower end of said curved forward ridge, and wherein an aft ridge of the sail device extends substantially straight from said corner to an upper end of said curved forward ridge.

25. Sailing vessel of clause 24, wherein the sail device comprises a jib which extends between said corner of the sail and the curved mast and is connected to the curved mast at a location above said lower curved region.

26. Sailing vessel of any of clauses 1-25, wherein during a shift from the left position to the right position or vice versa, the lower part of the sailing device is first moved forward relative to the vessel and subsequently moved rearward relative to the sailing vessel in order to allow the sail device to pass the mast assembly.

27. Sailing vessel of any of clauses 1-26, wherein an aft ridge of the sail passes the mast assembly on the forward side when travelling from left to right or vice versa.

28. Sailing vessel of any of clauses 1-27, comprising a third planing surface positioned substantially at a central longitudinal plane of the sailing vessel, in particular substantially at the rear of the sailing vessel.

29. Sailing vessel of clause 28, wherein a forward part of the third planing surface is located between the aft parts of the first and second planing surface and wherein an aft part of the third planing surface is locate behind the rear end of the first and second planing surface, the three planing surface being separated from one another by a space.

30. Sailing vessel of any of clauses 1-29, wherein the left and right planing surface (22, 24) and, if present, the third planing surface are oriented substantially horizontal or angled slightly upwards.

31. Sailing vessel of any clauses 8-30, wherein the first area (200) and the second area (202) are located at an area distance (204) from one another, the area distance (204) being a substantial distance relative to a width (91) of the hull assembly (21).

32. Sailing vessel of any of clauses 1-31, wherein the sail device is adjustable in order to allow a user to vary a position of the wind force axis relative to a position of the rotation axis such that the equilibrium can be restored, adjusted or intentionally terminated and turned into a bias in one direction or another direction.

[0223] It will be obvious to a person skilled in the art that numerous changes in the details and the arrangement of the parts may be varied over considerable range without departing from the spirit of the invention and the scope of the claims.

Claims

1. Sailing vessel (20), comprising:

- a hull assembly (21) comprising at least a left planing surface (22) positioned substantially on a left side of the vessel and a right planing surface (24) positioned substantially on a right side of the vessel, the left and right planing surface spaced apart from one another, the left and right planing surface being connected to one another via a frame or an intermediate hull part of the hull assembly;
- a mast assembly (43) connected to the hull assembly (21) and extending upwards from the hull assembly, the mast assembly being located at or near a rear part of the hull assembly; and
- a sail device (34) connected to the mast assembly (43) at an upper connection point located

at or near an upper end of the mast assembly, the sail device further being connected to the hull assembly at a lower connection point, the sail device (34) being pivotable relative to the hull assembly (21) about a rotation axis (64) which is defined by the upper and lower connection point, wherein the lower connection point is movable relative to the hull assembly (21) from a position substantially on the left side of the hull assembly to a position substantially on the right side and vice versa such that the inclination of the rotation axis relative to the hull assembly is variable.

2. Sailing vessel of claim 1, wherein the left planing surface (22) and the right planing surface (24) are connected to one another via a frame which extends between the left and right planing surface and which in use is located substantially above the waterline or wherein the left planing surface and the right planing surface form part of an integrated hull of which an intermediate part which connects the left and right planing surface in use is located substantially above the water line.

3. Sailing vessel of claim 1 or 2, wherein the lower connection point is movable along a curved trajectory from the left side of the vessel to the right side and vice versa.

4. Sailing vessel of any of claims 1-3, wherein when viewed from above the curved trajectory has a left end and a right end which form the rear parts of the trajectory and wherein a middle section of the curved trajectory is located more forward than the left and right end.

5. Sailing vessel of any of clauses 1-4, comprising a third planing surface positioned substantially at a central longitudinal plane of the sailing vessel, in particular substantially at the rear of the sailing vessel.

6. Sail device (33) for use in a sailing vessel (20) according to any of claims 1-5.

7. Sail device, comprising:

- a sail (36);
- a frame for providing a substantial rigidity to the sail device

wherein the sail device (34) is pivotably connectable about a rotation axis (64) to a sailing vessel at a lower end and an upper end of the sail device, the sail (36) comprising a forward part for in use urging the sail device in one rotation direction about the rotation axis and a rear part for in use urging the sail device in the opposite rotation direction.

8. Sail device of claim 6 or 7, wherein the forward part and the rear part have surface areas which are chosen such that in use a wind force axis (62) along which a resulting wind force (F) acts on the combined surface area of the forward part and the rear part of the sail extends approximately through the rotation axis (64).

9. Sail device of any of claims 7-8, comprising a frame and a sail, the frame being configured for providing a substantial rigidity to the sail.

10. Sail (36) for use in a sailing vessel according to any of claims 1-5.

11. Sail mast organ (38) for use in a sailing vessel according to any of claims 1-5.

12. Jib organ (40) for use in a sailing vessel according to any of claims 1-5.

13. Hull assembly (21) for use in a sailing vessel according to any of claims 1-5.

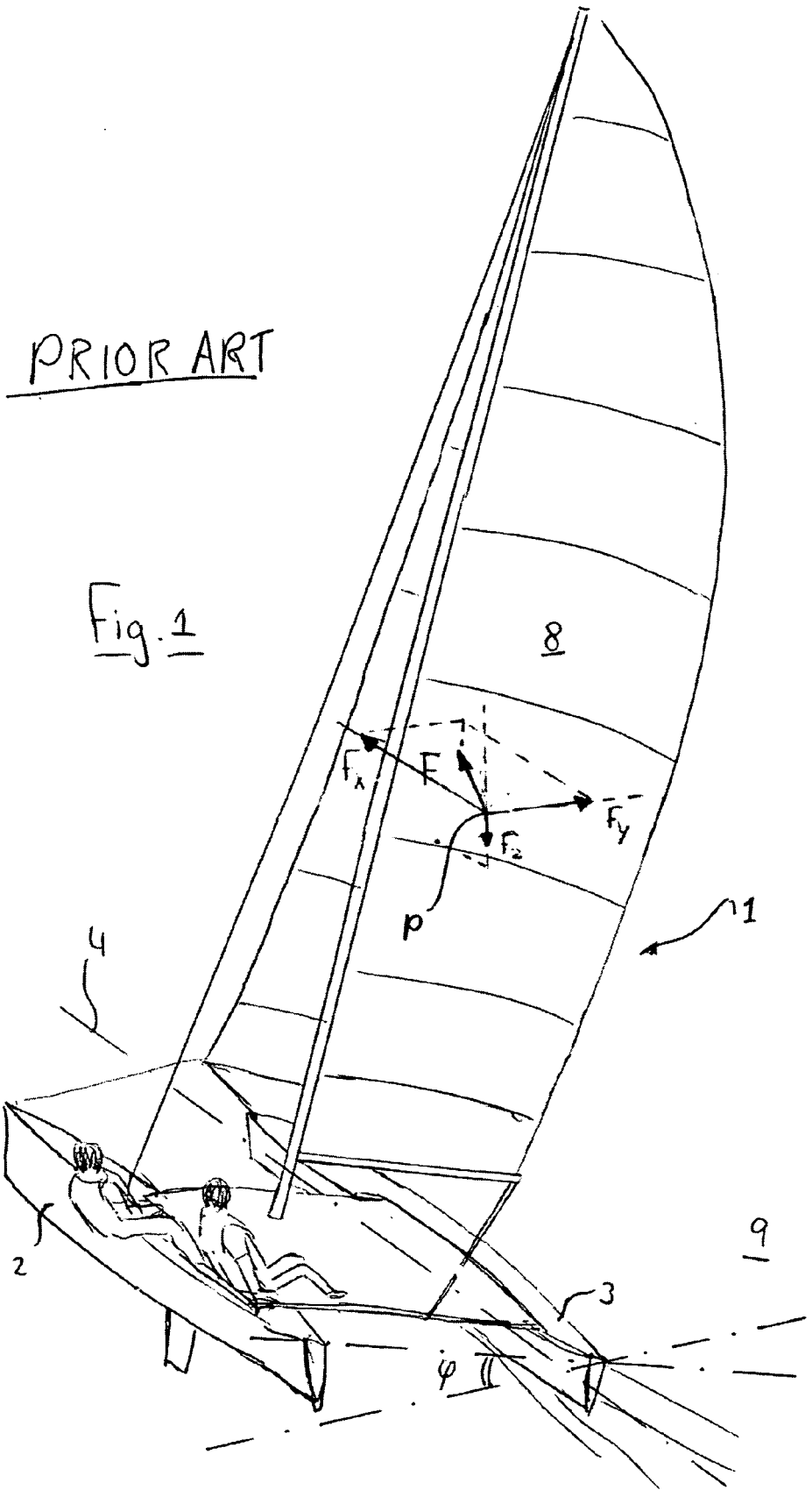
14. Planing surface (22, 24) for use in a sailing vessel according to any of claims 1-5.

15. Method of sailing comprising:

- providing a sailing vessel according to any of claims 1-5,
- positioning the sail device such that the lower connection point is located on the leeside of the vessel, the sail device being oriented such that an upper part of the sail is located more to the weather side of the vessel than a lower part of the sail,
- rotating the sail device (34) around the rotation axis (64) in order to keep the sailing vessel (2) in a substantial rotational equilibrium around a roll rotation axis (206) extending approximately parallel to a central longitudinal plane (33).

PRIOR ART

Fig. 1



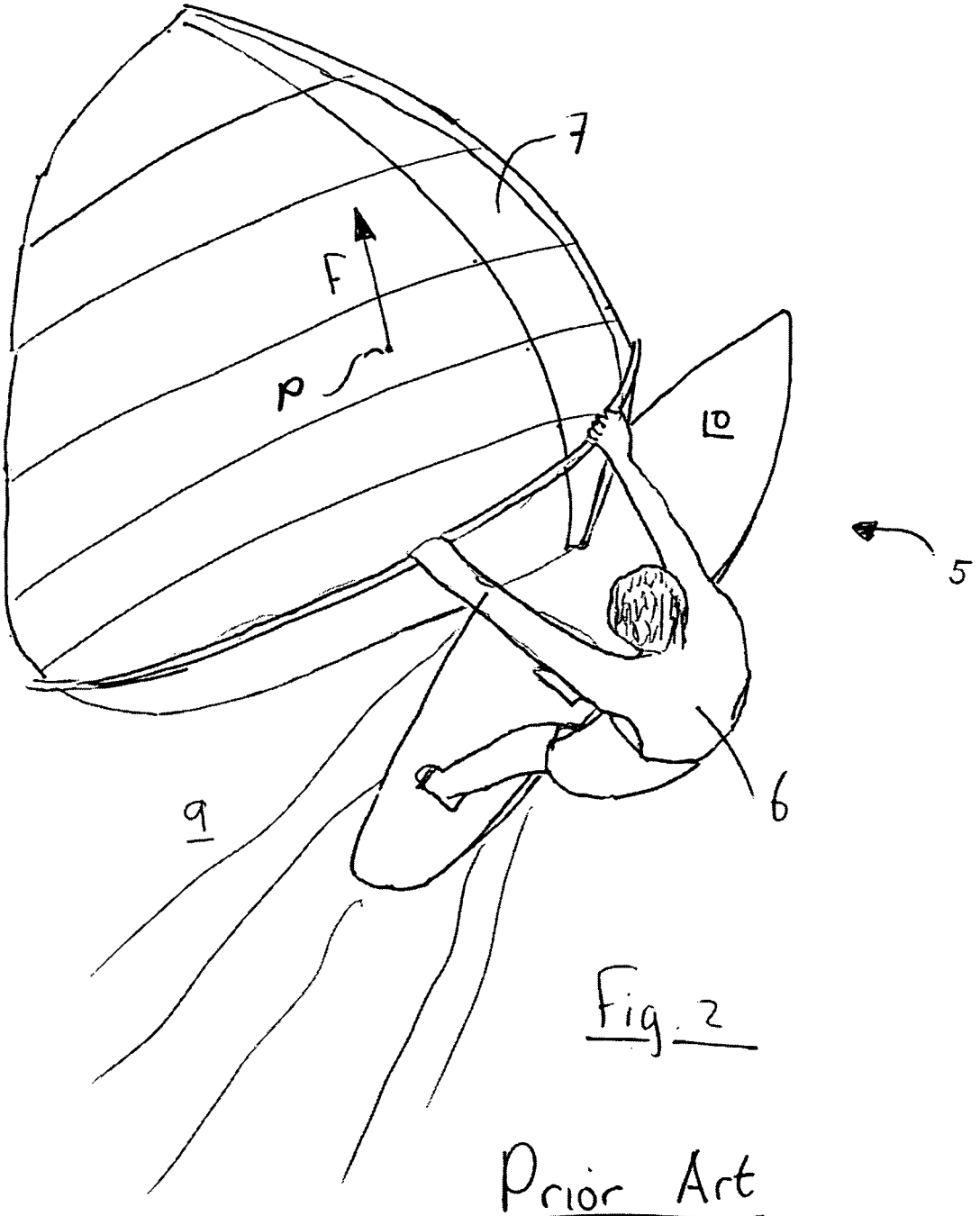
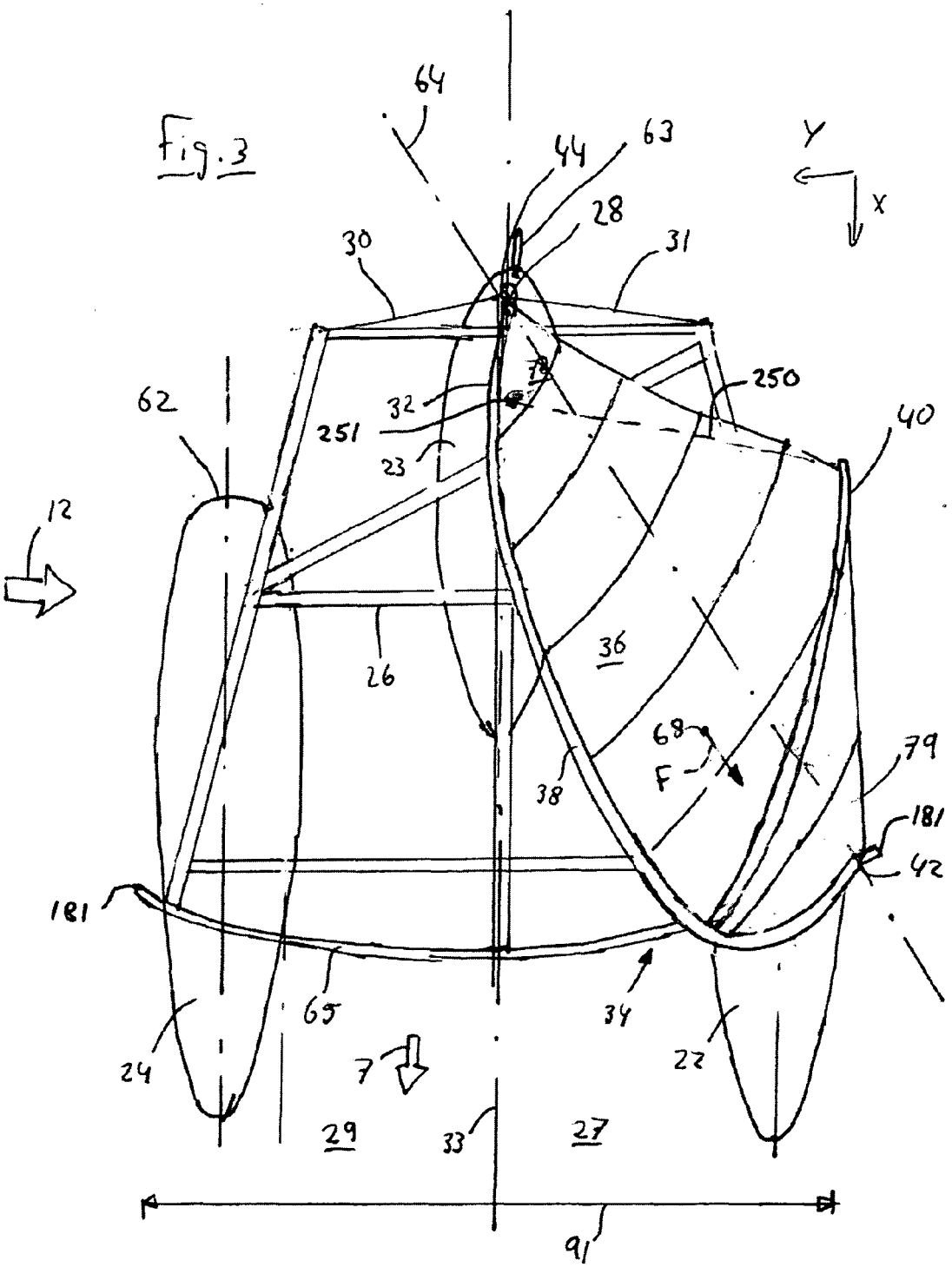


Fig. 2

Prior Art

Fig.3


64
63
44
28
Y
X
30
31
62
32
251
23
250
40
12
26
36
68
F
38
79
181
42
181
65
34
24
7
22
29
33
27
91

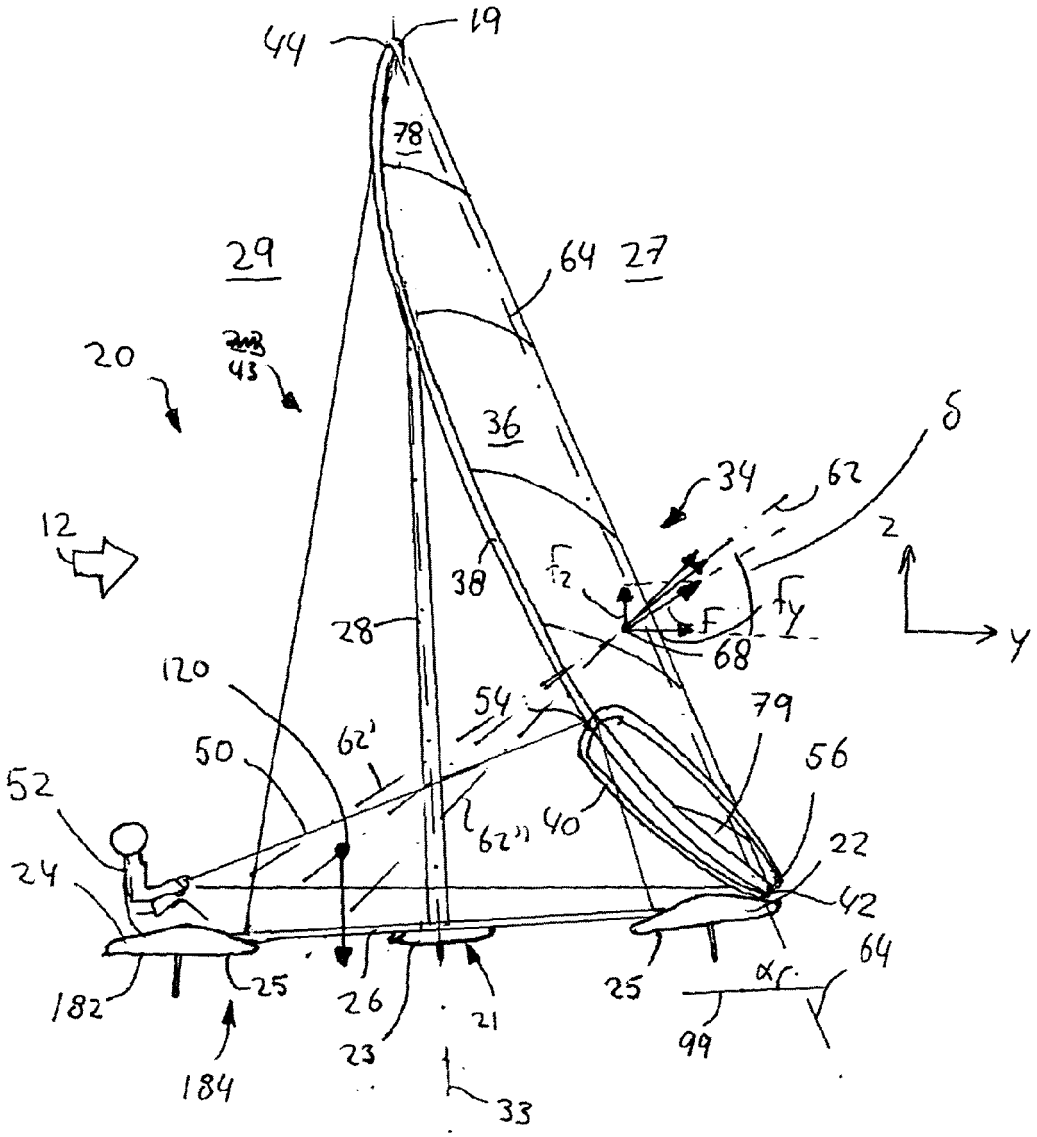

44
19
78
29
64
27
20
43
36
δ
34
62
12
38
z
y
28
68
120
54
79
50
62'
56
52
62''
40
22
24
42
64
182
25
26
25
21
23
99
184
33

Fig. 4a

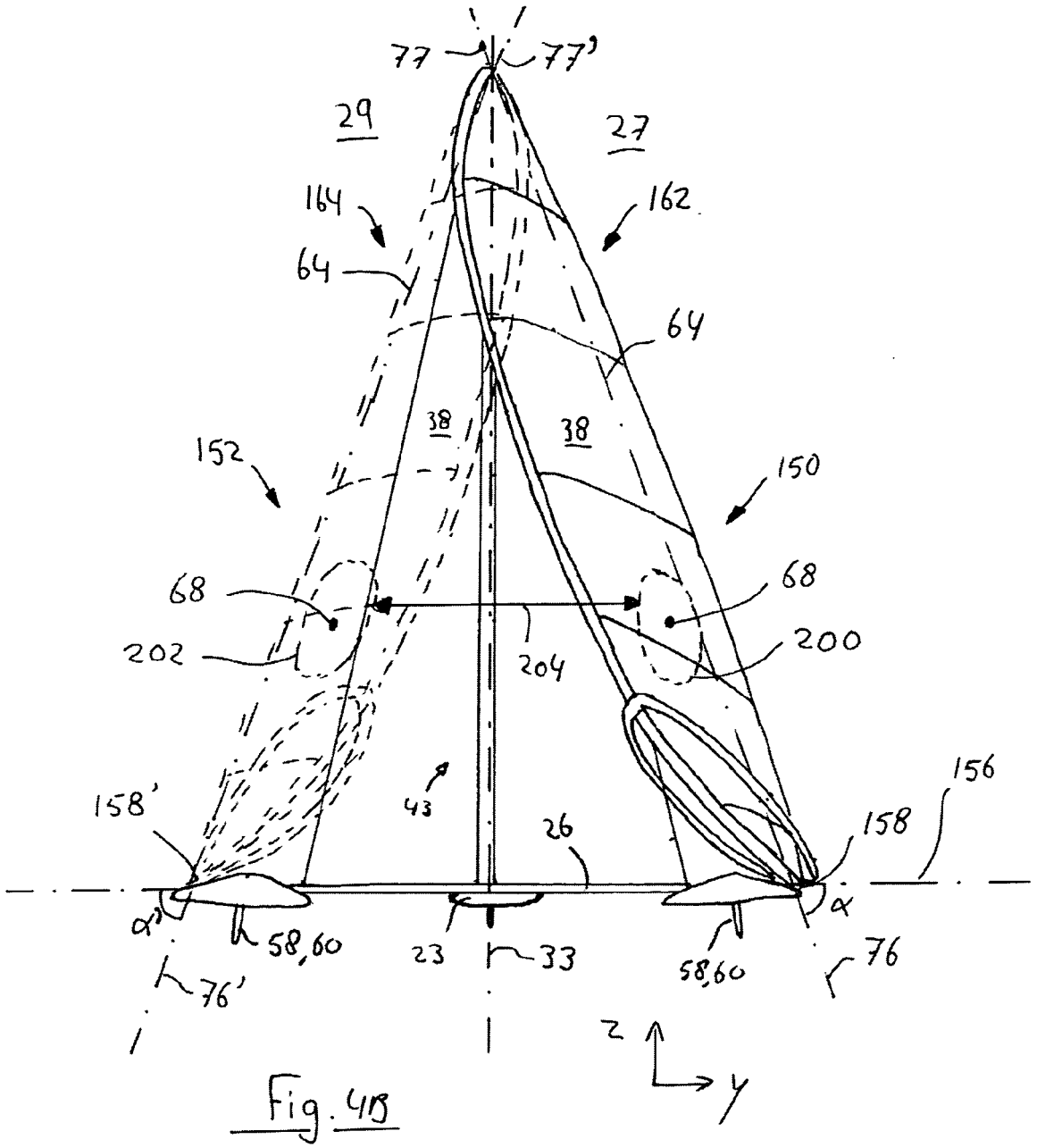

77
77'
29
27
164
162
64
64
38
38
152
150
68
68
202
204
200
158'
43
26
156
158
58,60
23
33
58,60
76
76'
z
y

Fig. 4B

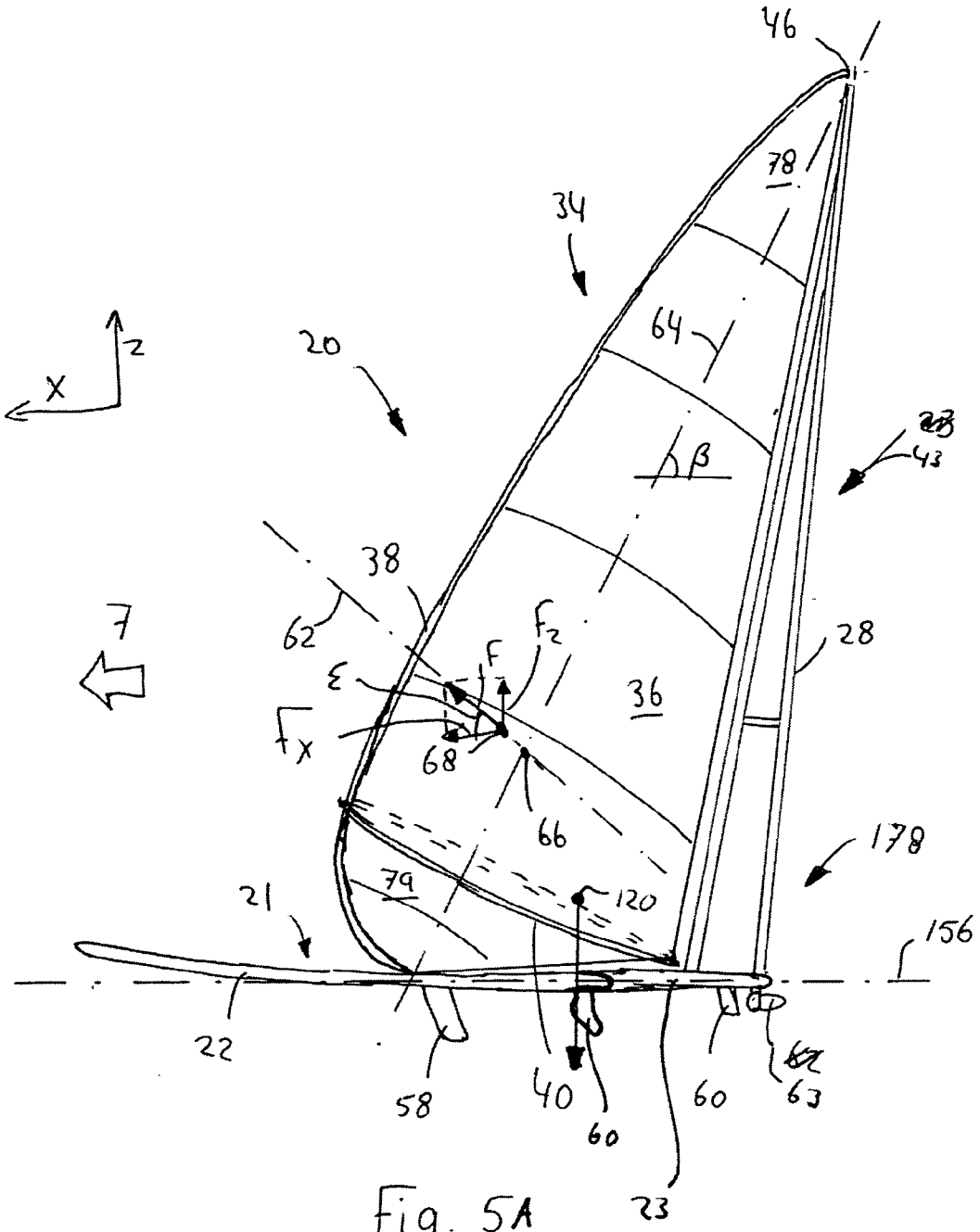

46
78
34
64
20
Z
X
43
38
62
7
F_z
28
ε
F
36
f_x
68
66
178
79
120
21
156
22
58
40
60
60
63
23

Fig. 5A

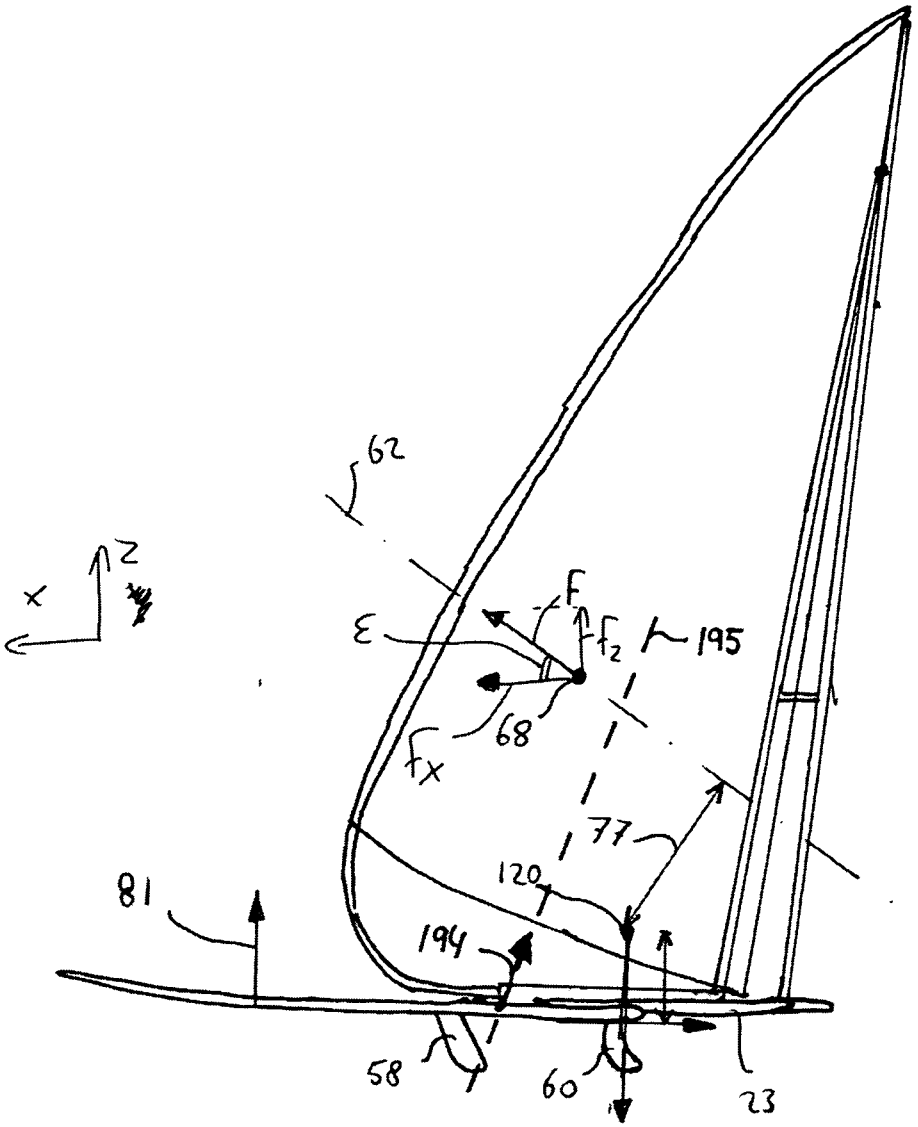


Fig. 5B

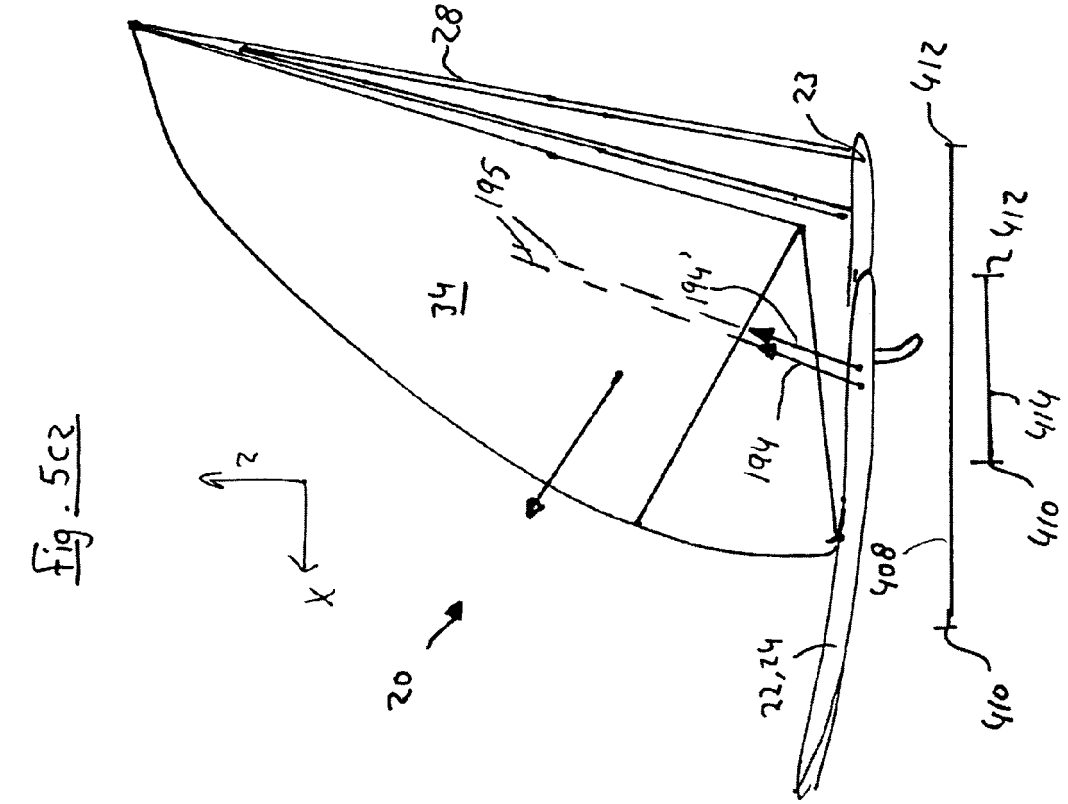


Fig. 5C2

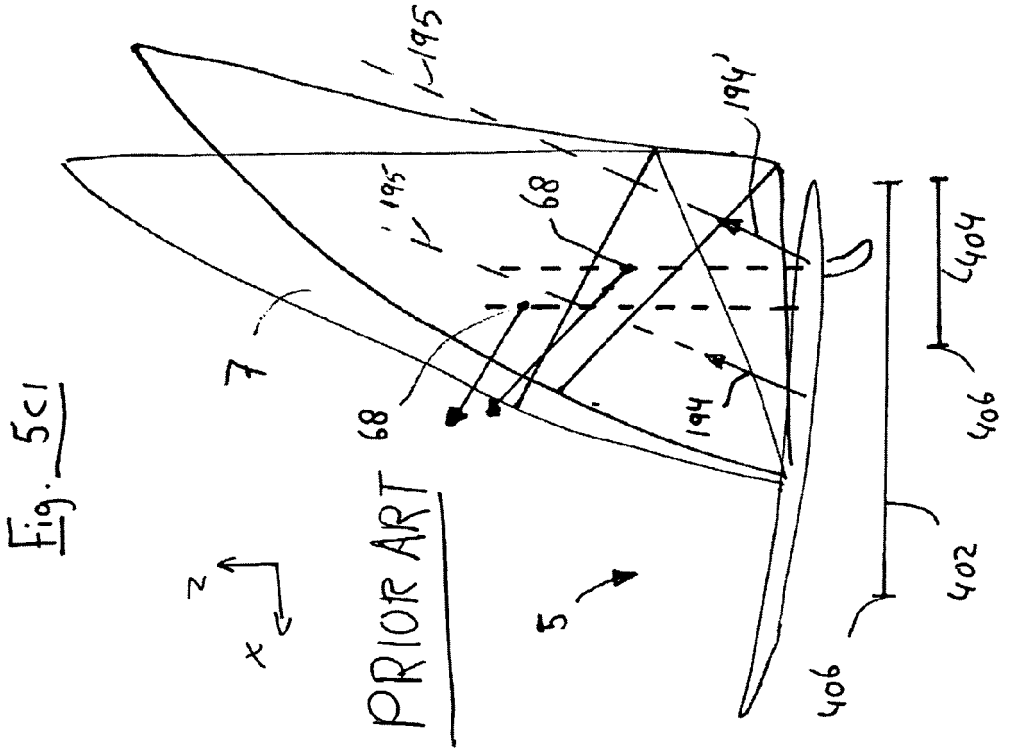


Fig. 5C1

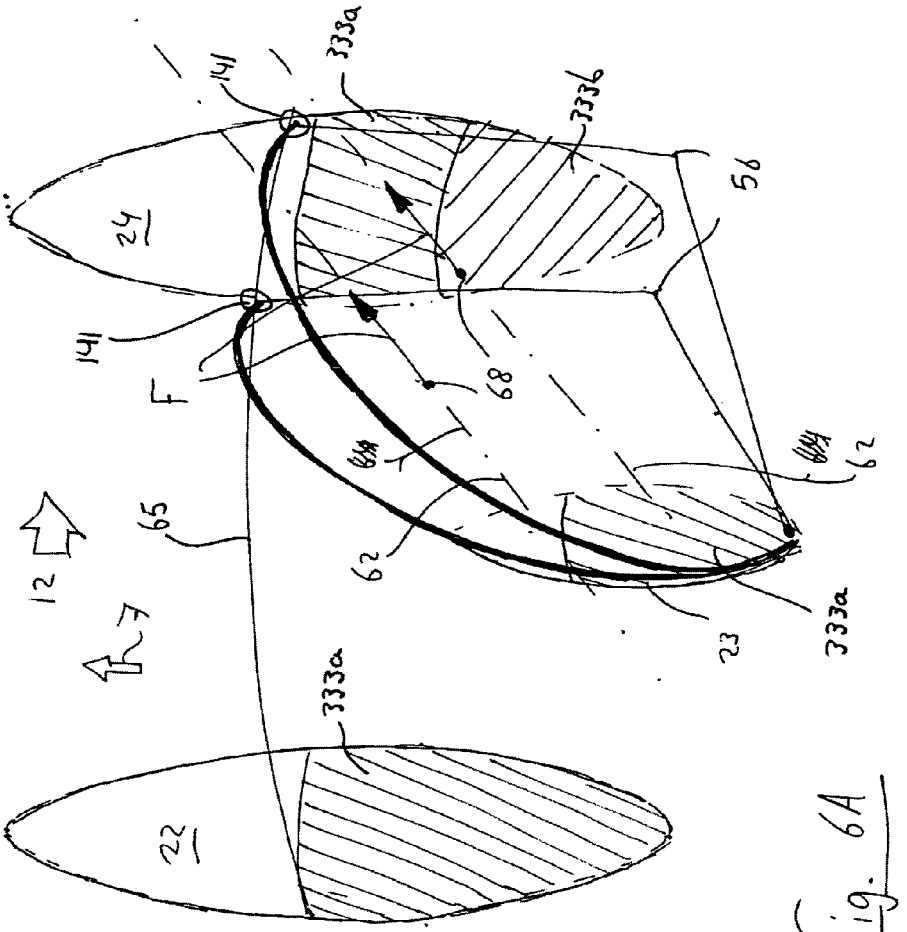
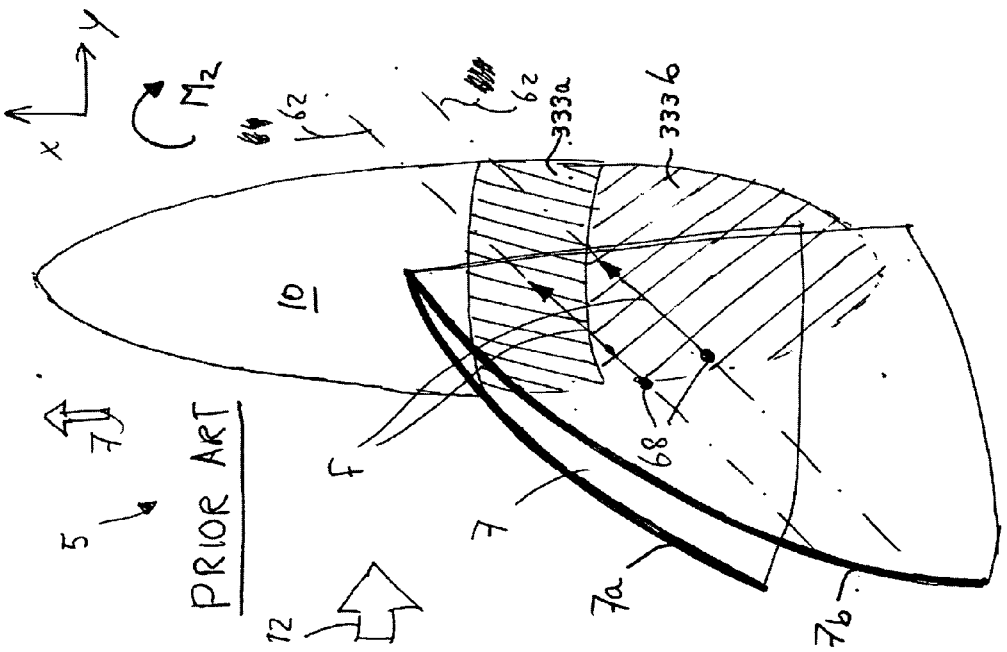


Fig. 6A



PRIOR ART

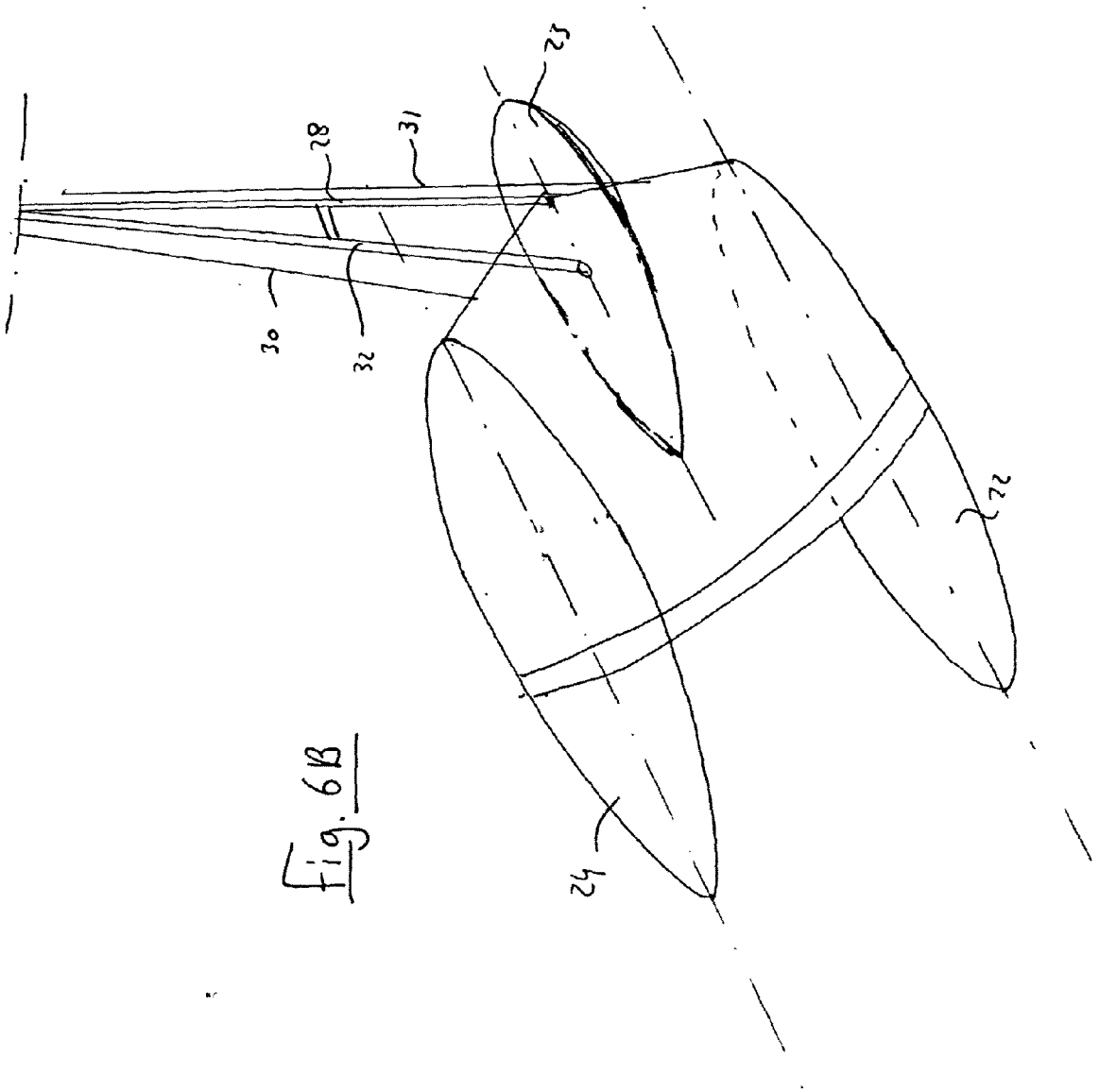


Fig. 6B

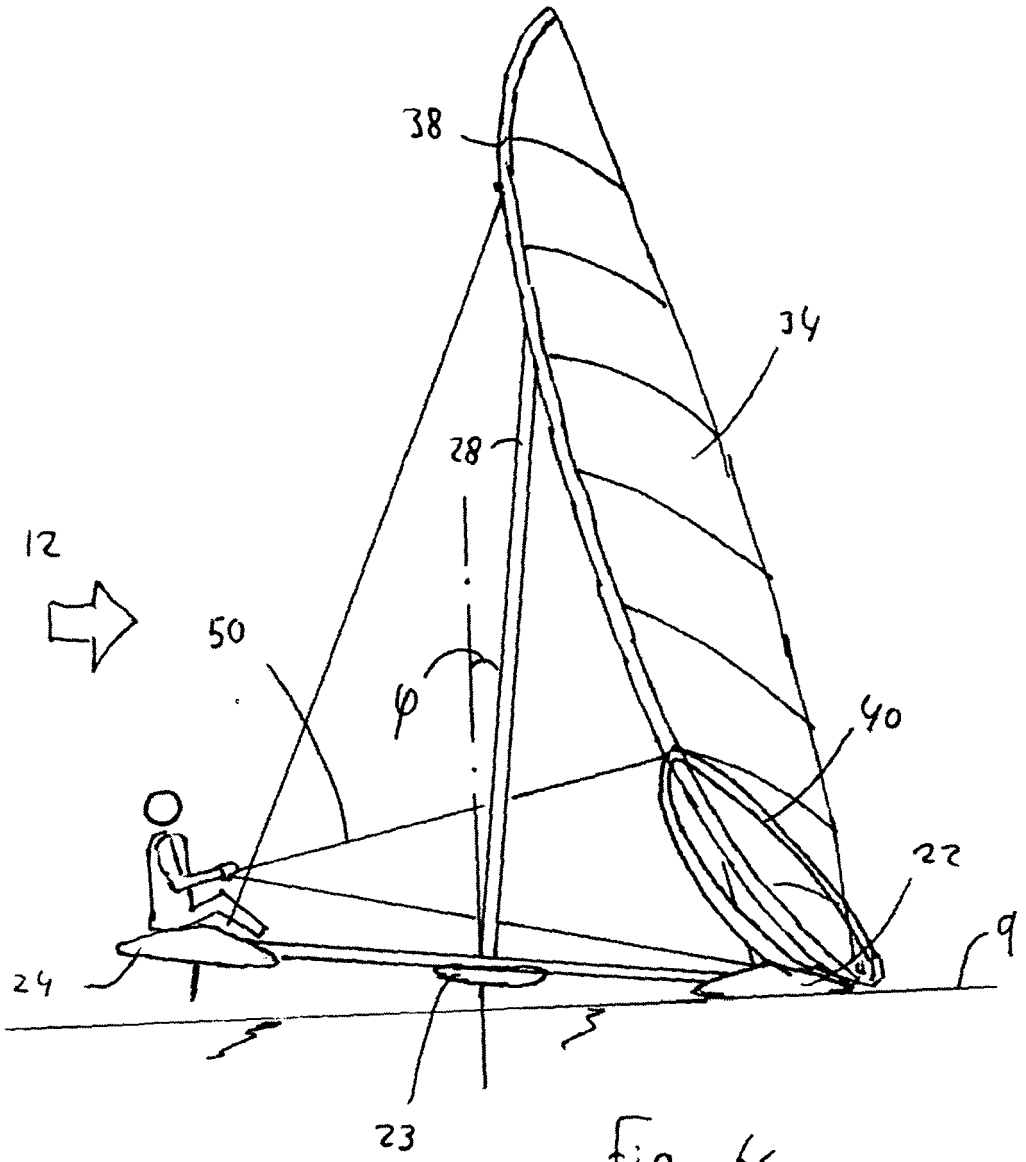


Fig. 6c

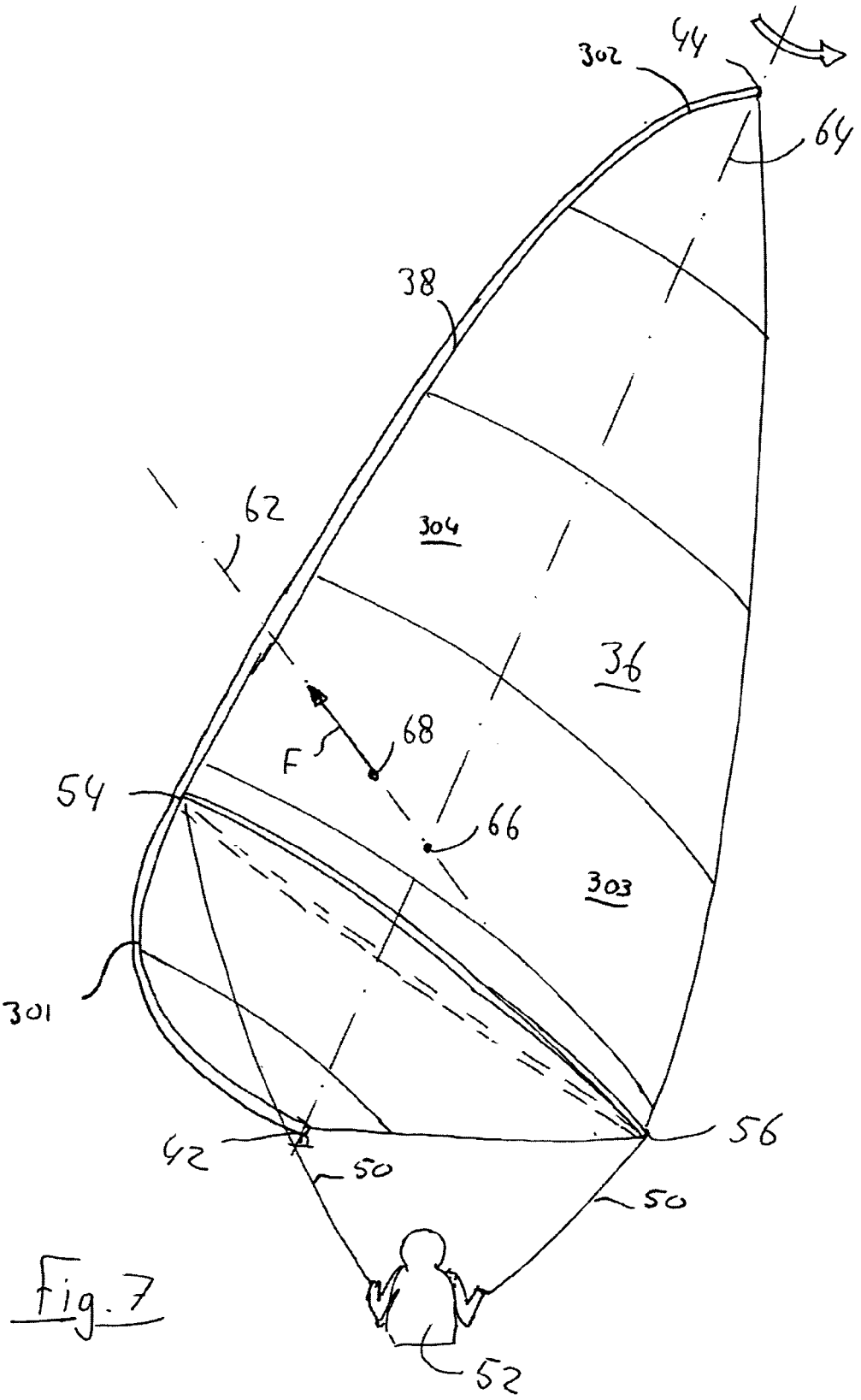
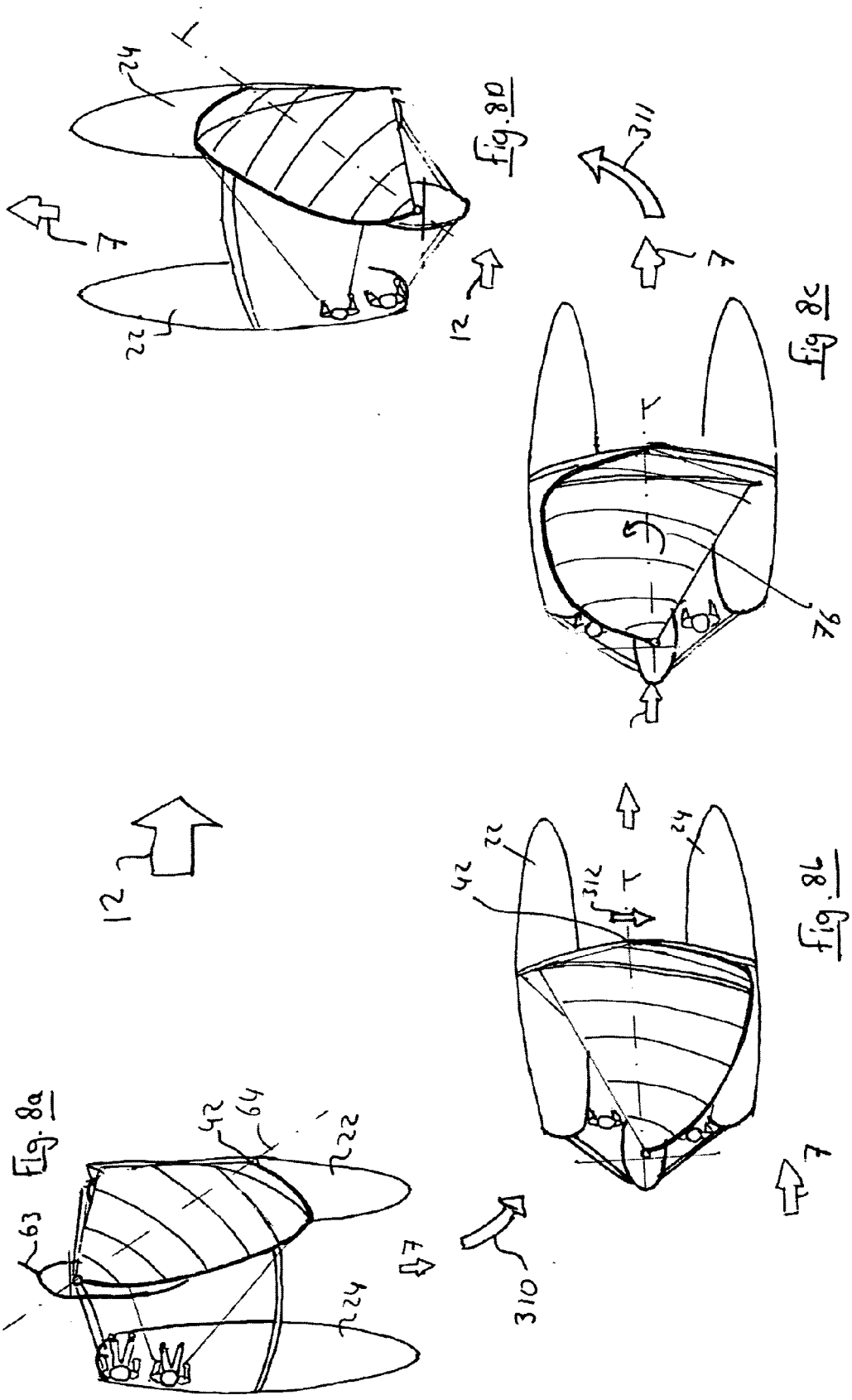


Fig. 7


42
22
12
311
24
312
310
63
64
Fig. 8a
Fig. 8b
Fig. 8c
Fig. 8d

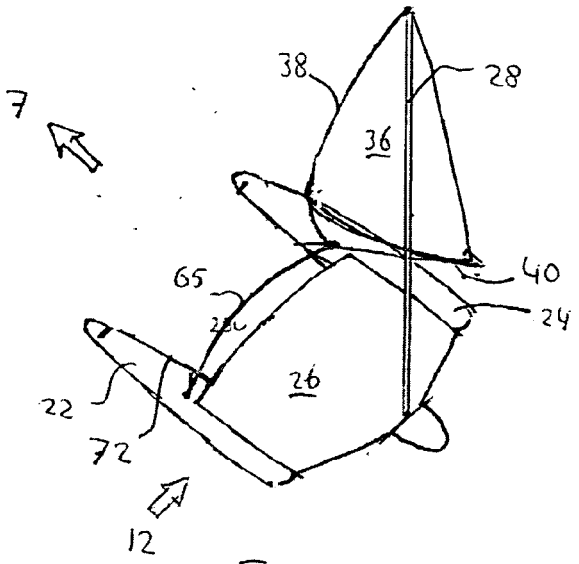


Fig. 9a

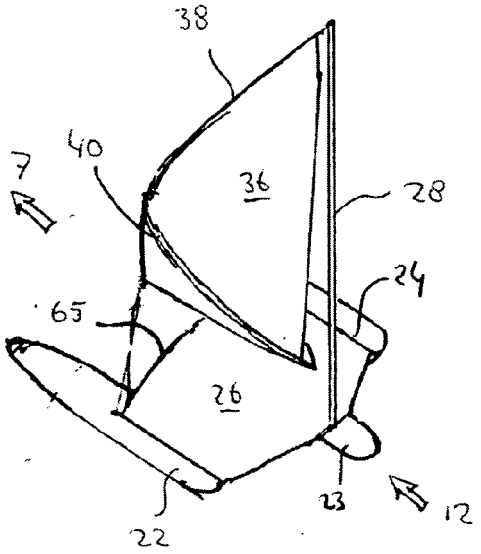


Fig. 9B

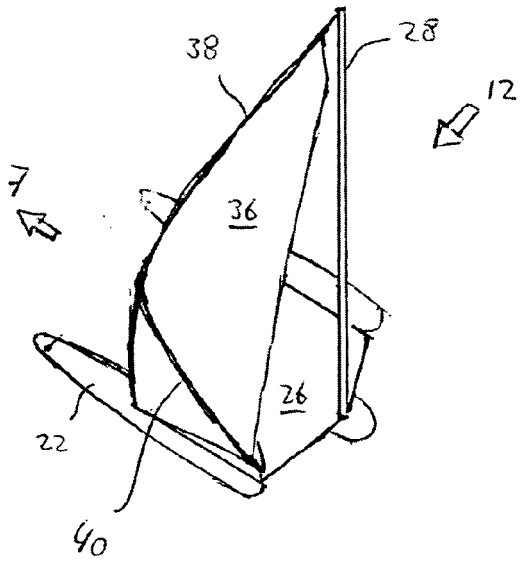


Fig. 9C

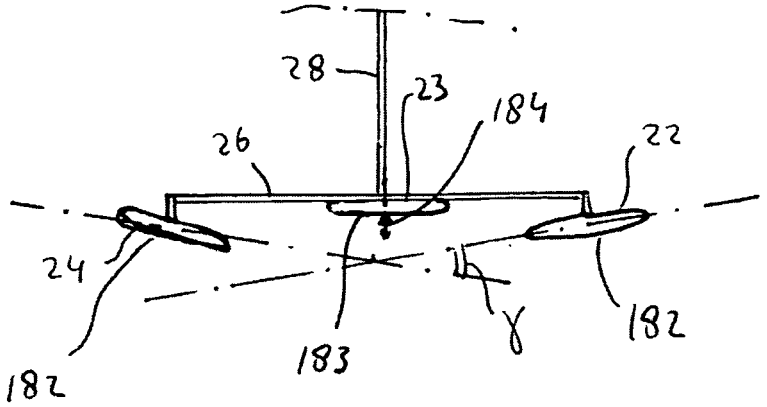


Fig. 10

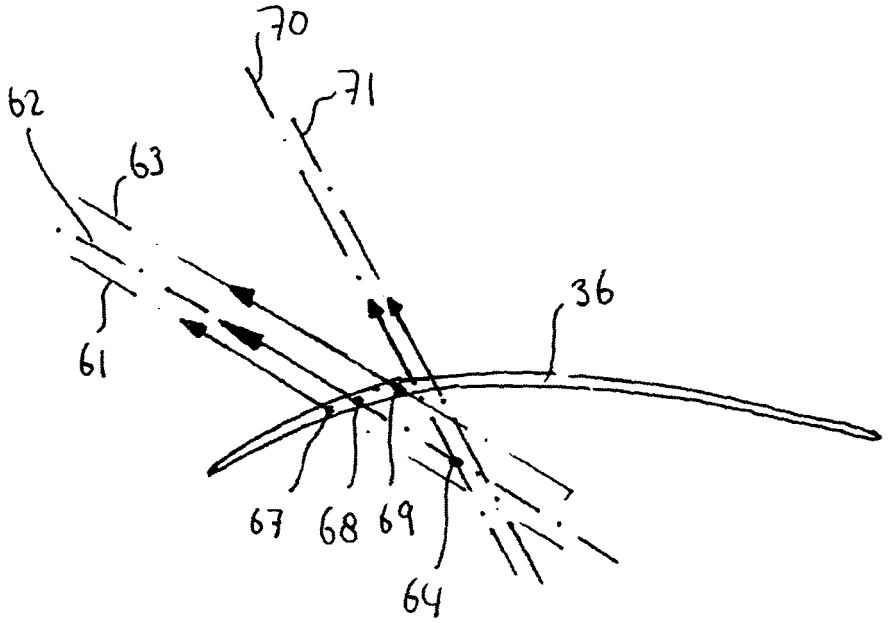
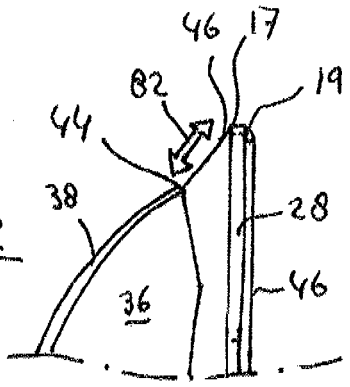


Fig. 11

Fig. 12



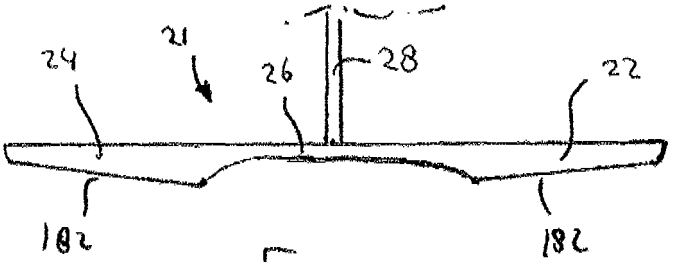
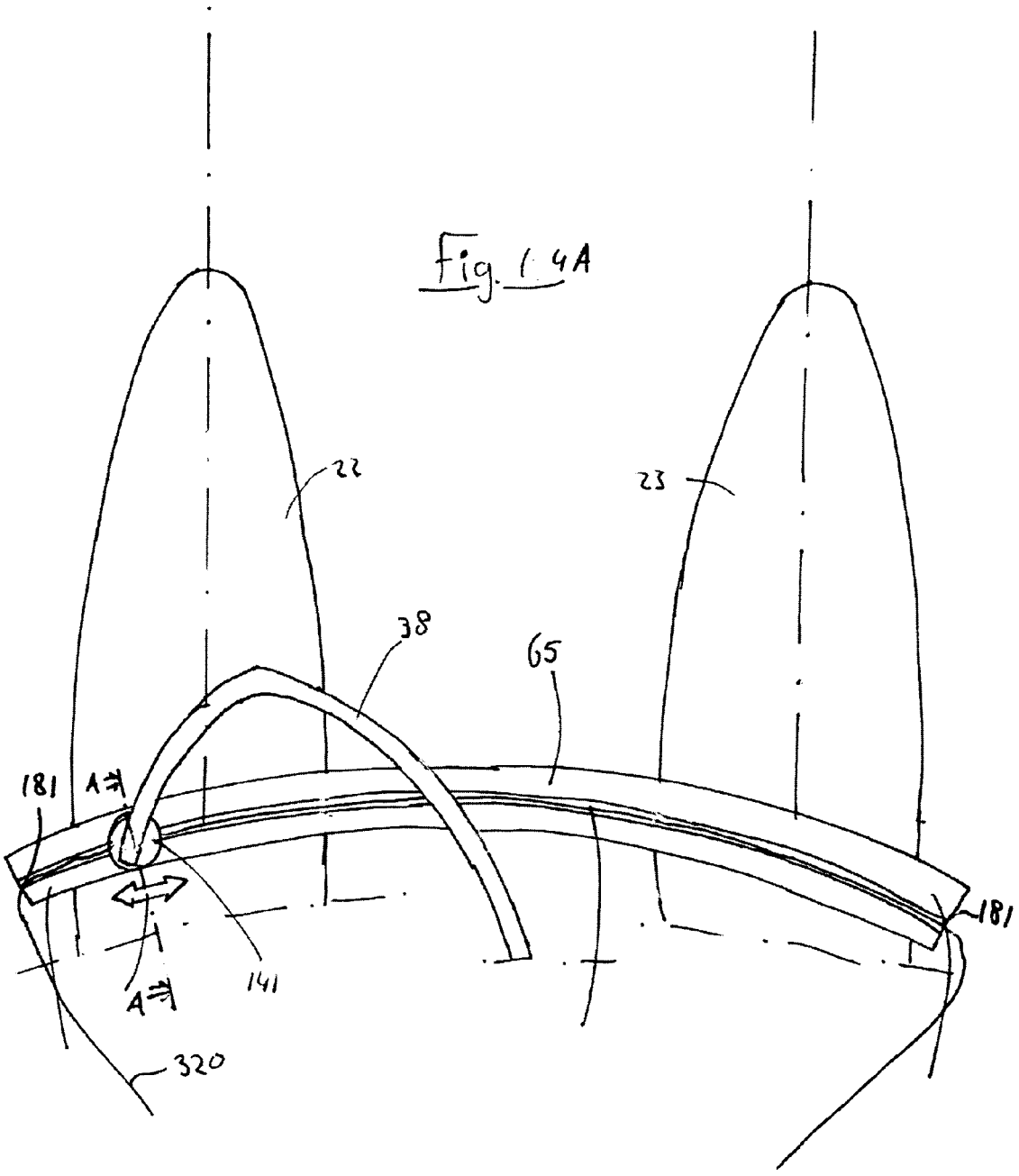


Fig. 13

Fig. 14A



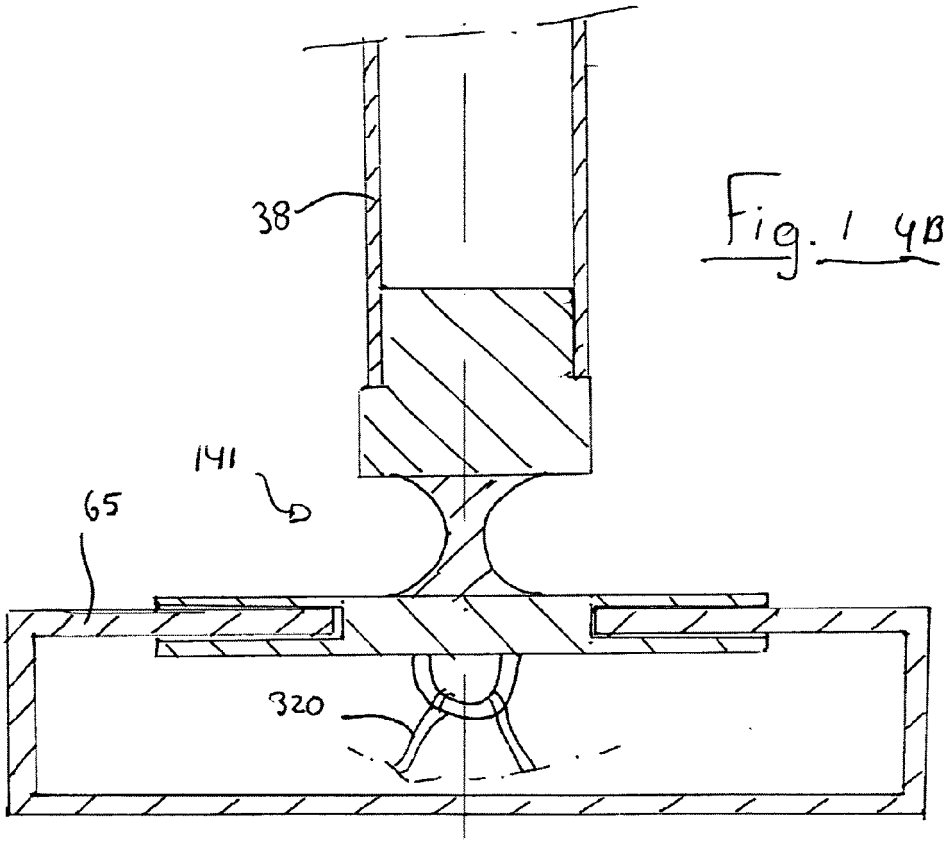


Fig. 14B

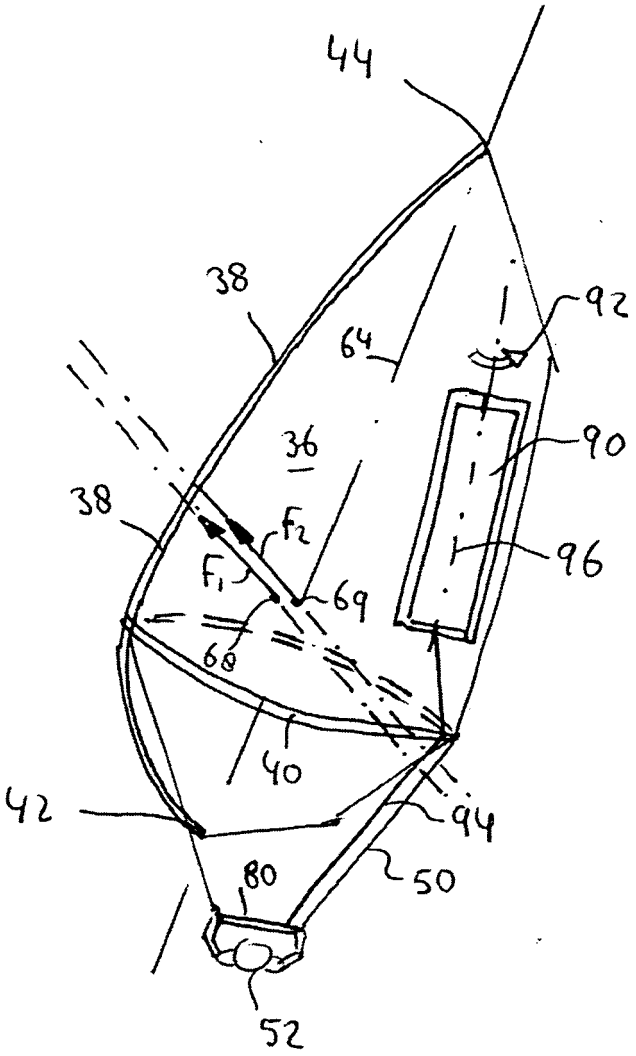


Fig. 15

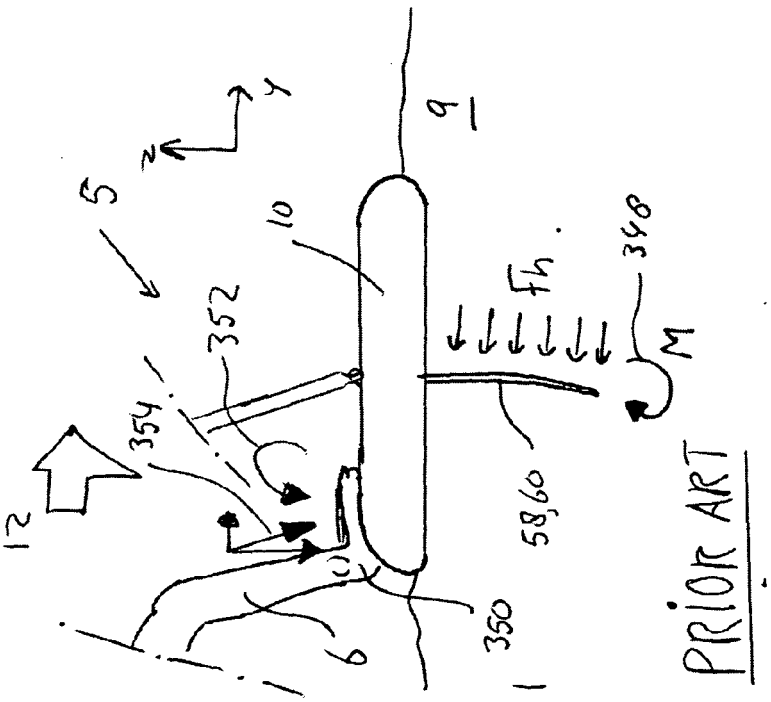


Fig. 16A

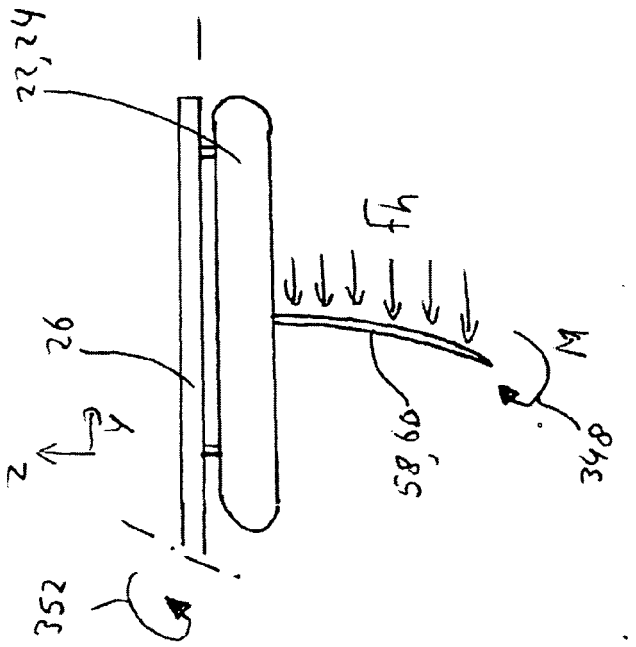


Fig. 16B