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(54) High-performance sailing boat using wing sections and lifting sails

(57) Multihull yare sailing boat, of the type having at least one main hull (1), sails and rigging, one steering system, at least one mast (2) and centreboard-rudder-foils (24,25), characterised in that, crosswise to said main hull (1) are mounted a pair of wing-section beams (3) with wing boxes (9,10) at a varying incidence angle, to which are orientably attached a plurality of sails (4) the top end of which is attached to the mast (2); that at least one pair of side peaks (19,20;26,27) with fin foils (21,22;28,29) are swingingly supported by said hull (1) and by said wing-section beam (3); and that there are provided means to manoeuvre said beams (3) peaks (19,20;26,27) and sails (4), so as to suitably orient wing boxes (9,10), fins (21,22;28,29) and sails (4), the sails (4) and rigging and the steering system being repeatable on the two sides of the boat.

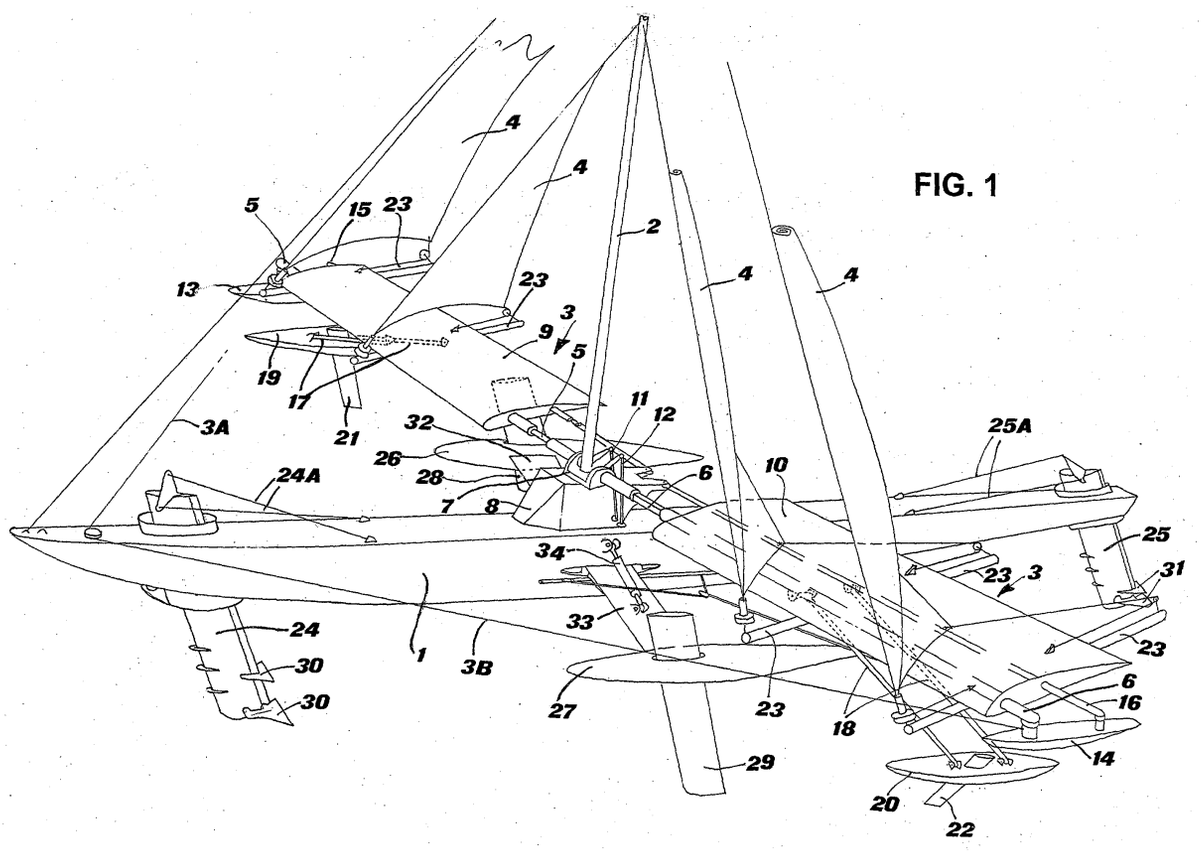

FIG. 1

EP 1 557 350 A1

Description

[0001] The present invention relates to a high-performance multihull yare sailing boat using wing sections and lifting sails.

[0002] It is known that today people aim to achieve high speeds on water by means of hulls or multihulls equipped with sails, wings and "kites", both in the open sea during long regattas, and in placid waters. In that regard, special speed races have also been held along short and sheltered courses, such as at Way-mouth, in Cornwall, to which a variety of different vessels took part.

[0003] In some of these vessels (monohulls and winged catamarans, kite-propelled hulls, particularly flexifoil-train-propelled ones, kite-drawn sailing boards) the upward wind flow was exploited. This allowed, indeed using "kites" for example (especially flexifoil ones), to produce boats which are lifted, as well as being pushed. Extensive and in-depth information on such boats is found in the well-known specialised magazine "Yachting World". The matter can be investigated further in particular by looking up the issues of May 2002 and November 2003 of said magazine, which report in detail and with plenty of photographs on the subject.

[0004] However, as emerges from this publication too, the results for yare boats, significant as they are, so far have not been truly satisfying, except perhaps in sailing boards.

[0005] As a matter of fact, while flexifoil-train-propelled mono-hull boats - potentially perhaps the ones most capable of achieving high speeds - are particularly difficult and awkward to launch and steer, multihull ones are penalised by their high weight and by the strong resistance offered to the wind flow by their hull-linking structures. Nor are solutions known up until today - despite the great variety of the extremely sophisticated solutions adopted - capable of effectively counterbalancing vertical sail moments which weigh down the outer hull.

[0006] The present invention now aims instead at fully exploiting the principle of using the upward wind flow to "lift" a sailing boat in the manner and time apt to guarantee its utmost performance, thereby achieving the desired results.

[0007] To that purpose, the present invention relates to a multihull yare sailing boat of the type having at least one main hull, sails and rigging, one steering system, at least one mast and centreboard-rudder-foils, characterised in that crosswise to said main hull are mounted a pair of wing-section beams with wing boxes with a varying angle of incidence, to which are orientably attached a plurality of sails, the upper end of which is attached to the mast; that at least one pair of side peaks with fin foils are swingingly supported by said hull and by said wing-section beams; and that there are provided means to manoeuvre said beams, peaks and sails, so as to suitably orient wing boxes, fins and sails, the sails and rigging and the steering system being repeatable on the two sides of the boat.

[0008] In a currently preferred embodiment of the present invention, the boat features a single main hull with a single mast, two wing-section beams with a varying angle of incidence aligned and orientable about a vertical axis, the structure of the boat and of its sails and rigging and steering system being fully symmetrical. Such boat is fitted with a pair of side peaks with fin foils swingingly and orientably supported by said wing-section beams of said boat and possibly by a pair of side peaks with fin foils linked to the main hull by at least one wishbone.

[0009] In an alternative embodiment of said boat three main hulls are provided lying side by side with a single mast mounted on the central hull and at least the first beam of said pair of wing-section beams is rotating about an axis parallel to said mast and located in front of it, while the second beam comprises a plurality of longitudinal rails wherein are sliding and lockable the restraints of the head sheet angles of the jibs of said sails and rigging, the clew angles of which are attached to the first beam. Preferably, the first beam is of a varying length, comprising two mutually sliding parts between which are interposed elastic means, while the second beam is sliding transversally to said hulls to arrange itself asymmetrically in respect of the boat on both sides thereof.

[0010] Preferably again, said second beam is curved with its concave side facing upwards. Furthermore, it can be equipped with a rail to restrain the sheet angle of a mainsail.

[0011] The invention will now be described in further detail, by way of a non-limiting example, with reference to the currently preferred embodiments mentioned above, taken in conjunction with the accompanying drawings wherein:

fig. 1 shows - in a perspective front-side view - a single main-hull yare sailing boat representing a first embodiment of the present invention;
fig. 2 is a plan view of a second embodiment of the yare sailing boat with three main hulls, according to the invention;
fig. 3 is a substantially raised front view of the boat of fig. 2;
fig. 4 shows in detail, in a plan view, the rotating beam of the boat of figs. 2 and 3, of which
fig. 5 is the cross section view.

[0012] A first embodiment of the invention, which is currently preferred, is shown in fig. 1. The illustrated boat comprises, in a manner known per se, a main hull 1 equipped with a mainmast 2, sails and rigging and a steering system, as well as centreboard-rudder-foils.

[0013] According to the invention, across the main hull a pair of beams 3 is provided comprising wing boxes, orientably mounted at an angle of incidence, which

extend over the two hull edges and represent fixing elements for a series of jibs 4, mutually spaced and with different tilting angles, attached from above to the mast 2.

[0014] More precisely, the wing-section beams 3 comprise two opposed bearing booms 5 and 6, rotatingly mounted about their own axis on a central holder 7, which in turn rotates about the step 8 of the mast 2 about a vertical axis (coinciding, in the embodiment shown, with that of the mast 2). The orientation of the beams 3 with the holder 7 is controlled by ropes 3A and 3B to adjust it according to the wind direction. Furthermore, with the booms 5 and 6 are integral the respective wing boxes 9 and 10.

[0015] In correspondence of the central holder 7, the bearing booms 5 and 6 are controlled so as to vary their angle of incidence by suitable manoeuvring members 11 and 12 which may be operated by the crew.

[0016] In this way it is possible to determine independently on both boat edges the angle of incidence of the two wing boxes 9 and 10.

[0017] Preferably, the bearing booms 5 and 6 project from the ends of the wing boxes 9 and 10 to support the displacing end peaks 13 and 14, capable of counteracting the sinking of the end of the beams 3 on the lee side.

[0018] Preferably again, these peaks 13 and 14 are orientably mounted within the plane of the wing-section beams 3. To that purpose, the peaks are rotatingly mounted in respect of the bearing booms 5 and 6, two manoeuvring rods 15 e 16, respectively, being further provided sliding inside the wing boxes 9 and 10 and restrained to the rear part of the peaks by a hinge. The manoeuvring rods 15 and 16 are mutually restrained to ensure that the two peaks 14 and 15 are parallel in any orientation condition of the beams 3 obtained by the ropes 3A and 3B.

[0019] According to a preferred embodiment, below each wing box 9 and 10 is hinged a pair of support rods 17 and 18, of auxiliary peaks 19, 20 equipped with a fin foil, 21, 22, respectively.

[0020] The fin foils 21, 22 are shaped so as to ensure increasing lift for an increasing sinking of the foil, thereby supplying a force which progressively counters leeside capsizing. To further avert capsizing, the already mentioned displacing peaks 13 and 14 are anyway provided at the ends of the wing-section beams 3.

[0021] The jibs 4 are restrained together above by the mast 2 and below, at a certain distance from one another, by respective booms 23, which are in turn fixed to the wing-section beams 3 by crew-operated means. Preferably, the stay of each jib 4 is equipped with a jib roller of a known type.

[0022] Finally, on the main hull 1 are provided two centreboard-rudder-foils, a front one 24 and a rear one 25, while the same hull 1 is flanked by a pair of hulls 26 and 27 with side fins 28, 29, respectively.

[0023] The front and rear centreboard-rudder-foils 24 and 25 of the main hull 1 are orientable about their own axis one in the opposite direction to the other by means of ropes 24A and 25A controlled by a pedalboard and therefore they act as rudders. Said fins are provided with horizontal foils 30 and 31, tiltable to control the lift and lift decrease, to facilitate lifting of the hull and exploitation of the wave motion.

[0024] The side hulls 26 and 27 are mounted up-and-over, by means of linking arms 32, 33 on the two edges of the main hull 1. The angle of up-and-over motion of the hulls 26 and 27 is determined by suitable manoeuvring means, such as hydraulic pistons 34. The fins 28 and 29 are mounted preferably sliding in a respective step of the same hulls, so as to be drawn out or retrieved to the desired measure.

[0025] The functioning of the yare sailing boat described above will now be briefly described in the following, highlighting especially the advantageous effects of the original teaching of the invention, with reference to the synergistic combinations which may be developed by the different components of the boat itself.

[0026] The hull 1 is very long because, as long as it does not lift over the fin foils (which only happens at high speeds), the speed depends on its length. Once the hull has acquired speed, the front foils 30 and the rear foils 31 are incidence-adjustable - by means of a "control stick" (not shown) - to adjust the displacement of the boat in the desired measure. As well as in order to obtain this consistent effect, i.e. developing same-direction forces, the front and rear foils may also be manoeuvred to function in a discordant manner (for example with different deflection entities) so as to supply nose-diving moments or zooming moments of the main hull.

[0027] When wind flow speed increases, since the sails and rigging - as is traditionally known - determine of their own accord an unstable balance, it is possible to intervene onto the leeward sails and onto the respective traits of the wing-section beams to increase the lift thereof and obtain a rectifying countermoment. Concerning that, it must be noted that, thanks to the lifting inclination of the jibs, it is possible to always have a component of the upward aerodynamic force and therefore apt to lift the boat and to diminish the capsizing moment. Furthermore, the windward sails can be suitably arranged so as to develop a certain lift decrease and thus further increase the countermoments.

[0028] The lift on the wing-section beams 3 is favourably increased by the "jibs effect" and by the "ground effect", especially when the beams approach the water free surface on the lee side. This allows to diminish the inclination of the sails, increasing the propulsive thrust that these are capable of developing. To the same effect contribute the sails inserted on the windward wing-section beams and the countermoment developed by the side fin foils.

[0029] The sum of the lift effects is perceived in a particularly effective manner in those cases in which the wind flow accelerates quickly, causing a rapid leeward inclination towards the water, thus making agreeable the

behaviour "under gusts of wind" of the boat according to the invention.

[0030] In figs. 2 and 4 is shown a second embodiment of the boat according to the invention.

[0031] In this case the boat is of the trimaran type with three main hulls 41A, 41B and 41C with main mast 42 on the central hull 41A and comprises a first wing-section beam 43 hinged on a vertical axis 43A about which it can rotate, located in front of the mast 42 and in its proximity, and a second wing-section beam 44, mounted transversally to the longitudinal axis of the hulls 41A, 41B and 41C, capable of sliding in respect thereof.

[0032] The first beam 43 comprises a wing box 45 which is mounted sliding over a relatively short trait and which rotates by modest angles with respect to its bearing boom 46, hinged in 43A, between the two parts 45 and 46 of the beam 43, there being interposed elastic means 47 (fig. 4). Along the same beam 43 are fixed to the wing box 45 the clew angles of the jibs 48, 49 and 50.

[0033] The second wing-section beam 44, mounted - in the embodiment of fig. 2 - behind the mast 42, is equipped with a series of rails 51, 52 and 53 wherein are sliding and lockable the sheet angles of the three jibs 48, 49 and 50 without boom. As can be clearly seen in fig. 3, the wing-section beam 44 features a certain curvature of the vertical plane which makes it upwardly concave and slides - thanks to pairs of vertical rollers 54, 55, 56 and 57, mounted on the side hulls 41B and 41C of the boat - from the position shown in figs. 2 and 3 to the symmetrical position. Thus it can be made to project from either of the two side hulls 41B and 41C, to repeat on the two sides of the boat the arrangement of the sails and rigging, the beam 44 being elastically restrained to the central hull 41A by elastic ropes 44A.

[0034] To resist the lifting forces imparted by the jibs 48, 49 and 50, the wing-section beam 43 is restrained below by means of a sheet, a downhaul or other restraint sliding within an arc-of-a-circle rail 58, located between the hulls 41A, 41B and 41C (fig. 2) and linking the same.

[0035] The sails and rigging are completed by a mainsail 59, equipped with a respective boom 60, itself sliding within a suitable rail 61 of the cross wing-section beam 44 (and shown by figs. 2 and 3 in the position of normal speed - continuous lines - and in that of high speed sailing - discontinuous lines).

[0036] At normal speed this embodiment allows to keep - for the boat according to the invention - a substantially traditional and symmetrical configuration, wherein the first wing-section beam 43 is aligned with the main hull 41A, and the jibs 48, 49 and 50 operate on the two sides of the boat, suitably shifting - for the necessary adjustments - the sheet angles along the rails 51, 52 and 53, while the mainsail 59 takes up the central continuous-line position.

[0037] At the same time, the invention allows to drastically change such configuration, rotating the beam 43 leeward. This causes the outward move, towards a side of the boat, of the clew angles of the jibs 48, 49 and 50, while consequently also the sheet angles of the same jibs are induced by the wind to move outwards with the beam 44, the curvature of which adapts to the positioning of the jib tacks in the lifting condition. At the same time the boom 60 of the mainsail 59 moves leewards.

[0038] In figs. 2 and 3 the whole sails and rigging - as was already mentioned, however - are shown in two distinct operating positions, one to be used for light winds (traditional, substantially symmetrical configuration) and the other for strong winds, wherein the jibs 48, 49 and 50 and the mainsail 59 are arranged with a tilted attitude so as to give the resulting forces an upward lifting component of remarkable intensity.

[0039] As is evident from the preceding text and as can be noticed from the drawings (figs. 2 and 3), in order to adequately tilt the jibs in the lifting function, the beam 43 is rotated leewards.

[0040] The fact of being able to tilt upwards the force resulting from the aerodynamic forces acting on the sails and rigging, as already previously mentioned, obtains the twofold effect of creating a lifting component and of reducing the capsizing moment leewards: all this contributes to a better exploitation of the aerodynamic forces and to making the boat faster.

[0041] Advantageously, also the two wing-section beams 43 and 44 offer an upward aerodynamic component, which is greater on the lee side, where also the first rotating beam 43 is located.

[0042] In particular, this beam 43 has a bearing section and - although it normally offers a wider angle to the wind, being swept over by the deviated flow of the jibs - accentuates the rectifying moments of the ground effect and of the jibs effect.

[0043] The wing-section beam 43 is shown in detail in figs. 4 and 5. They show very clearly how the wing box 45 of this beam is mounted translatable on the bearing boom 46 hinged in 43A, so as to be able to adapt the overall length of the beam 43 to the different requirements. Such adaptation is eased by elastic means 47 and allows the translation of the sheet points of the jibs 48, 49 and 50, in particular to facilitate their lifting function. From the same figs. 4 and 5 it can be clearly seen how the beam 43 comprises, on both sides, leading edge slat 62 and extension flaps 63, the control of which effectively combines with possible modest rotations of the wing box 45 on the boom 46 (to adjust its incidence) to the purpose of varying the lift of the beam 43 itself. In other words, the beam 43 can take up bearing or negative lifting attitudes on the two edges.

[0044] It can be concluded that, in the boat according to the embodiment of figs. 2 to 5 of the invention, when the force exceeds the steady state values, for instance under gusts of wind, the beam 43 extends, shifting outwards the clew angles of the jibs 48, 49 and 50, while the corresponding sheet angles of the same jibs also move outwards, locked onto the rails 51, 52 and 53 of the beam 44: this temporarily increases the inclination of the jibs - which have a more marked lifting function,

thereby reducing the capsizing moment acting on the boat.

[0045] Fig. 3 finally shows a pair of safety peaks or foils 64 and 65 mounted at the ends of the winged cross beam 44 to provide further contrast, upon contact with water, to the capsizing moment.

[0046] Since with strong wind the sails and rigging are shifted leeward, as can be guessed, the presence of other windward structures (wings, stays, booms, etc.) is greatly reduced, to the advantage of flow cleanliness and aerodynamic efficiency.

[0047] The hulls are completed - as already shown for the previous embodiment - by a series of suitably arranged and oriented foils and fin foils, such as the fin foils 66 and 67 of the side hulls 41B and 41C and the centreboard-rudder-foils 68 of the hull 41A.

[0048] The embodiment of the invention described above allows to achieve the objects detailed in the preliminary remarks, namely to supply a boat manoeuvrable in the most effective way and without too much effort, and capable of best exploiting the wind flow. Said boat thus allows to achieve high speeds, leaving unchanged the tacking capability, not to the detriment - more in general - of comfort and of the effectiveness of the manoeuvre.

[0049] It is understood, however, that the invention is not limited to the particular embodiments illustrated above, which represent only non-limiting examples of the scope of the invention, but that a number of changes to the described and illustrated boat are possible, all within the reach of the expert in the field.

Claims

1. Multihull yare sailing boat, of the type having at least one main hull, sails and rigging, one steering system, at least one mast and centreboard-rudder-foils, **characterised in that** crosswise to said main hull are mounted a pair of wing-section beams with wing boxes with a varying angle of incidence, to which are orientably attached a plurality of sails, the upper end of which is attached to the mast; that at least one pair of side peaks with fin foils are swingingly supported by said hull and by said wing-section beams; and that there are provided means to manoeuvre said beams, peaks and sails, so as to suitably orient wing boxes, fins and sails, the sails and rigging and the steering system being repeatable on the two sides of the boat.

2. Multihull boat as claimed in claim 1) wherein it is provided a single main hull with a single mainmast and there are provided two wing-section beams with a varying angle of incidence aligned and orientable about a vertical axis, the structure of the boat and of its sails and rigging and steering system being fully symmetrical.

3. Multihull boat as claimed in claims 1) and 2) wherein there are provided orientable front and rear centreboard-rudder-foils of the main hull.

4. Multihull boat as claimed in claims 1) to 3) wherein it is further provided a pair of side peaks with fin foils swingingly and orientably supported by said wing-section beams.

5. Multihull boat as claimed in claims 1) to 4) wherein it is further provided a pair of side peaks with fin foils linked to the main hull by at least one wishbone.

6. Multihull boat as claimed in claim 5) wherein said wishbone is controlled by a fluid-effect cylinder-piston unit.

7. Multihull boat as claimed in claim 1) wherein there are provided three main hulls side by side with a single mainmast on the central hull.

8. Multihull boat as claimed in claims 1) and 7) wherein at least the first beam of said pair of wing-section beams is rotating about an axis parallel to said mast and located in front of it, while the second beam comprises a plurality of longitudinal rails wherein are sliding and lockable the restraints of the sheet angles of the jibs of the sails and rigging, the clew angles of which are attached to the first beam.

9. Multihull boat as claimed in claims 1) and 7) wherein said first rotating beam is of a varying length, comprising two mutually sliding parts between which elastic means are interposed.

10. Multihull boat as claimed in claim 1) and in claims 7) to 9) wherein said second beam is sliding transversally to said hulls both in order to arrange itself asymmetrically in respect of the boat on both sides thereof, and to allow further elastic movements for further inclination of the jibs.

11. Boat as claimed in claim 10) wherein said second beam is curved and its concave side faces upwards.

12. Boat as claimed in claims 1), 7) and 8) wherein said second beam comprises at least one rail to restrain the sheet angle of a mainsail.

13. Multihull boat as claimed in claims 1) to 6) wherein the orienting of the sails is obtained by means of orientable booms crosswise restrained by said wing-section beams.

14. Boat as claimed in claim 1) and in claims 7) to 9) wherein said first rotating beam is restrained below by an arc-of-a-circle rail linking the three hulls of the boat.

15. Boat as claimed in claim 1) and in claims 7) to 9) wherein said first beam consists of a translatable wing box rotating over a bearing boom and comprises, on both sides, leading edge slats and extension flaps.

16. Boat as claimed in claim 10) wherein said second beam is mounted sliding thanks to pairs of vertical rollers mounted on the main side hulls.

FIG. 1

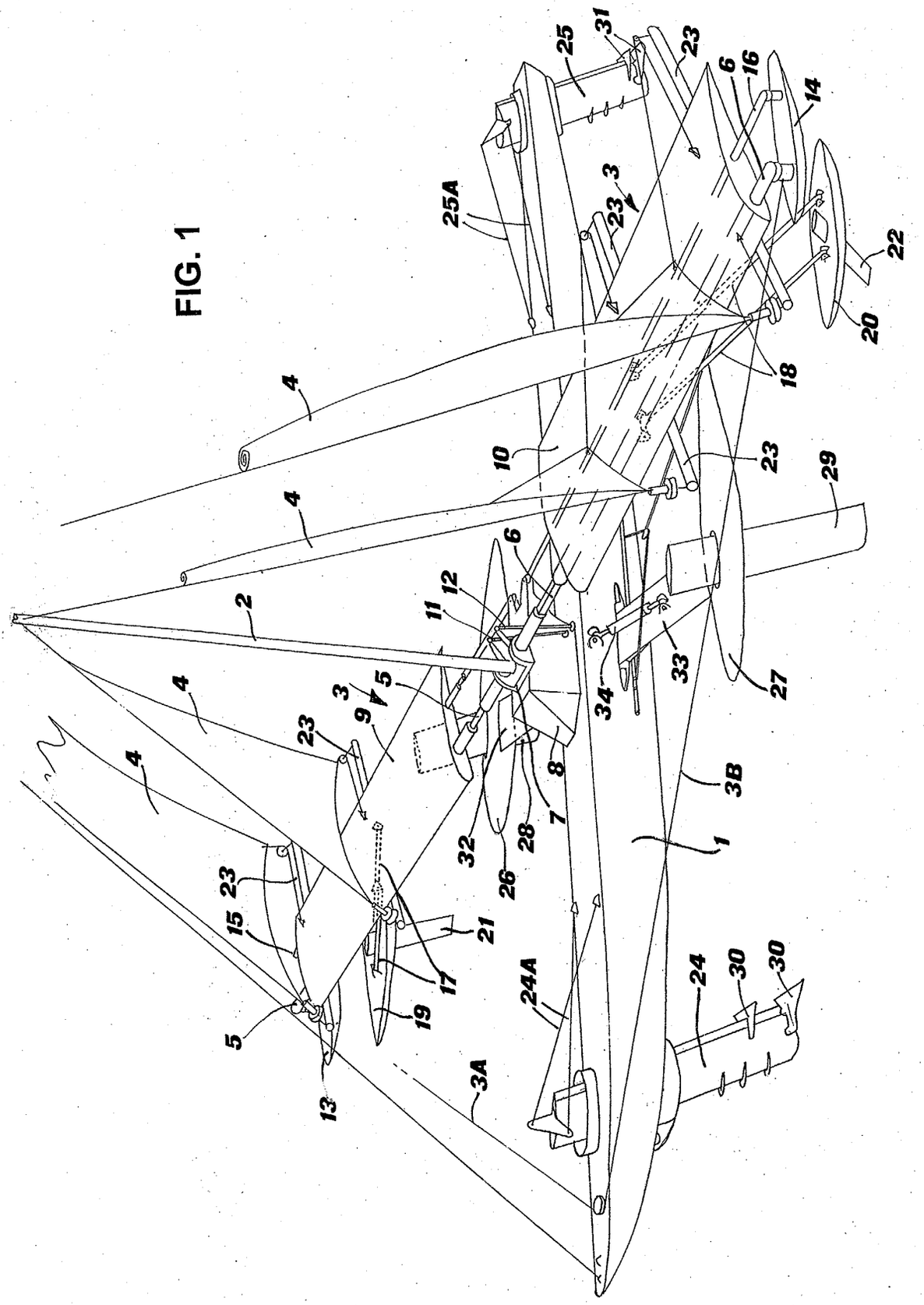
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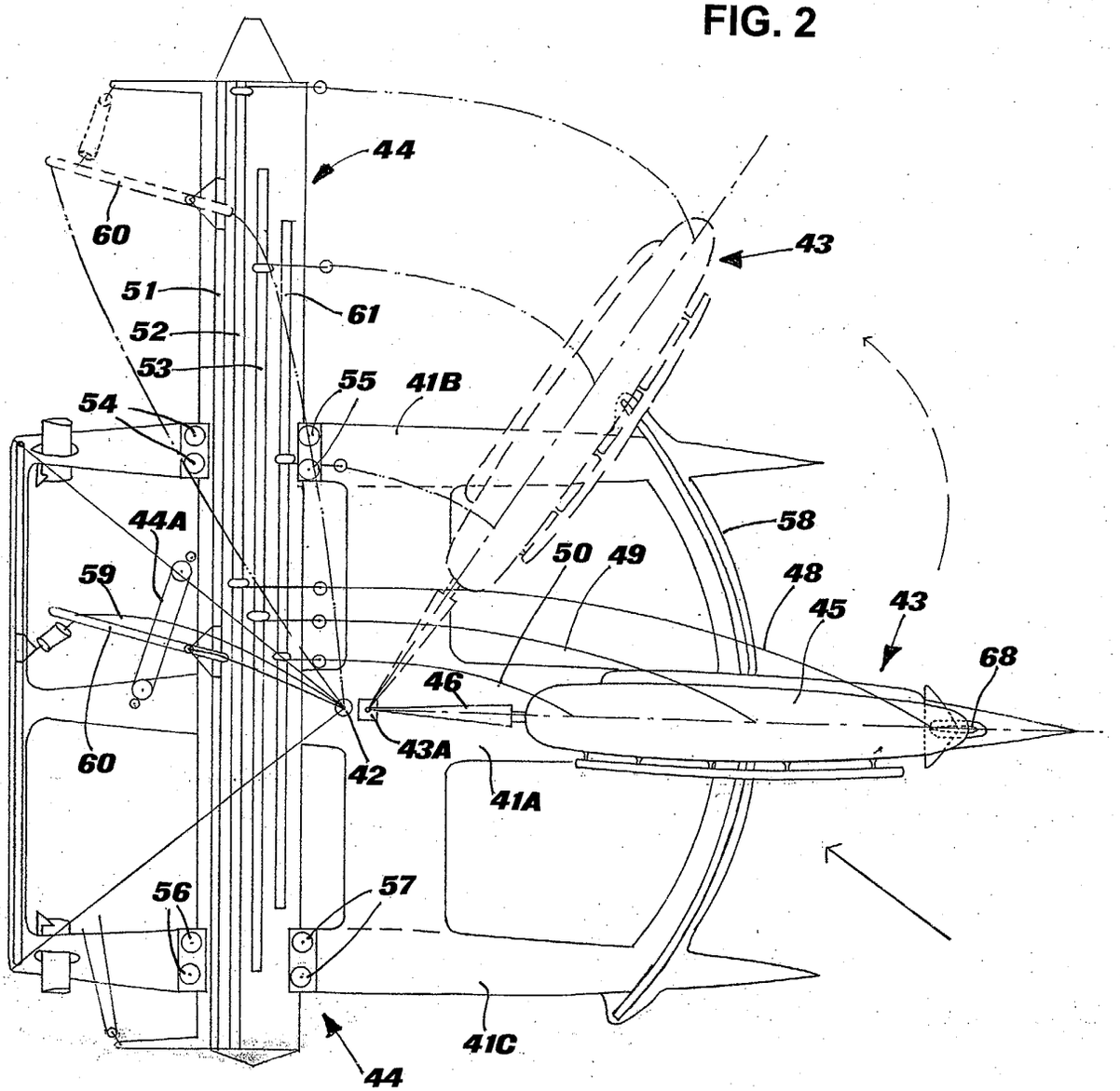
FIG. 2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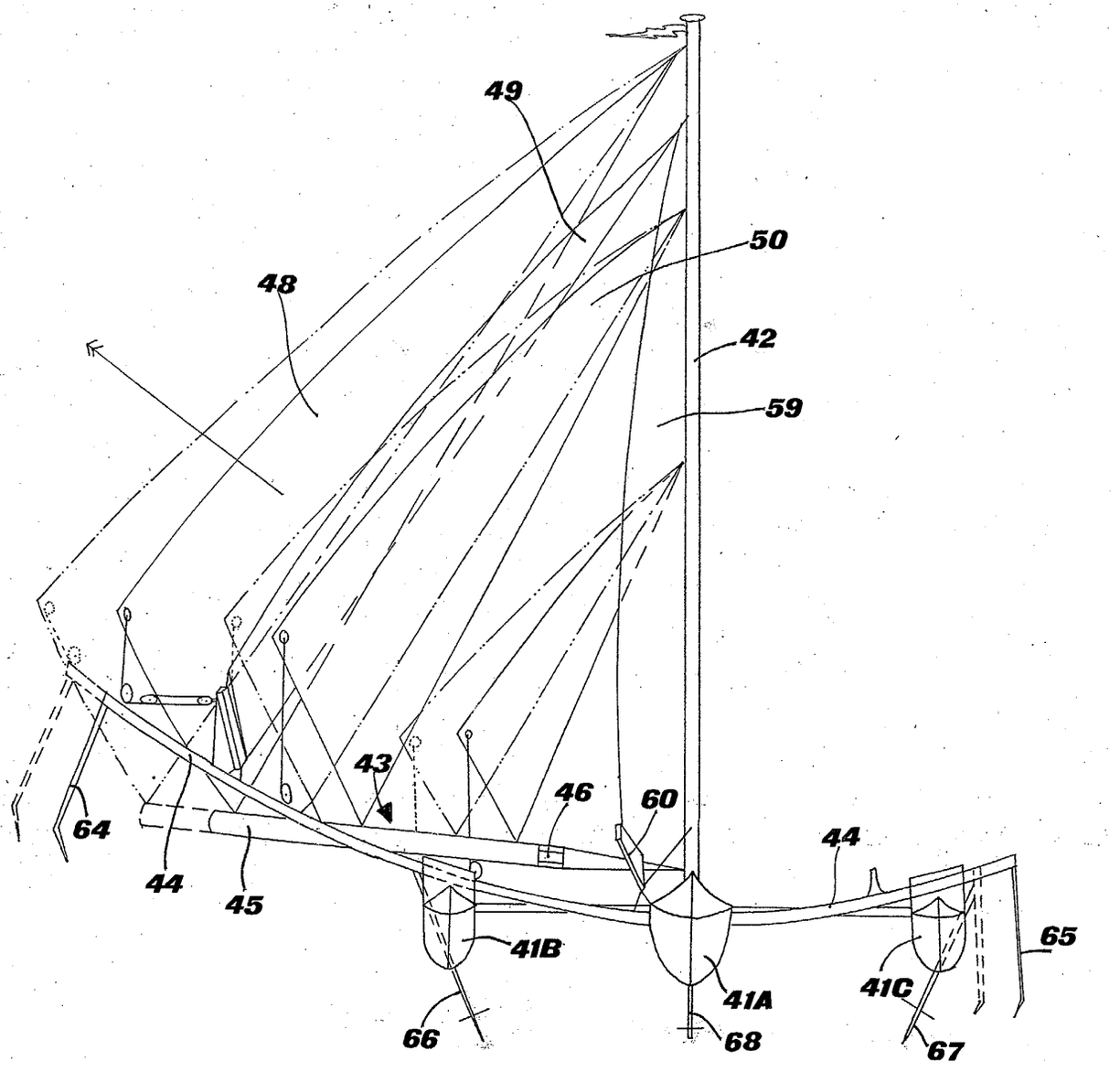

FIG. 3

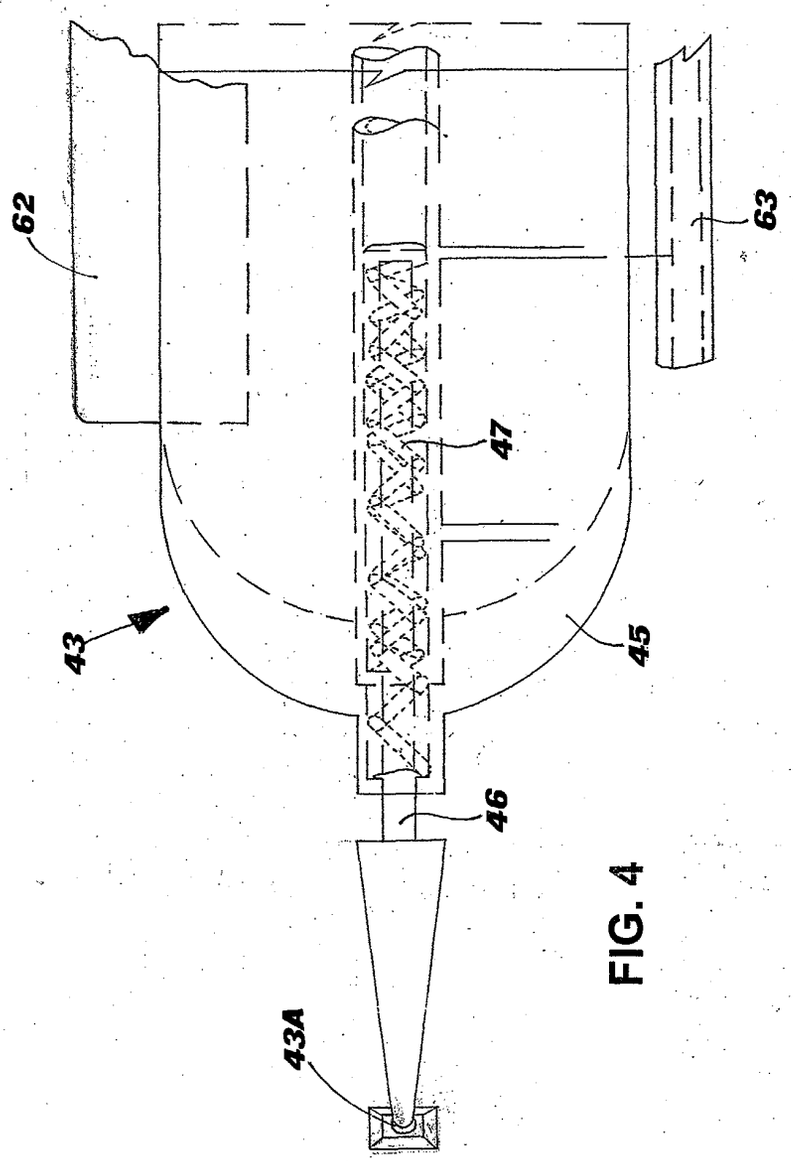

FIG. 4

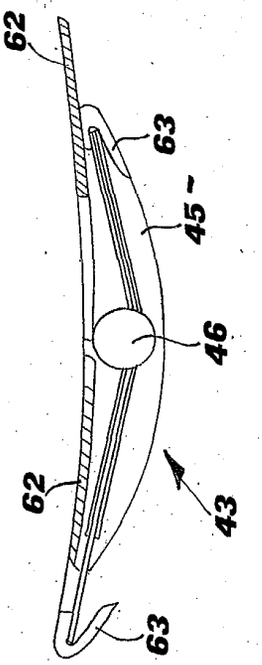

FIG. 5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 42 5039

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	25 June 2004	Vermeulen, T

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