This invention relates to a sailboat of the catamaran type which has a pair of pontoons or hulls which resemble, more or less, the hull of an airplane are secured fore and aft to the lateral edges of a deck and are supported in flight by a longitudinal arrangement of surface-piercing hydrofoils. These hydrofoils are positioned slightly aft of the center of gravity, on or slightly ahead of the aerodynamic center of pressure of the sail system and the boat is directed, trimmed and stabilized longitudinally by means of a pair of guidance and stabilizing hydrofoils located at the bow of the hulls. This sailboat can be operated either as a conventional sailboat or as a hydroplane in the event that ample wind velocity is available.

As will appear from the detailed description which follows, the more important objects of the invention are comprised as follows:

First—to provide a sailboat that is capable of attaining exceptionally high speeds yet being useful and enjoyable in light weather.

Second—to provide a sailboat that can maintain its own trim without complicated mechanism or adjustment by the pilot or crew.

Third—to provide a sailboat that has superior pointing capability and is easily controlled as to direction.

Fourth—to provide a sailboat that can be easily docked, safely flown at high speeds, handled and transported more easily and which is low in cost.

With these and other objects in view, my invention consists in the novel features and advantages of construction and arrangement of parts which will be more fully understood from the following specifications, reference being had to the accompanying drawings wherein:

FIG. 1 is a conventional view, in side elevation, showing the relative positions of the various hydrofoils and other elements;

FIG. 2 is a view, in side elevation, of the sailboat shown in FIG. 1;

FIG. 3 is a top plan view looking downwardly on line 3—3 of FIG. 1;

FIG. 4 is a view in perspective showing, conventionally, the relative positions of the hull and deck centerboards or keels, the spaced fuselage shaped pontoons or hulls, the guidance and stabilizing hydrofoils, control means therefore, main lifting hydrofoils and other details;

FIG. 5 is a sectional end view showing, in detail, a main lifting hydrofoil and a detachable band adapted to secure it to a respective hull;

FIG. 6 is a detailed view showing a quick release for the band;

FIG. 7 is a detailed view showing means to attach a lifting hydrofoil to a respective band by inserting therebetween a frangible fail safe element;

FIG. 8 is a broken away view of a mainsail showing means to attach it to a mast and associated streamlined shaft or fairing;

FIG. 9 is an enlarged view, in detail, of a sail track formed in the mast and an associated sail and mast fairing;

FIG. 10 is an enlarged view, partly in section, showing a quick detachable rotary support for a stabilizing hydrofoil;

FIG. 11 is a front elevation view of the deck mounted centerboard;

FIG. 12 shows, in detail, a hull mounted centerboard or keel which is retractable and shockproof;

FIG. 13 is a sectional view on line 13—13 of FIG. 12;

FIG. 14 is a detailed side view, partly in section, of the centerboard mounted on the rear deck in a manner to be either retracted or adjusted about its vertical axis, and FIG. 15 is a top plan view, in detail, showing a triangular shaped plate or deck section hingedly mounted adjacent to the forward edge of the rear deck and which supports a vertical bearing for the centerboard shaft.

Referring to the drawings in detail, the present invention is illustrated by a sailboat according to the present invention and with particular reference to FIGS. 1 to 3, comprises, as the main elements thereof, similar fuselage shaped pontoons or hulls 1 and 2, a rear deck 3, a forward deck 4, a pair of similar guidance and stabilizing hydrofoils 5 and 6, a pair of main similar lifting hydrofoil units 7 and 8, a deck mounted centerboard 9 and hull mounted centerboards 10 and 10' .

A mast 11 and a boom 12 serve to support a mainsail 13. A common form of rigging 14 is operatively connected to the mainsail while the boom is controlled by a sheetline 15 the free end of which is releasably secured to a head 16 shown in FIG. 4. A hollow strut 17 of streamline cross-section is connected to and between the forward ends of the hulls. Each hull is provided with a plurality of openings 18 forming cockpits to afford access to seats 19 and a canopy 20 covers, preferably, the forward pairs of cockpits.

**Deck Mounted Centerboard**

The deck mounted centerboard 9, shown in FIG. 14, is affixed to a rotatable shaft 21 mounted in a suitable bearing 22 and this centerboard, preferably, is streamlined in cross-section. This centerboard and shaft unit is adjustable to various positions by means of a control lever 23 and this lever can be locked in various positions of adjustment thereof by means of a detent 24 mounted on the lever in a manner to engage a series of detents 25, deck mounted. The centerboard, as shown in FIG. 14, may be swung to assume a retracted position parallel to the deck. A triangular shaped plate 26 serving as a bearing support is pivoted at 27 to the deck and the bearing 22 is held rigidly by said plate. The plate 26 is positioned within an opening 28 formed in the rear deck. When the lever 23 is raised, and swung forwardly, the plate 26 will swing clockwise on the pivots 27 to permit the centerboard to be elevated to a position parallel to the deck. A suitable detent 27' is pivoted at 28' and on a lock pin P. Before raising lever 23, pin P is removed to permit 27' to swing a little counterclockwise. When lever 23 is vertical, the detent 27' is returned to its locking position and it will hold the lever 23 locked up. A pair of brace members 29 is secured as by welding to pivot lugs 30 and to the lower end of the bearing 22. The lever 23 may ride over the upper end of the bearing 22 or a collar 22' on this lever may rest on this bearing.

The centerboard hydrofoil, which is to be used when the boat is sailed in light weather as a conventional boat, extends some feet into the water vertically and has the unique feature of directional control. It can be directionally set in such a manner as to provide drift stabilization without the necessity of pointing the boat as in the case in conventional sailboats and is to be retracted when the boat is to be flown on the hydrofoil system. The hydrofoil centerboard rotates with the shaft 21 which is located in the hydro-dynamic center of the vertical hydrofoil system so that the various positions may be selected with minimum effort on the part of the crew operator.

**Hull Mounted Centerboard**

In order to assure a proper drift stabilization for the
type of hulls used on the sailboat disclosed when sailed as a conventional boat, an additional centerboard hydrofoil of special design is mounted in each hull at substantially the same location fore and aft as for the deck mounted centerboard hydrofoil. These hull mounting centers as 14 and 14' are adapted to be retracted into housings or boxes 31 and the left hand centerboard is shown in detail in FIGS. 12 and 13. Each box 31 is open at its upper end. The upper portion or end plate 32 of each centerboard normally remains completely housed within its respective box 31 and is formed to taper to provide a relatively wide upper edge. This end plate, if desired, may be thick enough to fit a little loosely within its respective box. A stud 33 projects from each side of the plate 32 at a point shown close to the hull bottom and each stud is arranged to slide upwardly within a slot or groove 34 formed in each side of the box 31. An elastic shock cord 35 connects the upper aft corner of the plate at 35' to a point 36 on the box. In order to retract the centerboard 10 shown, a cable 37 is connected at point 35' on the plate end 32 and is passed over pulleys 38 and 39 as shown. The lower end 40 of each hull centerboard is formed as shown in FIG. 13 more or less aerofoil in cross-section from its lower end up to the bottom of the hull. The left hand hull centerboard is shown in FIG. 13 as set at about a 5 degree angle of attack or angle of incidence with respect to a line parallel to the centerline of the boat or respective hull. The right hand centerboard is set, as to its 5 degree angle of attack, opposite to that of the left hand centerboard. The use of these hull centerboards will provide proper drift stabilization on the boat disclosed. By setting these two centerboards at the angle of attack described, additional effectiveness is obtained without increase of the drag so that one centerboard will perform the work of two with no angle of attack. The boat is sailed with only the leeward hull centerboard foil extended in addition to the deck mounted centerboard 9. The centerboard box is designed to just accept the centerboard plate 32 and loose enough to maintain its steady and is built strong enough to withstand the required side loads. After the centerboard is slid downwardly through the upper open box top with the studs 33 within the slots 34, the shock cord and the retracting cable are fastened in place. By merely pulling this retracting cable, the centerboard will pivot around the studs 33 clockwise to its horizontal position. Reversely, by merely paying out this cable the centerboard will be rotated in a counterclockwise direction by the elastic shock cord 35 and the weight of the lower centerboard end. This unique feature of yieldingly mounting a hull centerboard is an important part of my invention. If the centerboard strikes an object while in forward motion, it will be deflected aft and up out of the way or, if struck an upward blow or is forced upwardly, it will be displaced upwardly since it is not restrained as to position. A combination of these undesired forces acting upon the centerboard might very well occur and the easiest and simplest deflection possible will be had.

Lifting Hydrofoils

The main lifting hydrofoils 7 and 8 are located slightly aft of the center of gravity and on or slightly ahead of the aerodynamic center of the centerboard system. This hydrofoil system provides the main lifting force, supporting the boat in such a manner as to provide optimum maneuverability. Each lifting hydrofoil is removably mounted upon its respective pontoon by means of a band 41. To permit quick detachment, the free ends of the band are secured together in any manner by means of an old form of lever clasp or loop 42 pivoted mounted on one band end in a manner to engage a detent 43 affixed to the other cooperating band end. Each hydrofoil is secured to a respective band by means of two angular members 44 and 45 by means of bolts 46. In order to provide a fail safe feature, each member 44 and 45 is formed from Bakelite or similar frangible material. In the event that a hydrofoil unit engages an obstruction, the frangible supporting members will fracture in a manner to drop the unit to prevent damage thereto. A restraining cable 47 is used to prevent loss of the released hydrofoil unit. The hydrofoil is adjustably held on its respective hull by means of a spur gear 48 the teeth of which pass through an opening in the hull and engage holes 49 formed in the centerboard. The shaft of the gear can be rotated by an electric motor or by a hand crank placed within the hull. This novel form of band support permits the desired retraction of each hydrofoil while docking by merely releasing a clasp 42 to permit the unit to drop by its own weight. A main feature of the lifting hydrofoil is that it can be quickly detached and stowed away on the forward deck. When it is desired to sail as a conventional sailboat, these hydrofoils will be removed and all three centerboards will be used. However, when these hydrofoils are in use, the hull centerboards will remain retracted and need not be used.

Guidance and Stabilization System

The guidance and stabilization system comprises a similar pair of hydrofoil units 5 and 6 supported rotatably on one unit at each forward end of a respective pontoon. Referring to FIG. 10, a tubular shaft 49 is supported in a manner to be rotated within a pair of upper and lower fittings or bearings 50 and 51. A cable drum 52 is shown as affixed to said shaft to be rotated therewith and in a manner to be described. A second tubular shaft 53 is arranged within the shaft 49. In order to provide a means to effectually increase in unison or to permit the inner shaft 53 to be readily detached from the outer shaft 49, a cap 57 is mounted on the upper shaft ends with the circular cap flange 55 arranged to contact and rotate on the fitting 50. A bolt 56 is adapted to be passed through registering openings in both shafts and this cap. A metallic plate 57 is affixed to the lower end of the shaft 53.

To provide for a fail safe feature for each guidance hydrofoil unit, the upper end of each unit comprises a plate member 58 formed from Bakelite or similar frangible material which is secured by bolts 59 to a plate member 57. Each unit comprises side members 60 forming a V-shaped and a plurality of dihedral shaped vanes 61. In the event that either hydrofoil unit might meet with an obstruction, the respective frangible member will become shattered at some point close to a corresponding end of a plate member 57. A restraining cable 52 is provided to prevent loss of the detached hydrofoil.

An important feature of the invention is the provision of a guidance control whereby both guidance hydrofoils 5 and 6 can be rotated in unison from any one of the series of cockpits or by a crew member stationed on the deck. As shown in FIG. 4, an endless cable 63 is passed through the shaft 47 and is engaged around both drums 52 in the front hull ends that serve to rotate the shafts 49 and 53. A second cable 64 also engages, in the bight thereof, around a respective drum and the two cable ends are extended rearwardly to pass each cockpit in one hull thence around pulleys 65 and 65' to permit each of the sail to be accessible at a deck crewman position 66. At each cockpit, a foot operated lever 67 functions to control the cable 64. A third and similar cable 68 is provided to cooperate with each cockpit in the other hull and the free cable ends extend, also, to said crewman position 66.

 Mast Track and Streamlined Casting

The mast is formed with a track or channel 69 which is substantially closed except for a narrow opening.
through which the leading edge of the sail projects. A
bend 71 is formed on said leading edge by sewing or
otherwise securing a rope 72 into this edge. This rope
is solid enough to retain its shape as it is introduced
into the track and slid upwardly into position along the
full length of the mast.

As a means to reduce head resistance to the mast as
well as to reduce the formation of eddy currents around
the mast which might impair the efficiency of the sail
and affect air currents on the leading face of the mast, I
provide a fairing or casing 73 stream-lined in cross-
section in position to surround the mast. The trailing
edge of this casing is provided with a narrow opening 74
that receives the sail. If desired, the sail may be reinforced
along the zone thereof that engages the casing ends that
contact the sail. The casing is arranged to rotate freely
around the mast so as to follow all lateral movements of
the sail thereby to reduce the effects of the objectionable
eddy currents upon the sail. This mast casing will form
a continuation of the sail up to and somewhat in advance
of the mast.

In view of the foregoing detailed description, it should be
obvious that, in the boat disclosed, a reduction of wind
resistance and consequent increase in efficiency is
obtained due to such factors as housing the crew within
a canopy of streamlined mast shell and hulls as well as the use of a deck section and forward
cable housing strut that are of airfoil shape.

Longitudinal stability is obtained by locating the stabiliza-
tion hydrofoil system at the bow of catamaran hulls.
Each hydrofoil assembly is made up of foil elements of a
well known hydrofoil cross section, and of small cord for
efficient high speed operation. These elements shaped
with a decided dihedral are spaced vertically. Each
whole assembly thus forms a V shape and is mounted on
an axis tilted about 5° to keep the resultant hydrodynamic
forces on the foil system within the plane of the axis
while the boat is foil borne.

Each foil element, having the proper angle of inci-
dence, exerts a separate lifting force. The total lifting
force exerted at any time increases very rapidly with
the degree of submergence of the hydrofoil assembly. An
increase in the wind velocity momentarily increases the sail
thrust forward which tends to depress the bow of the
boat. The stabilization hydrofoil assemblies being sub-
merged to a greater depth will instantly exert a greater
lift, immediately counteracting this increased sail thrust
and thus re-establish the trim of the boat automatically.

Since the boat is supported primarily by the main lift
hydrofoil system just aft of the center of gravity, the trim
changes required by movement of the crew and varia-
tion in wind velocity will require little force to correct.
With this arrangement of these hydrofoil systems, es-
pecially effective trim control is realized.

The trim or stability is attained, first by reason of the
wide "tread" or distance between the main lifting hy-
drofoils made possible by the use of the catamaran type
boat and, second, because of the design of the main hy-
drofoil system.

This system is made up of two assemblies, one for each
hull, which have elements of a well known hydrofoil
section of small cord for efficiency at high speeds. These
lifting elements, or foil, are spaced vertically to eliminate
hydrodynamic interference between lifting surfaces, and
extend from the inner in the outer struts to which they
are welded. The elements are perpendicular to the outer
strut and therefore exert a total lifting force parallel to the
outer strut which increases with the degree of sub-
mergence of the assembly as a whole.

As the boat is subjected to a side load due to an
increase in wind velocity or a change in wind direction, the
leeward hydrofoil assembly will be depressed or sub-
merged to a greater depth. This increase in submergence
immediately increases the lifting force exerted by this foil
assembly which tends to right the boat. The sail force is
thus instantaneously counteracted with the result that the
boat is immediately stabilized in a natural manner with-
out any action on the part of the pilot or screw.

Variations in the direction of the sustaining force
can be attained by rotating the hydrofoil assembly about
the hull to different settings. This makes it possible, for
instance, to increase the efficiency of the system while
going before the wind, which requires no drift stabiliza-
tion, by rotating both the right and left hand assemblies so
that the lifting force is vertical to the surface of the
water. Each submerged element would be thus lifting to
its maximum efficiency.

When the boat is foil borne, drift stabilization is at-
tained by setting the windward main foil assembly so
that the lifting force is vertical while the leeward main
foil assembly is still working to oppose the sail force.
With this arrangement, the boat would actually "crab" to
the windward momentarily as the wind velocity would
intermittently diminish in intensity. This would also
achieve the most desirable objective of maintaining the
"apparent" wind direction constant without loss of head-
ing.

This same result is achieved when the boat is sailed as
a conventional catamaran by reason of the unique hydro-
foil centerboard arrangement on this boat. The windward
hull centerboard foil is lowered and the deck centerboard
foil is set at a 5° heading in the same direction as that
of the lee hull centerboard foil. With both of these exert-
ing a force counteracting the effect of the wind against
this sail, when this wind momentarily diminishes this side
force is correspondingly reduced and the boat thus un-
opposed would "crab" to the windward, thus gaining in
position closer to the wind. Again the secondary effect
of this action would make it possible to maintain a con-
stant "apparent" wind direction and continue to realize the
advantages of this efficient attitude of sail with respect to
wind direction.

The boat is supported substantially at its center of grav-
ity and therefore can be directionally controlled with
great efficiency. Since the guidance system is at the
bow of the boat, its turning moment is great and direc-
tional changes are easily made. In addition, the fact
that the guidance system is hydrodynamically balanced
further reduces the pilot effort required to turn the boat,
it responds instantaneously to the touch of the rudder
pedals.

Docking is made easy by means of the adjustable fea-
ture of the main lifting hydrofoil assembly attaching
band. This band, which normally holds the main lift
assembly securely in position, can be easily loosened and
the assembly can be repositioned vertically below the hull
to clear the side of the catamaran to come along side the
dock. This adjustment can be made quickly by simply
brought the boat into the wind, permitting the boat to
lose speed and settle into the water, at which time there
being no load on the assembly, it can be released and
placed in the desired position.

The breakway or fail-safe feature is important be-
cause it is necessary to entirely remove the hydrofoil as-
sembly from the boat rather than permit it to be disturbed
or displaced which might result in some adverse loads of
considerable magnitude. There is also a secondary ad-
advantage gained by this breakaway feature which concerns
the reduction of the probable damage to the basic hull
structure when encountering obstructions. As a result,
the boat can be more safely flown at high speeds.

This boat is constructed of lightweight low cost ma-
terial as fiber glass which assures an economy which is
reflected in low production costs and therefore a reason-
able purchase price. Also, the boat is simple in design
and has no complicated mechanism. A preferred width
of eight feet will permit safe road trailing.

While a preferred form of the invention is disclosed and
various details thereof, it is to be understood that various
modifications are contemplated such as would be included within the scope of the appended claims as follows:

I claim:

1. A sailboat of the catamaran type comprising a pair of spaced fuselage shaped hulls, a deck secured rigidly to and between said hulls, each hull being provided with a main lifting hydrofoil unit positioned slightly aft of the center of gravity of the respective hull, a quickly detachable means for supporting each of said units, said means comprising a band encircling each of said hulls, each band including a quick release device for opening either band to permit removal of the respective unit.

2. In a sailboat as set forth in claim 1 wherein the deck is provided with openings through which the bands are adapted to pass freely whereby, during docking of the boat, the units are permitted to drop by gravity upon operation of the quick release devices and extend vertically.

3. In a sailboat as set forth in claim 1 wherein each hydrofoil unit is supported by a respective band by means of an interposed frangible element whereby, if the unit meets with an obstruction, said unit will be released quickly from the band.

4. In a sailboat as set forth in claim 1 wherein a forward portion of the deck is formed aerfoil in shape in fore and aft section.

5. In a sailboat as set forth in claim 1 wherein the forward ends of the hulls are rigidly interconnected by a transverse strut, said strut being of aerfoil shape in a manner to provide lift during forward motion.

6. A sailboat of the catamaran type comprising a pair of spaced hulls interconnected by a deck, a guidance and stabilizing unit rotatably mounted on and at the forward portion of each hull, each unit having a cylindrical bearing member extending upwardly and rearwardly through a respective hull and terminating above the hull, a control sleeve support surrounding said bearing member, means to detachably interlock the bearing member to the control sleeve, a control element affixed to each sleeve and a cable engaged with both elements whereby rotation of either element will cause rotation of the other element.

7. In a combination as set forth in claim 6 wherein the upper ends of the bearing member and the control sleeve are provided with means for releasably locking the member and sleeve whereby removal of the locking member will permit quick detachment of a respective unit.

8. In a combination as set forth in claim 6 wherein each hull is provided with cockpits, a foot operable lever positioned at each cockpit, main control cables in engagement with each control element, an end of each control cable being connected to the foot levers in each hull whereby the control cables may be operated by any member of the crew.

9. In the combination set forth in claim 6, a streamlined strut rigidly connected to and between the forward ends of the hulls, the control elements being positioned adjacent respective ends of the strut and said cable being located within the strut.

10. In the combination set forth in claim 6 wherein a frangible element is positioned between the upper end of each unit and a respective cylindrical bearing, said element being adapted to break in a manner to release the unit in the event that a respective unit encounters an obstruction.

11. A sailboat of the catamaran type comprising a pair of spaced hulls interconnected by a deck, said deck being provided with an opening, a deck section pivotally mounted in said opening in a manner to swing downwardly and rearwardly, a centerboard having a vertically extending shaft, a bearing mounted on said section, said shaft being rotatably supported within the bearing, a rearwardly extending handle on said shaft for swinging the centerboard laterally, said handle being operative, when moved upwardly and forwardly, to swing the centerboard rearwardly to a retracted position close to the lower side of the deck.

12. A sailboat of the catamaran type comprising a pair of spaced fuselage shaped hulls, a deck secured rigidly to and between said hulls, each hull being provided with a main lifting hydrofoil unit positioned substantially intermediate of the ends of the hull and on or slightly ahead of the aerodynamic center of pressure of the sail system but slightly aft of the center of gravity of the boat, each main hydrofoil having a pair of lateral supports connected to opposite sides of a respective hull and converging downwardly, a guidance and stabilizing unit of the hydrofoil type positioned on and below the forward end portion of each hull each guidance unit comprising transverse vanes decreasing in area downwardly whereby depression of the bow due to an increase in wind velocity and sail thrust will be counteracted by an increased lift on the bow and due to increased submersion of said stabilizing units, each last named unit being rotatably mounted on a respective hull and control means for rotating said last named units in unison.

13. A sailboat of the catamaran type as set forth in claim 12 wherein a shaft is rotatably mounted on each of the forward hull ends and being extended downwardly to a point below the respective hull end, each stabilizing unit being supported on the lower end of a respective shaft, the control means being associated with said shafts and including an operating element therefor which is extended to an operating position on the boat.

14. A sailboat as set forth in claim 12, a band encircling each hull and being adjustably mounted thereon, the main lifting hydrofoil units being supported on said bands and means for adjusting the position of each band and the hydrofoil supported thereon while the sailboat is in flight.

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