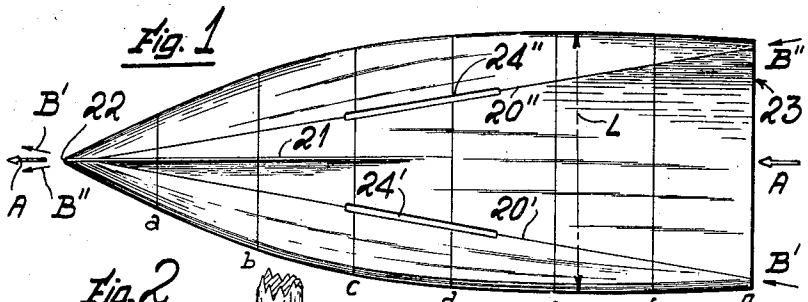
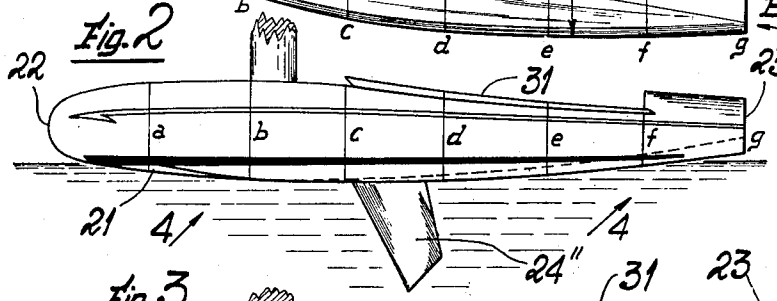
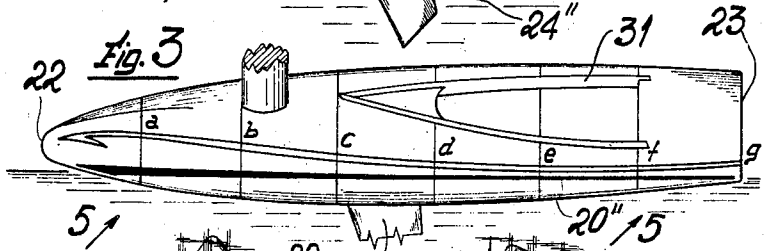
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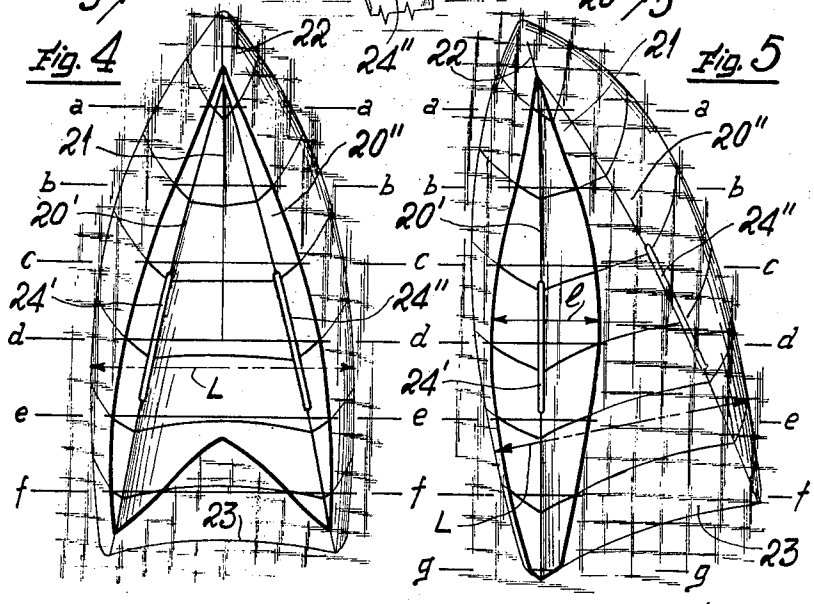
SAIL-BOAT

Filed July 21, 1959 3 Sheets-Sheet 1




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SAIL-BOAT

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Fig. 6A

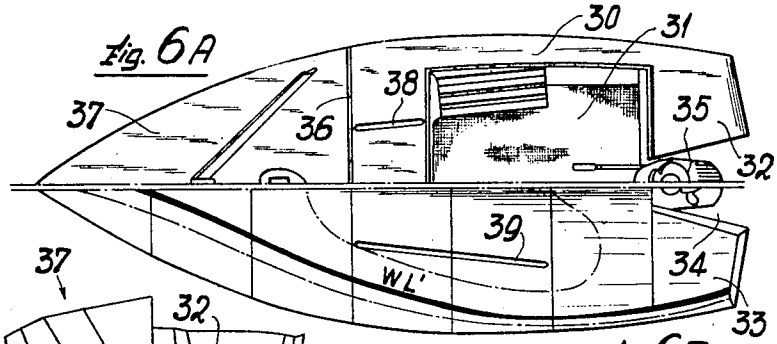



Fig. 6B

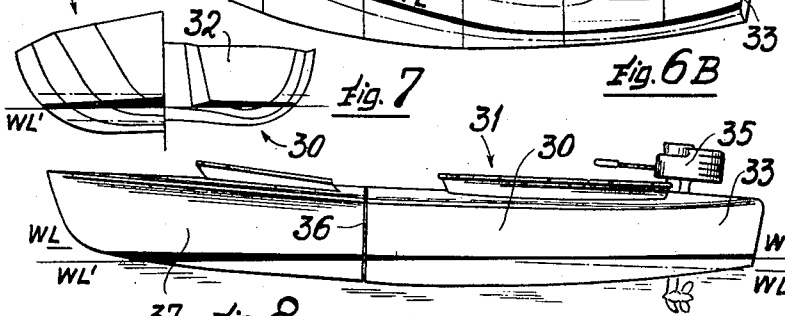



Fig. 7

Fig. 8

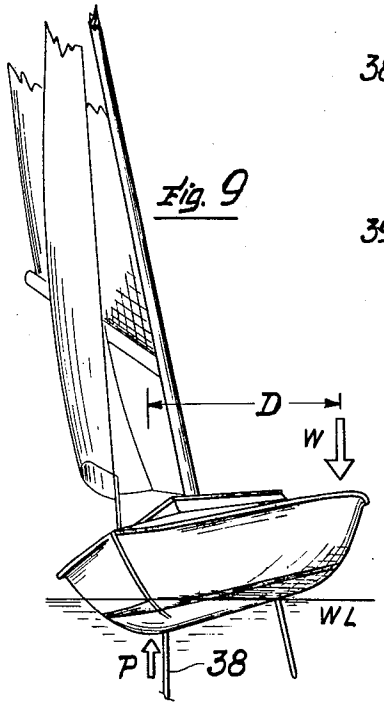



Fig. 9

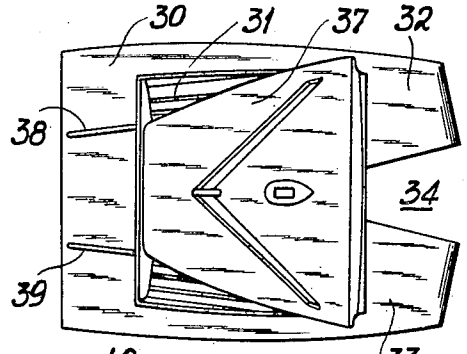



Fig. 10

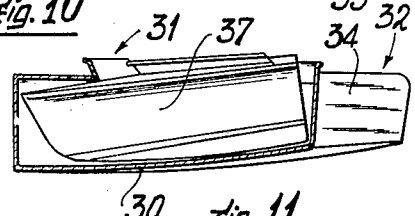



Fig. 11

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SAIL-BOAT

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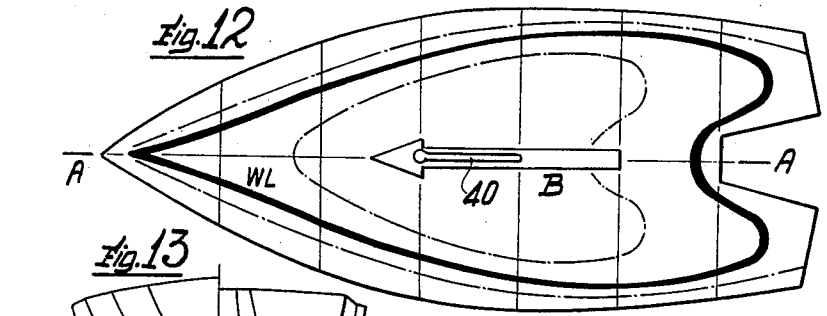



Fig. 12

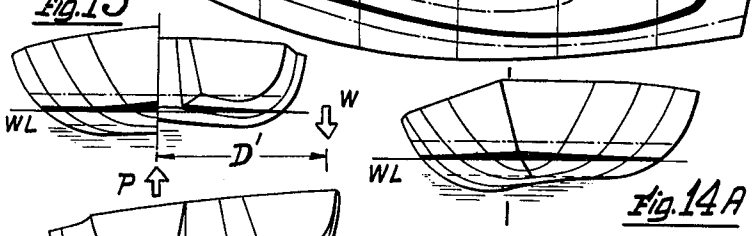



Fig. 13

Fig. 14A




Fig. 14B

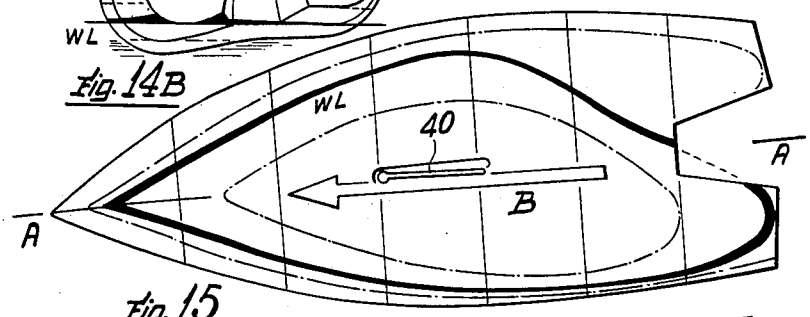



Fig. 15

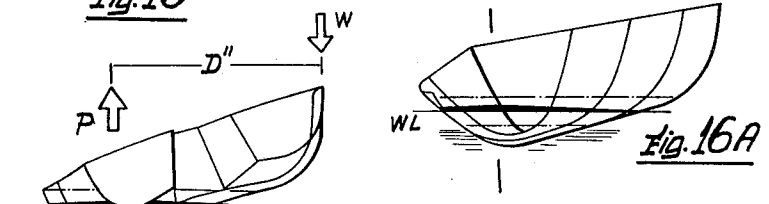



Fig. 16A

Fig. 16B

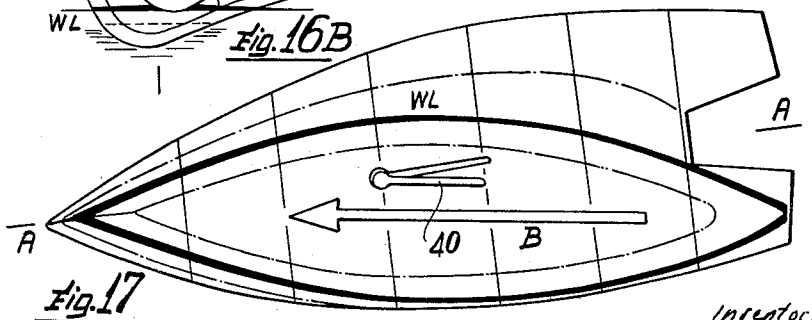



Fig. 17

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United States Patent Office

3,088,428
Patented May 7, 1963



3,088,428

# SAIL-BOAT

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Filed July 21, 1959, Ser. No. 828,502
Claims priority, application Italy July 22, 1958
5 Claims. (Cl. 114—61)

This invention generally relates to sailing boats and more particularly, it is related to fast small sized boats capable of travelling, in a regular full sail breeze, well over the "critical speed" which could be expected for their water line length. Specifically, this invention is concerned with the various problems involved with design and construction of sailing boats, hulls in view of the resistance, encountered as the boat is driven well over the critical speed typical of its water line length and of the ability of the hull of carrying sails capable of accelerating the boat up to such overcritical speeds.

According to current practice, a given boat's own critical speed is commonly referred to as the travelling speed at which wave making begins. Over such speed wave resistance to the motion is added to the surface or skin friction resistance, and for overcritical speeds the increasing of water resistance may be grossly considered as a function of the fourth power of the speed. For small sized hulls, such critical speed is very low. A noticeable bow wave is produced by a quite correctly shaped hull say of 15 ft. at 6 knots about, for example, and such low speed may be attained, in general, even in a light breeze. More powerful winds, however, cannot drive the boat, if conventionally shaped, at a speed satisfyingly over its own critical speed, because of the said enormous increasing of resistance.

In addition, water lines of conventionally designed dinghies and similar unballasted boats will lose their original symmetrically diverging angulation at bow as the boat is caused to leeward incline by the side thrust of wind. The sinus of the leeward diverging angulation of lines is therefore increased and a further bow wave resistance occurs.

Several methods for attaining well overcritical speeds in sailing relatively small boats had been devised. Boats that have a large amount of sail in proportion to weight and the wetted area of the hull, and that are sufficiently long and slender to provide the necessary initial speed, can be made to "plane," i.e. skim over the water and by doing so sometimes sail more than twice as fast as they could be expected for their length. However, "planing" requires, in general, an extra righting effect of the weight of the helmsman and crew, effect which can be got only by means of a trapeze, a sliding plank and of a somewhat acrobatic behaviour of skippers. A noticeable large bottom area of the stern portion of hull is further necessary for giving the lift necessary for proper planing or skimming over the water.

Extra speeds may be attained by elongated, flat bottomed and nearly rectangular "scow" type sailing boats. Such boats show elongated and well tapered water lines as travelling with their leeward portion immersed only. Such boats, however, do not posses a proper wave diverging bow and behave poorly in waves.

A typical mode of solving the above problems is given by twin-floats of "catamaran" boats. By joining together in well spaced and parallel relationship two (or more)



very elongated and extremely little beamed hulls a very small bow wave resistance may be encountered in an assembly capable of carrying very large sail area. As matter of fact, a catamaran (and more or less a scow type boat too) is a craft having a very narrow beam in respect to the water to be open by its bows and a very large beam in relation to its stability, i.e. power of carrying sail.

Any said driven boat is further provided with one or more side thrust resisting and direction of travel defining guide means, in addition to one or more rudders or steering means. Such guide means may consist of one or more centerboards, fins and/or of the very actual shape of the hull and are designed to resist, by acting inside the water, to the side component of the direction of drive applied by the sail or sails to the hull. Such means will be generally referred to as "direction of travel defining guide means" as this disclosure proceeds and in the appended claims. As far as I am aware, the direction of travel defined by such means in any type of sail driven floating means heretofore known corresponds or is parallel to the longitudinal or symmetry axis of the hull or assembly of hulls and it cannot be modified as the floating means is navigated.

Having the above and other condition in mind, it is an object of this invention to provide a new and improved sail-boat having direction of travel defining guide means designed for alternately defining at least two not parallel directions of travel of the boat in the water, said directions being symmetrically located in respect to the longitudinal axis of the assembly.

Another object of this invention is to provide an improved sail-boat having a hull provided with one wave diverging bow portion and symmetrically shaped and located side and stern portions, forming an angle therebetween, converging towards and merging into said bow portion, and provided with direction of travel defining guide means designed for alternately causing the boat to travel in the water in the direction defined by the leeward portion of the one or respectively the other of said converging side and stern portions.

A further object of this invention is to provide a new and improved sail-boat, as above, including a hull shaped for having at differing leeward inclinations a bow portion having diverging water lines, a stern portion including a lifting bottom surface and respectively a stern portion showing tapered water converging lines, and direction of travel defining guide means adapted to cause the boat to move in the water in a direction to which the leeward and the windward bow portion water lines are of substantially symmetrical angulation.

For better understanding of the present invention, together with other and further objects thereof, reference is had to the following detailed description taken in connection with the accompanying drawings, forming an essential component of this disclosure, the scope of the invention being pointed out in the appended claims.

Referring to the drawings:

FIG. 1 is a bottom view of a sail-boat hull produced according to a first form of embodiment of the invention;

FIG. 2 is a side elevational view of same as floating in upright position;

FIG. 3 is another side elevational view, showing the same as floating in a leftward inclined position;

FIGS. 4 and 5 are somewhat diagrammatical views from underwater, taken in the directions indicated by arrows 4 and 5 in FIGS. 2 and 3, respectively, of the same hull in upright and respectively in inclined position;

FIGS. 6A and 6B are a plan and respectively a bottom half-view of a boat produced according to another form of embodiment of the invention;

FIG. 7 is a conventional drafting of half-cross sections of the boat of FIG. 6B;

FIG. 8 is a side elevational view of same;

FIG. 9 illustrates, in front view taken in direction of travel, the mode of floating of same, as sailing windward;

FIGS. 10 and 11 illustrate, in plan view and respectively partly in side elevation and partly in longitudinal sectional view, as the boat of FIGS. 6A and 8 may be arranged for transportation;

FIG. 12 is a bottom view showing the water lines of boat similar to those of FIG. 6B, floating upright but in a differing longitudinal setting, and provided with steering direction of travel defining guide means;

FIG. 13 is a conventional cross-section showing plan of the hull of FIG. 12;

FIGS. 14A and 14B illustrate the cross-sectional lines, from bow to midship and respectively from midship to stern, of the same hull as floating at a relatively reduced leeward inclination;

FIG. 15 is a bottom view of same, showing the water lines as floating as shown in FIGS. 14A and 14B; and

FIGS. 16A, 16B and 17 are views illustrating the same boat, in manner similar to those of FIGS. 14A, 14B and 15, respectively, but as floating at greater leeward inclination.

Referring first to FIGS. 1 to 5 of the drawings, there is shown a representative embodiment of the sail-boat of the invention, including a hull provided with two symmetrically located keel lines **20'** and **20''** and with a third central keel line **21**, limited to the very fore portion of hull, the said keel lines converging into a bow **22**, of substantially conventional design. The hull may include a stern portion provided with a relatively large transom **23**. A—A indicates the trace of vertical longitudinal plane of symmetry of the boat and the arrows show the direction of travel thereof, if conventionally directed and navigated.

In such form of embodiment of the invention, the direction of travel defining guide means consists of two symmetrically located centerboards or fins **24'** and **24''** lying in the planes defined by said keel lines **20'** and **20''**, respectively. Such fin means may be however located outside from but parallel or at least substantially parallel to said converging keel lines. Such fin means may be constructed as conventional centerboards are and provided with means adapted for readily lowering and raising same. Said latter means are preferably constructed for admitting the raising up of both fins. A linking means may be provided for causing the fins to be alternately lowered into the water.

Two differing directions of travel, not parallel to the longitudinal axis of the boat, are therefore defined by said fin means **24'** and **24''**, respectively. The shape of the hull, including the said keel lines **20'** and **20''**, co-operates for said definition. From FIG. 4 the shape of the immersed portion of hull may be seen, as the boat is floating in upright position.

Supposing now to sail the boat in its noticeably inclined position of FIGS. 3 and 7 while the centerboard positioned parallel to the leeward direction of travel is down into the water and the opposite windward one is fully raised and concealed into the hull. The boat will be therefore caused to travel in a direction differing to its longitudinal axis of symmetry and defined by the plane of its activated leeward direction of travel defining guide means, say the centerboard **24'** of FIG. 5.



From what above and by a consideration of FIGS. 1 to 5 it may be readily therefore assumed that:

(*a*) The unique bow portion **22** of the hull may retain its proper water and waves cutting and diverging ability at various side inclinations and directions of travel, thus making the boat seaworthy at any point of sailing and in relatively severe sea conditions;

(*b*) The actual beam **1** (FIG. 5) of the immersed portion of the inclined hull may be greatly reduced in respect to the overall beam L (FIGS. 1, 4 and 5), thus improving the elongation and the taper of actual water lines;

(*c*) The angulation of diverging leeward and windward water lines at the bow portion of the hull, i.e. where bow waves are made, is substantially symmetrical in respect to the actual direction of travel.

By further developing the above objects of the invention other advantages and useful features may be provided, as it will be readily understood from a consideration of the improved form of embodiment of FIGS. 6 to 11 inclusive: in said figures a round bottomed hull having a conventional quite seaworthy bow is shown. In its relatively large beamed and deep middle and stern portion **30** a roomy cockpit **31** may be arranged for comfortable accommodation. In view of the above discussed typical mode of traveling into the water, the stern portion of the hull may be advantageously shaped into two symmetrical tail portions **32** and **33**, defining a space **34** therebetween, wherein an outboard motor **35** may be fit upon removal of the rudder. Such stern shape insures full protection of the motor and of the rudder and makes the boat best responsive to the helmsman's actions. The fore portion **37** of the hull, if desired, may be constructed as an independently floating unity and detachably connected at **36** to the middle and rear portion **30**. As consequence of the fact that no centerboard case exist in the hull, the detached fore portion **37** may be located into the cockpit, as shown in FIGS. 10 and 11, with the bow arranged between the cases of centerboards **38** and **39**, for easy transportation of the boat say on the roof of a car. A 15 ft. long boat constructed according to the invention may be reduced into an assembly 8 ft. 4 in. long for stowing and transportation.

The well angulated and tapered water lines at bow and the relatively large bottom surface astern make the boat well adapted for motoring too. In FIGS. 6B, 7 and 8 the hull is planned as floating at a somewhat planing position, as it may be attained when driven by a small outboard motor or when sailing fast before the wind, say by using a twin sail or a spinnaker. In such condition both centerboards are kept up and the boat has been proved as being surprisingly fast and seaworthy. The water line in said planing position is indicated by WL', while WL indicates the regular upright floating water line.

A boat produced according to the invention is therefore supposed to sail in direction forming an angle in respect to the longitudinal axis of the hull, except in sailing exactly before the wind, i.e. when no side thrust to be opposed by direction of travel defining guide means exists. FIG. 9 typically illustrates as the boat of FIGS. 6 to 8 appears to an observer in the actual direction of travel, in a windward approach. Such boat obviously requires some practicing for skippers accustomed to conventional sailing crafts, because the boat behaves quite differently from conventional ones.

FIG. 9 further illustrates as the typical asymmetry of a boat constructed according to the invention and floating as above described greatly improves the hull's ability of carrying sail. The noticeable windward shifting of the midship and in particular of the stern sections increases the lateral interval D between the center of buoyancy (lying on the vertical indicated by arrow P) and the position W of the crew's weight, who is supposed to comfortably sit on deck, near but inside the gunwale. A boat of the type considered, of 4 ft. 6 in. beam, may be

compared to a conventionally designed boat of at least 5 ft. 6 in. beam, speaking in terms of righting momentum, and to a sailing canoe of 3 ft. beam in respect of elongation and narrowness of water lines.

The new and surprising effects of effortless penetration in water which may be attainned according to the invention will be readily understood from FIGS. 12 to 17, wherein the plans of a boat similar to the one of FIGS. 6B, 7 and 9 are shown, and wherein the hull is provided with one central steerable fin 40 in lieu of the two converging centerboards.

FIGS. 12 and 13 show the water lines of hull as it floats upright; the fin is lying in the longitudinal vertical plane of symmetry of the boat. Such condition may be attained at rest or sailing before an exceptionally light breeze. The relatively large beam on water and the very reduced draft are advantageous for little transverse wave making. The pretty narrow angulation of water lines at bow is favourable for prompt acceleration of the boat as soon as the drive increases, and the hull will then easily attain its planing setting of FIG. 6B.

FIGS. 14A, 14B and 15 show the adaptation of the hull for typical planing conditions in moderate inclination, say of 8° to 12°. Well tapered bow wave diverging water lines in the fore portion will lead the boat at the necessary initial speed and a remarkable bottom area at midship will ensure the lift necessary for skimming on the water. For best enjoyment of the features of the improved hull, the steerable fin 40 should be set in a direction bisecting the angle between leeward and windward water lines at bow, so that the bow wave resistance would be reduced at its lowest value.

FIGS. 16A, 16B and 17 illustrate as, on the contrary, may be said to be surprisingly adapted for close-hauling sailing too. Upon greater leeward inclination, say of 15 to 20 degrees, the water lines became quite symmetrical to the actual direction of travel, as defined by the fin 40 which would be set at an angle, in respect to axis of symmetry A—A, greater than in FIG. 16, and properly tapered either at bow and at stern, while the beam at water level becomes smaller.

In such condition of sailing, the side thrust on sail is strong while the drive is comparatively small. The boat adapts itself to such condition, developing less resisting water lines and a greater righting momentum. In fact, within certain limits the lateral interval between the center of buoyancy and crew's weight increases as a function of side inclination, as shown in the drawings, wherein the said interval, indicated as D' in FIG. 14B, at relatively little inclination, increases up to value D'' in FIG. 16B, at greater inclination.

Of course, the use of trapeze, pontoons or other crew outrigging devices might lead to further righting momentum and consequent improved power of carrying sail, and therefore to further extra speed either in full sail planing condition and in close-hauling.

While there have been described what are at present considered to be preferred embodiments of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed to cover all such changes and modifications as fall within the true spirit and scope of the invention.

For example, a boat produced according to the invention and provided with two alternately activable symmetrical fin means or centerboards might be further provided with a third central centerboard for improving the direction of the boat when running before the wind or when motor driven. More than one steerable fin means may be provided too, if desired.

While a twin mainsail rigging is considered as very adapted to the boat for best enjoyment of its planing ability in upright condition, other rigs may be obviously made use of. A regular Bermuda or Gunter sloop rig may be used for example.

Having thus described the invention, what is claimed as new and desired to have protected is:

1. In a sailboat, a hull having a bow and a longitudinal vertical plane of symmetry, said hull of such shape that when the boat is tilted by wind to one side of said plane through a predetermined angle a first submerged portion is formed and when the boat is tilted by wind to the other side of said plane through the same predetermined angle a second submerged portion is formed, said first and second submerged hull portions of equal shape, each having a substantially straight keel line pointing toward the bow of the hull, and each substantially symmetrical with respect to its keel line, each submerged keel line defining a windward direction of travel for said boat.

2. In a sailboat, a hull comprising a bow and having a longitudinal vertical plane of symmetry and two substantially straight keel lines symmetrical with respect to said plane and converging toward said bow, said hull of such configuration that, when the boat is tilted by wind to one side of said plane through a predetermined angle and a portion thereof is submerged, said submerged portion has a longitudinal plane of symmetry passing through one of said keel lines and that, when the boat is tilted to the other side of said first mentioned plane through the same predetermined angle and another portion thereof is submerged, said other submerged portion has a longitudinal plane of symmetry passing through the other keel line, each submerged keel line defining a windward direction of travel for said boat.

3. In a sailboat, in combination, a hull having a bow and a longitudinal vertical plane of symmetry, said hull of such shape that when the boat is tilted by wind to one side of said plane through a predetermined angle a first submerged portion is formed and when the boat is tilted by wind to the other side of said plane through the same predetermined angle a second submerged portion is formed, said first and second submerged hull portions of equal shape, each having a substantially straight keel line pointing toward the bow of the hull, and each substantially symmetrical with respect to its keel line, each submerged keel line defining a windward direction of travel for said boat; and skipper operatable fin guide means having a pivot axis in said plane of symmetry, and pivotable into parallelism with the keel lines of said first and second submerged portions.

4. In a sailboat, in combination, a hull having a bow and a longitudinal vertical plane of symmetry, said hull of such shape that when the boat is tilted by wind to one side of said plane through a predetermined angle a first submerged portion is formed and when the boat is tilted by wind to the other side of said plane through the same predetermined angle a second submerged portion is formed, said first and second submerged hull portions of equal shape, each having a substantially straight keel line pointing toward the bow of the hull, and each substantially symmetrical with respect to its keel line, each submerged keel line defining a windward direction of travel for said boat; and skipper operatable first and second fin guide means extendable beneath said hull and located in the keel line of said first and second submerged portion, respectively.

5. In a sailboat, a hull having a bow, a longitudinal vertical plane of symmetry, and a stern including two symmetrically arranged tail portions, said hull of such shape that when the boat is tilted by wind to one side of said plane through a predetermined angle a first submerged portion is formed and when the boat is tilted by wind to the other side of said plane through the same predetermined angle a second submerged portion is formed, said first and second submerged hull portions of equal shape, each having a substantially straight keel line pointing toward the bow and extending rearwardly in a direction toward a different one of said tail portions, and each substantially symmetrical with respect to its keel

line, each submerged keel line defining a windward direction of travel for said boat.

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