May 22, 1928. 1,670,936

M. McINTYRE ET AL

SAILING CRAFT

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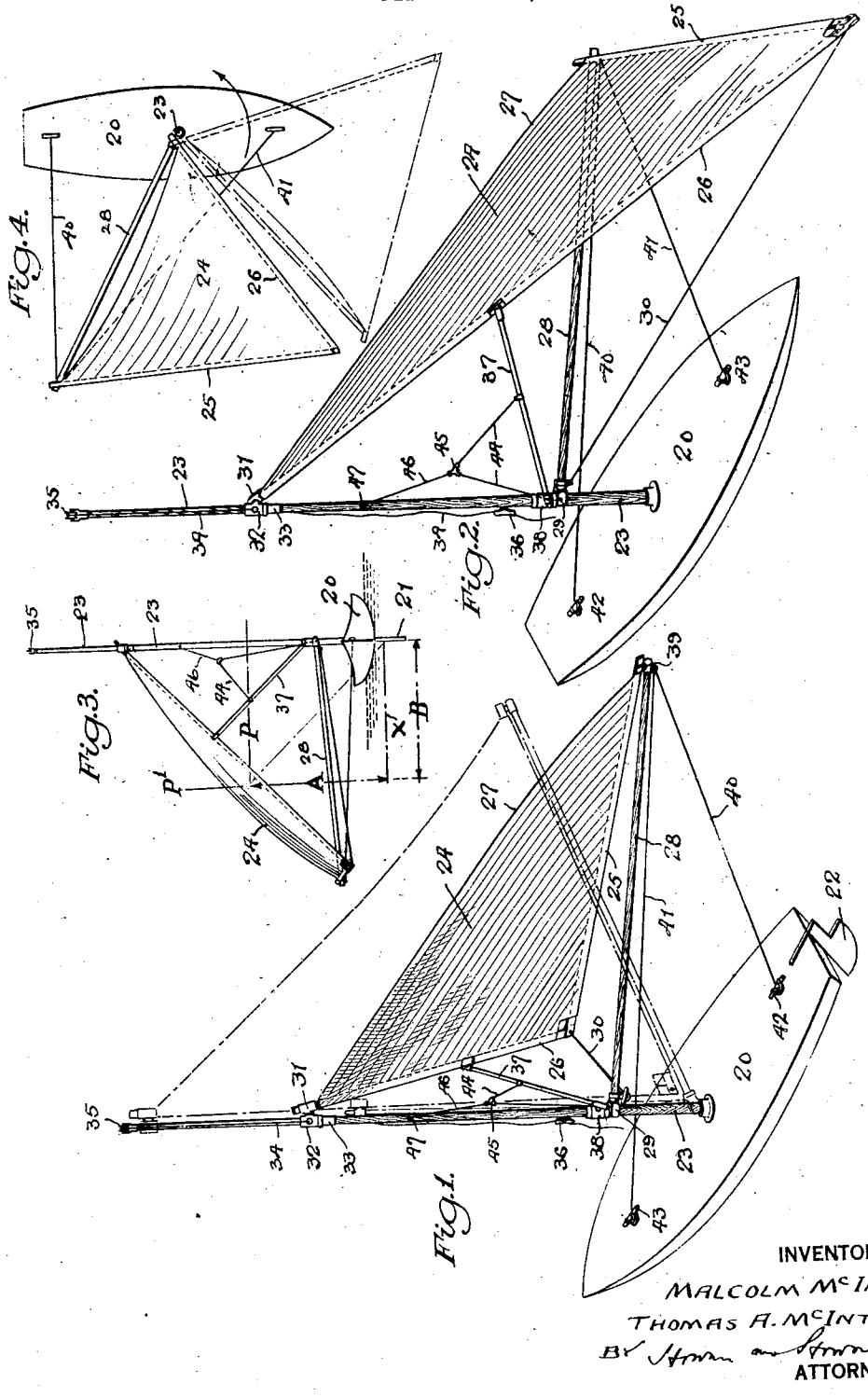

Fig. 4.

Fig. 2.

Fig. 3.

Fig. 1.

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SAILING CRAFT

Filed Nov. 24, 1923 3 Sheets-Sheet 2

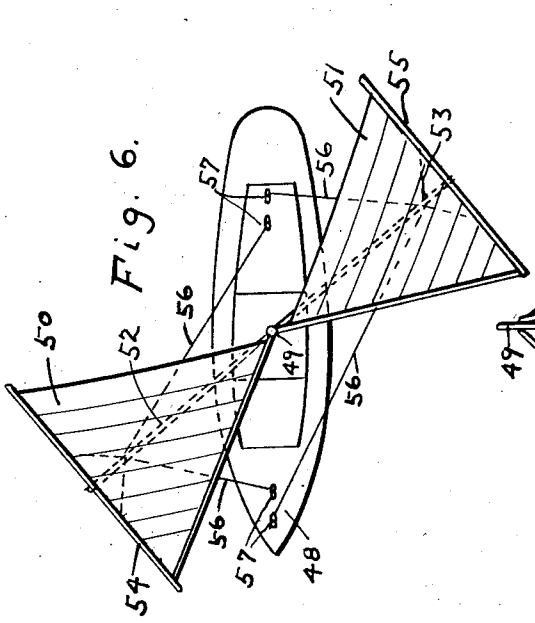

Fig. 6.

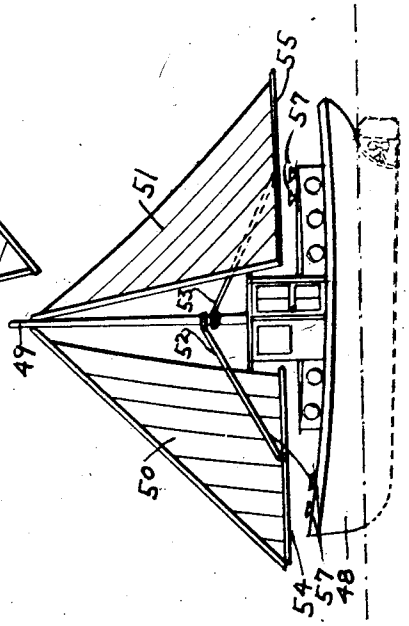

Fig. 5.

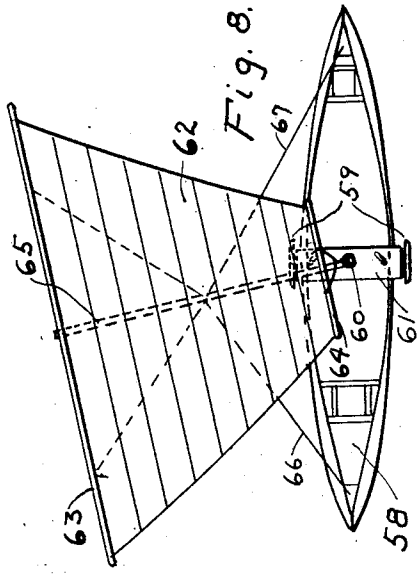

Fig. 8.

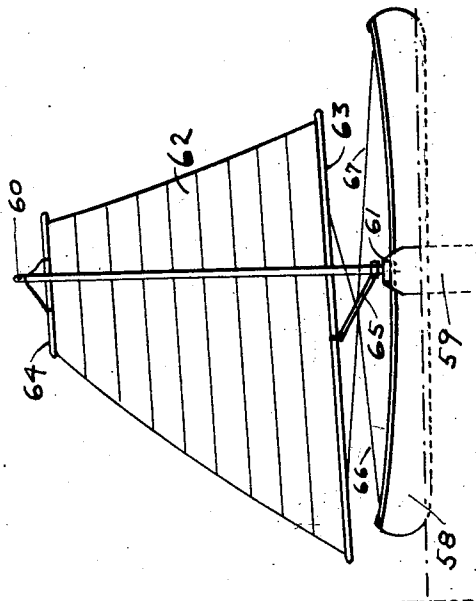

Fig. 7.

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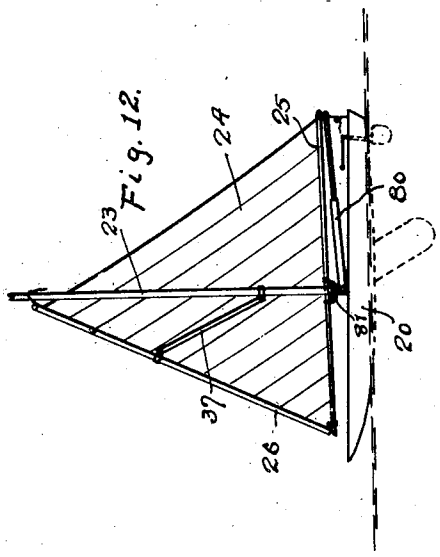
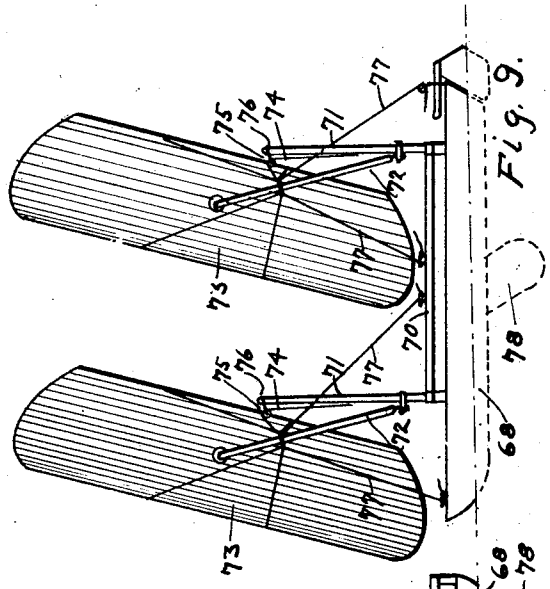
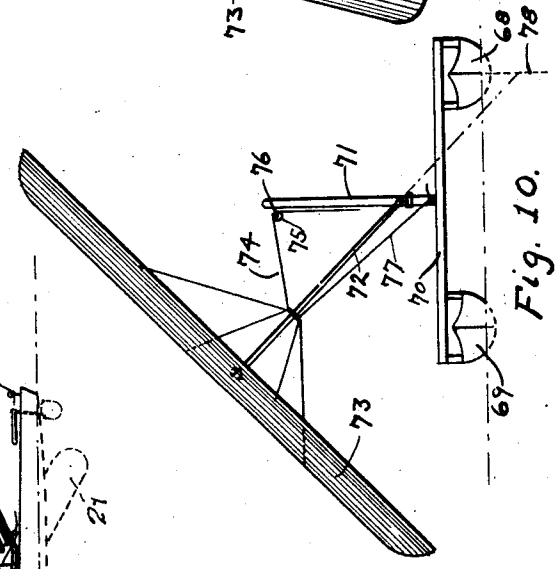
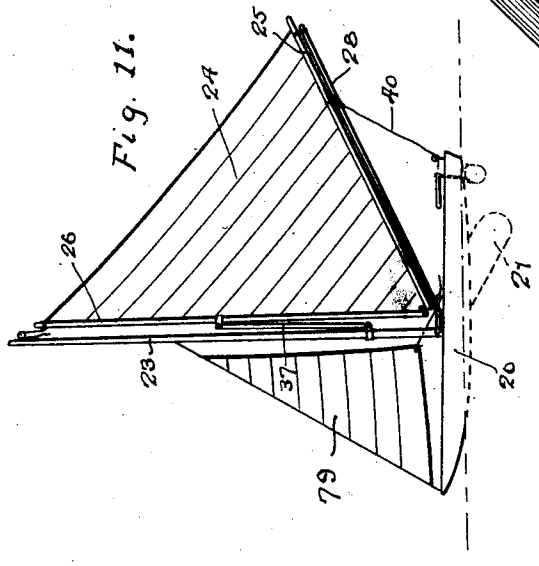
Filed Nov. 24, 1923 3 Sheets-Sheet 3









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UNITED STATES PATENT OFFICE.

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SAILING CRAFT.

Application filed November 24, 1923. Serial No. 676,772.

Our invention relates to sailing craft, and the object of our invention is to provide a sail rigging by which the sail may be held in such position that the effort exerted upon it by the wind not only propels the craft, but has little or no overturning action thereon.

There are at present in general use various types of sail rigging, all of which have the same fundamental defect, viz, the wind pressure on the sails tends to overturn the craft. This applies to sail boats, ice boats and also sailing bicycles or wagons. In sail boats, to counteract the overturning moment of the wind pressure on the sails, the hull has to be heavily ballasted, extremely wide or both, resulting in a large wetted surface and a heavy displacement hull compared with the small amount of sail the hull can safely carry. In even moderate wind, the pressure on the sail lays the boat over, and buries up the hull, while the effective sail area and leeway resistance of the hull are reduced as the boat lays over. Fore and aft rigged boats steer correctly only by the wind; on all other points of sailing a line extended from the center of effort and normal to the general plane of the sail, passes through a line aft of the center of lateral resistance of the hull (including the centerboard) thus necessitating a strong weather helm position for the large rudder which is essential on these sail boats. These are some of the reasons why present sail boats are relatively slow on all points of sailing, and why they are so uncomfortable and hard to handle in a strong breeze, some types being actually dangerous.

According to the present invention, the sail may be so positioned for strong winds, that the wind pressure thereon has little or no tendency to lay the boat over, but on the contrary exerts a substantial portion of its effort in an upward direction—thus also reducing the displacement of the hull. It is thus possible to obtain a maximum sail area with a minimum hull displacement—a condition favorable to highest possible speed.

Incidentally the boat travels substantially on even keel and the lifting, stabilizing sail has a cushioning effect in a sea. The boat is therefore not only faster, but more comfortable, and safe, than the present laying-over sail boats, in which the sail buries the hull.

In its preferred form, the rigging is such that the sail may be swung around the mast, so that on all points of sailing the sail occupies a position in which the resultant effort of the wind pressure thereon is exerted in such direction that the center of effort line passes approximately through the center of lateral resistance of the hull. The boat is therefore safely and easily steered at all times, by means of a small rudder.

Obviously a sail that lifts under wind pressure places the mast under tension to a certain extent. The mast can be very light therefore, and no supporting shrouds are really necessary.

The sail or sails can be quickly swung to reversing position to stop or back up the craft. This is an advantageous safety feature in maneuvering, not attainable with the usual fore and aft rigged sail boat.

The underlying conception of our invention which we believe to be fundamentally new, is susceptible of embodiment in a great many different forms of sail rigging. Only illustrative and more or less diagrammatically shown examples are hereinafter described or disclosed in the accompanying drawings, in which—

Fig. 1 is a perspective stern view of a boat to which a rigging in which our invention is embodied in one form is applied, the boat being shown on the port tack;

Fig. 2 is a similar bow view showing the sail rigging in position for a starboard reach;

Fig. 3 is a front elevation of a boat showing the wind coming over the port bow;

Fig. 4 is a plan view of Fig. 3 showing in dotted lines the manner in which the sail may be trimmed for different points of sailing;

Fig. 5 is a side elevation of a motor boat type of hull with a modified sail rigging in accordance with our invention;

Fig. 6 is a plan view of Fig. 5;

Fig. 7 is a side elevation of a canoe to which our invention is applied in another form;

Fig. 8 is a plan view of Fig. 7;

Fig. 9 is a side elevation of a catamaran

to which our invention is applied in still another form;

Fig. 10 is a bow view of Fig. 9;

Fig. 11 is a side elevation of the construction shown in Fig. 1, with the sail rigged for light weather; and

Fig. 12 is a similar view showing a modified rigging for use under similar conditions.

Referring to Figs. 1 to 4, the boat hull 20, provided with conventional keel, fin or center board 21 and rudder 22, carries the rigid mast 23, preferably arranged somewhere near the center of gravity of the boat. Carried by the mast is a triangular or leg-of-mutton sail 24 with a boom 25 at the foot of the sail, a sprit 26 at the luff of the sail, and a free leech 27. The boom 25 instead of being fast at one end to the mast, as usual, is spaced from the latter by a rigid strut 28, having at the mast end a jaw or hoop 29 to permit the strut to swing around the mast. The other end of the boom 25 is tied by a stay or guy 30 of substantially the same length as the strut 28, and extending at its inner end to the jaw 29. The sprit 26 at its upper end is connected by a universal joint 31 to a sliding sleeve 32 which normally rests against a fixed shoulder 33 on the mast. The sliding sleeve 32 has attached thereto a hoisting halyard 34 passing over a sheave 35 at the top of the mast and leading back toward the deck, where it may be made fast to a cleat 36 at any convenient point, here illustrated on the mast. To maintain the sprit (26) outboard, one end of a gaff 37 is attached thereto by a universal joint at some convenient point intermediate the ends of the sprit, while the other end of the gaff is connected by a similar joint to a collar 38 at some fixed point on the mast.

Toward the outboard end of the strut 28, which is connected by universal joint 39 to the leech end of the boom 25, are connected sheets 40 and 41, which extend inboard to cleats 42 and 43, respectively aft and forward of the mast. By trimming these sheets, the angular position of the boom, and consequently of the sail, with respect to the longitudinal axis of the boat, is varied, and the sail is thus trimmed to the desired course of the boat with respect to the wind. The downward pull of the two sheets 40 and 41 tends to keep the leech of the sail tight.

Referring to Fig. 3 of the drawings the theory of operation will be readily understood. Assuming P to be the effective horizontal pressure in pounds of the wind on the sail 24 at its center of effort, and A to be the vertical distance in feet from the effective center of lateral pressure on the sail to the projection of the center line X′ of the combined lateral water resistance of the hull 20 and keel, fin or center board 21, then the horizontal overturning moment of the sail is A × P foot pounds. With the sail set at an initial angle as shown in Fig. 3, the wind pressure P exerts an upward or vertical lifting reaction on the sail, indicated by P′. With the sail set at 45°, as shown, the upward thrust P′ equals P. If we assume B to be the horizontal distance in feet from the vertical projection of the lifting pressure P′ to the center of the lateral water resistance, then the righting moment due to the upward thrust P′ of the sail is B × P′ foot pounds. Inasmuch as P equals P′, if the distance B be made greater than A, the craft is in stable equilibrium in regard to overturning to leeward, and in fact will tend to lay over to windward. If the inclination of the sail 24 be made less than 45° to the horizontal, then the upward thrust P′ would be greater than the horizontal wind pressure P, and the distance B could be proportionately reduced to give proper stabilizing effect. Conversely, if the inclination of the sail 24 were greater than 45° to the horizontal, then the upward thrust P′ would be less than P, and the distance B would have to be proportionately increased to gain correct stabilizing effect.

In other words, the horizontal wind pressure on an inclined sail exerts its effort in a direction normal to the general plane of the sail, and if a line normal to this plane and extending from the center of effort of the sail, passes through the center of lateral resistance of the combined hull and associated elements, then stability is attained. This is the underlying thought of the sail rigging which we claim as our invention, and obviously may be embodied in various types of sails, without mathematical conformity to the underlying principle.

In Fig. 1 we have shown the sail arranged in position for sailing on the port tack, close hauled on the wind. When it is desired to come about and sail on the other tack, the sail is shifted to the other side of the boat, while maintaining the sprit or luff 26 of the sail forward. To accomplish this, as the boat is headed into the wind, sheet 41 is slacked off and the halyard 34 is hoisted in order to lift the upper end of the sprit to the mast head as indicated in dotted lines (Fig. 1). The gaff 37 is thus topped up into a practically vertical position, and the sprit 26 therefore assumes a position close to the mast and practically parallel to it, while the stay 30 becomes slack. The jaw end of the strut 28 is normally held up by a lifting and lowering rope 44 attached to the jaw at one end and passing over a sheave 45 to some convenient point on the gaff 37. The sheave is suspended by a pendant rope 46 from the mast, to which it is attached at 47. Consequently when the gaff 37 rises during the shifting of the sail for the tack, the rope 44 is slacked off, al-

lowing the jaw 29 to slide downward on the mast and thus affording clearance space for the cross swing of the forward end of the boom 25, to which the guy 30 is attached. As the bow pays off on the other tack, the halyard 34 is slacked off, thus permitting the head of the sail to again drop down to its normal position indicated in full lines. The sail is then at the proper inclination to the vertical, whereupon it is trimmed forward by the sheet 41, which has in the meantime been passed around the mast. Of course this arrangement of the sheet 41 is merely diagrammatic. A double ended sheet could be used straddling the mast.

Jibbing is accomplished by a manœuver of the rigging similar to that just described for tacking, with the exception that the sail is forward of the mast instead of aft. It may be noted that the rigid luff of the sail is toward the wind in both operations, as distinguished from a fore and aft rig of common type, in which the loose leech of the sail is toward the wind when jibbing and causes a sudden filling of the sail and consequent danger of overturning as the boat jibs.

Other riggings for the sheet 41 will readily occur to those skilled in the art, which obviate the necessity of passing sheet 41 around the mast. It will be further obvious that should the lifting effort of the wind on the sail tend to cause the sleeve 32 to ride up the mast, it can be made fast by a down haul secured thereto and to the cleat 36, or some other convenient anchorage.

In the remaining figures we have illustrated more or less diagrammatically various other embodiments of our invention.

Referring to Figs. 5 and 6, we have shown a motor boat, commercial or cargo type of hull 48, with a single mast 49 supporting two leg-of-mutton-type sails 50 and 51, one rigged to windward and one to leeward. In these figures the sails are set for sailing with a beam wind on the port tack. The sail to leeward has the wind on its under side and is lifting, while the sail to windward has the wind on its upper side and is holding down. Struts 52 and 53 are secured to the booms 54 and 55 at substantially central points thereof. Sheets 56 (Fig. 6) from the tie yokes attached to booms 54 and 55 extend to sheaves or cleats 57 at appropriate points forward and aft of the mast. When trimming the sails for different points of sailing, the struts 52 and 53 are usually kept substantially in line with each other, as shown in the drawings, but they can be swung independently so that both sails can be revolved to forward position when running before the wind. It is obvious that in this construction it is unnecessary to shift the sails from one side of the boat to the other on jibbing or coming about, it being necessary only that the struts 52 and 53 be swung to different angular positions with respect to the longitudinal axis of the hull. The sprit at the luff end of the sail is thus always forward without the necessity of shifting it across the struts 52 or 53 when coming about.

In Figs. 7 and 8 we have shown a canoe hull 58 with conventional type of lee boards 59, which are used when sailing. The mast 60 is stepped in a thwart 61 held in any suitable fashion to the gunwale. The thwart also could support the lee boards, making the whole rig detachable from the canoe. The sail 62 has a boom 63 at its foot, and a club 64 at its head, the club being close to the mast 60, while the foot 63 is held outboard by the strut 65 shown in position for a port tack by the wind. Instead of going about, the sail remains on the same side of the hull, which, on trimming the sail with the sheets 66 and 67 to reverse its driving effort, now travels in the reverse direction. A paddle can be used for steering, shifting it to aft position on reverse of direction of travel; or two rudders, one at each end, could be employed. To improve the set of the sail going to windward, light spars could be used on both edges of the sail, or several horizontal battens could be used. This reversable type of sail could be used to either leeward or windward of the hull, the former position being preferable by reason of the lifting effort on the hull.

In Figs. 9 and 10 we have shown the same thought applied to a catamaran type of construction, using a pair of floats or hulls 68 and 69 tied by a cross frame 70 which carries the mast 71 at a point intermediate the hulls. Stepped to the foot of the mast is a gaff 72, at the outer end of which is centrally fastened a rigid sail 73, such as an aeroplane wing. Inasmuch as an aeroplane wing is designed for efficient operation with the wind on one surface only, it is necessary to provide some means for shifting the wing from one side of the boat to the other, while still maintaining the luff of the wing, if it may be so called, forward. For this purpose we have provided a halyard 74 for holding up the gaff and swinging it across the vertical to be lowered down on the opposite side. The halyard 74 passes over the sheave 75, which may be supported upon a swivelling support 76 attached to the upper end of the mast. The sail may be trimmed to suit the direction of the wind by means of sheets 77, the inner end of the gaff 72 being swivelled on the mast.

While a single sail may be used, we have indicated in the side elevation, Fig. 9, a plurality of masts and sails. The angle of the sail as shown in Fig. 10 is such that the effective wind pressure on the sail is directed, from its center of effort, through the center

of lateral resistance of the lowered centerboard 78 in the windward hull 68, the centerboard in the lee hull 69 being hauled up in its trunk. If the sail be inclined more nearly to the horizontal, the lifting pull of the sail would pass through the center of combined resistance of the entire hull elements with the centerboards in both hulls in their down positions.

When sailing in very light winds, the stabilizing effect is unnecessary, and under proper conditions it is advantageous to set the sail practically parallel to the mast in the customary manner. Fig. 11 shows one method of accomplishing this. The centerboard hull 20 is equipped with sail 24 and rigging such as shown in Figs. 1, 2, 3 and 4. The sail is now made fast however, with its sprit 26 parallel to the mast 23 in vertical position, and with its boom 25 lashed to the strut 28. The boom may be swung out or in by the sheet 40 to trim sail in well understood manner for different points of sailing. With the sail set in this manner, the center of effort of the sail is too far aft of the center of lateral resistance with the centerboard 21 in its full down position. To compensate for this and make the boat steer correctly on the wind, the centerboard can be swung further aft as indicated, while a jib 79 could be rigged forward of the mast in conventional manner.

Another method of rigging the sail parallel to the mast is shown in Fig. 12. The strut 80, which is used to hold the boom 25 outboard, is of telescopic construction, so that it may be shortened. This permits the boom 25 to swing forward close to the mast, until the center of effort on the sail is about over the center of lateral resistance of the hull and centerboard. A loose collar 81 near the foot of the mast 23 is attached to the boom 25 to hold the latter in position, while permitting the sail to be swung with respect to the mast for different points of sailing.

With the sails set as in Figs. 11 and 12, the sail tends to lay over and bury the hull, as in conventional riggings, and this rig is appropriate only in light winds. In a strong wind the sails would be swung out to the inclined stabilizing or lifting position above described with reference to Figs. 1 to 4.

From the foregoing description it will be obvious that the invention is susceptible of various embodiments, and is not limited to the particular constructions shown. The thought which underlies all of the illustrative examples described, is the arrangement of the foot of the sail outboard to secure a general inclination of the sail such that the upward or downward effort of the wind against the same, counteracts its overturning effort. It is further obvious that features shown only in certain of the figures are applicable to other constructions where appropriate, and that all of the constructions are merely indicative of the structural principles which underlie what we claim as our invention. It is to be understood that in the following claims we use the expression "hull" to denote in general the body structure as distinguished from the sail rigging, and that the body structure may be of any appropriate type—comprising, for example, one or more hulls, and associated keels and centerboards, ice-boat frames, chassis or body for land vessels. Similarly the expression "sailing craft" includes auxiliary power boats, model or toy boats, ice boats, sailing land or beach wagons, bicycles, etc., to all of which and to others, the invention is applicable.

We claim—

1. A sailing craft having a hull, a mast supported thereby, a sail supported at its upper end by the mast, and means for holding outboard the foot of the sail to set the sail at an inclination to the mast such that a line normal to the general plane of the sail and extending from the center of effort of the wind pressure thereon passes approximately through the center of lateral resistance of the hull, together with means for swinging the sail around the mast in such inclined position on changing course with respect to the wind.

2. A sailing craft having a hull, a mast, a sail supported by the mast in such position that a line substantially normal to the plane of the sail and extending from the center of wind effort on the sail, passes substantially through the center of lateral resistance of the hull, and means effective to positively maintain the foot of the sail outboard of the hull and a general upward and inward inclination of the sail at an angle to the mast such that the wind pressure against the sail exerts substantially no overturning effort on the hull, together with means for revolving the sail at such inclination around the mast.

3. A sailing craft having a hull, a mast, a sail supported by the latter, and rigid means for holding the foot of the sail outboard to incline the sail to such extent that a line normal to the general plane of the sail at its center of effort passes approximately through the center of lateral resistance of the hull.

4. A sailing craft having a hull, a mast, a sail supported by the latter, and rigid means operative at all points of sailing for holding the foot of the sail outboard to incline the sail to such extent that a line normal to the general plane of the sail at its center of effort passes approximately through the center of lateral resistance of the hull.

5. In a sailing craft, a hull, a mast supported therefrom, a sail supported at its upper end to the mast, a boom at the foot of

the sail, rigid means extending from the mast to the leech end of the boom for holding the boom outboard and thus to maintain the sail at an inclination to the mast, and means for dropping the mast end of the rigid means to permit the luff end of the boom to pass over the mast end of the rigid means on shifting the sail from one side to the other of the hull.

6. In sailing craft, a hull, a mast supported therefrom, a sail attached at its upper end by the mast, a substantially rigid member at the luff edge of the sail, a rigid strut extending from the mast to the foot of the sail for holding the latter outboard of the hull, and means for dropping the mast end of the strut to permit the rigid luff member to pass thereover on the shifting of the sail from one side to the other of the hull.

7. In sailing craft, a hull, a mast supported therefrom, a sail attached at its upper end to the mast, a substantially rigid member at the luff edge of the sail, a gaff engaging the same to hold the luff at an inclination to the mast, and a rigid strut extending from the mast to the foot of the sail for holding the latter outboard of the hull.

8. In sailing craft, a hull, a mast supported therefrom, a sail attached at its upper end to the mast, a substantially rigid member at the luff edge of the said, a gaff engaging the same to hold the luff at an inclination to the mast, and a rigid strut extending from the mast to the foot of the sail for holding the latter outboard of the hull, said strut engaging the foot of the sail towards its leech end, together with a stay extending from the luff end of the boom to a point of attachment inboard of the hull.

9. In sailing craft, a hull, a mast supported therefrom, a sail attached at its upper end to the mast, a substantially rigid member at the luff edge of the sail, a gaff engaging the same to hold the luff at an inclination to the mast, and a rigid strut extending from the mast to the foot of the sail for holding the latter outboard of the hull, said strut engaging the foot of the sail toward its leech end, together with a stay extending from the luff end of the boom to the mast end of the strut.

10. In sailing craft, a hull, a mast supported therefrom, a sail attached at its upper end to the mast, a substantially rigid member at the luff edge of the sail, a gaff engaging the same to hold the luff at an inclination to the mast, and a rigid strut extending from the mast to the foot of the sail for holding the latter outboard of the hull, said strut engaging the foot of the sail toward its leech end, together with a stay extending from the luff end of the boom, and sheets extending inboard from the outboard portion of strut to tie down the latter.

In testimony whereof we have signed our names to this specification.

MALCOLM McINTYRE.
THOMAS A. McINTYRE.