July 20, 1965 P. T. ROBIN 3,195,494

SAIL CONTROL FOR VESSELS

Filed April 30, 1964 3 Sheets-Sheet 1

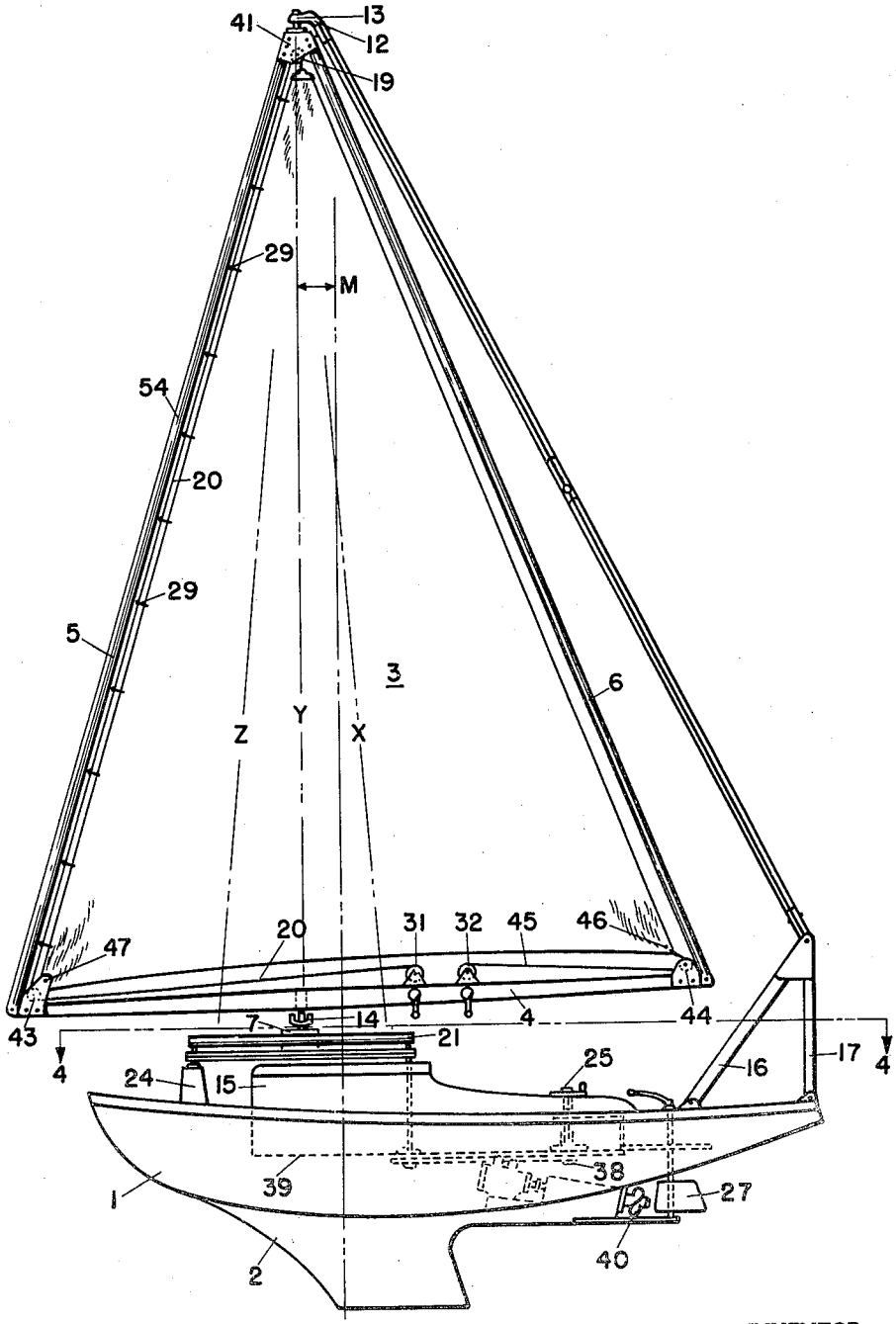


FIG. 1

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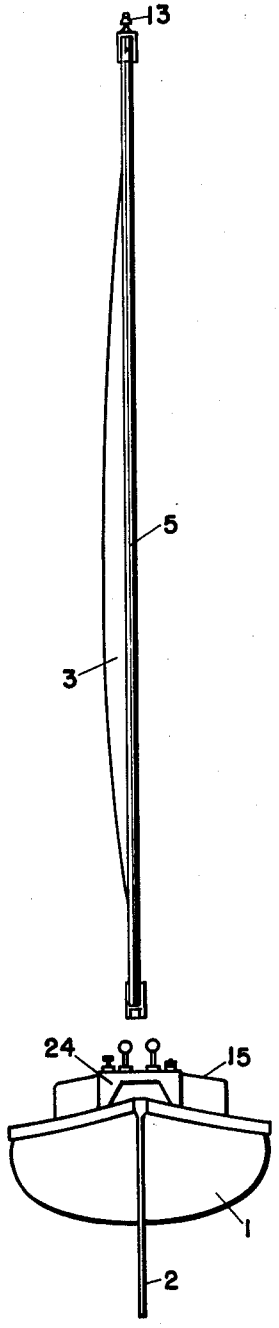


FIG. 2

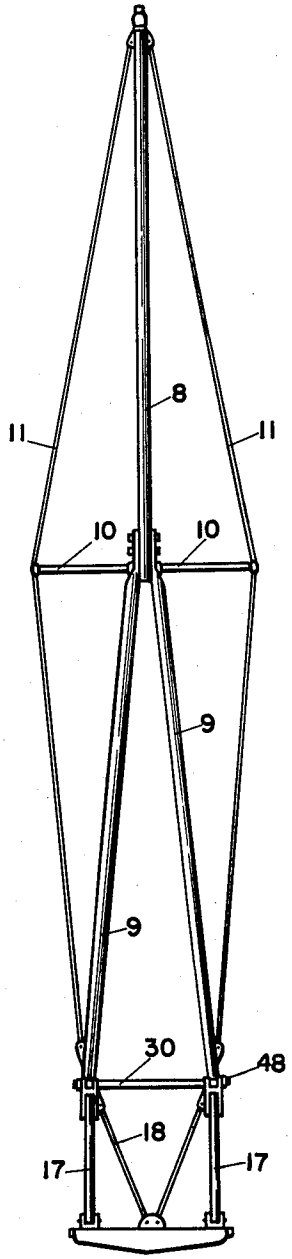


FIG. 3

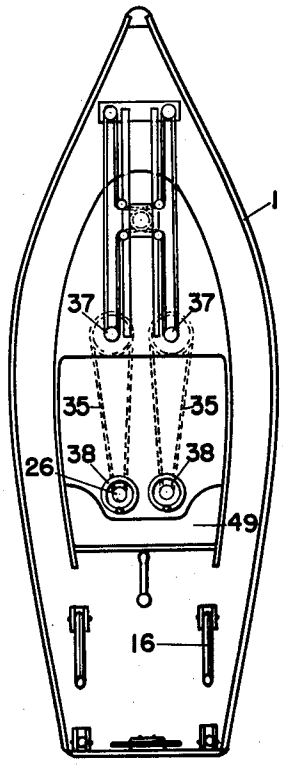


FIG. 4

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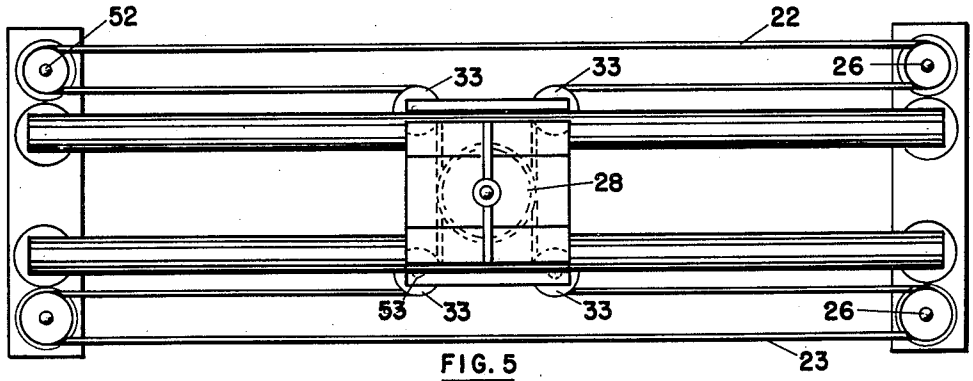


FIG. 5

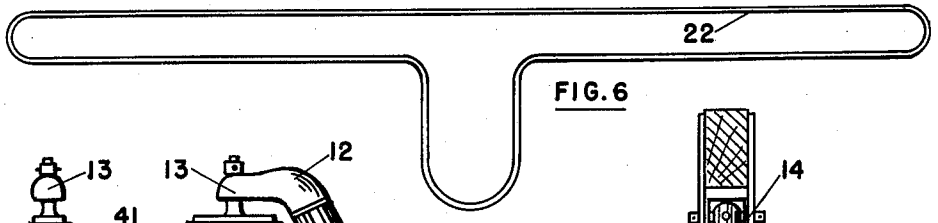


FIG. 6

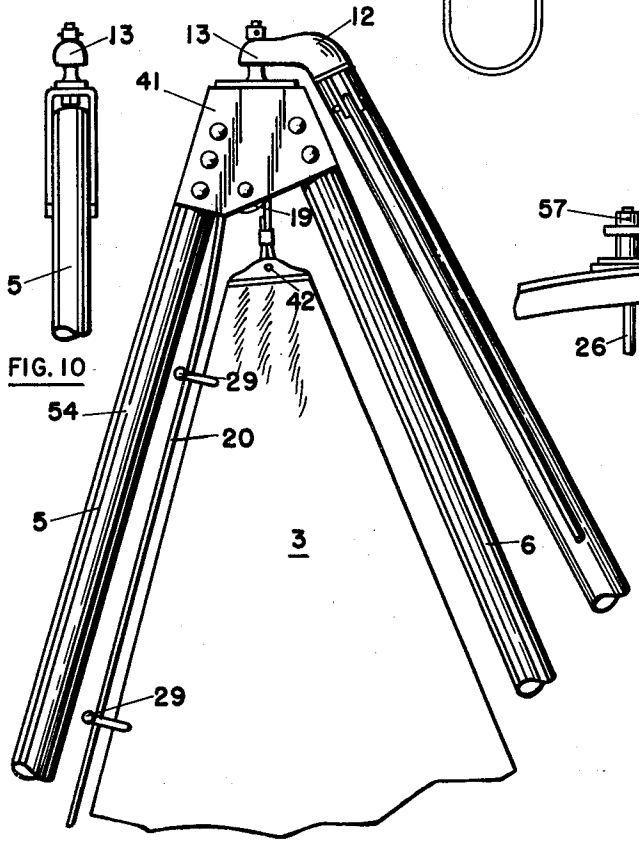


FIG. 7

FIG. 10

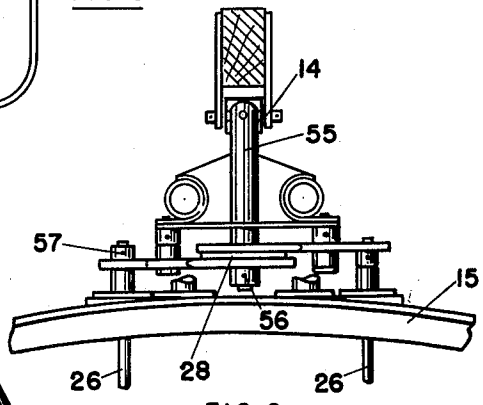


FIG. 8

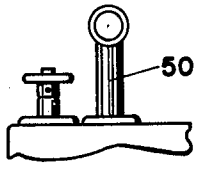


FIG. 9

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SAIL CONTROL FOR VESSELS

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5 Claims. (Cl. 114—39)

This invention relates to improvements in sailing vessels, more particularly of the pleasure or racing types; and the objects of my improvement are to provide a sail rig suitable for attachment to the hulls of such craft with inherent ability to increase their speed, maneuverability and safety to a degree beyond that now attainable by the same.

The said sail rig includes a triangular sail membrane of flexible material drawn permanently tight within a peripheral frame, the latter being positioned amidships with its apex pivotally connected aloft to a transversely rigid frame attached to the extreme after portion of the hull and extending upward and forward therefrom; and pivotally connected below at a point intermediate the ends of its base to a traveler arranged to move on guide rails in a fore-and-aft direction, parallel to the keel, the said point of connection being located along the base so that the vertical axis joining said upper and lower connections is eccentrically disposed relative to the center of effective force of the wind upon the sail membrane; a differential mechanism, adapted to actuate the fore-and-aft motion of the traveler and/or rotative movement, through three hundred and sixty degrees, of the peripheral frame about its vertical axis; and means for execution of these two movements, simultaneously or independently, by the pilot located at a single control point on the vessel.

It is an object of the invention to provide an improved sailing vessel.

Another object is to provide a sailing vessel with an improved sail rig.

A further object is to provide an improved controlling arrangement for a sail in combination with a sail vessel.

These objects are attained by means of the structure and mechanism illustrated in the drawings accompanying this application, in which:

FIG. 1 is a side elevation of the entire vessel, showing the peripheral sail frame in the middle range of its fore-and-aft movement.

FIG. 2 shows a front elevation of the vessel with the rigid rear frame removed.

FIG. 3 is an elevation of the transversely rigid frame, as viewed from a position above the stern of the vessel.

FIG. 4 is a sectional plan of the hull and traveler mechanism taken on line 4—4 of FIG. 1.

FIG. 5 shows an enlarged view of the traveler guide rails and the differential operating and control mechanism.

FIG. 6 shows the contour of the differential belts with pulleys removed.

FIG. 7 is an enlarged elevation at the mast head.

FIG. 8 shows a sectional elevation of traveler and differential mechanism.

FIG. 9 is a detailed view of the forward end of the mechanism.

FIG. 10 is an elevation similar to FIG. 7 from a different perspective.

Referring more specifically to FIGS. 1 and 7 of the drawings, it will be seen that 1 represents the hull of the vessel, with its bow shown to the left and its stern to the right, 2 is a keel made of a fin-like portion of the underwater surfaces, 3 the flexible sail membrane, drawn taut within the triangular, peripheral frame 54 by means of cables 20 and 45, operated by winches 31 and 32 respectively.

The flexure-resistant base 4, together with struts 5 and 6 and the apex plate 41, comprise the said frame. The

vertical axis of rotation of the same will be seen to pass through the ball-and-socket joint 13 aloft and the universal joint 14 below, in eccentric relationship to the center of effective force of the wind upon the sail as indicated by the dimension M. Sail membrane 3 thus is supported in the frame to rotate about an axis of rotation Y that passes through ball-and-socket joint 13 and universal joint 14.

The cable 20 is connected to the head of the sail membrane by pin 42, then reeved over pulley 19 and down, through a plurality of rings 29, over the pulley 43, and aft to a connection on the winding drum of the winch 31. The tack of the sail membrane is connected by pin 47 to a bracket mounted on the forward end of the base 4, and the clew of the same is connected by the pin 46 to the cable 45, the latter being reeved over the pulley 44 and thence forward to a connection on the winding drum of winch 32. It will be seen that by tightening the cable 20, the winch 31 will raise the head of the sail membrane aloft, while at the same time acting to stiffen the leading edge of the same by reason of the tautness of cable 20 being transmitted by the rings 29. Tightening cable 45 by winch 32 will exert a tensile force along both the foot and the leech of the sail membrane, so that the entire surface will tend to maintain a relatively flat condition instead of being deflected by pressure of the wind.

The universal joint 14 pivotally connects the base 4 and the traveler 7, the latter being slidably mounted on the guide rails 21 which are supported by the roof of the cabin 15 and the pedestal 24 through the fittings 50. With reference to FIGS. 5 and 8, endless friction belts 22 and 23, each in separate horizontal planes, with contours as shown in FIG. 6, constitute a differential system when reeved around the several pulleys 33 and the double-grooved, one-piece pulley 28. Shafts 52 and 53 are idlers, part 55 of the universal joint is locked to the double pulley 28 by means of the cotter pin 56; and shafts 26 are each locked to one of the pulleys 33 by means of the cotters 57. In FIGS. 1 and 4 it will be observed that the shafts 26 extend downward, through the roof of the cabin 15 and the floor of the same 39, and are adapted to be rotated individually, in either direction, by the pilot through manipulation of the hand wheels 25 and by means of the pulleys 38 and 37 and the endless, friction belts 35. The pilot seat 49 is the location from which the pilot will be enabled to control, single-handedly, all the functions of the vessel when proceeding under sail.

In FIGS. 1 and 3 the lower portion of the transversely rigid frame is comprised by the struts 16 and 17 and the bracing members 18, which terminate at their upper ends at the horizontal pivot shaft 48 and the spacer 30. The upper portion of the said frame consists of the bipod struts 9, pivotally mounted at their lower ends on the shaft 48 and joined at their upper ends to the central strut 8. Transverse rigidity is maintained from the pivot shaft 48, aloft to gooseneck 12 and the ball-and-socket joint 13 by means of spreader bars 10 and the bracing members 11.

The rudder 27 and the power unit 40 are intended for auxiliary or occasional use only, and will not be required for any normal functioning of the vessel under sail.

The following description of several fundamental sailing situations will serve to bring out, specifically, the manner in which the improvements provided by my invention will apply:

It is well recognized in the art that when a sailing vessel is proceeding toward the wind at an angle of about 45 degrees, any means for drawing the surface of the sail relatively tight so as to present as flat a cross section of the same as possible in the plane of the air flow, will raise the efficiency of the rig in terms of propulsive effort obtainable from a given sail area. To sailmakers, pilots and crews, especially of racing vessels, flatness of the sail contour is of major importance, though difficult to

achieve except in the lower portion of the sail by reason of the natural tendency of the leech, or after edge of the sail to sag into a relatively deep curve, which not only deepens the upper airfoil sections, but results in their assuming a greater angle with respect to the keel than the ideal angle selected by the pilot for the lower portion of the sail area. The peripheral frame provided for herein is intended to offset such undesirable features of conventional sail rigs.

It is also well known that while a vessel is proceeding under sail, a continual shifting occurs with respect to the relative fore-and-aft positions of the horizontal components of (1) the effective force of the wind upon the sail area and (2) the center of lateral resistance of the water upon the immersed portions of the hull. Especially when velocity of the wind becomes sufficient to cause substantial heeling of the hull to one side, the imbalance of these components generates force couples of such magnitude as to cause the vessel to deviate strongly from its proper course. Such a situation will then be corrected by the pilot, either by use of the rudder or, if the vessel be equipped with more than one sail, by trimming or easing, as may be required, of sail areas with centers of effort located a substantial distance fore or aft of the center of lateral resistance. Sustained rudder action, however, creates a drag tending to impede forward progress of the vessel; and tampering with the optimum set of a sail area for the purpose of adjusting the course of the vessel will, obviously, reduce headway. To overcome these disadvantages, my invention provides a single-area sail readily maneuvered to any required position fore-and-after in relation to the center of lateral resistance, together with universal adjustment of its rotative position so that any desired aspect to the direction of the wind may be attained. Hence the pilot may readily balance the opposing component forces by manipulation of the control wheels alone.

A further major loss in overall speed, as reckoned on a time basis for a given distance, is inherent in the maneuver of a sailing vessel of conventional rig running before the wind on a broad reach (for example, on a course of about 135 degrees relative to direction of the wind) under circumstances which require a change of course to, say, 270 degrees. If the vessel be turned to the right to accomplish this by use of the rudder, the operation known as jibing will be involved, which is well understood to be hazardous except when undertaken in relatively light winds. The alternative available to the pilot is to bring the vessel about by turning to the left and rounding the vessel up into the wind and then falling off on the opposite tack to proceed on the new course of 270 degrees. Especially when racing, this latter maneuver consumes much valuable time. A pilot operating a vessel in similar circumstances, but equipped with the sail rig provided for in my invention, would be able to change course safely and directly from said 135 degrees to the required 270 degrees by employing the following technique:

(1) On the course of 135 degrees, with wind astern, the leading edge of the sail membrane would lie to port, or on the left side of the hull as one faced forward; and the traveler would be in position Z of FIG. 1 of the drawings.

(2) Pilot will now release both control wheels, thus freeing the sail element and permitting it to rotate about its vertical axis in a counter-clockwise direction due to eccentricity M of the center of effective force of the wind in respect to the said axis, until the leading edge of the sail membrane points directly into the direction of the wind and hence in a slack, or neutral condition.

(3) By turning the port, or left-hand control wheel, in a counter-clockwise direction, the pilot will bring about a continued rotative movement of the sail element in the counter-clockwise direction with respect to the hull, thereby causing the leading edge of the sail to move to the starboard, or right side and fill with wind, thus steering the vessel positively to the right and toward the intended course of 270 degrees, without the danger of jibing, use of the rudder, or time lost in the operation of turning the vessel about. Thus, in effect, the sail element has been put about without involving the hull.

From the location of seat 49 the pilot is enabled, single-handedly and precisely, to control all phases of operation of the vessel when under sail merely by manipulation of the handwheels **25** in various directions of rotation, as follows:

(1) Turning both wheels at equal speed in opposite directions will cause the traveler 7 (and with it the sail element) to move in a fore-and-aft direction without rotating the sail; forward movement of the same resulting from rotation of the left-hand wheel counter-clockwise with simultaneous rotation of the right-hand wheel in a clockwise direction or vice versa if it is desired to move the traveler aft. As mentioned above, rotation of the wheels in opposite directions at an equal rate of speed will move the traveler while rotation of the sail element on its vertical axis remains zero. Conversely, turning both wheels at equal speeds in the same direction will produce rotation, in corresponding directions, of the sail element of its vertical axis accompanied by a condition of zero movement of the traveler. It will be apparent, therefore, that innumerable combinations of such movements are available to the pilot for the purpose of presenting the sail membrane at any desired angle to the wind and/or moving the same fore or aft with respect to the center of lateral resistance of the water. A further important feature of the control system is that the force of the wind upon the sail may instantly and automatically be reduced to zero by the simple expedient of releasing both wheels. This release has three aspects, as follows:

(1) If the vessel should heel to a dangerous degree, it will return at once to an approximately even keel.

(2) When running with wind astern, the driving force will be cut off, thereby making it feasible to reduce the forward progress of the vessel without altering course—an impossibility with vessels of conventional rig, and,

(3) In order to facilitate a shift in the fore-and-aft position of the traveler under conditions of high wind velocity, momentary release of the force of the wind upon the sail will minimize the effort required in said shift of position.

Finally, with the traveler aft, as shown in position X in the drawings, rotation of the sail element in an appropriate direction will effectively swing the bow away from the wind when the vessel is going about, so that the undesirable and often dangerous tendency of conventional vessels to "hang in irons" when pointing directly toward the wind may be avoided.

The foregoing specification sets forth the invention in its preferred practical forms but the structure shown is capable of modification within a range of equivalents without departing from the invention which is to be understood is broadly novel as is commensurate with the appended claims.

I claim:

1. In combination, a sailing vessel, a sail and a sail rig, said sail comprising a generally trangular sail membrane,

strut means attached to the aft end of said boat and extending upwardly and forwardly therefrom,

a generally triangular frame comprising a base member and two strut members fixed together in generally triangular relation,

said strut members being fixed together at a first end thereof defining an apex and each said strut being fixed to said base member at an opposite end thereof from the other,

said apex end of said struts being fixed to said strut means at its upper end,

a universal joint fixed to said base member at an intermediate position thereon,
a traveler connected to said universal joint,
guide members on said boat generally parallel to the keel thereof and means on said traveler to guide it on said guide members,
and means to rotate said universal joint relative to said traveler whereby said sail membrane may be rotated relative to said vessel and the bottom of said sail may be moved forward and aft relative to said vessel.

2. The vessel recited in claim 1 wherein
said means to rotate said universal joint comprises two laterally spaced belt members extending generally parallel to said guide members,
a double pulley means fixed to said universal joint,
means to selectively move said belt member in a first direction whereby said traveler is moved along said guide members,
said means being adapted to move said belt member in opposite direction whereby said sail membrane is rotated relative to said vessel.

3. In combination, a sailing vessel, a sail and a sail rig,
said sail comprising a generally trangular sail membrane,
strut means attached to the aft end of said boat and extending upwardly and forwardly therefrom,
a generally triangular frame comprising a base member and two strut members fixed together in generally triangular relation,
said strut members being fixed together at a first end thereof defining an apex and each said strut being fixed to said base member at an opposite end thereof from the other,
said apex end of said struts being fixed to said strut means at its upper end,
a universal joint fixed to said base member at an intermediate position thereon,
a traveler connected to said universal joint,
guide members on said boat generally parallel to the keel thereof and means on said traveler to guide it on said rails,
means to rotate said universal joint relative to said traveler whereby said sail membrane may be rotated relative to said vessel and the bottom of said sail may be moved forward and aft relative to said vessel,
and means holding said sail membrane taut.

4. In combination, a sailing vessel comprising a sail, a vessel and control structure for said sail means,

said control structure comprising means fixed relative to said vessel for supporting the top of said sail means,
means to rotate said sail means about an axis of rotation,
means to shift the lower end of said axis of rotation forward and rearwardly relative to said vessel, whereby the forces of wind on said sails are transmitted to said vessel in an efficient manner,
said means to shift said lower end of said axis of rotation comprising a pulley member attached to said sail means, and
means to rotate said pulley and to shift said pulley longitudinally of said vessel,
said means to shift said pulley comprising two belts engaging said pulley, two crank means to move said belts selectively in a first direction when said cranks are rotated in the same direction and to move said belts in opposite directions when said pulleys are rotated in opposite directions.

5. A sailing vessel comprising
a sail,
rigid frame means supporting said sail in relative flat relation,
means on said vessel supporting the top of said sail and means attached to the bottom of said sail for moving the bottom of said sail forward and aft relative to said vessel and for rotating said sail about a vertical axis,
said means for moving the bottom of said sail comprises a shaft attached to the bottom of said rigid frame,
means for moving said shaft forward and rearward relative to said vessel,
and means to rotate said shaft with said rigid frame attached thereto.

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