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Dorland

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[54] **SYMMETRICAL SAIL ASSEMBLY**

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[51] **Int. Cl.** **B63h 9/08**

[58] **Field of Search** 114/39, 102, 103

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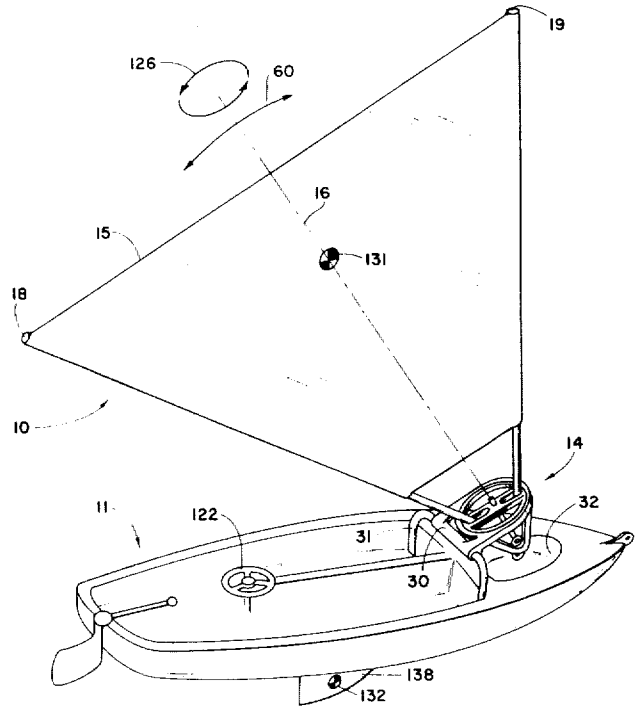
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Assistant Examiner—Stuart M. Goldstein
Attorney, Agent, or Firm—William S. Dorman

[57] **ABSTRACT**

A sail and sail assembly to drive a wind propelled vehicle includes a pair of booms configured in a "V" pattern to carry a triangular sail between them. The booms are mounted with their adjacent ends upon a rotatable mount which is attached to the vehicle, the axis of symmetry between the two booms being in a vertical plane passing through a longitudinal axis of the vehicle. The booms are rotatable at least 180° about the axis of symmetry to enable the sail to catch the wind from any direction. The rotatable mount includes a turntable within a race mounted to the vehicle, to facilitate the rotation of the sail assembly, and a screw interconnection between the connected ends of the booms and the turntable to enable the angular separation of the booms to be controlled.

4 Claims, 8 Drawing Figures



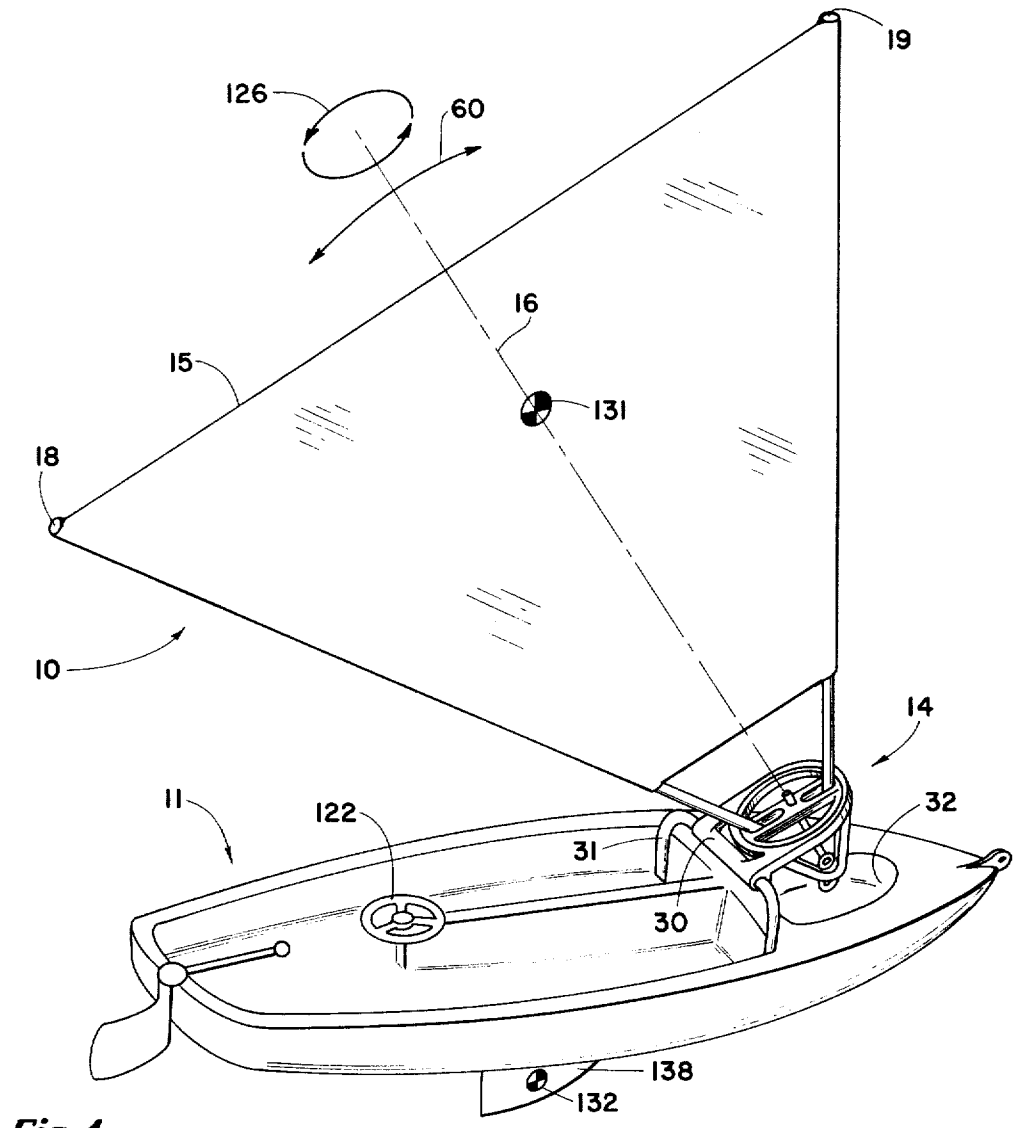

19
126
60
16
15
131
18
10
14
11
122
32
31
30
138
132

Fig. 1

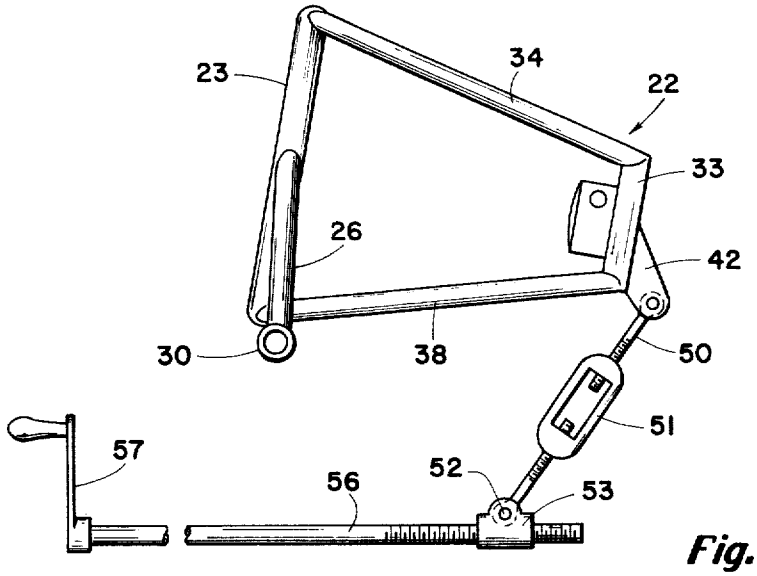

23
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56

Fig. 2

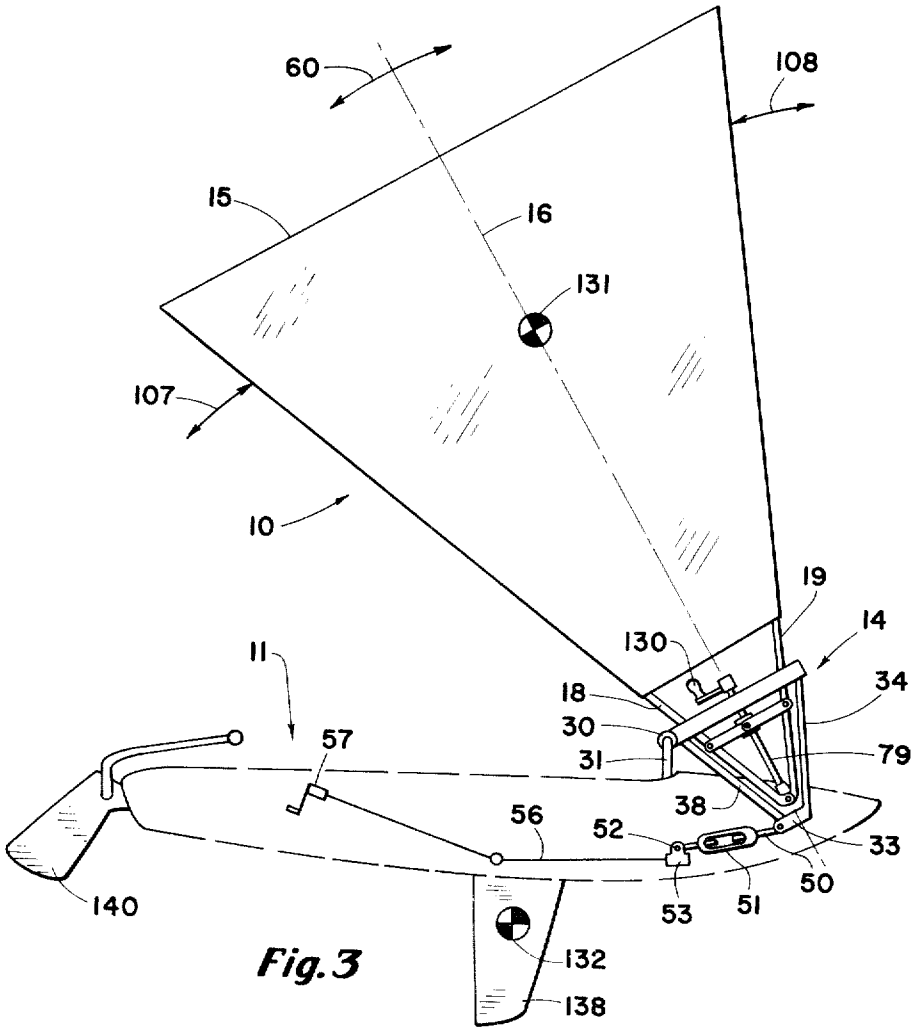

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Fig. 3

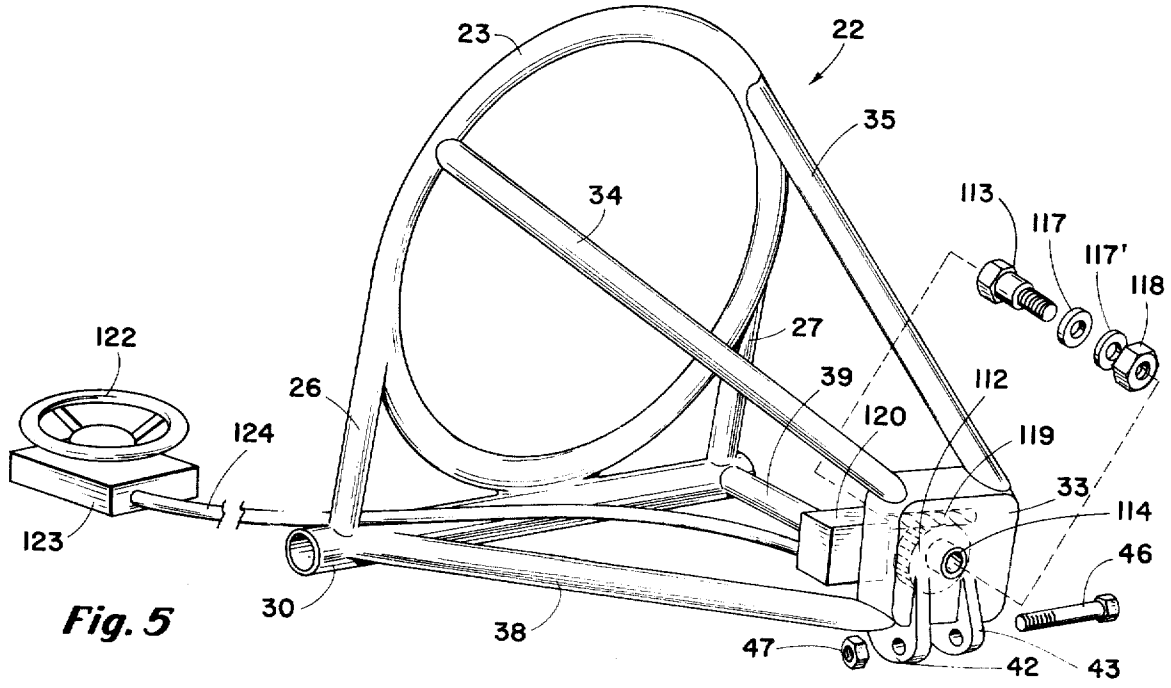

23
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113
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117'
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Fig. 5

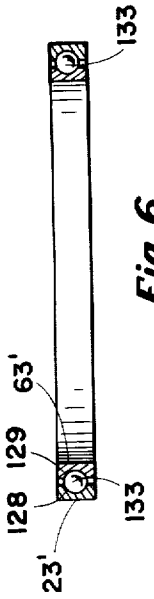


Fig. 6

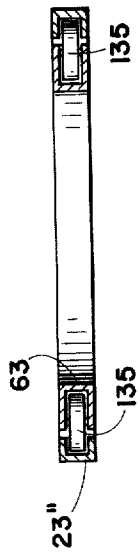


Fig. 7

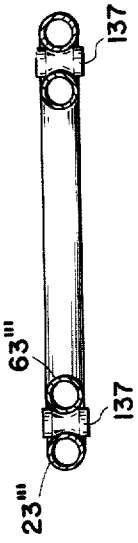


Fig. 8

Fig. 4

SYMMETRICAL SAIL ASSEMBLY

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to improvements in sails, sail carrying assemblies, and the like, for wind propelled vehicles, and more particularly to a rotatable, symmetrical sail, and to an assembly for carrying, manipulating, and positioning same.

2. Description of the Prior Art

Although many shapes and configurations for sails and sail carrying apparatuses have been proposed, the most widely known and widely used sail configuration is that of a right triangle. Ordinarily, a vertical mast is provided attached to the boat or other vehicle to be propelled, and a horizontal boom is provided extending outwardly at a right angle from the mast. The sail is then attached between the mast and the boom, and is usually rotatable about the axis of the mast, the boom describing upon rotation a horizontally oriented circle having its center at the axis of the mast.

Although many other types of sail configurations have been advanced, because the simplicity of construction and operation of the above described right triangular shaped sail, most are variations of such sail, and enjoy its advantages and disadvantages. One of the particular disadvantages of the right triangular type sail is in its operation in a direction in which the boom is oriented essentially into the wind. When the wind moves from one side of the boom to the other, it may catch the sail and whip the boom from one side of the boat to the other. The condition, known as "jibing," is particularly dangerous when it occurs unexpectedly.

Another disadvantage of the triangular sail designs is that when sailing cross-wind, the boat typically swings over to one side, the mast, for example, being at an angle of 45° or less from horizontal. Thus, special hull design considerations must be made to reduce the water drag against the hull surface, and particular operating precautions must be taken to prevent the boat from capsizing completely.

Additionally, the triangular sail configurations previously used restrict the manuverability of the boat. There are, in fact, particular angles or directions with respect to the wind in which the boat is "in irons;" that is, cannot be made to move at all. This condition, for example, is when the bow of the boat is oriented directly into the wind.

Finally, the operation of most commonly used right triangular shaped sails requires some expertise, and, commonly, considerable physical strength to operate the cables and rigging used in conjunction with it. Thus, ordinarily a certain degree of experience is necessary to perform even the simplest sailing operations using commonly employed sails and rigging. Because of this, using typical right triangular sails and their associated mast and boom rigging, ordinary sailboats are not amenable to being operated by automatically controlled equipment, such as servomotors, computerized quidance systems, and the like.

SUMMARY OF THE INVENTION

In light of the above, it is, therefore, an object of the invention to provide a symmetrical sail for a wind propelled vehicle.

It is another object of the invention to provide an assembly for rotatably carrying a symmetrical sail with its axis of symmetry angularly located over a longitudinal axis of a wind propelled vehicle.

It is another object of the invention to provide a jibe proof sail.

It is another object of the invention to present a sail having a center of wind pressure which remains in a constant position regardless of the attitude of the sail.

It is another object of the invention to present a sail which increases the degree of manuverability of the vehicle upon which it is employed.

It is another object of the invention to present an apparatus for carrying, manipulating, and positioning a generally symmetrical sail, and particularly a triangular sail.

It is another object of the invention to provide a sail-carrying assembly which can be manually or automatically operated.

These and other objects, features, and advantages will become apparent to those skilled in the art from the following detailed description when read in conjunction with the accompanying drawings and appended claims.

In accordance with the broad principles of the invention, a symmetrical sail and an assembly for carrying it above a wind propelled vehicle are presented. The assembly includes a pair of booms for carrying the sail therebetween. Means are provided for attaching one end of each of the booms adjacent the vehicle in a position adjacent each other, and for supporting the other end of each of the booms away from the vehicle apart from each other in a generally V-shaped or triangular configuration. Means are provided on the attaching means for rotating the booms about an axis centrally located between each of the booms. When the booms are rotated, the center of wind effort upon the sail remains in a substantially constant location with respect to the vehicle.

In accordance with the invention, the mount utilizes a turntable having a pair of holes through which the sail carrying booms extend to maintain the rotational position of the booms. A race is provided carrying the turntable to facilitate its rotation, and a clamp is attached between the adjacent ends of the sail carrying booms. Means are provided for maintaining and adjusting the distance between the boom interconnecting clamp and the turntable to widen and narrow the distance between the booms.

BRIEF DESCRIPTION OF THE DRAWING

The invention is illustrated in the accompanying drawing, wherein:

FIG. 1 is a perspective view of a sailboat including a sail and sail assembly, in accordance with the principles of the invention.

FIG. 2 is a side elevation of an adjustable sail-carrying turntable receiving frame, as used in the sailboat embodiment of FIG. 1.

FIG. 3 is a side elevation, partly cut-away, of the sailboat and sail and sail assembly of FIG. 1 diagrammatically showing the mounting details for operation of the sail-carrying turntable receiving frame of FIG. 2.

FIG. 4 is a perspective view of the sail-carrying turntable, as used in the sailboat of FIG. 1.

FIG. 5 is a perspective view of the sail-carrying turntable receiving frame of FIG. 2, particularly illustrating its operable relationship with the sail-receiving turntable of FIG. 4.

FIG. 6 is a plan view, partially cut away, of one embodiment of the sail-carrying turntable and receiving frame, showing a ball bearing race therebetween.

FIG. 7 is a plan view, partially cut away, of another embodiment of a sail-carrying turntable and receiving frame, showing a wheeled bearing assembly.

And FIG. 8 is a plan view, partially cut away, of another embodiment of a sail-carrying turntable and receiving frame showing a bearing assembly using cylindrical separating bearing members.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The sail assembly in accordance with the invention is generally denoted by the reference numeral **10**, and is shown in FIG. **1** mounted on a boat **11**. Although the sail and sail assembly are described and illustrated herein as being used in conjunction with a sailboat, it will be appreciated that the sail and sail assembly, in accordance with the principles of the invention, can be equally advantageously employed upon any wind propelled vehicle, such as an ice riding cart, or the like, the illustration on description of a boat being primarily by way of example. The sail **10** is attached, in a manner below described in detail, to the boat **11** by a turntable mount assembly **14** at a generally forward location for convenience, as will become apparent.

The sail assembly **10** includes a sail **15**, of canvas or any other well known sail material, mounted between two masts or booms **18** and **19**, arranged in a V configuration. The sail **15** is actually in the form of a trapezoid (or truncated triangle) but will, nevertheless be considered to be of generally triangular shape. It will be appreciated that the triangular sail **15**, carried upon the V configured frames **18** and **19**, is symmetrical about a center line axis **16**, located midway between, and equidistant from, the booms **18** and **19**, as shown in FIGS. **1** and **3**.

The turntable mount assembly **14** includes two main sections, a sail-carrying turntable **62**, shown particularly in FIG. **4**, and a supporting frame **22** shown in FIGS. **2** and **5**, for receiving the turntable. The sail-carrying turntable **62**, which is described below in detail, rotatably supports the sail **15** and booms **18** and **19** from the boat **11** upon the supporting frame **22**, and the supporting frame **22** supports and facilitates raising and lowering the entire sail assembly **10**. As shown particularly in FIGS. **2**, **3**, and **5**, the supporting frame **22** has a circular race or frame **23** within which the sail-carrying turntable **62** rotates, as below described. The circular frame **23** is attached by members **26** and **27** to a hollow tube **30**, which in turn is hingedly or rotatably mounted upon a rod or pipe **31** attached to the boat to locate the supporting frame **22** above a well opening **32** in the deck of the bow of the boat **11** (see FIG. **1**). The circular frame **23** and the tube **30** are connected to a gear mounting base **33** by members **34** and **35**, and **38** and **39** respectively. Thus, the circular frame **23** together with the members **34**, **35**, **38**, and **39**, form a conically shaped receptacle, for receiving the sail-carrying turntable **62**, as shown in FIG. **3**.

The gear mounting base **33** has a pair of outstanding flanges **42** and **43** which are rotatably attached by a bolt **46** and nut **47** to a position control rod **50**. The position control rod **50** is rotatably connected by a bolt **52** to a rider **53** threadedly moveable upon a screw **56**, which can be rotated by an attached handle **57** in the interior of the boat. The screw **56** is fastened to the boat by bearings (not shown) to enable it to be turned in place and provide a supporting base for the supporting frame **22**. The length of the rod **50** can be adjusted if desired by a turnbuckle **51** between its ends. The same movement of the frame **22** can be achieved by making the pivot point **52** stationary and by replacing the rod **50** and turnbuckle **51** with a hydraulic piston-cylinder actuator (not shown).

The operation of the supporting frame **22** can be seen from the diagrammatic illustration in FIG. **3**. As the handle or crank **57** near the stern of the boat **11** is rotated to turn the screw **56**, the rider **53** is moved in the direction of the thread travel. The rider **53** thereby pulls or pushes the rod **50** depending on the direction the crank **57** is turned, to rotate the supporting frame **22** upon the pipe **31** about the pipe **30**. The entire sail is thus raised or lowered in a vertical plane, as shown by the arrows **60** in FIGS. **1** and **3**.

The sail-carrying turntable **62** to control the rotation of the sail and the separation of the booms **18** and **19**, is shown particularly in FIG. **4**. The turntable **62** includes a circular frame **63** of diameter slightly smaller than the circular frame **23** of the supporting frame **22**, of FIGS. **2** and **5**, in which it is located in bearing relationship, as below described further in detail. An arm **66** extends across the interdiameter of the circular frame **63**, and is provided with a pair of slots **68** and **69** to receive the booms **18** and **19**, respectively.

The ends of the booms **18** and **19** are connected by connection members **71** and **72** within a U-shaped bracket **73** and rotatably connected thereto by a bolt **75**. The connection members **71** and **72** can be U-shaped metal brackets encircling the masts **18** and **19**, and connected thereto by welds, screws, or other suitable means (not shown). The U-shaped bracket **73** includes a bearing **76** for rotatable attachment to a spreader screw **79**. The screw **79** extends between the arm **66** and the U-shaped bracket **73**, rotatable connection being made to the arm **66** by a radial bearing **80** to present an end **83** having a squared portion **84** formed thereon to enable the screw **79** to be turned. The screw, rotatably attached to the U-shaped bracket **73** by a combination radial and thrust bearing **76**, is held in place by a pair of nuts **77** (only one of which is shown in FIG. **4**) located on opposite sides of the bracket **73**.

A mast separating assembly **87** includes a rider block **88** which threadedly engages the screw **79** to ride up and down thereupon upon turning the screw **79**. Four elongated connection members **91**, **92**, **93**, and **94** are rotatably attached to the rider **88** upon outstanding bolts on top and bottom, top bolt **97** being shown, and secured by nuts **98** and **100**, respectively. In a similar fashion, the elongated rods **91**, **92**, and **93**, and **94** are attached to booms **18** and **19**, respectively, by sleeves **102** and **103**, and held in rotatable secured relationship by bolts **105** and **106** having nuts **109** and **110** respectively connected thereto. Thus, the booms **18** and **19** are moved closer together or further apart by turning the screw **79** to move the rider block **88** up and down upon the threaded portion of the screw **79**.

A gear **112** is bolted by bolts **115** and **116** to the U-shaped bracket **73** to facilitate rotation of the turntable assembly **62**. Thus, the entire turntable assembly **62** is located within the conical shape of the supporting frame **22**, above described with reference to FIGS. **2**

and 5, with the circular frame 63 of the sail-carrying turntable coaxially located in bearing relationship with the circular frame 23 of the supporting frame 22, and with the gear wheel 112 located adjacent the gear mounting base 33 of the supporting frame 22, as shown in FIG. 5. The gear 112 is rotatably connected to the base 33 by means of the combination thrust and radial bearing 114 mounted in the base, bolt 113, washer 117 which is received on the bolt 113 between the gear and base, nut 118, and washer 117' which is received on the bolt between the base 33 and the nut 118. A worm gear 119 extends from a rotation transmission means, illustrated by box 120 in FIG. 5, and engages the teeth of the gear wheel 112 to rotate the gear wheel and the sail-carrying turntable 62. Rotational movement can be transmitted to the transmission box 120 from the interior of the boat by a wheel 122 and gear assembly 123 via a cable 124. The cable 124 conveniently is of the type having an outer non-rotating sheath which can be fastened to the hull of the boat, with an interiorly disposed turning cable portion connecting the rotational movement of the gear box 123 to the transmission box 120. Thus, upon turning the handle or wheel 122, the worm gear 119 is turned against the circular gear 112 to rotate the sail-carrying turntable 62. If desired, the wheel 122 can be remotely located within the boat at a position easily accessible by the normal position of the operator. It will be appreciated that the rotation of the worm gear 119 can be effected by a motor drive (not shown) controlled, for example, by switches within the boat. Likewise, the rotation of the screw 56 to raise and lower the sail can be effected by a motor drive (not shown) controlled remotely from within the cabin of the boat. This feature enables the sail and sail-carrying assembly, in accordance with the principles of the invention, to be automatically controllable by servomechanisms or the like, or, further enables the sail and sail assembly to be operated by remote control by means such as a digital or analog computer, receiving, for example, inputs from various detectors (not shown) detecting and relating the direction of the wind, the water currents, and so forth, and moving the sail in response to signals from the computer to effect the required direction of travel.

Various bearing assemblies can be employed in forming the bearing surface between the circular frame 23 of the supporting frame 22 and the circular frame 63 of the sail-carrying turntable 62. For example, as shown in FIG. 6, a ball bearing type bearing can be employed. In such ball bearing configuration, the outer circular frame 23' is provided with a ball bearing race 128, and the inner circular frame 63' of the sail-carrying turntable 62 is provided with a corresponding ball bearing race 127. Thus, ball bearings 133 can be located within the races 128 and 129 to effect the desired bearing connection.

An alternative embodiment of the bearing assembly is shown in FIG. 7, in which the outer circular frame 23'' of the supporting frame 22 is channeled. The circular frame 63'' of the sail-carrying turntable 62 is likewise channeled to carry a plurality of wheels 135 therein which ride within the channel of the outside circular frame 23'', thereby effecting a suitable rotational bearing therebetween.

In still another embodiment of the bearing assembly, the outer circular frame 23''' and inner circular frame 63''' can be of circular cross-section to enable cylindrical bearings, such as cylindrical bearings 137, to be disposed between them, to effect the rotational bearing of the turntable assembly within the supporting frame. Still other forms of rotational bearings can be provided, the above being disclosed primarily by way of illustration.

In the operation of the sail assembly, in accordance with the principles of the invention, initially, the sail is mounted upon the sail-boat in a manner as above described, conveniently with the two masts or booms 18 and 19 located adjacent and essentially parallel to each other, with the sail wrapped around the masts, and tied, or covered with a sheath or the like (not shown), for storeage and to facilitate towing or moving the sailboat 11 from place to place on a trailer, or the like (not shown). Upon arrival at the site at which the boat is to be launched, the sail is raised to its desired operating angle by rotating the crank 57, which rotates the supporting frame 22 upon the bar 31. The sail is then unfurled by rotating the screw 79, by such as a handle, crank, ratchet, or the like, ratchet 130 being shown for this purpose in FIG. 3. Thus, the booms are separated or controlled in the directions shown by the arrows 107 and 108 in FIG. 3 by rotation of the ratchet 130. The sail is then rotated to an appropriate angle to catch the wind, by turning the handle 122 to drive the worm gear 119 rotating the turntable 62, as shown by the arrow 126 in FIG. 1.

It will be appreciated that the sail should be rotatable through an angle of at least 180°, and perferably an angle of 360°, or more, to enable it to catch the wind from any direction. Because the sail has a particular line of symmetry 16, the resultant point of the wind forces (the center of effort) 131 will be located thereon. Since the axis of rotation 16 is moveable only up and down in a verticle plane passing through the axis of the boat, the center of effort 131 will always remain directly above the boat 11. This is true regardless of the amount of rotation of the sail assembly about the center line 16, since the rotation is through a line passing through the center of effort 131. Thus, regardless of the amount of rotation of the sail about the center line 16, the center of effort will remain at a stationary fixed location with respect to the boat 11.

The center of effort 131 can be located slightly forward or aft of the center of lateral resistance 132, ordinarily located on the keel 138 (the center of lateral resistance corresponding to the resultant forces of the water upon the boat). Thus, in accordance with normal sailing practices, the center of effort 131 and the center of lateral resistance 132 can be located at any desired relationship to each other forward and aft. This is in contradistinction, for example, to the right triangular shaped sails in which the center of effort often times was located off the starboard or port side of the boat, depending upon the direction of the boom, or in which weight changes are required within the boat to properly locate the center of effort forward and aft.

Additionally, it can be seen that the sail assembly 10 is jibe proof, since if the boat is inadvertantly sailed to allow the wind to change from one side of the sail 15 to the other, the sail assembly will not be swung around to the other side of the boat, no such swinging boom being provided. The wind will instead merely act upon the reverse side of the fixed sail to somewhat brake the boat.

Also, it should be noted that since the center line **16** is disposed at an angle from horizontal less than 90°, a certain degree of lift will be realized by the action of the wind upon the sail. This lifting force tends to keep the boat upright rather than tilting or heeling it to one side, since the lifting force tends to cancel the sideward forces of the wind upon the sail, particularly for small wind velocities.

It can be seen that the sail assembly **10** is positioned without the necessity for cables, ropes, pulleys, and the like, and requires relatively little strength or skill in erecting to the sailing position.

Another advantage of the sail is that the boat can be operated in reverse, even when the wind is coming directly over the bow. Thus, by aligning the sail perpendicular to the axis of the boat (90° from the position illustrated in FIGS. **1** and **3**), the wind will be enabled to catch the sail and move the boat backwards. Also, the sail can be operated to function as a brake under normal sailing conditions, by simply turning the face of the sail opposite to that required for forward motion, thus, for example, enabling the wind from the side of the boat to catch the front side of the sail rather than the back. This feature furthermore permits the power supplied by the wind to the boat to be varied as desired to regulate the speed of the boat. Thus, the sail assembly **10**, in accordance with the invention, together with the rudder **140** of the boat, can be used to effect virtually any manuver desired.

It should be pointed out that although the sail is illustrated for clarity as being aligned in a plane passing longitudinally through the boat, ordinarily, it will be operated at a larger angle from the axis of the boat, for instance 90°. Thus, for full wind power with the wind coming directly over the stern, the plane within which the sail will be located will be perpendicular to the longitudinal axis of the boat.

Although the invention has been described and illustrated with a certain degree of particularity, it is understood that the present disclosure has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. In combination with a wind propelled vehicle, an assembly for carrying a sail above said wind-propelled vehicle comprising:

a turntable mounted on said vehicle,

means for rotating said turntable relative to said vehicle around an axis of symmetry passing through said turntable,

a pair of booms for carrying a sail therebetween pivotally mounted at their lower ends to said turntable and extending divergently upwardly from said turntable and defining a plane with said axis of symmetry, said booms extending symmetrically upwardly with respect to said axis of symmetry,

and means for tilting said turntable with respect to said vehicle about a substantially horizontal transverse axis whereby said axis of symmetry is movable from a substantially vertical position to a substantially horizontal position.

2. The improvement according to claim **1** including means for pivoting said booms simultaneously relatively towards each other and simultaneously relatively away from each other within said plane for decreasing or increasing the divergency of said booms.

3. The improvement according to claim **2** wherein said turntable is provided with a pair of slots through which said booms extend and within which said booms are relatively movable towards and away from each other.

4. A sail boat comprising,

a hull and a keel therebeneath,

a mount carried by the hull,

means for pivoting said mount with respect to said hull about a substantially horizontal transverse axis,

a turntable rotatably carried by said mount,

a race carried by said mount for rotatably supporting said turntable therein to facilitate its rotation,

means for rotating said turntable with respect to said mount about a central axis of symmetry passing through said turntable and said mount,

said turntable having a pair of elongated slots extending radially on opposite sides of said axis of symmetry,

a pair of booms pivotally mounted at their lower ends in said turntable and extending divergently outwardly from said turntable through said elongated slots, said booms extending outwardly symmetrically with respect to said axis of symmetry,

and means co-acting between said turntable and said booms for simultaneously moving said booms towards and away from each other so as to decrease or increase the divergency therebetween while maintaining the symmetrical relationship of said booms with respect to said axis of symmetry.

* * * * *