

Oct. 1, 1968

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3,403,653

SAILS

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2 Sheets-Sheet 1

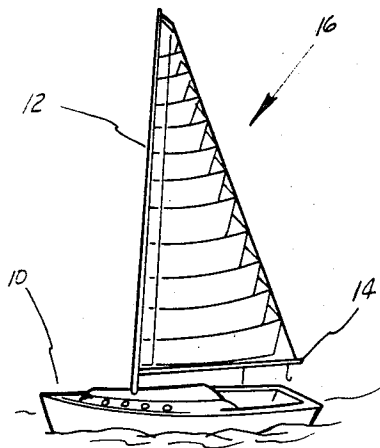


FIG. 1

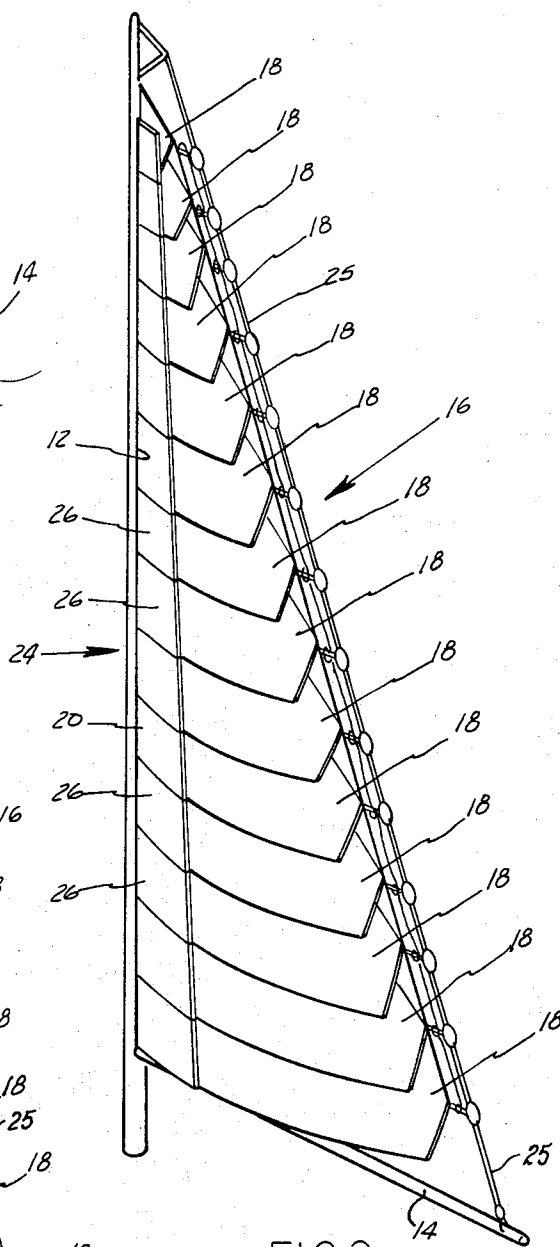


FIG. 2

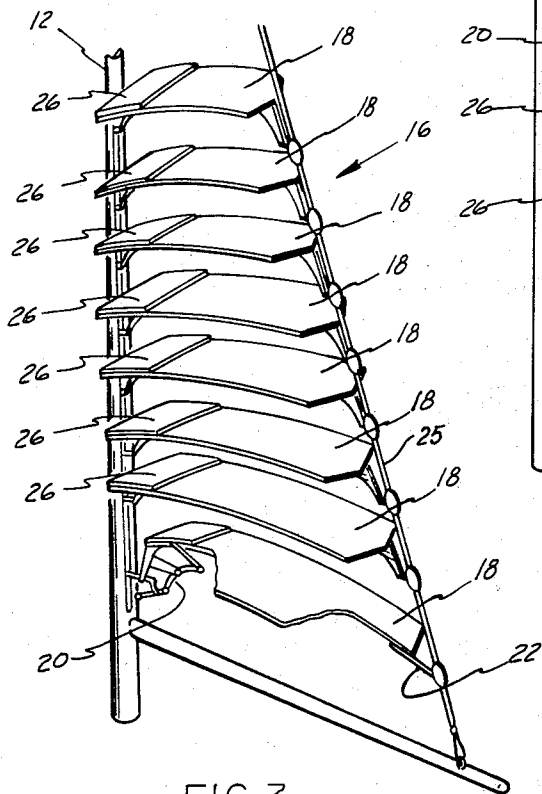


FIG. 3

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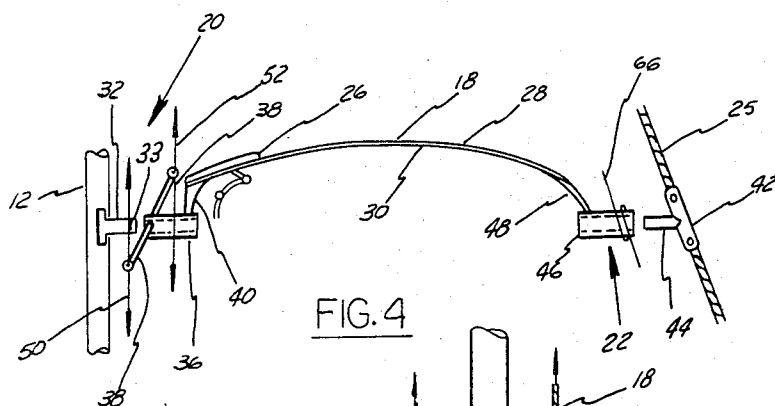


FIG. 4

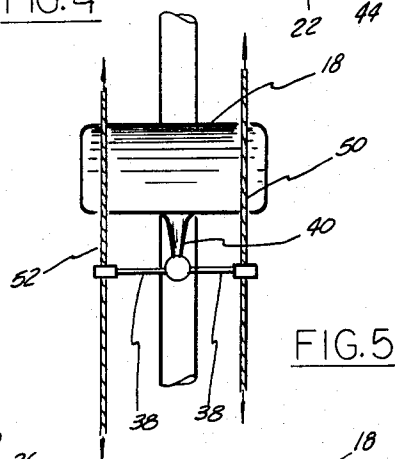


FIG. 5

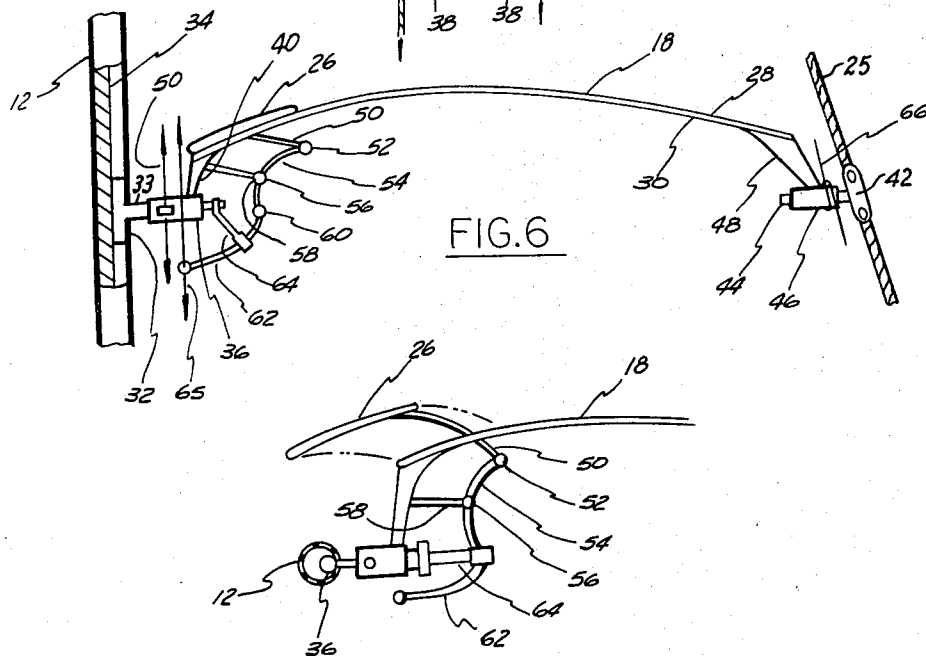


FIG. 6

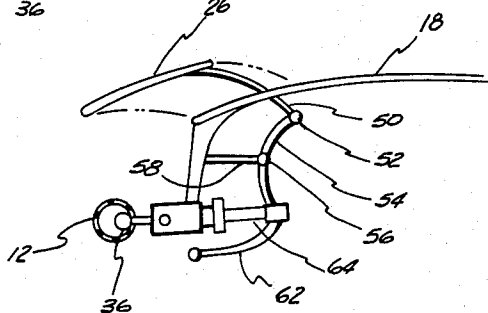


FIG. 7

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6 Claims. (Cl. 114-103)

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Summary

The preferred embodiment of the present invention, which will be subsequently described in detail, employs a series of rigid elongated panel sections arranged in overlapping relationship one above the other. Each panel section is supported for rotation about a horizontal axis and preferably has a length extending from the luff to the leach of the sail assembly. The panels are rotatable about their individual axes for a synchronized movement between one extreme position wherein they collectively present a continuous surface to the wind and a second extreme position wherein they are arranged in spaced parallel relationship. By rotating the panel sections about their respective axis to a selected angle, the horizontal thrust produced on the vessel can be precisely controlled and a vertical lift component developed.

Each panel section has an arcuate longitudinal cross section taking the form of an aerodynamic profile. The panels are formed of a rigid material so that an optimum profile is available and presented to the wind irrespective of fluctuations in wind forces. This "Venetian Blind" arrangement permits a more useful employment of the wind force available while underway, and also permits a more efficient maneuvering of the vessel while approaching a buoy or pier.

Each panel section is provided with a guide member at its luff edge which is slidably seated in a vertical slot provided in the mast to permit the sail assembly to be easily hoisted up the mast or collapsed toward the boom.

It is well known that by increasing the velocity of the air stream flowing on the convex side of the sail assembly, that a greater negative pressure area can be achieved thereby producing a greater thrust from a given wind force. The preferred embodiment of the present invention provides an efficient nozzle means for deflecting a quantity of air from the windward side of the sail assembly and directing this air in a stream to the convex or downward side of the sail assembly. This nozzle means comprises a second series of smaller panel sections each of which is associated with the luff edge of the main panels on their concave side. Each nozzle panel is attached to its associated main panel by a linkage arranged to move the nozzle panel between a retracted position where it is adjacent to the main panel and an extended position wherein it is spaced from its main panel to define a throat for receiving and directing a wind stream toward the convex side of the main panel assembly. A suitable linkage provides means for moving the nozzle panels between their retracted and extended positions to a selected spacing from the main panel members.

It is therefore an object of the present invention to provide a sail assembly having contour retaining properties under varied wind conditions by providing a series of elongated panels each having a contoured longitudinal cross section and arranged in overlapping relationship to provide a continuous surface, each panel formed of a rigid shape-retaining material.

It is another object of the present invention to provide a sail assembly having means for readily reducing the effective sail area presented to the wind without lowering or raising the sail by providing a series of sail panels supported for synchronized rotation one above the other about horizontal axes and which are movable between a first extreme position wherein they present a continuous surface to the wind and an opposite extreme position wherein they present spaced edgewise surfaces to the wind.

Still another object of the present invention is to provide an improved sail assembly which may be easily hoisted and readily collapsed by providing a series of panel sections each supported along a horizontal axis and

ABSTRACT OF THE DISCLOSURE

A sail assembly formed of a series of elongated, rigid, panel sections arranged one above the other and each supported for rotation about a horizontal axis. Each panel has an arcuate, longitudinal profile defining a concave and convex side. Suitable lines provide means for rotating the panel sections simultaneously about their axis to control the propulsive force produced by the panels and the available wind force. A series of smaller panels are linked to the luff edge of each panel and selectively spaced from the convex sides thereof to define a nozzle assembly. The nozzle assembly is arranged to deflect air from the windward concave side of the panels to provide air streams for increasing the negative pressure on the convex side of the panels.

Background of the invention

This invention relates to watercraft and more particularly to a sail assembly for watercraft having a plurality of elongated overlapping panel sections supported for rotation and having means for moving the panel section in synchronization to control the magnitude of the propulsive force developed by the sail assembly and a wind force.

Description of the prior art

Sails have long been used as a means for converting a wind force to a directed thrust for a vessel. Conventionally sails utilize a fabric sheet which has two surfaces, one of which is convex and the other correspondingly concave. This shape is normally assumed when the sail is inflated by a wind force. The thrust effect results from a directed circulation of the wind force acting on the aerodynamic profile assumed by the sail so that a positive pressure area is produced on the concave side of the sail and a lesser or negative pressure area is produced on the convex side of the sail. The net force developed by the positive and negative pressure areas produces a thrust on the mast in a direction determined by the plans of the sail.

Obviously the net force developed by the sail is a function of the area of the sail. Thus a larger sail area will develop a larger directed force on the vessel and a smaller sail area will produce a smaller force. Thus, it can be seen that by varying the area of the sail presented to the wind, that the resultant thrust produced on the vessel can be varied to accommodate a desired rate of travel.

One attempt of the prior art to control the effect of the wind acting on the sail by varying the area of the sail, other than by raising or lowering the sail, was disclosed in Patent No. 1,516,063 issued to F. A. Scammell Nov. 18, 1924. The Scammell patent disclosed a sail comprising a series of canvas strips secured at their opposite ends to a boom and the mast by means capable of adjustment. By tightening one edge of each strip and loosening the other edge, the wind effect could be controlled to a limited degree. The present application discloses a novel improvement over the aforementioned art to produce a sail assembly providing a precise control for effectively employing the wind force available to the sail.

having a slide element along their luff edge which rides in a vertical track formed in the mast.

Still further objects and advantages of the present invention will readily occur to one skilled in the art to which the invention pertains upon reference to the following detailed description.

Description of the drawings

The description refers to the accompanying drawing in which like reference characters refer to like parts throughout the several views and in which:

FIG. 1 is a perspective view depicting a sailing vessel propelled by a sail assembly illustrating a preferred embodiment of the invention;

FIG. 2 is an enlarged view of the sail assembly illustrated in FIG. 1 and with the panel sections rotated to present a full surface to the wind;

FIG. 3 is a fragmentary perspective view of the sail assembly illustrated in FIG. 1 with the panel sections rotated to present a minimum surface to the wind;

FIG. 4 is an enlarged, exploded view of a typical panel assembly;

FIG. 5 is a view looking toward the leading edge of a typical panel;

FIG. 6 is a view of the panel assembly illustrated in FIG. 4 with the various elements assembled;

FIG. 7 is a view illustrating a nozzle panel spaced from the luff edge of its panel to define a nozzle throat for directing air toward the convex side of the panel.

Description of the invention

Now referring to the drawings, FIG. 1 illustrates a sailing vessel 10 having an upwardly directed mast 12 and a laterally directed boom 14 supporting a sail assembly 16.

Referring to FIGS. 2 and 3, the sail assembly 16 comprises a series of elongated panels 18, each of which is supported for rotation about a generally horizontal axis. The panels 18 are collectively rotatable about their respective axes between a generally vertical position wherein they cooperate to form a continuous surface as illustrated in FIG. 2 and an opposite extreme position wherein they each essentially lie in spaced parallel relationship to one another as seen in FIG. 3. Each of the panels 18 is supported at its leading edge by a forward linkage mechanism 20 (FIG. 4) and at its trailing edge by a rearward linkage mechanism 22. The forward linkage mechanism provides a connection between the luff edge of the panel and the mast 12 and the rear linkage 22 provides a supporting connection between the leech of each panel and a cable 25. As can best be seen in FIG. 2 the cable 25 extends from the tip of the mast 12 to the outer end of the boom 14.

The panels 18 are elongated about their horizontal axes and gradually increase in length from the uppermost panel to the lowermost panel to form a triangular configuration similar to what is known as a Marconi rig.

A nozzle assembly 24 (FIG. 2) comprising a series of individual nozzle panels 26 is associated with the luff of the sail assembly 16. The nozzle assembly 24 is arranged so that the individual panels 26 may be collectively extended forwardly and away from the associated panels 18 or retracted to a position adjacent the panels 18.

The nozzle assembly 24 is associated with the convex side of the sail assembly 16 and is intended to deflect air from the windward side of the sail assembly to create air stress on the convex side of the sail assembly thereby increasing the negative pressure on the downward side to produce a greater net thrust from a given quantity of wind.

Now referring to FIGS. 4 and 6, a typical panel 18 is illustrated as having an arcuate longitudinal cross section and is preferably formed of a rigid material so that an optimum cross section is always available under varying wind conditions. It will be noted that the arcuate cross section provides a convex side 28 and a concave side 30.

A maximum horizontal thrust is developed by presenting the concave sides 30 to the wind.

The forward linkage 20 provides a connection with the leading edge of the panels 18 and the mast 12 and includes a generally T-shaped slide member 32 slidably disposed in a vertical slot 34 defined in mast 12. Thus, the slide 32 is arranged so that the panels 18 may be raised to a selected height when getting underway, and lowered when the sail assembly is collapsed. Each slide 32 has a journal 33 for supporting a sleeve 36 having a pair of laterally directed arms 38. A forward supporting arm 40 provides a rigid connection between the sleeves 36 and the leading edge of the panel 18.

The trailing edge of each panel 18 is supported by an anchor member 42 which is fixed to the cable 25. The anchor member 42 supports a short shaft 44 on a rearward extension of the axis of the journal 33 supporting the forward sleeve 36.

A rear supporting sleeve 46 is rotatably journaled on the shaft 44. A rear supporting arm 48 provides a rigid connection between the leech of the panel 18 and the sleeve 36. Each of the panels 18 has a similar longitudinal profile so that when arranged in their overlapping position, they form a continuous surface. The trailing edge of each panel 18 is progressively shortened from the lowermost panel to the uppermost panel. Thus, the rear supporting arm 48 of each panel is progressively lengthened from the lowermost panel to the uppermost panel. This structure is best illustrated in FIGURE 3.

Thus, it can be seen that each panel 18 is supported for rotation about a generally horizontal axis defined by the journals 33 and the shafts 44. To rotate the panels 18 to a selected angle, a pair of control cables 50 and 52 are joined to the outer ends of arms 38 so that the panels 18 can be simultaneously rotated to a selected position.

The nozzle panels 26 are each supported by a link 50 through a ball and socket joint 52 to an actuating link 54. The link 54 is supported by a second ball and socket joint 56 to a link 58 rigidly attached to the support 40. A third ball and socket joint 60 provides a connection between an actuating lever 62 which is carried by a supporting crank 64. The supporting crank 64 is fixed against rotation to the journal 33. The outer end of the support 62 is connected to an actuating cable 65. Thus, it can be seen that as the cable 65 is moved between lowered and raised positions, the nozzle panels 26 are collectively moved between a retracted position wherein they are disposed adjacent the main panels 18 and an extended position wherein they are spaced from the leading edge of their associated panels 18. Preferably the nozzle panels 26 are arranged so that they are in their extended position when the main panels 18 are in their overlapping vertical arrangement and in their retracted position when the main panels 18 are in the raised parallel position as illustrated in FIG. 3.

To provide stability to the panels 18 as they are simultaneously rotated between their various positions, a cable 66 is wrapped around the rear supporting sleeves 46 and rotates with the sleeves 46 as illustrated.

Although I have described but one preferred embodiment of my invention, it is to be understood that various changes and revisions can be made therein without departing from the spirit of the invention as expressed by the scope of the appended claims.

I claim:

1. A sail assembly useful in converting a wind force into a directed thrust for a vessel, comprising a series of generally horizontal panel sections, each of said panel sections being formed of a substantially rigid material and having an arcuate, longitudinal cross-section defining concave and convex sides; and means supporting said panel sections along their lateral sides, one above the other.

2. A sail assembly as defined in claim 1, wherein each of said panels are arranged one above the other in an overlapping relationship.

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3. A sail assembly as defined in claim 1, wherein each of said panels is supported for rotation about a generally horizontal axis, and including means for simultaneously rotating said panels about their individual horizontal axes.

4. A sail assembly as defined in claim 3, wherein said panels are arranged in parallel relationship to one another throughout their arcs of rotation.

5. A sail assembly as defined in claim 4, including a series of nozzle panels, said series of nozzle panels associated with the leading convex edges of said panels, said series of nozzle panels forming air nozzle means to deflect air from the concave side of said panel sections to produce air streams on the convex side of said panels effective to increase the area of negative pressure on the convex side of said panel sections.

6. A sail assembly as defined in claim 5, including link

means connecting said nozzle panels to the leading edge of said panel sections for movement between a first position wherein said nozzle panels are adjacent said panel sections and a second position wherein said nozzle panels are spaced from said panel sections to define a nozzle means.

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