April 20, 1937. W. F. GERHARDT 2,077,685

SAIL

Filed April 18, 1934

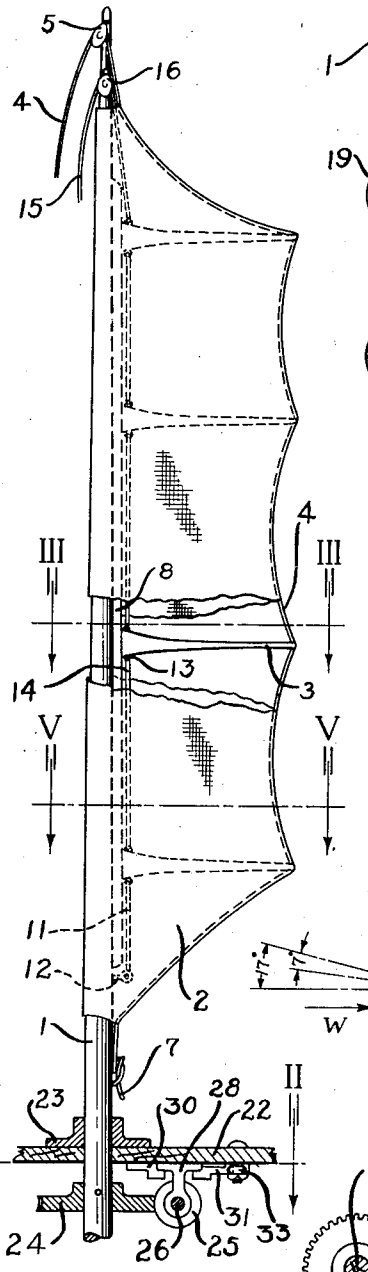


Fig. 1

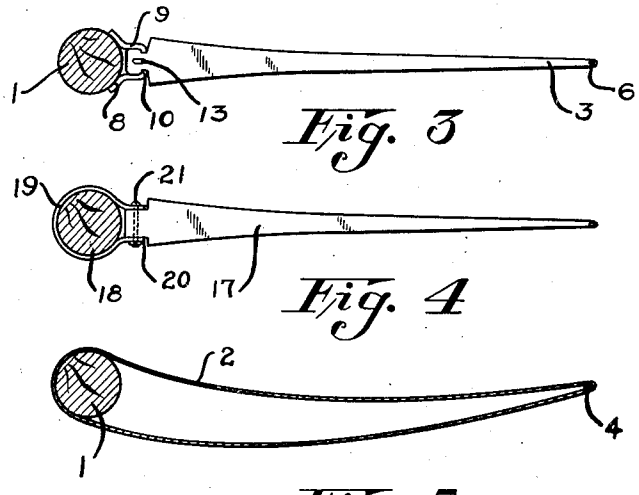


Fig. 3

Fig. 4

Fig. 5

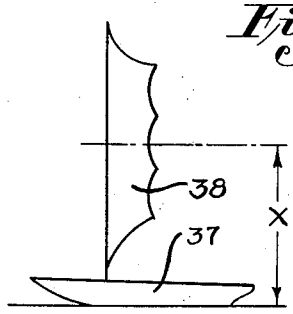


Fig. 6

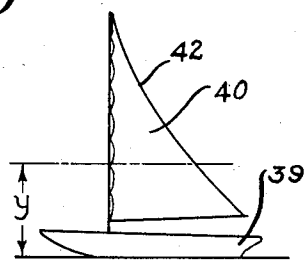


Fig. 7

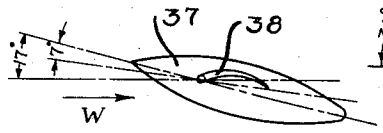


Fig. 8

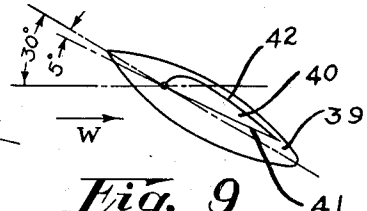


Fig. 9

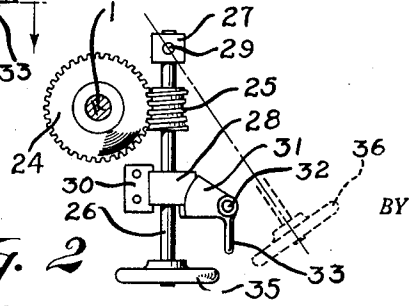


Fig. 2

INVENTOR.
William F. Gerhardt
BY
ATTORNEYS.

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2,077,685

SAIL

William F. Gerhardt, Detroit, Mich.

Application April 18, 1934, Serial No. 721,198

15 Claims. (Cl. 114—103)

My invention relates to sails or means of propulsion which utilize the wind, and in particular it relates to the construction and disposition of the sail elements in a manner which results in the attainment of an unusual degree of efficiency.

For a great number of years very little development or improvements have been made in means for propelling water craft by wind velocities. In consideration that water crafts are dependent upon the natural elements for their propulsion I provide a sail wherein its combined features have shown a decided improvement over any conventional type of propulsion means dependent upon the natural elements.

It is an object of my invention to dispose the sail canvas to wind velocities in the most suitable manner. Another object is to construct the sail in a manner so as to obtain substantially the maximum reduction in air resistance.

Another object is that, in comparison, a craft utilizing a sail of my invention is capable of a greater speed, with a sail of the same projected area than a similar craft carrying a conventional sail, or I may reduce the projected area of canvas in my sail and still retain the same reaction to wind velocities by propelling a craft carrying my sail at the same speed as a similar craft carrying a conventional sail of greater area.

Another object is that I am able to maintain the sail canvas at a uniform angle relative to the wind, and a further object is that a craft carrying the sail of my invention is capable of progressing at a lesser angle against the wind than crafts carrying conventional sails.

Another object is the elimination of the conventional boom, which is a matter of great convenience both to operators and/or passengers of water crafts. Furthermore, the width of the sail or boom length does not generally extend beyond the beam of the vessel.

A further object is that the sail angle may be conveniently controlled by rotary movement of the mast. A still further object is to provide tensioning means for controlling the curvature of the sail comprising an air foil so that such curvature may provide the correct air foil for different wind velocities. Other objects are that it is generally not necessary to lower the sail nor is it generally necessary to reef the sail.

These and other objects and advantages will appear more fully in the following detailed description when considered in connection with the accompanying drawing in which:

Figure 1 is a side elevational view partly in section of an embodiment of my invention.

Figure 2 is a plan view of means for controlling radial movement of the mast taken along lines II—II of Figure 1.

Figure 3 is a plan view partly in section of a sail strut taken along lines III—III of Figure 1.

Figure 4 is a somewhat similar view as that shown in Figure 3 exemplifying a modification of the sail strut.

Figure 5 is a transverse view in section of the sail foil taken along lines V—V of Figure 1.

Figure 6 is a side elevational view of a water craft carrying the sail of my invention.

Figure 7 is a comparative view in side elevation of a conventional water craft carrying a conventional sail.

Figure 8 is a plan view of a boat and sail of my invention, and

Figure 9 is a comparative illustration in plan view of a similar boat carrying a conventional sail.

With reference to Figure 1, I show an embodiment of my invention comprising a mast 1 and a sail canvas 2. As a support for the sail canvas I provide a plurality of struts 3 in substantial parallelism and at right angles to the mast 1. A rope or cord 4 extends around the pulley 5 attached to the mast 1 and is threaded through apertures 6 (Figure 3) at the outer ends of each of the struts 3. From the lowermost strut 3 the cord 4 is attached to some means on the mast such as a cleat 7. The opposite end of the cord 4, after it passes through pulley 5, may extend downwardly and become attached to any convenient means on the boat or at the lowermost part of the mast.

The structure thus far described provides an outline frame work upon which the sail canvas 2 is retained. In transverse section and as shown in Figure 5, the sail canvas 2 is in the form of a sleeve or envelope suspended between the mast 1 and the cord 4 supported by the struts 3. The sail canvas merely loops around the mast and is not attached thereto. The sail canvas is, therefore, free to adjust itself to proper air foil shape according to wind direction. In other words, if the sail is permitted to adjust itself freely according to the direction of the wind, the sail canvas will assume an outline of substantially straight side surfaces tapering from the mast to the cord 4. On the other hand, a transverse section of the sail will assume an arcuate foil shape when the sail is held in angular relation with the wind direction.

In order to provide the proper degree of tensioning for the air foil, the cord 4 is made adjustable as by drawing it tighter or permitting more slack in the cord 4 in its attachment to the cleat 7. If preferable, the opposite end of the cord 4 may provide the adjustable means for controlling the tension of the air foil by any conventional means of attachment of the cord 4 to the deck or other part of the boat.

By providing tensioning means for adjusting the air foil it is possible to obtain the greatest efficiency of the sail in accordance with low or high wind velocities. In other words, where the wind velocity is low it may be preferable to slack the cord 4 so as to provide an increased arcuate curvature of the foil. On the other hand, when the wind velocities are high it may be preferable to increase the tension on the cord 4 and thus reduce the curvature of the foil shown in Figure 5.

As a general rule, it is not particularly essential to take down the sail while the boat is not in operation for reason that when the sail is permitted to adjust itself freely with respect to the direction of the wind, the sail of my invention provides less resistance than a mast alone. However, for purposes of convenience, I provide means for lowering the sail canvas. In order to accomplish this, I provide channel strips 8 and 9 extending longitudinally of the mast 1 and attached thereto. The channel strips 8 and 9 thus form a slideway for the struts 3. Furthermore, these channel strips 8 and 9 have inwardly turned marginal portions 10 which associate with complementary depressions in the base of the struts 3. In this manner the struts 3 are held at substantial right angles to the mast 1 and are prevented from moving radially of the mast. In other words, the struts 3 are restricted to longitudinal sliding movement relative to the mast 1.

In order to properly space the struts 3 and to retain them in proper spaced relation, I provide a cord 11 attached to an eye 12 which in turn is attached to the mast 1. The opposite end of the cord 11 is attached to the under side of lowermost strut 3. Any convenient mode for facilitating the attachment may be used, such as a screw-eye 13. In a similar manner a short length of cord 14 attaches each of the struts together in spaced relation. The cord 15 extending from the uppermost strut 3 passes around a pulley 16 attached to the mast 1 and returns downward to the deck of the boat where it may be attached in any convenient manner. It may, therefore, be seen that by releasing the cord 15 together with the cord 4 in their attachment to the deck of the boat, the sail together with the struts may be lowered to form a convenient and compact bundle at the lower portion of the mast.

While I have shown one form of raising or lowering the sail it is to be understood that this may be accomplished in other methods. For example, as shown in Figure 4, I may attach struts 17 to a mast 18 in a hinged manner as by providing a collar clamp 19 around the mast in a manner so as to provide outwardly extending lugs 20 for co-operative engagement with the base of the strut 17. A pin 21 extending through the lugs 20 of the collar 19 and through the base end of the strut 17 provides the desired hinged effect. In this method of collapsing the sail, the collar clamps 19 remain permanently attached to the mast 1 and upon release of one end of the cord, as 4, the struts may be folded in parallel relation with the mast. The sail canvas is thus carried along with the struts to form a compact bundle along the length of the mast.

As shown in Figure 3, I prefer that the struts 3 have their side surfaces in the form of a concave arcuate outline extending at its base end substantially tangent to the mast and being substantially thinner at its opposite end. The purpose of the concave outline of the struts 3 is to supply as near as possible a strut which will conform to the true air foil shape assumed by the sail canvas which encases the struts. Therefore, the presence of the struts does not interfere materially in distorting the true assumed air foil shape of the canvas. It is understood, of course, that in the event the struts do form slight interference with the air foil shape of the canvas, such interference is localized only at those regions where the struts are located. However, the back of the sail, with respect to the wind direction, is free from any projections resulting from the struts, and, as the back of the sail is the most important as far as the propulsion of the ship is concerned, it may be said that the sail throughout its entire area is positioned in substantially the most efficient manner for reaction with wind velocities.

As before stated, the sail of my invention requires means for rotatably moving the mast so as to dispose the sail in proper relation with the wind direction. In Figure 1, I show the mast 1 extending through a portion of the boat structure, such as the deck 22. A flange 23 is preferably attached to the deck 22 to operate as a supporting bushing for the mast 1. The extreme lowermost portion of the mast 1 is also provided with means (not shown) for rotatably supporting the mast. Beneath the deck 22 a worm gear 24 is attached to the mast 1 and co-operates with a worm pinion 25 keyed to a shaft 26.

As shown particularly in Figure 2 the shaft 26 is supported by brackets 27 and 28. The bracket 27 is pivoted to the deck 22 while the opposite bracket 28 is free from permanent attachment to the deck 22. The purpose of the pivoted bracket arrangement is to provide means for quickly disengaging the worm 25 with the worm gear 24 so as to permit the mast carrying the sail to move freely according to the direction of the wind.

When the worm 25 is brought into engagement with the worm gear 24 the bracket 28 engages on one side with a depending arm 30 attached to the deck 22 while the opposite side of the bracket 28 may be associated with a complementary pivoted arm 31 hingedly attached to the deck 22 at 32. Movement of this pivoted arm may be effected by manual operation of a hand lever 33 extending integrally from the pivoted arm 31. A hand wheel 35 attached to the shaft 26 supplies means for manual rotation of the worm 25 and the resultant control of the sail angle.

As shown in Figure 2, the various elements are in proper position for manual control of the sail angle. However, when it is desired to permit the sail to move freely with the wind it is only necessary for the operator to grasp and move the hand lever 33 so as to move the pivoted arm 31 out of engagement with the bracket 28. The assembly may then be swung on the pivot 29 so that the hand wheel 35 assumes a position such as that shown by 36. This operates to disengage the worm 25 with the worm gear 24, thus removing all positive control from the mast 1.

While the foregoing method of controlling the

mast has been described according to a specific construction, it is to be understood that I do not intend to limit the method of rotatably moving the mast to this specific construction as it is obvious that various other methods may be employed to accomplish the same movement with equal results.

With reference to Figure 6, I show a side elevational view of a water craft **37** carrying a sail **38** of my invention. This view is intended to be comparative with that of Figure 7 which shows a similar water craft **39** carrying, however, a conventional sail **40** of the Marconi type. Sail **40** may, however, also represent the gaff type sail. In these comparative views I intend that the projected area of sail **38** should be substantially equal to the projected area of the sail **40**.

In Figure 6, the character X represents a distance from the water level to the center of the area of the sail **38**, whereas Y represents a distance from the water level to the center of the area of the sail **40**. It is a generally known fact that the wind velocity varies according to the heights from the water level. In other words, the wind velocity is zero at the water level and attains its maximum velocity at about 50 feet above water level.

It has been demonstrated that, assuming there is a twelve miles per hour wind velocity, the effective velocity at a height represented by the distance X shows ten miles per hour wind velocity, whereas the height represented by Y in Figure 7 shows a wind velocity of but eight miles per hour. Therefore, by comparative disposition of the outline of the sail only, I am able to attain a greater benefit from wind velocities.

Figures 8 and 9 represent plan views of Figures 6 and 7 respectively. In Figure 8, the arrow W represents the direction of the wind, and the boat **37** is shown inclined at an angle of which it is capable of proceeding against the wind. It has been demonstrated that when the sail is positioned substantially at 7 degrees relative to the keel of the boat, the boat is capable of progressing against the wind at an angle of 17 degrees relative thereto.

In comparison with the boat **39** shown in Figure 9, the conventional sail **40** is generally incapable of progressing the boat at a lesser angle than **30** degrees into the wind. In such case the boom **41** is positioned at about 5 degrees relative to the keel of the boat. The hypothenuse of the sail **40** assumes a curved line **41** thus showing that the angles of the conventional sail are numerous. For example, when the boom is disposed 5 degrees relative to the keel, the differential angularity of the top portion of the sail frequently varies as much as 90 degrees.

These comparative Figures 8 and 9 have for their purpose to show that the sail of my invention is throughout its area correctly positioned in angular relation to the wind while the conventional sail assumes various angles from the boom to the uppermost area of the sail. This is of considerable importance when it is definitely known that in order to obtain the greatest efficiency from a sail, it is highly desirable that the entire surface area of the sail should be correctly positioned in definite angular position with the wind.

It may, therefore, be seen that in combination with the true air foil transverse shape of my sail, with its comparative disposition in side elevational outline, and together with its capability of retaining a substantially uniform plane throughout its area, I have attained a sail of much greater efficiency than any heretofore conventional sail of practical design.

While I have shown a present preferred embodiment of my invention, it is to be understood that I contemplate within the scope of my invention all those changes which are obvious except as limited by the scope of the appended claims.

Having thus described my invention what I claim is:

1. In a sail of the character described, a mast, a plurality of struts hingedly attached to said mast and extending substantially at right angles therefrom and in a single plane, means attached to the ends of the struts opposite the mast to define with the mast a substantially rigid trapezoidal outline, and a canvas envelope loosely supported by the leading portion of said mast and enclosing the mast, and said struts.

2. In a sail of the character described, a mast, a plurality of struts extending from the mast at substantially right angles therefrom and in a single plane and a canvas envelope loosely supported by the leading portion of said mast and enclosing the mast and struts, said struts being longitudinally slidable relative to said mast.

3. In a sail of the character described, a mast, a plurality of struts in a single plane and in spaced relation extending from the mast and in slidable relation therewith, a canvas envelope loosely supported by the leading portion of said mast and enclosing the mast and struts, and means attached to each of the struts for holding same in spaced relation.

4. In a sail, a mast, struts extending in a single plane from said mast, means connecting the ends of the struts opposite said mast, and a canvas envelope in contact relation with the leading portion of said mast and enclosing the mast and said struts.

5. In a sail, a mast, a sail canvas looped around the mast and in contact relation with the leading portion thereof to form an air foil, a plurality of struts in a single plane and in spaced relation extending from the mast and within the air foil, and means for connecting the ends of the struts opposite the mast, the air foil formed by said canvas having a cross-sectional outline at its leading portion substantially equal to the width of the mast and decreasing in width to a feather edge at the aft end of the cross-sectional outline.

6. In a sail, a mast, a sail canvas looped around the mast and in contact relation with the leading portion thereof to form an air foil of tear-drop shape, a plurality of struts in a single plane and in spaced relation extending from the mast and within the air foil, and means for connecting the ends of the struts opposite the mast, said struts being attached to said mast in a manner so that they will pivot in a substantially parallel relation with the mast.

7. In a sail, a mast, a plurality of struts in a single plane and in spaced relation extending substantially at right angles from the mast, a canvas envelope looped around the mast and in contact relation with the leading portion thereof and enclosing mast and struts, and means for rotatably moving the mast.

8. In a sail, a mast, a plurality of struts in a single plane and in spaced relation extending substantially at right angles from the mast, a canvas envelope looped around the mast and in contact relation with the leading portion thereof

and enclosing the mast and struts, means for rotatably moving the mast, and means for restricting rotary movement of the mast due to wind force against the sail.

9. In a sail, a mast, a plurality of struts in a single plane and in spaced relation extending substantially at right angles from the mast, a canvas envelope looped around the mast and in contact relation with the leading portion thereof and enclosing the mast and struts, means for rotatably moving the mast, and means for detaching the latter means to permit free movement of the mast.

10. In a sail, a mast, a plurality of struts in a single plane only and in spaced relation extending from the mast, a canvas envelope looped around the mast and in contact relation with the leading portion thereof and enclosing the mast and struts, said struts being rigidly attached to the mast.

11. A sail comprising a mast, a support spaced aft of the mast, and a sail-canvas forming an envelope inclosing the mast and support, said canvas being in contact relation with the leading portion of said mast.

12. A sail comprising a mast, a support spaced aft of the mast, and a sail-canvas looped around the mast in contact relation with the leading portion thereof and joined together substantially at and attached to said support.

13. A sail comprising a mast, a support spaced aft of the mast, a sail-canvas looped around the mast in contact relation with the leading portion thereof and joined together substantially at and attached to said support, and struts extending from the mast for maintaining said support in spaced relation with the mast.

14. A sail comprising a mast, a support spaced aft of the mast, a sail-canvas looped around the mast in contact relation with the leading portion thereof and joined together substantially at and attached to said support, struts extending from the mast for maintaining said support in spaced relation with the mast, and means for adjusting the tension of said support.

15. In a sail, the combination of a mast, a sail-canvas in the form of an envelope looped around the mast and in contact relation with the leading portion thereof and comprising two wings spaced apart at the mast and joined together at a considerable distance aft from the mast, and struts within the canvas envelope and attached to the mast for supporting the aft end of the canvas envelope.

WILLIAM F. GERHARDT.