

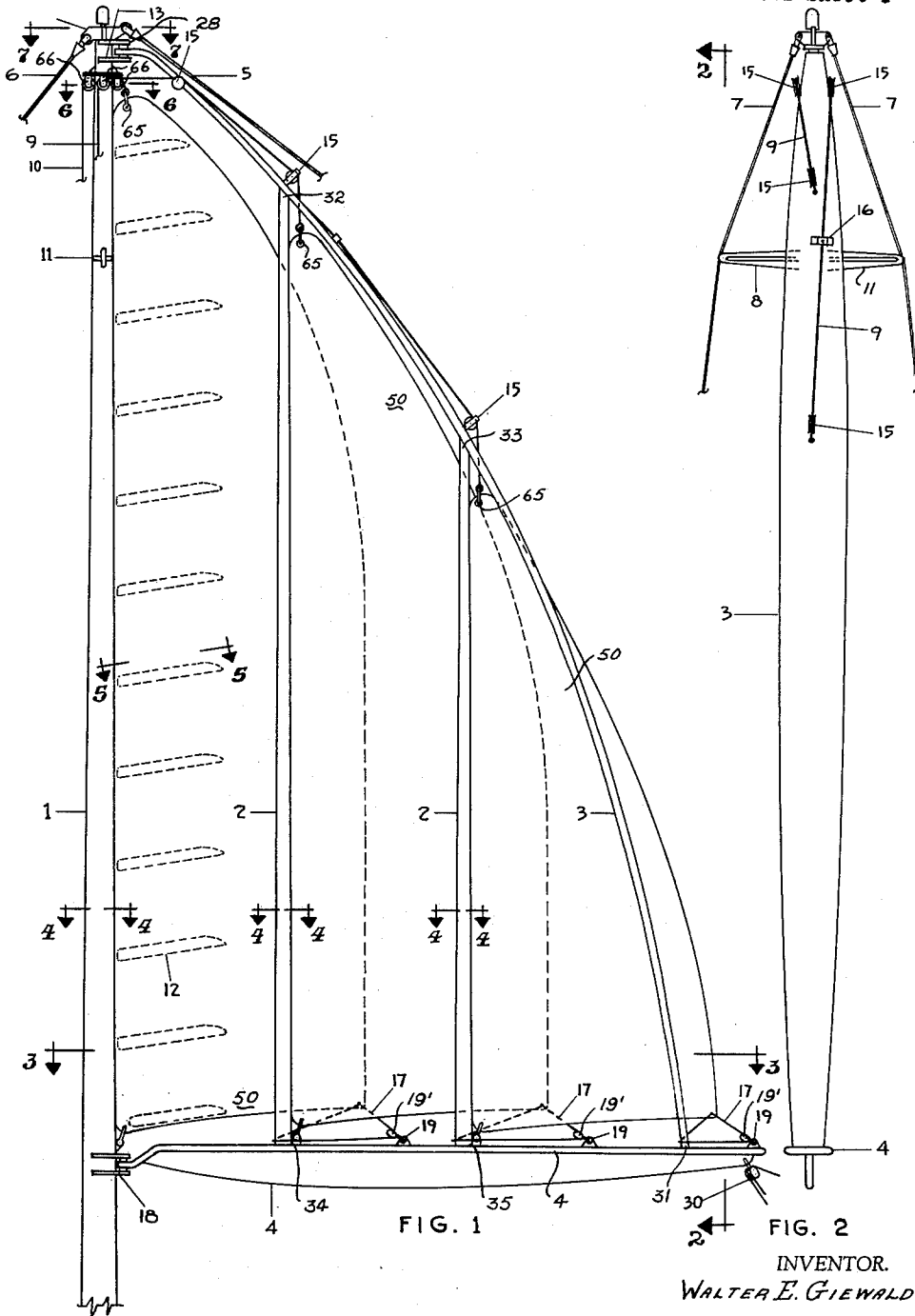
May 16, 1961

W. E. GIEWALD
MULTI-SAIL STRUCTURE

2,984,199

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2 Sheets-Sheet 1



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2 Sheets-Sheet 2

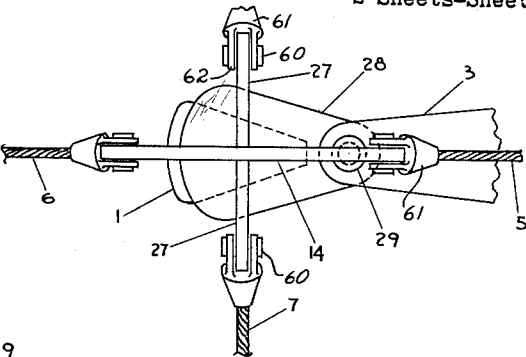


FIG. 7

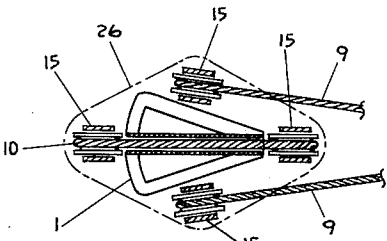


FIG. 6

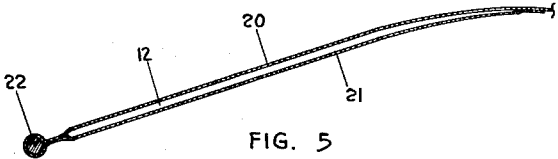


FIG. 5

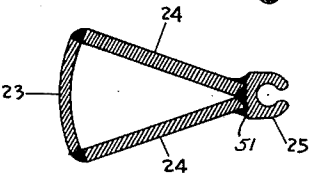


FIG. 4

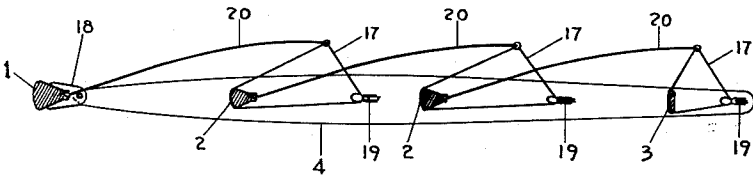


FIG. 3

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MULTI-SAIL STRUCTURE

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7 Claims. (Cl. 114—102)

This invention relates to sails and structures therefor for use on sailing vessels. In particular, it relates to a new and improved type of sail and sail structure which are designed in accordance with the basic laws of aerodynamics.

Aerodynamically, the action of the wind which causes the main forward motion of a sailing vessel is against the leading or luff portion of a sail. If the luff portion is curved or partially curved, the efficiency of operation of the sailing vessel is lower than that which can be obtained when the luff portion is planar and set at the proper angle to the direction of the wind.

Accordingly, it is an object of this invention to provide a sail for use on a sailing vessel having a mast, which sail is coupled to the mast and has means attached to the luff portion for maintaining the luff portion substantially planar when in operative position and subjected to the action of the wind.

Another object of this invention is to provide a sail structure comprising a plurality of independent sails each of which has a substantially planar luff portion, and each of which has a leech portion that overlaps the adjacent sail whereby the air which is spilled over from one sail to another is effectively utilized.

It is a still further object of this invention to provide a multi-sail structure which incorporates means for effectively supporting a plurality of sails in operative position whereby the efficiency of sail structure is greatly increased.

Yet another object of this invention is to provide a method of securing a sail having a planar luff portion in operative position on a sailing vessel in such a manner that continued adjustment of the sail itself is not necessary.

A more specific object of this invention is to provide a sail incorporating battens in the luff portion thereof for maintaining the luff portion substantially planar or of the proper aerodynamic configuration.

Still other objects of this invention will become apparent to those of ordinary skill in the art by reference to the following detailed description of the exemplary embodiments of the invention. The various features of the exemplary embodiments provided in accordance with this invention may be best understood with reference to the accompanying drawings wherein:

Figure 1 is a side view of the improved sail structure provided by this invention which incorporates the preferred type of sails constructed in accordance with the invention.

Figure 2 is a rear view of the sail structure of Figure 1 taken on the line 2—2 and showing the leech boom and parts associated therewith.

Figure 3 is a plan view taken along the line 3—3 of Figure 1 showing the disposition of various sails in relation to the foot boom in accordance with the multi-sail structure provided by this invention.

Figure 4 is a plan view of an improved type mast provided by this invention.

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Figure 5 is a plan view taken along the line 5—5 of Figure 1 and showing a section of an improved sail provided by this invention.

Figure 6 is a plan view taken along the line 6—6 of Figure 1 showing a part of the rigging apparatus used with this invention.

Figure 7 is a plan view taken along the line 7—7 of Figure 1 showing another part of the rigging apparatus used with this invention, and also showing details of a pivotal connection used herein.

By reference to Figure 1 it will be noted that the frame of the improved sail structure comprises a main mast 1, a generally horizontally disposed foot boom 4 pivotally secured as at 18 to the main mast 1, and a leech boom 3 of arcuate configuration extending between the foot boom 4 and the main mast 1. The leech boom 3 is pivotally secured at its upper end, as at 28, to the main mast 1. The opposite end of the leech boom 3 is fixedly secured to the horizontal boom 4 as at 31 by any suitable means such as a weld, a bolt, a dowel, or any other commonly used securing expedient. The pivotal connections of foot boom 4 and leech boom 3 to the main mast 1 are made by means of lugs which are shaped to engage the mast and pins which extend through suitably formed apertures in the lugs and booms as shown at 18 and 28 in Figure 1. The construction is shown in detail in Figure 7 wherein the lugs are designated by numeral 28 and the pins are designated by numeral 29. Of course, Figure 7 shows the connection with the leech boom, but the same type connection is used with the foot boom 4. The lugs may be welded to the main mast or attached by any other suitable means, and moreover need not be shaped as described above although such is preferable.

Parallel to the main mast 1 are disposed intermediate masts 2 which are secured at their upper end as at 32 and 33 to the leech boom 3, and which are secured at the opposite end as at 34 and 35 to foot boom 4. The means for securing intermediate masts in place may be the same as used for securing leech boom 3 to horizontal boom 4.

Suitably coupled to each mast is a sail 50. The sails are of progressively decreasing vertical height with increasing distance from main mast 1. Each sail 50 has provided therein a series of battens 12 which are substantially parallel to, but vertically spaced from, one another. These battens are in the luff portion of the sail and act to maintain that portion substantially planar. The leech portion of each sail 50 overlaps the luff portion of the adjacent rearwardly disposed sail.

According to the preferred embodiment of this invention, the battens 12, which are provided in the luff portion of each sail, are permanently sewn into the sail, as best shown in Figure 5. It will be noted that opposed faces 20 and 21 form a pocket in which a batten 12 is placed. The thickness of the rearwardly disposed end of each batten is thinned or feathered so as to permit a bend in the surface of the sail at this point. By maintaining the luff portion planar or flat, there is an effective "lift" at the rear surface of the said similar to that obtained at the undersurface of an aeroplane wing. This "lift" is most effective when the luff portion of each sail is planar, because then, the effective restriction in the path of air flow is increased, as is the case with aircraft wings, and as a result the velocity of the air increases with a resultant decrease in pressure in front of the sail.

Preferably, the leech portion of each sail overlaps the luff portion of the adjacent sail only to the point where the luff battens are feathered. Such overlap is preferable because there is a reduced air pressure between the two sail surfaces at the overlap caused by the effective restriction in the path of air flow due to the configuration of the sail. In accordance with basic

principles of aerodynamics as set forth above, the reduced air pressure results from the increase in velocity of the air passing through the effective restriction. Accordingly, by providing an overlap as above set forth, the forward movement of the wind action action at the luff portion of each sail will be increased. Although the designated overlap is preferable, it should be understood that such overlap need not be provided within the scope of this invention or to come within the scope of the claims appended to this specification. Overlapping a sail more than the described amount set forth above will, however, create an action on the sails in a direction perpendicular to the longitudinal axis of the vessel on which the sail is used. Of course, such action is objectionable as, at the expense of forward movement, compensation must be made therefor.

A sail of the above described type, that is, one having a planar luff portion or incorporating means to maintain the luff portion planar when in operative position may be used alone and need not be incorporated in a multi-sail structure such as that shown in Figure 1. The planar luff portion is itself one aspect of this invention and therefore, just one sail having a planar luff portion may be used to increase the overall efficiency of a sailing vessel. However, most efficient operation results when a plurality of such sails are incorporated into a multi-sail structure, such as that shown in Figure 1.

Having thus set forth the general aspects of the improved sail and multi-sail structure utilizing such sails, attention will now be directed to the detailed features of the multi-sail structure. The structure preferably incorporates a new and improved type of main mast 1 having angularly disposed side faces 24 as shown in Figure 4. The angularly disposed side faces 24 join at a vertex 51 and are coupled to a sail slot portion or member 25, by any suitable means such as a weld. It should be understood that the sail slot portion 25 may be modified to permit the use of sail slides instead of a slot or any other coupling device, and therefore member 25 may be properly said to be one component of a means for coupling a sail to the mast.

Intermediate masts 2 are of the same design as main mast 1. The design of the masts, which may be wood, aluminum, or any other suitable material, is such that the mast provides an additional propelling surface. With the sides angularly disposed in accordance with the above discussion, the wind incident upon those sides will cause a certain amount of forward push.

When the masts are made of aluminum they may consist of four basic parts, sides 24, arcuate front surfaces 23, and component 25, whereby a hollow mast will be provided as shown. It is only necessary, however, that the main mast have sloping sides for it may be solid or hollow, and still fall within the scope of this particular modification of the invention. Of course, the improved sails may be used without the improved type of mast, but the greatest efficiency of operation is achieved when the improved sails are used with the improved masts.

By again referring to Figure 1 in particular, it will be noted that the main mast may be supported in the usual manner by a back-stay 5, and fore-stay 6. As best shown in Figure 2, shrouds 7 are also used for support and are run over spreaders 8 and 11. Cross-bars 14 and 27 (Figure 7) are provided at the top of the mast for fastening of the shrouds and stays. Each of the cross-bars 14 and 27 is provided with suitably formed apertures in either end thereof, and the back-stay 5, fore-stay 6, and shrouds 7 are provided with couplers 61. Bolts 60 extend through the apertures in cross members 14 and 27 and through arms 62 of couplers 61 whereby suitable fastening is obtained. The intermediate masts 2 to which attention was directed above, subdivide the generally triangular frame formed by main mast 1, foot boom 4 and leech boom 3 into sections.

Since the upper end of the leech boom and the forward end of the foot boom 4 are pivotally secured to the main mast, the sail frame may be angularly displaced to either side of the longitudinal axis of the vessel on which the frame is used.

In the preferred embodiment of the invention, each of the sub-divided areas of the generally triangular frame is provided with a separate sail of the improved design, that is, one which utilizes the aerodynamic principles as above set forth. Preferably the luff portion of each sail is set at an angle of approximately 18° to the direction of the wind. In order that a continuous adjustment of the sails may be eliminated, the sails are set at approximately an 18° angle to an imaginary plane running longitudinally of, and perpendicular to, the foot boom 4. After such adjustment, the foot boom 4 may be used to set the sails in the proper direction to the wind.

In Figure 1, battens 12 are shown in the forward sail only for purposes of clarity. However, it should be understood that each of the sails 50, according to the preferred embodiment of this invention, incorporates the vertically separated battens just aft of the luff rope 22. As is conventional, luff rope 22 cooperates with sail slot portion 25 for raising and lowering of the sail.

Although it is not intended that the same be a general limitation of this patent, it has been found that when the battens are spaced approximately 12 inches from center to center, best results are obtained.

To provide for rigging the multi-sail structure, conventional apparatus, including luff rope 22 (Figure 5) and sail slot portion 25, is provided. Each halyard 9 and 10 (Figure 1) is joined to an associated sail through grommet 65 and is reeved through a block 15, and over a pulley 66 and is made fast to the main mast by any conventional means. The halyard for the sail farthest aft is also run through a guide clip 16 on the leech boom 3 (Figure 2). At the lower aft corner of each sail a jack sheet 17 is provided (Figure 1). This jack sheet 17 is reeved through a pulley 19¹ which is secured to a fastener 19 on foot boom 4. The pulleys 19¹ are located on the foot boom 4 somewhat rearwardly or aft of the lower aft corner of each associated sail. The jack sheet, or rope, 17 is run around the forward side of the intermediate mast 2 forward of the lower aft corner of each sail. In the case of the sail farthest aft, the jack sheet 17 is run around the leech boom 3. These jack sheets 17 are preferably adjusted and of such length as to maintain the planar luff portion of each sail at an angle of 18° to the center line of the foot boom. The positioning of the various parts discussed immediately above is clearly indicated in Figure 3. The forward lower corner of each sail is made fast to the masts in the conventional manner. The independent sails are connected at their lower ends to an adjacent mast by any suitable fastening means as at 51.

The above described sail structure will increase the speed of sailing vessels to a considerable extent. By using a plurality of such sails, a much greater force is obtainable.

After considering the foregoing description in conjunction with the annexed drawings, it is apparent that there is provided by this invention a device by which the various phases, objects, and advantages herein set forth, are successfully achieved. Modifications of this invention will become apparent to those of ordinary skill in the art after reading this disclosure. Therefore, it is intended that the matter contained in the foregoing description and the accompanying drawings be interpreted as illustrative and not in a limiting sense, when consideration is given to the appended claims.

I claim:

1. A multi-sail structure comprising a main mast; a substantially horizontally disposed boom pivotally secured to said main mast; a leech boom secured at one end to said horizontally disposed boom and pivotally

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secured at the opposite end to said main mast whereby a generally triangular frame is formed by said main mast, said substantially horizontally disposed boom and said leech boom; at least one intermediate mast disposed substantially parallel to said main mast and coupled at one end to said substantially horizontally disposed boom and coupled at its opposite end to said leech boom; a plurality of separate sails having luff and leech portions, one of said sails being associated with each mast and coupled thereto; and means attached to the luff portion of each sail for maintaining said luff portion substantially planar when in operative position and subjected to the action of the wind.

2. A multi-sail structure as defined in claim 1 wherein said masts are so disposed that, and said sails are of such size that, the leech portion of each sail overlaps the luff portion of the next adjacent rearwardly disposed sail.

3. A multi-sail structure, as defined in claim 2 wherein each of said masts have angularly disposed side faces which join at a vertex adjacent the luff of the associated sail.

4. A multi-sail structure comprising a main mast; a substantially horizontally disposed boom pivotally coupled to said main mast; a leech boom secured at one end to said horizontally disposed boom and pivotally coupled at the opposite end to said main mast whereby a generally triangular frame is formed by said main mast, said substantially horizontally disposed boom and said leech boom; at least one intermediate mast disposed substantially parallel to said main mast and coupled at one end to said substantially horizontally disposed boom and coupled at its opposite end to said leech boom; and a plurality of separate sails having luff and leech portions, one of said sails being associated with each of said masts and coupled thereto.

5. A multi-sail structure as defined in claim 4 wherein said masts are so disposed that, and sails are of such size that, the leech portion of each sail overlaps the luff portion of the next adjacent rearwardly disposed sail.

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6. A multi-sail structure comprising a main mast; a substantially horizontally disposed boom pivotally coupled to said main mast; a leech boom secured at one end to said horizontally disposed boom and pivotally coupled at the opposite end to said main mast whereby a generally triangular frame is formed by said main mast, said substantially horizontally disposed boom and said leech boom; a plurality of separate intermediate masts disposed substantially parallel to said main mast and apart from one another, each of said intermediate masts being coupled at one end to said substantially horizontally disposed boom and coupled at its opposite end to said leech boom; and a plurality of separate sails, one of said sails being associated with each of said masts and coupled thereto, said sails being of decreasing vertical height with increasing distance from said main mast.

7. A multi-sail structure as defined in claim 1 wherein said means includes a plurality of reenforcing battens vertically spaced in parallel relationship along the forward portion of the sail for maintaining said luff portion substantially planar when in operative position and subjected to the action of the wind.

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