

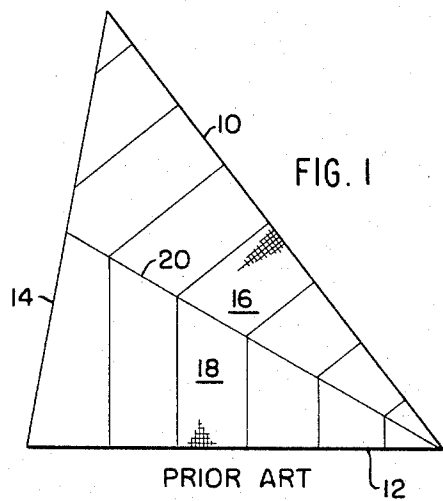
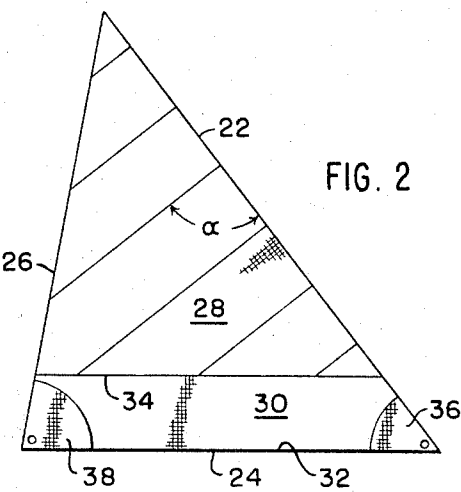
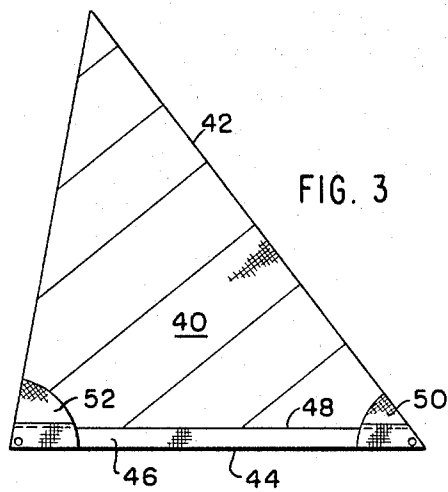
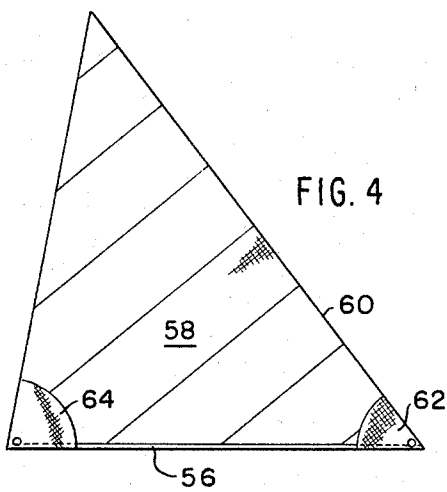
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This invention relates generally to the art of sail making and more particularly to the fabrication of a loose-footed sail which is substantially stretch-free.

In the art of sail making it has been known for many years that an ideally cut sail will not stretch to any substantial extent along its leech. It is also extremely important that the sail not stretch along its foot. When the sail is employed with a boom to which the foot is attached, stretching along the foot may be easily controlled by the manner of attachment to the rigid boom. In such instances, stretch of the sailcloth along the leech becomes the principal concern for the sail maker. To insure against stretch under these conditions, it is common to construct the sail with a plurality of panels of sailcloth which are oriented square to the leech, that is at right angles thereto, so that the warp and woof of the sailcloth are generally parallel respectively to the leech of the sail and a line normal to the leech. The foot of the sail is then laid out along the boom and cut. Each of the panels of sailcloth at the foot will thus be cut at a bias. Although the cloth could stretch along this bias cut, such stretching is prevented by the firm attachment of the several panels to the boom.

The making of loose-footed sails whether jibs or mainsails presents substantially more complex considerations. In the loose-footed sail no boom is located adjacent the foot, the foot being maintained in proper position and the proper aerodynamic curvature of the sail being fixed by the adjustment of the manipulating lines attached at the corners of the sail. It will immediately be apparent that the bias cut foot which is acceptable where the foot is attached to a boom is quite unacceptable in a loose-footed sail since stretching of the sailcloth along the bias cut foot will result in the ultimate deformation of the sail changing the desired curvature of the sail and, in the case of a jib, making maintenance of the proper wind slot with the mainsail extremely difficult if not impossible.

In order to overcome these defects, loose-footed sails are conventionally cut according to a "mitre-cut" technique. In this construction, a plurality of panels of sailcloth are oriented, as before, square to the leech of the sail and a second plurality of panels are oriented square to the foot of the sail thereby rendering both the leech and foot substantially stretch-free. These panels meet along a bias line extending from the clew to approximately the mid-point of the luff. This construction is generally satisfactory for preventing stretch along the leech and foot. Stretch along the bias line joining the panels is not, however, prevented and continued use of the sail inevitably results in a stretching through the central area thereof deforming the sail and destroying its proper aerodynamic characteristics.

It is, accordingly, a principal object of this invention to make a loose-footed sail which avoids the conventional mitre-cut construction and is at the same time substantially stretch-free along the leech and foot thereof.

It is a further object of this invention to provide a loose-footed sail which is substantially stretch-free along its leech and foot, the major area of which comprises a plurality of panels of sailcloth oriented square to the leech of the sail.

In the practice of the invention in a preferred embodiment thereof a loose-footed sail, for example, a jib, is assembled from a plurality of panels of sailcloth which are

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oriented square to the leech of the sail. Means are provided, for example a wire or a panel of sailcloth square to the foot of the sail, to prevent any substantial stretching of the bias cut bottom edges of the panels square to the leech. Clew and tack patches are fitted as usual with the patch material being oriented parallel to the orientation of the warp and woof of the underlying portions of sailcloth.

These and other objects and the features of the invention will appear as the description proceeds with the aid of the accompanying drawings, in which:

FIG. 1 is a side elevation of a loose-footed sail according to the prior art "mitre-cut" technique;

FIG. 2 is a side elevation of a preferred embodiment of a sail embodying the invention;

FIG. 3 is a side elevation of an alternative embodiment of the invention; and

FIG. 4 is a side elevation of a second alternative embodiment of the invention.

Referring to FIG. 1 of the drawings, a conventional mitre cut jib is illustrated for purposes of explaining the prior art construction. The jib has a leech 10, foot 12 and luff 14 and includes two major areas of sailcloth. The first area of sailcloth comprises a plurality of panels 16 which are square to the leech 10. The second major portion comprises a plurality of panels 18 square to the foot 12. The several panels 16 and 18 meet along a bias cut connection 20 where the several panels are sewn together.

As stated above, a loose-footed sail similar to that of FIG. 1 is substantially stretch-free along its leech and its foot, although substantial stretching is possible along the bias or "mitre" cut 20.

FIG. 2 shows a preferred embodiment of our new loose-footed sail which eliminates the unsatisfactory bias cut of the prior art yet maintains the leech and foot of the sail substantially stretch-free. The sail of FIG. 2 has a conventional configuration with a leech 22, foot 24 and luff 26. The major portion of the sail area is, however, made up of a plurality of panels 28 of suitable sailcloth which are cut square to the leech 22 of the sail. It has been found that a woven synthetic fabric of polyester fiber which is substantially stretch-free along the warp and woof directions provides the most suitable sailcloth for the present construction. In practice, a Dacron "firm" sailcloth is employed. It will be noted that the panels 28 are cut such that the relatively unstretchable warp and woof of the fabric are oriented either parallel to or at right angles with the leech 22 of the sail. With this construction, stretching of the sail along the leech is substantially prevented.

In order to prevent stretching of the sail along the foot 24 thereof, in the preferred embodiment, a panel of sailcloth 30 is employed which is cut square to the foot with the warp and the woof of the material respectively either parallel to or at right angles with the foot 24. A lower edge 32 and an upper edge 34 are therefore formed on the bottom panel 30 which edges are selvage edges and are themselves substantially stretch free. In this fashion the lower edge 32 forms a substantially stretch-free foot 24 for the sail and the upper edge 34 of the panel 30 forms a substantially stretch-free line parallel to the foot 24 of the sail to which the several panels 28 may be sewn. It will be noted that the panels 28 are cut at a bias at the point of their connection to the upper edge 34 of the panel 30. Since, however, the upper edge 34 is substantially stretch-free, stretching of the panels 28 along this bias cut is not possible.

It will be observed that a loose-footed sail is constructed the leech and foot of which are substantially stretch-free and which does not include a bias or mitre cut central seam as was common in the prior art. Although some

of the sail panels are cut at a bias, these bias cuts are sewn directly to the selvage edge of the panel 30 in a line parallel to the foot 24 of the sail rather than to the bias edge of the panels square to the foot of the sail as was the case in the prior art.

While the panels 28 forming the major portion of the sail have been described as being square to the leech 22 thereof, it should be understood that experimentation has shown that the angle between the leech of the sail and the panel need not be exactly 90° to obtain the desired benefits. It has been found that the angle α in FIG. 2 between the leech and the panel may be decreased to as little as 60° without destroying the stretch-free characteristics of the construction. The angle α should not exceed 90°, however. In fact, the angle α may be changed slightly from panel to panel to "fair" the panels in where it is desired.

The bottom panel 30 serves an additional function in providing a suitable panel of sailcloth for the attachment of a clew patch 36 and tack patch 38 as is conventionally required. With the construction of the preferred embodiment of the warp and woof of the clew patch 36 and the tack patch 38 may be easily oriented parallel to the warp and woof respectively of the panel 30 thereby forming a substantially stronger patch than would result if the warp and woof of the patches was at a discrete angle to the warp and woof of the adjacent sailcloth. Where required due to the extremely large area of the sail, a second or even a third panel 30 may be inserted parallel to the foot 24 above the panel 30 to permit the use of clew and tack patches having a height greater than the height of the single panel 30. Since the warp and woof of the plurality of panels 30 is oriented in the same direction a clew or tack patch may be utilized which is cut from a single piece of sailcloth and which will have its warp and woof in proper parallel orientation with that of the underlying panels 30.

FIG. 3 shows an alternative embodiment of the invention which differs from the preferred embodiment of FIG. 2 principally in minimizing the height of the panel 30 located adjacent the foot 24 of the preferred embodiment. In FIG. 3 a plurality of panels of sailcloth 40 similar to the panels 28 of the preferred embodiment comprise substantially the entire area of the sail. The panels 40 are oriented square to the leech 42 of the sail and extend substantially the entire distance to the foot 44 thereof. A tape of sailcloth 46 is employed at the foot 44 to bind the bias cut edges of the panels 40 at the foot of the sail. The tape 46 is cut from sailcloth similar to the panels 40 and is, as is the panel 30 in the preferred embodiment, oriented with its warp and woof parallel to the foot 44 or at right angles thereto respectively to present an upper selvage edge 48 to which the bias cut edges of the panels 40 are sewn. It will be noted that the alternative embodiment of FIG. 3 provides the same substantially stretch-free characteristics along the foot of the sail as does the preferred embodiment of FIG. 2.

In the alternative embodiment of FIG. 3, however, the clew patch 50 and tack patch 52 now each overlie areas of sailcloth whose warp and woof are oriented at discrete angles to each other, namely at least a portion of one panel 40 and a portion of tape 46. In order to provide the necessary patch strength the clew patch 50, for example, must be formed from a number of segments of sailcloth the warp and woof of each of which is oriented parallel to the warp and woof of the underlying sailcloth and which must be sewn together and then applied to the sail. In this manner requisite patch strength may be obtained while employing a tape 46 of minimal height. Minimizing the height of tape 46 at the same time minimizes the portion of the leech 42 which is formed by the bias cut end of the tape 46 thereby minimizing the possibility for stretch along the leech in that area.

FIG. 4 illustrates yet another alternative embodiment of the invention in which a wire 56 defines the foot of the sail. The entire area of the sail is thus formed by a plurality of panels 58 of sailcloth which are, as before, cut square to the leech 60 of the sail. A composite clew patch 62 and tack patch 64 are employed as in the alternative embodiment of FIG. 3 to insure proper patch strength. The wire 56 is itself substantially stretch free and the bias cut lower edges of the panels 58 at the foot of the sail are joined to the wire 56 in conventional fashion thereby preventing any substantial stretch along the bias cut edges of the respective panels 58.

By utilizing the structure of the preferred or alternative embodiments of the invention it will be observed that a loose-footed sail may be made which is substantially stretch-free along both its leech and foot as is desired and which eliminates the disadvantages of the prior art mitre or bias cut construction by forming substantially the entire sail area of panels of sailcloth oriented square to the leech of the sail. Employing this construction applicants have produced a loose-footed sail which eliminates stretch even in heavy wind conditions while maintaining the desired airfoil across the sail itself. In the case of jibs, the proper wind slot may be much more easily maintained between the mainsail and the jib. These advantages have several substantial benefits for the sailor. For example, class boats fitted with loose-footed sails according to the invention have been able to head up into the wind substantially further and have traveled faster than similar class boats fitted with conventional loose-footed sails.

Throughout, applicants have referred to the leech of the sail and it should be pointed out that in some loose-footed sail constructions it is desirable to have an arcuate leech which is not a straight line from head to clew. In such instances the teaching of applicants' invention envisions that the panels comprising the major portion of the sail be cut square to a projected straight leech line between the head and the clew regardless of the position of the actual leech. If desired, the angle α between each panel and the projected leech may be varied slightly from panel to panel to "fair" the panels in as above described.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A loose-footed sail including a plurality of panels of woven sailcloth defining the major area of said sail, said sailcloth being substantially stretch-free in its warp and woof directions, a leech edge on said sail parallel to one of said substantially stretch-free directions of said sailcloth comprising said major area of said sail and generally normal to said other of said stretch-free directions, a foot edge on said sail, a bottom edge on said major area of said sail generally parallel to said foot edge, said bottom edge comprising bias cut edges of a portion of said plurality of panels, substantially stretch-free means joining said bottom edge of said major area along said bias cut edges to said foot edge, and a luff edge on said sail at a discrete angle to said leech edge and to said foot edge and extending therebetween.

2. A loose-footed sail as defined in claim 1 wherein said stretch-free means comprises a tape of sailcloth substantially stretch-free in its warp and woof directions and oriented to present an upper selvage edge attached to said bias cut bottom edge of said major area of said sail and a lower selvage edge at said foot edge of said sail.

3. A loose-footed sail as defined in claim 1 wherein said substantially stretch-free means comprises a stretch-free wire joining said plurality of bias cut edges at said bottom of said major area of said sail to said foot edge of said sail.

4. A loose-footed sail as defined in claim 1 wherein said substantially stretch means comprises at least one panel of sailcloth extending across said foot of said sail, said sailcloth being substantially stretch-free in its warp and woof directions and oriented to present upper and

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lower selvage edges parallel to one of its substantially stretch free directions, means attaching said bias cut bottom edge of said major area of said sail to said upper selvage edge of said at least one panel, and means attaching said lower selvage edge to said foot edge of said sail. 5

5. A loose-footed sail as defined in claim 4 wherein said sail is fitted with clew and tack patches at the clew and tack corners thereof respectively and wherein said upper and lower selvage edges of said at least one panel 10 are spaced apart a distance at least as great as the maximum height of said clew or tack patch whereby said patches may be cut of a unitary piece of woven sailcloth having a warp and woof direction and applied to said at least one panel with said warp and woof directions 15

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thereof parallel respectively to the warp and woof directions of the said at least one panel.

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