

[54] ATTACHMENT POINT

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- [52] U.S. Cl. 114/115, 24/141
[51] Int. Cl. B63h 9/08
[58] Field of Search 114/114, 115; 24/141, 202

[56] References Cited

FOREIGN PATENTS OR APPLICATIONS

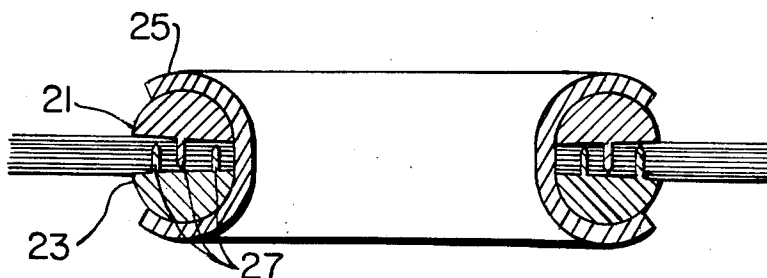
- 7,217 1888 Great Britain 114/115

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[57] ABSTRACT

The attachment point disclosed herein is adapted for applying a substantial load to a fabric sheet. A particularly fitting example of an application for such an attachment point is at the clew of a sail such as a Genoa jib where, in a large sailboat, the jib sheet (a rope) may be holding the sail in position under a load of several hundreds to several thousands of pounds. The attachment point employs a pair of complementary ring members, each having a multiplicity of needle-like teeth. These ring members are clamped on opposite sides of a plurality of cloth layers by means of a metallic inner liner which is rimmed down over the ring members so as to apply a clamping force sufficient to prevent combing of the teeth through the cloth layers under a lateral pressure in the same order of magnitude as the strength of the cloth layers themselves.

2 Claims, 14 Drawing Figures



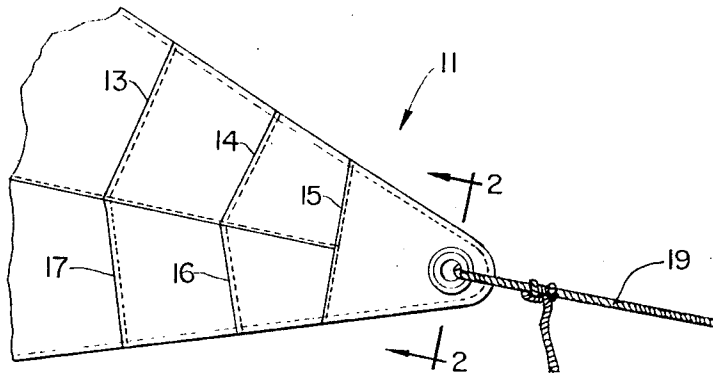


FIG. 1

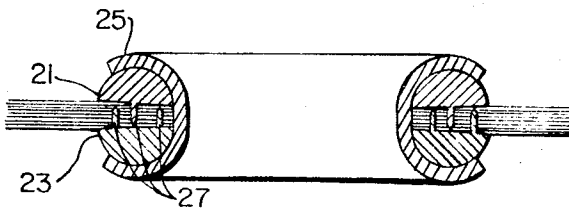


FIG. 2

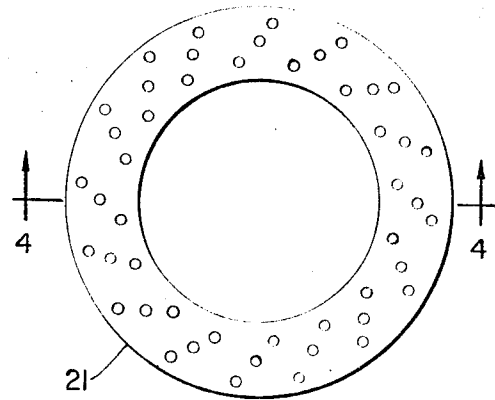


FIG. 3

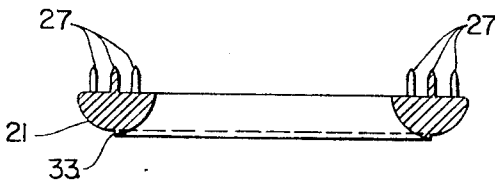


FIG. 4

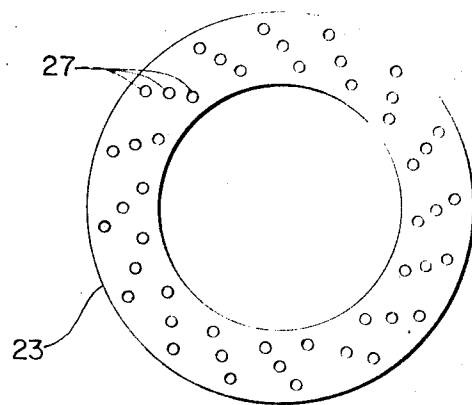


FIG. 5

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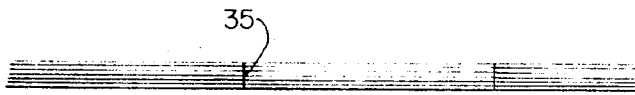


FIG. 6

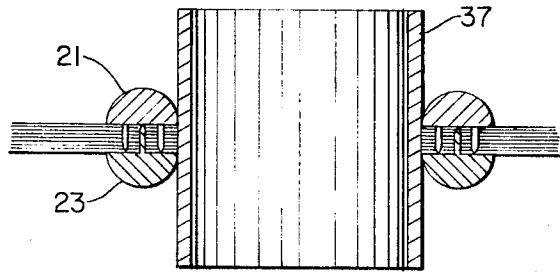


FIG. 7

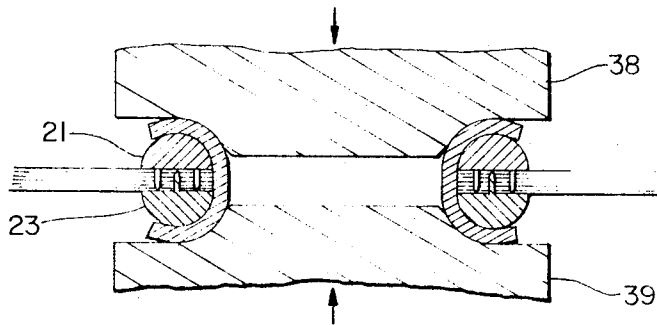


FIG. 8

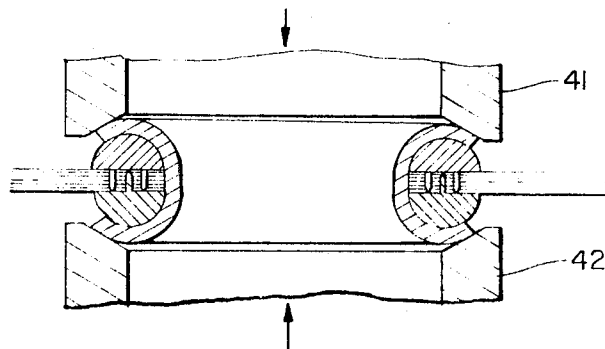


FIG. 9

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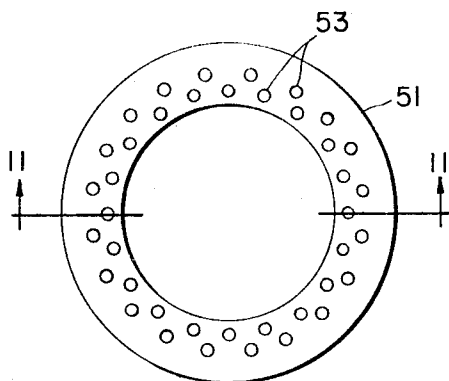


FIG. 10

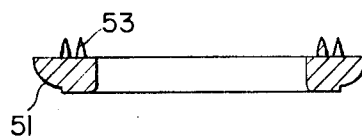


FIG. 11

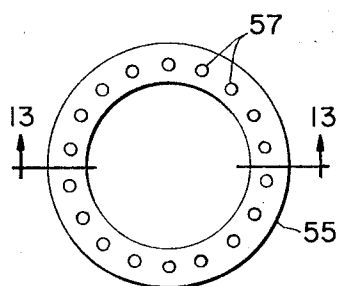


FIG. 12

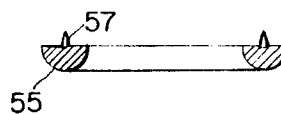


FIG. 13

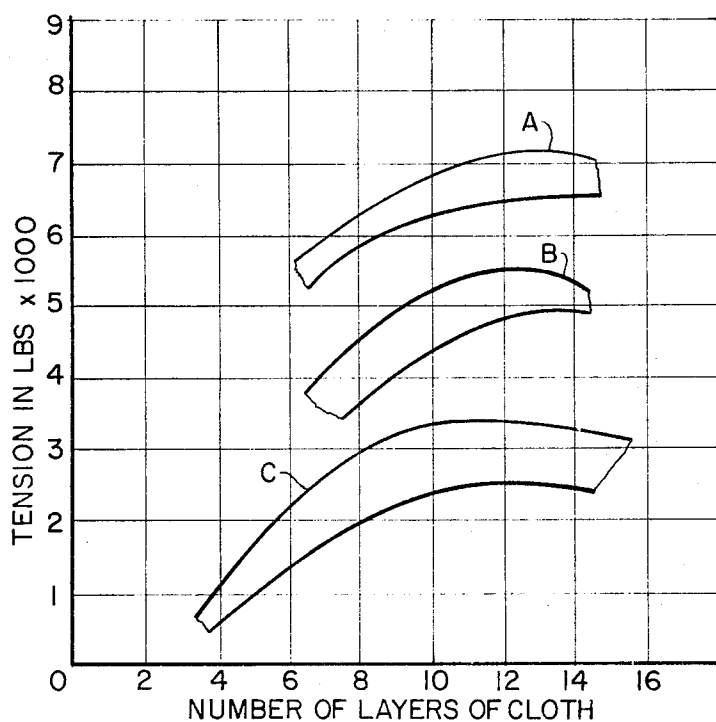


FIG. 14

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ATTACHMENT POINT

BACKGROUND OF THE INVENTION

This invention relates to an attachment point or grommet, and more particularly, to such an attachment point which is suitable for applying and distributing rather large local loads to a fabric sheet.

In conventional sailmaking procedures, attachment points for heavy loads, e.g., at the clew of a Genoa jib, were provided by hand sewing in a metal or rope ring, together with strips of rope and leather which were employed to distribute the load from the ring along the edges of the sail away from the clew. In sails where a particularly heavy load was to be applied, wire rope might also be used and the load from a principle ring might be applied through two or more intermediate rings so as to facilitate the initial distribution of the concentrated local forces. As the construction of such conventional attachment points is typically performed by hand, the attachment points represented a substantial item of cost in the sail manufacturing operation.

Among the several objects of the present invention may be noted the provision of a normal attachment point for applying and distributing a substantial local load to a fabric sheet; the provision of such an attachment point which does not require a large amount of hand work; the provision of such an attachment point providing improved load handling capability; the provision of such an attachment point which is relatively lightweight; the provision of such an attachment point which is relatively simple and inexpensive in construction and which is reliable in use. Other objects and features will be in part apparent and in part pointed out hereinafter.

SUMMARY OF THE INVENTION

As noted previously, the attachment point of the present invention is adapted for applying and distributing a substantial or concentrated local load to a fabric sheet such as a sail. A plurality of cloth layers are fastened to the fabric sheet for distributing the load, the several layers being apertured at the desired point of attachment. A pair of complementary ring members are provided, each of which has on one side a substantially flat face and, on the other side, a toroidally rounded surface. Each ring member also includes a multiplicity of integral needle-like teeth upstanding from the respective flat face. The transverse dimensions of the teeth are substantially the same in different directions and are scaled to permit the teeth to pierce the weave of the cloth layers without substantial disruption thereof. An inner liner extends through the rings and the aperture in the cloth layers, the liner being rimmed, substantially symmetrically, over the rounded surfaces of both ring members, thereby to clamp the multiple cloth layers between the rings under sufficient force to prevent combing of the teeth through the cloth under lateral pressures of the same order of magnitude as the strength of the cloth layers themselves.

A BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of the clew of a Genoa jib provided with an attachment point constructed in accordance with the present invention;

FIG. 2 is a sectional view taken substantially on the line 2—2 of FIG. 1;

FIG. 3 is a plan view of one of a pair of ring members employed in the attachment point of FIG. 1;

FIG. 4 is a sectional view taken on the line 4—4 of FIG. 3;

FIG. 5 is a plan view of the other of the ring members employed in the FIG. 1 attachment point;

FIGS. 6-9 illustrate successive steps in the method of forming the attachment point of FIG. 1;

FIG. 10 is a plan view of a ring member employed in a somewhat different embodiment of the attachment point of this invention;

FIG. 11 is a sectional view taken substantially on the line 11—11 of FIG. 10;

FIG. 12 is a plan view of another ring member employed in a relatively small embodiment of the invention;

FIG. 13 is a sectional view taken substantially on the line 13—13 of FIG. 12; and

FIG. 14 is a graph representing the strength of the different embodiments for various numbers of fabric layers.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIGS. 1 and 2, there is indicated at 11 generally the clew of a Genoa jib. While the main portion of the jib itself will typically comprise only one or two layers of the sailcloth, depending upon the particular cut used and the size of the jib, the thickness of the sail is built up toward the clew corner by successively adding layers of sailcloth on one or both sides of the main fabric sheet. These several layers are continued for different distances into the body of the sail for distributing the load and are sewn thereto as indicated at 13—17.

Close to the corner of the clew, the several fabric layers are apertured and a metal attachment point is applied as may be best seen in FIG. 2. A jib sheet (rope) is indicated at 19 and is tied to the jib at the attachment point. A shackle might also be used. The attachment point itself employs a pair of complementary ring members 21 and 23 which are clamped on opposite sides of the cloth layers by means of an inner, generally tubular liner 25 which extends through the rings and the aperture in the cloth layers. One side of each ring member is substantially flat and includes a multiplicity of integral needle-like teeth 27 which are driven into the cloth layers. The other side of each ring is rounded, i.e. generally in the form of a toroidal surface. The liner 25 is rimmed substantially symmetrically over the rounded surfaces of both the ring members, thereby to clamp the multiple cloth layers between the ring as is pointed out in greater detail hereinafter. Sufficient force is applied in rimming over the liner member so that the residual clamping force left on the rings is sufficient to prevent combing of the teeth through the cloth, even when a load approaching the strength of the cloth layers themselves is applied through the completed attachment point.

The ring 21 is illustrated in greater detail in FIGS. 3 and 4, while the ring 23 is illustrated in FIG. 5. Each ring includes three circumferential rows of teeth. The teeth in successive radially spaced rows are offset so as to substantially reduce the chance of teeth in the successive rows from falling into alignment with the weave of the cloth layers. It may be seen, by comparing FIGS. 3 and 5, that the pins in the ring 21 form a sort of right-hand spiral when viewing the flat face while the teeth on the ring 23 form a left-hand spiral when similarly viewed. Accordingly, it may be seen that the spirals will effectively interleave when the two rings are clamped on opposite sides of the plural cloth layers.

Preferably, the teeth 25 are cast integrally with the rings 21 and 23, using conventional investment casting procedures. The preferred material is 316 stainless steel. After casting, the rings are then electro-polished to provide a bright finish and to further reduce the possibility of corrosion.

As may be seen from FIG. 4, the teeth 27 are generally needle-like in character so that they can pierce the weave of the various cloth layers without substantial disruption thereof. In other words, the transverse dimensions of the teeth are substantially the same in different directions at any given level or height. While a circular cross section is preferred, this shape is not necessary as long as the transverse dimensions are sufficiently equal so that the teeth are not flat or blade-like. As will be understood, a flat or blade-like shape would tend to disrupt or cut the weave, disturbing its integral nature.

While the side of the ring member carrying the piece 27 is generally flat, it has been found desirable to round the corner at the outside of the ring so as to prevent cutting of the cloth layers by the outer edges of the rings. Similarly, while the

outer surfaces are generally of a toroidally rounded shape, a slight shoulder may be provided as indicated at 33 to facilitate locking of the rimmed-over portion of the liner 25.

The method of applying this attachment point is illustrated in FIGS. 6 through 9. The plural cloth layers are first die-cut to provide a circular aperture 35 in the several cloth layers as illustrated in FIG. 6. A tubular sleeve 37 (which later becomes the liner 25) is inserted through the aperture (FIG. 7) and the rings 21 and 23, centered on the sleeve, are pressed against the cloth layers on opposite sides thereof so as to drive the teeth 27 into the weave of the cloth layers. As a further precaution against rusting, the toothed sides of the rings 21 and 23 may be sprayed with an acrylic spray coating prior to being pressed into the cloth layers. The sleeve 37 is preferably also constructed of electropolished 316 stainless steel and is annealed so as to permit working during the subsequent rimming operation.

After the rings have been positioned, the sleeve 35 is then rimmed over, substantially symmetrically, by a pair of dies 38 and 39 as illustrated in FIG. 8. The ends of the sleeve are preferably slightly beveled to facilitate initial entry of the dies. A final closing or rimming is preferably provided by a separate set of dies at 41 and 42 as illustrated in FIG. 9. As noted previously, relatively heavy pressures are provided during the rimming operation so that the residual clamping force on the ring members 21 and 23 is sufficient to prevent combing of the teeth through the cloth layers under lateral forces which are in the same order of magnitude as the ultimate strength of the cloth layers themselves.

In one particular construction of the embodiment illustrated in FIGS. 2-9, the outer diameter of the rings 21 and 23 was 2.688 inches and the inside diameter was 1.688 inches; the outer diameter of the sleeve 35 which became the liner was 1.625 inches and its wall thickness was 0.125 inches; the dies 38 and 39 and the dies 41 and 42 were applied with a force which reached a peak pressure of 30 tons. The residual clamping pressure, though not subject to exact measurement, was then sufficient to prevent combing of the teeth 27 through the weave of the cloth during tests to failure.

In general, it is believed that the teeth provide interlocking of the rings with the woven fabric and that the relatively high clamping pressure so compresses the mass of fibers that combing of the teeth through the weave is substantially prevented. The mode of ultimate failure is then such that, around most of the circumference of the aperture, pieces of woven cloth are torn intact from the several layers. In a small downstream area, some of the cloth may be entirely removed from between the rings, but typically the teeth are bent over rather than being combed through the cloth. With 12 layers of 8 oz. cloth, attachment points constructed as just described will typically withstand an applied force of well over 6,000 pounds. While this may not be fully equal to the ultimate strength of a strap of individual cloth layers of width equal to the diameter of the aperture, it is generally within an order of magnitude. It can thus be seen that a very strong attachment point is provided. Accordingly, this attachment point is suited for use in situations where a substantial local load has to be applied to a large fabric sheet. For example, such an attachment point may be used at the clew of a Genoa jib suited for a relatively large sailing craft, e.g. the 12 meter yachts raced in international competition.

While it is difficult to designate a corresponding conventional construction for comparison, it may in general be noted that this embodiment will typically provide greater strength with about half the weight than the most directly comparable conventional construction.

The ring employed in another embodiment is illustrated in FIGS. 10 and 11. This ring, designated 51, employs two rows of teeth 53, which, though generally conical in nature, are still essentially needle-like. The teeth are arranged in two rows with the teeth being staggered between the two rows. Since only two rows are employed, the rings used on both sides of the cloth layers may be of the same construction, and it is not

necessary to provide both left-hand and right-hand members of differing construction. This arrangement is generally suitable for intermediate loads. Further, with the use of a relative thin liner member, the over-all thickness of the attachment point may be kept small enough so that essentially conventional hooks and snap fixtures may be used herewith.

FIGS. 12 and 13 illustrate the ring used in a still smaller version of the attachment point. In this version, only a single row of teeth 57 are used, the ring 55 being correspondingly narrower so that a very light and easily managed attachment point is provided.

FIG. 14 is a graph representing the variation in strength with the number of layers of cloth for the several illustrated embodiments of the invention. In each of these embodiments, the cloth layers are woven dacron 8 oz. sailcloth having a strength of about 300-400 pounds per inch. As there will understandably be some statistical variation from sample to sample, the performance of the various embodiments has not been designated as a single line but rather by a corresponding area, the area being intended to include approximately 90 percent of the statistical population of test samples.

The shaded area designated A represents the general range of strength provided by the larger size attachment point of FIGS. 2 through 9 with different numbers of cloth layers. Similarly, the shaded area designated B represents the behavior of the embodiment illustrated in FIGS. 10 and 11, while the area designated C correspondingly represents the embodiment of FIGS. 12 and 13. In the first two, the liner sleeve used had an initial wall thickness of 0.125 inches and forces of approximately 30 tons were applied during rimming of the sleeve. In the third (FIG. 13), a thinner liner was used having an initial wall thickness of 0.065 inches and the rimming force was held to 20 tons to prevent cutting of the fabric. The thinner liner may also be used with the intermediate size rings since, as noted previously, it may be desirable in some situations to use a thinner liner so as to provide an attachment point which is useable with relatively small hooks and snap fasteners. With the intermediate rings, the thinner liner, that is, one having an initial wall thickness of 0.065 inches, may be used without significantly weakening the strength of the attachment point.

In view of the foregoing, it may be seen that several objects of the present invention are achieved and other advantageous results have been attained.

As various changes could be made in the above construction and methods without departing from the scope of the invention, it should be understood that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. In a sail, an attachment point for applying and distributing a substantial local load to the sail, said attachment point comprising:

a plurality of cloth layers sewn to the sail for distributing said load, said layers being apertured at the desired point of attachment;

a pair of complementary ring members investment cast of stainless steel, each of which has on one side a substantially flat face and on the other side a substantially toroidally rounded surface, each ring member including also a multiplicity of integral needle-like teeth of round cross section upstanding from the respective flat face, said teeth being adapted to pierce the weave of said cloth layers without substantial disruption thereof;

a stainless steel, generally tubular liner extending through one of said ring members, the aperture in said cloth layers and the other of said ring members, said liner being rimmed substantially symmetrically over the rounded surfaces of both of said ring members thereby to clamp said multiple cloth layers between said rings under sufficient force to substantially prevent combing of said teeth through the cloth under a lateral pressure in the same order of magnitude as the strength of said cloth layers.

2. An attachment point as set forth in claim 1 wherein said liner is rimmed over under a force in the order of 30 tons.

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