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(54) **Sailboat forestay**

Vorstag eines Segelbootes

Etai d'un bateau à voile

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(56) References cited:
DE-A- 2 258 421 **GB-A- 1 340 777**
GB-A- 2 042 378

- **PATENT ABSTRACTS OF JAPAN vol. 4, no. 164**
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Description

The present invention relates to a sailboat forestay, of the kind comprising at least a longitudinal groove adapted to allow the hoisting of a headsail (or jib or genoa).

These forestays, known as hollow forestays and having an aerodynamic profile, are used on high performance and racing sailboat. They allow a very good aerodynamic shape of the leading edge of the sail which increases its efficiency in comparison with the sails hoisted through the traditional snap-hooks on the steel cable of the traditional forestay. In racing applications, two grooves are used in such a way as to hoist a new headsail close to the other, without decreasing the speed of the sailboat during the change of the headsail. Hollow forestays for cruising boats, provided with devices for rolling up the headsail (furlers), are also used making the sailing of cruising yachts easier; in this specific application, the forestay has only one groove for the hoisting of the headsail.

Present forestays, particularly those which are used on high performance sailboats, are essentially made according to three different designs.

The first presents an extruded section bar of polymeric material which is snap engaged around the steel cable which links the front side of the mast to the hull; such extruded section bar normally has two longitudinal grooves for hoisting the sails.

The second design, similar to the first, presents two aluminium shell shaped section bars coupled together on a supporting metal strand cable. In this design, one of the aluminium section bars presents the longitudinal groove for hoisting the sails. Both the above designs, even though economical and easy to install, present drawbacks typical of the forestays made of a steel cable or steel rod, that is a high weight and a high flexibility under the load which derives from the forces which are acting on the headsail, such load causing a deviation from the straight configuration of the forestay, which is the most favourable in term of aerodynamic efficiency of the sail.

GB-A- 1 340 777 describes a sailboat forestay strip having two longitudinal passages, one adapted to allow the hoisting of a sail and the other one arranged to receive the metal rod performing the function of supporting the mast and bearing the load to which the sails are subjected. A fibres reinforced resin can be used to make the forestay strip.

In order to overcome such drawbacks, hollow forestays made of metallic extruded aluminum or cobalt alloy rods have been proposed. This third design, even though it makes the forestay stiffer and guarantees therefore a better aerodynamic profile of the sail, it does not solve the problem of decreasing the total weight of the sail and, in the case where cobalt alloys are used, considerably increases the cost of the final product.

The object of the present invention is to provide a hollow forestay which does not present the above draw-

backs and which is light, reliable and of low cost.

According to the invention, the above object is obtained thanks to the fact that the forestay is made of composite material with continuous reinforcing fibres impregnated with resin.

As "fibres", here all the reinforcing fibres normally used in the manufacturing of composite articles are intended, for instance glass fibres, carbon fibres and aramidic fibres. The latter, known as kevlar fibres, are particularly preferred in the manufacturing of the forestay according to the invention. The fibres can be used also as a mat, fabric, sheath but they always comprises an amount of continuous fibres.

As "resin", here either the thermoplastic resins or the thermosetting resins adapted to form the matrix of the composite forestay are intended. Particularly preferred are the thermosetting resins, for instance the acrylic IPN (interpenetrated network) resin, the unsaturated polyester resins and the epoxy resins. Among the thermoplastic resins, liquid crystal polymers are preferred.

The forestay according to the invention is preferably made using pultrusion technology in which continuous fibres which have been impregnated with resin are drawn through a die into which the polymer cross-linking (or its solidification in case of thermoplastic polymers) takes place and from which comes out, in the form of a continuous bar, the final material which is transferred by caterpillar or clamp pullers. This technique for producing the forestay, other than allowing high tensile strength which are typical of articles made of continuous fibre composites, gives a great freedom in the definition of the section of the forestay in order to optimize its aerodynamic performances in connection with the kind of sailboat and its sails.

The hollow forestay can be integrally made of resin impregnated fibres, or can comprise a front element (with reference to the direction of the boat when sailing close to the wind) made of composite material coupled to a back element made of extruded polymeric material which present the two longitudinal grooves for hoisting the sails. The coupling between the two elements is preferably made corresponding to a longitudinal spline having undercut portions and into which a corresponding shaped rib of the back element is inserted.

In the embodiment of the two coupled elements, the load-bearing function of the forestay which, as it is known, must bear part of the heavy loads to which the sails are subjected, particularly when sailing close to the wind, is assured by the front element of composite material, while the function of supporting the headsail is guaranteed by the back element made of the polymeric material most suitable to assure a low friction with the footrope of the sail.

Preferably the longitudinal spline of the front element of the forestay is dovetail shaped. According to a version the shape of such spline for coupling with the back element may be the same as that of the longitudinal grooves for the hoisting of the sails in order to

assure, in case of breaking the back element and after removing it entirely, the provisional hoisting of the head-sail directly on the front element of the forestay.

According to another version, in the case in which the forestay is made completely of composite material, the cross section of the forestay presents an elongated drop shape defining a round front portion, two curvilinear sides and a truncated back portion, a first longitudinal groove for hoisting the sail being placed on a side and a second groove being placed on the truncated back portion. In this embodiment the hollow forestay of the invention presents better aerodynamic characteristics.

Other advantages and features of the forestay according to the invention will appear evident from the following detailed description, which is not to be intended to limit the scope of the invention, with reference to the appended drawing in which:

- fig. 1 is a cross section of a forestay according to the invention,
- fig. 2-11 are sections similar to those in fig. 1 and show other versions of the forestay,
- fig. 12 is a cross section of a forestay made entirely of composite material, and
- fig. 13 shows a more aerodynamic version of the forestay of fig. 12.

With reference to the drawings, S indicates a shaped hollow forestay for sailboats having a shaped front element 10 made of kevlar fibres and acrylic IPN resin by pultrusion technology, and a shaped back element 12 of PVC obtained by extrusion. The front element 10 presents preferably a reinforcing fibre content of about 60 % by weight (the remaining 20 % being acrylic resin).

With reference to fig. 1, the front element 10 has a back concave face 10a in the centre of which a longitudinal spline 13, having a dovetail shape, is placed. On the concave face 10a of the front element 10 the back element 12 is mounted, which is formerly provided with a longitudinal dovetail-shaped rib 12a inserted in the spline 13.

Moreover the back PVC element 12 comprises, on its substantially flat back face 12b, two longitudinal grooves 14 for hoisting the footropes of the headsails. The whole appears externally as a single bar with a convex front face A (adapted to be the leading edge of the sail), substantially straight parallel sides B and a flat back face C.

The ends of the forestay are connected, through metallic clamping sleeves, to rolling devices (not shown) which link the forestay respectively to the mast and to the hull. These devices, made of roller bearings or of low-friction polymeric bushes, allow the forestay to rotate with the sail in relation to the tack and the point of sailing of the boat.

In fig. 2-4 and in fig. 11 versions are shown in which the coupling between the front and back elements is

always dove-tail-shaped, but with different forms.

In fig. 5 a version is shown in which the back element 12 presents a rib 16 having a mushroom cross section with a stem 16a having parallel and rectilinear walls joined to an end 16b having circular cross section. Such a rib is inserted in a spline 17 having a corresponding hollow in the front element 10.

In the version according to fig. 6 the rib of back element, indicated with the reference 18, presents a T cross section, while in fig. 8 this rib, indicated with 20, presents a goblet cross section.

According to the version of fig. 7, the back element 12 presents two parallel dovetail ribs 22, while in fig. 10 these ribs, indicated with reference 24, are divergent parallelepipeds which define a protruding V-shaped portion on the face of the back element opposite to the even face 12b.

The version of fig. 9 is similar to that of fig. 6; in relation to the back face 10a of the front element 10 a T rib 26 is placed instead of the spline, which is coupled with a corresponding T spline 27 on the back element 12.

In the embodiment shown in fig. 12, the forestay S is made integrally of composite material. In order to avoid fibre delamination, particularly in the longitudinal grooves for hoisting the sails which are subjected to friction, this embodiment of the forestay is preferably made by feeding the pultrusion die with a woven sheath of reinforced fibres prepared around a central beam of longitudinal continuous unidirectional fibres. In this way it is easier to obtain the articles without needing to fully weave together all the pultrusion fibres, and the outer surface of the forestay thanks to such a precaution, is more resistant to cracking. The same production method may be used for making the drop shaped forestay shown in fig. 13 in which a first longitudinal groove 14a is placed on a curvilinear side B, and in which the second longitudinal groove 14b is placed on the back truncated face C.

The above technology (woven fibres sheath + parallel fibres) may be obviously used also for making the front element of the forestay according to fig. 1-11.

Claims

1. Sailboat forestay, of the kind comprising at least a longitudinal groove adapted to allow the hoisting of a sail, characterised in that it is made of composite material with continuous fibres impregnated with resin.
2. Forestay according to claim 1, characterised in that it is made through pultrusion technology.
3. Forestay according to claim 1 or 2, characterised in that it comprises a front element (10) of composite material coupled with a back element (12) of polymeric material on which the groove (14) for hoisting the sail is placed.

4. Forestay according to claim 3, characterised in that the front element (10) presents at least a undercut longitudinal spline (13) in which a corresponding shaped rib (12a) of the back element (12) is inserted. 5
5. Forestay according to claim 4, characterised in that the spline (13) of the front element (10) is dovetail-shaped. 10
6. Forestay according to claim 4, characterised in that it presents a convex front face (A), two substantially straight parallel sides (B) and a flat back face (C) on which two longitudinal parallel grooves (14) are placed. 15
7. Forestay according to claim 1, characterised in that the reinforcing fibres are formed by a woven sheath in the inside of which longitudinal parallel fibres are placed. 20
8. Forestay according to claim 7, characterised in that it presents a drop shaped cross section comprising a front rounded portion (A), two curvilinear sides (B) one of which has a first longitudinal groove (14a), and a back truncated face (C) on which a second longitudinal groove (14b) is placed. 25
9. Forestay according to claim 4, characterized in that the front element (10) presents two undercut longitudinal splines which have a cross section identical to the cross section of the longitudinal grooves (14) for the hoisting of the sail which are placed in the back element (12) of the forestay (S). 30

Patentansprüche

1. Segelbootvorstag, dergestalt, daß sie wenigstens eine Längsnut beinhaltet, die das Aufziehen eines Seiles erlaubt, **dadurch gekennzeichnet, daß** die Vorstag aus einem Verbundmaterial hergestellt ist, welches mit Harz getränkte Endlosfasern aufweist. 40
2. Vorstag entsprechend Anspruch 1, **dadurch gekennzeichnet, daß** sie durch Strangpresstechnologie hergestellt ist. 45
3. Vorstag entsprechend 1 oder 2, **dadurch gekennzeichnet, daß** sie ein Vorderelement (10) aus Verbundmaterial beinhaltet, daß mit einem rückseitigen Element (12) aus Polymer-Material, an dem die Nut (14) für das Aufziehen des Seiles angeordnet ist, verbunden ist. 50
4. Vorstag entsprechend Anspruch 3, **dadurch gekennzeichnet, daß** das Vorderelement (10) wenigstens einen hinterschnittenen, längs angeordneten Keilwellennutrücken aufweist, in den eine 55

korrespondierende, angepaßte Rippe (12a) des rückseitigen Elementes (12) eingesetzt ist.

5. Vorstag entsprechend Anspruch 4, **dadurch gekennzeichnet, daß** der Keilwellennutrücken (13) des Vorderelementes (10) einem Schwalbenschwanz angepaßt ist.
6. Vorstag entsprechend Anspruch 4, **dadurch gekennzeichnet, daß** sie eine konvex geformte vordere Fläche (A), zwei im wesentlichen gradlinige parallele Seiten (B) und eine flache Rückseite (C) aufweist, auf der zwei parallel laufende Längsnuten (14) plaziert sind.
7. Vorstag entsprechend Anspruch 1, **dadurch gekennzeichnet, daß** die Verstärkungsfasern aus einer gewebten Umhüllung, in dessen Innern parallel angeordnete Längsfasern plaziert sind, gebildet sind.
8. Vorstag entsprechend Anspruch 7, **dadurch gekennzeichnet, daß** sie eine tropfenförmig ausgestalteten Querschnitt bildet, der einen gerundeten Frontbereich (A), zwei kurvenförmige Seiten (B), von denen eine eine erste Längsnut (14a) besitzt, und eine hintere abgestochene Fläche (C) aufweist, in der eine zweite Längsnut (14b) angeordnet ist.
9. Vorstag entsprechend Anspruch 4, **dadurch gekennzeichnet, daß** das Vorderelement (10) zwei hinterschnittene Längskeilwellennutrücken aufweist, die einen identischen Querschnitt haben, wie der Querschnitt der Längsnuten (14) für das Aufziehen des Seils, das in dem rückseitigen Element (12) der Vorstag (S) plaziert ist.

Revendications

1. Etai de bateau à voile du type comprenant au moins une gorge longitudinale agencée de manière à permettre de hisser une voile, caractérisé en ce qu'il est en une matière composite ayant des fibres continues imprégnées de résines.
2. Etai suivant la revendication 1, caractérisé en ce qu'il est fabriqué par une technique de pultrusion.
3. Etai suivant la revendication 1 ou 2, caractérisé en ce qu'il comprend un élément avant (10) de matériau composite couplé à un élément arrière (12) de matériau polymère sur lequel est placé la gorge (14) pour hisser la voile.
4. Etai suivant la revendication 3, caractérisé en ce que l'élément frontal (10) présente une cannelure (13) longitudinale en contredépouille dans laquelle

est insérée une nervure (12a), conformée de manière correspondante, de l'élément arrière (12).

5. Etai suivant la revendication 4, caractérisé en ce que la cannelure (13) de l'élément avant (10) est en queue-d'aronde. 5
6. Etai suivant la revendication 4, caractérisé en ce qu'il présente une face frontale (a) convexe, deux côtés (b) parallèles sensiblement droit et une face arrière (c) plate sur laquelle sont prévues deux gorges (14) longitudinales parallèles. 10
7. Etai suivant la revendication 1, caractérisé en ce que les fibres de renforcement sont formées d'une gaine tissée à l'intérieur de laquelle sont placées des fibres longitudinales parallèles. 15
8. Etai suivant la revendication 7, caractérisé en ce qu'il présente une section transversale en forme de goutte comprenant une partie avant (a) arrondie, deux côtés (b) curvilignes dont l'un a une première gorge (14a) longitudinale et une face arrière (c) tronquée sur laquelle est prévue une seconde gorge (14b) longitudinale. 20 25
9. Etai suivant la revendication 4, caractérisé en ce qu'élément frontal (10) présente deux cannelures longitudinales en contredépouille, qui ont une section transversale identique à la section transversale des gorges (14) longitudinales destinées à hisser la voile, qui sont prévues sur l'élément arrière (12) de l'étau (S). 30

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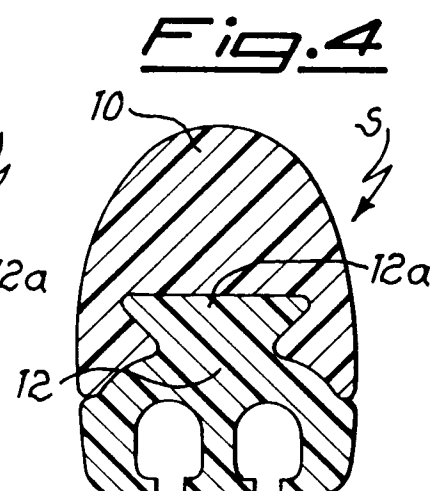
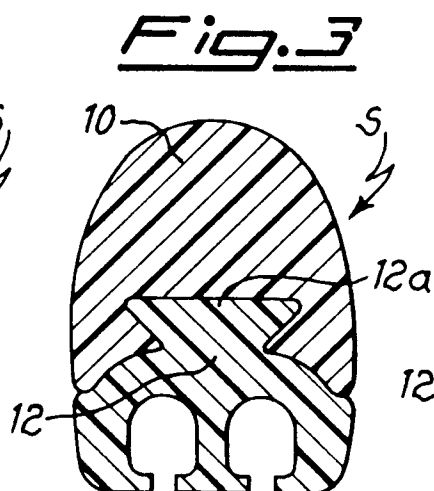
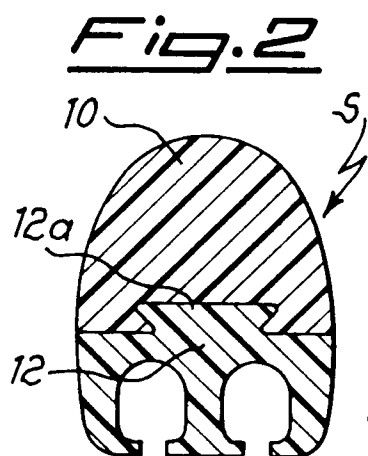
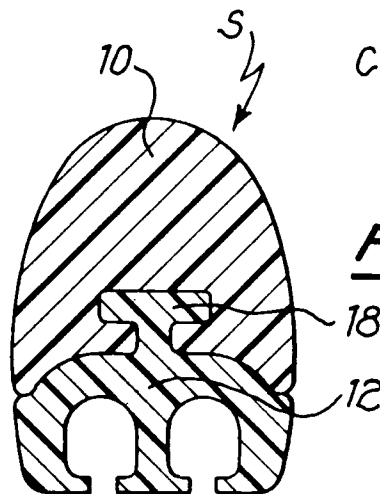
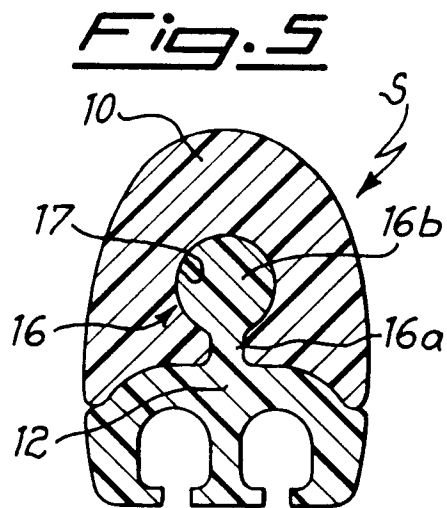
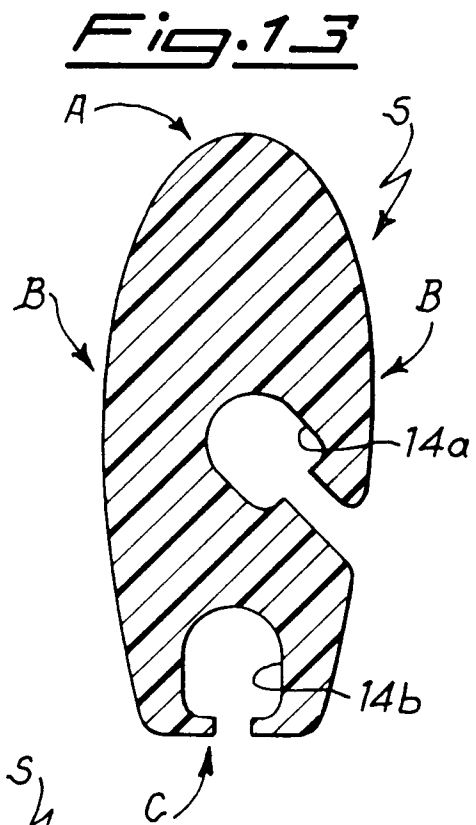
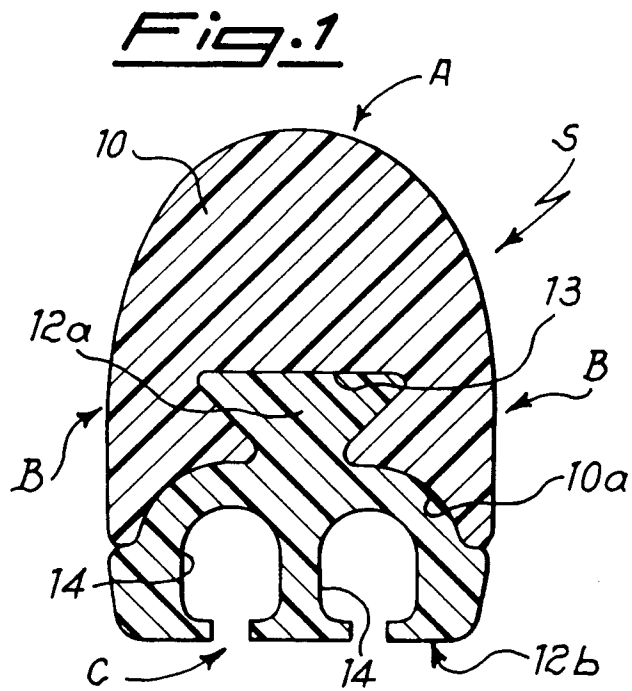


Fig. 7

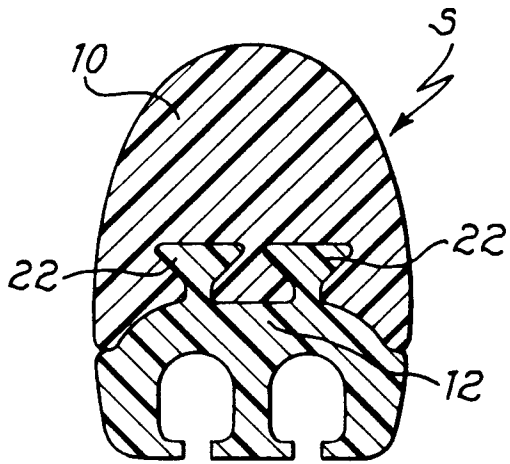


Fig. 8

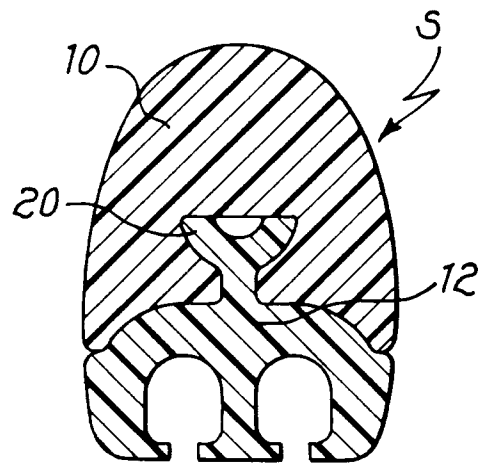


Fig. 9

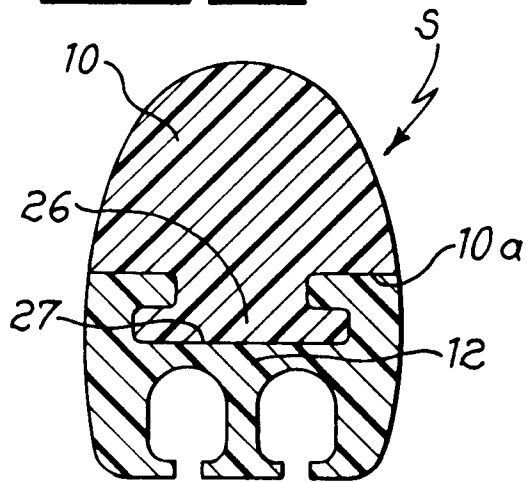


Fig. 10

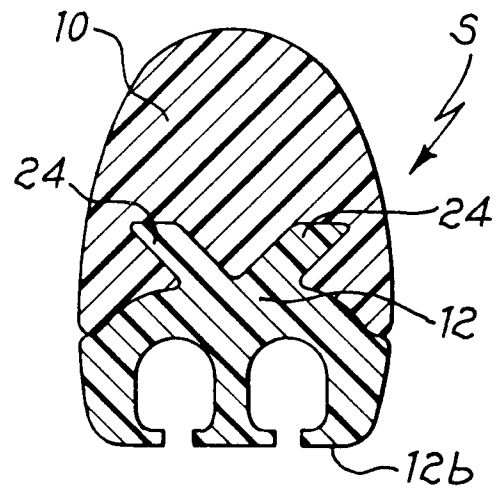


Fig. 11

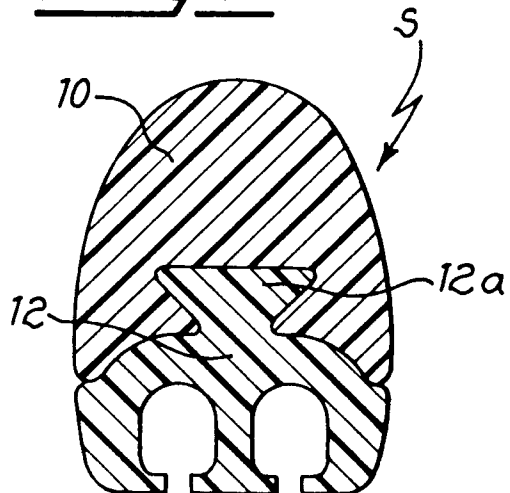


Fig. 12

