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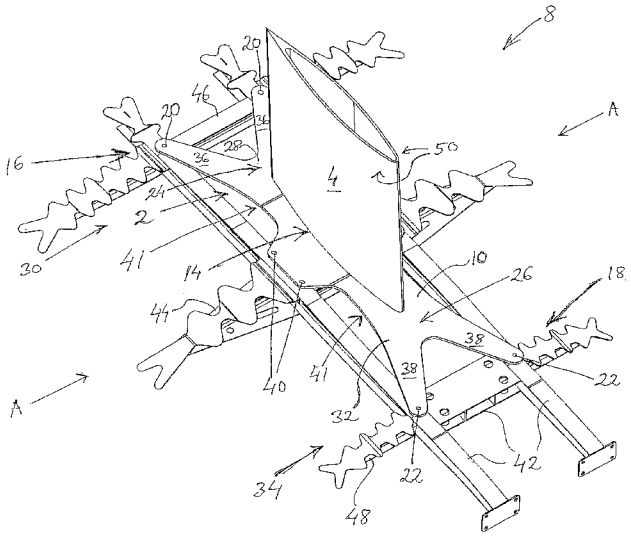
(54) **Title:** APPARATUS FOR ATTACHMENT OF A KEEL, AND ALSO AN ARRANGEMENT AND A SAILING BOAT COMPRISING THE APPARATUS



(57) **Abstract:** The present invention relates to an attachment apparatus (2) for attachment of a keel (4) to a hull base (6) of a boat. The apparatus for attachment (2) comprises an elongated sheet-shaped element (10), extending in one propagation plane (P), on which the keel (4) is intended to be attached between the short ends (14, 16) of the elongated element. The sheet-shaped element (10) is arranged to be attached to the hull base (6) of the boat by means of front attachments (20) and by means of rear attachments (22) , and that the sheet-shaped element (10) is designed to elastically deflect from said propagation plane (P) when the element (10) is subjected to a torque around the attachment position (14) of the keel in a plane perpendicular (V) against said propagation plane (P) . The present invention also relates to an arrangement (8) respectively a sailboat comprising the attachment apparatus (2).

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APPARATUS FOR ATTACHMENT OF A KEEL, AND ALSO AN ARRANGEMENT AND A SAILING BOAT COMPRISING THE APPARATUS

Technical field

The present invention relates to an attachment apparatus for attachment of a keel to a hull base of a boat, and also an arrangement and a sailing boat comprising the attachment apparatus.

Background

Below is described the occurring problems of today, relating to keel attachments on sailing boats having a fin keel or a bulbous keel. The development of keels on modern sailboats of today is focused on larger draught, shorter keel blades and a bulbous of lead at the extremity. The purpose with all of this is to facilitate an increased performance with a larger straightened moment without increasing the weight. The centre of gravity of the keel ends up lower in the design with a bulbous of lead. However, this results in some new problems, since the surface pressure between the hull of the boat and the keel increases dramatically compared to prior design. In the long run, the problem can result in a broken laminate at the sides of the keel towards the hull. This may in its turn result in that the keel starts to "swing" and the keel bolts, by which means the keel is attached to the hull, are exposed to bending stresses instead of tensile stresses. Thereby the risk for shipwreck increases dramatically. In the worst case, the keel may get lost and a larger hole in the bottom may be the result.

Another problem arises at grounding. The typical performance of attachments for keels on sailboats compose of a number of so called "floor plates", that is longitudinal and transverse beams of glass fibre or steel and also a so called "keel pocket", that works as an

upside down beam. What usually takes place at grounding is that the speed of the boat suddenly decreases, whereby the front edge of the keel is pulled down while the rear edge of the keel is pushed up in the hull. The keel rotates around a "point of rotation", so to speak. What usually happens then is that the floor plates are torn off and fractures in the laminate occurs. Local stress concentrations results in that the floor plates are "ripped" away and does not work the way the boat designer imagined.

Description of the Invention

One object with the present invention is to provide a keel attachment that at least in part eliminates those drawbacks that are associated with apparatuses according to the state of the art. One object is further to achieve an apparatus that minimises the damages that may arise on the keel and the hull of the boat in the shape of stresses/impacts at grounding or other pressure on the keel.

This object is achieved with an attachment apparatus for a keel to a hull base of a boat, according to the present invention as defined in claim 1, which comprises an elongated sheet-shaped element, extending in one propagation plane, on which the keel is intended to be attached on an attachment position between the short ends of the elongated element. The sheet-shaped element is arranged to be attached to the hull base of the boat by means of front attachments situated in front and at distance from the attachment position of the keel and by means of rear attachments situated behind and at distance from the attachment position of the keel, seen in the longitudinal direction of the boat. The sheet-shaped element is designed to elastically deflect from said

propagation plane when the element is subjected to a torque around the attachment position of the keel in a plane perpendicular against said propagation plane.

One advantage with this solution according to the present invention is that the sheet-shaped element below the hull contributes to distribution of the surface pressure between the hull and keel of the boat to a larger area. Owing to that the sheet-shaped element is designed to be able to elastically deflect in a plane perpendicular against said propagation plane, flexibility of the keel relatively the hull base can be provided for, seen in the longitudinal direction of the boat, during grounding or other pressure on the keel. By providing zones/areas in front and astern of the keel, that can be elastic at twisting/rotation in e.g. a point of rotational or other motion of the keel, stress concentrations in the hull of the boat can be avoided to a large extent or at least partly be eliminated. Further, also the occurring impacts may in this way be distributed, and the energy that is present can be absorbed in the structure of the boat, owing to a design with the sheet-shaped element in the attachment apparatus according to the present invention.

According to the present invention, the attachment apparatus suitably comprises that, between the front attachments and the rear attachments, respectively, and the attachment of the keel, the sheet-shaped element is provided with thin-walled elastic portions, that admits said elastic deflection of the sheet-shaped element from said propagation plane. These thin-walled elastic portions can be compared to zones of the sheet-shaped element, between the front attachments and the rear attachments, respectively, and the attachment of the keel, that forms "membrane-like" portions, which admits said elasticity of the sheet-shaped element. The sheet-shaped element may

suitably be produced of sheet metal, glass fibre, composite material, carbon fibres, and/or the similar, or combinations thereof. At least the zones with the "membrane-like" portions of the sheet-shaped element may have material properties and/or a shape or dimensions such that said elasticity can be achieved.

The elongated sheet-shaped element may preferably comprise a front tongue-shaped portion having a front end and a rear tongue-shaped portion having a rear end, whereby the front and rear attachments are arranged in the respective tongue-shaped portions. The front end of the front tongue-shaped portion and the rear end of the rear tongue-shaped portion may in that respect be divided in two, such that two points of tongues are formed in the respective end, whereby the attachments are arranged in each point of tongue. The sheet-shaped element can be fixedly arranged to the hull base of the boat my means of side attachments situated on each side of the attachment position of the keel, seen transversely the longitudinal direction of the sheet-shaped element. Between the side attachments and the one respectively the other short end of the sheet-shaped element, the sheet-shaped element may be provided with a tapering waist portion.

The present invention also relates to an arrangement comprising the attachment apparatus described above, which arrangement is characterised in that a keel is attached on the attachment position of the sheet-shaped element. Further, the arrangement can be characterised by hull base for a sailing boat, which hull base comprises a beam system, to which the sheet-shaped element is attached. Further, according to the arrangement, the side attachments of the sheet-shaped element may on each sides of the keel, be attached to a transverse beam, that extends across and centrally over the elongated sheet-

shaped element. Further, the attachments of the sheet-shaped element, on distance in front and behind the keel, can be attached to a front transverse beam, that is arranged in front and parallel to the central transverse beam, respectively a rear transverse beam, that is arranged behind and parallel to the central transverse beam.

The present invention also relates to a sailboat comprising the attachment apparatus or the arrangement described above.

Further preferred advantages, features and preferable embodiments according to the invention are evident from the claims, and also in the following description of the embodiments.

Description of the drawings

The present invention will now be described in embodiments in greater detail, with reference to the accompanying drawings, without limiting the interpretation of the invention thereto, where

fig. 1A schematically in a side view shows the principle for elasticity of the sheet-shaped element of the attachment apparatus and the arrangement according to the present invention, attached to a beam system that is intended for arrangement in a hull base of a boat,

fig. 1B schematically shows the apparatus and the arrangement according to fig. 1A in a view from above,

fig. 2 schematically shows the apparatus and the arrangement according to fig. 1 in a perspective view but with a part of the keel and the bulbous of the keel removed, and

fig. 3 schematically shows the apparatus and the arrangement in a cross-section A-A according to fig. 2,

where the apparatus/arrangement is arranged to a hull of a sailing boat.

Detailed description of embodiments

With reference to fig. 1-3 is shown below an embodiment of an attachment apparatus 2, according to of the present invention, intended for a keel 4, that may comprise a bulbous of lead 5, to a hull base 6 of a boat and an arrangement 8 comprising the attachment apparatus 2. The attachment apparatus 2 comprises a sheet-shaped element 10, extending longitudinally and elongated L of the boat in a propagation plane P. Consequently, the longitudinal extension L is in a direction between the fore of the boat in one direction 12 and the aft of the boat in the opposite other direction 13. The sheet-shaped element 10 may suitably be of a small thickness T and can be completely or partly formed of suitable materials such as sheet metal, glass fibre, composite material, carbon fibres, and/or the similar, or a combination of materials.

A keel 4 to a boat is intended to be attached on an attachment position 14 on the sheet-shaped element 10, between the short ends 16, 18 of the elongated element. The sheet-shaped element 10 is arranged to be fixed to the hull base 6 of the boat by means of front attachments 20, such as fasteners, for instance screw joint reinforcement, situated in front (in direction 12 towards the fore of the boat) and on distance from the attachment position 14 of the keel, and by means of rear attachments 22, such as fasteners, for instance screw joint reinforcement, situated behind (in direction 13 towards the aft of the boat) and on distance from the attachment position 14 of the keel, seen in the longitudinal extension L of the boat. When grounding or other pressure F on the keel, the sheet-shaped element 10 is arranged such that it can be

elastic in a plane perpendicular V against said propagation plane P. As a consequence of this, owing to that, the keel 4 is allowed to be elastic relatively the hull base 6 seen in the longitudinal extension L of the boat. Preferably, the sheet-shaped element 10 is designed such that, with respect to material properties and/or configuration/dimensions, that it elastically deflects from said propagation plane P when the element 10 is subjected to a torque around the attachment position 14 of the keel in a plane perpendicular V against said propagation plane P. Between the front attachments 20 and the rear attachments 22, respectively, and the attachment position 14 of the keel, the sheet-shaped element 10 is provided with thin-walled elastic portions 24, 26, that admits said elastic deflection of the sheet-shaped element 10 from said propagation plane P. The thin-walled elastic portions 24, 26 can be compared to shaping of defined zones of the sheet-shaped element between the front attachments and the rear attachments 22, 24, respectively, and the attachment position 14 of the keel, that forms "membrane-like" portions 24, 26, which admits said elasticity of the sheet-shaped element 10. The broken line 10' in fig. 1A shows a condition when the sheet is elastic as a consequence of a stress F. Such mentioned and defined, or partial, zones of the sheet-shaped element 10 may for example be achieved by plastical treatment of a sheet metal and/or by the shaping itself of the sheet-shaped element, such as for instance with tongue-shaped portions and a waist (described below). The reason that the sheet-shaped element 10 elastically may deflect from said propagation plane P, when the sheet-shaped element is fixedly arranged to the hull base 6 in i.a. front and rear attachments 20, 22, is due to that elongation is admitted within the elastic range for the material, for example a

metallic material such as steel, of the sheet-shaped element.

The elongated sheet-shaped element 10 may comprise a front tongue-shaped portion 28 having a front end 30 and a rear tongue-shaped portion 32 having a rear end 34, whereby the front and rear attachments 20, 22 are arranged in the respective tongue-shaped portions 28, 32. The front end 30 of the front tongue-shaped portion 28 and the rear end 34 of the rear tongue-shaped portion 32 may in that respect be divided in two, such that two points of tongues 36, 38 are formed in the respective end 30, 34, whereby the attachments 20, 22 are arranged in each point of tongue 36, 38. This configuration in two-piece points of tongues 36, 38, formed in the respective ends of the sheet-shaped element 10, contributes to the forming of the "membrane-like" portions 24, 26 and to create a desired elasticity.

As evident from fig. 2, the sheet-shaped element 10 may preferably be arranged to be fixed to the hull base 6 by means of side attachments 40 (only evident on one side in fig. 2), such as fasteners, for example screw joint reinforcement, situated on each side of the keel, seen in the transverse direction of the keel, across the longitudinal extension L of the boat and the sheet-shaped element, but suitably in close vicinity to the attachment position 14 of the keel. Between the side attachments 40 and the short ends 16, 18 of the sheet-shaped element, or the preferred tongue-shaped portions 28, 32, alternatively points of tongues 36, 38, the sheet-shaped element 10 may be provided with a tapering waist portion 41.

The present invention also relates to an arrangement 8 comprising the attachment apparatus 2 described above, which arrangement is characterised in that a keel 4 is attached on the attachment position 14 of

the sheet-shaped element 10, as evident from figs. 1-3. Further, the present invention also relates to a sailboat comprising the attachment apparatus 2 described above. In that respect, the sheet-shaped element 10 is attached to the beam construction/system 42 of the hull base 6 of the sailboat, as evident from fig. 3. As further evident in fig. 1-2, the side attachments 40 of the sheet-shaped element on each side of the keel 4 are suitably attached to a central transverse beam 44 arranged across at the position over the keel 4 in the longitudinal extension L of the boat and the sheet-shaped element. Further, the attachments 20, 22 of the sheet-shaped element, on distance in front and behind the keel 4, are suitably attached to a front transverse beam 46, that is arranged in front and parallel to the central transverse beam 44, respectively a rear transverse beam 48, that is arranged behind and parallel to the central transverse beam 44. Preferably, the attachments 20, 22, to the front respectively the rear transverse beam 46, 48, are arranged in the preferred front and rear points of tongues 36, 38, respectively, that are formed in the respective end of said tongue-shaped portions 28, 32. The beam system 42 contributes in distribution of the arising forces F, e.g. impacts at grounding or other influence on the keel, to the hull 6.

With reference again to figs. 1A-B, according to the present invention, the principle is that the keel 4 is intended to be arranged such that it may rotate around a theoretic point of rotation R at the attachment 14 of the keel to the sheet-shaped element 10 under pressure on the keel through impacts F, such as at grounding or other influence. The defined, partial zones that are designed as the "membranes" 24, 26, formed by the design of the tongue-shaped portions 28, 32, or alternatively by

material properties of the sheet-shaped element in these zones, are arranged to curve and be elastic substantially in a plane perpendicular V against the propagation plane P of the sheet-shaped element. In this way the impacts F that arises can be distributed, and the energy that arises is absorbed in the boat structure, owing to a design with the sheet-shaped element 10 in the apparatus according to the present invention. A rotation of the keel at a stress F does not have to make a rotation in a certain point of rotation, but may also imply another movement of the keel 4 at the attachment position 14 along a curve/line.

By providing areas/zones in front and astern of the point of rotation R of the keel (or alternatively a pivot) for rotation, which areas/zones may work as an energy absorbing membrane 24, 26, stress concentrations in the hull 6 of the boat can, to a large extent, be avoided. If the sheet-shaped element 10 is designed in accordance to the present invention, it may resist the surface pressure between the blade of the keel 4 and the hull 6, and fatigue damages at the long sides 50 of the keel can be prevented. The beam construction 42 is attached within the hull, in the base of the hull, in such a way that said surfaces of the membrane 24, 26, of the sheet-shaped element 10 are admitted to be elastic without immediately displacing the attachment positions. The beam system 42 is placed within the hull 6 and attached in the hull at areas essentially outside the working ranges of the membranes 24, 26. This results in that the beam system 42 does not instantaneously will be "torn" away at a grounding F. Any other forces that origin from the pressure of the mast, shroud attachments, etc., are carried through bulkheads and reinforcements down to the beam system. The flexibility of the construction substantially increases the durability against grounding. By the mentioned

solution, according to the present invention, the action of the forces is restructured in a way that is permitted to be easier calculated/dimensioned. Accordingly, in other words, the present invention is related to a sheet-shaped element 10, arranged in a hull base 6 of a boat, that distributes the surface pressure between the hull and the keel of the boat, to a larger area simultaneously as the sheet-shaped element 10 comprises membrane-like portions 24, 26 that contributes to the receiving, absorbing or alternatively the propagation in the structure of the impacts F that arises at grounding.

Claims

1. An attachment apparatus (2) for attachment of a keel (4) to a hull base (6) of a boat, **characterised in** that the attachment apparatus (2) comprises an elongated sheet-shaped element (10), extending in one propagation plane (P), on which the keel (4) is intended to be attached on an attachment position (14) between the short ends (14, 16) of the elongated element, that the sheet-shaped element (10) is arranged to be attached to the hull base (6) of the boat by means of front attachments (20) situated in front and at distance from the attachment position (14) of the keel and by means of rear attachments (22) situated behind and at distance from the attachment position (14) of the keel, seen in the longitudinal direction (L) of the boat, and that the sheet-shaped element (10) is designed to elastically deflect from said propagation plane (P) when the element (10) is subjected to a torque around the attachment position (14) of the keel in a plane perpendicular (V) against said propagation plane (P).

2. Attachment apparatus (2) according to claim 1, **characterised in** that between the front attachments (20) and the rear attachments (22), respectively, and the attachment position (14) of the keel, the sheet-shaped element (10) is provided with thin-walled elastic portions (24, 26), that admits said elastic deflection of the sheet-shaped element (10) from said propagation plane (P).

3. Attachment apparatus (2) according to claim 1, **characterised in** that the elongated sheet-shaped element (10) comprises a front tongue-shaped portion (28) having a front end (30) and a rear tongue-shaped portion (32) having a rear end (34), whereby the front and rear attachments (20, 22) are arranged in the respective tongue-shaped portions (28, 32).

4. Attachment apparatus (2) according to claim 3, **characterised in** that the front end (30) of the front tongue-shaped portion (28) and the rear end (34) of the rear tongue-shaped portion (32) are divided in two, such that two points of tongues (36, 38) are formed in the respective end (30, 34), whereby the attachments (20, 22) are arranged in each point of tongue (36, 38).

5. Attachment apparatus (2) according to any of the preceding claims, **characterised in** that the sheet-shaped element (10) is arranged to be fixed to the hull base (6) by means of side attachments (40), situated on each side of the attachment position (14) of the keel, seen in the longitudinal extension (L) of the sheet-shaped element.

6. Attachment apparatus (2) according to claim 5, **characterised in** that between the side attachments (40) and one of the short ends (16) respectively the other of the short ends (18) of the sheet-shaped element (10), the sheet-shaped element (10) is provided with a tapering waist portion (41).

7. Attachment apparatus (2) according to any of the preceding claims, **characterised in** that the sheet-shaped element (10) is completely or partly formed of sheet metal, glass fibre, composite material, carbon fibres, and/or the similar, or a combination of thereof.

8. Arrangement (8) comprising an attachment apparatus (2) according to any of the preceding claims, **characterised in** that a keel (4) is attached on the attachment position (14) of the sheet-shaped element (10).

9. Arrangement (8) according to claim 8, **characterised by** a hull base (6) for a sailing boat, which hull base (6) comprises a beam system (42), to which the sheet-shaped element (10) is attached.

10. Arrangement (8) according to claim 9, **characterised in** that the side attachments (40) of the sheet-shaped element (10) on each sides of the keel (4) is attached to a transverse beam (44), that extends transverse and centrally over the elongated sheet-shaped element, and that the attachments (20, 22) of the sheet-shaped element (10) on distance in front and behind the keel (4) are attached to a front transverse beam (46), that is arranged in front and parallel to the central transverse beam (44), respectively a rear transverse beam (48), that is arranged behind and parallel to the central transverse beam (44).

11. Sailboat comprising an attachment apparatus (2) according to any of the claims 1-7 or an arrangement (8) according to any of the claims 8-10

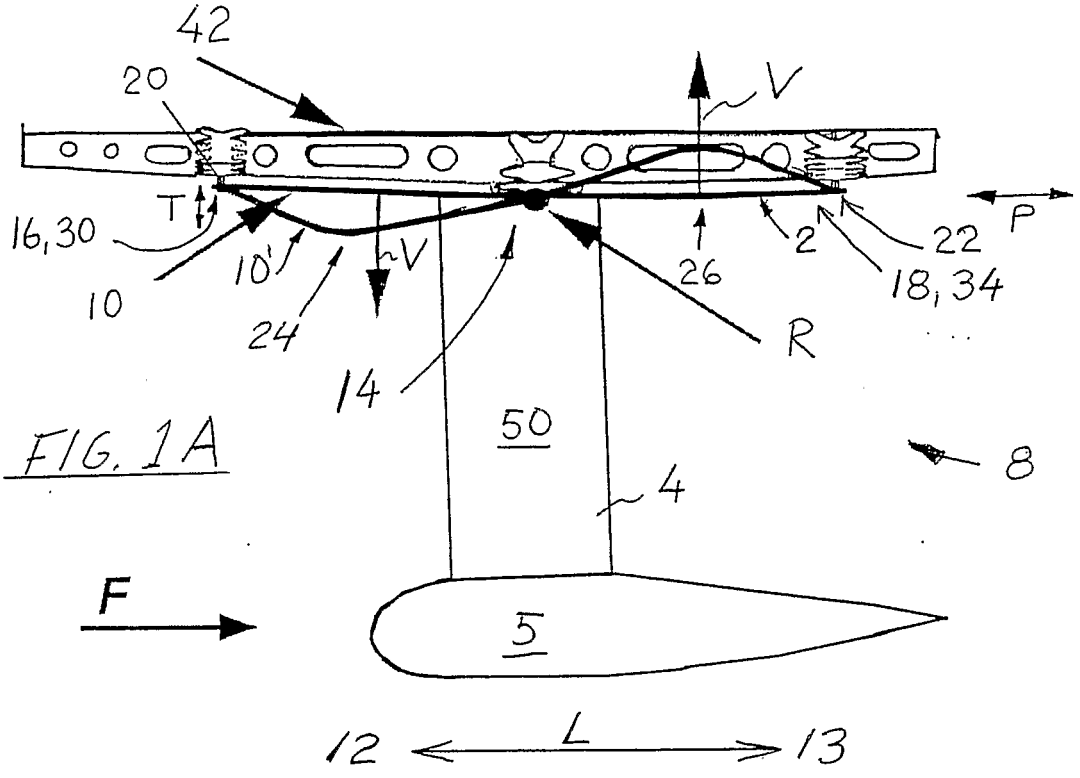
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FIG. 1A

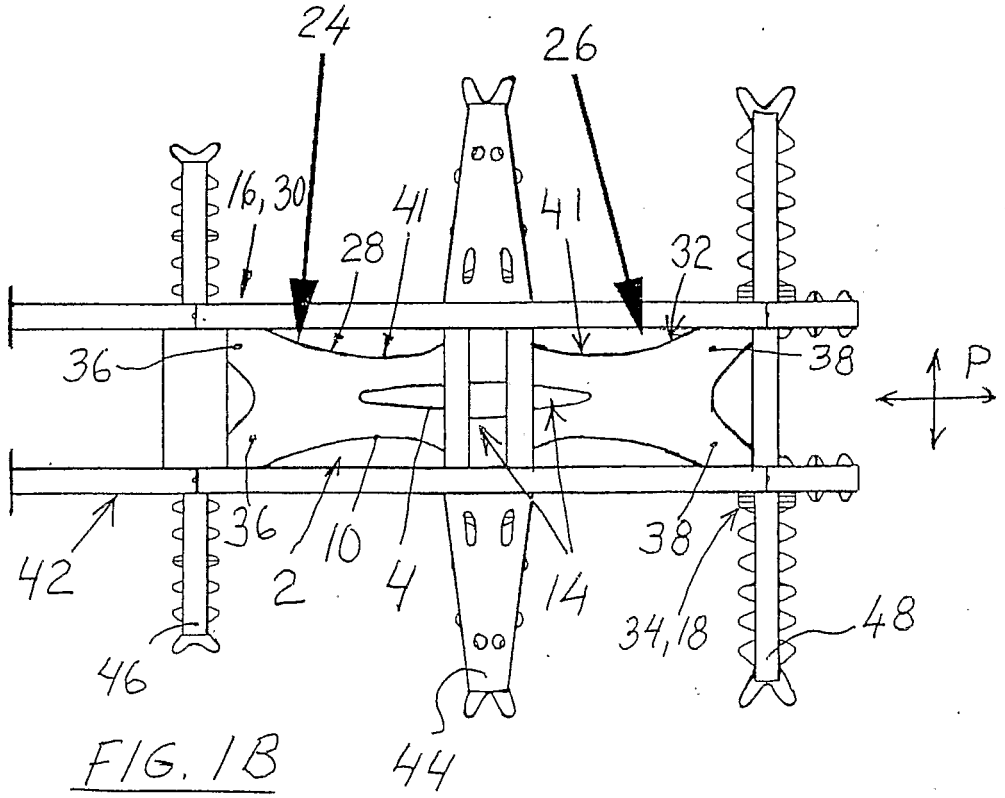
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FIG. 1B

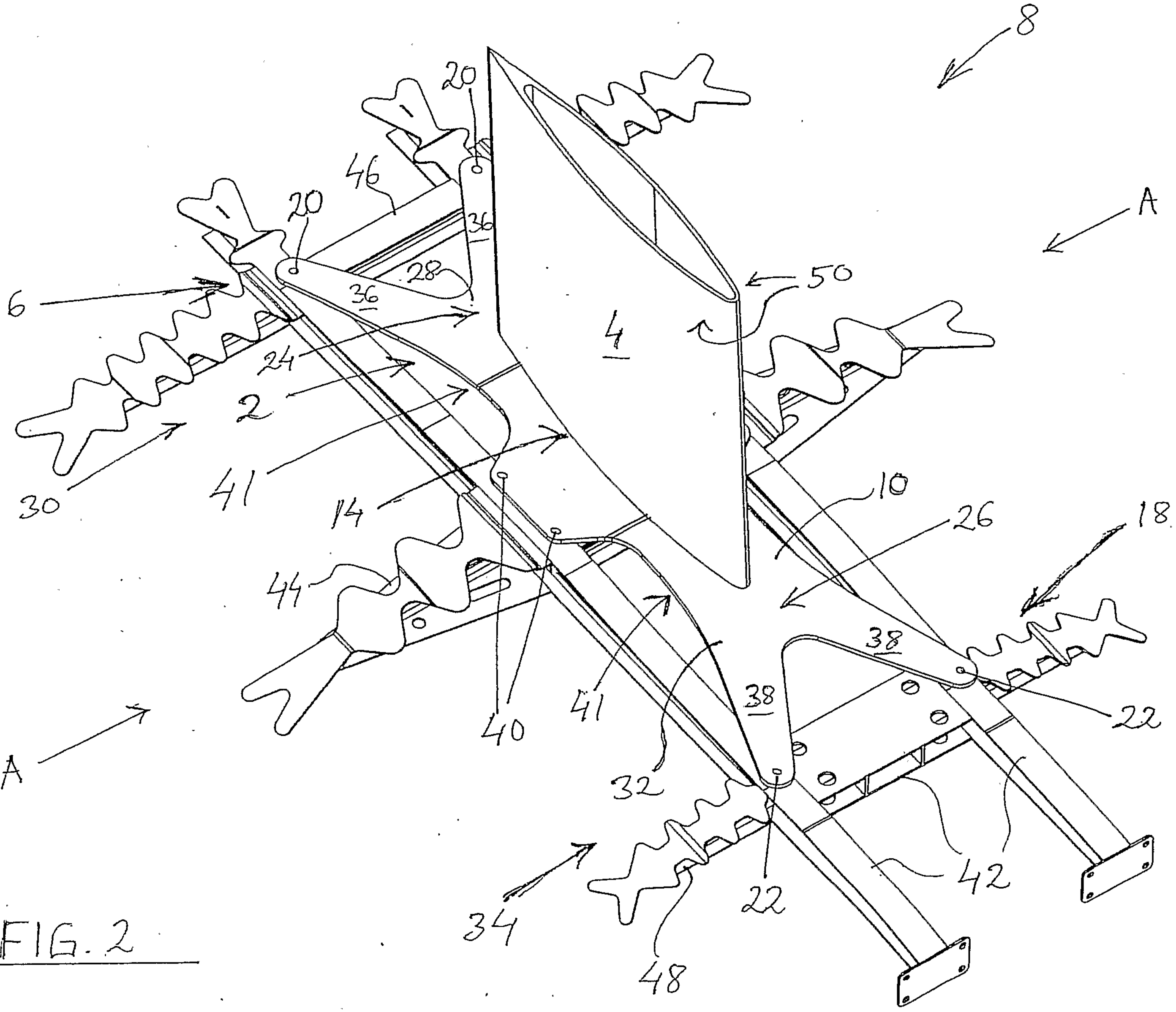
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FIG. 2

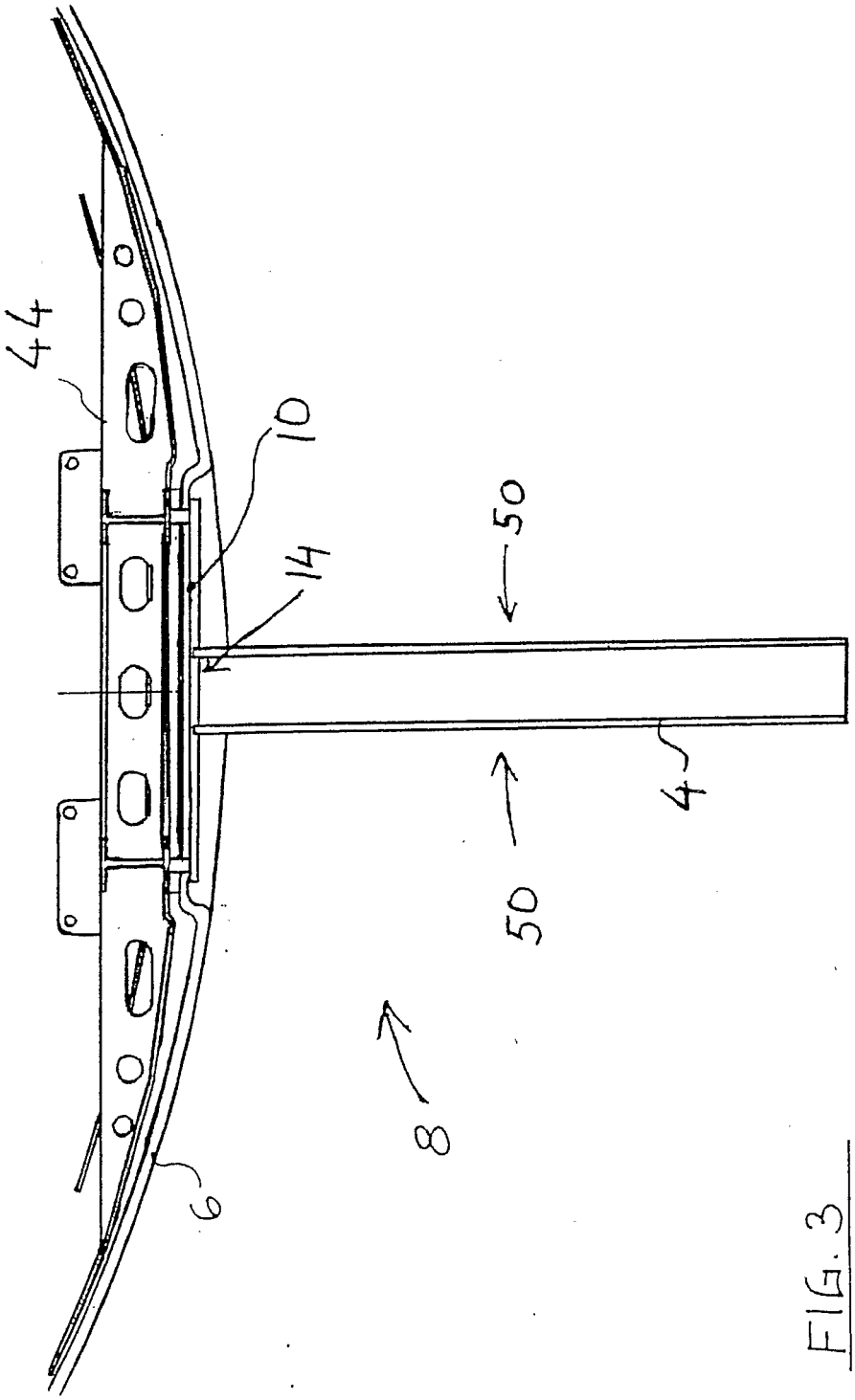

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2007/000052

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B63B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 19604966 A1 (MISBACH, MARCO), 7 August 1997 (07.08.1997), the whole document ---	1-11
A	US 3572279 A (ERNEST CLYDE SMOOT, JR), 23 March 1971 (23.03.1971), column 1, line 58 - line 65, figure 1 ---	1-11
A	WO 0073130 A1 (LARSEN, PER ET AL), 7 December 2000 (07.12.2000), figures 1,2, abstract ---	1-11
A	EP 0189154 A1 (MARGGRAFF, FRITZ), 30 July 1986 (30.07.1986), figure 4, abstract ---	1-11

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
25 April 2007	26 -04- 2007
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Carl Fröderberg/EK Telephone No. +46 8 782 25 00

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2834686 A1 (VIRONNEAU PIERRE), 18 July 2003 (18.07.2003), figures 1,2, abstract ---	1-11
A	FR 2822797 A1 (BARON DENIS PHILIPPE), 4 October 2002 (04.10.2002), figure 8, abstract ---	1-11
A	NL 1002124 C (LUMIFLEX PRECISION ENGINEERING TE AMERSFOORT), 1 Sept 1997 (01.09.1997), figures 6a, 6b,6c, abstract --- --------	1-11

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B63B 41/00 (2006.01)

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