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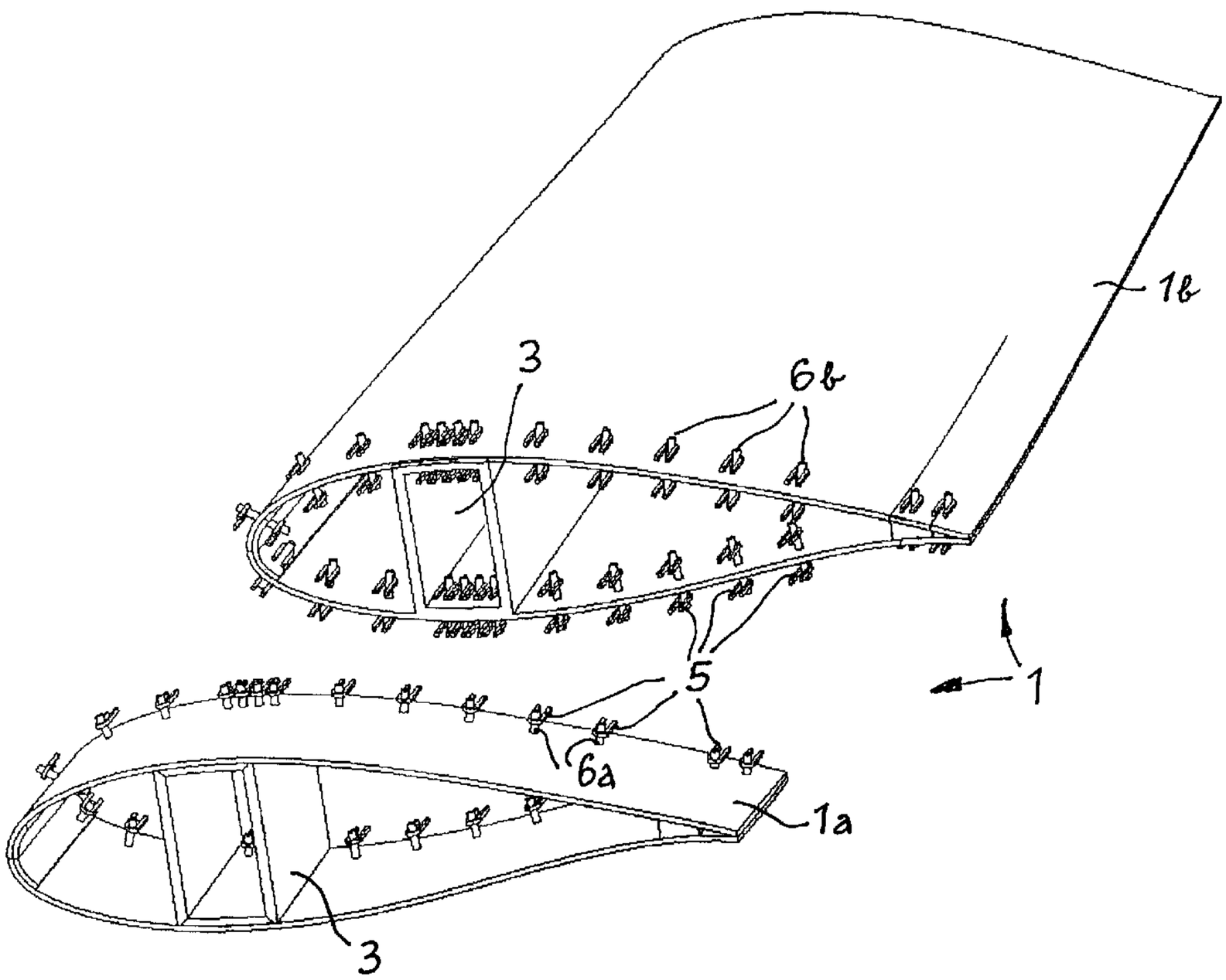


(57) Abrégé/Abstract:
A butt connection of divided hollow profile members, which is suitable in particular for rotor blades of wind power installations, comprises a multiplicity of straps which are arranged along the joint and which bridge over same and which are respectively fixed with their ends to one of the profile members to be connected. In this respect the arrangement is preferably such that one of the two bolts fixing the strap at the ends thereof has a wedge-shaped flattening, by means of which a tensile prestressing can be imparted to the strap.

ABSTRACT

A butt connection of divided hollow profile members, which is suitable in particular for rotor blades of wind power installations, comprises a multiplicity of straps which are arranged along the joint and which bridge over same and which are respectively fixed with their ends to one of the profile members to be connected. In this respect the arrangement is preferably such that one of the two bolts fixing the strap at the ends thereof has a wedge-shaped flattening, by means of which a tensile prestressing can be imparted to the strap.

Butt connection for hollow profile members

The invention concerns the use of a butt connection between components, in which straps arranged along a butt joint bridge over the butt joint and are respectively fixed with their ends directly to one of the components to be connected with a small longitudinal spacing from the butt joint.

Similarly to aircraft propellers, the rotors of wind power installations have rotor blades comprising a load-bearing spar or beam member - in most cases with an upper and a lower flange - and a hollow profile member which determines the aerodynamic properties of the rotor. Nowadays the hollow profile members generally comprise composite materials, namely glass or carbon fibers with polyester or epoxy resins as binders. What has become the usual practice is producing the rotor blade hollow profile members (whose cross-section generally changes over the length thereof) in the form of two longitudinally divided half-shell portions which are assembled to the spar to form the finished blade.

With the increasing power of modern wind power installations, the rotors thereof are also becoming larger in diameter, which requires the production of correspondingly longer rotor blades. If the production of such long rotor blades, that is to say the half-shell portions required for same, in one piece, is already not without its problems (inter alia because of the correspondingly large factory building), transportation which is then required to the location at which the wind power installation is erected represents a serious obstacle.

DE 29 21 152 A1 discloses a transversely divided rotor blade whose hollow profile member parts are connected by means of the butt connection described in the opening part of this specification. In that arrangement the ends of the profile member parts are engaged by tensile anchors, between

which the clamping elements in the form of steel cables or steel plates are tensioned, which pass through in the interior of the profile member parts over the blade length, possibly also through additional intermediate anchors. That arrangement gives rise to problems insofar as the specific change in length of the clamping elements under the effect of fluctuations in temperature and/or centrifugal forces, which depends on the coefficient of expansion and the modulus of elasticity of the material used, has the effect, because of the great length of the clamping elements, of giving rise to considerable absolute changes in length which cannot be accommodated by the prestressing of the clamping elements and which result in loosening of the butt connection.

US No 3 310 327 A1 also discloses the butt connection described in the opening part of this specification, which serves for connecting prefabricated component parts of buildings or the like. Fixed to the ends of the straps are bolts which engage over their entire length into the full material of the component parts.

In accordance with the invention the butt connection known from US No 3 310 327 A1 is used with the proviso that the component parts are divided hollow profile members, in particular rotor blades of wind power installations, and the straps are arranged along the joint at the periphery of the profile member parts. That attains the object of developing a butt connection which does not seriously influence the aerodynamic properties of the rotor blade, which is of low weight, and which in particular is capable of withstanding the considerable fluctuating loads to which the rotor blades are exposed in operation of a wind power installation, without involving the risk of coming loose. The straps replace entirely the one-piece flange connection which is conventionally usual for connecting hollow profile members or the also one-piece tensile anchor connection known from DE 29 21 152 A1; they are substantially lighter than that and can be arranged distributed over the periphery of the hollow profile member discretely at different spacings from each other, namely in dependence on the forces to be transmitted at the joint line, so that the design of the connection - with very good application of the forces involved - is simpler in terms of its

operating strength, than when using one of the known flange or tensile anchor connections. Although this kind of connection can also be used for longitudinally divided hollow profile members (rotor blades), it is suitable in particular for transversely divided hollow profile members of non-round cross-section, with the bars or straps being arranged at the periphery of the hollow profile member.

The freedom from maintenance of the new butt connection is of particular advantage because the connection is not self-releasing and therefore there are no prestressing losses that also have to be tolerated.

Preferably each strap connection comprises double bars or straps with a respective bar or strap arranged on the outside and on the inside of the hollow profile member. In addition it is advantageously provided that each strap can be prestressed with a defined tensile force. A sufficiently high tensile force prestressing provides that, in spite of an alternate loading (tensile force/compression force) in the course of a revolution of the rotor, the situation at the butt connection still remains one involving tensile forces and it is only the magnitude of such forces that changes over the course of a revolution.

In order to apply the tensile force prestressing required for that purpose to the individual straps which jointly form the butt connection, it is preferably provided that each strap is fixed to the hollow profile member

parts by means of two bolts and at least one of the bolts, in the respective contact region with the strap or straps, has a wedge-shaped flattening in its axial direction and is held non-rotatably. Alternatively the bolt could also be of a part-conical configuration, and then it can also be rotated. At any event, when fixing the straps, when they are pushed with their (suitably configured) ends over the bolt and urged in a direction towards the surface in question of the hollow profile member, at the same time tensile force prestressing is built up in the longitudinal direction of the strap and thus perpendicularly to the joint line. In order to implement that in a simple fashion, the bolt advantageously comprises a sleeve provided with the wedge-shaped flattenings, and a screw which passes axially through the sleeve and which has a nut, wherein both the screw head and also the nut press by means of cup-like pressure portions against the associated strap and prestress same by movement along the wedge surface (or cone surface).

A further alternative form of the prestressing mechanism can provide that at least one of the bolts, in the respective contact regions with the straps, has a bulge which is eccentric with respect to its axis. By rotating the bolt - which moreover does not need to be rotated to fix the straps - it is also possible in that way to produce the desired tensile force prestressing in the strap.

Summary of Invention

The present invention comprises a butt connection and the use thereof, the butt connection comprising a connection between components in which straps arranged along a butt joint (an abutting of two sides of the respective components) joining of two between the components bridge over the butt joint and are respectively fixed with each one of their ends directly fixed to one of the components to be connected. The components may be divided hollow-profile members, such as rotor blades of wind power installations. The straps are arranged along the joint at a periphery of each one of the

components. The density of arrangement (ie. the relative number of straps at any set distance along the joint) is preferably greater in areas of the joint where tensile forces to be transmitted are greater.

The straps may comprise double straps, a first strap arranged on the outside of the hollow profile member, and a second strap arranged on inside of the hollow profile member, and each strap can be prestressed with a defined tensile force.

In one embodiment of the invention, the straps are fixed to the profile members by means of first and second bolts, and at least one of the bolts in the contact regions with the straps has a wedge-shaped flattening in its axial direction and is held non-rotatably. The first bolt may comprise a sleeve provided with the wedge-shaped flattening and a screw with a nut which passes axially through the sleeve, wherein both the screw head and also the nut press by means of cup-shaped pressure portions against the associated strap and prestress the strap by movement along the wedge surface.

Alternatively, the butt connection can have straps fixed to the profile members by means of first and second bolts, at least one of said bolts having in the contact region with its respective strap a bulge which is eccentric with respect to a longitudinal axis of the bolt.

The drawing illustrates the invention by means of an embodiment. In the drawing:

Figure 1 shows a plan view of a (singly) transversely divided rotor blade for the rotor of a wind power installation in the form of a diagrammatic cross-section (the gap between the parts serves only for enhanced clarity of the drawing),

Figure 2 shows a plan view of the portion x of the butt connection according to the invention between the two rotor blade parts in Figure 1,

Figure 3 shows a perspective view of the entire butt connection between the two rotor blade parts in Figure 1, but which is opened up as in Figure 1,

Figure 4 is a view in longitudinal section on an enlarged scale through one of the strap connections forming the butt connection in the entirety thereof,

Figure 5 shows a plan view of the strap connection in Figure 4, and

Figure 6 shows a partial view taken along line A-A in Figure 4.

Figure 1 is a diagrammatic view in cross-section of a transversely divided rotor blade of a wind power installation. The joint 2 between the parts 1a and 1b of the rotor blade 1 is open. The two rotor blade parts 1a and 1b comprise a load-bearing core profile member 3 and an aerodynamically shaped shell portion 4.

Figure 2 is a plan view showing a part of the butt connection between the parts 1a and 1b of the rotor blade 1 when the joint 2 is closed. The butt connection comprises a plurality of bars or straps 5 which bridge over the joint 2 and which are respectively fixed by means of bolts 6a, 6b to both rotor blade parts 1a, 1b.

In Figure 3 - as in Figure 1 - the joint 2 is opened, and portions of the two rotor parts 1a, 1b are shown in a perspective view. The bars or straps 5 are also cut away (only for the purposes of clearer illustration) and the overall view of the (opened) butt connection shows how the straps 5 with their bolts 6a, 6b are distributed over the - non-round - cross-section of the divided hollow profile member. The arrangement of the straps 5 is at its densest in the region of the core profile member 3 because it is there that the highest transmission of forces occurs; in the other regions, there are larger spacings between the straps 5.

Figures 4 to 6 show a strap connection in detail. A respective strap 5 is arranged above and below the hollow profile member parts 1a, 1b. Both straps 5 are fixed to the part 1b by means of a bolt 6b, with the interposition of washers 7, by a screw 8 with nut 9. Fixing of the straps 5 to the part 1a is similar, but the bolt 6a has wedge-shaped flattened portions 10 which taper from the center of the bolt towards its ends and towards the axis 11 of the (longer) screw 8 with nut 9. Cup-like pressure portions 12 are provided between the head of the screw 8 and the strap 5 adjacent thereto on the one hand and between the nut 9 and the strap 5 adjacent

thereto on the other hand. When the screw 8 with the nut 9 is tightened, the pressure portions 12 exert corresponding forces on the straps 5; the approach movement thereof, in particular towards the profile member part 1a, causes them to slide upwardly along the flattened portions 10 of the bolt 6a, whereby a tensile stress is built up in the straps 5 (in the contact regions of the straps 5 with the flattened portions 10, the inside wall of the straps 5 can be adapted to the surfaces of the flattened portions 10). The tensile stress in the straps 5 results in a closing pressure stress applied to the hollow profile parts 1a, 1b in the region of their joint 2.

CLAIMS

1. A butt connection between divided hollow-profile members, in which straps arranged along a butt joint between the divided hollow-profile members bridge over the butt joint and are respectively fixed with each one of their ends directly fixed to one of the divided hollow-profile members to be connected, characterised in that the divided hollow-profile members are rotor blades of wind power installations, and wherein the straps are arranged along the joint at a periphery of each one of the divided hollow-profile members.

2. A butt connection as described in claim 1 wherein the density of arrangement of the straps along the joint is greater in areas of the joint where tensile forces to be transmitted are greater.

3. A butt connection as set forth in claim 1 or claim 2 characterised in that the straps comprise double straps, a first strap arranged on the outside of the hollow-profile member, and a second strap arranged on the inside of the hollow-profile member.

4. A butt connection as set forth in any one of claims 1, 2, or 3, characterised in that each strap can be prestressed with a defined tensile force.

5. A butt connection as set forth in claim 4 characterised in that the straps are fixed to the profile members by means of first and second bolts wherein at least one of the bolts in the contact regions with the straps has a wedge-shaped flattened portion in its axial direction and is held non-rotatably.

6. A butt connection as set forth in claim 5, characterized in that the first bolt comprises a sleeve provided with the wedge-shaped flattened portion and a screw with a nut which passes axially through the sleeve, wherein both the screw head and also the nut press by means of cup-shaped pressure portions against the associated strap and prestress the strap by movement along the surface of the wedge-shaped flattened portion.

7. A butt connection as set forth in claim 4 characterised in that the straps are fixed to the profile members by means of first and second bolts, at least one of said bolts having in the contact region with its respective strap a bulge which is eccentic with respect to a longitudinal axis of the bolt.

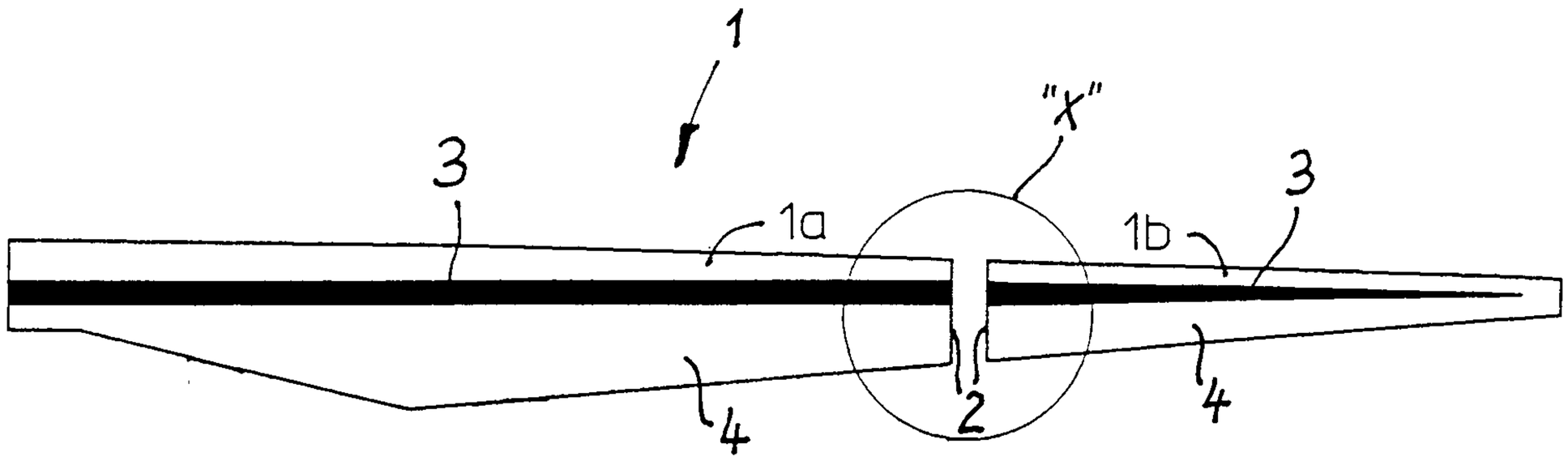


Fig.1

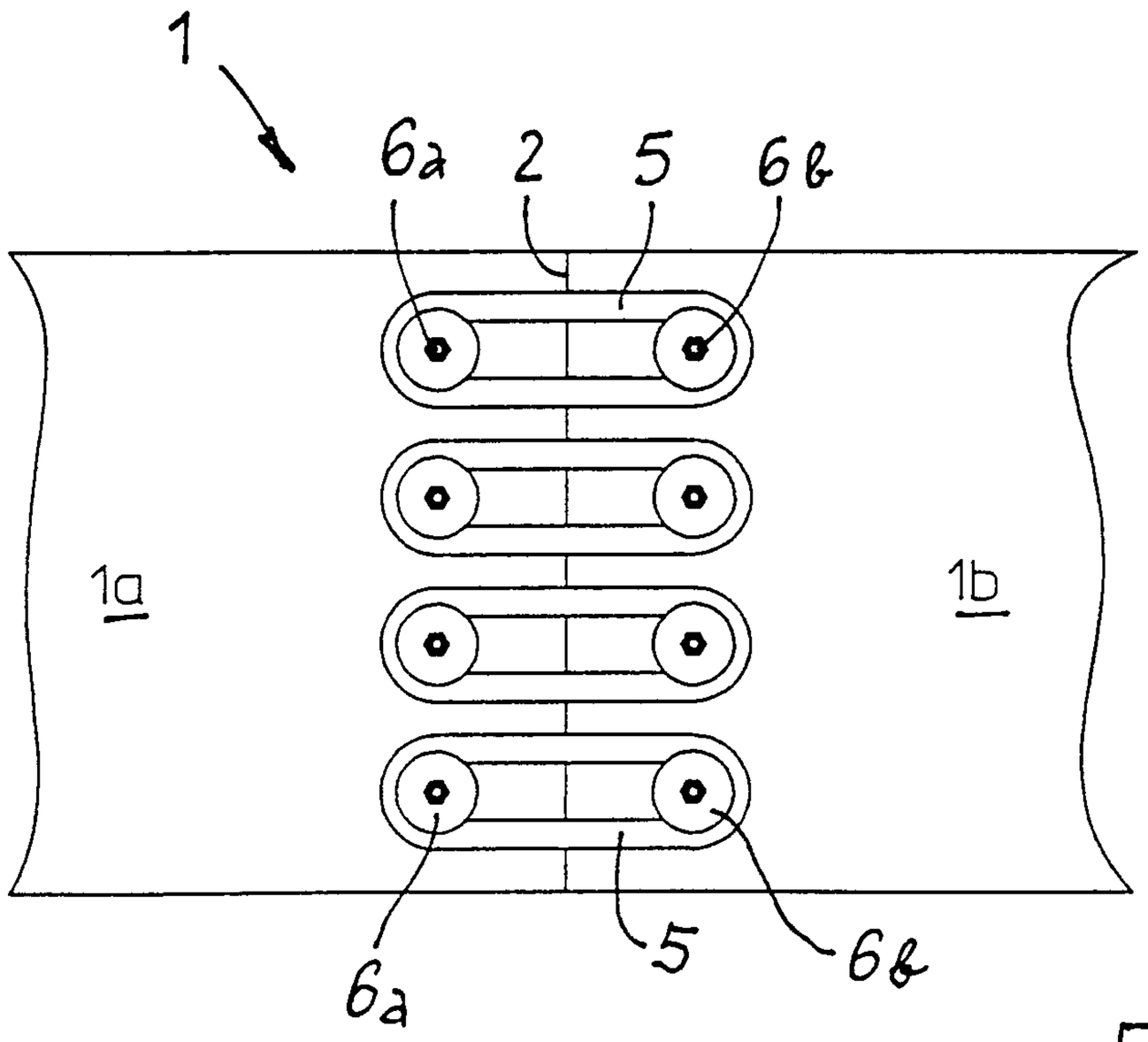


Fig.2

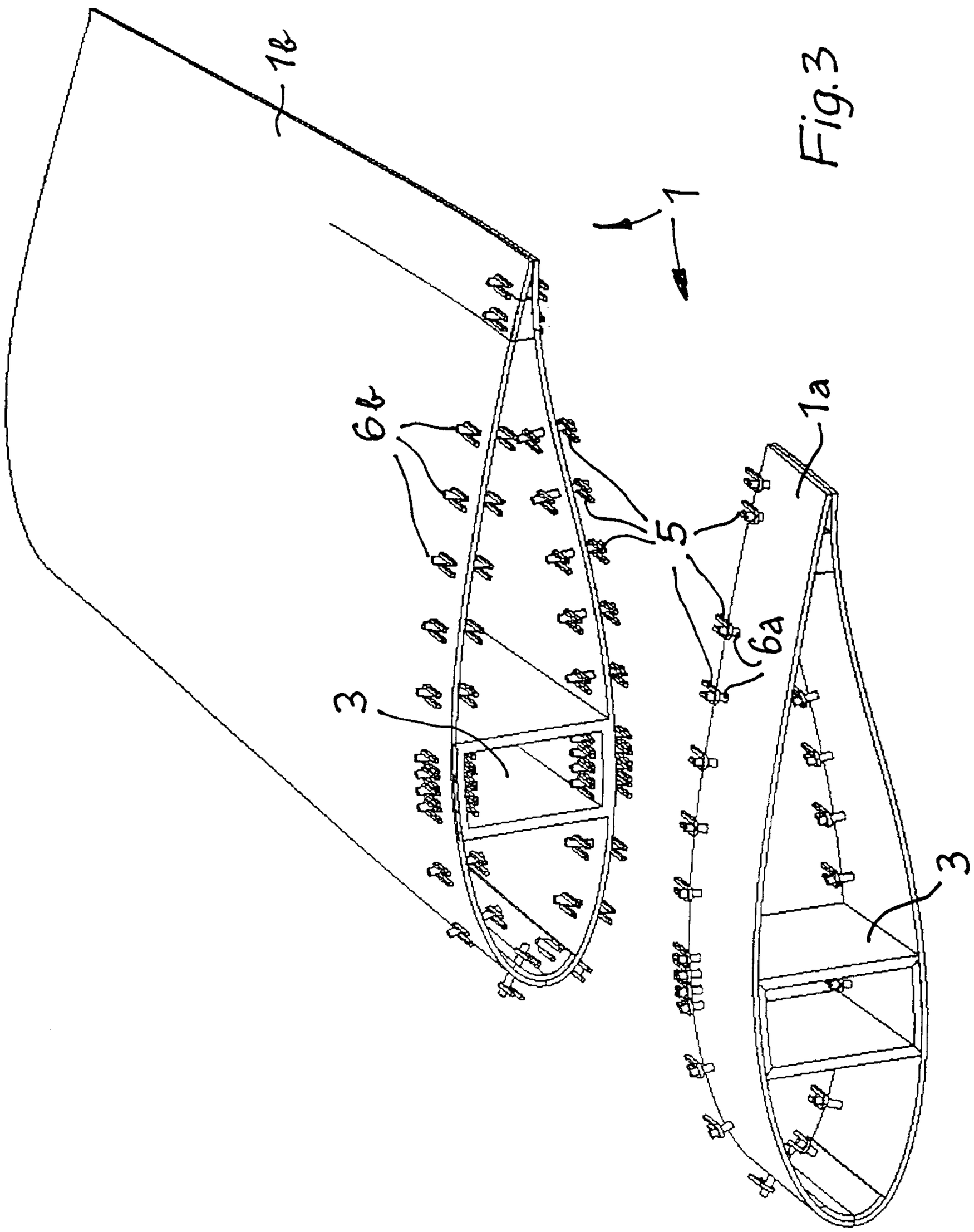


Fig.3

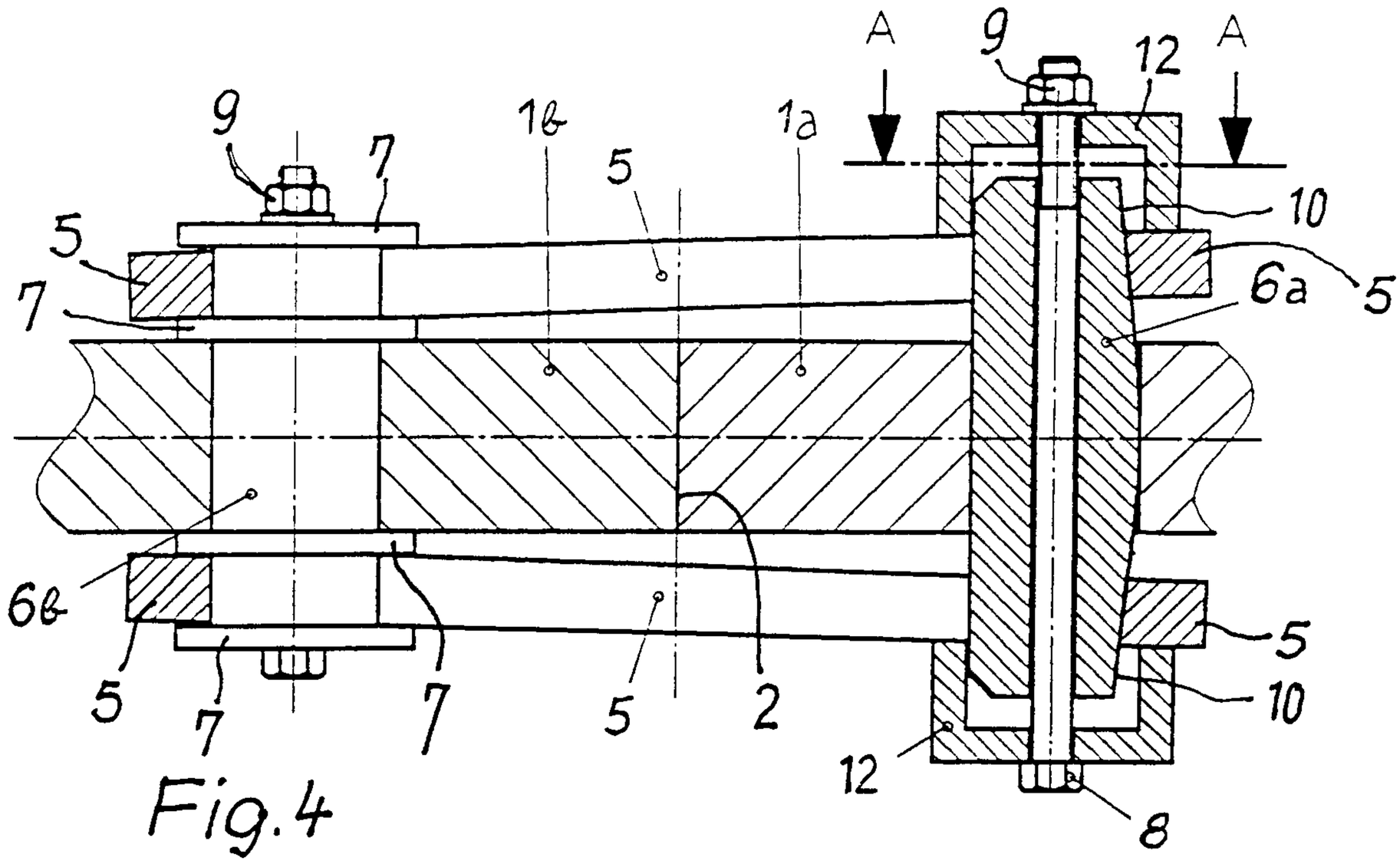


Fig.4

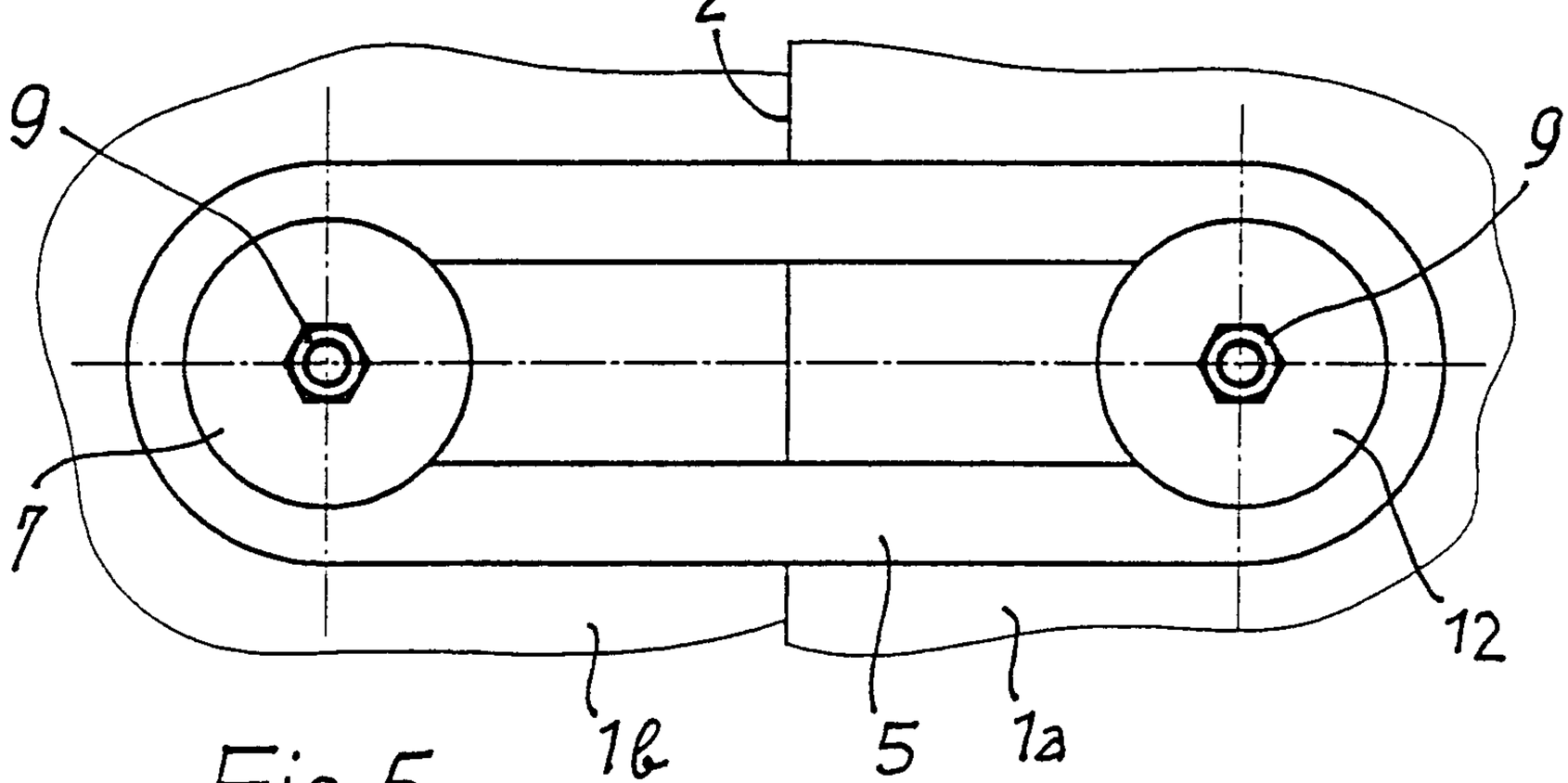


Fig.5

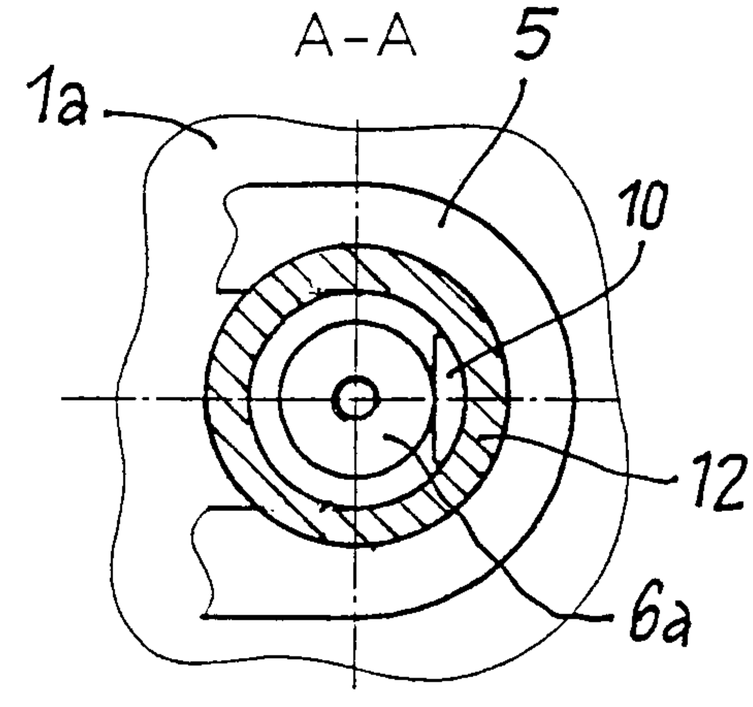
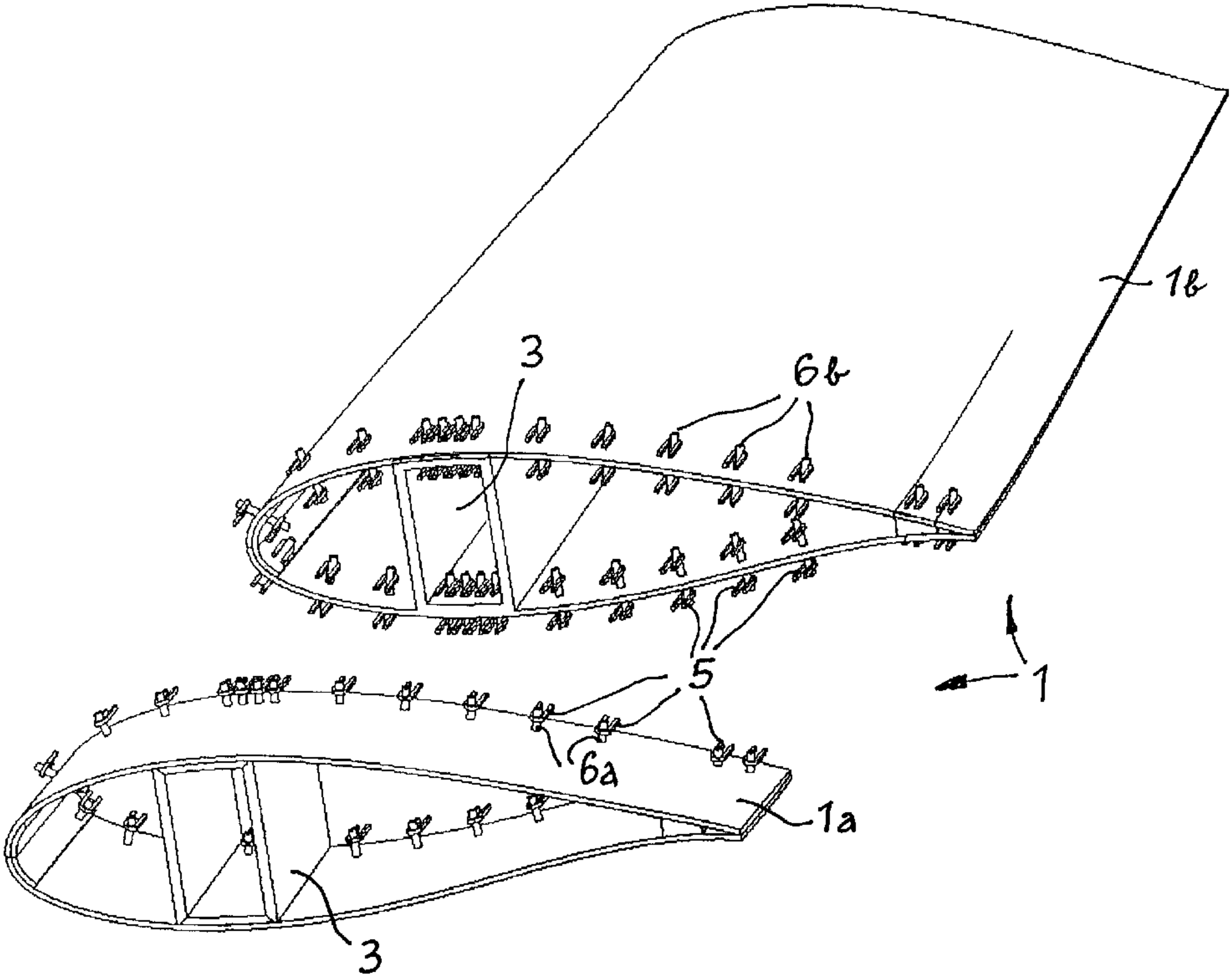


Fig.6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3
6b
5
1
6a
1a
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