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 join 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.
Fig. 1

Fig. 2
BUTT JOINT FOR HOLLOW PROFILES

[0001] The invention concerns a butt connection for divided hollow profile members, in particular for rotor blades of wind power installations.

[0002] 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.

[0003] 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.

[0004] Having regard thereto and having regard to the foreseeable further increase in the length of rotor blades for wind power installations, consideration is to be given to transversely dividing rotor blades of that kind and in that respect more specifically the hollow profile members thereof, transporting them separately, and only finishing the rotor blades at the location of erection of the wind power installation, by assembling the individual parts at their butt joints. The problem which arises out of that approach however is that 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.

[0005] The invention resolves that problem by a multiplicity of bars or straps which are arranged along the join line and which bridge over same and which are fixed with their ends respectively to one of the profile member parts to be connected. The straps or bars replace entirely the one-piece flange connection conventionally usual for connecting hollow profile members; 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 join 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 a conventional flange/screw connection. 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.

[0006] 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.

[0007] 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.

[0008] 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 join line. In order to implement that in a simple fashion, the bolt advantageously comprises a sleeve provided with the wedge-shaped flattening, 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).

[0009] 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.

[0010] The drawing illustrates the invention by means of an embodiment. In the drawing:

[0011] FIG. 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).

[0012] FIG. 2 shows a plan view of the portion x of the butt connection according to the invention between the two rotor blade parts in FIG. 1.

[0013] FIG. 3 shows a perspective view of the entire butt connection between the two rotor blade parts in FIG. 1, but which is opened up as in FIG. 1.

[0014] FIG. 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,
FIG. 5 shows a plan view of the strap connection in FIG. 4, and

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

FIG. 1 is a diagrammatic view in cross-section of a transversely divided rotor blade of a wind power installation. The join 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.

FIG. 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 join 2 is closed. The butt connection comprises a plurality of bars or straps 5 which bridge over the join 2 and which are respectively fixed by means of bolts 6a, 6b to both rotor blade parts 1a, 1b.

FIG. 3— as in FIG. 1—the join 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.

FIGS. 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 upward 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 join 2.

1. A butt connection for divided hollow profile members, in particular for rotor blades of wind power installations, characterised by a multiplicity of straps (5) which are arranged along the join (2) and which bridge over same and which are respectively fixed with their ends to one of the profile members parts (1a, 1b) to be connected.

2. A butt connection as set forth in claim 1 for transversely divided hollow profile members of non-round cross-section characterised in that the straps (5) are arranged at the periphery of the hollow profile member (1).

3. A butt connection as set forth in claim 1 or claim 2 characterised in that the density of arrangement (proximity) of the straps (5) along the join (2) is different in dependence on the tensile forces to be transmitted at the join (2).

4. A butt connection as set forth in one of claims 1 to 3 characterised in that there are respectively provided double straps with a respective strap (5) arranged on the outside and on the inside of the hollow profile member (1).

5. A butt connection as set forth in one of the preceding claims characterised in that each strap (5) or double strap can be prestressed with a defined tensile force.

6. A butt connection as set forth in claim 5 characterised in that the straps (5) are fixed to the profile member parts (1a, 1b) by means of two bolts (6a, 6b) and at least one of the bolts (6a) in the contact regions with the straps (5) has a wedge-shaped flattening (10) in its axial direction and is held non-rotatably.

7. A butt connection as set forth in claim 4 and claim 6 characterised in that the bolt (6a) comprises a sleeve provided with the wedge-shaped flattenings (10) and a screw (8) with nut (9), which passes axially through the sleeve, wherein both the screw head and also the nut press by means of cup-shaped pressure portions (12) against the associated strap (5) and prestress same by movement along the wedge surface.

8. A butt connection as set forth in claim 5 characterised in that the straps (5) are fixed to the profile member parts (1a, 1b) by means of two bolts (6) and at least one of the bolts respectively has in the contact regions with the straps (5) a bulge which is eccentric with respect to the axis thereof.

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