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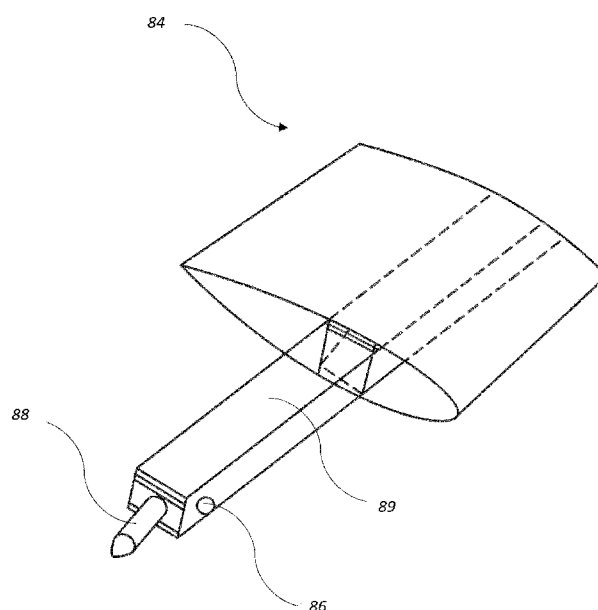


Fig. 6

(57) Abstract: The present invention relates to a mechanism for joining an elongated member and a receiving portion. The mechanism includes a locking pin, which is configured to connect the elongated member and the receiving portion. At least one first aperture is defined in one of the elongated member and the receiving portion and a plurality of second apertures is defined in other of the elongated member and the receiving portion. The at least one first aperture is selectively aligned with one of the plurality of second apertures, and the locking pin is configured to engage the aligned apertures to connect the elongated member and the receiving portion in different slidable lengths.

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Title

A mechanism for connecting an elongated member and a receiving portion.

5 Field of the Invention

The present invention relates in general to wind turbines. Particularly, the present invention relates to a wind turbine blade with a length adjusting feature. In addition, the present invention relates to methods of assembling the wind turbine blade.

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Background of the Invention

Wind power is one of the fastest-growing renewable energy technologies and provides a clean and environmentally friendly source of energy. Typically, wind turbines comprise a tower, generator, gearbox, nacelle, and one or more rotor blades. The kinetic energy of wind is captured using known aerofoil principles. Modern wind turbines may have rotor blades that exceed 90 meters in length.

Wind turbine blades are usually manufactured by forming a shell body from two shell parts or shell halves comprising layers of woven fabric or fibre and resin. Spar caps or main laminates are placed or integrated in the shell halves and may be combined with shear webs or spar beams to form structural support members. Spar caps or main laminates may be joined to, or integrated within, the inside of the suction and pressure halves of the shell.

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Generally, as the size of wind turbines increases, manufacturing and transporting of wind turbine blades becomes more challenging and costly. As a solution to this problem, wind turbine blades can be provided in two or more segments. This can result in an easier manufacturing process and may reduce the cost of transportation and erection of wind turbines. The respective blade segments may be transported to the erection site individually, where they can be assembled by various techniques to form the wind turbine blade having certain length. Also, with change in seasonal conditions and other environmental factors, wind turbine blade of different sizes may be necessary for optimizing annual energy production (AEP) for various conditions.

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Several challenges are associated with meeting the requirement of adapting wind turbine blades of different sizes to optimize AEP. As the existing wind turbine blades are manufactured with fixed lengths, new wind turbine blades of different sizes are to be adapted to meet the requirements in various seasons, which is cumbersome and adds on to additional cost, which is undesired.

It is therefore an object of the present invention to provide a wind turbine blade or related structures with a length adjusting feature, such that a single blade may be adapted to cater different length requirements, based on the various factors.

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Summary of the Invention

In one non-limiting embodiment of the present invention, a mechanism for connecting an elongated member and a receiving portion is disclosed. The mechanism comprises a locking pin, which is configured to connect the elongated member and the receiving portion. At least one first aperture is defined in one of the elongated member and the receiving portion and a plurality of second apertures is defined in other of the elongated member and the receiving portion. The at least one first aperture is selectively aligned with one of the plurality of second apertures. The locking pin is configured to engage the aligned apertures of the elongated member and the receiving portion, at different slidable lengths.

In an embodiment of the present invention, the elongated member is a spar beam structure of a wind turbine blade.

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In an embodiment of the present invention, the receiving portion is a spar receiver box of the wind turbine blade.

In an embodiment of the present invention, the receiving portion is defined with a cavity at one end to receive a guide pin for aligning the elongated member and the receiving portion.

In an embodiment of the present invention, the receiving portion comprises a hollow cavity extending lengthwise for receiving the elongated member.

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In another exemplary embodiment of the present invention, a wind turbine blade is disclosed. The wind turbine blade comprises a first blade segment and a second blade segment. The first blade segment comprises a spar beam structure and the second blade segment comprises a receiving portion. At least one first aperture is defined in one of the spar beam structure and the receiving portion and, a plurality of second apertures is defined in other of the spar beam structure and the receiving portion. The at least one first aperture is selectively aligned with one of the plurality of second apertures. A locking pin configured to engage the aligned apertures of the spar beam structure and the receiving portion, for connecting the first blade segment and the second blade segment.

10 In an embodiment of the present invention, the spar beam structure extends lengthwise within the first blade segment and a portion of the spar beam structure protrudes from the first blade segment.

15 In an embodiment of the present invention, each of the first and the second blade segments include a pressure shell member and a suction side shell member.

In an embodiment of the present invention, the first blade segment and the second blade segment are joined in chord wise direction.

20 In an embodiment of the present invention, the wind turbine blade comprises a guide pin, extending from a lateral side of a free end of the spar beam structure, and the guide pin is oriented in a span-wise direction.

25 In an embodiment of the present invention, the receiving portion is defined with a hole at one end to receive the guide pin for aligning the first blade segment with the second blade segment in a span-wise direction.

30 In an embodiment of the present invention, the receiving portion comprises a hollow cavity extending lengthwise for receiving the spar beam structure.

In an embodiment of the present invention, the wind turbine blade comprises a removable cover segment adapted to cover a gap between the first blade segment and the second blade segment. The removable cover segment include a pressure shell member and a suction side shell member. Further, the removable cover segment comprises a clasp-
35 ing arrangement for connecting the removable cover segment to the wind turbine blade. In yet another exemplary embodiment of the present invention, a method of assembling a wind turbine blade comprising a spar beam structure and the second blade segment

comprises a receiving portion, is disclosed. The method comprises a step of inserting the spar beam structure of the first blade segment into the receiving portion of the second blade segment. Further, the method comprises a step of selectively aligning the at least one first aperture defined in one of the spar beam structure and the receiving portion with one of a plurality of second apertures defined in the other of the spar beam structure and the receiving portion to vary length of the blade. Furthermore, the method comprises a step of engaging a locking pin with aligned apertures of the spar beam structure and the receiving portion for connecting the first blade segment and the second blade segment in a chord-wise direction.

10 In an embodiment of the present invention, the method comprises arranging a first blade segment and a second blade segment in opposite directions to form a chord-wise joint.

15 In an embodiment of the present invention, the method comprises engaging a guide pin defined in the spar beam structure with a aperture defined in an end of the receiving portion, for aligning the first blade segment with the second blade segment in a span-wise direction.

20 In an embodiment of the present invention, the method comprises positioning a removable cover segment to cover a gap between the first blade segment and the second blade segment, wherein the removable cover segment includes a pressure shell member and a suction side shell member.

25 As used herein, the term "spanwise" is used to describe the orientation of a measurement or element along the blade from its root end to its tip end. In some embodiments, spanwise is the direction along the longitudinal axis and longitudinal extent of the wind turbine blade.

30 As used herein, the term "chordwise" is used to describe the orientation of a measurement or element along the blade from its pressure side to suction side. In some embodiments, chordwise direction is the direction perpendicular to longitudinal axis of the wind turbine blade.

35 Various other features will be apparent from the following detailed description and the drawings

Description of the Invention

The invention is explained in detail below with reference to an embodiment shown in the
5 drawings, in which

Fig. 1 shows a wind turbine,

Fig. 2 shows a schematic view of a wind turbine blade,
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Fig. 3 shows a schematic view of a cross-section of a wind turbine blade,

Fig. 4 is a schematic cut-open view of the wind turbine blade,

15 Fig. 5 is an enlarged view of the encircled section in Fig. 4,

Fig. 6 is a perspective view of a portion of a first blade segment of the wind turbine blade,
according to the present invention,

20 Fig. 7 is a perspective view of a portion of a second blade segment of the wind turbine
blade, according to the present invention,

Fig. 8 is an exploded perspective view of a spar beam structure and a receiving portion,
according to the present invention,
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Fig. 9 is a partial perspective assembled view of the first blade segment and the second
blade segment of the wind turbine blade forming short length configuration of the wind
turbine blade, according to the present invention,

30 Fig. 10 is a partial perspective assembled view of the first blade segment and the second
blade segment forming longer length configuration of the wind turbine blade, according
to the present invention,

Fig. 11 is a perspective view of a portion of the first blade segment, according to another
35 embodiment of the present invention,

Fig. 12 is a view of perspective view of a portion of the second blade segment, according to another embodiment of the present invention,

Fig. 13 is a partial perspective assembled view of the first blade segment and the second blade segment forming shorter length configuration of the wind turbine blade, according to an embodiment of the present invention,

Fig. 14 is a partial perspective assembled view of the first blade segment and the second blade segment forming longer length configuration of the wind turbine blade, according to an embodiment of the present invention, and

Fig. 15 is a flow chart of a method of assembling the wind turbine blade, according to the present invention.

Detailed Description

Fig. 1 illustrates a conventional modern upwind wind turbine according to the so-called "Danish concept" with a tower 4, a nacelle 6 and a rotor with a substantially horizontal rotor shaft. The rotor includes a hub 8 and three blades 10 extending radially from the hub 8, each having a blade root 16 nearest the hub 8 and a blade tip 14 farthest from the hub 8.

Fig. 2 shows a schematic view of a wind turbine blade 10. The wind turbine blade 10 has the shape of a conventional wind turbine blade 10 and comprises a root region 30 closest to the hub 8, a profiled or an airfoil region 34 farthest away from the hub 8 and a transition region 32 between the root region 30 and the airfoil region 34. The blade 10 comprises a leading edge 18 facing the direction of rotation of the blade 10, when the blade 10 is mounted on the hub 8, and a trailing edge 20 facing the opposite direction of the leading edge 18.

The airfoil region 34 (also called the profiled region) has an ideal or almost ideal blade shape with respect to generating lift, whereas the root region 30 due to structural considerations has a substantially circular or elliptical cross-section, which for instance makes it easier and safer to mount the blade 10 to the hub 8. The diameter (or the chord) of the root region 30 may be constant along the entire root area 30. The transition region 32 has a transitional profile gradually changing from the circular or elliptical shape of the root region 30 to the airfoil profile of the airfoil region 34. The chord length of the transition

region 32 typically increases with increasing distance r from the hub 8. The airfoil region 34 has an airfoil profile with a chord extending between the leading edge 18 and the trailing edge 20 of the blade 10. The width of the chord decreases with increasing distance r from the hub 8.

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A shoulder 40 of the blade 10 is defined as the position, where the blade 10 has its largest chord length. The shoulder 40 is typically provided at the boundary between the transition region 32 and the airfoil region 34. Fig. 2 also illustrates the longitudinal extent L , length or longitudinal axis of the blade 10.

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It should be noted that the chords of different sections of the blade 10 normally do not lie in a common plane, since the blade 10 may be twisted and/or curved (i.e. pre-bent), thus providing the chord plane with a correspondingly twisted and/or curved course, this being most often the case in order to compensate for the local velocity of the blade 10 being dependent on the radius from the hub 8.

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The blade 10 is typically made from a pressure side shell part 36 and a suction side shell part 38 that are glued to each other along bond lines at the leading edge 18 and the trailing edge 20 of the blade 20.

20

Fig. 3 shows a schematic view of a cross section of the blade 10 along the line I-I shown in Fig. 2. As previously mentioned, the blade 10 comprises a pressure side shell part 36 and a suction side shell part 38. The pressure side shell part 36 comprises a spar cap 41, also called a main laminate, which constitutes a load bearing part of the pressure side shell part 36. The spar cap 41 comprises a plurality of fibre layers 42 mainly comprising unidirectional fibres aligned along the longitudinal direction of the blade 10 in order to provide stiffness to the blade 10. The suction side shell part 38 also comprises a spar cap 45 comprising a plurality of fibre layers 46. The pressure side shell part 38 may also comprise a sandwich core material 43 typically made of balsa wood or foamed polymer and sandwiched between a number of fibre-reinforced skin layers 52. The sandwich core material 43 is used to provide stiffness to the shell in order to ensure that the shell substantially maintains its aerodynamic profile during rotation of the blade 10. Similarly, the suction side shell part 38 may also comprise a sandwich core material 47.

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The spar cap 41 of the pressure side shell part 36 and the spar cap 45 of the suction side shell part 38 are connected via a first shear web 50 and a second shear web 55.

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The shear webs 50, 55 are shown in the embodiment, shaped as substantially I-shaped webs. The first shear web 50 comprises a shear web body and two web foot flanges. The shear web body comprises a sandwich core material 51, such as balsa wood or foamed polymer, covered by a number of skin layers 52 made of a number of fibre layers 42. The blade shells 36, 38 may comprise further fibre-reinforcement at the leading edge 18 and the trailing edge 20. Typically, the shell parts 36, 38 are bonded to each other via glue flanges.

Fig. 4 is a schematic cut-open, exploded view of a wind turbine blade 10 according to a present invention, wherein Fig. 5 is an enlarged view of the encircled section in Fig. 4. The wind turbine blade 10 comprises a first blade segment 70 and a second blade segment 68 according to the present invention. The first blade segment 70 and the second blade segment 68 extends in opposite directions from a chord-wise joint. In an embodiment, the first blade segment 70 is a tip end segment and the second blade segment 68 is a root end segment and both includes a pressure side shell member and a suction side shell member.

Figs. 6 and 7 are a perspective view of a section of the first blade segment 70 and a section of the second blade segment 68 respectively, according to a present invention. The first blade segment 70 includes a spar beam structure 89, which extends lengthwise within the first blade segment 70. A portion of the spar beam structure 89 extends away and outwardly from the first blade segment 70. That is, a portion of the spar beam structure 89 extends outside the first blade segment 70. As shown in fig. 7, the second blade segment 68 includes a receiving portion 85, which extends lengthways within the second blade segment 68. In an embodiment, the receiving portion 85 may be a spar receiver box. The receiving portion 85 comprises a hollow cavity 92 which extends lengthways of the receiving portion 85. In an embodiment, the receiving portion 85 of the second blade segment 68 is configured to slidably receive the spar beam structure 89 of the first blade segment 70 to releasably connect the first blade segment 70 and the second blade segment 68 in a chord-wise direction.

As shown in Fig. 6, the spar beam structure 89 is defined with at least one first aperture 86, typically on a side surface of the spar beam structure 89. As an example, the at least one first aperture 86 is a through aperture or hole, which extends through transverse sides of the spar beam structure 89. As seen in Fig. 7, the receiving portion 85 is defined

with a plurality of second apertures 87, typically on side surfaces of the receiving portion 85.

In an embodiment of the present invention, the spar beam structure 89 includes a guide pin 88, which extends from a lateral side of a free end of the spar beam structure 89. The guide pin 88 may be oriented in a span-wise direction. The guide pin 88 is received by a hole 92 (as seen in Figure. 8), defined at one end of the receiving portion 85. The guide pin 88 facilitates in aligning the first blade segment 70 with the second blade segment 68 in a span-wise direction, during assembly of the first blade segment 70 and the second blade segment 68.

In the present embodiment the spar beam structure 89 includes a section of a rectangular shape, but may include other geometrical shapes such as circular, cylindrical and the like. The receiving portion 85 includes a section in conformity with the shape of the spar beam structure 89 for slidably receiving the spar beam structure 89.

Figures. 9 and 10 shows assembly of the wind turbine blade 10 with the first blade segment 70 and the second blade segment 68 joined together, according to an embodiment of the present invention. As shown in Fig. 9, the spar beam structure 89 is slidably inserted into the receiving portion 85 and, at least one first aperture 86 defined in the spar beam structure 89 is selectively aligned with one of the plurality of second apertures 87 defined in the receiving portion 85, based on the required length of the blade 10, which depends upon seasonal and other environmental factors. A locking pin 90 is engaged with the aligned at least one first aperture 86 and one of the plurality of second apertures 87, for connecting the spar beam structure 89 and the receiving portion 85 (thus, locking the first blade segment 70 and the second blade segment 68) in a chord-wise direction forming a wind turbine blade 10 of desired length.

In an embodiment, the locking pin 90 engages with the aligned apertures in an interference fit for securing/locking the first blade segment 70 and the second blade segment 68 in position or place. In an embodiment, bushings (not shown in figures) may be provided in the aligned apertures to slidably receive the locking pin 90.

For instance, as shown in Fig. 9, the at least one first aperture 86 is aligned with a foremost aperture of the plurality of second apertures 87 nearer to the hub 8. This alignment of the apertures for connecting the first blade segment 70 and the second blade segment 68, results in shorter length configuration of the wind turbine blade 10. Further, as shown

in Fig. 10, the at least one first aperture 86 is aligned with a aperture of the plurality of second apertures 87 farthest from the hub 8. This alignment of the apertures for connecting the first blade segment 70 and the second blade segment 68, results in longer length configuration of the wind turbine blade 10. Accordingly, the length of the wind turbine blade 10 may be varied based on requirement by aligning each of the apertures at different locations to achieve desired length.

In an embodiment, apart from the shorter length configuration of the wind turbine blade 10 a gap may be created between the first blade segment 70 and the second blade segment 68. A removable cover segment 91 is inserted to cover the gap and retain the aerodynamic properties of the wind turbine blade 10. The removable cover segment 91 comprises a pressure shell member and a suction shell member. Further, the removable cover segment 91 comprises a clasping arrangement (not shown in figures) to facilitate connecting of the removable cover segment 91 to the wind turbine blade 10 to cover the gap. In an embodiment, the clasping arrangement may be but not limiting to magnetic latch, snap fit and the like.

In an embodiment, as the size of the wind turbine blade 10 increases, the gap between the first blade segment 70 and the second blade segment 68 increases and different sizes of the removable cover segments 91 confirming to size of the gap are adapted to cover the gap for retaining the aerodynamic profile of the wind turbine blade 10.

In accordance to another exemplary embodiment of the present invention, and as seen in Fig. 11, the spar beam structure 89 is defined with a plurality of second apertures 87 and as seen in Fig. 12, the receiving portion 85 is defined with the at least one first aperture 86.

As seen in Fig.13, the spar beam structure 89 is received by the receiving portion 85 and one of the plurality of second apertures 87 defined in the spar beam structure 89 is aligned with at least one first aperture 86 defined in the receiving portion, based on the required length of the blade 10 depending upon seasonal and other environmental factors. A locking pin 90 is engaged with the aligned at least one first aperture 86 and one of the plurality of second apertures 87, for connecting the spar beam structure 89 and the receiving portion 85 to obtain a wind turbine blade 10 of required length.

For instance, as shown in Fig. 13, a foremost aperture of the plurality of second apertures 87 of the spar beam structure 89 is aligned with at least one first aperture 86 of the

receiving portion 85. This alignment of the apertures for joining the first blade segment 70 and the second blade segment 68, results in shorter length configuration of the wind turbine blade 10. Further, as shown in Fig. 14, an end most aperture of the plurality of second apertures 87 of the spar beam structure 89 is aligned with at least one first aperture 86 of the receiving portion 85. This alignment of the apertures aids in securing the first blade segment 70 and the second blade segment 68, thereby resulting in longer length configuration of the wind turbine blade 10.

- Fig. 15 is a flow chart of method 150 of assembling the wind turbine blade 10, according to the present invention. The assembling method 150 includes the steps of inserting the spar beam structure 89 of the first blade segment 70 into the receiving portion 85 of the second blade segment 68. Further, the method 150 includes a step of selectively aligning at least one first aperture 86 defined in one of the spar beam structure 89 and the receiving portion 85 with one of a plurality of second apertures 87 defined in the other of the spar beam structure 89 and the receiving portion 85 to vary length of the blade 10. Furthermore, the method 150 includes a step of engaging a locking pin 90 with aligned apertures of the spar beam structure 89 and the receiving portion 85 for connecting the first blade segment 70 and the second blade segment 68 in a chord-wise direction.
- In an embodiment, inserting the spar beam structure 89 includes slidably displacing the spar beam structure 89 within the receiving portion 85 for selectively aligning at least one first aperture 86 and one aperture of the plurality of second apertures 87, for engaging the locking pin 90 to join the beam structure and the receiving section.
- In an embodiment, joining the first blade segment 70 and the second blade segment 68 to attain different lengths of the wind turbine blade 10 is an exemplary embodiment, and the same cannot be considered as a limitation, as any mechanism may be adapted to connect two different structures such as an elongated member and a receiving portion into other types of wind-exposed surfaces negotiating aerodynamic forces, resistance and aerodynamics, such as helicopter rotor blades or fan blades.

In an embodiment, the mechanism of the present invention aids in varying the length of the structures such as but not limiting to wind turbine blade, thus eliminating the need of individual wind turbine blades based on seasonal changes and various other factors for optimizing annual energy production (AEP).

Itemized list of embodiments

- 5 1. A mechanism for connecting an elongated member and a receiving portion, the mechanism comprising:
a locking pin, configured to connect the elongated member and the receiving portion;
wherein, at least one first aperture is defined in one of the elongated member and the receiving portion and a plurality of second apertures is defined in other of the elongated member and the receiving portion;
10 wherein, the at least one first aperture is selectively aligned with one of the plurality of second apertures; and
the locking pin is configured to engage the aligned apertures to connect the elongated member and the receiving portion in different slidable lengths.
- 15 2. The mechanism according to item 1, wherein the elongated member is a spar beam structure of a wind turbine blade.
- 20 3. The mechanism according to item 1, wherein the receiving portion is a spar receiver box of the wind turbine blade.
- 25 4. The mechanism according to item 1, wherein the receiving portion is defined with a hole at one end to receive a guide pin for aligning elongated member and the receiving portion.
5. The mechanism according to item 1, wherein the receiving portion comprises a hollow cavity extending lengthwise for receiving the elongated member.
- 30 6. A wind turbine blade, comprising:
a first blade segment and a second blade segment;
the first blade segment comprising a spar beam structure and the second blade segment comprising a receiving portion;
wherein, at least one first aperture is defined in one of the spar beam structure and the receiving portion and a plurality of second apertures is defined in other of the spar beam structure and the receiving portion;
35 the at least one first aperture is selectively aligned with one of the plurality of second apertures; and

a locking pin, configured to engage the aligned apertures of the spar beam structure and the receiving portion, for connecting the first blade segment and the second blade segment.

- 5 7. The wind turbine blade according to item 6, wherein the spar beam structure extends lengthwise within the first blade segment and a portion of the spar beam structure protrudes from the first blade segment.
- 10 8. The wind turbine blade according to item 6, wherein each of the first and second blade segments include a pressure shell member and a suction side shell member.
- 15 9. The wind turbine blade according to item 6, wherein the first blade segment and the second blade segment are joined in a chord wise direction.
- 20 10. The wind turbine blade according to item 6, comprises a guide pin, extending from a lateral side of a free end of the spar beam structure.
- 25 11. The wind turbine blade according to item 10, wherein the guide pin is oriented in a span-wise direction.
- 30 12. The wind turbine blade according to item 6 and 10, wherein the receiving portion is defined with a hole at one end to receive the guide pin for aligning the first blade segment with the second blade segment in a span-wise direction.
- 35 13. The wind turbine blade according to item 6, wherein the receiving portion comprises a hollow cavity extending lengthwise for receiving the spar beam structure.
14. The wind turbine blade according to item 6, comprises a removable cover segment adapted to cover a gap between the first blade segment and the second blade segment, wherein the removable cover segment include a pressure shell member and a suction side shell member.
15. The wind turbine blade according to item 6, wherein the removable cover segment includes a clasp arrangement for connecting the removable cover segment to the wind turbine blade.

16. The wind turbine blade according to item 6, wherein the second blade segment comprises a plurality of spar structures extending lengthwise, and wherein an end of the spar structure is connected to the receiving portion.
- 5 17. A method of assembling a wind turbine blade, comprising a first blade segment and a second blade segment, and the first blade segment comprising a spar beam structure and the second blade segment comprising a receiving portion, the method comprising:
- 10 inserting the spar beam structure of the first blade segment into the receiving portion of the second blade segment;
- selectively aligning at least one first aperture defined in one of the spar beam structure and the receiving portion with one of a plurality of second apertures defined in the other of the spar beam structure and the receiving portion to vary length of the blade; and
- 15 engaging a locking pin with aligned apertures of the spar beam structure and the receiving portion for connecting the first blade segment and the second blade segment in a chord-wise direction.
18. The method according to item 17, comprising arranging a first blade segment and a second blade segment in opposite directions to form a chord-wise joint.
- 20 19. The method according to item 17, comprising engaging a guide pin defined in the spar beam structure with a aperture defined in an end of the receiving portion, for aligning the first blade segment with the second blade segment in a span-wise direction.
- 25 20. The method according to item 17, comprising positioning a removable cover segment to cover a gap between the first blade segment and the second blade segment, wherein the removable cover segment includes a pressure shell member and a suction side shell member.
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List of reference numerals

- 2 wind turbine
- 35 4 tower
- 6 nacelle
- 8 hub

	10	blade
	14	blade tip
	16	blade root
	18	leading edge
5	20	trailing edge
	30	root region
	32	transition region
	34	airfoil region
	36	pressure side shell part
10	38	suction side shell part
	40	shoulder
	41	spar cap
	42	fibre layers
	43	sandwich core material
15	46	fibre layers
	47	sandwich core material
	50	first shear web
	51	core member
	52	skin layers
20	55	second shear web
	56	sandwich core material of second shear web
	57	skin layers of second shear web
	60	filler ropes
	62	spar structure
25	64	first part
	65	end surface of first part
	66	second part
	67	spar member
	68	second blade segment
30	69	cutting plane
	70	first blade segment
	80	access opening
	82	shear web
	85	receiving portion
35	86	first aperture
	87	plurality of second apertures

- 88 guide pin
- 89 spar beam structure
- 90 locking pin
- 91 removable cover segment
- 5 92 cavity

Claims:

- 5 1. A wind turbine blade, comprising:
 a first blade segment and a second blade segment;
 the first blade segment comprising a spar beam structure and the second
 blade segment comprising a receiving portion;
 wherein, at least one first aperture is defined in one of the spar beam struc-
10 ture and the receiving portion and a plurality of second apertures is defined in
 other of the spar beam structure and the receiving portion;
 the at least one first aperture is selectively aligned with one of the plurality
 of second apertures; and
 a locking pin, configured to engage the aligned apertures of the spar beam
15 structure and the receiving portion, for connecting the first blade segment and the
 second blade segment.
- 20 2. The wind turbine blade according to claim 1, wherein the spar beam structure
 extends lengthwise within the first blade segment and a portion of the spar beam
 structure protrudes from the first blade segment.
- 25 3. The wind turbine blade according to claim 1 or claim 2, wherein each of the first
 and second blade segments include a pressure shell member and a suction side
 shell member.
- 30 4. The wind turbine blade according to any of the preceding claims, wherein the first
 blade segment and the second blade segment are joined in a chord wise direc-
 tion.
- 35 5. The wind turbine blade according to any of the preceding claims, comprises a
 guide pin, extending from a lateral side of a free end of the spar beam structure.
6. The wind turbine blade according to claim 5, wherein the guide pin is oriented in
 a span-wise direction.

7. The wind turbine blade according to any of the preceding claim when dependent on claim 5, wherein the receiving portion is defined with a hole at one end to receive the guide pin for aligning the first blade segment with the second blade segment in a span-wise direction.
- 5 8. The wind turbine blade according to any of the preceding claims, wherein the receiving portion comprises a hollow cavity extending lengthwise for receiving the spar beam structure.
- 10 9. The wind turbine blade according to any of the preceding claims, comprises a removable cover segment adapted to cover a gap between the first blade segment and the second blade segment, wherein the removable cover segment include a pressure shell member and a suction side shell member.
- 15 10. The wind turbine blade according to any of the preceding claims, wherein the removable cover segment includes a clasping arrangement for connecting the removable cover segment to the wind turbine blade.
- 20 11. The wind turbine blade according to any of the preceding claims, wherein the second blade segment comprises a plurality of spar structures extending lengthwise, and wherein an end of the spar structure is connected to the receiving portion.
- 25 12. A method of assembling a wind turbine blade, comprising a first blade segment and a second blade segment, and the first blade segment comprising a spar beam structure and the second blade segment comprising a receiving portion, the method comprising:
- 30 inserting the spar beam structure of the first blade segment into the receiving portion of the second blade segment;
- selectively aligning at least one first aperture defined in one of the spar beam structure and the receiving portion with one of a plurality of second apertures defined in the other of the spar beam structure and the receiving portion to vary length of the blade; and
- engaging a locking pin with aligned apertures of the spar beam structure and the receiving portion for connecting the first blade segment and the second blade segment in a chord-wise direction.
- 35

13. The method according to claim 12, comprising arranging a first blade segment and a second blade segment in opposite directions to form a chord-wise joint.
14. The method according to claim 12 or claim 13, comprising engaging a guide pin defined in the spar beam structure with an aperture defined in an end of the receiving portion, for aligning the first blade segment with the second blade segment in a span-wise direction.
15. The method according to any of claims 12-14, comprising positioning a removable cover segment to cover a gap between the first blade segment and the second blade segment, wherein the removable cover segment includes a pressure shell member and a suction side shell member.

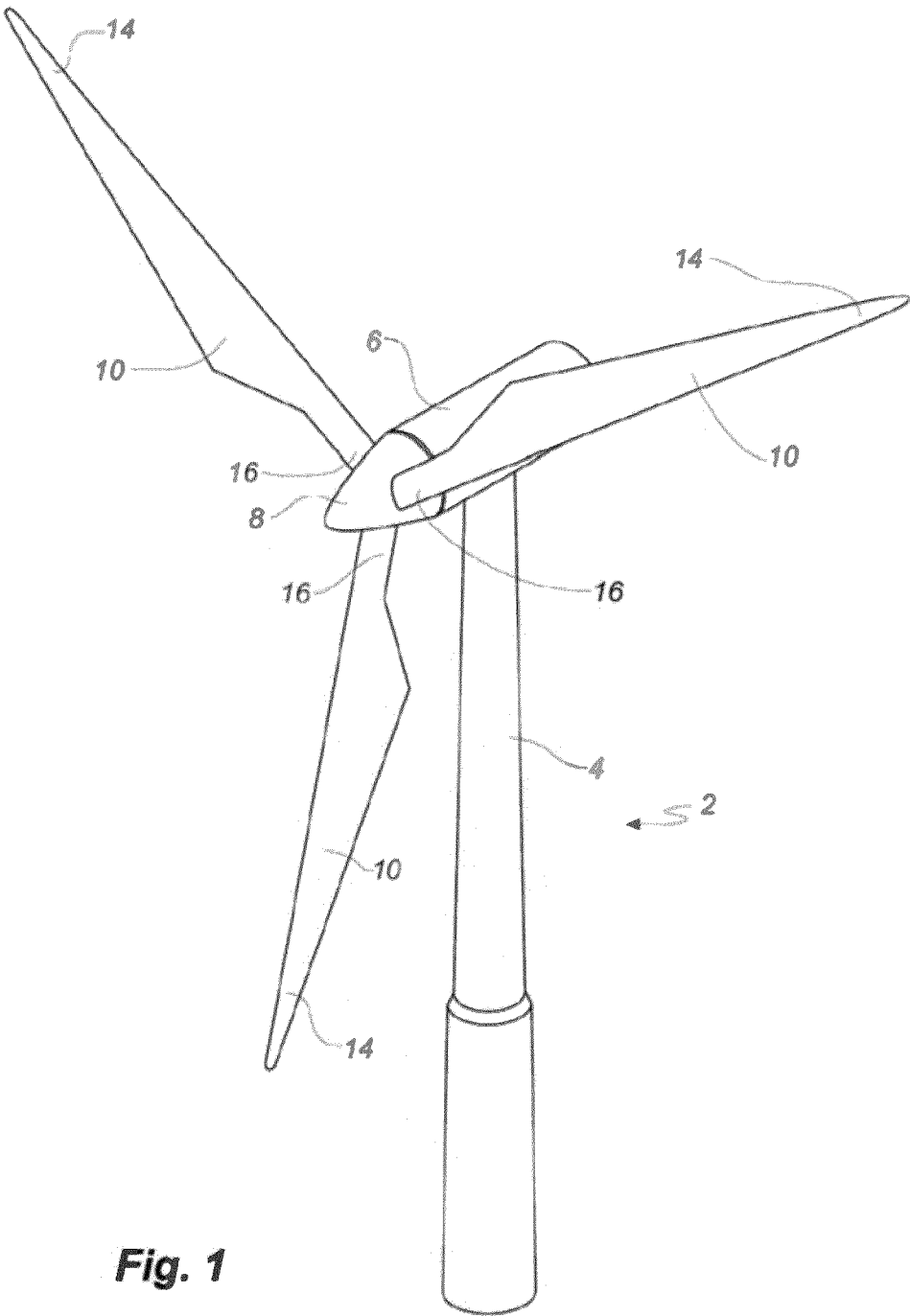


Fig. 1

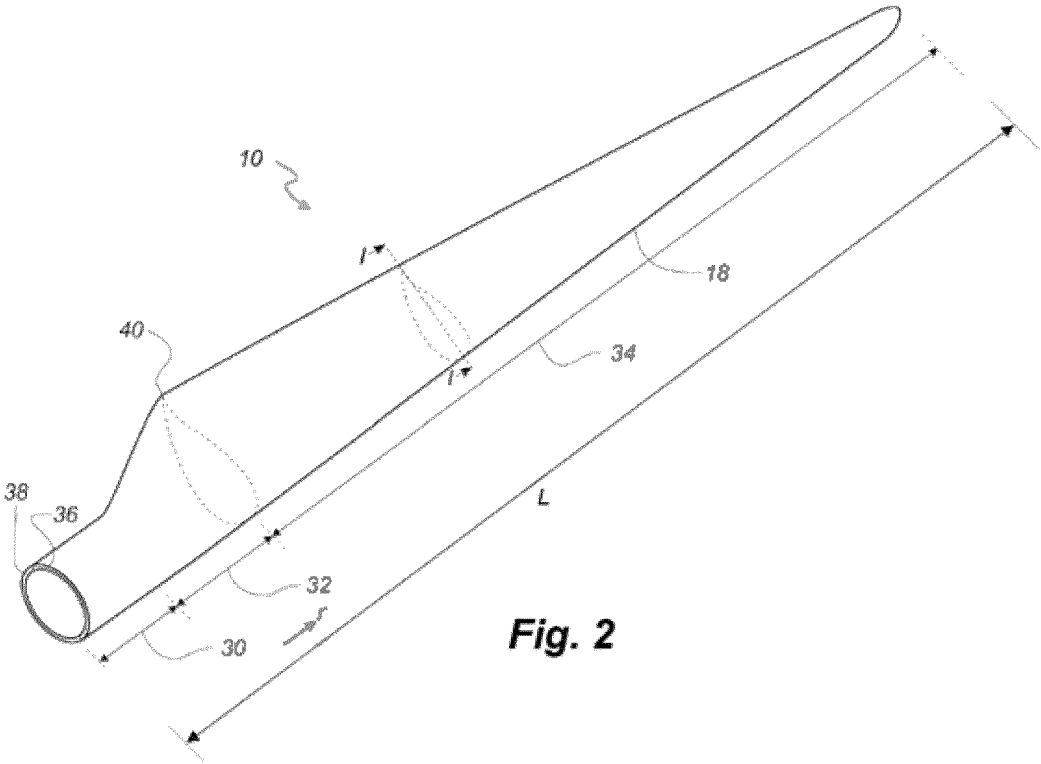


Fig. 2

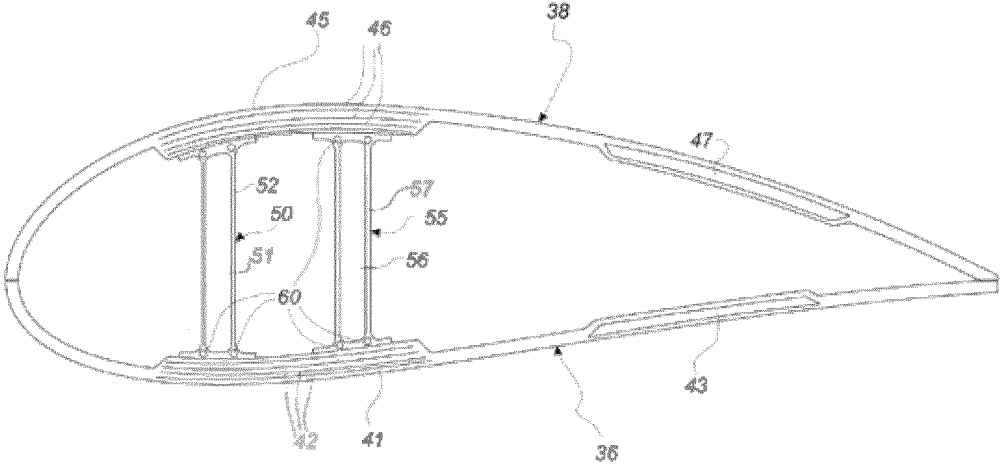
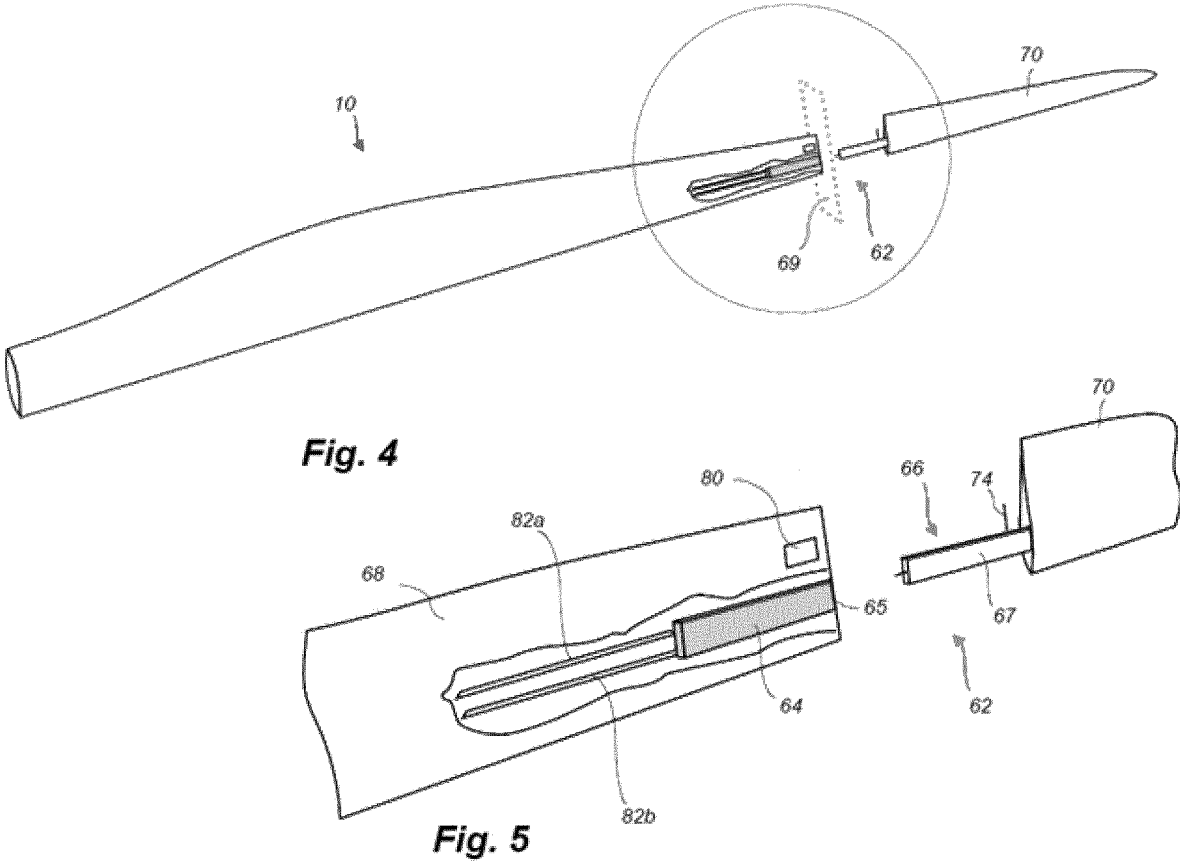


Fig. 3



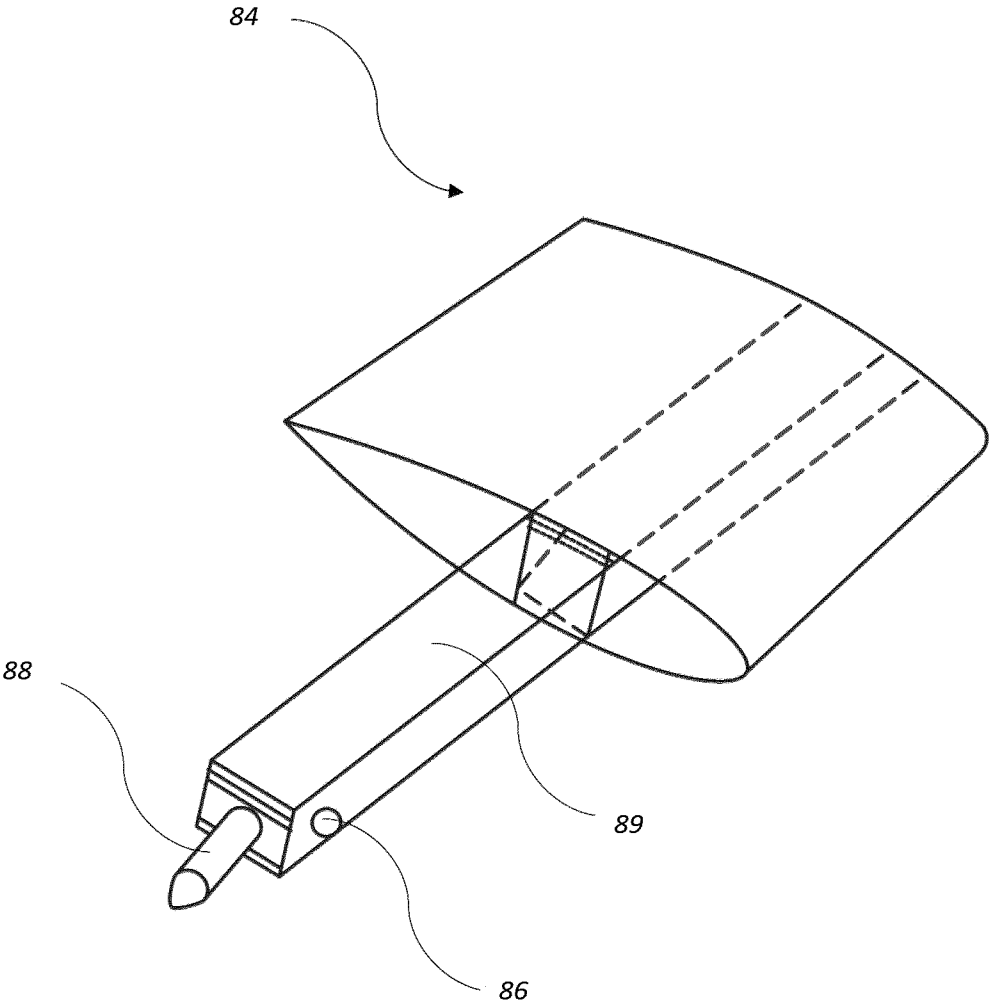


Fig. 6

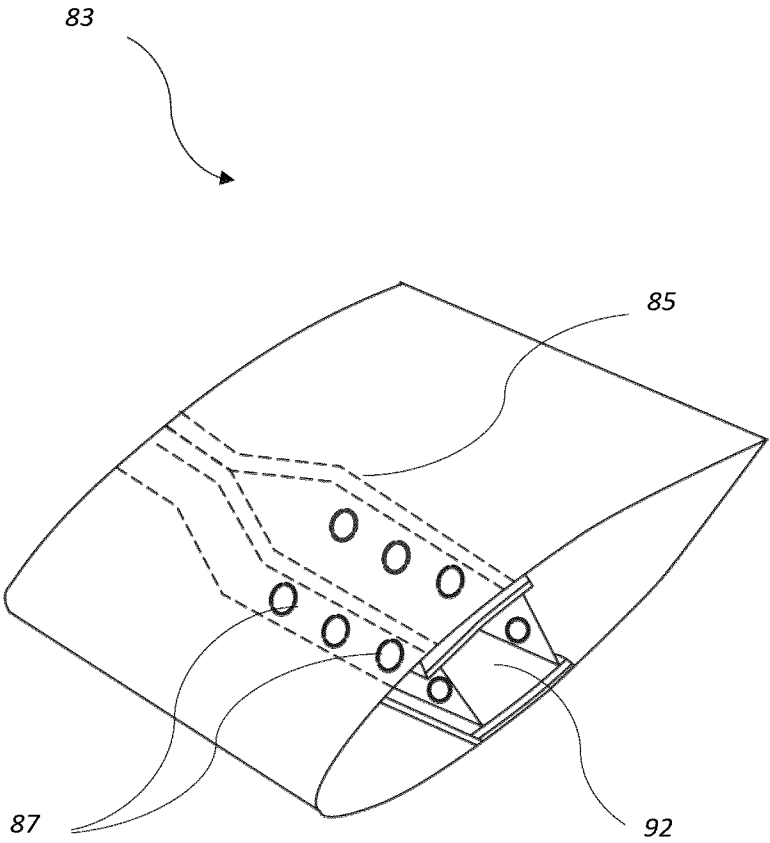


Fig. 7

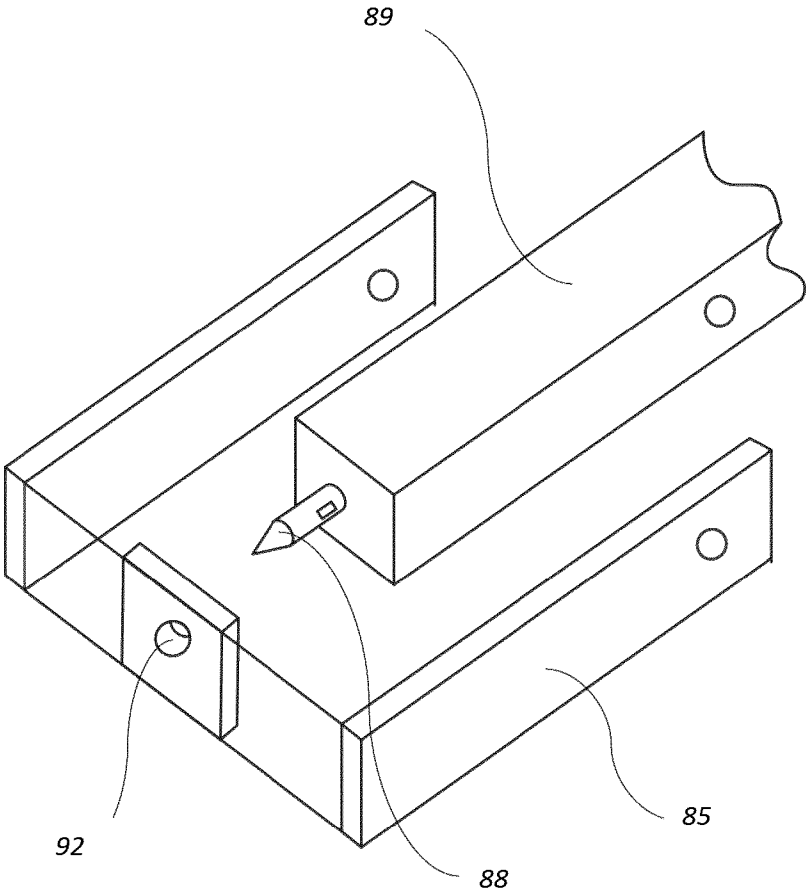


Fig. 8

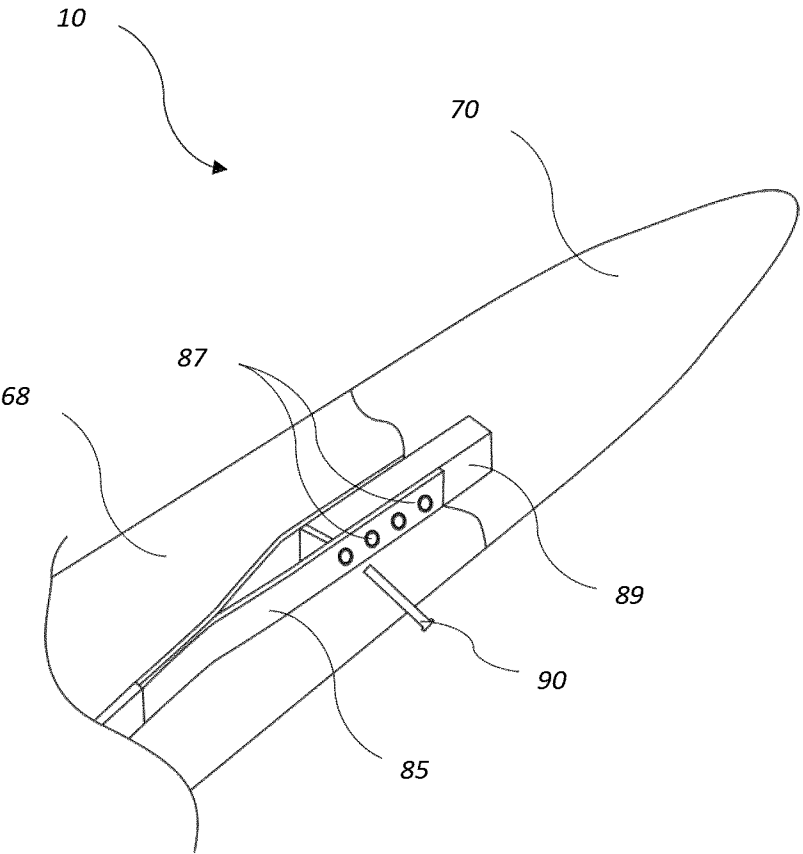


Fig. 9

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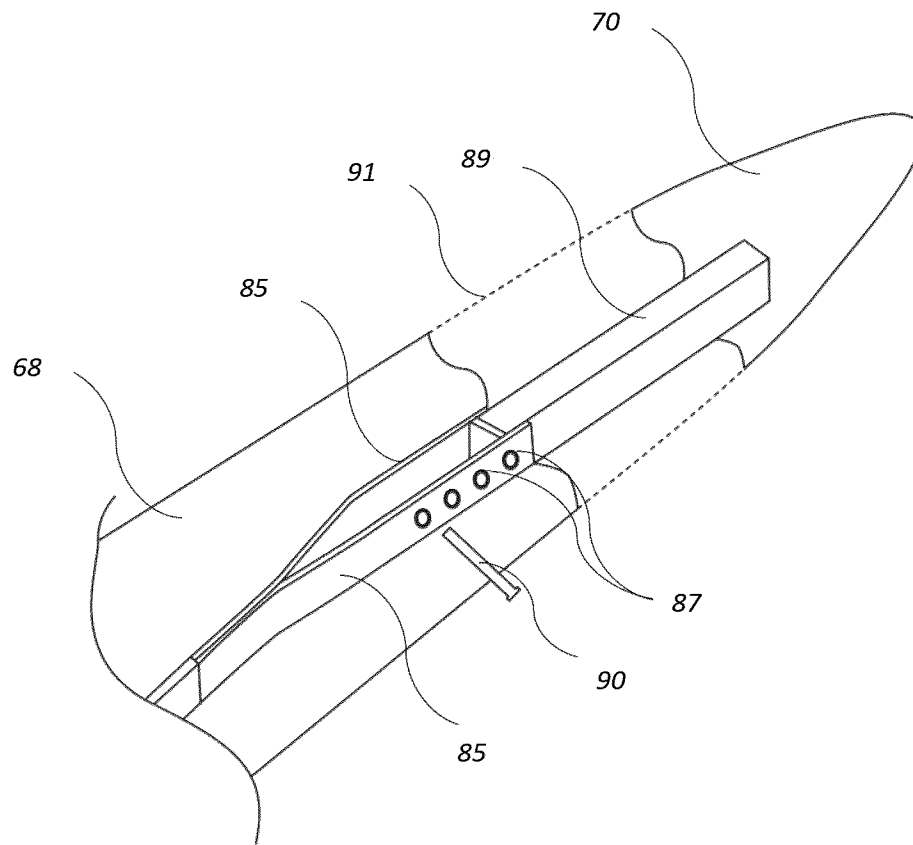


Fig. 10

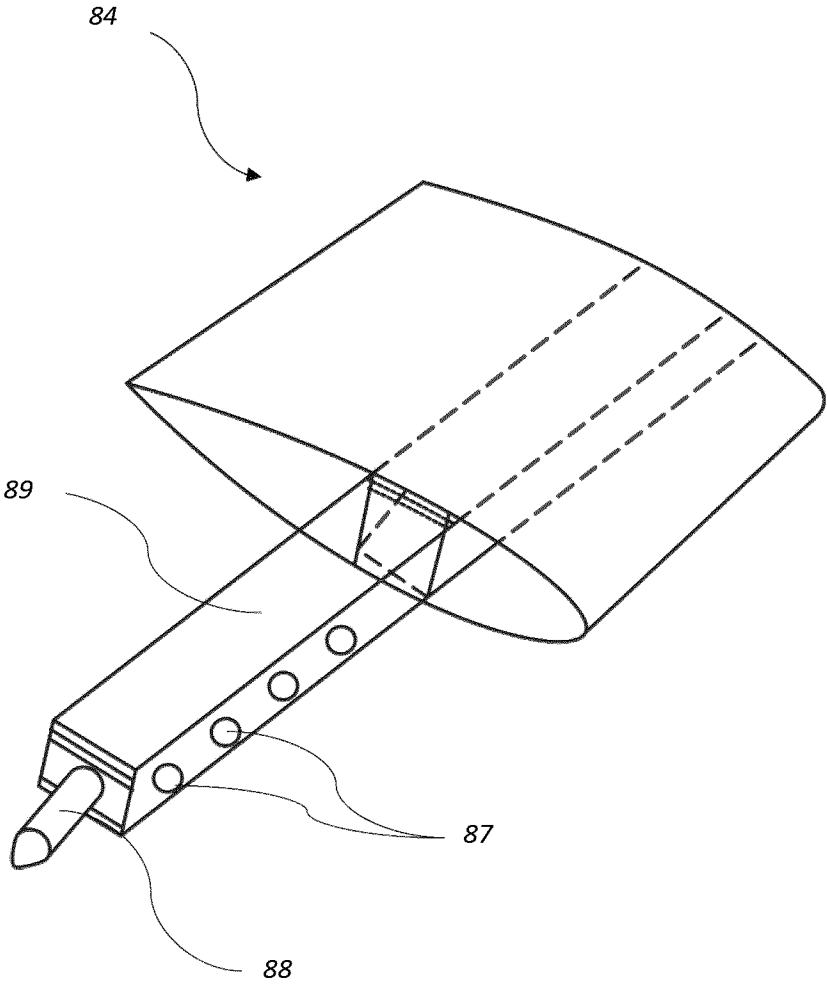


Fig. 11

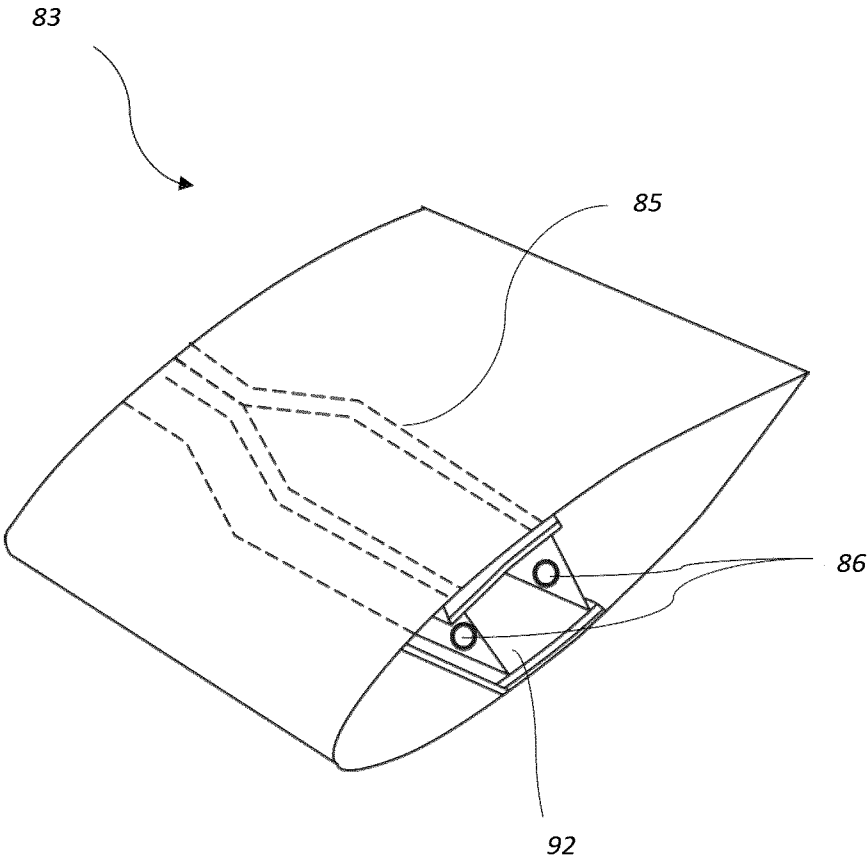


Fig. 12

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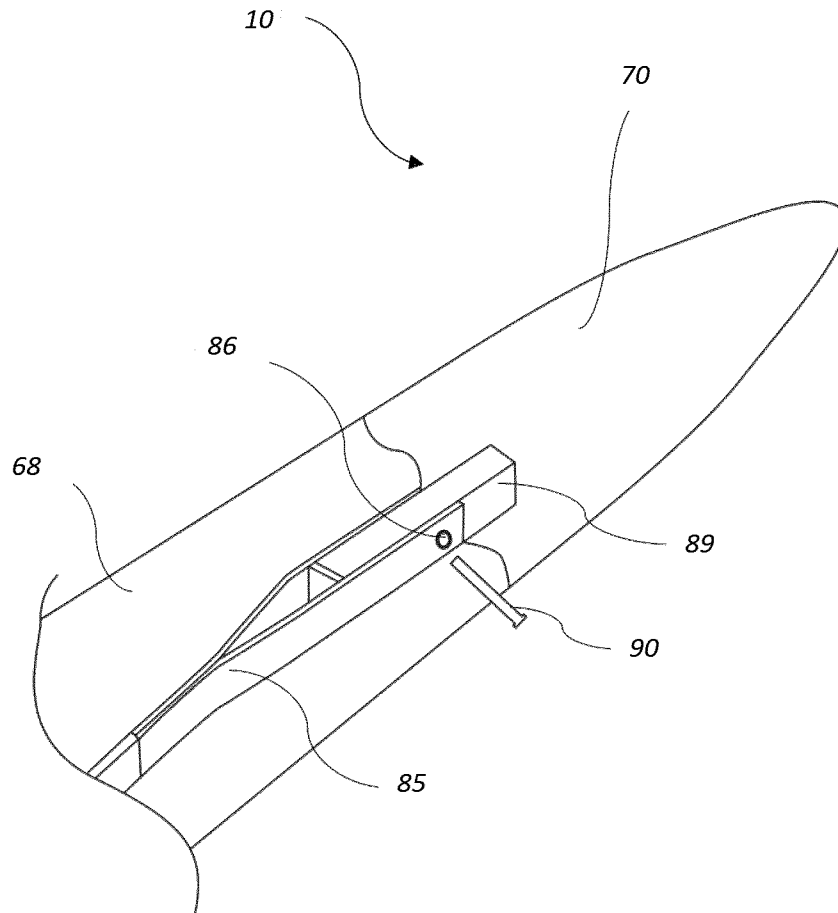


Fig. 13

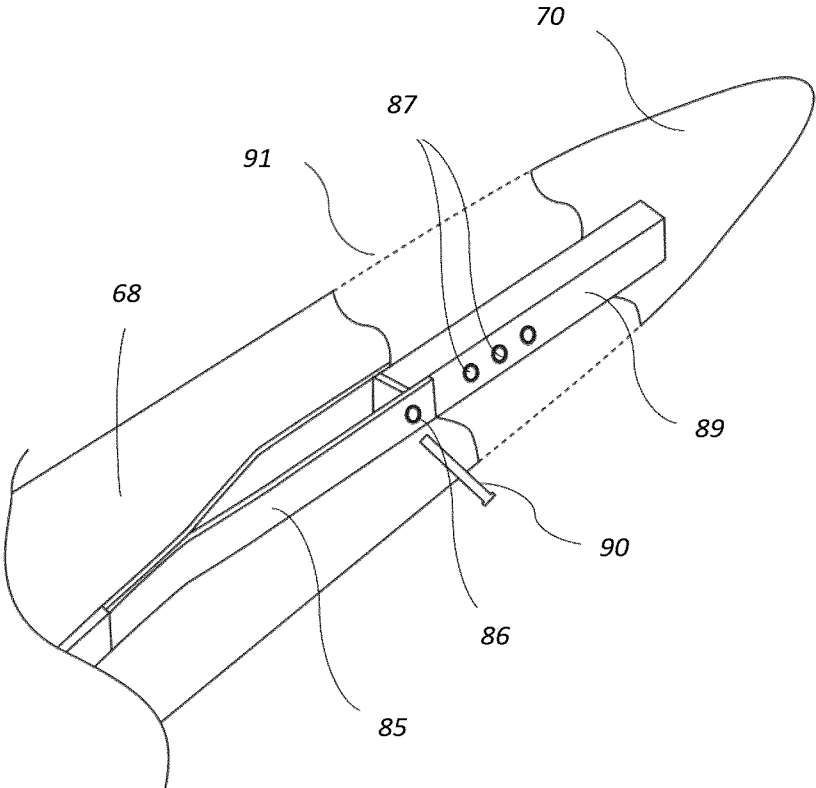
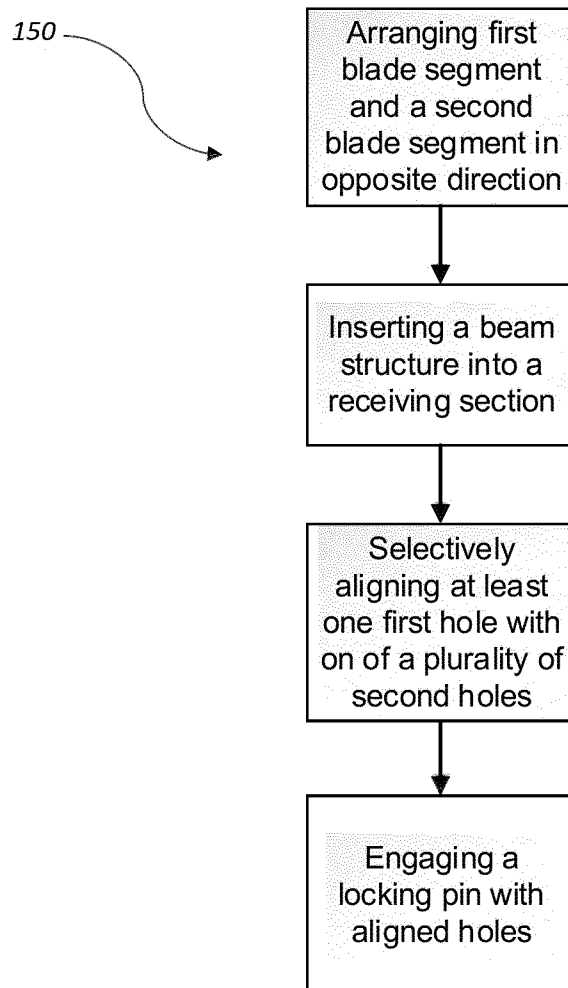


Fig. 14

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**FIG. 15**

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2021/080244

A. CLASSIFICATION OF SUBJECT MATTER INV. F03D1/06 F03D80/00 F03D7/02 ADD.		
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) F03D		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2019/136828 A1 (HANCOCK MARK [GB] ET AL) 9 May 2019 (2019-05-09)	1-7, 11-14
Y	paragraph [0036] - paragraph [0040]; figure 2	9, 10, 15
	paragraph [0038]; figures 5-6	
	paragraph [0042] - paragraph [0043]	

X	CN 203 362 389 U (STATE GRID CORP CHINA; ANYANG POWER SUPPLY CO HENAN) 25 December 2013 (2013-12-25)	1, 3, 12
	paragraph [0012]; figure 1	
	paragraph [0007]	

Y	EP 2 092 191 A2 (CLIPPER WINDPOWER TECHNOLOGY [US]) 26 August 2009 (2009-08-26)	9, 10, 15
	paragraph [0052]; figure 9	

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☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search		Date of mailing of the international search report
24 January 2022		01/02/2022
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Tack, Gaël

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2021/080244

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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International application No

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