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(54) Title: A CONNECTION ASSEMBLY FOR A WIND TURBINE BLADE AND A METHOD OF ASSEMBLY THEREOF

(57) Abstract: The present disclosure relates to a connection assembly (20) for connecting segments of a wind turbine blade (10). The assembly (20) includes a connection segment (6) positioned between two segments of the blade (10). The connection segment (6) includes one or more load carrying members (11) extending in the body (9) along a longitudinal axis of the connection segment. The connection segment (6) is structured to receive and accommodate at least a portion of segments of the blade on either sides. The assembly (20) further includes a securing element (13) structured to lock the connection segment with each of the two segments of the blade. The connection segment (6) is configured to juxtapose with load carrying members (12) in each of the two segments. The securing element (13) is configured to interlock the connection segment with the load carrying member of each of the two segments.

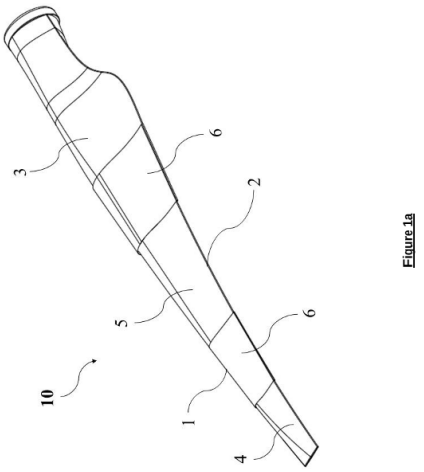

Figure 1a

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FORM 2

THE PATENTS ACT 1970
(39 OF 1970)
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Complete Specification
(See Section 10 and Rule 13)

1. TITLE OF THE INVENTION

A CONNECTION ASSEMBLY FOR A WIND TURBINE BLADE AND A METHOD OF ASSEMBLY THEREOF

2. APPLICANT(S)

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3. PREAMBLE TO THE DESCRIPTION

COMPLETE

The following specification particularly describes the invention and the manner in which it is to be performed.

DESCRIPTION

TECHNICAL FIELD

[001] The present disclosure is related, in general, to the field of wind turbine blades. Particularly, but not exclusively, the present disclosure relates to a connection assembly for connecting segments of a wind turbine blade. More particularly, the present disclosure discloses a connection segment for connecting segments of the wind turbine blade.

BACKGROUND OF THE INVENTION

[002] Wind turbines include blades (also called as rotor blades) for conversion of wind energy into electrical energy. Wind turbines are configured to capture the wind energy in form of rotational energy of blades, which is further utilized to turn a shaft that couples the blades to a gearbox and/or a generator. It is well known in the art that increase in size of the blade increases energy production capacity of the wind turbine. Accordingly, present day wind turbines have blade lengths that are usually in range of 20 meters to 70 meters and may also have a length of up to 80 meters, for rated capacity of up to 8 megawatt (MW). Further, wind turbines with rated capacity of 10 to 15 MW may have blade length spanning in the range of up to 118 meters.

[003] Although increase in size of the blade increases total energy production capacity of the wind turbine, however manufacturing and transportation costs associated therewith also increases. Blades with such a long length are difficult to manufacture and are also difficult to transport to installation site. Manufacturing of such long length blades require custom made moulds and manufacturing equipment's which increases the overall cost of manufacturing the blade. Further, such increase in length of blades also demands redesign and reconfiguration of associated elements of the wind turbine such as, but not limited to, tower, hub, generator, gearbox, nacelle, and the like.

[004] Further, installation sites of wind turbines are often remotely located due to wind flow requirements Wind turbines are generally installed on mountain tops, slopes, elevated regions, hilly areas, and the like, having required wind flow throughout the year. Furthermore, wind turbines are usually installed in rural areas and in remote places to keep the associated land costs at the minimum. Wind turbines are installed away from airports and urban centers to avoid turbulence to aircraft and to comply with safety regulations. Accordingly, installation sites of wind turbines are located away

from highways and main roads and may lack proper road access for transportation requirements. Transportation of long length blades to such installation sites may be difficult and is often expensive.

[005] In addition to the above, transportation of such long length blades, owing to length and weight associated therewith, mandates meticulous route planning, obtaining prior approval and permission from local traffic management authorities, placing required limitations and barriers to prevent unnecessary traffic movement and like. Thus, in view of aforesaid limitations and requirements, transportation of long length wind turbine blades is a risky and expensive activity and may substantially increase costs associated with installation of wind turbines.

[006] In light of the above, it is evident that there exists a need for wind turbine blades that are easier to transport, while being suitable for larger wind turbines. Further, there is need for wind turbine blades that are easier to manufacture, have minimum transportation and installation costs associated therewith, while being appropriate for larger wind turbines. The present disclosure is directed to overcome one or more limitations stated above or any other limitations associated with the prior art.

SUMMARY OF THE INVENTION

[007] The present disclosure overcomes one or more drawbacks of conventional wind turbine blades having long length as described above and provides additional advantages through a connection assembly as claimed in the present disclosure. Additional features and advantages are realized through the techniques of the present disclosure. Other embodiments and aspects of the disclosure are described in detail herein and are considered a part of the claimed disclosure.

[008] In one non-limiting embodiment of the present disclosure, a connection assembly (also referred to as ‘assembly’ hereinafter) for connecting segments of a wind turbine blade (also referred to as ‘blade’ hereinafter). The connection assembly includes a connection segment positioned between two segments of the wind turbine blade. Each of the two segments of the wind turbine blade is defined with a leading edge and a trailing edge. The connection segment is defined by a body formed by a pressure side shell and a suction side shell having a leading edge and a trailing edge. The connection segment further includes one or more load carrying members extending in the body along a longitudinal axis of the connection segment. The connection segment is structured to receive and accommodate at least a portion of segments of the wind turbine blade on either sides. The assembly further includes a securing element structured to lock the connection segment with each of the two

segments of the wind turbine blade. The connection segment is configured to juxtapose with load carrying members in each of the two segments. The securing element is configured to interlock the connection segment with the load carrying member of each of the two segments.

[009] In an embodiment of the present disclosure, the segments of the wind turbine blade and the connection segment are defined with aerofoil profile. The aerofoil profile of the leading edge and the trailing edge of the connection segment complements the aerofoil profile of the segments of the wind turbine blade.

[0010] In an embodiment of the present disclosure, the connection segment forms a flush engagement with each of the two segments.

[0011] In an embodiment of the present disclosure, the one or more load carrying members of the connection segment is configured to juxtapose with load carrying members in each of the two segments of the wind turbine blade. The one or more load carrying members of the connection segment and the load carrying member of each of the two segments are defined with complementing apertures to accommodate the securing element.

[0012] In an embodiment of the present disclosure, the apertures are defined along a lateral axis of the connection segment.

[0013] In an embodiment of the present disclosure, the securing element includes a locking pin and a locking component.

[0014] In another non-limiting embodiment of the present disclosure, a method for connecting segments of a wind turbine blade is disclosed. The method includes positioning a connection segment between two segments of the wind turbine blade. The step of positioning includes aligning a leading edge and a trailing edge of the connection segment with a corresponding leading edge and trailing edge of each of the two segments of the wind turbine blade. The method further includes engaging the connection segment with at least a portion of each of the two segments of the wind turbine blade. The step of engaging includes juxtaposing the connection segment with load carrying members of each of the two segments. The method further includes securing the connection segment to each of the two segments by a securing element. The step of securing includes interlocking the connection segment to the load carrying members of the two segments.

[0015] In an embodiment of the present disclosure, the method includes aligning apertures defined in the one or more load carrying members of the connection segment with corresponding apertures of the load carrying members of each of the two segments, for connecting the connection segment and each of the two segments by the securing element.

[0016] In an embodiment of the present disclosure, the step of positioning includes forming a flush engagement between the connection segment and each of the two segments.

[0017] In yet another non-limiting embodiment of the present disclosure, a wind turbine blade is disclosed. The wind turbine blade includes a root segment, a tip segment, and an intermediate segment, each defined with a leading edge and a trailing edge along longitudinal axis of the wind turbine blade. The wind turbine blade further includes a connection segment configured to connect at least one of the root segment and the tip segment with the intermediate segment. The connection segment is defined by a body formed by a pressure side shell and a suction side shell having a leading edge and a trailing edge. The connection segment further includes one or more load carrying members extending in the body along a longitudinal axis of the connection segment. The connection segment is structured to receive and accommodate at least a portion of segments of the wind turbine blade on either sides. The assembly further includes a securing element structured to lock the connection segment with each of the two segments of the wind turbine blade. The connection segment is configured to juxtapose with load carrying members in each of the two segments. The securing element is configured to interlock the connection segment with the load carrying member of each of the two segments.

[0018] The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects, embodiments, and features described above, further aspects, embodiments, and features will become apparent by reference to the drawings and the following detailed description.

BRIEF DESCRIPTION OF DRAWINGS

[0019] The novel features and characteristics of the disclosure are set forth in the appended description. The disclosure itself, however, as well as a preferred mode of use, further objectives, and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying figures. One or more embodiments are now described, by way of example only, with reference to the accompanying figures wherein like reference numerals represent like elements and in which:

[0020] Figures 1a and 1b illustrate a perspective view and a top view of a wind turbine blade, in accordance with an embodiment of the present disclosure.

[0021] Figure 2a and 2b illustrate a front perspective view and a rear perspective view of a connection assembly, in accordance with an embodiment of the present disclosure.

[0022] Figure 3a and 3b illustrate a sectional view of the connection assembly and an exploded view of the connection assembly, respectively.

[0023] Figure 4a illustrates a perspective view of a connection segment, in accordance with an embodiment of the present disclosure.

[0024] Figures 4b and 4c illustrate sectional views of the connection segment of Figure 4a.

[0025] Figure 4d illustrates a front view of the connection segment of Figure 4a.

[0026] Figure 5 illustrates a flow chart of a method for connecting segments of a wind turbine blade of Figure 1a and 1b, in accordance with an embodiment of the present disclosure.

[0027] The figures depict embodiments of the disclosure for purposes of illustration only. One skilled in the art will readily recognize from the following description that alternative embodiments of the assemblies and methods illustrated herein may be employed without departing from the principles of the disclosure described herein.

DETAILED DESCRIPTION

[0028] While the embodiments in the disclosure are subject to various modifications and alternative forms, specific embodiment thereof has been shown by way of example in the figures and will be described below. It should be understood, however, that it is not intended to limit the disclosure to the particular forms disclosed, but on the contrary, the disclosure is to cover all modifications, equivalents, and alternatives falling within the scope of the disclosure.

[0029] It is to be noted that a person skilled in the art would be motivated from the present disclosure and modify a connection assembly for connecting segments of a wind turbine blade as disclosed herein. However, such modifications should be construed within the scope of the disclosure. Accordingly, the drawings show only those specific details that are pertinent to understand the embodiments of the present disclosure, so as not to obscure the disclosure with details that will be readily apparent to those of ordinary skill in the art having the benefit of the description herein.

[0030] The terms "comprises", "comprising", or any other variations thereof used in the disclosure, are intended to cover a non-exclusive inclusion, such that a system, an assembly, a device, and a method that comprises a list of components does not include only those components but may include other components not expressly listed or inherent to such system, assembly, device, and method. In other words, one or more elements in a system or assembly or device proceeded by "comprises… a" does not, without more constraints, preclude the existence of other elements or additional elements in the system or assembly or device.

[0031] Embodiments of the present disclosure disclose a connection assembly (also referred to as 'assembly' hereinafter) for connecting segments of a wind turbine blade (also referred to as 'blade' hereinafter). The connection assembly includes a connection segment positioned between two segments of the wind turbine blade. Each of the two segments of the wind turbine blade is defined with a leading edge and a trailing edge. The connection segment is defined by a body formed by a pressure side shell and a suction side shell having a leading edge and a trailing edge. Profile and configuration of the leading edge and the trailing edge of the body of the connection segment is complementary with respect to profile and configuration of the leading edge and the trailing edge of the two segments of the blade. The connection segment further includes one or more load carrying members extending in the body along a longitudinal axis of the connection segment. The connection segment is structured to receive and accommodate at least a portion of the two segments of the blade

on either sides. The assembly further includes a securing element structured to lock the connection segment with each of the two segments of the blade. The one or more load carrying members of the connection segment is configured to juxtapose with load carrying members in each of the two segments. The securing element is configured to interlock the one or more load carrying members of the connection segment with the load carrying member of each of the two segments of the blade.

[0032] The following paragraphs describe the present disclosure with reference to Figures 1 - 5. In the figures, the same element or elements which have similar functions are indicated by the same reference signs. It is to be noted that, the wind turbine including a tower, gear train arrangement, generator, hub, nacelle, and plurality of blades is not illustrated in the figures for the purpose of simplicity. One skilled in the art would appreciate that the connection assembly as disclosed in the present disclosure may be used in any wind turbine including blades, where such blades may be of aerofoil profile and configuration. Also, such connection assembly may be employed in connection of blade segments that may be used in other machine/systems, such as, but not limited to, turbines, aircraft wings, helicopter rotor blades and the like.

[0033] The term ‘assembly’ as used herein refers to the connection assembly of the present disclosure and is described in the context of a connection assembly for a wind turbine blade. However, such description may not be viewed as a limitation of the present disclosure and the connection assembly of the present disclosure may be suitably adapted to be implemented in any other rotor blades that are found suitable.

[0034] Figures 1a and 1b illustrate a perspective view and a top view of a wind turbine blade (10) (also referred to as ‘blade’ hereinafter) in accordance with an embodiment of the present disclosure. The blade (10) includes a leading edge (1) and a trailing edge (2). The term ‘leading edge’ as used herein refers to a frontmost edge of aerofoil (i.e., the front edge/nose of the blade) that has maximum curvature. Further, the term ‘trailing edge’ as used herein refers to a rearmost edge of aerofoil (i.e., the rear edge/tail of the blade) having maximum curvature. The blade (10) includes a pressure side shell (7) and a suction side shell (8) (not visible in Figures), extending between the leading edge (1) and the trailing edge (2). The term ‘pressure side shell’ as used herein refers to a concave surface of the blade (10) and pressure is highest on the pressure side shell (7). Further, the term ‘suction side shell’ as used herein refers to a convex surface of the blade (10) and pressure is lowest on the suction side shell (8). The blade (10) may include a root segment (3), a tip segment (4) and an intermediate

segment (5). A connection segment (6) may be positioned in between the root segment (3) and the intermediate segment (5), and another connection segment (6) may be positioned between the tip segment (4) and the intermediate segment (5).

[0035] Figures 2a and 2b illustrate a front perspective view and a rear perspective view of a connection assembly (20) (also referred to as 'assembly' hereinafter) in accordance with an embodiment of the present disclosure. It is to be noted that the assembly (20) illustrated in Figures 2a and 2b only depict a part of the assembly between the root segment (3) and a connection segment (6) (which is positioned adjacent to the intermediate segment (5), not shown in Figures 2a and 2b), for purposes of illustration and description. It is to be understood that although the remaining part of the assembly is not illustrated in Figures 2a and 2b, a same type of connection/assembly exists between the connection segment (6) and the intermediate segment (5) positioned adjacent to the connection segment (6).

[0036] Figure 3a illustrates a sectional view of the assembly (20), when viewed along direction depicted by pointer 'A' (shown in Figure 2b). Further, Figure 3b illustrates an exploded view of the assembly (20) of the present disclosure. The connection assembly (20) of the present disclosure is now described with reference to the aforesaid Figures 1a to 3b. The present disclosure discloses the assembly (20) for connecting segments of the blade (10). The assembly (20) may include one or more connection segments (6) positioned between two segments of the blade (10). The two segments of the blade (10) may include the root segment (3) and the tip segment (4). However, the two segments of the blade (10) may also include the tip segment (4) and the intermediate segment (5). Further, the two segments of the blade (10) may also include the root segment (3) and the intermediate segment (5). Furthermore, the two segments of the blade (10) may also include a pair of intermediate segments (5) of the blade (10). Each of the two segments of the blade (10) is defined with the leading edge (1) and the trailing edge (2). The profile and configuration of the leading edge (1) and the trailing edge (2) of the connection segment (6) is complementary to the profile and configuration of the leading edge (1) and the trailing edge (2) of each of the two segments of the blade. Such complementary configuration of the leading edges (1) and the trailing edges (2) of the connection segment (6) and the adjacent two segments ensures that there is no discontinuity in the aerofoil profile of the blade (10) and the blade (10) structure, in an assembled condition of the blade (10) including the connection segment (6). Such configuration of the connection segment (6) enables the connection segment (6) to

form a flush engagement with each of the two segments (adjacent segments) of the blade (10), in an assembled condition of the blade (10).

[0037] Figure 4a illustrates a perspective view of the connection segment (6) in accordance with an embodiment of the present disclosure. Further, Figures 4b and 4c illustrate sectional views of the connection segment (6), when viewed along directions depicted by pointer 'B' and pointer 'C', respectively (shown in Figure 4a). Figure 4d illustrates a front view of the connection segment (6), when viewed along direction depicted by pointed 'D' (shown in Figure 4a). The connection segment (6) of the present disclosure is described in the following paragraphs with reference to the above-mentioned Figures.

[0038] Referring to Figure 4a, the connection segment (6) is defined with a body (9) formed by the pressure side shell (7) and the suction side shell (8). The pressure side shell (7) and the suction side shell (8) extend between the leading edge (1) and the trailing edge (2) of the connection segment (6). In an embodiment, the segments of the blade (10) and the connection segment (6) are defined with aerofoil profile. The aerofoil profile of the leading edge (1) and the trailing edge (2) of the connection segment (6) complements the aerofoil profile of the segments of the blade (10). Profile and structural configuration of the leading edge (1) and the trailing edge (2) of the body (9) of the connection segment (6) is complementary with respect to profile and configuration of the leading edge (1) and the trailing edge (2) of the two segments of the blade (10). The connection segment (6) may be structured to receive and accommodate at least a portion of the two segments of the blade (10) on either sides.

[0039] In an embodiment, the two segments of the blade (10), that are connected on either sides of the connection segment (6), may be defined with taper such that an end portion of the two segments may be received and accommodated in the connection segment (6). For instance, in an embodiment, the connection segment (6) may be positioned between the root segment (3) and the tip segment (4) of the blade (10). In such embodiment, the connection segment (6) may be configured to receive and accommodate at least a portion of the root segment (3) and the tip segment (4) of the blade (10) on either sides. Further, when the connection segment (6) is positioned between the tip segment (4) and the intermediate segment (5), the connection segment (6) may be configured to receive and accommodate at least a portion of the tip segment (4) and the intermediate segment (5) of the blade (10) on either sides. Likewise, when the connection segment (6) is positioned between the root

segment (3) and the intermediate segment (5), the connection segment (6) may be configured to receive and accommodate at least a portion of the root segment (3) and the intermediate segment (5) of the blade (10) on either sides. Furthermore, when the connection segment (6) is positioned between two the intermediate segments (5) of the blade (10), the connection segment (6) may be configured to receive and accommodate at least a portion of two the intermediate segments (5) of the blade (10) on either sides.

[0040] In an embodiment, both ends of the connection segment (6) may be defined with taper such that an end portion of both ends of the connection segment (6) is received and accommodated in the two segments (i.e., the adjacent segments) positioned on either sides of the connection segment (6). For instance, in an embodiment, the connection segment (6) may be positioned between the root segment (3) and the tip segment (4) of the blade (10). In such embodiment, either ends of the connection segment (6) may be defined with taper such that the at least a portion of the ends of the connection segment (6) is received and accommodated in the two segments (i.e., the adjacent segments) positioned on either sides of the connection segment (6). Further, when the connection segment (6) is positioned between the tip segment (4) and the intermediate segment (5), at least a portion of either ends of the connection segment (6) (defined with taper) is received and accommodated in the tip segment (4) and the intermediate segment (5). Likewise, when the connection segment (6) is positioned between the root segment (3) and the intermediate segment (5), at least a portion of either ends of the connection segment (6) (defined with taper) is received and accommodated in the root segment (3) and the intermediate segment (5). Furthermore, when the connection segment (6) is positioned between two the intermediate segments (5) of the blade (10), at least a portion of either ends of the connection segment (6) (defined with taper) is received and accommodated in the two the intermediate segments (5) of the blade (10).

[0041] Referring to Figure 4a again, the connection segment (6) may further include one or more load carrying members (11). The one or more load carrying members (11) of the connection segment may be configured to juxtapose with load carrying members (12) in each of the two segments (adjacent segments) of the blade (10). The one or more load carrying members (11) of the connection segment (6) may be configured to juxtapose with load carrying members (12) in each of the two segments (adjacent segments) of the blade (10). The load carrying members (11) may extend in the body (9) along a longitudinal axis (X-X) of the connection segment (6). The term ‘load carrying

members' as used herein refers to spars or ribs comprised in the body (9) of the connection segment (6). Structure and configuration of the load carrying members (11) of the connection segment (6) is complementary to structure and configuration of load carrying members (12) of the adjacent segments of the blade (10). The phrase 'load carrying members (12) of the adjacent segments of the blade (10)' as used herein also refers to spars or ribs comprised in the body of the adjacent segments of the blade (10).

[0042] As illustrated in the embodiment depicted in Figure 3b, while the connection segment (6) includes three load carrying members (11), the adjacent segment of the blade (10) (which is the root segment (3) in the depicted embodiment) includes two load carrying members (12). Accordingly, in an assembled connection of the blade (10), the load carrying members (11) of the connection segment (6) juxtapose with the load carrying members (12) of the adjacent segments of the blade (10). In the embodiment, the load carrying members (11) of the connection segment (6) occupy at least a portion of space available in between the load carrying members (12) and the body (9) (i.e., the pressure side shell and the suction side shell of the adjacent segments) of the adjacent segments of the blade (10).

[0043] In another embodiment, while the connection segment (6) may include two load carrying members (11), the adjacent segments of the blade (10) may include three load carrying members (12), whereby resulting in a complementary configuration therebetween. Such complementary configuration of the load carrying members (11) of the connection segment (6) and the load carrying members (12) of the adjacent segments of the blade (10) enables juxtaposing of the load carrying members (11 and 12), while maintaining required structural integrity and unity between the segments of the blade (10).

[0044] The assembly (20) further includes a securing element (13) structured to lock the connection segment (6) with each of the two segments (adjacent segments) of the blade (10). The securing element (13) may be configured to interlock the one or more load carrying members (11) of the connection segment (6) with the load carrying members (12) of each of the two segments (adjacent segments) of the blade (10). Referring to Figures 3b and 4a, the one or more load carrying members (11) of the connection segment (6) and the load carrying members (12) of each of the two segments (adjacent segments) are defined with complementing apertures (14 and 15) to accommodate the securing element (13). Further, as illustrated in Figure 4d, the pressure side shell and/or the suction side shell of the blade (10), that form fairing of the blade (10) are also defined with apertures for

insertion and removal of the securing element (13), during assembly and disassembly of the blade (10). The pressure side shell and/or the suction side shell of the blade (10), that form fairing of the blade (10) may either be defined with apertures (similar to a perforation/hole) and/or a portion of apertures (similar to a semi-circle, as depicted in Figure 4d) for insertion and removal of the securing element (13), during assembly and disassembly of the blade (10).

[0045] In an embodiment, the apertures (14 and 15) may be defined along a lateral axis (Y-Y, shown in Figure 3b) of the connection segment (6) and the adjacent segments of the blade (10). The complementing apertures (14 and 15) are configured to have same alignment, that is, the complementing apertures (14 and 15) lie along a same line that is suitable for accommodating the securing element (13). The securing element (13) may include a locking pin (16) and a locking component (17). In an embodiment, the locking pin (16) may be clevis pin and the locking component (17) may be a cotter pin. The securing element (13) may be any other fastening element that is suitable for coupling of the connection segment (6) and the adjacent segments of the blade (10), by means of inserting through the complementing apertures (14 and 15). Securing the connection segment (6) and the adjacent segments of the blade (10), by the securing element (13) as described above, enables juxtaposition of the one or more load carrying members (11) of the connection segment (6) with the load carrying members (12) of the adjacent segments of the blade (10). Such juxtaposition of the load carrying members (11 and 12) interlock the connection segment (6) with each of the two segments (adjacent segments) of the blade (10).

[0046] Figure 5 is an exemplary embodiment of the present disclosure illustrating a flow chart of a method (200) for connecting segments of a wind turbine blade (10).

[0047] The order in which the method (200) is described is not intended to be construed as a limitation, and any number of the described method blocks may be combined in any order to implement the method (200). Additionally, individual blocks may be deleted from the method (200) without departing from the scope of the subject matter described herein.

[0048] As depicted at block 201, the method (200) includes positioning a connection segment (6) between two segments of the blade (10). The step of positioning includes aligning a leading edge (1) and a trailing edge (2) of the connection segment (6) with a corresponding leading edge (1) and trailing edge (2) of each of the two segments of the blade (10). The step of positioning also includes

forming a flush engagement between the connection segment (6) and each of the two segments (adjacent segments) of the blade (10).

[0049] As depicted at block 202, the method (200) further includes engaging the connection segment (6) with at least a portion of each of the two segments of the blade (10). The step of engaging includes juxtaposing the load carrying members (11) of the connection segment (6) with the load carrying members (12) of each of the two segments (adjacent segments) of the blade (10). The step of engaging also includes aligning apertures (15) defined in the one or more load carrying members (11) of the connection segment (6) with corresponding apertures (14) of the load carrying members (12) of each of the two segments (adjacent segments), for connecting/coupling the connection segment (6) and each of the two segments (adjacent segments) by the securing element (13).

[0050] As depicted at block 203, the method (200) further includes securing the connection segment (6) to each of the two segments (adjacent segments) of the blade (10), by a securing element (13). The step of securing includes interlocking the load carrying members (11) of the connection segment (6) with the load carrying members (12) of each of the two segments (adjacent segments) of the blade (10).

[0051] In an embodiment, the present disclosure provides an assembly (20) and a method (200) for joining segments of the blade (10). The assembly (20) and the method (200) may be employed in manufacturing and assembly of blades (10) that are longer in length, whereby reducing requirement of custom-made moulds and manufacturing equipment's. Further, the assembly (20) and the method (200) of the present disclosure eliminate problems associated with transportation and installation of long length blades, by allowing for manufacturing and transportation of blades (10) in smaller segments and further, allowing onsite assembly and installation of blades (10). The assembly (20) and the method (200) of the present disclosure reduces costs and risks associated with transportation and installation of long length blades in remote locations.

[0052] It is to be understood that a person of ordinary skill in the art may develop a powertrain of similar configuration without deviating from the scope of the present disclosure. Such modifications and variations may be made without departing from the scope of the present invention. Therefore, it is intended that the present disclosure covers such modifications and variations provided they come within the ambit of the appended claims and their equivalents.

EQUIVALENTS

[0053] With respect to the use of substantially any plural and/or singular terms herein, those having skill in the art can translate from the plural to the singular and/or from the singular to the plural as is appropriate to the context and/or application. The various singular/plural permutations may be expressly set forth herein for sake of clarity.

[0054] It will be understood by those within the art that, in general, terms used herein, and especially in the appended claims (e.g., bodies of the appended claims) are generally intended as "open" terms (e.g., the term "including" should be interpreted as "including but not limited to," the term "having" should be interpreted as "having at least," the term "includes" should be interpreted as "includes but is not limited to," etc.). It will be further understood by those within the art that if a specific number of an introduced claim recitation is intended, such an intent will be explicitly recited in the claim, and in the absence of such recitation no such intent is present. For example, as an aid to understanding, the following appended claims may contain usage of the introductory phrases "at least one" and "one or more" to introduce claim recitations. However, the use of such phrases should not be construed to imply that the introduction of a claim recitation by the indefinite articles "a" or "an" limits any particular claim containing such introduced claim recitation to inventions containing only one such recitation, even when the same claim includes the introductory phrases "one or more" or "at least one" and indefinite articles such as "a" or "an" (e.g., "a" and/or "an" should typically be interpreted to mean "at least one" or "one or more"); the same holds true for the use of definite articles used to introduce claim recitations. In addition, even if a specific number of an introduced claim recitation *is* explicitly recited, those skilled in the art will recognize that such recitation should typically be interpreted to mean *at least* the recited number (e.g., the bare recitation of "two recitations," without other modifiers, typically means *at least* two recitations, or *two or more* recitations). Furthermore, in those instances where a convention analogous to "at least one of A, B, and C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system (100) having at least one of A, B, and C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). In those instances where a convention analogous to "at least one of A, B, or C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system (100) having at least one of A, B, or C"

would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). It will be further understood by those within the art that virtually any disjunctive word and/or phrase presenting two or more alternative terms, whether in the description, claims, or drawings, should be understood to contemplate the possibilities of including one of the terms, either of the terms, or both terms. For example, the phrase "A or B" will be understood to include the possibilities of "A" or "B" or "A and B."

[0055] In addition, where features or aspects of the disclosure are described in terms of Markush groups, those skilled in the art will recognize that the disclosure is also thereby described in terms of any individual member or subgroup of members of the Markush group.

[0056] While various aspects and embodiments have been disclosed herein, other aspects and embodiments will be apparent to those skilled in the art. The various aspects and embodiments disclosed herein are for purposes of illustration and are not intended to be limiting, with the true scope and spirit being indicated by the following claims.

We Claim:

1. A connection assembly (20) for connecting segments of a wind turbine blade (10), the connection assembly (20) comprising:

a connection segment (6) positioned between two segments of the wind turbine blade (10) each defined with a leading edge (1) and a trailing edge (2), the connection segment (6) is defined by:

a body (9) formed by a pressure side shell (7) and a suction side shell (8) having a leading edge (1) and a trailing edge (2); and

one or more load carrying members (11) extending in the body (9) along a longitudinal axis of the connection segment (6);

wherein the connection segment (6) is structured to receive and accommodate at least a portion of segments of the wind turbine blade (10) on either sides; and

a securing element (13) structured to lock the connection segment (6) with each of the two segments of the wind turbine blade (10);

wherein, the connection segment (6) is configured to juxtapose with load carrying members (12) in each of the two segments, and wherein the securing element (13) is configured to interlock the connection segment (6) with the load carrying member (12) of each of the two segments.

2. The connection assembly as claimed in claim 1, wherein segments of the wind turbine blade (10) and the connection segment (6) are defined with aerofoil profile and wherein the aerofoil profile of the leading edge (1) and the trailing edge (2) of the connection segment (6) complements the aerofoil profile of the segments of the wind turbine blade (10).

3. The connection assembly (20) as claimed in claim 1, wherein the connection segment (6) forms a flush engagement with each of the two segments.

4. The connection assembly (20) as claimed in claim 1, wherein the one or more load carrying members (11) of the connection segment (6) is configured to juxtapose with load carrying members (12) in each of the two segments of the wind turbine blade (10), and wherein the one or more load carrying members (11) of the connection segment (6) and the load carrying

member (12) of each of the two segments are defined with complementing apertures (14) to accommodate the securing element (13).

5. The connection assembly (20) as claimed in claim 4, wherein the apertures (15) are defined along a lateral axis of the connection segment (6).

6. The connection assembly (20) as claimed in claim 1, wherein the securing element (13) includes a locking pin (16) and a locking component (17).

7. A method (200) for connecting segments of a wind turbine blade (10), the method (200) comprising:

positioning, a connection segment (6) between two segments of the wind turbine blade (10), wherein positioning includes aligning a leading edge (1) and a trailing edge (2) of the connection segment (6) with a corresponding leading edge (1) and trailing edge (2) of each of the two segments of the wind turbine blade (10);

engaging, the connection segment (6) with at least a portion of each of the two segments of the wind turbine blade (10), wherein engaging includes juxtaposing the connection segment (6) with load carrying members (12) of each of the two segments; and

securing, the connection segment (6) to each of the two segments by a securing element (13), wherein securing includes interlocking the connection segment (6) to the load carrying members (12) of the two segments.

8. The method (200) as claimed in claim 7, comprises aligning apertures (15) defined in the one or more load carrying members (11) of the connection segment (6) with corresponding apertures (14) of the load carrying members (12) of each of the two segments, for connecting the connection segment (6) and each of the two segments by the securing element (13).

9. The method (200) as claimed in claim 7, wherein positioning includes forming a flush engagement between the connection segment (6) and each of the two segments.

10. A wind turbine blade (10), comprising:

a root segment (3), a tip segment (4), and an intermediate segment (5), each defined with a leading edge (1) and a trailing edge (2) along longitudinal axis of the wind turbine blade (10);

a connection segment (6) configured to connect at least one of the root segment (3) and the tip segment (4) with the intermediate segment (5), the connection segment (6) is defined by:

a body (9) formed by a pressure side shell (7) and a suction side shell (8) having a leading edge (1) and a trailing edge (2); and

one or more load carrying members (11) extending in the body (9) along a longitudinal axis of the connection segment (6);

wherein the connection segment (6) is structured to receive and accommodate at least a portion of at least one of the root segment (3), the tip segment (4), and the intermediate segment (5); and

a securing element (13) structured to lock the connection segment (6) with at least one of the root segment (3), the tip segment (4), and the intermediate segment (5);

wherein, the one or more load carrying members (11) of the connection segment (6) is configured to juxtapose with load carrying members (12) in at least one of the root segment (3), the tip segment (4), and the intermediate segment (5), and wherein the securing element (13) is configured to interlock the one or more load carrying members (11) of the connection segment (6) with the load carrying member (12) of at least one of the root segment (3), the tip segment (4), and the intermediate segment (5).

Dated this 11th Day of March 2022

Robin Koshy Varghese (INPA No: 3705)
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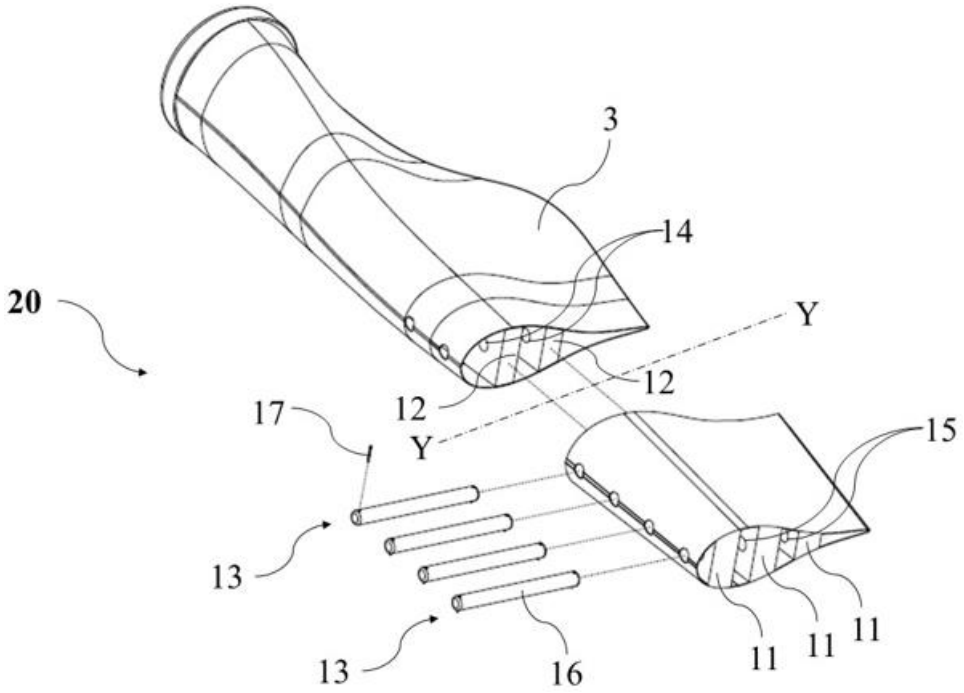
ABSTRACT

A CONNECTION ASSEMBLY FOR A WIND TURBINE BLADE AND A METHOD OF ASSEMBLY THEREOF

The present disclosure relates to a connection assembly (20) for connecting segments of a wind turbine blade (10). The assembly (20) includes a connection segment (6) positioned between two segments of the blade (10). The connection segment (6) includes one or more load carrying members (11) extending in the body (9) along a longitudinal axis of the connection segment. The connection segment (6) is structured to receive and accommodate at least a portion of segments of the blade on either sides. The assembly (20) further includes a securing element (13) structured to lock the connection segment with each of the two segments of the blade. The connection segment (6) is configured to juxtapose with load carrying members (12) in each of the two segments. The securing element (13) is configured to interlock the connection segment with the load carrying member of each of the two segments.



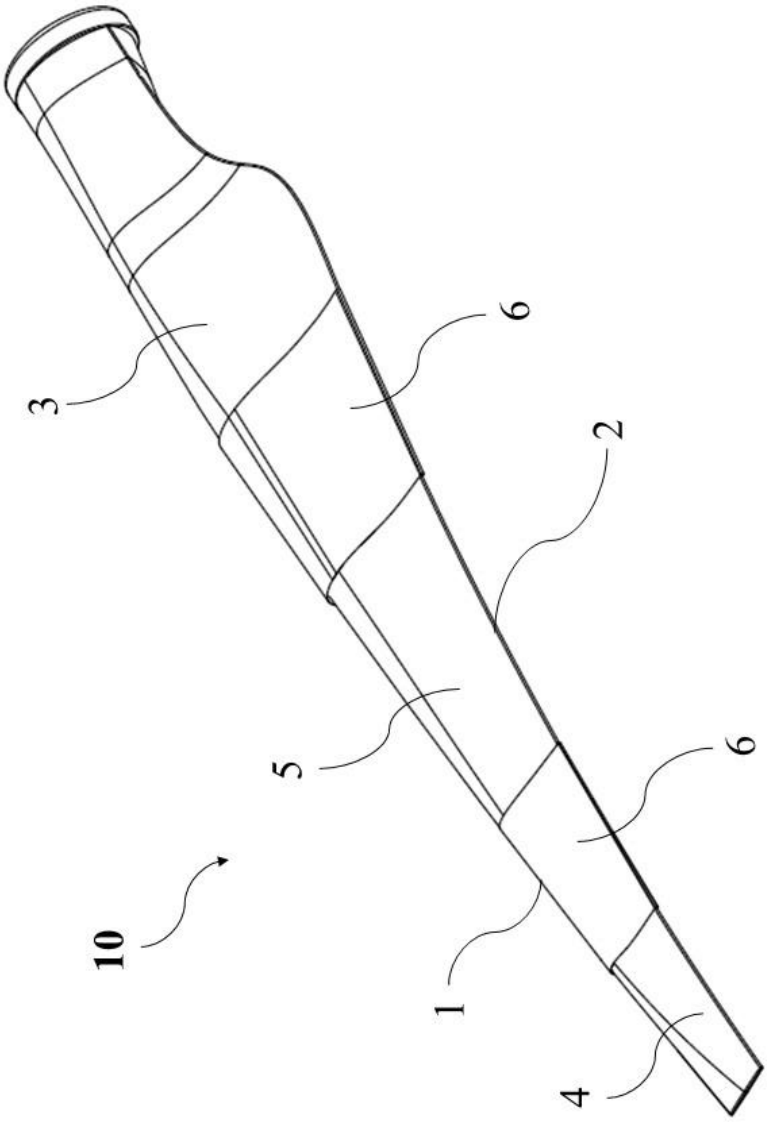


Figure 1a

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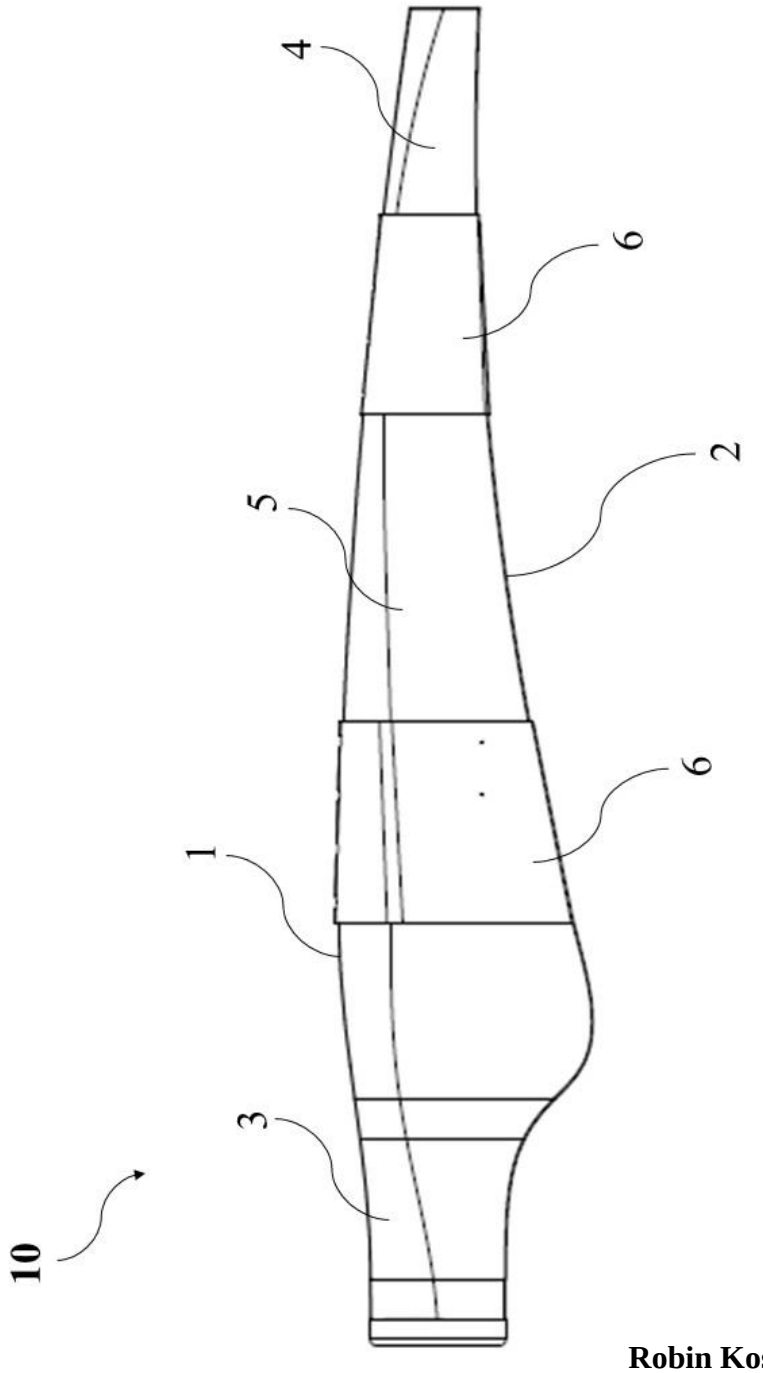

Figure 1b

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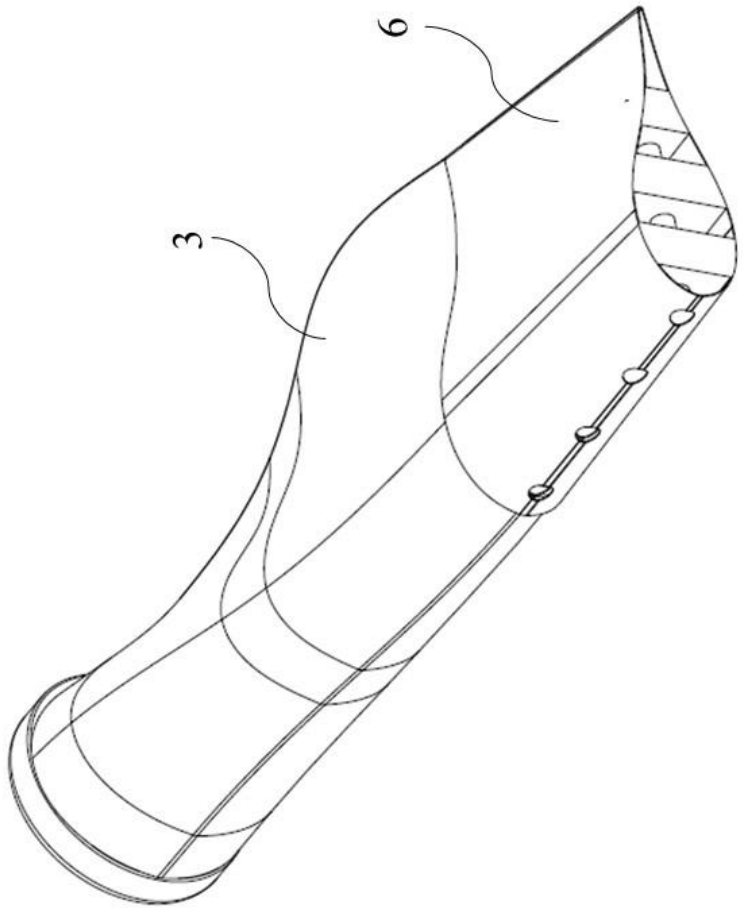

Figure 2a

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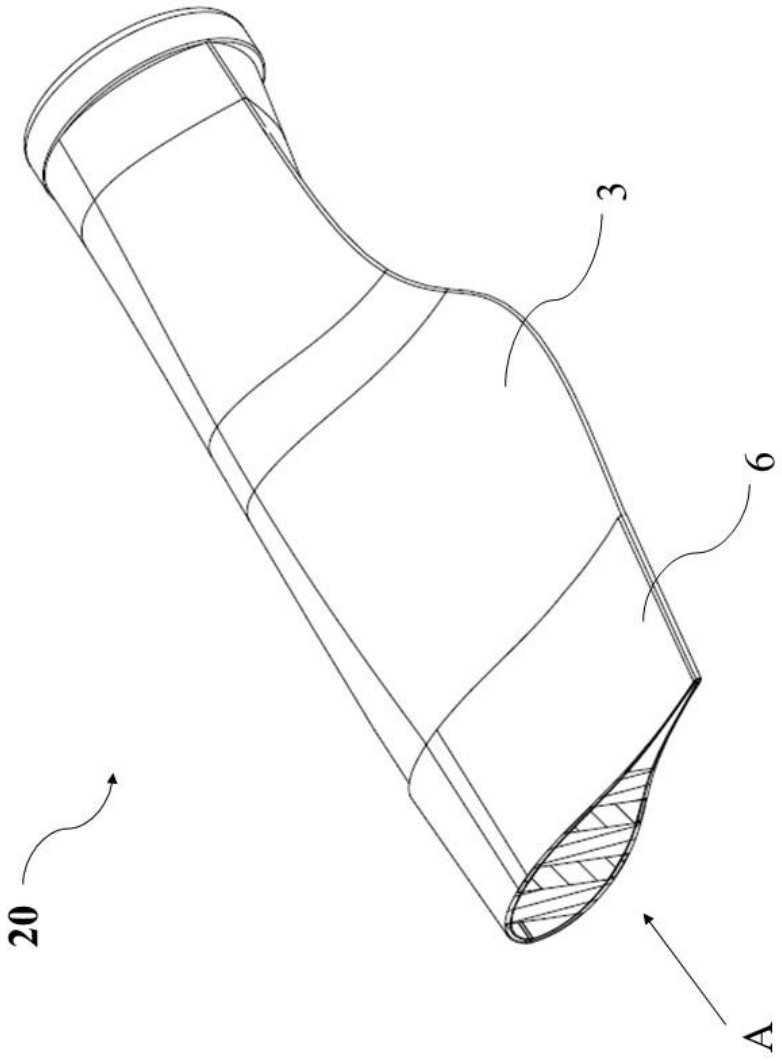

Figure 2b

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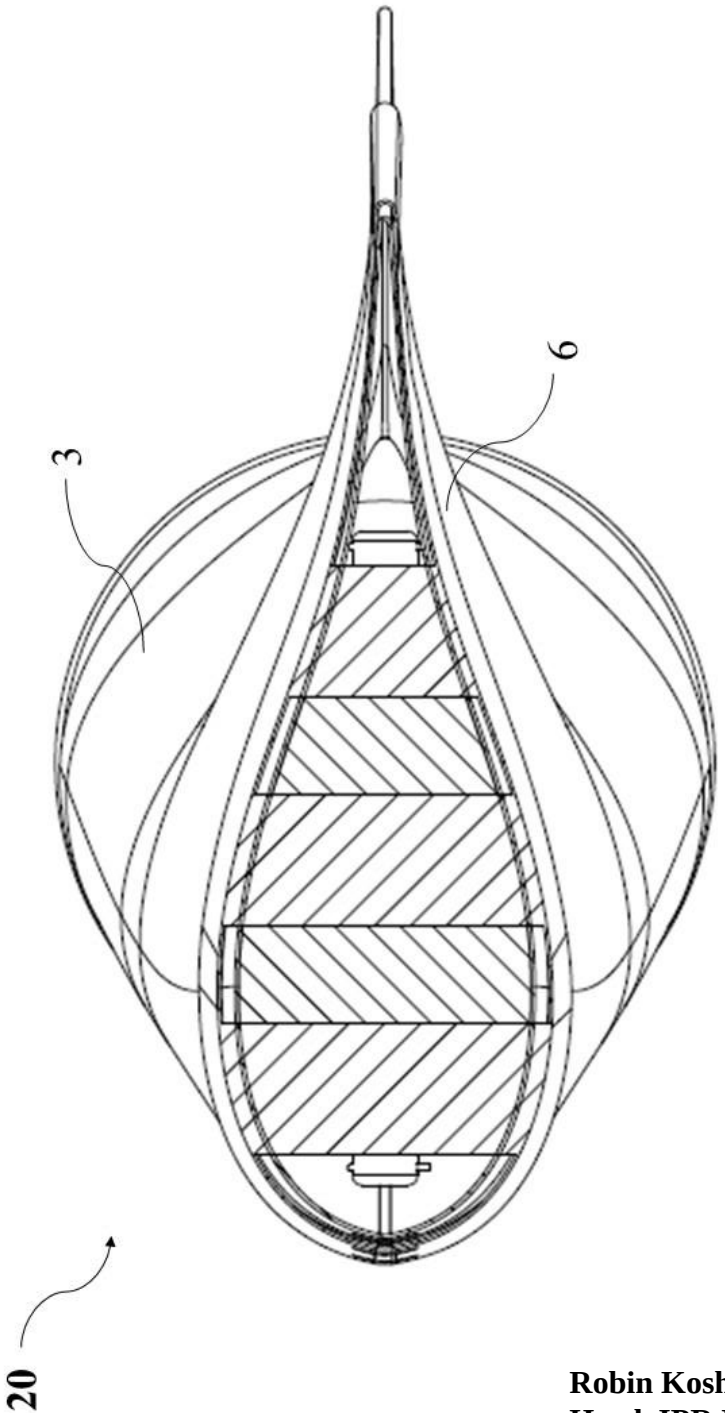

Figure 3a

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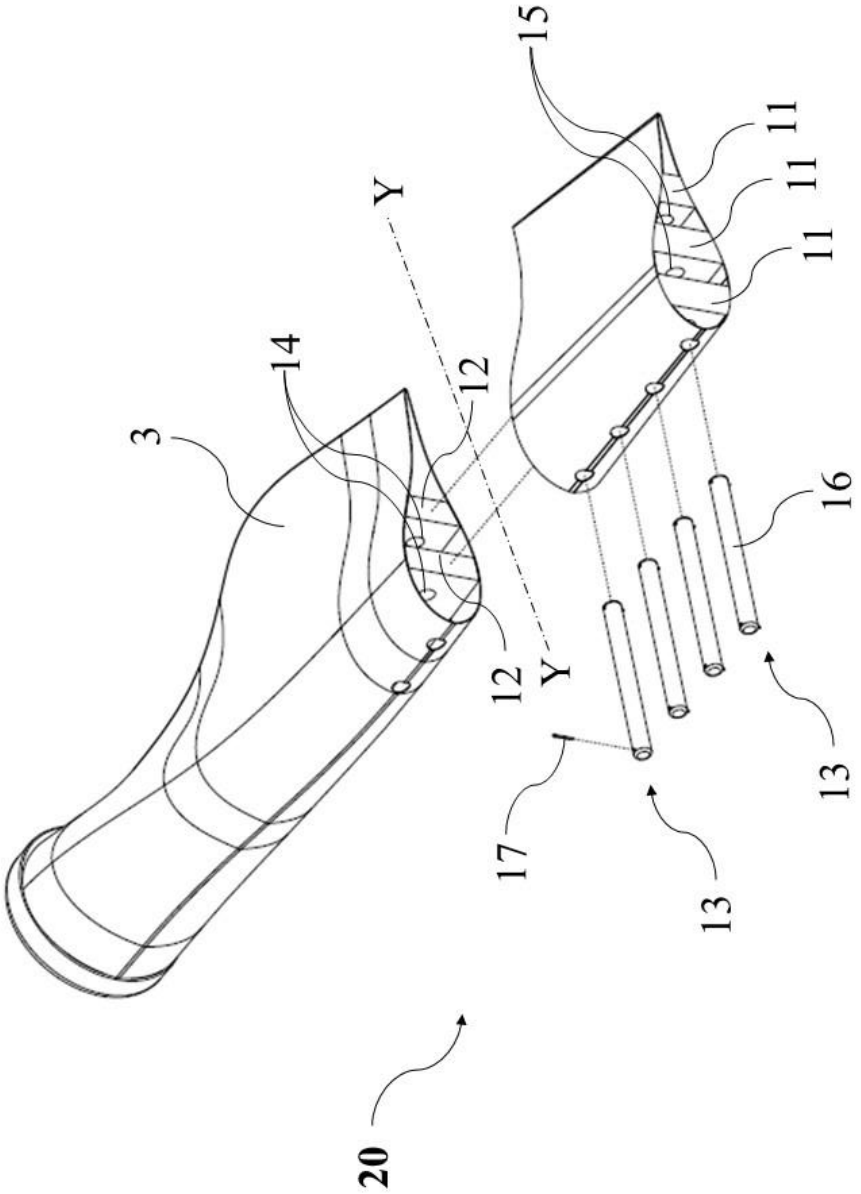

Figure 3b

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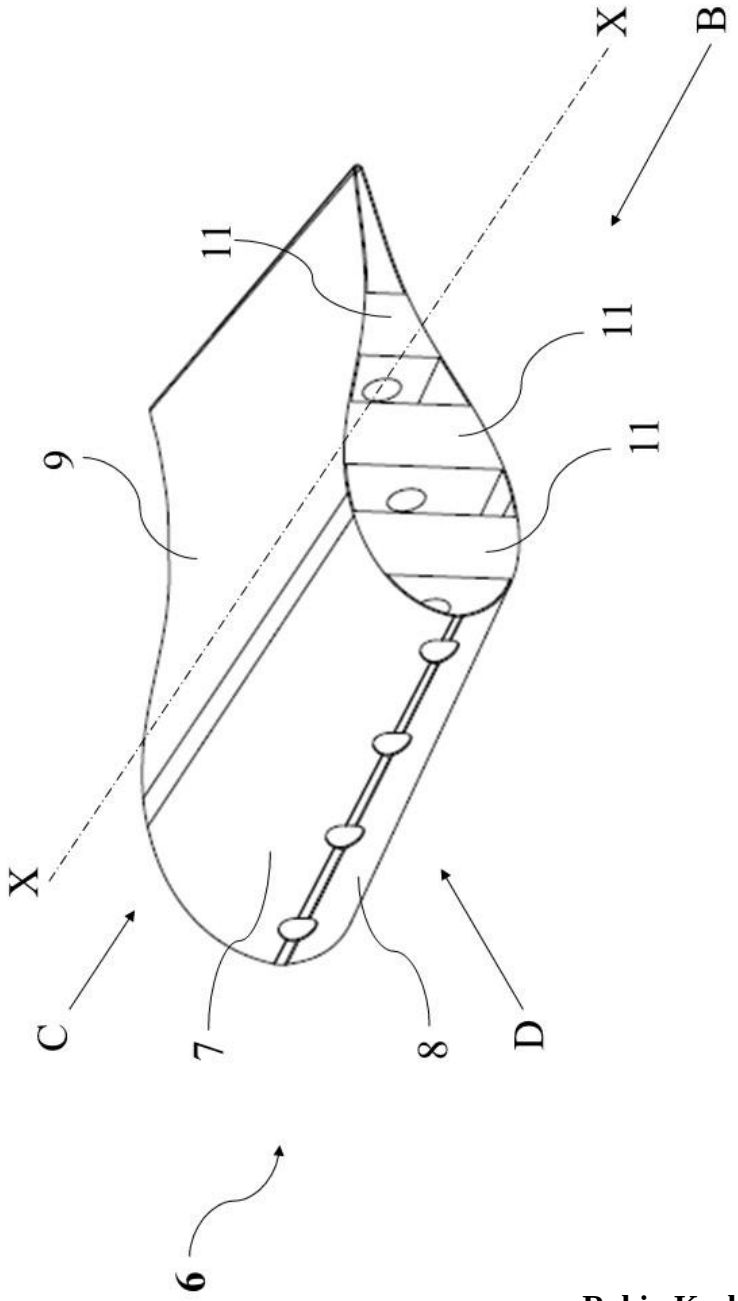

Figure 4a

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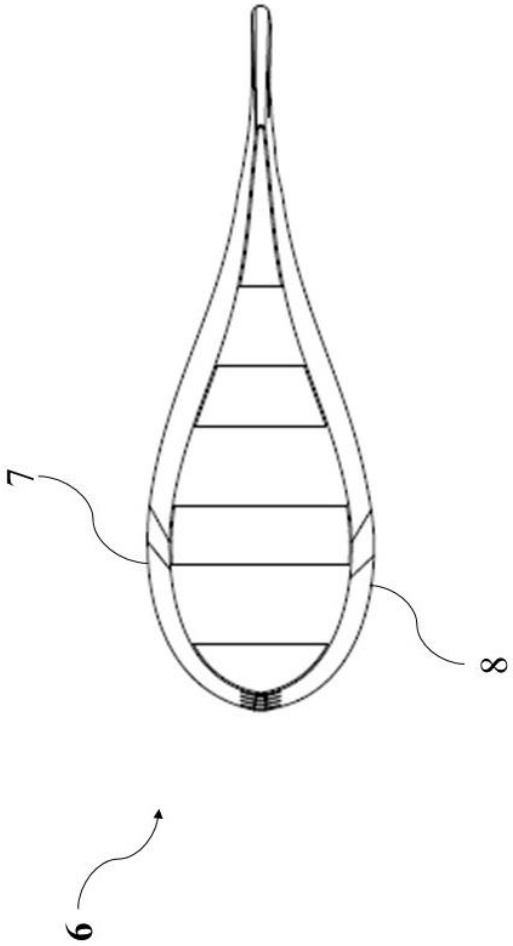

Figure 4b

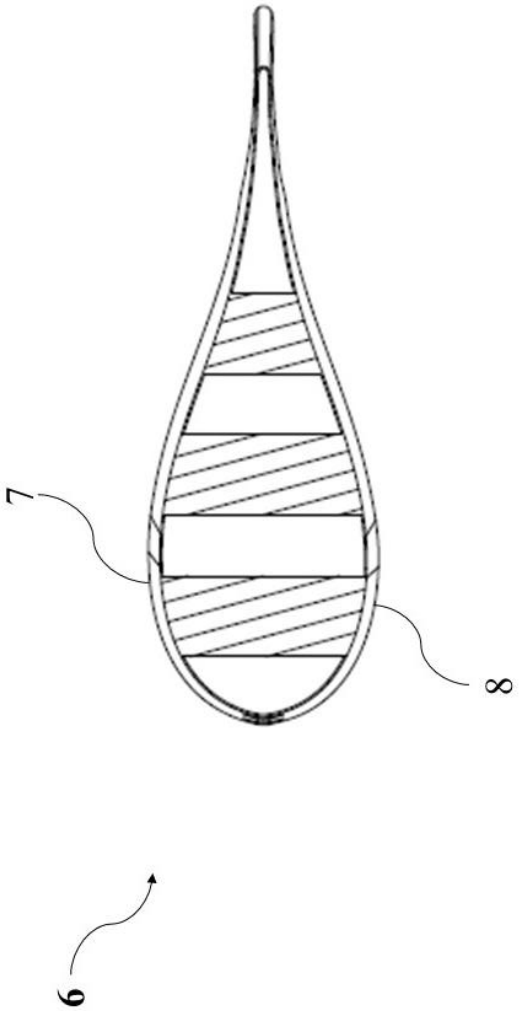

Figure 4c

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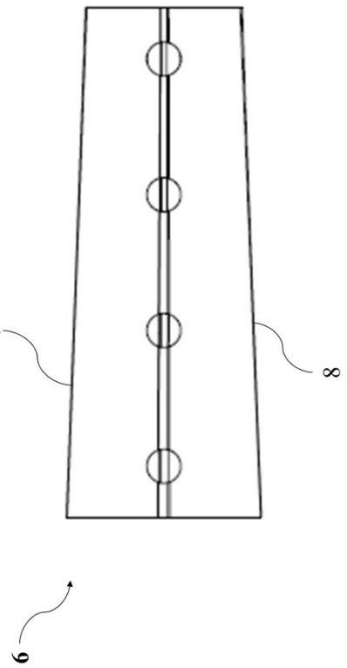

Figure 4d

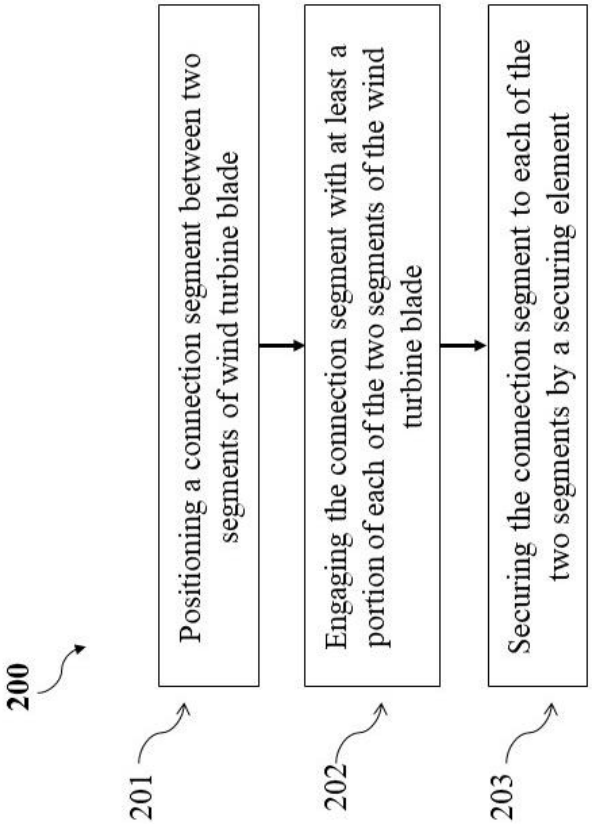

Figure 5

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