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(54) Title: **BLADE HUB ADAPTOR**

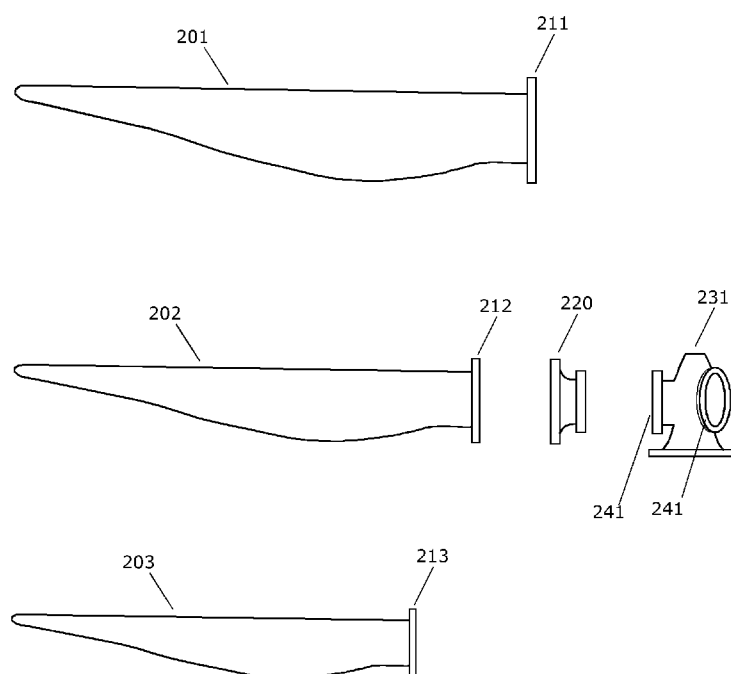


FIG.2

(57) Abstract: The invention relates to wind turbine generators and to methods for enabling fixation of different blade types to the hub of a wind turbine generator. Since different blade types normally does not have identically designed fastening means for connecting to the hub it becomes impossible to connect different types of blades to a given hub. The methods are based on hub adaptors which enables connection of different blade types. One hub adaptor comprises at least three differently designed fastening means so that at least two different blades can be connected to a hub or so that the hub adapter matches at least two hub types each configured with different fastening means.



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BLADE HUB ADAPTOR

FIELD OF THE INVENTION

The invention relates to wind turbine generators and in particular to connection of
5 a wind turbine blade to a wind turbine hub.

BACKGROUND OF THE INVENTION

A wind turbine generator for producing electricity from wind comprises wind
turbine blades which are connected to a wind turbine hub. The blades are
10 connectable to the hub via fastening means such as bolts. Normally the blade and
the hub are configured so that a specific blade type matches a specific hub type.

It may be a problem that only one blade type matches a given hub so that only
one blade type may be used with a specific wind turbine generator. Accordingly, it
15 is desirable to improve the flexibility of component configurations of wind turbine
generators by enabling connection of more than one blade type to a particular
hub.

WO 03060319 relates to wind energy plants, comprising a tower, a pod on top of
20 the tower and a rotor arranged on the pod with a rotor hub, at least one rotor
blade and a spacer between the rotor hub and the rotor blade. The spacer is fixed
to the rotor hub by means of a first flange and comprises a second flange for
fixing the rotor blade thereto. According to the invention, a collision between the
rotor blade and the tower of the wind energy plant as a result of the wind load
25 may be avoided whereby the planes of the flange include a given acute angle and
the spacer is mounted on the rotor hub such that said acute angle opens away
from the tower.

Whereas WO 03060319 discloses a spacer to modify the properties of the blade,
30 the spacer does not enable more than one blade type to be connected to the rotor
hub.

SUMMARY OF THE INVENTION

In general, the invention preferably seeks to alleviate or eliminate one or more of
35 the above mentioned limitations with respect to enabling different component

configurations, in particular different blade-hub configurations of wind turbine generators. In particular, it may be seen as an object of the present invention to provide a modular hub system which enables connection of different blade types to a particular hub or different hub types of wind turbine generators.

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To better address one or more of these concerns, in a first aspect of the invention a wind turbine adaptor for connecting a wind turbine blade to a wind turbine hub is presented. The adaptor comprises:

- first and second mounting faces,
- 10 - first and second fastening means for connecting the first and second mounting faces with the blade and the hub, respectively,
- a third fastening means having a configuration different from the first and second fastening means for connecting,
 - the first mounting face with an alternative blade not connectable with the
 - 15 first fastening means, or
 - the second mounting face with an alternative hub not connectable with the second fastening means.

The third fastening means may enable connection, either of an alternative blade
20 to a given hub or connection to an alternative hub. Thus in the first case, at least two different blade types may be connected to a particular hub. In the second case a particular blade type may be connected to at least two different hub types via the second and third fastening means, thereby enabling connection of a blade type to one or both of the at least two different hub types, which blade type would
25 not otherwise be connectable to the one or both different hub types. Thus, the adaptor may advantageously improve the possibility of combining different blade types with a given hub and thereby a given nacelle or a given wind turbine type. The modular hub system may advantageously enable selection of a blade with some desired properties to a wind turbine type which was not designed to match
30 this blade. Further, the modular hub system may enable reuse of blades with useful service life, e.g. from decommissioned wind turbines, on different wind turbine types. Thus, a reused blade may be connected to another wind turbine without needing to change the hub or the connection means of the hub.

In an embodiment each of the first, second and third fastening means may comprise fastening features engageable with matching fastening features of the blade or the hub. The fastening features may have a form which provides direct engagement, e.g. the blade may be provided with threaded rods being directly
5 engageable with the third fastening means which are configured as holes.

Alternatively, the fastening features may have a form which provides indirect engagement, e.g. the both the blade and the third fastening means may be provided with fastening means in the form of through holes which are connectable with insertable bolts.

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In an embodiment at least one of the first, second and third fastening means may be integrally formed with the first or second mounting faces. Thus, the fastening means may be integrally formed as holes or rods.

15 In an embodiment said first and second mounting faces may be defined on a solid body. The first and second mounting faces may be plane faces configured to at least partially match corresponding mounting faces of hubs and roots of blades. The solid body may further define the first, second and third fastening means. For example, any of the first, second and third fastening means may be formed as
20 holes passing through anyone of the first and second mounting faces.

Furthermore, the first and second mounting faces may be parallel and formed on opposite ends of the body. I.e. the body may entirely constitute the hub adaptor, or may constitute a part of the hub adaptor.

25 In an embodiment the fastening features of each of the first, second and third fastening means may be concentrically arranged. As an example, first and third fastening features formed as holes may be concentrically arranged where the holes may be arranged to form a circle, an ellipse or other pattern.

30 In an embodiment each of the fastening features of at least one of the first, second and third fastening means forms a hole, e.g. a through hole or threaded hole, engageable with matching fastening features, e.g. holes or rods, of the of the blade or the hub. The holes of at least one of the first, second and third fastening means may extend through the first face or the second face.

Furthermore, the holes of at least one of the first, second and third fastening means may be engageable with matching holes or rods of the blade or the hub.

A second aspect of the invention relates to a wind turbine comprising at least one
5 rotor blade, and a hub for receiving at the least one rotor blade and at least one adaptor according to the first aspect with the first face connected to the at least one rotor blade and the second face connected to the hub.

A third aspect of the invention relates to a method for assembling a wind turbine
10 using a wind turbine adaptor according to the first aspect, the method comprising

- selecting two fastening means of the first, second and third fastening means,
- connecting the first face of the adaptor to the hub using one of the selected fastening means, and
- connecting a blade to the second face of the adaptor using the other selected
15 fastening means.

Thus, with a given hub and a given blade it is decided which of the fastening means of the adaptor matches the hub and the blade. The order of connecting the adaptor to the hub and the blade is arbitrary. Thus, the adaptor may first be
20 connected to the hub and then the blade may be connected to the adaptor, or vice versa.

A fourth aspect of the invention relates to a method for assembling a wind turbine, the method comprising,

25 - providing a plurality of adaptors, each adaptor comprising,

- first and second mounting faces,
- first and second fastening means for connecting the first and second mounting faces with a blade and a hub, respectively, each fastening means being configured with a plurality of connection features engageable with matching
30 fastening features of the blade or the hub,

where each of the plurality of adaptors differs from each other with respect to the configuration of at least one of the first and second fastening means, so that each adaptor is connectable with a pair comprising a blade and a hub which are not connectable by any other adaptor,

35 - selecting one of a plurality of adaptors,

- connecting the first face of the adaptor to the hub using the first fastening means of the selected adaptor, and
- connecting a blade to the second face of the adaptor using the second fastening means of the selected adaptor.

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Instead of providing a hub adaptor with a third connection means, an equivalent method for assembling a wind turbine may comprise providing a plurality of adaptors and selecting one of the plurality of adaptors instead of selecting two fastening means of the first, second and third fastening means of a single

10 adaptor. Thus, instead of selecting which of the first, second and third fastening means matches a given hub and a given blade, the hub adaptor having first and second fastening means which matches the given hub and blade is selected.

Accordingly, the methods according to the third and fourth aspect are equivalent in that both methods share the inventive concept of selecting two fastening

15 means from a larger number of fastening means which are either comprised by a single hub adaptor or by a plurality of adaptors.

A fifth aspect of the invention relates to a set of wind turbine adaptors for connecting a wind turbine blade to a wind turbine hub, each adaptor comprising:

20 - first and second mounting faces,

- first and second fastening means for connecting the first and second mounting faces with a blade and a hub, respectively, each fastening means being configured with a plurality of connection features engageable with matching fastening features of the blade or the hub,

25 wherein each of the plurality of adaptors differs from each other with respect to the configuration of at least one of the first and second fastening means, so that each adaptor is connectable with a pair comprising a blade and a hub which are not connectable by any other adaptor.

30 Thus, since a set of wind turbine adaptors may be available where each adaptor in the set have different fastening means, it is possible to select one adaptor from the set which matches a given blade and a given hub. It is understood that a plurality of sets may be available, e.g. at least three sets, so that three identical adaptors can be selected for the wind turbine with three blades.

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In the following, embodiments of the fifth aspect are described. The embodiments of the fifth aspect corresponds to the embodiments of the first aspect and differs only in that the adaptors of the fifth aspect does not necessarily have a third fastening means.

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In an embodiment of the fifth aspect, for each adaptor, each of the first and second fastening means comprise fastening features engageable with matching fastening features of the blade or the hub.

- 10 In an embodiment of the fifth aspect, said first and second mounting faces are defined on a solid body of each adaptor.

In an embodiment of the fifth aspect each of the fastening features of at least one of the first and second fastening means forms a hole engageable with matching

- 15 fastening features of the blade or the hub.

In an embodiment of the fifth aspect the holes of at least one of the first and second fastening means are engageable with matching holes or rods of the blade or the hub.

20

A sixth aspect of the invention relates to a wind turbine comprising at least one rotor blade, and a hub for receiving the least one rotor blade and one or more identical adaptors, each adaptor selected from one or more sets of wind turbine adaptors according to the fifth aspect, with the first face connected to the at least

25 one rotor blade and the second face connected to the hub.

In summary the invention relates to wind turbine generators and to methods for enabling fixation of different blade types to the hub of a wind turbine generator.

Since different blade types normally do not have identically designed fastening

- 30 means for connecting to the hub it becomes impossible to connect different types of blades to a given hub. The methods are based on hub adaptors which enables connection of different blade types. One hub adaptor comprises at least three differently designed fastening means so that at least two different blades can be connected to a hub or so that the hub adapter matches at least two hub types
- 35 each configured with different fastening means.

In general the various aspects of the invention may be combined and coupled in any way possible within the scope of the invention. These and other aspects, features and/or advantages of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be described, by way of example only, with reference to the drawings, in which

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Fig. 1 shows a wind turbine generator,
Fig. 2 shows different blade types, a hub adaptor and a hub,
Figs. 3-5 show different examples of hub adaptors,
Fig. 6 shows how different blade types may be connected to a hub using
15 differently configured hub adaptors.

DETAILED DESCRIPTION OF AN EMBODIMENT

Fig. 1 shows a wind turbine generator 100 comprising a tower 101 and a nacelle 102. Rotor blades 103 are fixed to a hub 104. The assembly of rotor blades 103, i.e. the rotor, is rotatable by action of the wind. Thus, the wind induced rotational energy of the rotor blades 102 may be transferred via the hub to a generator in the nacelle. Thus, the wind turbine generator 100 is capable of converting energy of the wind into mechanical energy by means of the rotor blade and, subsequently, into electric energy by means of the generator.

25

Rotor blades 103 or just blades 103 includes, but is not limited to, an elongated structure having an airfoil-shaped profile suitable for providing an aerodynamic lift upon relative movement through air.

30 The hub 104 is a structure provided with fastening means for fastening one or more rotor blades 103 and connectable with a shaft for transferring the rotational energy of the blades to the generator or a gearbox.

The blades 103 may be connected to the hub 104 via bolts. Thus, the root end of
35 a blade 103 and a matching mounting flange of the hub may be provided with

fastening means, for example in the form of threaded holes arranged in a circle with a given radius on the root end of the blade and corresponding through holes formed in the flange of the hub and arranged in a circle with the same radius. The blade 103 can be fastened to the hub by bolts or threaded rods inserted through
5 the holes in flange of the hub and screwed into the threaded holes in the root of the blade.

Different blade types may have different configurations of the fastening means, i.e. one blade type may have threaded holes arranged in a circle with one
10 diameter and another blade type may have threaded holes arranged in a circle with a different diameter. Since the wind turbine 100 is configured with a hub provided with a given fastening means, only blades with matching fastening means can be connected to the hub.

15 Fig. 2 shows different blade types 201-203 provided with differently configured fastening means 211-213 in the form of threaded holes, where the number and geometrical arrangement of the holes is different for each blade type. Fig. 2 further shows a hub 231 provided with fastening means 241 in the form of through holes (not shown) arranged in a flange of the hub. The hub fastening
20 means 241 only matches one of blade fastening means 211-213.

According to an embodiment of the invention, Fig. 2 illustrates a blade-hub adaptor 220 which enables two or more of the blades 201-203 to be connected to the same hub 231 since the adaptor 220 is provided with more than one adaptor
25 fastening means, each having different configurations which matches different blade fastening means 211-213.

The adaptor 220 is also provided with a single fastening means matching the fastening means 241 of the hub 231, alternatively a plurality of differently
30 configured fastening means matching different fastening means 241 of hubs 231.

Thus, the adaptor 220 may be provided with a plurality of fastening means for connecting to different blades 201-203 and a single fastening means for connecting to a single hub type 231 to allow combinations of different blades with
35 a single hub-type. Alternatively, the adaptor 220 may be provided with a plurality

of fastening means for connecting to different blades 201-203 and a plurality of fastening means for connecting to different hub-types to allow different combinations of different blades and different hubs. Furthermore, the adaptor 220 may be provided with a single fastening means for connecting to a single blade
5 201 and a plurality of fastening means for connecting to different hub-types to allow a single blade to be connected to different hub-types.

A blade 201 may be connected to a hub 231 via a bearing (not shown) which enables the blade 201 to pitch around its longitudinal axis. When such a bearing is
10 used together with a blade hub adaptor 220, a first fastening face of the bearing is advantageously connected to the fastening means 241 of the hub 231 and a second adjacent fastening face of the bearing is advantageously connected to the hub adaptor 220. In this way both the hub adaptor 220 and the blade 201 may be rotated about a longitudinal axis so as to position the blade in desired orientation.

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Fig. 3 shows an example of a hub adaptor 300 in a top view 301 and a side view 302. The hub adaptor 300 has a first mounting face 303 and a second mounting face 304 for enabling fastening to corresponding faces of the blade 201-203 and the hub 231.

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Further, the hub adaptor 300 has a first fastening means 311 in the form of a number of holes 305 arranged in a circle for connecting the first mounting face 303 with a blade, and a second fastening means 321 in the form of a number of holes 305 arranged in a circle for connecting the second mounting face 304 with
25 the hub.

In addition, the hub adaptor 300 has a third fastening means 312 in the form of holes 305 arranged in a circle with a radius different than radius of the first fastening means 311 and the second fastening means 321. Thus, the third
30 fastening means 312 enables connection of the first mounting face 303 with a blade which is not connectable with the first fastening means 311 since the configuration in terms of the arrangement of holes of the third connection means 312 matches the fastening means 212 of the blade whereas the first fastening means 311 matches another fastening means 211 of another blade. In other
35 words, the third fastening means 312 enables connection of the first mounting

face 303 with a blade having blade fastening means 212 which do not fit with the first fastening means 311 but with the third fastening means 312.

The hub adaptor 300 may comprise any number of additional fastening means, such as the illustrated fourth fastening means 313 which is equivalent to the third fastening means 312 in terms of the functionality of the additional fastening means which enables combination of different blades 201-203 with a hub 231.

Fig. 3, to the right, shows a blade 201 connected to the first face 303 of the adaptor 300 via the blade's fastening means 211 which matches the first fastening means 311 of the adaptor. The second face 304 of the adaptor is connected to the hub 231 via the second fastening means 312 of the adaptor which matches the hub's fastening means 241.

Fig. 3 also shows another blade 202 provided with fastening means 212 having fastening holes 305 arranged in a circle with a radius different the circle of holes of the fastening means of the other blade 201. Accordingly, the blade 202 is connected to the first face 303 of the adaptor 300 by the blade's fastening means 212 and the third alternative fastening means 312 of the adaptor. The adaptor 300 is connected to the hub 231 by the second fastening means 312 and the hub's fastening means 241.

In the same way, a blade 203 having a differently configured fastening means 213, e.g. holes 305 arranged in a smaller diameter can be connected to the hub 231 via the possible fourth fastening means 313 of the hub which matches the blade fastening means 213.

The first, second and third fastening means 311, 312 and 313 may enable fastening by other means than holes 305. Also, holes 305 need not be arranged in circles, but could be arranged in any pattern. Accordingly, the third fastening means 313 may have a configuration different from the first 311 and second 312 fastening means not only in terms of the radius of circles wherein holes 305 are arranged, but also in terms of any variation of geometries of holes 305, or other different configurations of fastening features other than holes.

Instead of holes 305 any one of the first, second and third fastening means 311-313 may be embodied by rods, e.g. threaded rods, connectable with matching receiving fastening features, e.g. holes, provided in a blade 201-203 or a hub 231.

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Fig. 3 shows that the hub adaptor 300 may be fastened to the hub 231 using bolts 360 so that the threaded rods of the bolts are inserted through holes of the hub's fastening means 241 and screwed into adjacent threaded blind holes 305 of the second fastening means 321 of the adaptor 300. Similarly, the blade 201 may be
10 fastened to the adaptor by bolts 360 inserted in through holes 305 and screwed into adjacent threaded holes 305 of the fastening means 211 of the blade 201. It is not essential which kind of fastening units 360 are used, i.e. the fastening units 360 may comprise bolts, threaded rods with bolts, press fittings or other units or fastening systems being applicable with the given fastening features.

15

Fig. 4 shows an adaptor 400 in a top view 401 and a side view 402 and comprising a first mounting face 403 and a second mounting face 404. As shown in Fig. 4 a mounting face 404 need not be a plane face or a single continuous face, but may be comprised by a number of plane faces or generally a number of
20 faces shaped according to any geometry.

The adaptor 400 comprises a first fastening means 411 and a second fastening means 421 for connecting to a blade and a hub, respectively. The adaptor 400 mainly differs from the adaptor 300 by having both additional third fastening
25 means 412-413 for connecting to different blades 201-203 as well as additional third fastening means 422-423 for connecting to different hubs. Any of the additional fastening means 412-413 for connecting to different blades and additional fastening means 422-423 for connecting to different hubs are referred to as third fastening means (312, 412-413, 422-423) in the following.

30

Thus, in addition to combination of different blades with a single hub as shown in Fig. 3, Fig. 4 shows how the adaptor 400 enables combinations of different hubs 431-433 with different blades.

Thus, the first fastening means 411 and any of the additional fastening means 412-413 enables connection of different blades 201-203 (only blade 201 is shown) to the first face 403 of the adaptor 400. The second fastening means 421 and any of the additional fastening means 422-423 enables connection of different hubs 5 431-433 to the second face 404.

Generally, the third fastening means comprising any of the additional fastening means 412-413, 422-423 having a configuration different from the first and the second fastening means 411, 421 enables connection of the first mounting face 10 403 with an alternative blade 202-203 not connectable with the first fastening means 411, or enables connection of the second mounting face with an alternative hub 432-433 not connectable with the second fastening means 421.

Fig. 5 shows an adaptor 500 comprising a first fastening means 511 and a second 15 fastening means 521 for connecting to a blade and a hub, respectively. The adaptor 500 is similar to adaptor 400 and mainly differs in terms of the number of additional third fastening means 512, 522 and the structural shape of the adaptor.

Fig. 5 shows how a blade 501 is fixed to the adaptor 500 via the third fastening 20 means 512. The additional third fastening means 512 as well as the first fastening means 512 is formed in an internal flange 570 formed by making a groove 571 at the inner periphery 572 of a centre hole formed in the adaptor 500.

In comparison, Fig. 4 shows an external flange 470 accessible from the outside of 25 the adaptor, whereas the internal flange 570 is only accessible from the inside of the adaptor. The embodiment of Fig. 4 is also provided with an internal flange 471 which is functionally equivalent with the internal flange 570.

Internal flanges 471, 570 allow a service technician to access the bolts 512 from 30 within the hub 220, thereby facilitating safer inspection, maintenance or installation.

Fig. 6 shows how blades 201-203 provided with differently configured fastening means 211-213 can be connected to a hub 231 provided with a fastening means 241 which matches only one of the fastening means 211-213 of the blades 201- 35 203 by use of a plurality of adaptors 651-653.

The plurality of adaptor 651-653 constitutes a set of wind turbine adaptors. Consequently, a plurality of sets of adaptors may be available for modifying or installing wind turbines.

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Each of the adaptors 651-653 is provided with only first 611-613 and second 621 fastening means for connecting the first and second mounting faces 603,604 with a blade 201-203 and a hub 211-213, respectively. Each fastening means is configured with a plurality of connection features, for example in the form of holes
10 305, matching corresponding connection features of the hub 231 and one of the blades 201. Each of the plurality of adaptors 651-653 differs from each other with respect to the configuration of at least one of the first and second fastening means 611, 621.

15 Accordingly, an adaptor 651-653 may be provided with first and second mounting faces 303,304 and only first and second fastening means 611, 621 for connecting the first and second mounting faces 303,304 with a blade and a hub, respectively. Each fastening means 611,621 is configured with a plurality of connection features, e.g. in the form of holes 305, which are engageable with matching
20 fastening features of the blade or the hub.

Within the inventive concept of the invention a wind turbine may be assembled using either an adaptor 220,300,400,500 having more than two fastening means in the form of first 311 and second 312 fastening means and at least one
25 additional third fastening means 313, or adaptors 651-653 having only two fastening means 611 and 612.

Each of the concepts for connecting blades to the hub has their advantages with respect to simplicity of the adaptor, cost of the adaptor and flexibility of the
30 adaptor, but both concepts enables different blade types to be connected to a given hub or even different hubs.

When a wind turbine is assembled using the adaptor 300 having more than two fastening means, then it has to be decided which of the first, second or third
35 fastening means 311-312,321 matches the relevant blade and hub. Then the wind

turbine is assembled by connecting one face 304 of the adaptor 300 to the hub using one of the selected fastening means, and by connecting a blade 201 to the other face of the adaptor using the other selected fastening means. Clearly, the wind turbine may be assembled oppositely by first connecting the adaptor 300 to the blade 201 and then connecting the blade with the adaptor to the hub 231.

Generally, any of the hub adaptors 220, 300, 400, 500 may be attached to the hub 231, 431-433 to begin with and then a blade 201-203 may be attached to the hub adaptor, or oppositely, the hub adaptor may be connected to a blade to begin with and the blade-adaptor assembly may be connected to the hub. However, depending on the configuration of the hub adaptor, e.g. depending on the availability of internal 471 or external flanges 470 a particular order of mounting the components may be preferred.

When a wind turbine is assembled using the selection of adaptors 651-653, where each adaptor is provided with only two fastening means 611,621, then it is first decided which of the first fastening means 611-613 matches the actual blade, and possibly which of a plurality of second fastening means 621 matches the actual hub. Then the relevant adaptor 651-653 having the required configuration of the first fastening means and the required configuration of the second fastening means is selected. The assembly of the wind turbine using the selected adaptor is equivalent to assembly using the other adaptor type.

It is noted that even though the hub 231 of Fig. 2 and Fig. 6 illustrate external flanges, internal hub flanges as illustrated in Figs. 3-5 may be used instead.

While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed embodiments. Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality.

CLAIMS

1. A wind turbine adaptor for connecting a wind turbine blade to a wind turbine hub, the adaptor comprising:
 - 5 - first and second mounting faces,
- first and second fastening means for connecting the first and second mounting faces with the blade and the hub, respectively,
- a third fastening means having a configuration different from the first and second fastening means for connecting,
 - 10 - the first mounting face with an alternative blade not connectable with the first fastening means, or
- the second mounting face with an alternative hub not connectable with the second fastening means.
- 15 2. A wind turbine adaptor according to claim 1, where each of the first, second and third fastening means comprise fastening features engageable with matching fastening features of the blade or the hub.
3. A wind turbine adaptor according to claim 1, where at least one of the first,
20 second and third fastening means are integrally formed with the first or second mounting faces.
4. A wind turbine adaptor according to claim 1, where said first and second mounting faces are defined on a solid body.
- 25 5. A wind turbine adaptor according to claim 4, where the solid body further defines the first, second and third fastening means.
6. An adaptor according to claim 4, where the first and second mounting faces are
30 parallel and formed on opposite ends of the body.
7. An adaptor according to claim 2, where the fastening features of each of the first, second and third fastening means are concentrically arranged.

8. An adaptor according to claim 2, where each of the fastening features of at least one of the first, second and third fastening means forms a hole engageable with matching fastening features of the blade or the hub.
- 5 9. An adaptor according to claim 8, where the holes of at least one of the first, second and third fastening means extends through the first face or the second face.
- 10 10. An adaptor according to claim 8, where the holes of at least one of the first, second and third fastening means are engageable with matching holes or rods of the blade or the hub.
- 15 11. A wind turbine comprising at least one rotor blade, and a hub for receiving the least one rotor blade and at least one adaptor according to claim 1 with the first face connected to the at least one rotor blade and the second face connected to the hub.
- 20 12. A method for assembling a wind turbine using a wind turbine adaptor according to claim 1, the method comprising
- selecting two fastening means of the first, second and third fastening means,
 - connecting the first face of the adaptor to the hub using one of the selected fastening means, and
 - connecting a blade to the second face of the adaptor using the other selected fastening means.
- 25 13. A method for assembling a wind turbine, the method comprising,
- providing a plurality of adaptors, each adaptor comprising,
 - first and second mounting faces,
 - first and second fastening means for connecting the first and second
- 30 mounting faces with a blade and a hub, respectively, each fastening means being configured with a plurality of connection features engageable with matching fastening features of the blade or the hub,
- where each of the plurality of adaptors differs from each other with respect to the configuration of at least one of the first and second fastening means, so that each

adaptor is connectable with a pair comprising a blade and a hub which are not connectable by any other adaptor,

- selecting one of a plurality of the adaptors,
- connecting the first face of the adaptor to the hub using the first fastening

5 means of the selected adaptor, and

- connecting a blade to the second face of the adaptor using the second fastening means of the selected adaptor.

14. A set of wind turbine adaptors for connecting a wind turbine blade to a wind
10 turbine hub, each adaptor comprising:

- first and second mounting faces,
- first and second fastening means for connecting the first and second mounting faces with a blade and a hub, respectively, each fastening means being configured with a plurality of connection features engageable with matching fastening

15 features of the blade or the hub,

wherein each of the plurality of adaptors differs from each other with respect to the configuration of at least one of the first and second fastening means, so that each adaptor is connectable with a pair comprising a blade and a hub which are not connectable by any other adaptor.

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15. A set of wind turbine adaptors according to claim 14, where, for each adaptor, each of the first and second fastening means comprise fastening features engageable with matching fastening features of the blade or the hub.

25 16. A set of wind turbine adaptors according to claim 14, where said first and second mounting faces are defined on a solid body of each adaptor.

17. An adaptor according to claim 15, where each of the fastening features of at least one of the first and second fastening means forms a hole engageable with
30 matching fastening features of the blade or the hub.

18. An adaptor according to claim 17, where the holes of at least one of the first and second fastening means are engageable with matching holes or rods of the blade or the hub.

35

19. A wind turbine comprising at least one rotor blade, and a hub for receiving the least one rotor blade and one or more identical adaptors, each adaptor selected from one or more sets of wind turbine adaptors according to claim 14, with the first face connected to the at least one rotor blade and the second face connected
5 to the hub.

1/6

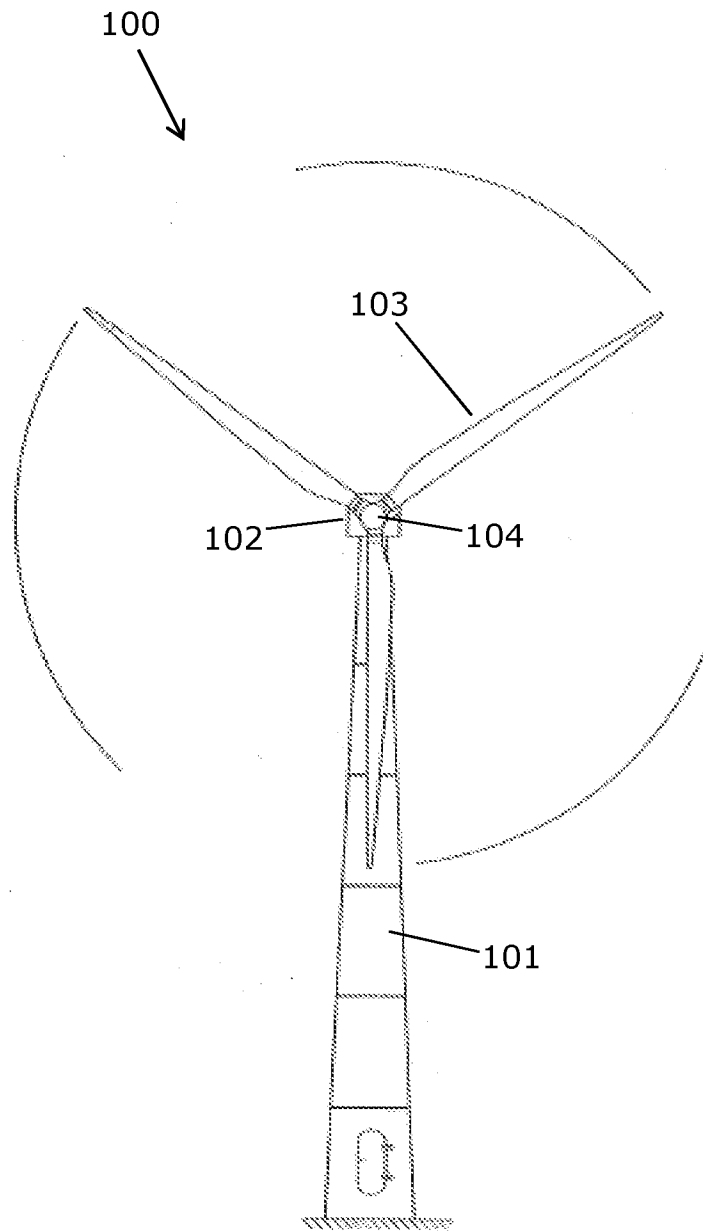


FIG.1

2/6

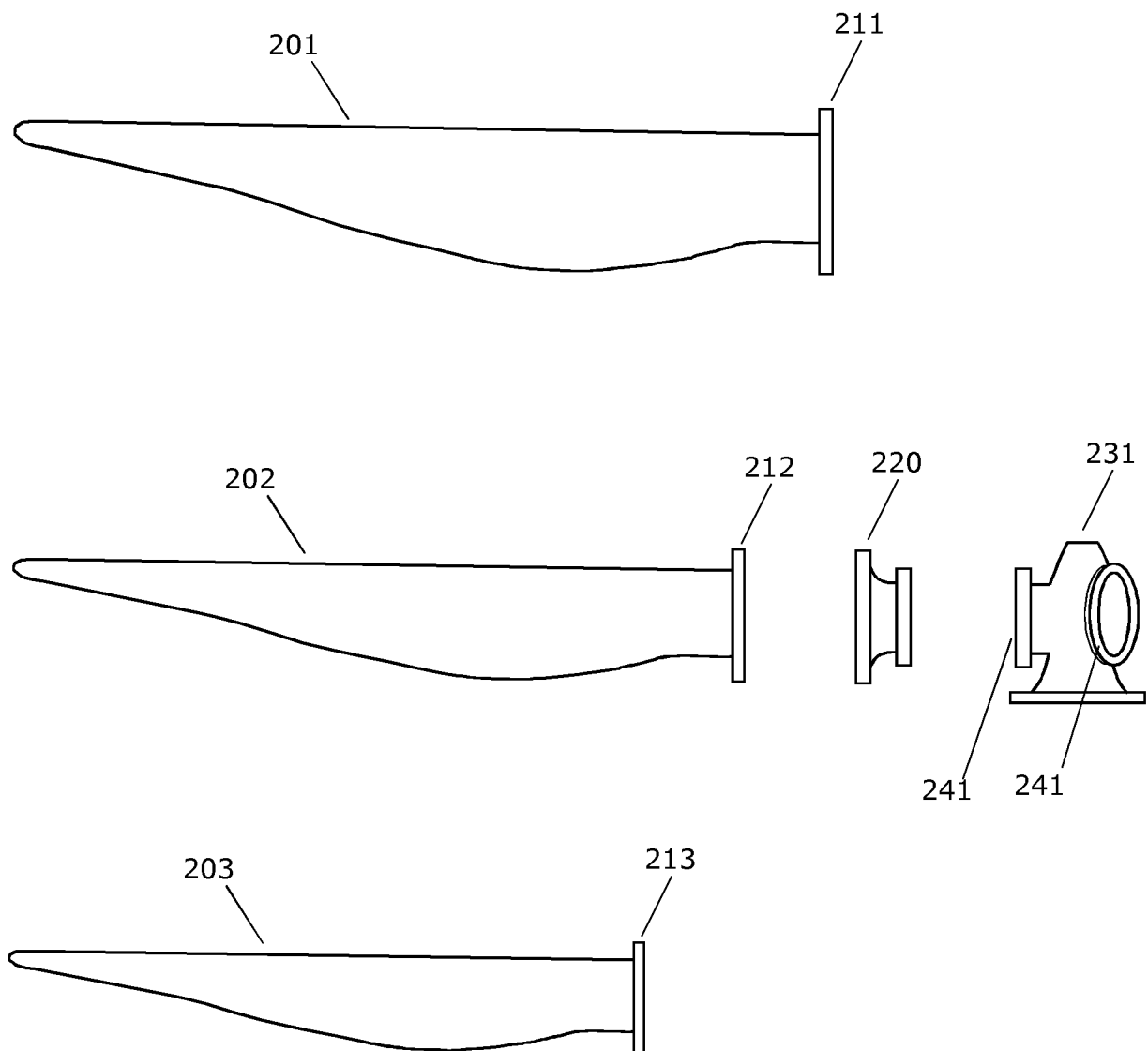


FIG. 2

3/6

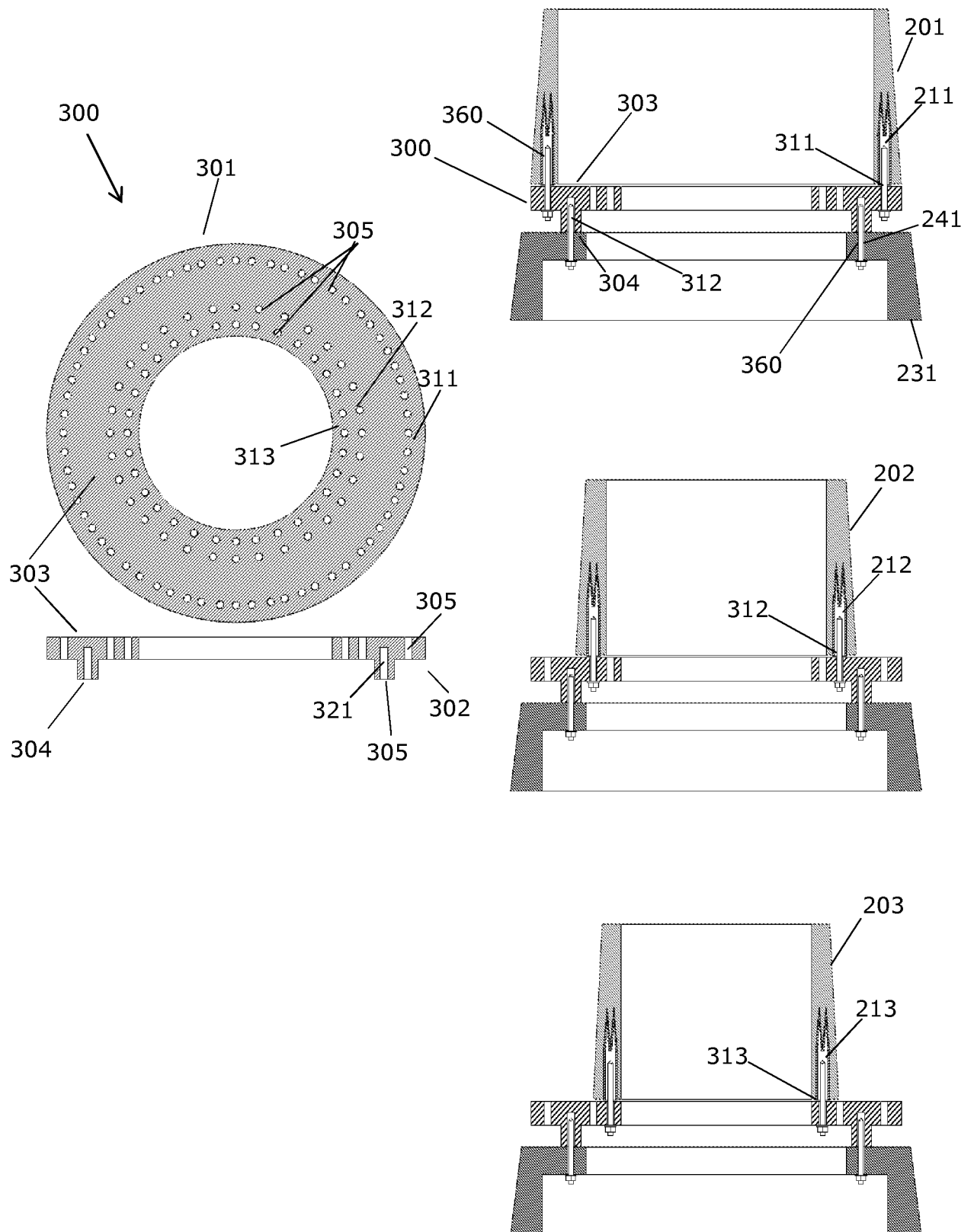


FIG.3

4/6

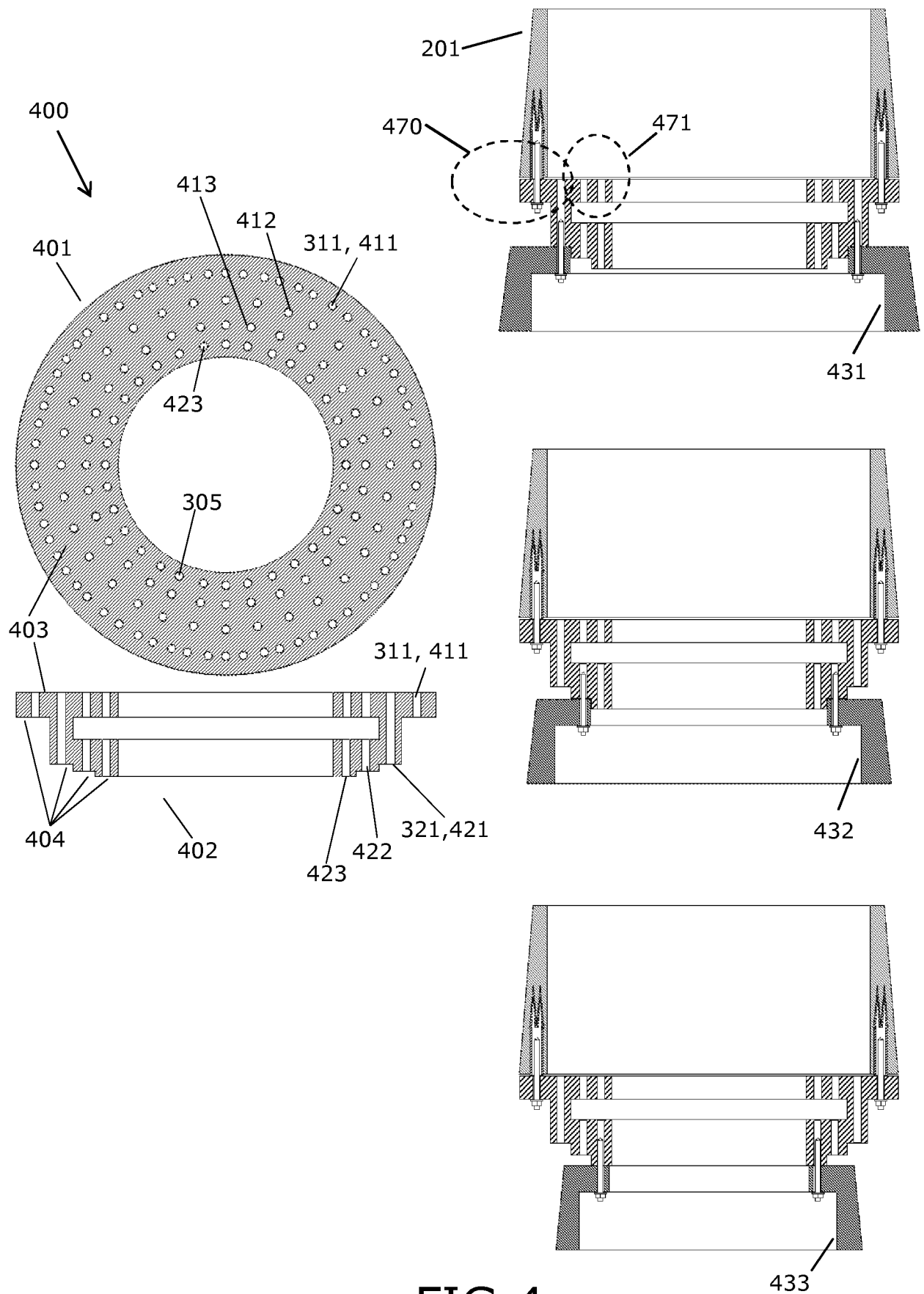


FIG.4

5/6

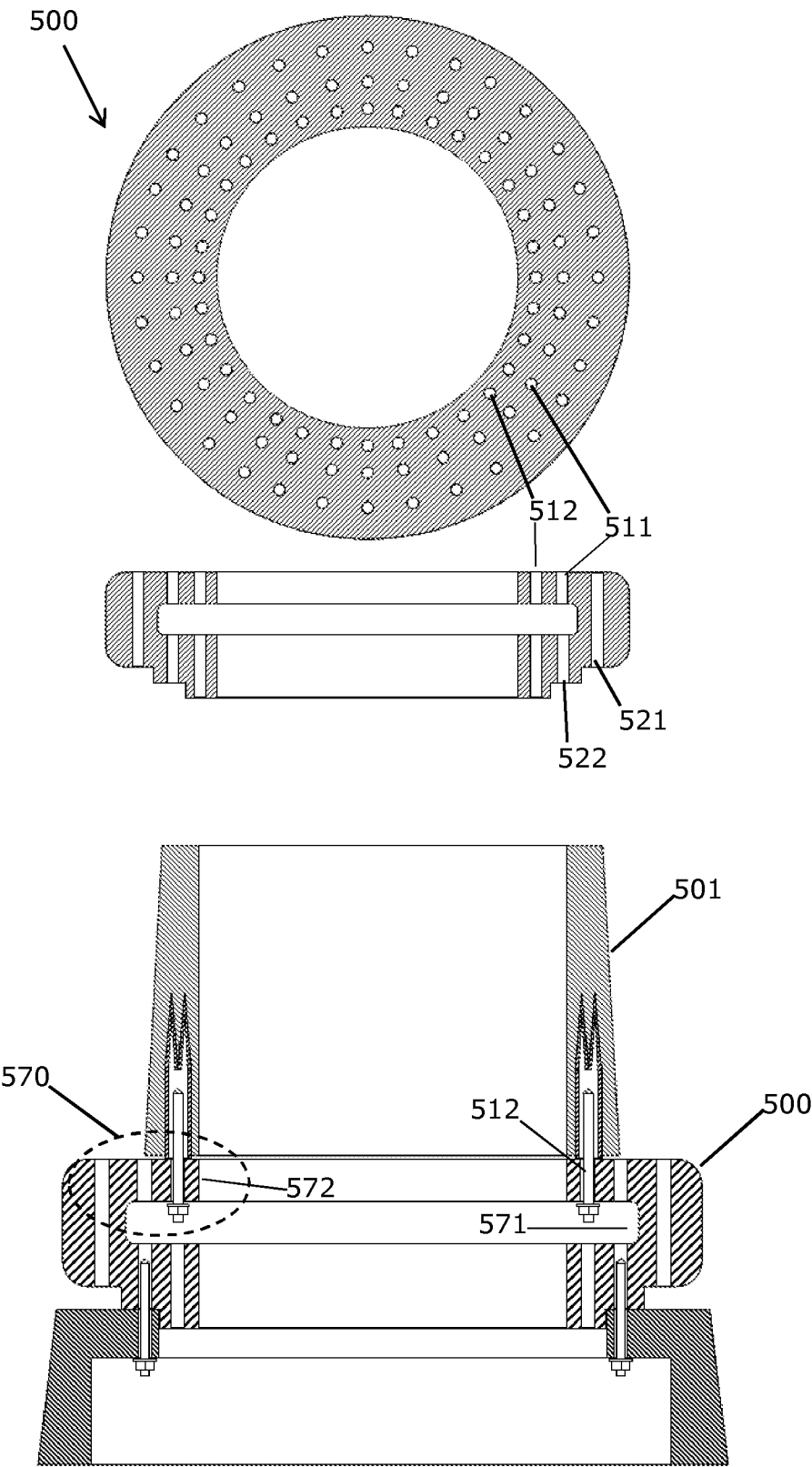


FIG.5

6/6

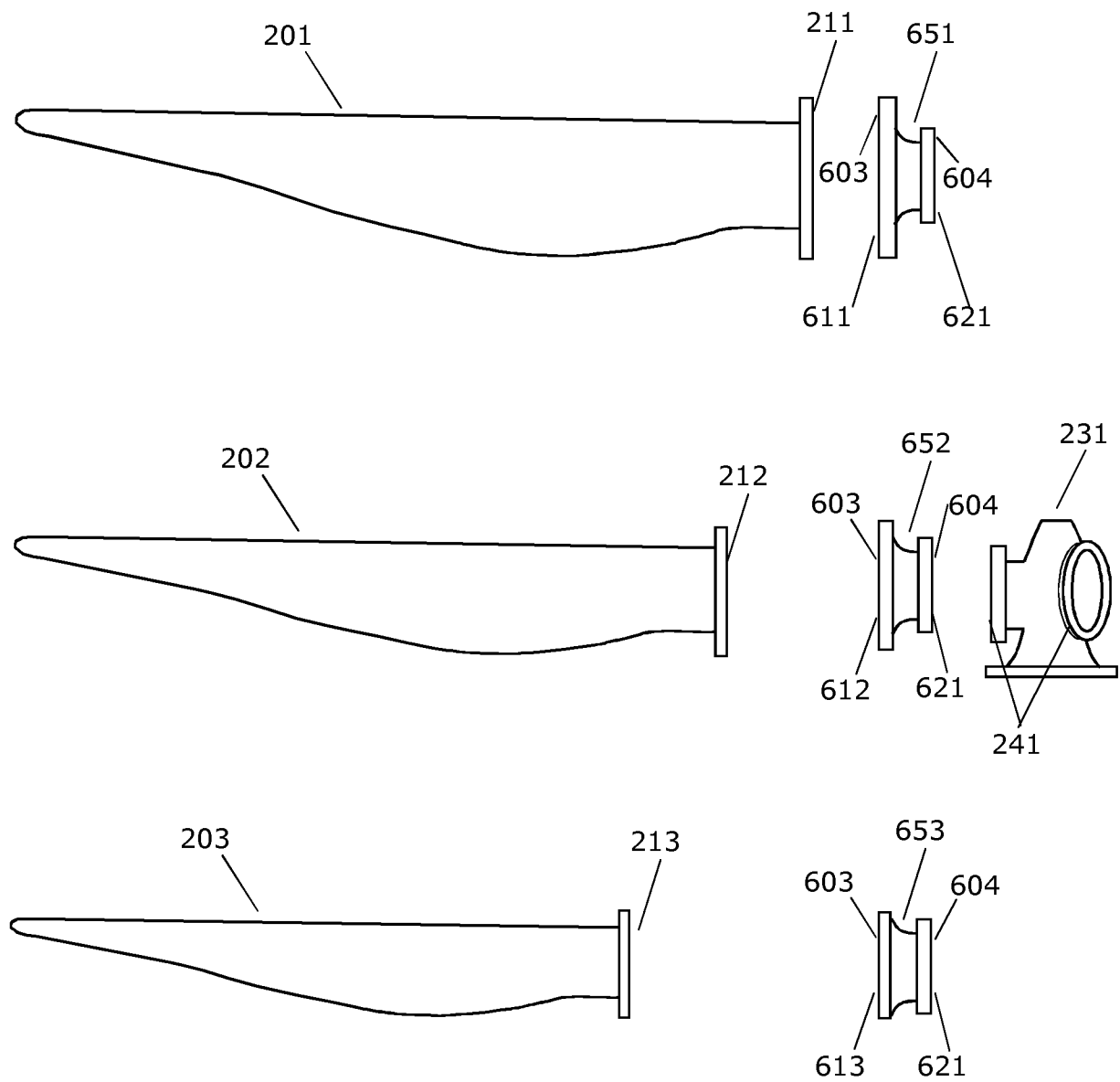


FIG.6