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[Continued on next page]

(54) Title: A METHOD FOR MAKING A WIND TURBINE

(57) Abstract: A method for making a wind turbine where a nacelle is manufactured with an initial aerodynamic property. To reduce a drag coefficient during erection of the wind turbine, a temporary change that property of the nacelle is introduced.

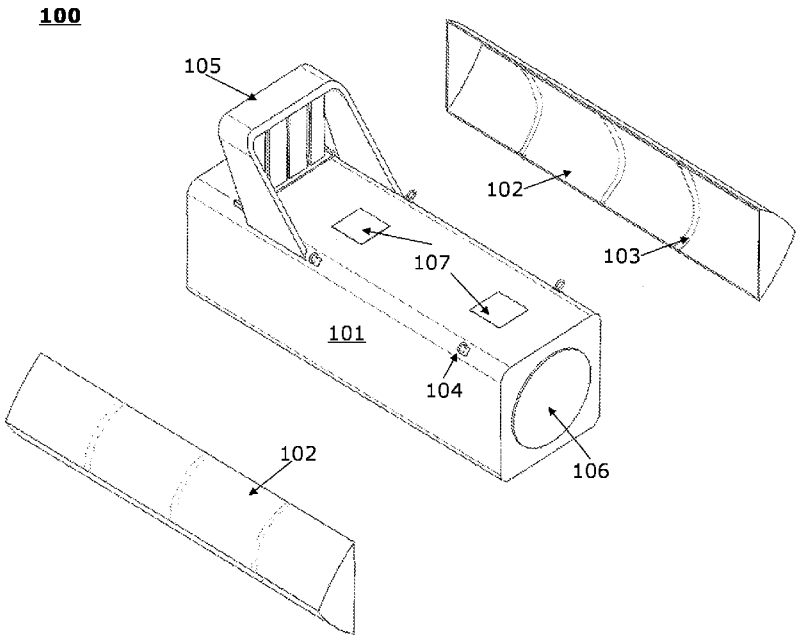


FIG. 1

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A METHOD FOR MAKING A WIND TURBINE

FIELD OF THE INVENTION

The present invention relates to a method for making a wind turbine at a site of construction and to a nacelle facilitating the method. More specifically, the invention relates to a method where parts of the wind turbine including the nacelle are transported to a construction site where the wind turbine is to be erected. At this site, the nacelle is lifted and placed on top of a wind turbine tower by use of a crane.

BACKGROUND OF THE INVENTION

Modern wind turbines comprise a tower construction which is traditionally formed by tapered round tower sections mounted on top of each other. The sections are mounted on each other in situ by use of a crane. When the tower is ready, the nacelle, which houses the drive train, generator, and other components, is lifted and attached to the top of the tower. Typically, the nacelle is made in a factory and transported to the construction site where it is lifted in one piece to the position on top of the tower. During this operation, the wind may cause movement of the nacelle while it is suspended from a crane. The movement makes precise positioning and assembly difficult.

There is a general need for a wind turbine which is designed for efficient and easy transport from the factory to the construction site and for efficient and easy handling at the construction site.

DESCRIPTION OF THE INVENTION

It is an object of embodiments of the invention to provide an improved method for erecting a wind turbine and to provide a wind turbine which is easier and safer to build. Additionally, it is an object of the invention to increase the allowable wind speed during lifting of the wind turbine nacelle by a crane and to allow easy transport of the nacelle from a factory to the construction site.

According to these and other objects, the invention, in a first aspect, provides a method for making a wind turbine, the method comprising the steps of:

- manufacturing a nacelle with an initial aerodynamic property
- providing a temporary change of the aerodynamic property of the nacelle;

- lifting the nacelle with the changed aerodynamic property and attaching it to a tower;

In a second aspect, the invention provides a nacelle assembly for a wind turbine, the nacelle assembly comprising a nacelle which houses different parts of the wind turbine and which is attachable to a wind turbine tower, the assembly further comprising at least one add-on profile configured to provide a temporary change in shape of the nacelle.

In a third aspect, the invention provides a lifting gear for lifting a nacelle, the lifting gear being configured to shield the nacelle and thereby reduce the drag coefficient.

In further embodiments, the invention provides a wind turbine nacelle add-on configured for temporary use for amending the shape of the nacelle during lifting when the wind turbine is erected.

By aerodynamic property is herein particularly considered the drag coefficient and/or back pressure. Accordingly, an initial aerodynamic property may be an initial drag coefficient, and a change of the aerodynamic property may be a change of the drag coefficient.

The wind turbine may particularly be a horizontal axis wind turbine, comprising a tower and at least one nacelle on top of the tower. The tower may e.g. be a regular steel tower made from steel plates, or it could be a concrete tower or any other kind of tower construction. The nacelle houses main technical parts of the wind turbine such as a gearbox, a generator, the drive train connecting the rotor to the generator via the gearbox, the low- and high-speed shafts, and a brake, etc. The rotor is connected to a number of accompanying blades. Through the blades-rotor system the electrical energy is generated and further transferred to at least one power grid or the like.

A nacelle is typically manufactured in a factory with an initial shape, usually a rectangular box shape. The nacelle is made in accordance with predefined standards in factory facilities which are often far away from the site of construction. The nacelle is normally transported by truck, railway, boat, or the like, and due to transport complications, it may be an advantage to transport the nacelle in its initial shape. The initial shape is typically as small as possible considering the content and functions of the nacelle and considering the need for transportation.

Once the nacelle and tower are brought to the installation site, the next step is to mount the nacelle to the tower by a crane. During this operation, the wind may cause movement of the nacelle while it is suspended from the crane. These movements make precise positioning and assembly difficult. A parameter which describes the influence of the wind on the nacelle is a

drag coefficient. The drag coefficient is a function of parameters including the shape and size of the nacelle.

According to the invention, the lifting procedure and the transport procedure are both facilitated by a nacelle which is made with an initial aerodynamic property in which it can be transported efficiently and subsequently hoisted with a changed aerodynamic property such that the drag profile and/or back pressure is/are reduced at least during hoisting.

Particularly, the change of the aerodynamic property may be introduced by changing the shape of the nacelle or by covering or shielding the nacelle by aerodynamic profiles forming part of the crane or other lifting equipment thereby reducing the influence of wind during lifting.

The method may include the step of reversing the temporary change of the aerodynamic property once the nacelle is attached to the tower. By reversing is herein meant that the initial shape is re-established, or that another shape is established. As an example, the initial shape could be partly or fully re-established.

The nacelle may be transported with its initial aerodynamic property. The initial aerodynamic property could particularly be obtained with a smaller volume of the nacelle, which thereby makes transport more efficient. The change in aerodynamic property, e.g. by changing the shape of the nacelle or by shielding the nacelle, is introduced to reduce the drag coefficient or the back-pressure. This may increase the volume of the nacelle, but it may also create a steadier lifting, and it may allow lifting at higher wind speed. Accordingly, the method may include the step of transporting the nacelle in a state where it has an initial volume, and increasing the volume at the site of construction before lifting it by crane.

The change of the aerodynamic property may be introduced by changing the shape of the nacelle or by covering or shielding the nacelle by aerodynamic profiles, herein referred to as add-on profiles attached directly to an outer surface of the nacelle or attached to the crane, or forming part of the crane or other lifting equipment thereby reducing the influence of wind during lifting.

The aerodynamic add-on profiles could e.g. be attached to an outer surface of the nacelle and/or to a lifting yoke of the nacelle, and/or to lifting gear of the crane etc. In this embodiment, the add-on profile may e.g. be used as an interface between the crane and the nacelle for attaching the nacelle to the crane which is used for lifting the nacelle. The add-on profiles may e.g. be connected to a lifting cable or a lifting hook or spreader of the crane. In one embodiment, the add-on profiles are attached both to an outer surface of the nacelle and to the lifting yokes or other lifting structures of the nacelle or of the crane used for lifting the

nacelle. Particularly, the add-on profiles could be fixed ot the nacelle, and the nacelle and the add-on profiles could be indifidually attaced to a crane which is used for lifting the nacelle. When the nacelle is in place, the add-on profiles and the crane could be detached from the nacelle and the add-on profiles may thereafter be lowered to the ground and used for lifting another nacelle.

The nacelle may e.g. be transported with an outer shieling layer, e.g. a housing of the kind generally known as the outer shell of a nacelle, and that outer shielding layer could be covered at least partly with the add-on profiles which are attached directly to the nacelle.

The aerodynamic add-on profiles can be rigid, dimensionally stable, elements made of aluminum, steel, composite of fibers and polyester etc., or, as an alternative to dimensionally stable elements, they may be made of flexible materials such as rubber etc. Preferably, such a flexible add-on profile may be inflatable.

The profiles can be triangular, semi-elliptical, or any other aerodynamic shape that can reduce the drag coefficient or back pressure of the nacelle. The profiles can be attached to the nacelle by different fastening means such as screws, flexible straps, hooks, magnets, or adhesives etc. Particularly, the profiles may be attached by fastening means which can be released from inside the nacelle to thereby avoid work on the outside of the nacelle in high altitude.

The profiles can be in several separate pieces which can be mounted temporarily to the nacelle cover during lifting. Since the profiles are in separate pieces, it may be easier to transport them e.g. in a standard container, and it may be easier to handle them during use, e.g. easier to detach them from a nacelle and lower them to the ground, and it may be easier to ship them to another location for use in connection with erection of another wind turbine.

When the add-on profiles are made of a flexible material, the step of introducing a temporary change to the shape of the nacelle may comprise the step of attaching the flexible material to an outer surface of the nacelle and inflating it e.g. before the lifting of the nacelle or once drag or back pressure becomes a problem. In one embodiment, the inflation is controlled by a level of back pressure or drag.

According to the invention, once the aerodynamic add-on profiles are attached and possibly inflated, the method for making a wind turbine further comprises a step of lifting the nacelle assembly for attachment to a tower. This step is typically performed by use of a crane, typically a mobile crane, or similar lifting equipment. Typically this step is performed at a wind speed lower than 15 meters per second and it should comply with the essential safety requirements. Having a profile of a nacelle with reduced drag coefficient the maximum

permissible wind speed during lifting by crane may be significantly increased. In one embodiment, the add-on profile(s) form lifting lugs for lifting the nacelle and thereby constitute not only a drag reducing structure but also a lifting aid for the crane operation. The add-on profiles may thus form part of the nacelle and/or it may form part of the lifting lug or other lifting structure of the crane.

Once the nacelle assembly is attached to the tower, the method for making a wind turbine further comprises a step of re-establishing the initial shape of the nacelle. The shape of the nacelle is thereby changed from an aerodynamic shape back to the initial shape. This step may be performed by removing add-on profiles which provide only a temporary change in the shape of the nacelle.

When the aerodynamic add-on profiles are inflatable or generally made of a flexible material, the step of re-establishing the initial shape of the nacelle may comprise a step of deflating the inflated profiles and optionally detaching the profiles from the nacelle. If the deflated profiles are not detached from the nacelle, the initial shape is only partly re-established.

In one embodiment the add-on profiles are arranged to shield side-surfaces of the nacelle, the side-surface being surfaces arranged on opposite sides of a drive train in the nacelle. In that way, the add on profiles may e.g. attached symmetrically, e.g. with respect to the centre of gravity of the nacelle, with respect to the location of the drive train e.g. symmetrically relative to a plane through the centre of the rotor shaft of the wind turbine, or symmetrically relative to the centre of gravity of the complete nacelle or relative to the centre of gravity of the drive train or just the drive shaft.

At least one add-on profile may be arranged on each side-surface of the nacelle. The add-on profiles added on one side-surface could be identical to the add-on profiles arranged to shield the other side-surface, and the identical add-on profiles may be arranged symmetrically.

In a second aspect, the invention provides a nacelle assembly for a wind turbine, where the nacelle assembly comprises a nacelle which encloses a drive train. The nacelle is attachable to a wind turbine tower, and the nacelle assembly further comprises at least one add-on profile configured to provide a temporary change in shape of the nacelle to thereby reduce drag coefficient or back pressure while being in the temporary shape. The nacelle assembly may also comprise different yokes and similar elements attached to the nacelle for lifting the nacelle by crane.

The add-on profile may be inflatable and/or detachable and detachable to and from the nacelle.

In another embodiment, the temporary aerodynamic add-on profiles may comprise a plurality of straps to serve as a connection between the profiles and the nacelle. Typically the straps are bendable ropes or wires etc. They can be made of leather, polyester, cotton or similar, as well as from different pieces breaded into a single yarn. The straps are to be attached to the outer surface of the aerodynamic add-on profiles via fasteners. To attach the aerodynamic add-on profiles to the nacelle, the straps can be fitted through openings in the nacelle, and fastened inside the nacelle so that a tight connection between the nacelle and the aerodynamic profiles is provided.

In one embodiment of the invention, the temporary aerodynamic add-on profiles may form protrusions on an outer surface of the nacelle. Such protrusions may e.g. be horizontally outwards protrusions, e.g. having a rounded shape. Such a design of add-on profiles significantly reduces the drag coefficient of the nacelle assembly. The protrusions may bend and terminate in rearward end portions.

In order to lift the entire nacelle assembly to the top of a tower, the assembly needs to be mounted to a crane hook etc. Therefore, the aerodynamic add-on profiles may comprise one or more hooks so that a more stable connection between the nacelle assembly and the crane is provided.

In yet another embodiment of the invention, the temporary aerodynamic add-on profiles may be formed of at least two projections, e.g. extending in opposite directions, e.g. outwards from the nacelle.

The nacelle may particularly comprise side-surfaces on opposite sides of a drive train, each side-surface comprising a removable add-on profile.

The add-on profiles on opposite side-surfaces may be symmetrical profiles, e.g. symmetrical relative to a plane through the drive train, or relative to the centre of gravity of the nacelle or drive train.

The add-on profiles arranged on one side-surface may be identical to the add-on profiles arranged on the other side-surface, and the identical add-on profiles could be symmetrically arranged relative to centre of gravity and/or the location of the drive train, or shape of the nacelle etc.

In another embodiment, the invention provides a wind turbine with a nacelle assembly.

In a third aspect, the invention provides a lifting gear for lifting the nacelle comprising a profile configured to amend the aerodynamic profile of the nacelle by shielding an outer surface of the nacelle during lifting.

In a fourth aspect, the invention provides a wind turbine nacelle add-on profile configured for temporary attachment to an outer surface of a wind turbine nacelle to thereby reduce drag coefficient of the nacelle during erection of the wind turbine.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will now be described in further details with reference to the accompanying drawings in which:

FIG. 1 illustrates a nacelle with an initial shape and with temporary aerodynamic add-on profiles;

FIG. 2 illustrates a front view of the nacelle with the temporary aerodynamic add-on profiles;

FIG. 3 illustrates a nacelle with an initial shape with a first temporary aerodynamic add-on profiles alternative;

FIG. 4 illustrates a nacelle with an initial shape with a second temporary aerodynamic add-on profiles alternative;

FIG. 5 illustrates a front view of the nacelle the second temporary aerodynamic add-on profiles; and

FIG. 6 illustrates lifting the nacelle for mounting to a tower; and

FIG. 7 illustrates a specific shape for add-on profiles.

DETAILED DESCRIPTION OF THE DRAWINGS

Further scope of applicability of the present invention will become apparent from the following detailed description and specific examples. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the scope of the invention will become apparent to those skilled in the art from this detailed description.

FIG. 1 illustrates a first embodiment of a nacelle assembly 100 comprising a nacelle 101 with an initial rectangular shape together with temporary aerodynamic add-on profiles 102. The temporary aerodynamic add-on profiles are illustrated as triangular, but they can be semi-elliptical or may take any other shape that can reduce the drag coefficient on the nacelle. In one embodiment the temporary aerodynamic add-on profiles comprise a plurality of bulkheads 103 to support the entire element and at the same time to serve as the connectors between the elements 102 and the nacelle 101. A plurality of hooks 104 are attached to the nacelle to be used for lifting the nacelle. The add-on profiles 102 are arranged on opposite side surfaces on opposite sides of the drive train, and the add-on profiles are symmetrically about a plane through the opening 106 for the drive shaft.

Heat exchanger 105 is placed at the upper part of the housing for keeping the generator cool. The nacelle 101 features the opening 106 for the rotor and openings 107 allowing access to the roof from inside the nacelle.

FIG. 2 illustrates a front view of the nacelle assembly 100 when the temporary aerodynamic add-on profiles 102 are attached to the nacelle 101 ensuring good aerodynamic shape of the entire nacelle assembly 100. The temporary aerodynamic add-on profiles are attached to the nacelle via the bulkheads or side-surfaces 103.

FIG. 3 illustrates a second embodiment of a nacelle assembly 300 comprising a nacelle 101 with an initial shape together with temporary aerodynamic add-on profiles 301. In this embodiment the temporary aerodynamic add-on profiles comprise a plurality of straps 302 to serve as a connection between the elements 301 and the nacelle 101. The straps 302 are attached to the outer surface of the temporary aerodynamic add-on profiles 301 via fasteners 303. To attach the temporary aerodynamic add-on profiles 301 to the nacelle 101, the straps 302 can be fitted through the small circular openings 304 and fastened inside the nacelle so that a tight connection between the nacelle and the temporary aerodynamic add-on profiles is provided. As in the previous embodiment, a plurality of hooks 104 is attached to the nacelle 101 to be used for lifting the nacelle for mounting to a tower. Heat exchanger 105 is also placed at the upper part of the housing keeping the generator cool. The nacelle 101 features an opening 106 where the rotor accompanied by blades will be attached.

FIG. 4 illustrates yet another embodiment of a nacelle assembly 400 comprising a nacelle 101 with an initial shape together with temporary aerodynamic add-on profiles 401. In this embodiment the temporary aerodynamic add-on profiles comprise a plurality of hooks 402 to serve as a connection between the temporary aerodynamic add-on profiles 401 and the nacelle 101. Each hook 402 has a corresponding attachment opening 403 in the nacelle wall, so that the hook 402 penetrates the wall of the nacelle providing an easy and strong connection between the nacelle and the temporary aerodynamic add-on profiles. Therefore,

by the use of two interacting parts 402 and 403 the temporary aerodynamic add-on profiles 401 can be suspended on the nacelle 101.

In order to lift the entire nacelle assembly, the assembly is attached to a crane. As in the previous embodiments, a plurality of hooks 104 is attached to the nacelle 101. In the illustration of Fig. 4, the nacelle is lifted in the lifting lugs 104. The lifting lugs may, however, also be formed in the temporary aerodynamic add-on profiles and the add-on profiles may therefore be used for lifting the nacelle by forming an interface to the crane.

FIG. 5 illustrates a front view of the nacelle assembly 400 when the temporary aerodynamic add-on profiles 401 are attached to the nacelle 101 ensuring good aerodynamic shape of the entire nacelle assembly 400. The temporary aerodynamic add-on profiles are attached to the nacelle by use of the hooks 402.

FIG. 6 illustrates lifting the nacelle for mounting to a tower using a crane 601. In this figure, the purpose of a number of hooks 104 and 404 is shown. Using appropriate rope 602, wire or similar, the nacelle assembly can be attached to the crane 601 via the hooks 104 and 404 and lifted to a tower. The add-on profiles 401 are attached both to an outer surface of the nacelle and to the crane 601 used for lifting the nacelle. Since the add-on profiles and the nacelle are attached individually to the crane, the crane can easily be used also for lowering the add-on profiles after the nacelle has been attached to the tower, simply by releasing the nacelle from the crane and from the add-on profiles.

It may be an advantage if the add-on profiles can be released from inside the nacelle to thereby avoid work on the outer surface of the nacelle.

FIG. 7 illustrates a specific embodiment of a nacelle assembly in which the aerodynamic add-on profiles 701, 702 extends outwards from a sidewall 703 of the nacelle 704. Herein, the sidewall is a wall extending along the drive shaft in the nacelle. The drive shaft rotor axis is illustrated by the dotted line 705. The aerodynamic add-on profiles change direction and terminate in rearwardly extending end portions 706, 707.

LIST OF EMBODIMENTS

1. A method for making a wind turbine, the method comprising the steps of:
   - manufacturing a nacelle with an initial aerodynamic property;
   - providing a temporary change of the aerodynamic property;

- lifting the nacelle with the changed aerodynamic property and attaching it to a tower.

2. A method according to embodiment 1, further comprising the step of reversing the temporary change of the aerodynamic property once the nacelle is attached to the tower.

3. A method according to embodiment 1 or 2, where the nacelle, prior to the lifting of the nacelle, is transported with its initial aerodynamic property.

4. A method according to any of the preceding embodiments, where the step of providing a temporary change of the aerodynamic property comprises a step of shielding a part of an outer surface of the nacelle with at least one aerodynamic add-on profile.

5. A method according to embodiment 4, where an outer surface is shielded by attaching the add-on profile to the nacelle.

6. A method according to embodiment 4, where the outer surface is shielded by attaching the add-on profile to lifting yokes or other lifting structures of the nacelle or of a crane used for lifting the nacelle.

7. A method according to embodiments 2 and 4-6, where the step of reversing the temporary change of aerodynamic property comprises the step of removing the aerodynamic add-on profiles from the nacelle.

8. A method according to any of the preceding embodiments, where the step of providing a temporary change of the aerodynamic property comprises the step of inflating an inflatable element attached to an outer surface of the nacelle.

9. A method according to embodiment 2 and 8, where the step of reversing the temporary change of aerodynamic property comprises the step of deflating the inflatable element.

10. A method according to any of the preceding embodiments, where the step of providing a temporary change of the aerodynamic property comprises the step of shielding the nacelle with dimensionally stable add-on profiles.

11. A nacelle assembly for a wind turbine, the nacelle assembly comprising a nacelle housing a drive train and being attachable to a wind turbine tower, the assembly further comprising at least one add-on profile configured for providing a temporary change of aerodynamic property of the nacelle.

12. A nacelle assembly according to embodiment 11, where the aerodynamic add-on profile is inflatable.

13. A nacelle assembly according to embodiment 11, where the aerodynamic add-on profile is dimensionally stable.

14. A nacelle assembly according to any of embodiments 11-13, where the aerodynamic add-on profile is removably attached to an outer surface of the nacelle.

15. A nacelle assembly according to any of embodiments 11-14, where the aerodynamic add-on profile forms projection on an outer surface of the nacelle.

16. A nacelle assembly according to any of embodiments 11-15, where the aerodynamic add-on profile forms one or more horizontal projections extending in opposite directions from the nacelle.

17. A nacelle assembly according to any of embodiment 11-16, where the aerodynamic add-on profile extends outwards from the nacelle and where the aerodynamic add-on profile change direction and terminates in a rearward extending end portion.

18. A wind turbine with a nacelle according to embodiments 11-17.

19. A wind turbine nacelle aerodynamic add-on profile configured for temporary attachment to an outer surface of a wind turbine nacelle or to a lifting equipment of a crane to thereby amend the aerodynamic property of the nacelle during lifting of the nacelle by crane.

CLAIMS

1. A method for making a wind turbine, the method comprising the steps of:

- manufacturing a nacelle with an initial aerodynamic property;
- providing a temporary change of the aerodynamic property;
- lifting the nacelle with the changed aerodynamic property and attaching it to a tower.

2. A method according to embodiment 1, further comprising the step of reversing the temporary change of the aerodynamic property once the nacelle is attached to the tower.

3. A method according to embodiment 1 or 2, where the nacelle, prior to the lifting of the nacelle, is transported with its initial aerodynamic property.

4. A method according to any of the preceding embodiments, where the step of providing a temporary change of the aerodynamic property comprises a step of shielding a part of an outer surface of the nacelle with at least one aerodynamic add-on profile.

5. A method according to claim 4, where the outer surface is shielded by attaching the add-on profile to a crane used for lifting the nacelle.

6. A method according to claim 5, wherein the add-on profile is used as an interface for attaching the nacelle to the crane used for lifting the nacelle.

7. A method according to any of claims 5-6, wherein the add-on profiles attached to the nacelle, and wherein the add-on profile and the nacelle are attached individually to a crane.

8. A method according to claim 7, wherein the nacelle is detached from the crane and from the add-on profile after it has been attached to the tower, and the add-on profile is lowered to the ground by the crane used for lifting the nacelle.

9. A method according to any of claims 4-8, where add-on profiles are provided as dimensionally stable add-on profiles.

10. A method according to any of claims 4-9, where add-on profiles are arranged to shield side-surfaces of the nacelle, the side-surface being surfaces arranged on opposite sides of a drive train in the nacelle.

11. A method according to claim 10, wherein the add-on profiles which are arranged to shield side-surfaces are arranged to shield the side surfaces symmetrically.

12. A method according to claim 10 or 11, wherein at least one add-on profile is arranged on each side-surface, the add-on profiles arranged to shield one side-surface being identical to the add-on profiles arranged to shield the other side-surface.

13. A nacelle assembly for a wind turbine, the nacelle assembly comprising a nacelle housing a drive train and being attachable to a wind turbine tower, the assembly further comprising at least one add-on profile configured for providing a temporary change of aerodynamic property of the nacelle.

14. A nacelle according to claim 13, comprising side-surfaces on opposite sides of a drive train, each side-surface comprising a removable add-on profile.

15. A nacelle according to claim 14, wherein the add-on profiles on opposite side-surfaces are symmetrical relative to a plane through the drive train.

16. A nacelle according to claim 14 or 15, wherein the add-on profiles arranged on one side-surface is identical to the add-on profiles arranged on the other side-surface.

17. A lifting gear for lifting the nacelle comprising a profile configured to amend the aerodynamic profile of the nacelle by shielding an outer surface of the nacelle during lifting.

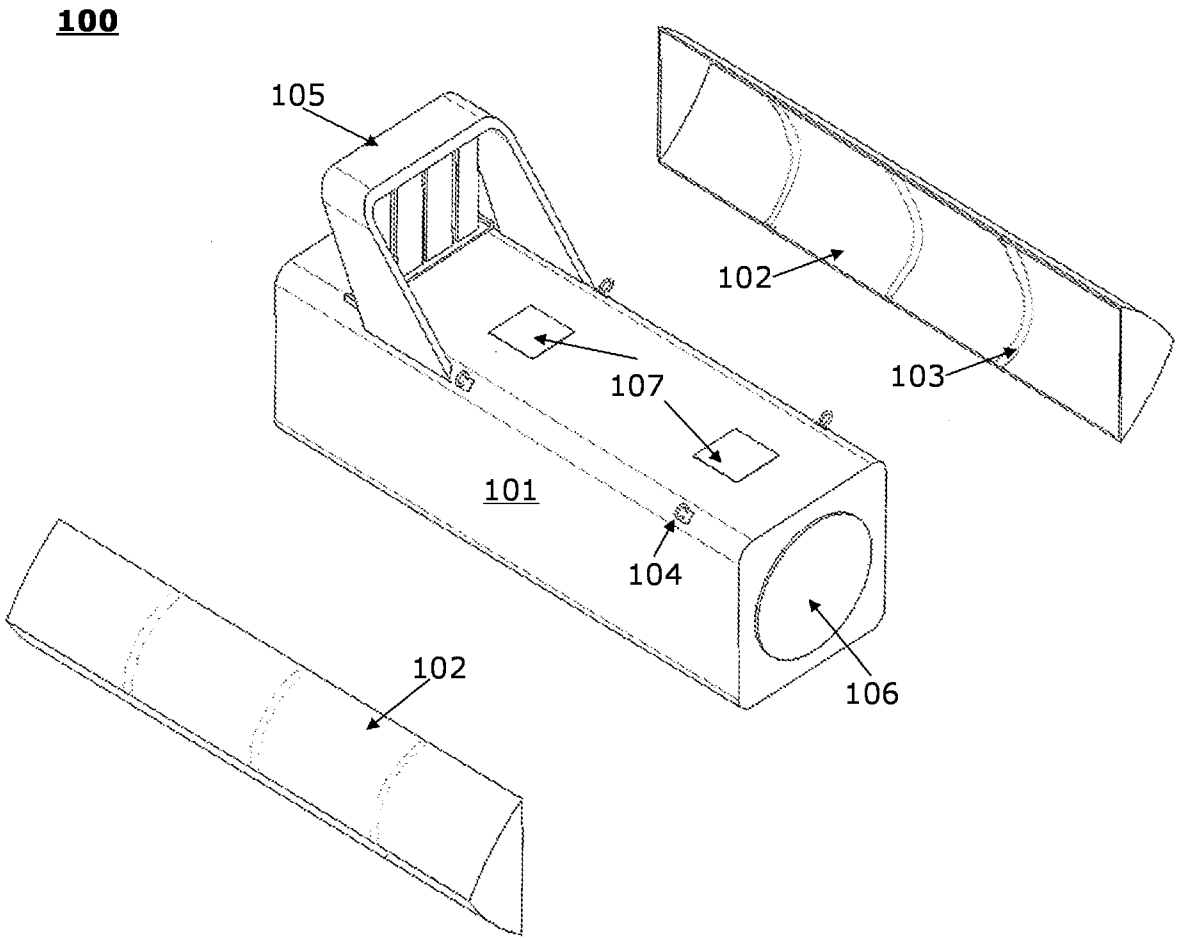


FIG. 1

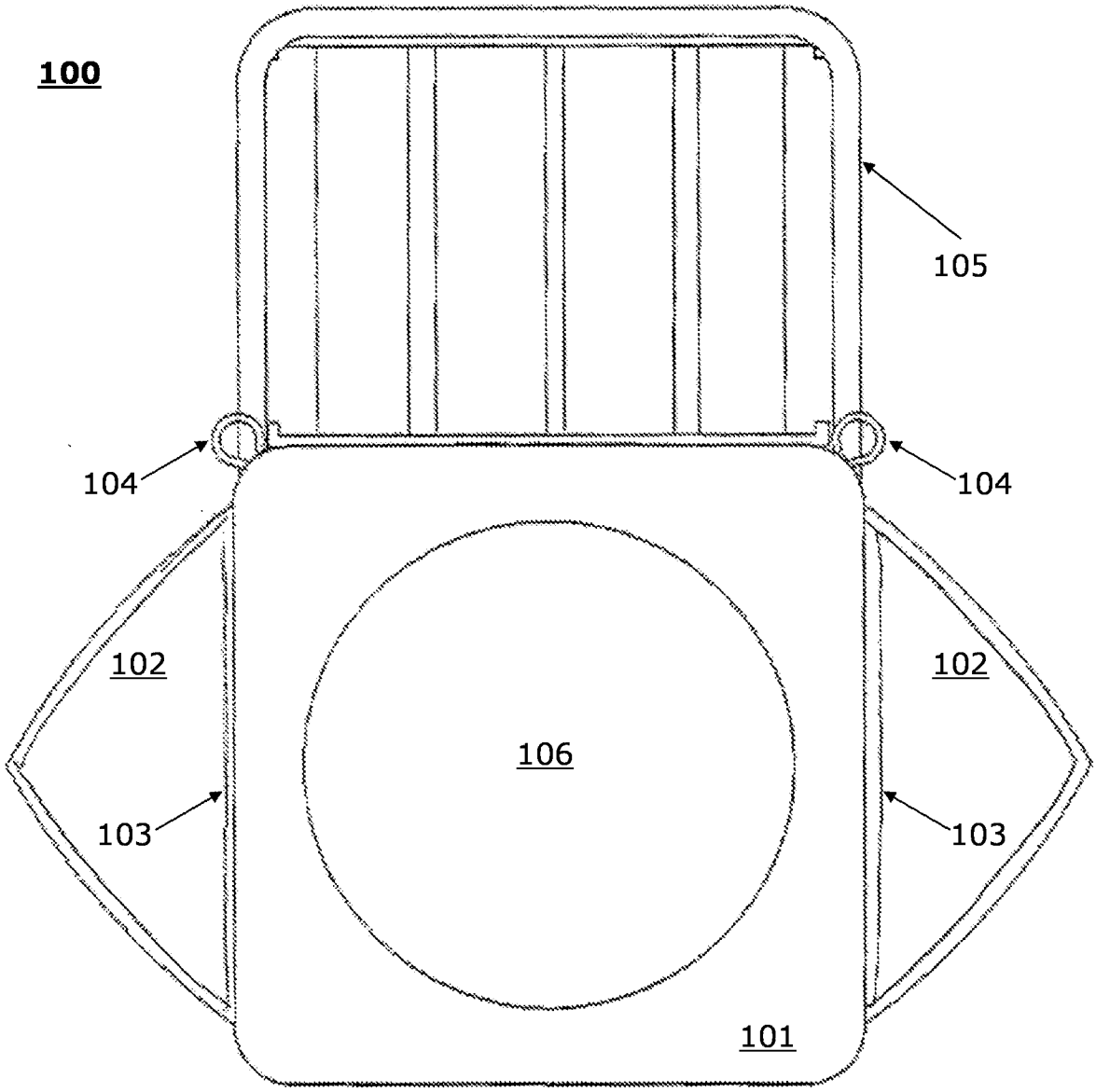


FIG. 2

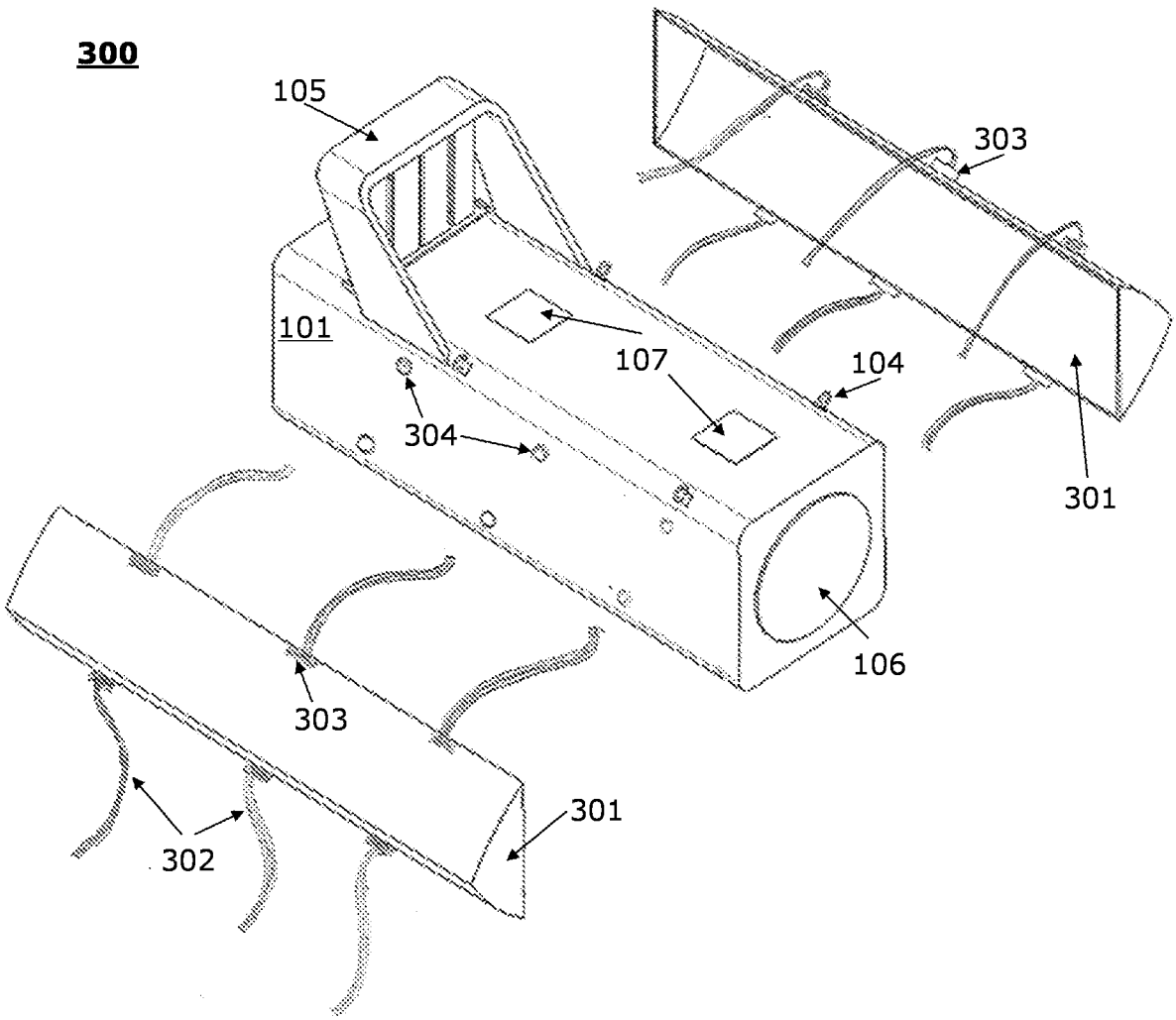


FIG. 3

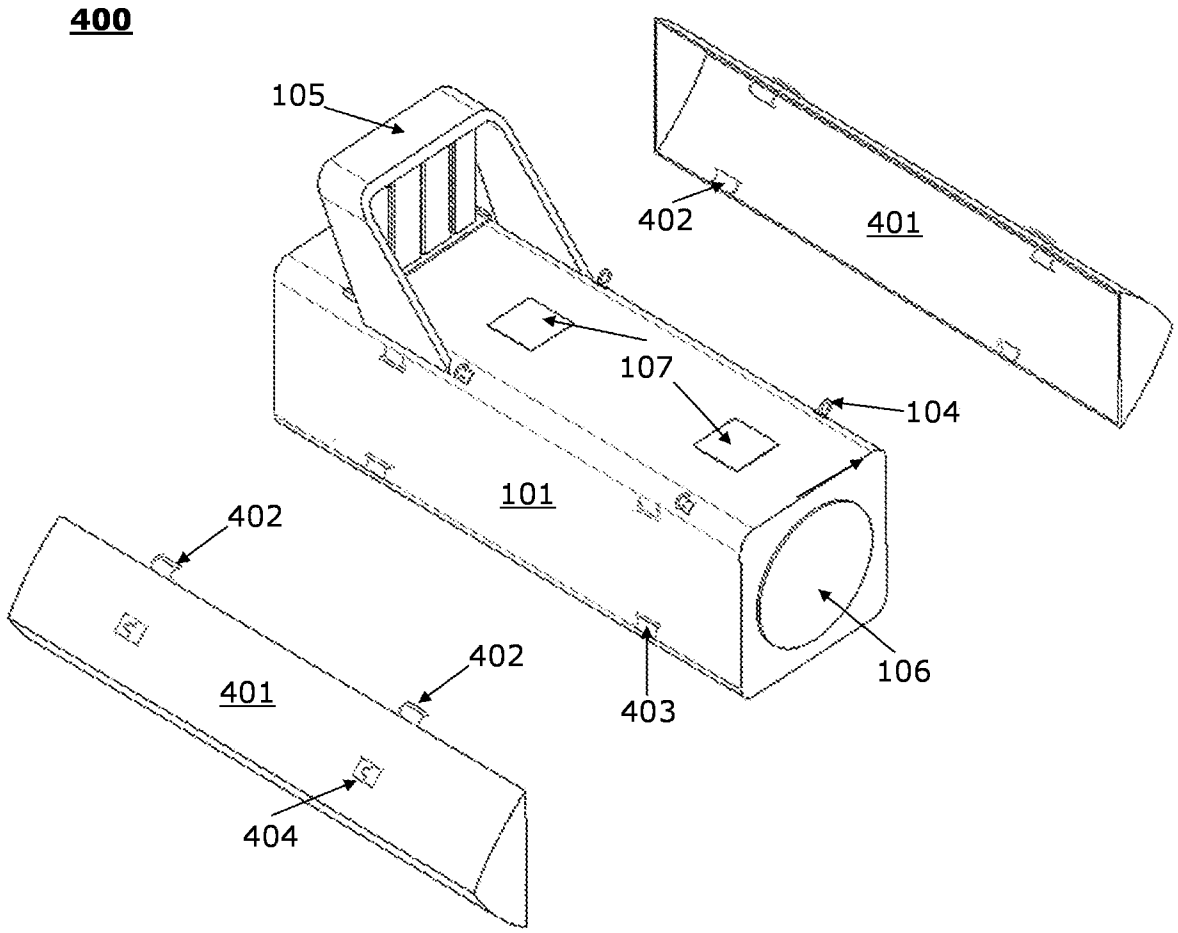


FIG. 4

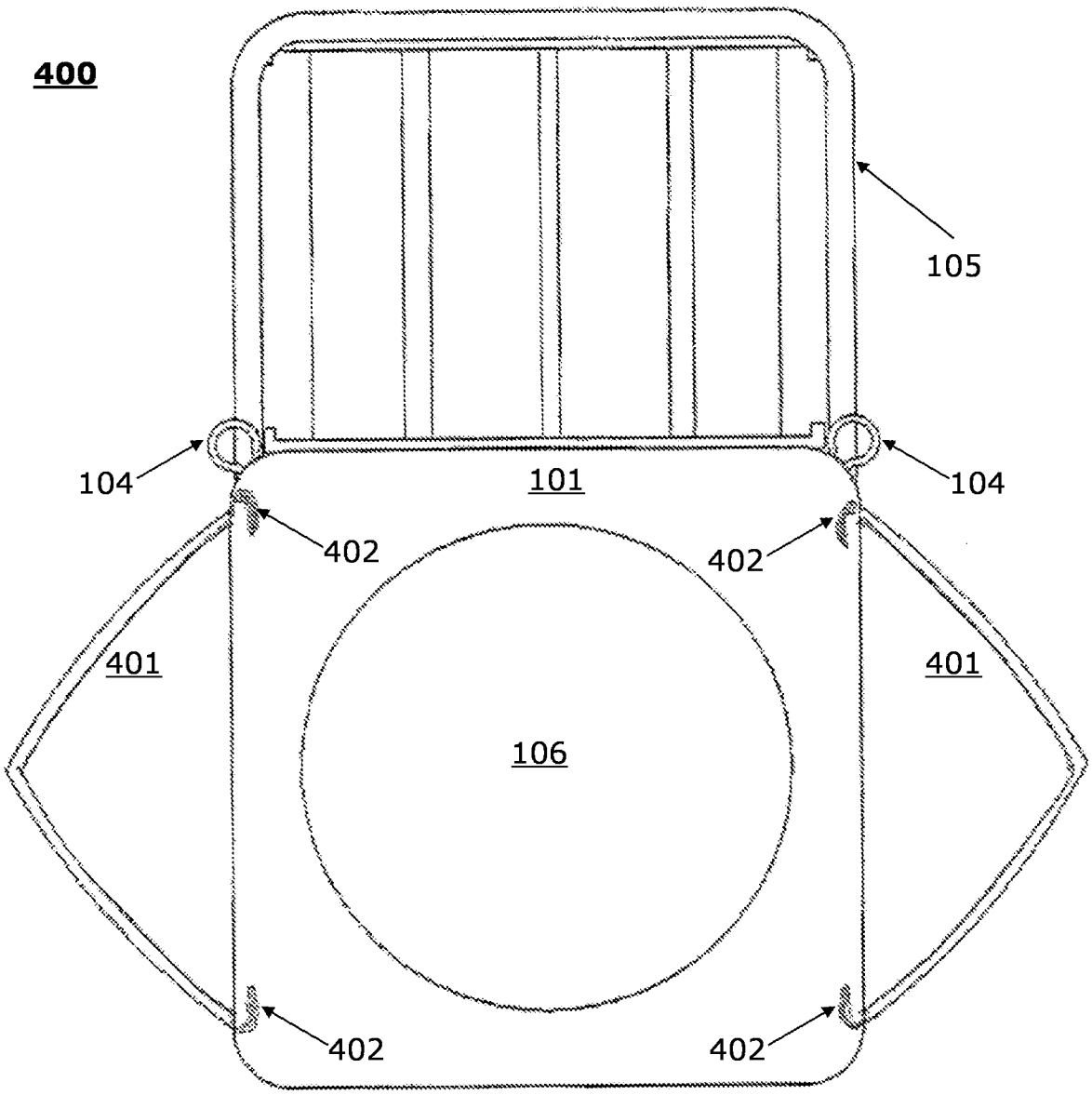


FIG. 5

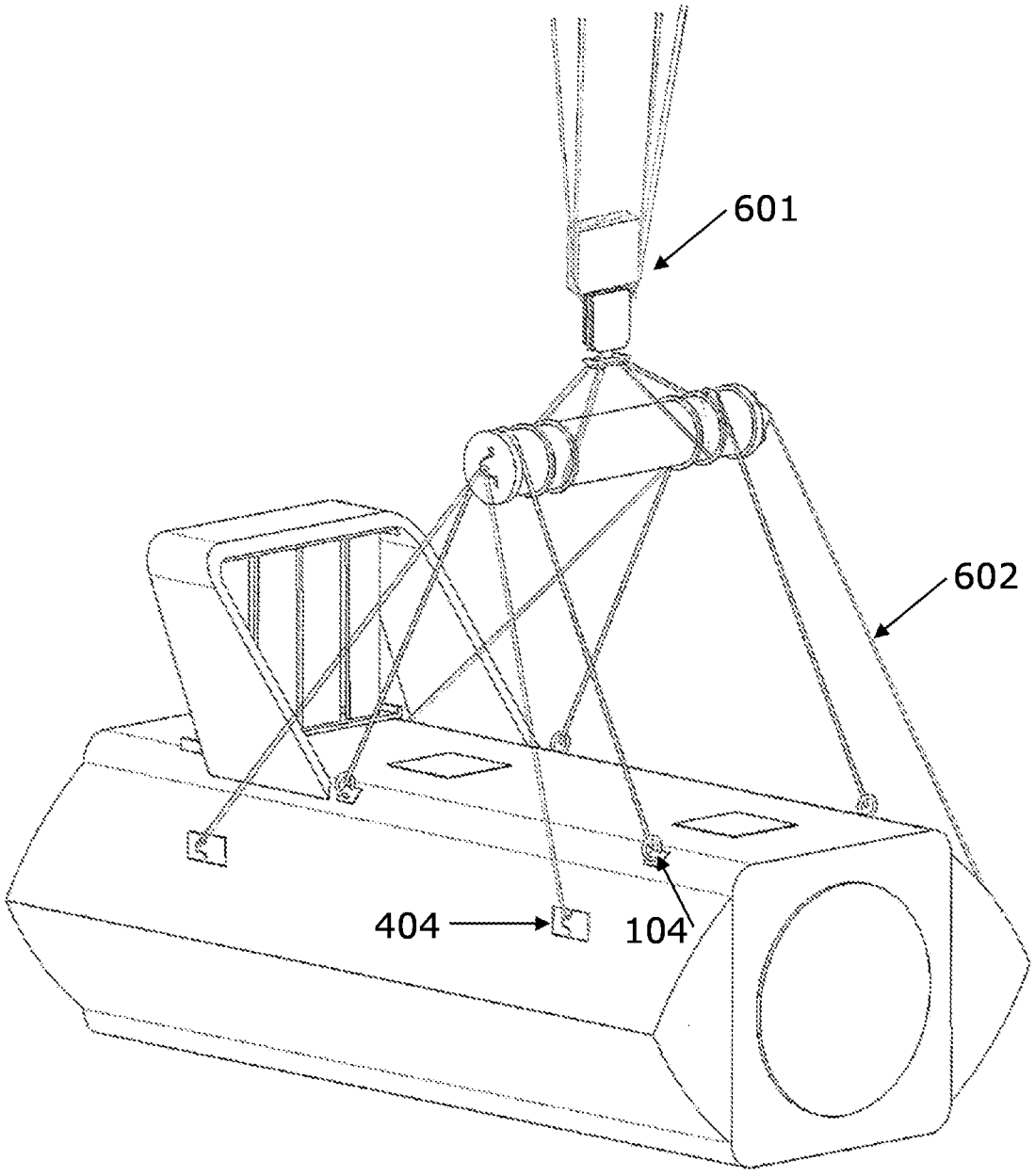


FIG. 6

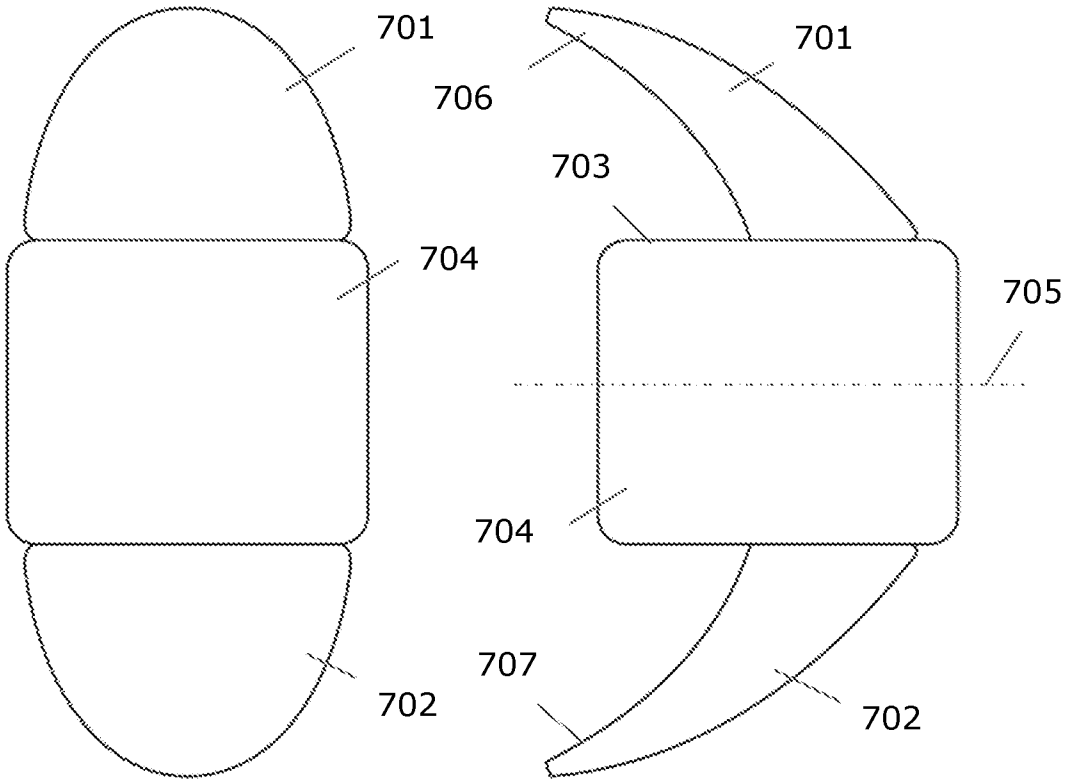


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/DK2016/050457

A. CLASSIFICATION OF SUBJECT MATTER
INV. F03D13/10
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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2010/094287 A2 (VESTAS WIND SYS AS [DK]; PEDERSEN GUNNAR KAMP STORGAARD [DK]) 26 August 2010 (2010-08-26)	1-7,9-17
A	abstract page 6, line 31 - page 11, line 5 figures	8

X	GB 2 466 209 A (VESTAS WIND SYS AS [DK]) 16 June 2010 (2010-06-16)	13-16
A	abstract page 11, line 25 - page 13, line 16 figures	1-12,17

X	EP 2 669 238 A1 (SIEMENS AG [DE]) 4 December 2013 (2013-12-04) abstract paragraph [0047] - paragraph [0061] figures	1-17

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
9 March 2017	16/03/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Kolby, Lars

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/DK2016/050457

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	WO 2013/091632 A1 (VESTAS WIND SYS AS [DK]; FRIIS JESPER FYHN [DK]) 27 June 2013 (2013-06-27) abstract figure 7	1-17

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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