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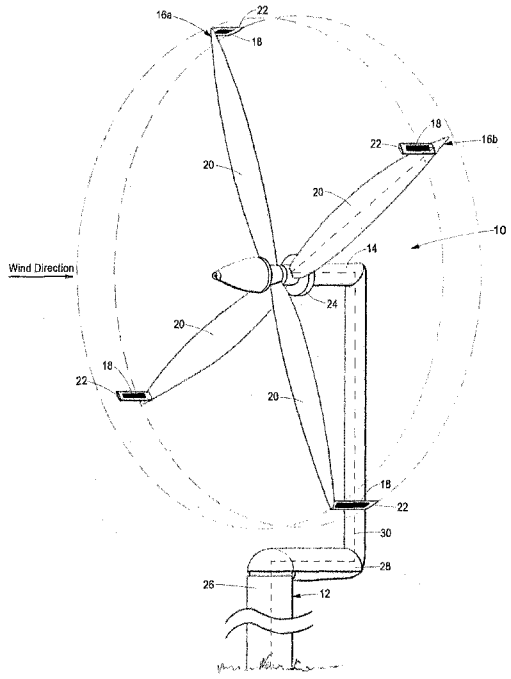

(57) Abstract: The wind turbine (10) includes a shaft (14), a first and a second propeller (16a, 16b) which are rotatably connected to the shaft (14) and rotate in opposite directions. At least one permanent or electro-magnet (18) is located on the first propeller (16a) and at least one coil (18) is located on the second propeller (16b). By that way the generator is integrated in the rotating propellers (16a, b). Each propeller-blade can include a tab (22) projecting towards the other propeller (16a, b) and carrying a magnet (18) or a coil (18).

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Generator

BACKGROUND

The present invention relates to a generator. More specifically, the present invention relates to a contra-rotating generator for generating electricity from the wind.

Contra-rotating wind-powered generators are known. For instance, each of US774,168 "Windmill", US2,153,523 "Wind operated electric generator", US2,237,857 "Wind operated generator", US4,213,057 "Wind energy conversion device", US4,039,848 "Wind operated generator", US5,506,453 "Machine for converting wind energy to electrical energy", US6,476,513 "Electrical generator system", US6,619,921 "Driving vane assembly for a windmill" and US7,679,249 "Contra rotating generator" describe wind generators including counter-rotating sets of blades that drive counter-rotating shafts linked to an electric generator.

A drawback of known contra-rotating wind-powered generators is that the rotating shafts and separate electric generator are somewhat complex and bulky and add weight to the systems. Futhermore, to increase the speed at which the flux fields cut each other, they often require complex gearboxes.

The generator according to the present invention aims to address these drawbacks.

SUMMARY OF THE INVENTION

According a preferred embodiment of the present invention there is provided a generator including:

a shaft;

a first propeller rotatably connected to the shaft;

a second propeller rotatably connected to the shaft, the second propeller having a pitch opposite to that of the first propeller;

at least one permanent or electro magnet on the first propeller; and

at least one coil on the second propeller.

Preferably, the first and second propellers are spaced axially along the shaft.

Typically, the electro or permanent magnets and coils are: (i) spaced radially substantially the same distance from the axis of the shaft to form an axial flux electric motor; or (ii) spaced relative to each other radially relative to the axis of rotation to form an axial flux electric motor.

Generally, the electro or permanent magnets and coils are located on the propellers, closer to the free ends of the propellers than the shaft. Preferably, the electro or permanent magnets and coils are located at or near the free ends of the propellers.

Typically, each propeller includes a tab that projects towards the other propeller.

Generally, the tab on one of the propellers is located closer to the shaft than the tab on the other propeller.

Preferably, the tabs on the propellers overlap when aligned but define an air gap there between.

Typically, the permanent or electro magnets and coils are located on the tabs.

Optionally, the magnets and coils are configured to form a radial flux generator.

Typically, the shaft is secured to a mast.

Generally, the shaft is not rotatable relative to the mast.

Preferably, an electric circuit travels from the at least one coil along at least a portion of the mast.

Typically, the electric circuit includes a slip ring located at or near the connection of the second propeller and shaft to electrically connect an electrically conductive cable on the propeller with an electrically conductive cable on the shaft or mast.

The mast may comprise first and second sections rotatably connected to each other. Preferably, the second section of the mast does not extend axially from the first section. More preferably, the shaft is connected to the free end of the second section of the mast and the connection between the shaft and the mast is spaced from the axis of the first section of the mast. Even more preferably, the shaft extends from the second section of the mast towards the axis of the first section of the mast.

Typically, each propeller includes at least two blades with aerofoil cross sections.

Generally, a permanent or electro magnet or coil is located on each propeller blade.

Preferably, the blades in the vicinity of the permanent and/or electro magnets and/or coils are made from a non magnetic and/or non-electrically conductive material.

In a second embodiment, each propeller includes a ring connecting the blades at or near their free ends, and the permanent or electro magnets and coils are located on the propeller rings.

In a third embodiment, each propeller includes a cylindrical section connecting the blades at or near their free ends. Preferably, the permanent or electro magnets and coils are located on the cylindrical sections. More preferably, the internal diameter of the cylindrical section on one of the propellers is greater than the external diameter of the cylindrical section on the other propeller.

Typically, the generator is powered by wind.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in more detail, by way of examples only, with reference to the accompanying drawings in which:

Figure 1 is a perspective side view of a generator according a preferred embodiment of the present invention;

Figure 2 is a side view of the generator in Figure 1;

Figure 3 is a perspective view of a generator according to a second embodiment of the invention with the free ends of each propeller connected by a ring; and

Figure 4 is a perspective view of a generator according to a third embodiment of the invention with the blades of each propeller connected by a cylindrical section.

DESCRIPTION OF EMBODIMENTS OF THE INVENTION

With reference to Figures 1 and 2 of the drawings, a generator 10 according to a preferred embodiment of the present invention is in the form of a wind powered electric generator that includes a mast 12, a shaft 14, a first propeller 16a, a second propeller 16b, and permanent and/or electro magnets 18 on the first propeller 16a and coils 18 on the second propeller 16b.

The propellers 16a 16b are rotatably connected to the shaft 14 and spaced axially along the shaft 14. Each propeller 16 comprises two blades 20, each blade 20 being rotatably connected at one end either directly or indirectly to the shaft 14 and having an aerofoil cross sectional shape. The blades on the first propeller 16a are set at an opposite pitch to the blades on the second propeller 16b to cause the propellers 16a and 16b to contra-rotate in the presence of wind (not shown).

In an alternative embodiment (not shown), the blades 20 may be connected to the shaft 14 by a hub with control rods to vary the pitch of the blades 20 in response to changes in wind speed.

Each blade 20 on a propeller 16 includes a tab 22 at or near its free end that projects towards the blades 20 on the other propeller 16. The tab 22 on the second propeller 16b is located closer to the shaft 14 (i.e. radially inwards relative to the axis of rotation of the propellers 16) than the tab 22 on the first propeller 16a so that they overlap when aligned to define a small air gap there between.

Propeller 16a includes a permanent magnet or an electro magnet 18 at or near the distal ends of its blades 20 on tab 22, whereas propeller 16b includes a coil at or near the distal ends of its blades 20 on tab 22. The electro or permanent magnets 18 and coils 18 located on the tabs 22 are configured to form a radial flux generator.

Although the permanent or electro magnets 18 and coils 18 are described as being at or near the distal ends of the blades 20, it will be appreciated that the magnets and coils could be located in any other location on the propellers 16. However, the further the magnets 18 are located from the shaft 14, the greater the speed the flux fields generated by the permanent or electro magnets 18 will cut each the coils 18. As such, the permanent or electro magnets and coils 18 are preferably located on the propellers 16, closer to the free ends of the blades 20 than the shaft 14.

Importantly, the blades 20 (at least, in the vicinity of the permanent or electro magnets and coils 18) and tabs 22 are made of a non-magnetic and/or non-electrically conductive material.

However, the generator 10 according to the present invention is not limited to a radial flux arrangement. The magnets 18 and coils 18 could alternatively be secured directly to the blades (i.e. not via tabs 22) and equally spaced from the axis of the shaft to form an axial flux electric generator. But, it will be appreciated that the radial flux electric generator arrangement described above is less susceptible to flexing of the blades 20 than the axial flux electric generator arrangement - the tabs 22, permitting the propellers 16 to be spaced axially further from each other while maintaining only a small air gap between the permanent or electro magnets 18 and coils 18.

The shaft 14 is cylindrical. Bearings (not show) are located between the shaft 14 and the propellers 16. And, a slip ring 24 is mounted on the shaft 14 proximate the second propeller 16b to electrically connect the shaft and the electro-magnets 18 on the second propeller 16b.

The mast 12 comprises a first section 26 that is at an operative bottom end, in use, secured to a foundation (not shown) embedded in the ground, and extends vertically. A second section 28 of the mast 12 is rotatably connected at an operative bottom end to the operative top end of the first section 26. The second section 28 extends orthogonally from the first section 26 before bending through 90 degrees to extend in a direction parallel to the axis of the first section 26.

The shaft 14 is secured against rotation to the operative top end of the second section 28, and extends radially towards the first section 26 of the mast. In this arrangement, wind, causes the second section 28 to swing down wind of the first section 26, however, with the shaft 14 extending radially towards the first first section 26 and the propellers 16 rotatably connected to the shaft 14, the wind causes the propellers to rotate orthogonally to the direction of the wind, without the wind being obstructed by the mast 12.

An electrically conductive cable 30 extends from the coils 18, via the slip ring 24, along the shaft 14, down the mast 12 (i.e. along the second section 28, via a second slip ring (not shown) and along the first section 26) to conduct electricity generated by the contra-rotating permanent or electro magnets 18 and coils 18 to a battery or an electrical circuit (not shown).

In a second embodiment shown in Figure 3, a ring 132 connects the free ends of the propellers 116a and 116b The ring on each of the propellers 116 having the same diameter so as to overlap each other with a small air gap therebetween. A plurality of permanent or electro magnets 118 are located on one of the rings 132, while coils 118 are located on the other ring 132. It will be appreciated that the inclusion of rings 132 increases the generator's 110 capacity to house magnets and coils 118 while simultaneously increasing the stiffness of the propellers 116.

In a third embodiment shown in Figure 4, each propeller 216 includes a cylindrical section 332 coaxial with the shaft 214 that connects the propeller blades. The cylindrical sections 332 can be regarded as "extensions" of the tabs 22 in Figure 1. The cylindrical section 332 on the first propeller 216a has a greater diameter than the cylindrical section 332 on

the second propeller 216b, such that the cylindrical section on the second propeller 216b locates and rotates within the cylindrical section on the first propeller 216b. A plurality of permanent or electro magnets 218 are located on one of the cylindrical sections 232, while coils 218 are located on the other cylindrical section 232. As with the second embodiment, this arrangement increases the generator's 210 capacity to house magnets and coils 218 while simultaneously increasing the stiffness of the propellers 216.

It will be appreciated that locating the magnets on the propellers instead of causing the propellers to rotate a shaft that, in turn, drives a generator simplifies the electric generator 10. The reduction in moving parts also makes the generator 10 more stable and reduces the weight of the mechanism at the top end of the mast 12.

CLAIMS

1. A generator including:

a shaft;

a first propeller rotatably connected to the shaft;

a second propeller rotatably connected to the shaft, the second propeller having a pitch opposite to that of the first propeller;

at least one permanent or electro magnet on the first propeller; and

at least one coil on the second propeller.

2. A generator according to claim 1, wherein the first and second propellers are spaced axially along the shaft.

3. A generator according to claim 2, wherein the electro or permanent magnets and coils are: (i) spaced radially substantially the same distance from the axis of the shaft to form an axial flux electric motor; or (ii) spaced relative to each other radially relative to the axis of rotation to form an axial flux electric motor.

4. A generator according to claim 3, wherein the electro or permanent magnets and coils are located on the propellers, closer to the free ends of the propellers than the shaft.

5. A generator according to claim 4, wherein the electro or permanent magnets and coils are located at or near the free ends of the propellers.

6. A generator according to claim 5, wherein each propeller includes a tab that projects towards the other propeller.

7. A generator according to claim 6, wherein the tab on one of the propellers is located closer to the shaft than the tab on the other propeller.

8. A generator according to claim 7, wherein the tabs on the propellers overlap when aligned but define an air gap there between.

9. A generator according to claim 8, wherein the permanent or electro magnets and coils are located on the tabs.

10. A generator according to claim 9, wherein the magnets and coils are configured to form a radial flux generator.

11. A generator according to claim 10, wherein the shaft is secured to a mast.

12. A generator according to claim 11, wherein the shaft is not rotatable relative to the mast.

13. A generator according to claim 12, wherein an electric circuit travels from the at least one coil along at least a portion of the mast.

14. A generator according to claim 13, wherein the electric circuit includes a slip ring located at or near the connection of the second propeller and shaft to electrically connect an electrically conductive cable on the propeller with an electrically conductive cable on the shaft or mast.

15. A generator according to claim 14, wherein the mast comprises first and second sections rotatably connected to each other.

16. A generator according to claim 15, wherein the second section of the mast does not extend axially from the first section.

17. A generator according to claim 16, wherein the shaft is connected to the free end of the second section of the mast and the connection between the shaft and the mast is spaced from the axis of the first section of the mast.

18. A generator according to claim 17, wherein the shaft extends from the second section of the mast towards the axis of the first section of the mast.

19. A generator according to claim 18, wherein each propeller includes at least two blades with aerofoil cross sections.

20. A generator according to claim 19, wherein a permanent or electro magnet or coil is located on each propeller blade.

21. A generator according to claim 20, wherein the blades in the vicinity of the permanent and/or electro magnets and/or coils are made from a non magnetic and/or non-electrically conductive material.

22. A generator according to claim 5, wherein each propeller includes a ring connecting the blades at or near their free ends.

23. A generator according to claim 22, wherein the permanent or electro magnets and coils are located on the propeller rings.

24. A generator according to claim 5, wherein each propeller includes a cylindrical section connecting the blades at or near their free ends.

25. A generator according to claim 24, wherein the permanent or electro magnets and coils are located on the cylindrical sections.

26. A generator according to claim 25, wherein the internal diameter of the cylindrical section on one of the propellers is greater than the external diameter of the cylindrical section on the other propeller.

27. A generator according to claim 21, claim 23 or claim 26, wherein the generator is powered by wind.

CLAIMS

1. A generator including:

a shaft;

a first propeller rotatably connected to the shaft;

a second propeller rotatably connected to the shaft, the second propeller having a pitch opposite to that of the first propeller;

the first propeller including a first tab located closer to the free end of the first propeller than the shaft, which first tab projects towards the second propeller;

the second propeller including a second tab located closer to the free end of the second propeller than the shaft, which second tab projects towards the first propeller;

the tab on one of the propellers being located closer to the shaft than the tab on the other propeller.

at least one permanent or electro magnet on the first tab extending from the first propeller; and

at least one coil on the second tab extending from the second propeller,

characterized in that the at least one electro or permanent magnet on the one hand and the at least one coil on the other hand are spaced relative to each other radially relative to the axis of rotation to form a radial flux generator.

2. A generator according to claim 1, wherein the first and second propellers are spaced axially along the shaft.

3. A generator according to claim 2, wherein the tabs on the propellers overlap when aligned but define an air gap there between.

4. A generator according to claim 3, wherein the shaft is secured to a mast.

5. A generator according to claim 4, wherein the shaft is not rotatable relative to the mast.

6. A generator according to claim 5, wherein an electric circuit travels from the at least one coil along at least a portion of the mast.

7. A generator according to claim 6, wherein the electric circuit includes a slip ring located at or near the connection of the second propeller and shaft to electrically connect an electrically conductive cable on the propeller with an electrically conductive cable on the shaft or mast.

8. A generator according to claim 7, wherein the mast comprises first and second sections rotatably connected to each other.

9. A generator according to claim 8, wherein the second section of the mast does not extend axially from the first section.

10. A generator according to claim 9, wherein the shaft is connected to the free end of the second section of the mast and the connection between the shaft and the mast is spaced from the axis of the first section of the mast.

11. A generator according to claim 10, wherein the shaft extends from the second section of the mast towards the axis of the first section of the mast.

12. A generator according to claim 11, wherein each propeller includes at least two blades with aerofoil cross sections.

13. A generator according to claim 12, wherein a permanent or electro magnet or coil is located on each propeller blade.

14. A generator according to claim 13, wherein the blades in the vicinity of the permanent and/or electro magnets and/or coils are made from a non magnetic and/or non-electrically conductive material.

15. A generator according to claim 2, wherein each propeller includes a ring connecting the blades at or near their free ends.

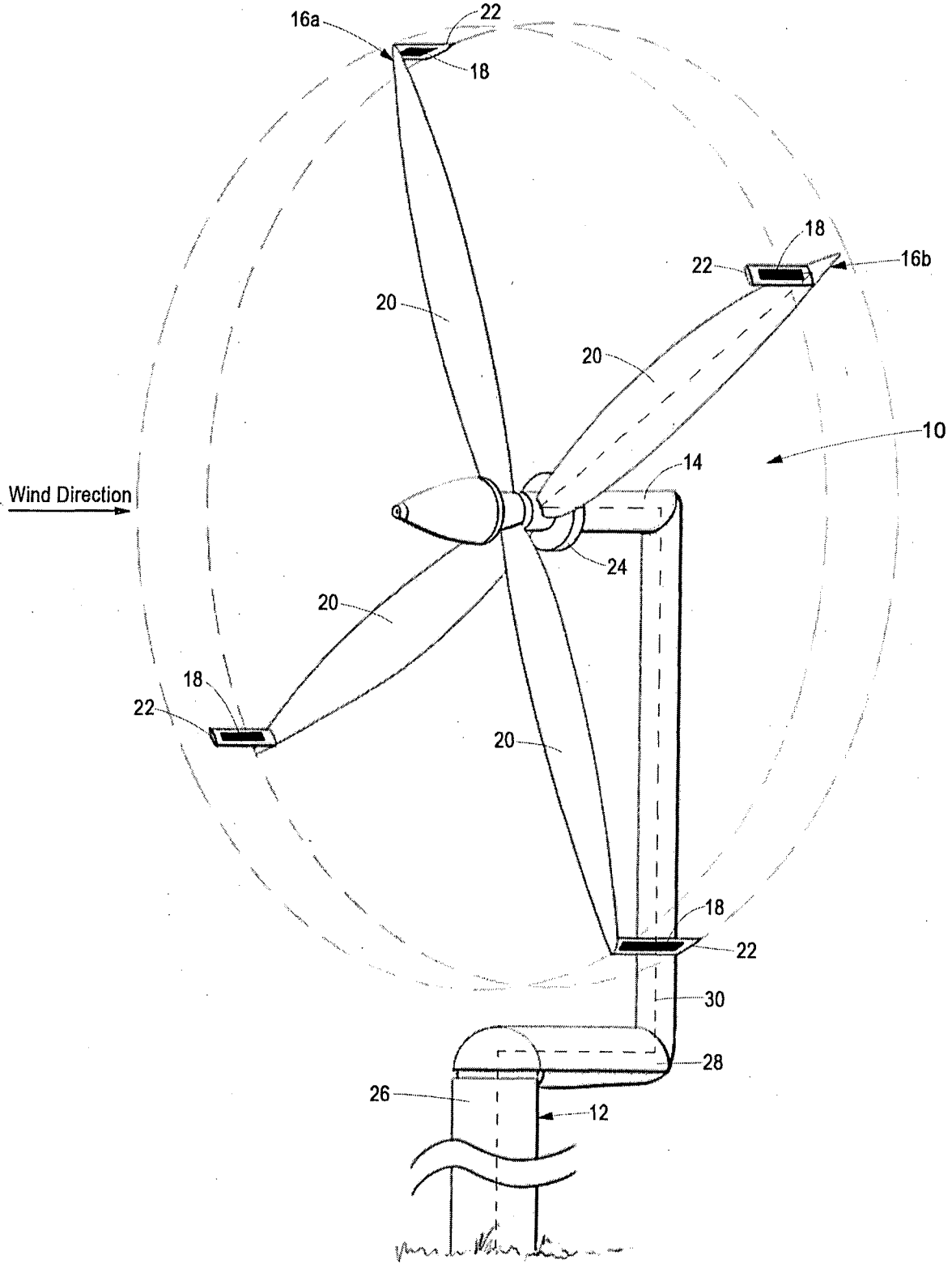
16. A generator according to claim 15, wherein the tabs, permanent or electro magnets and coils are located on the propeller rings.

17. A generator according to claim 2, wherein each propeller includes a cylindrical section connecting the blades at or near their free ends.

18. A generator according to claim 17, wherein the permanent or electro magnets and coils are located on the cylindrical sections.

19. A generator according to claim 18, wherein the internal diameter of the cylindrical section on one of the propellers is greater than the external diameter of the cylindrical section on the other propeller.

20. A generator according to claim 14, claim 16 or claim 19, wherein the generator is powered by wind.


16a
22
18
18
22
16b
20
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10
14
Wind Direction
24
20
18
22
20
18
22
30
28
26
12

Figure 1

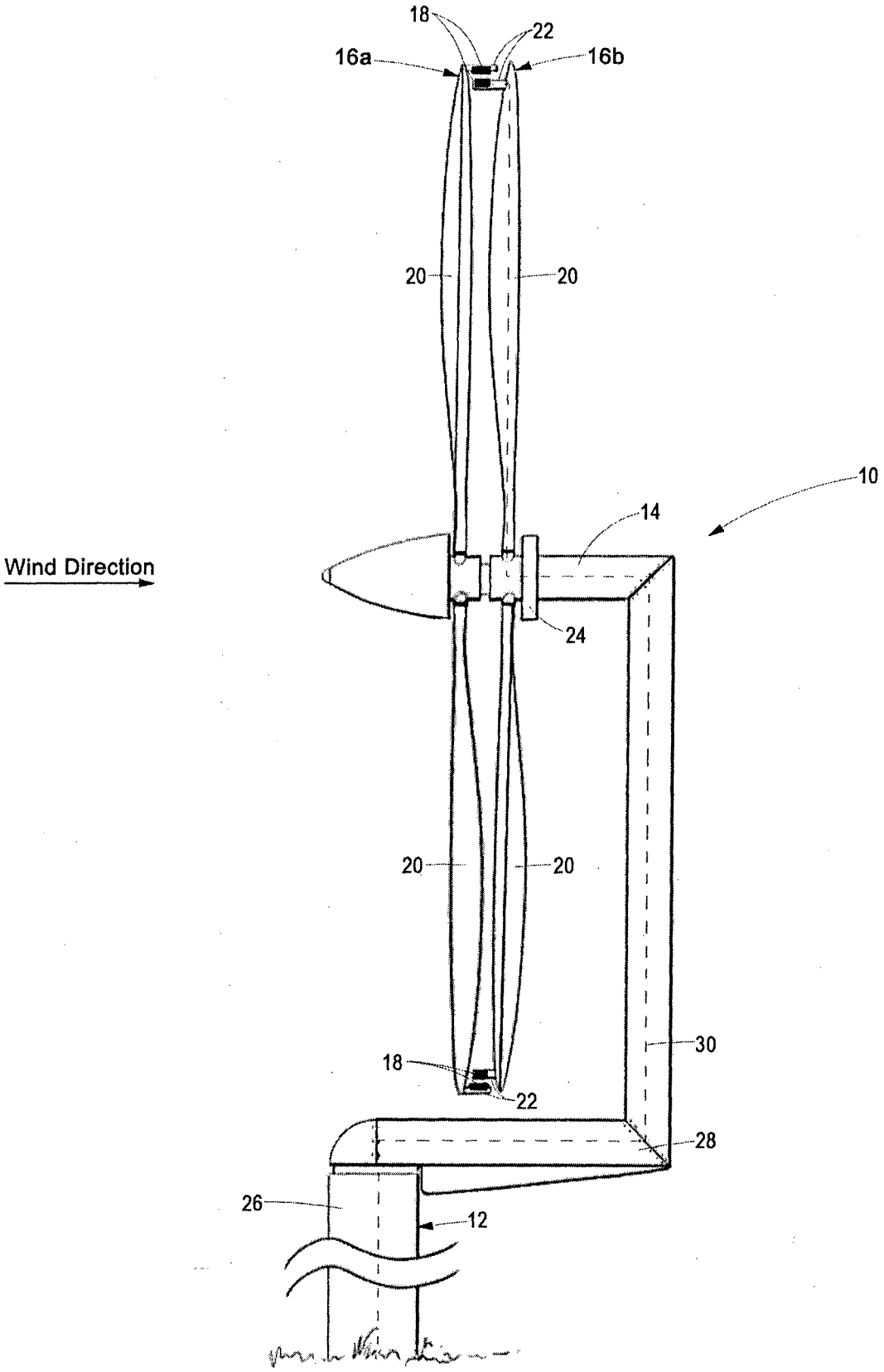

Figure 2

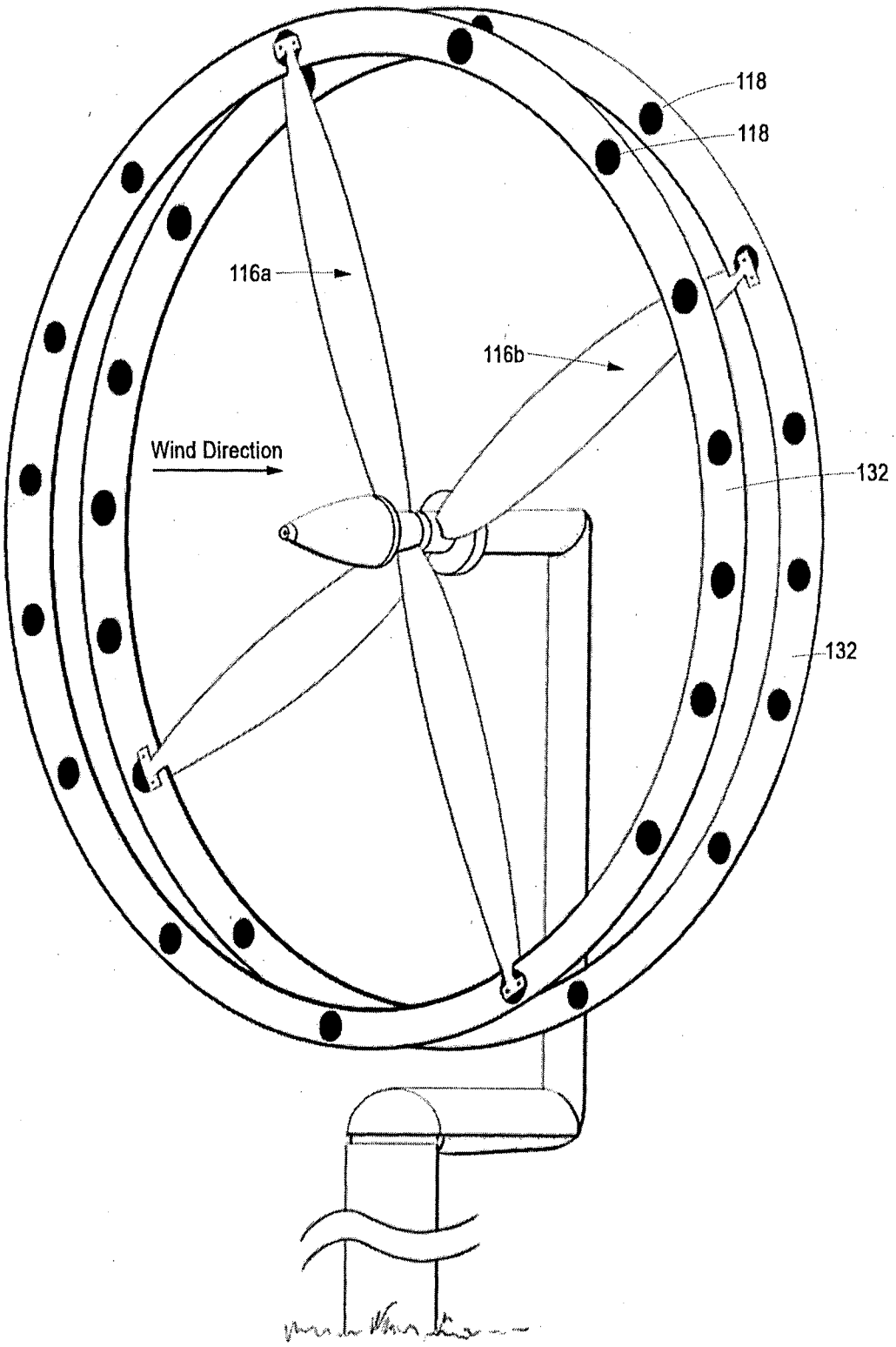

Figure 3

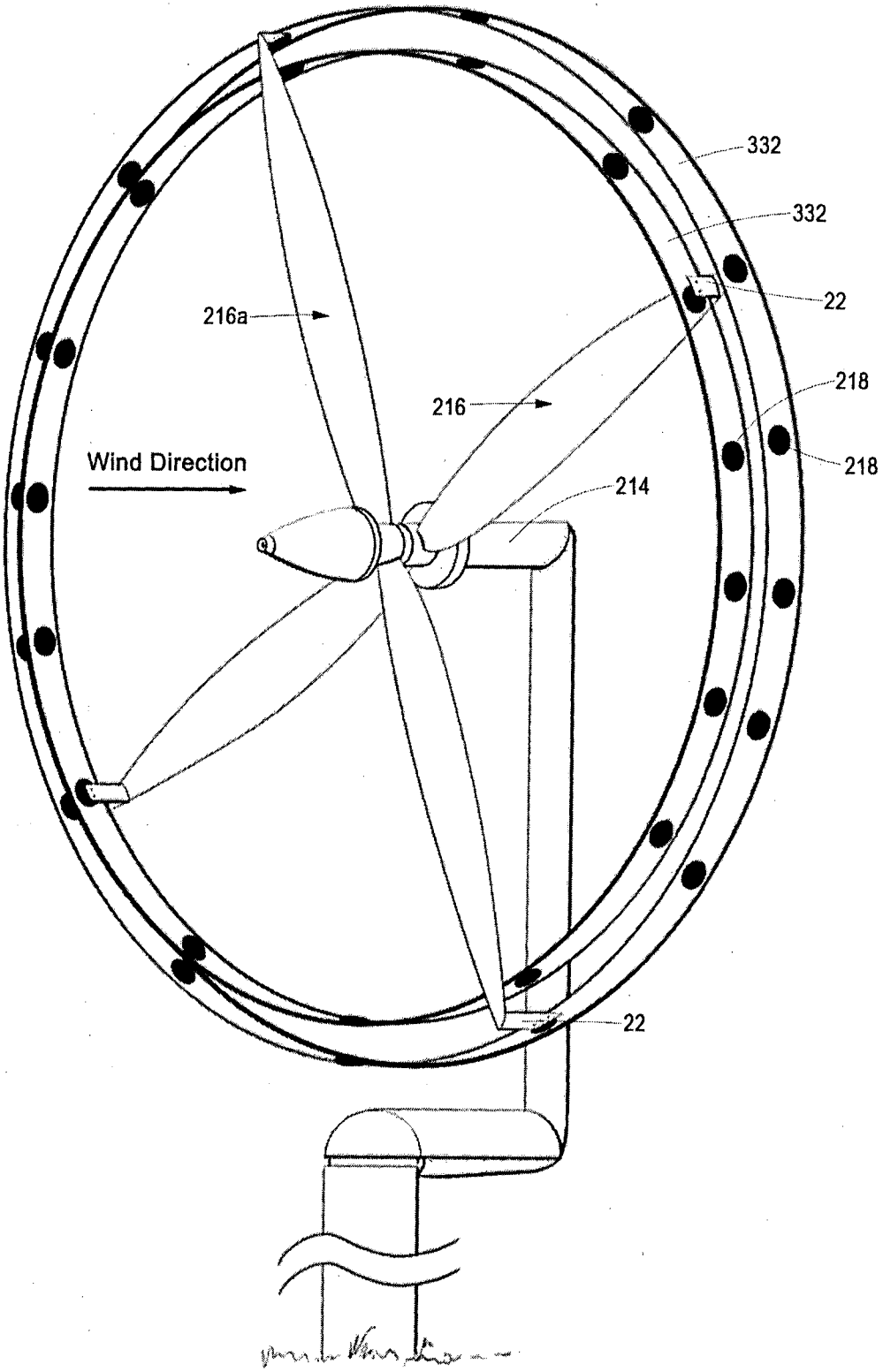

Figure 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT / ZA 2012/000076

A. CLASSIFICATION OF SUBJECT MATTER

IPC: ***F03D 9/00*** (2006.01); ***F03D 11/04*** (2006.01); ***F03D 1/02*** (2006.01); ***H02K 7/18*** (2006.01)

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, H02K

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)

EPODOC, FULLTEXT

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 1944239 A (HONNEF) 23 January 1934 (23.01.1934) Fig. 1-3, page 1 lines 39-59	1-5, 22-27
X	US 2167265 A (HONNEF ET AL.) 25 July 1939 (25.07.1939) Fig. 1-3, page 1 line 41 - page 2 line 6, page 2 lines 32-39	1-5, 22-27
X	DE 733223 C (HONNEF) 22 March 1943 (22.03.1943) Fig. 1, page 2 lines 8-31	1-5, 22-27
A		14
X	DE 102010007214 A1 (WEH) 11 August 2011 (11.08.2011) Fig. 1, 1b, abstract	1-3, 24-27
A	DE 3606353 A1 (FEDDERSEN) 22 January 1987 (22.01.1987) Fig. 1, column 7 lines 12-24	15-18

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 December 2012 (14.12.2012)	27 December 2012 (27.12.2012)
Name and mailing address of the ISA/AT Austrian Patent Office Dresdner Straße 87, A-1200 Vienna Facsimile No. +43 / 1 / 534 24-535	Authorized officer EHRENDORFER K. Telephone No. +43 / 1 / 534 24-367

INTERNATIONAL SEARCH REPORT

International application No.

PCT / ZA 2012/000076

C. (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2010059092 A1 (OESTERGOETLANDS FASTIGHETSSERVICE) 27 May 2010 (27.05.2010) Fig. 2	15-18

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT / ZA 2012/000076

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			US	A	2167265	1939-07-25
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DE	A1	3606353	DE	A1	3606353	1987-01-22
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			EP	A1	2361356	2011-08-31
			WO	A1	2010059092	2010-05-27
			US	A1	2011260464	2011-10-27