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(71) Applicant(s):
John Butkus
Glenroy, King Street, WINTERTON, Lincs,
DN15 9RN, United Kingdom

Robert Evans
71 Broadway, Llanblethian, COWBRIDGE,
South Wales, CV71 7EY, United Kingdom

(72) Inventor(s):
John Butkus
Robert Evans

(74) Agent and/or Address for Service:
Chapman Molony
Cardiff Business Technology Centre,
Senghennydd Road, Cathays, CARDIFF, CF24 4AY,
United Kingdom

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(56) Documents Cited:
US 5062765 A **US 4926061 A**
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(58) Field of Search:
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Other: **EPODOC, TXTE, WPI**

(54) Title of the Invention: **Wind turbine**
Abstract Title: **Stackable modular wind turbine for generating electrical power**

(57) The wind turbine 10 comprises a frame having a base 16 and a head 17, and a rotor 12 which is arranged to rotate about a longitudinal axis of the frame, eg about a vertical axis. The turbine further comprises at least two, eg four, blades 15 extending parallel to the rotor 12 and coupled to the rotor. At least one of the frame base 16 and the frame head 17 comprise coupling means which enables the frame base of one wind turbine to detachably couple with the frame head of another wind turbine, such that the wind turbines can be stacked one upon another. The central region of the frame base 16 may have a rotor bearing housing 20 having a flange 21 coupled to a generator 22. The central region of the frame head 17 may have a rotor bearing housing 23. The turbine may have a processing unit for recording and processing operational data associated with the turbine, eg rotor revolution rate and frames stresses.

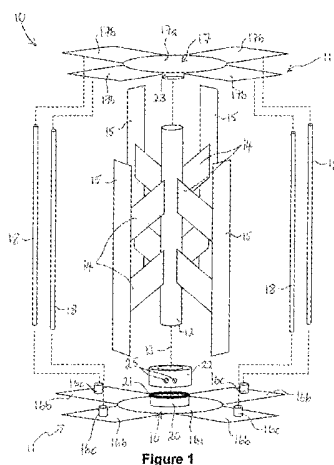


Figure 1

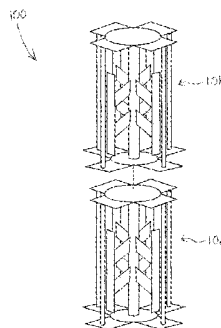


Figure 3

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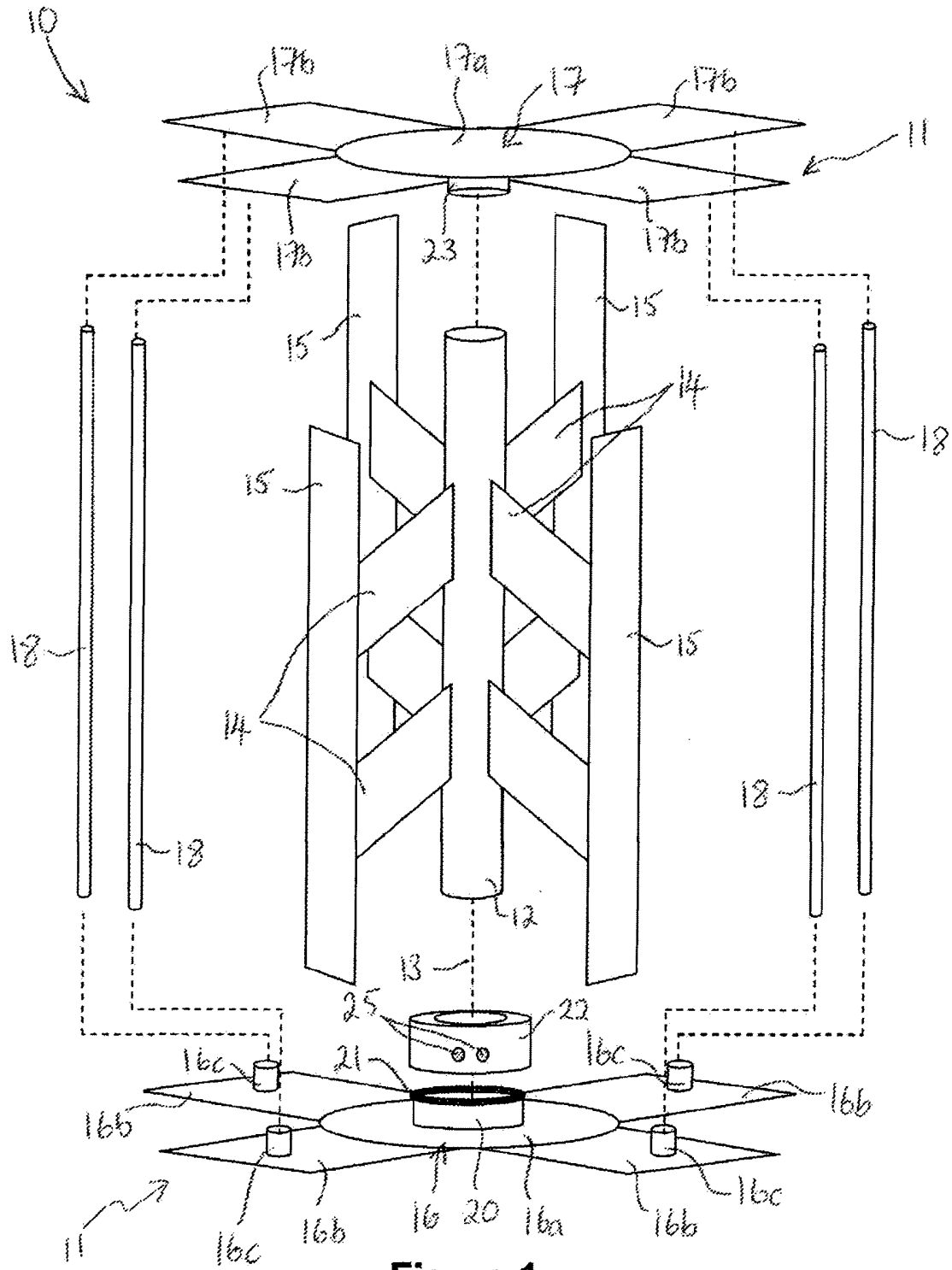


Figure 1

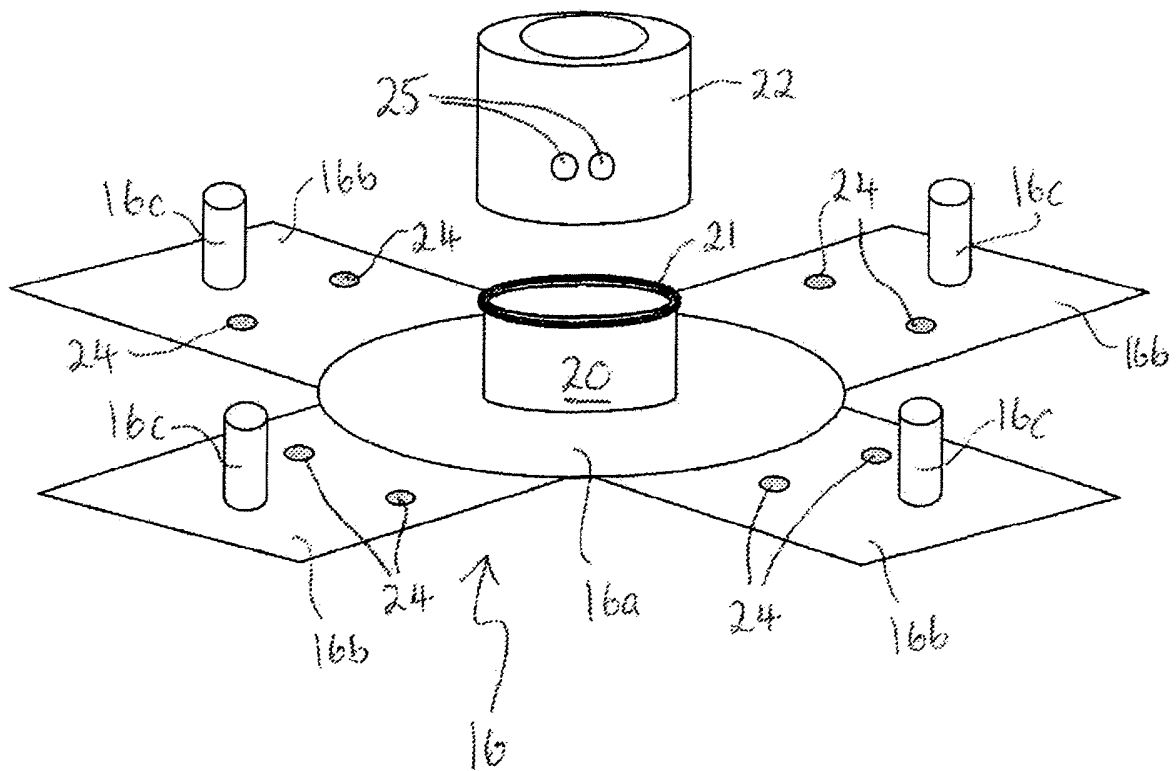


Figure 2

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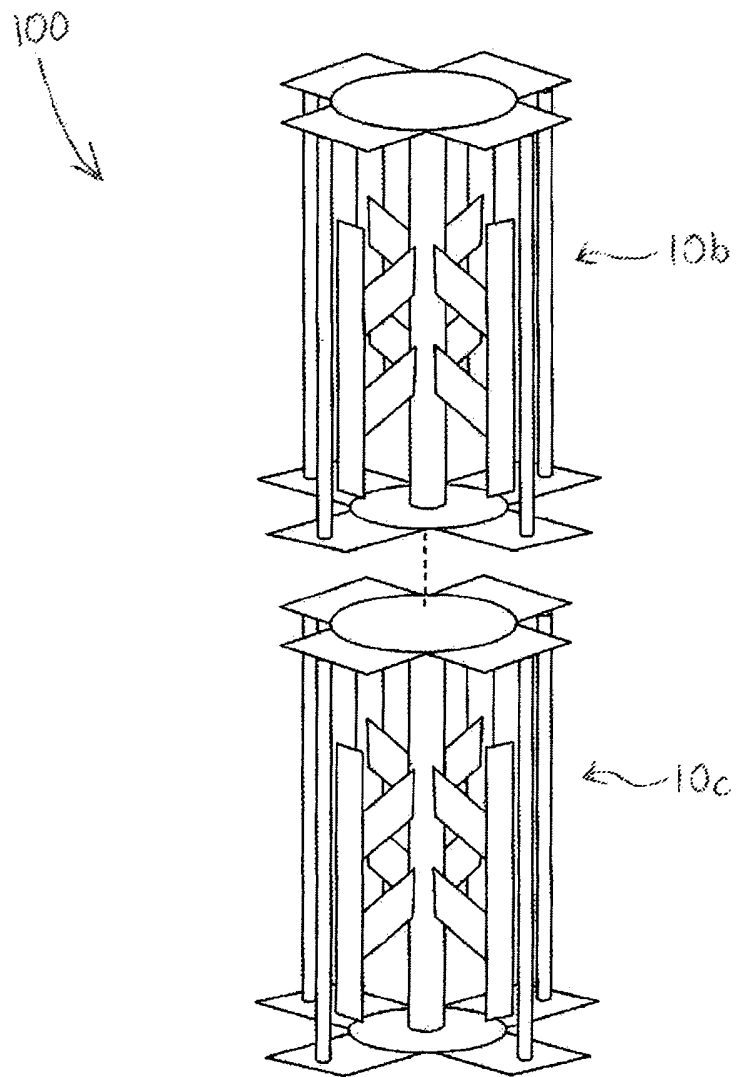


Figure 3

Wind Turbine

The present invention relates to a wind turbine.

5 Vertical axis wind turbines are well known alternatives to the more traditional horizontal axis wind turbines. Vertical axis wind turbines offer the advantage that they can be sited closer together, since the turbines create less wake turbulence downstream of the turbine, compared with horizontal axis turbines. In addition, vertical axis wind turbines typically house the gear mechanism and generator near the ground which provides for
10 ease of repair and maintenance.

Vertical axis wind turbine can be grouped into two basic designs, namely the Darrieus design and the Savonius design. In the Darrieus design, two blades are arranged to arc between an upper and lower region of a vertically orientated boom. The blades are
15 arranged to rotate around the boom during a flow of air over the blades, to generate electricity. However, it is found that the design creates a periodic stressing of the boom as the blades rotate about the boom, since the driving force upon the blades produced by the flow of air over the blades, will increase and decrease during a complete revolution around the boom. This is found to create a pulsating torque which can lead to
20 an early failure of the turbine.

The Savonius design comprises two arcuate panels which are coupled together either side of a vertically orientated rotor such that the panels form an S-shaped cross-sectional profile. The Savonius design suffers less stress loading compared with the
25 Darrieus design, but the weight of the panels limit the speed of rotation about the rotor and thus the electrical power that can be generated.

In addition, since both the Darrieus and Savonius designs are vertically orientated, the wind flow across the lower region of the respective turbine is often less than the wind flow
30 across the upper region of the respective turbine, with the result that the lower region of the turbine contributes very little to the overall rotation of the turbine blades/panels. Accordingly, vertical axis wind turbines typically require a support platform for mounting the respective turbine at an elevated position and therefore require considerable time

and planning to site at a particular location. As a result, it can be a difficult time consuming task to relocate and erect a vertical axis wind turbine.

We have now devised a wind turbine which addresses these limitations.

5

In accordance with a first aspect of the present invention, there is provided a wind turbine, the turbine comprising a frame having a frame base and a frame head, and a rotor which is arranged to rotate about a longitudinal axis thereof,

the turbine further comprising at least two blades coupled to the rotor, which are
10 arranged to interact with a flow of air to cause the rotor to rotate with respect to the frame, wherein,

at least one of the frame base and frame head comprise coupling means which enables the frame base of one wind turbine to detachably couple with the frame head of another wind turbine such that the wind turbines can be stacked one upon another.

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The modular nature of the turbine thus enables several units to be readily transported and a tower 100 of two or more turbines to be erected to generate the required amount of electrical power. If necessary, further units can be added or removed to tailor the particular electrical power requirements.

20

The rotor is preferably rotatably coupled at one end to the frame base and at the other end to the frame head.

Preferably, the rotor is arranged to extend in a substantially vertical orientation.

25

The coupling means preferably comprises a plurality of apertures disposed within the frame base which are arranged to align with a plurality of apertures disposed in the head of another wind turbine, for receiving fastening means. Alternatively, or in addition thereto, the coupling means may comprise a male and female type coupling
30 arrangement which enable the frame base of one wind turbine to detachably couple with the frame head of another wind turbine.

Preferably, the blades are arranged to extend substantially parallel to the rotor. The blades are preferably spaced around the rotor by substantially equal angles. Preferably,

the turbine comprises four blades angularly spaced around the rotor by substantially 90° . Each blade preferably comprises an aerofoil cross-sectional shape.

5 Preferably, the base comprises four arms which extend substantially radially of the base, away from the base. The head preferably comprises four arms which extend radially of the head, away from the head.

10 The frame preferably further comprises four legs which separately extend between an arm on the head and an arm on the base to hold the head and the base in spaced relation.

Preferably, the frame is substantially four-fold rotationally symmetric, such that the frame appears unchanged when rotated through substantially 90° .

15 The base and head preferably separately comprise a bearing housing disposed substantially at the centre of the base and head respectively, for receiving one end of the rotor.

20 The bearing housing disposed upon the base preferably further comprises means for coupling a generator thereto. The rotor is preferably arranged to extend through the generator to provide relative rotational movement between the rotor and the generator to generate electricity.

25 The wind turbine preferably further comprises a processor for processing operational data relating to the turbine, and sensing means for sensing the operational characteristics of the wind turbine.

30 Preferably, the turbine further comprises electrical terminals for extracting the electrical energy generated by the generator.

In accordance with a second aspect of the present invention, there is provided a wind turbine system, the system comprising at least two wind turbines of the first aspect mounted one on top of the other.

Preferred features of the wind turbine system may comprise one or more of the features of the wind turbine of the first aspect.

5 In accordance with a third aspect of the present invention there is provided a method of generating electricity, the method comprising the use of the wind turbine according to the first aspect.

An embodiment of the present invention will now be described by way of example only and with reference to the accompanying drawings in which:

10

Figure 1 is an exploded view of a wind turbine according to an embodiment of the present invention;

Figure 2 is a magnified view of the base of the wind turbine illustrated in figure 1; and,

15

Figure 3 is an exploded view of a wind turbine system according to an embodiment of the present invention.

Referring to figure 1 of the drawings, there is illustrated an exploded view of a wind turbine 10 according to an embodiment of the present invention. The wind turbine 10 is arranged to stack upon another substantially identical turbine 10, such that a tower 100 of turbines can be erected as required to generate the required amount of electricity. The modular nature of the turbines 10 means that the required number of turbines 10 can be transported and secured together at the required location to satisfy the electrical power requirements at the site.

25

The wind turbine 10 comprises a frame 11 and a substantially linear rotor 12 which is arranged to extend substantially along a longitudinal axis 13 of the turbine, and which is arranged to rotate about the longitudinal axis 13 with respect to the frame 11. The rotor 12 further comprises a plurality of blade supports 14 disposed along the length thereof, which extend radially from the rotor 12 and which terminate at a turbine blade 15. In the embodiment illustrated, the wind turbine 10 comprises four blades 15, which are arranged to extend substantially parallel to the rotor 12 and which are angularly spaced around the rotor 12 by substantially 90° . Each blade support 14 comprises substantially

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the same length so that each blade 15 is separated from the rotor 12 by substantially the same distance. Each blade 15 comprises a transverse cross-sectional profile having an aerofoil shape, such that as air flows over the blades 15, the blades 15 create a component of force analogous to a "lift force", which acts to cause the rotor 12 to rotate.

5

The frame 11 comprises a frame base 16 and frame head 17 which are held in spaced relation by four frame legs 18, which are arranged to extend substantially parallel to the longitudinal axis 13 and thus the rotor 12. The frame base 16 comprises a substantially planar arrangement comprising a central region 16a and four arms 16b which extend
 10 outwardly from the central region 16a in a radial direction. The arms 16b are angularly spaced around the central region 16a by approximately 90° and separately comprise a leg seat 16c disposed at a distal end thereof which is arranged to receive one end of a frame leg 18. The frame head 17 similarly comprises a substantially planar arrangement comprising a central region 17a and four arms 17b which extend outwardly from the
 15 central region 17a in a radial direction. The arms 17b are angularly spaced around the central region 17a of the frame head 17 by approximately 90° and separately comprise a leg seat (not shown) disposed at a distal end thereof which is arranged to receive the other end of a frame leg 18. The resulting frame 11 is substantially rotationally four-fold symmetric about the longitudinal axis 13 and is thus substantially unchanged when
 20 rotated through 90° .

Referring to figure 2 of the drawings, the central region 16a of the frame base 16 comprises a bearing housing 20 comprising a bearing arrangement (not shown). The housing 20 is arranged to receive a lower end of the rotor 12 such that the rotor 12 can
 25 freely rotate within the housing 20 upon the bearing arrangement (not shown). The bearing housing 20 is substantially cylindrical in shape and comprises a flange 21 which extends from an upper open region of the housing 20. The turbine 10 further comprises a generator 22 which is arranged to couple with the flange 21 such that the rotor 12 is arranged to extend through the generator 22 and pass into the bearing housing 20.

30

The central region 17a of the frame head 17 similarly comprises a bearing housing 23 comprising a further bearing arrangement (not shown), and is arranged to receive an upper region of the rotor 12. The bearing housing 20, 23 at the upper and lower regions of the frame thus serve to hold the rotor 12 and thus the blades 15 in a fixed orientation,

while allowing the rotor 12 to rotate within the housings 20, 23 about the longitudinal axis 13.

5 The turbine 10 further comprises a processing unit (not shown) disposed thereon or otherwise arranged in communication with a sensing arrangement (not shown) disposed on the turbine 10, for recording and processing operational data associated with the turbine 10, such as rotor revolution rate, stresses upon the frame 11 and electrical output from the generator 22. The processing unit (not shown) is further arranged to communicate the processed signal to a control unit (not shown) which may be disposed
10 on the turbine 10 or remote to the turbine 10. The control unit (not shown) is further arranged to communicate control signals to the processing unit (not shown) to effect the operation of the wind turbine 10.

15 In use, the modular nature of the wind turbine 10 enables several turbines 10 to be easily transported to the required site and coupled together to provide a wind turbine system suitable for generating electrical power supply. The turbines 10 may be mounted upon the ground and electrically coupled together, or stacked on top of each other to create a tower 100 of turbines as illustrated in figure 3 of the drawings. This is achieved by anchoring the frame base 16 of a first turbine 10a to the ground by passing anchor
20 pins (not shown) through the frame base 16 of the first turbine 10a into the ground. The frame base 16 of a second wind turbine 10b is then placed upon the frame head 17 of the first turbine 10a such that the arms 16b of the frame base 16 of the second turbine 10b align with the arms 17b of the frame head 17 of the first turbine 10a. The frame head 17 and frame base 16 of each turbine 10a, 10b comprise a plurality of aligned
25 apertures 24 (only illustrated in the frame base 16 in the drawings), such that upon mounting the second turbine 10b on top of the first turbine 10a, the apertures 24 in the frame base 16 of the second turbine 10b become aligned with the apertures in the frame head 17 of the first turbine 10a. Suitable fasteners, such as a nut and bolt type fastening arrangement (not shown) may then be located within the aligned apertures 24 to secure
30 the first and second turbines 10a, 10b together. It is also envisaged that the frame head 17 and frame base 16 may comprise or further comprise a male and female type coupling arrangement (not shown), which enables the frame head 17 of the first turbine 10a to readily and detachably couple with the frame base 16 of the second turbine 10b.

If necessary, further turbines may be secured atop the second turbine 10b to provide for more electrical power.

5 With the tower 100 of turbines 10a, 10b suitably erected, electrical terminals 25 on the generators 22 of the turbines 10a, 10b associated with the tower 100 may be coupled to a wiring arrangement (not shown) for converting the generated electrical power to a suitable voltage rating for example, for powering electronic devices (not shown). Once erected, the operation of each turbine 10a, 10b of the tower 100 may be monitored and controlled using the control unit (not shown), which may comprise a computer station
10 (not shown) remotely located to the turbine tower 100. If one or more of the turbines 10a, 10b develop a fault for example, then the control unit (not shown) is arranged to shut down the turbine 10a, 10b, by applying a braking force for example, upon the respective rotor 12 to prevent further rotation. Similarly, if more electrical power is required, then one or more turbines 10a, 10b associated with the tower 100 may be switched on by
15 releasing a braking force.

In a further embodiment which is not illustrated, it is envisaged that the rotor of one turbine of the tower may be coupled with the rotors of other turbines associated with the tower, so that the coupled rotors rotate in unison. In this manner, the blades of one
20 turbine of the tower could be used to assist the rotation of rotors of other turbines of the tower, to enable electrical power to be generated from the generator of each turbine associated with the tower. This coupling of the rotors of the turbines of the units will therefore encourage those turbines which experience little air flow, to turn.

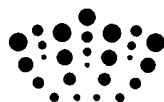
25 From the foregoing therefore, it is evident that the wind turbine of the present invention provides for a simple yet effective means of providing an electrical power supply.

Claims

1. A wind turbine, the turbine comprising a frame having a frame base and a frame head, and a rotor which is arranged to rotate about a longitudinal axis thereof,
5 the turbine further comprising at least two blades coupled to the rotor, which are arranged to interact with a flow of air to cause the rotor to rotate with respect to the frame, wherein,
at least one of the frame base and the frame head comprise coupling means which enables the frame base of one wind turbine to detachably couple with the frame
10 head of another wind turbine, such that the wind turbines can be stacked one upon another.
2. A wind turbine according to claim 1, wherein the rotor is rotatably coupled at one end to the frame base and at the other end to the frame head.
15
3. A wind turbine according to claim 1 or 2, wherein the rotor is arranged to extend in a substantially vertical orientation.
4. A wind turbine according to any preceding claim, wherein the coupling means
20 comprises a plurality of apertures disposed within the frame base which are arranged to align with a plurality of apertures disposed in the head of another wind turbine, for receiving fastening means.
5. A wind turbine according to any preceding claim, wherein the coupling means
25 comprises or further comprises a male and female type coupling arrangement which enable the frame base of one wind turbine to detachably couple with the frame head of the other wind turbine.
6. A wind turbine according to any preceding claim, wherein the blades are
30 arranged to extend substantially parallel to the rotor.
7. A wind turbine according to any preceding claim, wherein the blades are spaced around the rotor by substantially equal angles.

8. A wind turbine according to any preceding claim, wherein the turbine comprises four blades angularly spaced around the rotor by substantially 90° .
9. A wind turbine according to any preceding claim, wherein each blade comprises an aerofoil cross-sectional shape.
10. A wind turbine according to any preceding claim, wherein the base comprises four arms which extend substantially radially of the base, away from the base.
11. A wind turbine according to any preceding claim, wherein the frame head comprises four arms which extend radially of the head, away from the head.
12. A wind turbine according to claims 10 and 11, wherein the frame comprises four legs which separately extend between an arm on the frame head and an arm on the frame base to hold the frame head and the frame base in spaced relation.
13. A wind turbine according to any preceding claim, wherein the frame is substantially four-fold rotationally symmetric, such that the frame appears unchanged when rotated through substantially 90° .
14. A wind turbine according to any preceding claim, wherein the frame base and frame head separately comprise a bearing housing disposed substantially at the centre of the frame base and frame head respectively, for receiving one end of the rotor.
15. A wind turbine according to claim 14, wherein the bearing housing disposed upon the frame base further comprises means for coupling a generator thereto.
16. A wind turbine according to claim 15, wherein the rotor is arranged to extend through the generator to provide relative rotational movement between the rotor and the generator to generate electricity.
17. A wind generator according to any preceding claim, further comprising a processor for processing operational data relating to the turbine, and sensing means for sensing the operational characteristics of the wind turbine.

18. A wind turbine according to claim 15 or 16, further comprising electrical terminals for extracting the electrical energy generated by the generator.
- 5 19. A wind turbine system, the system comprising at least two wind turbines according to any preceding claim, mounted one on top of the other.
20. A method of generating electricity, the method comprising the use of the wind turbine according to any of claims 1 to 18.



Application No: GB1007003.5

Examiner: John Twin

Claims searched: 1 to 20

Date of search: 3 September 2010

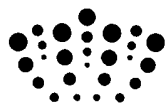
Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-3, 5-7, 9-14, 19, 20 at least	US 4245958 A (Ewers)
X	1-3,5-7,13-16,18-20 at least	US 4134707 A (Ewers)
X	1-4,13,19,20 at least	US 2008/0258468 A1 (Fuller)
X	1-4,13,19,20 at least	US 2009/0246027 A1 (Johnson)
X	1,3,6,7,17,19,20 at least	US 2003/0059306 A1 (Miller)
X	1,3,5-7,9,1719,20 at least	US 5062765 A (McConachy)
X	1-3,6,7,13,17,19,20 at least	US 4926061 A (Arreola)
X	1-3,7,14,17,19,20 at least	US 4321005 A (Black)

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.



Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^X :

Worldwide search of patent documents classified in the following areas of the IPC

F03D

The following online and other databases have been used in the preparation of this search report

EPODOC, TXTE, WPI

International Classification:

Subclass	Subgroup	Valid From
F03D	0003/02	01/01/2006
F03D	0007/06	01/01/2006
F03D	0011/04	01/01/2006