Title of the Invention: Wind Turbine Generator
Abstract Title: Wind turbine with magnetic levitation

A wind turbine assembly includes aerofoil blades 10 secured to a shaft 12 mounted for rotation about a vertical axis relative to stationary supporting structure 32 of the assembly. The supporting structure includes recesses 30 into which the upper and lower ends 22, 24 of the shaft project. First and second magnets 25, 27 of the same polarity are positioned along each side of each recess and along the sides of the shaft which project into the recesses. In use, the shaft levitates due to the repelling forces of the magnets. An electricity generator is provided in the form of a coil (40, fig 2) secured to the stationary structure and positioned between one of the aforesaid magnets and a third magnet 38 of opposite polarity. The ends of the shaft are preferably generally conical and may have a lesser inclined shoulder 16, with the recess being complimentary.

Fig. 1
FIELD OF THE INVENTION

The present invention relates to wind turbine assemblies, particularly vertical axis wind turbine assemblies in which aerofoil blades are supported by a shaft mounted for rotation about a vertical axis within fixed structure of the assembly.

BACKGROUND TO THE INVENTION

Wind turbine assemblies are well known and are proven providers of electrical energy. In these assemblies, aerofoil blades secured to a shaft mounted for rotation about a horizontal or vertical axis are turned by the prevailing wind to cause a metal coil to spin between magnetic poles to induce an alternating current (AC) or direct current (DC) depending on the set-up of the coils. The amount of power produced is dependent on different factors including the size of the aerofoil blades, the efficiency of the mechanical parts and the wind speed.

Relatively small wind turbines can be used to provide power for individual buildings or groups of buildings, or to charge batteries on boats, caravans and motor homes. Additionally, if there is adequate wind, they can provide power for lighting and low consumption appliances in remote buildings; alternatively, they may also supplement other power sources.

Previously proposed wind turbines utilise conventional systems which enable the rotation of the aerofoil blades to drive a separate generator. Other wind turbines use systems in which the blades themselves are magnetized or include magnets in order to generate a moving magnetic field which is picked up
by surrounding coils. Examples of such wind turbines include
2010/0148515.

Generally, the rotary shafts of these wind turbines are
physically supported within static structure of the assembly
with the result that, in use, frictional forces are produced
which create excessive noise and can cause damage to the
turbine. This noise can be disturbing and, if the wind turbine
is located on or next to a building, the vibrations generated
can cause structural damage.

To overcome such issues, wind turbines have been proposed
which utilise the concept of magnetic levitation. An example
of such a wind turbine is disclosed in Japanese Patent
Application JP 2008038605. Magnetic levitation is produced
when like poles of adjacent permanent magnets are closely
are placed on the rotor shaft or on the aerofoil blades. This
has the disadvantage of adding additional weight to the rotor
and/or to the blades making the turbine assembly less
efficient.

These and other disadvantages are overcome, or at least
alleviated, with wind turbines in accordance with the present
invention.

SUMMARY OF THE INVENTION

In one aspect the present invention provides a wind turbine
assembly which comprises a plurality of aerofoil blades
secured to a shaft mounted for rotation about a vertical axis
relative to stationary supporting structure of the assembly,
the supporting structure including recesses into which the
upper and lower ends of the shaft project, first and second magnetic means of the same polarity positioned one along the or each side of each recess and the other positioned along the sides of the shaft which project into the recesses whereby, in use, the shaft ends are spaced from the sides of the recesses by magnetic levitation forces, and electricity generating means comprising a coil secured to stationary structure of the assembly and positioned between one of the aforesaid magnetic means and a third magnetic means of opposite polarity to that of the first and second magnetic means, and means for connecting the coil to convey electricity generated during operation of the wind turbine assembly to a location remote from the assembly.

The ends of the shaft may be shaped to define generally conical end pieces and the recesses maybe shaped to complement the generally conical shape of the end pieces.

Each end piece may include an inclined shoulder section and a more steeply inclined end section.

The first magnetic means may comprise caps located over each end of the shaft, each cap extending lengthwise of the shaft to a position in which, in use of the assembly, it is fully located within the respective recess of the stationary supporting structure

**BRIEF DESCRIPTION OF THE DRAWINGS**

The invention will now be described by way of example only with reference to the accompanying diagrammatic drawings in which:-
Figure 1 is a cross-sectional view of a vertically aligned bladed rotor shaft of a wind turbine assembly in accordance with one embodiment of the present invention;

Figure 2 is a cross-sectional view to an enlarged scale of a detail of the assembly illustrated in Figure 1;

Figure 3 is a cross-sectional view to an enlarged scale of a section of the rotor shaft and supporting structure illustrated in Figure 1; and

Figure 4 is a cross-sectional view of an alternative bladed rotor shaft and supporting structure of a wind turbine assembly in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The vertical axis wind turbine assembly illustrated in Figures 1 to 3 of the drawings includes a plurality of aerofoil blades 10 secured to a vertically aligned rotor shaft 12 of the assembly.

Typically, twelve blades 10 may be supported by the shaft 12 each being produced from a non-reflective and relatively light weight waterproof material such as plastics or fibreglass. The blades 10 may be secured to the shaft 12 by fastenings which enable individual blades readily to be replaced in the event of damage. Preferably each blade will have a degree of flex and be provided with protruding fixing elements to enable each blade to locate within slots formed in the sides of the rotor.

Each blade 10 may be curved between its leading and trailing edges and may be fixed in either a clockwise or anti-clockwise direction relative to the shaft. By so doing, the shaft will
always turn in the same direction regardless of the direction of the prevailing wind.

The ends of the shaft 12 remote from the blades are enlarged to define generally conical end pieces 14 each formed with a shoulder section 16 and a more steeply inclined end section 18. Each shoulder section 16 includes a generally disc shaped section 20 one positioned immediately above and the other immediately below the aerofoil blades 10. The end 22 of the uppermost end piece 14 is generally flat and the end 24 of the lowermost end piece is generally pointed.

As will be seen from Figure 1, the end pieces 14 protrude into and are spaced from the walls 28 of complementary shaped recesses 30 of stationary housings 32 of the assembly.

The inclined surfaces of each conical end piece 14 are lined with a suitably contoured permanent magnet 25 (or a series of such magnets); similarly, the opposed inclined surfaces of each recess 30 of each stationary housing 32 are lined with a suitably contoured permanent magnet 27 (or a series of such magnets). The polarity of the magnets 25, 27 is the same to enable the rotor shaft, in use of the wind turbine assembly, to levitate a predetermined distance away from the surface of the housings 32. The distance between the respective surfaces during levitation will be dependent upon the strength of the repulsive field set up by the magnets 25, 27.

As will be seen more clearly from Figure 2, each housing 32 includes an annular member 34 whose inner surface lies parallel to but spaced from the edge 36 of the respective disc section 20. The inner surface of each annular member 34 is lined with a permanent magnet 38 (or a series of such magnets) and each peripheral edge 36 is lined with a permanent magnet
40 (or a series of such magnets) of different polarity to that of the permanent magnet 38.

The distance between the opposed surfaces of each shoulder section 16 of the end pieces 14 and the magnetically repelling adjacent walls of the stationary housings 32 is less that the distance between the opposed surfaces of the annular members 34 and the disc sections 20 to ensure that the repulsive force created by the magnets 25, 27 of the same polarity is always greater than the attraction force created by the magnets 38, 40 of different polarity. This ensures that the opposed surfaces of the shaft end pieces 14 and the stationary housings do not come into contact one with the other.

15 Coils 42 composed of an electrically conducting material are positioned about the annular members 34 whereby rotation of the shaft 12 and the magnets 38 relative to the housings 32 and the magnets 36 induces within the coils 40 an electric current which passes to an external power storage or source remote from the wind turbine assembly.

The spacing between the lowermost end piece 14 and the opposed stationary housing 32 enables any small airborne detritus caught between the opposed surfaces to be flushed out by rain.

Turning now to the wind turbine assembly illustrated in Figure 4, in which like integers have been given the same reference numerals, in this embodiment each end of the rotor shaft 12 comprises a magnetic cap 50 of a first polarity and a central section 52 positioned between the caps 50 which comprises a magnet or magnets of opposite polarity to that of the caps. As for the first embodiment, aerofoil blades are secured to the shaft 12.
The ends of the shaft including the caps 50 and the adjoining portions of the central section 52 protrude into recesses 54 of stationary housings 56 of the assembly. These recesses 54 are lined with magnetic material 58 of opposite polarity to that of the magnetic caps 50 and therefore the same polarity as that of shaft central section 52.

Thus, when axially positioned with its ends positioned within the recesses of the housings 56, the rotor shaft 12 will be levitated by the repulsive magnetic forces between the axially located rotor caps 50 and the facing magnetic interior of the housing.

Mounted and aligned circularly on the inward facing ends of the magnetic material 58 opposite the magnetic material of the shaft central section 52 are coils 42 composed of a conducting material, wherein relative motion between the rotor shaft 12 and the coils 42 generates an electric current.

In operation, when impelled by wind forces acting on the turbine blades 10, the rotor shaft 12 is caused to rotate about its vertical axis. This spinning motion coupled with the proximity of the magnets 38 and the coils 40 generates a magnetic field and the induction of an electrical current as described.

One advantage of a wind turbine in accordance with the invention is that it can be fixed against walls or on buildings without creating excessive noise and/or vibrations. In such a location the assembly will act as an acoustic baffle thus alleviating urban planning concerns.

Other advantages of wind turbine assemblies in accordance with the invention are that the turbine assembly is almost silent
and substantially frictionless in use; additionally, unlike more conventional horizontal axis turbines, the vertical axis wind turbine will be rotated by a prevailing wind from any (lateral) direction; also, unlike conventional horizontal axis wind turbines, the assembly will operate in relatively static and blustery wind conditions. Furthermore, wind turbines assemblies in accordance with the invention enjoy the advantage of enabling rain to flush out small airborne detritus.

Wind turbine assemblies in accordance with the invention will appeal to those having an interest in green energy and it is possible for a DC output from the assembly to be integrated into the DC output from a solar panel system meaning that no other equipment is required for it to function. The assembly will not compete with a solar panel’s output but will work all year round at all hours day and night and so complement photovoltaic solar arrays. It also has the advantage of being cheap to build, relative to solar panels, and easier to install.

In summary, the invention provides a relatively cheap and convenient levitating wind turbine assembly, suitable for use and installation with, for example, homes and offices, with an arrangement of magnets between the rotor and the unit housing which prevents any contact between attracting magnets, wherein the magnetized rotor which is of opposite magnetic polarity to the surrounding structure may be rotated by interaction with the prevailing wind to produce a moving magnetic field.

It will be appreciated that the foregoing is merely descriptive of example embodiments of this invention and that modifications can readily be made to these embodiments without
departing from the true scope of the invention as set out in the appended claims.
CLAIMS

1. A wind turbine assembly which comprises a plurality of aerofoil blades secured to a shaft mounted for rotation about a vertical axis relative to stationary supporting structure of the assembly, the supporting structure including recesses into which the upper and lower ends of the shaft project, first and second magnetic means of the same polarity positioned one along the or each side of each recess and the other positioned along the sides of the shaft which project into the recesses whereby, in use, the shaft ends are spaced from the sides of the recesses by magnetic levitation forces, and electricity generating means comprising a coil secured to stationary structure of the assembly and positioned between one of the aforesaid magnetic means and a third magnetic means of opposite polarity to that of the first and second magnetic means, and means for connecting the coil to convey electricity generated during operation of the wind turbine assembly to a location remote from the assembly.

2. A wind turbine assembly as claimed in claim 1 wherein the ends of the shaft are shaped to define generally conical end pieces and wherein the recesses are shaped to complement the generally conical shape of the end pieces.

3. A wind turbine assembly as claimed in claim 2 wherein each end piece has an inclined shoulder section and a more steeply inclined end section.

4. A wind turbine assembly as claimed in claim 1 wherein the first magnetic means comprises caps located over each end of the shaft, each cap extending lengthwise of the shaft to a position in which, in use of the assembly, it is
fully located within the respective recess of the stationary supporting structure.

5. A wind turbine as claimed in claim 1 wherein the diameter of the shaft is equal along its length and wherein the sides of each recess lie parallel or substantially parallel to the longitudinal axis of the shaft.

6. A wind turbine as claimed in claim 5 wherein the magnetic means positioned on the ends of the shaft comprise caps of magnetic material.

7. A wind turbine as claimed in any one of the preceding claims wherein twelve aerofoil blades are supported by the shaft.

8. A wind turbine as claimed in any one of the preceding claims wherein each blade is secured to the shaft by fastenings which enable the blade readily to be replaced.

9. A wind turbine as claimed in any one of the preceding claims wherein each blade is produced from a plastics material or fibreglass.
**Application No:** GB1311262.8  
**Examiner:** Alan Jones  
**Claims searched:** 1-9  
**Date of search:** 28 October 2014

**Patents Act 1977: Search Report under Section 17**

**Documents considered to be relevant:**

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**Categories:**

- **X** Document indicating lack of novelty or inventive step
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- **P** Document published on or after the declared priority date but before the filing date of this invention.
- **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:

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

F03D; H02K

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

Online: WPI, EPODOC

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