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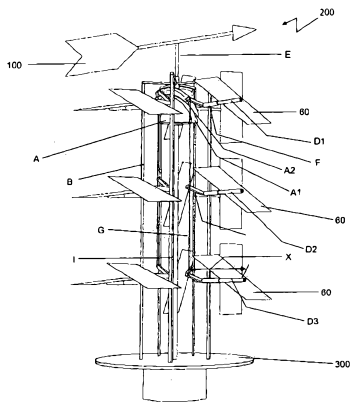

FIGURE 1

(57) **Abstract**: The present invention relates to a wind turbine with a vertical axis of rotation. The wind turbine includes at least one set of blades connected to a travel assembly which engages a closed loop track, the track being inclined with respect to said vertical axis of rotation. The blades are also connected to the rotating frame via a blade arm in a manner that allows for the blades to be capable of rotating about a substantially horizontal axis as dictated by the relative position of the travel assembly on the track and wherein the wind causes the frame to rotate about the vertical axis upon catching the blades.

A WIND TURBINE

STATEMENT OF CORRESPONDING APPLICATIONS

This application is based on the Provisional specification filed in relation to New Zealand Patent Application Number 568505, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

This invention relates to a wind turbine. More particularly the principles of the present invention relate to a vertical axis wind turbine.

BACKGROUND ART

Wind power has been used for generations as a device for generating both mechanical and electrical energy.

Today, wind turbines are widely used throughout the world for generating electricity on small and large scales, using both horizontal and vertical axis turbines. Vertical axis turbines have a number of advantages over the horizontal axis turbines generally used in commercial wind farms. The vertical axis turbine is generally positioned with the moving parts near to the ground, and as such they do not require free standing towers to operate, the result being that they are cheaper and easier to maintain, and also more robust in the high winds that are often found in certain areas close to the ground. For example hilltops, ridgelines and passes can produce powerful winds near the ground which can be effectively captured by a vertical axis wind turbine.

There is a wide range of vertical axis wind turbines available both commercially and disclosed in prior art documents. GB Patent No. 2356431 describes a vertical axis

wind turbine that comprises a number of vertical blades attached at both ends to pivots, allowing them to rotate on a vertical axis to best catch the passing wind. This vertical movement of the blades goes some way to improving the efficiency of the turbine, although as the blades are fixed in position vertically they are not able to take advantage of wind coming from a wide range of directions. GB Patent No. 2391590 describes a different vertical axis turbine that again has a series of blades that are rotatable around a vertical axis. This configuration is limited by the lack of horizontal movement of the blades permitted by the structure of the turbine.

Other turbines known in the art that operate on a vertical axis are available in a variety of configurations, such as the "eggbeater" turbine and the "helical" turbine. While turbines of this style have been found to have a good efficiency they need to be mounted on towers and often need an external power source to start turning. Turbines of this style work well when produced on a large scale; however they are not particularly suitable for everyday uses when a smaller, more compact method of power generation is needed.

It is an object of the present invention to address the foregoing problems or at least to provide the public with a useful choice.

All references, including any patents or patent applications cited in this specification are hereby incorporated by reference. No admission is made that any reference constitutes prior art. The discussion of the references states what their authors assert, and the applicants reserve the right to challenge the accuracy and pertinence of the cited documents. It will be clearly understood that, although a number of prior art publications are referred to herein; this reference does not constitute an admission that any of these documents form part of the common general knowledge in the art, in New Zealand or in any other country.

Further aspects and advantages of the present invention will become apparent

from the ensuing description which is given by way of example only.

DISCLOSURE OF INVENTION

According to one aspect of the present invention there is provided a wind turbine which includes:

- A rotating frame which rotates about a substantially vertical axis of rotation; and
- At least two blades, each blade connected to a travel assembly which engage a closed loop track, the track being inclined with respect to said vertical axis of rotation;

wherein the blades are also connected to the rotating frame via a blade arm in a manner that allows for the blades to be capable of rotating about a substantially horizontal axis as dictated by the relative position of the travel assembly on the track;

wherein the wind causes the frame to rotate about the vertical axis upon catching the blades.

According to a second aspect of the invention there is provided a wind turbine which includes:

- A rotating frame which rotates about a substantially vertical axis of rotation;
- A first set of blades connected to a travel assembly which engage a closed loop track, the track being inclined with respect to said vertical axis of rotation; and

- At least one further set of blades which are connected to the first set of blades in a manner that allows for these blades to mimic the movements of the first set of blades;

wherein the blades are also connected to the rotating frame via a blade arm in a manner that allows for the blades to be capable of rotating about a substantially horizontal axis;

as dictated by the relative position of the travel assembly on the track;

wherein the wind causes the frame to rotate about the vertical axis upon catching the blades.

The blade arms are caused to rotate via movement of the travel assembly along the cam track which changes the spatial position of the blades between a substantially vertical plane ahead of the wind and in a substantially horizontal plane when the blades come around into the wind.

Preferably, the closed loop track which is inclined with respect to the horizontal extends around the periphery of a drum which is co-axial with the rotating frame.

Preferably, the closed loop track is a cam track.

In other embodiments the closed loop track is a rail or the like.

Preferably, each blade arm includes:

- A first bearing intermediate between the travel assembly and the blade to allow rotation of the blades along a substantially horizontal axis;

- A proximate portion of the blade arm adjacent to the travel assembly, which is angled with respect to a distal portion of the blade arm attached to the blade; and

- A second bearing intermediate between the proximate portion and the distal portion to allow for rotation of the proximate portion relative to the blade as the follower device follows the travel assembly.

Preferably, the blades rotate about a substantially horizontal axis by an angle of substantially 90°.

Preferably, the proximate portion of the blade arm may be angled substantially 90° to the distal portion of the blade arm.

Preferably, the angle of rotation of the proximate portion of the blade arm relative to the distal portion of the blade arm may be at an angle of substantially 90°.

Preferably, the proximate portion is pivotally attached to the travel assembly.

Preferably, the travel assembly is a follower device adapted to engage and follow the horizontally inclined closed loop track, the follower device being positioned at an end of each blade arm distal from the blade.

Preferably, the follower device may be at least one wheel.

In other embodiments the follower device may be a roller, roller skid or the like.

Preferably, the wind turbine also includes a wind vane to orientate the closed loop track in the direction of the wind.

Preferably, the first set of blades consists of 5 blades.

Preferably, the further sets of blades consist of 5 blades per set.

Preferably, the wind turbine also includes a speed limiting device to limit the speed of rotation of the framework around the closed loop track to suit the wind conditions.

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BRIEF DESCRIPTION OF DRAWINGS

Further aspects of the present invention will become apparent from the following description which is given by way of example only and with reference to the accompanying drawings in which:

Figure 1: shows a side view of the wind turbine of the present invention, and

Figure 2: shows a close-up side view of the drum of the preferred embodiment shown in Figure 1.

BEST MODES FOR CARRYING OUT THE INVENTION

Figure 1 shows a wind turbine generally indicated by arrow 200. The cylindrical drum A has a horizontally inclined closed loop in the form of cam track 20 defined by lower A1 and upper A2 cam rails (best seen in Figure 2 showing a detailed side view of the drum A) extending in a 360° closed loop around the periphery of a drum A wherein a first region on the closed loop (20A) is vertically higher on the periphery of the drum A than a second region of the closed loop (20B).

A rotating frame B encloses the drum A. A rectangular blade 60 is attached at the end of each of the blade arms X distal from a travel assembly in the form of a follower wheel 50. The blade arms X follow the cam track 20 around the circumference of the drum A when the blades 60 catch the wind. The path of the cam track 20 dictates the orientation of the blades 60 in a vertical orientation ahead of the wind and in a horizontal orientation when the blades 60 come around into the wind.

A proximate portion of the blade arms X in the form of a radial arm C is attached at one end to a follower device in the form of a follower wheel 50 which is angled at a 90° angle with respect to a bearing portion housed in a sleeve F, which is attached to the opposite end of the radial arm C. Sleeve F is connected about a longitudinal

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BRIEF DESCRIPTION OF DRAWINGS

Further aspects of the present invention will become apparent from the following description which is given by way of example only and with reference to the accompanying drawings in which:

Figure 1: shows a side view of the wind turbine of the present invention, and

Figure 2: shows a close-up side view of the drum of the preferred embodiment shown in Figure 1.

BEST MODES FOR CARRYING OUT THE INVENTION

Figure 1 shows a wind turbine generally indicated by arrow 200. The cylindrical drum A has a horizontally inclined closed loop in the form of cam track 20 defined by lower A1 and upper A2 cam rails (best seen in Figure 2 showing a detailed side view of the drum A) extending in a 360° closed loop around the periphery of a drum A wherein a first region on the closed loop (20A) is vertically higher on the periphery of the drum A than a second region of the closed loop (20B).

A rotating frame B encloses the drum A. A rectangular blade 60 is attached at the end of each of the blade arms X distal from a travel assembly in the form of a follower wheel 50. The blade arms X follow the cam track 20 around the circumference of the drum A when the blades 60 catch the wind. The path of the cam track 20 dictates the orientation of the blades 60 in a vertical orientation ahead of the wind and in a horizontal orientation when the blades 60 come around into the wind.

A proximate portion of the blade arms X in the form of a radial arm C is attached at one end to a follower device in the form of a follower wheel 50 which is angled at a 90° angle with respect to a bearing portion housed in a sleeve F, which is attached to the opposite end of the radial arm C. Sleeve F is connected about a longitudinal

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pivot axis to spar D1 which is in turn attached to the blade 60. The sleeve F is fixed to the frame B via welding or a means of attachment such as a bracket. In this way, the blade arms X move with the frame B. The sleeve F includes a first bearing (not shown) at the apex of the 90° angle in the blade arms X allows for horizontal rotation of the blades 60 in a substantially horizontal axis preferably by 90°. The sleeve F also includes a second bearing (not shown) which allows for partial rotation of the radial arm C relative to a distal portion of the blade arm, in the form of a spar D1, in a substantially vertical axis by 90° as the follower wheel 50 follows the cam track defined by rails A1 and A2. The first and second bearings may be contained in bearing races in an inner surface of the sleeve F.

In alternative embodiments the bearing F may be replaced with a hydraulic feathering system mounted on to each individual spar D1. The blades are feathered at an angle of 45° for optimal wind catching efficiency.

The framework B is attached to a base 300. A drive system (not shown) is attached below the base 300. In alternative embodiments the framework B may be attached to shaft I and the drive system (not shown) is attached to the lower end of the shaft I. The drive system multiplies the low speed rotary motion of base 300 to a higher speed rotary motion for an output. A number of different drive systems known in the art may be incorporated with varying gear multiplication factors. The mechanical energy generated by the drive system is converted into electrical energy via a generator. This generated electrical energy may be stored in a battery, fuel cell or super-capacitor for subsequent use.

Figure 1 shows the attachment of a wind vane 100 to the wind turbine 200 via shaft E. The wind vane 100 orientates the drum A, and therefore indirectly the power generating blades 60, in an optimum position in relation to shifting wind directions. A bearing H allows rotation of the drum A on the vertical shaft I. The bearing H has a 10 tonne bearing capacity. In alternate embodiments the wind turbine 200 may

or electronic speed limiting feature (not shown). Alternatively, adjustment of the angle of the cam track 20 in relation to the followers 50 can limit the speed of rotation of the framework B around the drum A. Such a speed limiting device provides for a relatively constant power generation in different wind conditions and improves the reliability of the wind turbine 200.

The wind turbine 200 also includes a brake (not shown) to halt movement of the framework B and optionally blades 60 to permit maintenance of the wind turbine 200. A person skilled in the art will appreciate that known brakes such as a coil brake or a hydraulic brake may be used.

In use the catching of the wind on the blades 60 causes the blade arms X to follow the cam track defined by rails A1 and A2 on the drum A, which causes the orientation of the blades 60 to have a vertical position ahead of the wind and conversely a horizontal position when the blades 60 come around into the wind. At any one time three blades 60 are positioned into the wind.

Thus preferred embodiments of the present invention may have a number of advantages over the prior art which can include:

- more efficient power generation from varying wind directions;
- a relatively simple construction with a minimum of moving parts thereby providing for easy maintenance;
- a relatively low profile design which provides for relatively low speeds of blade revolution which improves reliability;
- a relatively more compact and self contained design suitable for domestic applications or building tops, and

- a flexible stacking system allowing blades to be added or removed to suit particular applications or wind conditions.

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof as defined in the appended claims.

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WHAT I CLAIM IS:

1. A wind turbine which includes:

- a rotating frame which rotates about a substantially vertical axis of rotation; and

- a first set of blades, each blade connected to a travel assembly which engage a closed loop track, the track being inclined with respect to said vertical axis of rotation;

wherein each blade is connected to the rotating frame via a blade arm in a manner that allows for the blades to be capable of rotating about a substantially horizontal axis as dictated by the relative position of the travel assembly on the track; each blade arm including:

- a proximate portion of the blade arm adjacent to the travel assembly, which is angled with respect to a distal portion of the blade arm attached to the blade;

- a first bearing intermediate between the proximate portion and the distal portion to allow rotation of the blades about a substantially horizontal axis;

- a second bearing intermediate between the proximate portion *and* the first bearing to allow for rotation of the proximate portion relative to the distal portion.

2. A wind turbine as claimed in claim 1 wherein the wind turbine also includes at least one further set of blades which are connected to the first set of blades in a manner that allows for the at least one further set of blades to mimic the movements of the first set of blades.

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3. A wind turbine as claimed in claim 1 or claim 2 wherein the closed loop track is of sinusoidal form at a constant radial distance from the vertical axis of rotation.

4. A wind turbine as claimed in any one of claims 1 to 3 wherein the closed loop track is a cam track.

5. A wind turbine as claimed in any one of claims 1 to 4 wherein the blades rotate about a substantially horizontal axis by an angle of substantially 90°.

6. A wind turbine as claimed in any one of claims 1 to 5 wherein the proximate portion of the blade arm is angled substantially 90° to the distal portion of the blade 10 arm.

7. A wind turbine as claimed in any one of claims 1 to 6 wherein the proximate portion of the blade arm is offset relative to the distal portion of the blade arm at an angle of substantially 90°.

8. A wind turbine as claimed in any one of claims 1 to 7 wherein the proximate portion is pivotally attached to the travel assembly.

9. A wind turbine as claimed in any one of claims 1 to 8 wherein the travel assembly is a follower device adapted to engage and follow the horizontally inclined closed loop track, the follower device being positioned at an end of each blade arm distal from the blade.

10. A wind turbine as claimed in any one of claim 9 wherein the follower device is at least one wheel.

11. A wind turbine as claimed in any one of claims 1 to 10 wherein the wind turbine also includes a wind vane to orientate the closed loop track in the direction of the wind.

12. A wind turbine as claimed in any one of claims 1 to 11 wherein the first set of blades consists of 5 blades.

13. A wind turbine as claimed in any one of claims 2 to 12 wherein the at least one further sets of blades consist of 5 blades per set.

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14. A wind turbine as claimed in any one of claims 1 to 13 wherein the wind turbine also includes a speed limiting device to limit the speed of rotation of the framework to suit the wind conditions.

15. A wind turbine as claimed in any one of claims 1 to 14 wherein the distal portion of the blade arm is attached to the blade substantially midway along the length of the blade.

16. A wind turbine as claimed in any one of claims 1 to 15 wherein the blades are profiled.

17. A wind turbine as claimed in claim 16 wherein the blades have a concave surface proximal to a wind direction.

18. A wind turbine substantially as illustrated in any one of the accompanying figures 1 and 2.

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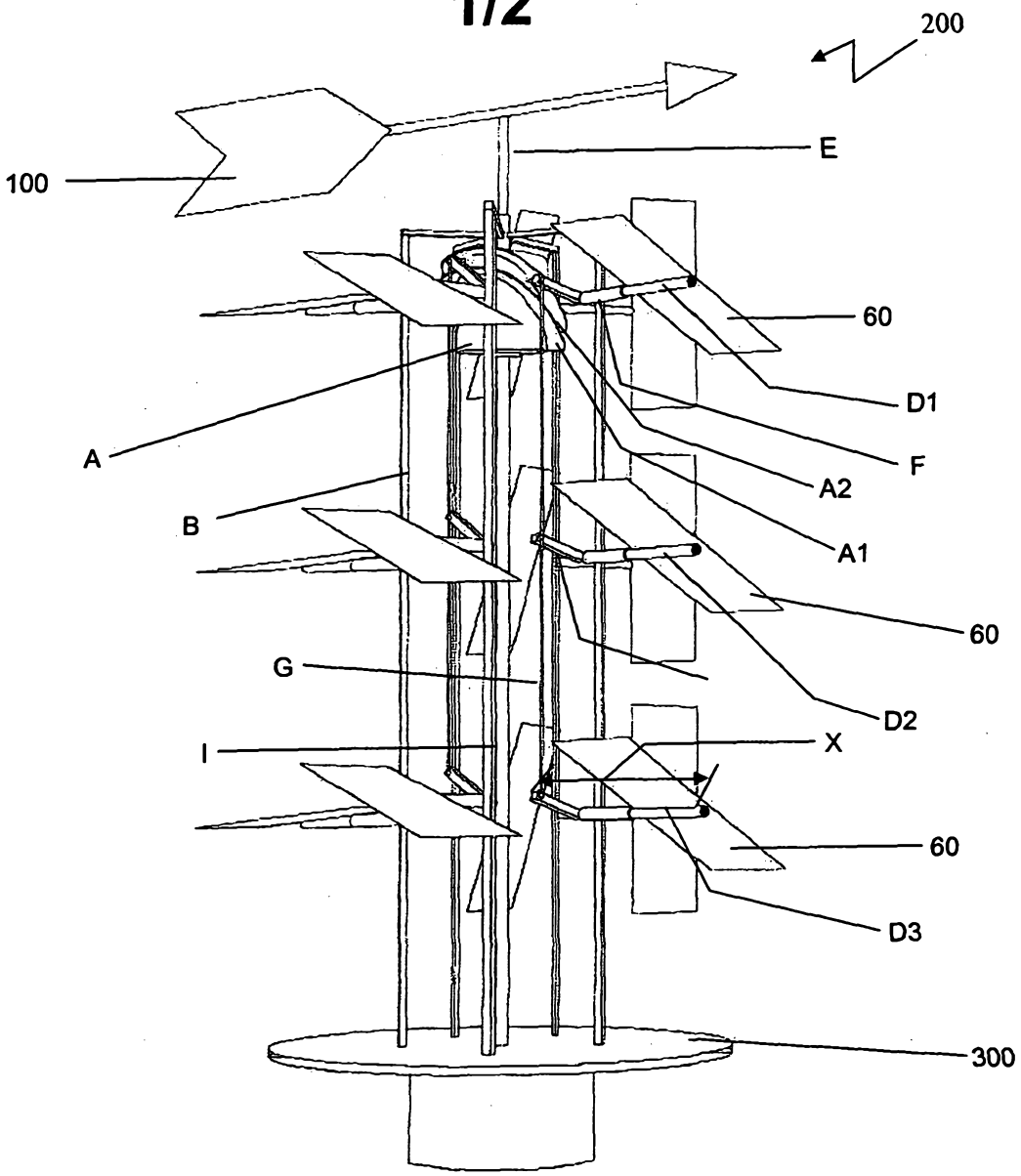

FIGURE 1

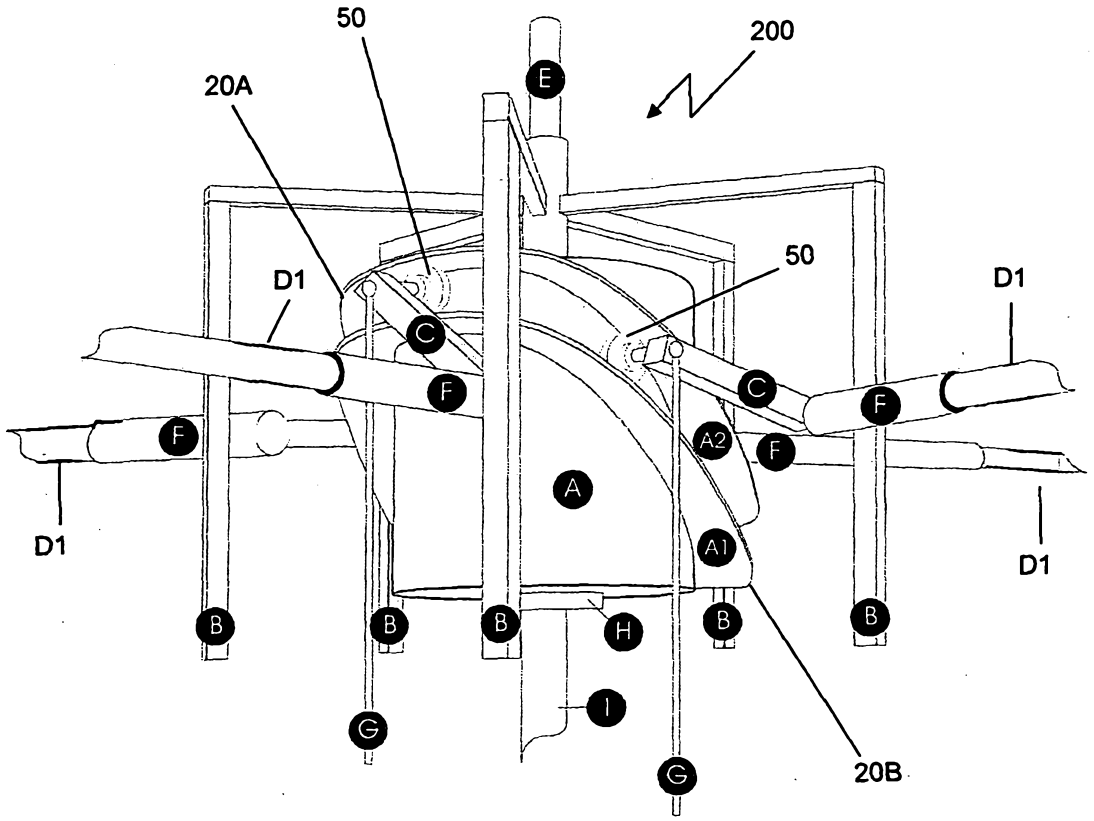

FIGURE 2