

(51) International Patent Classification:
F03D 3/06 (2006.01)(21) International Application Number:
PCT/IB2010/053013(22) International Filing Date:
1 July 2010 (01.07.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1556/MUM/2009 1 July 2009 (01.07.2009) IN

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,

HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- as to the identity of the inventor (Rule 4.17(i))
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))
- of inventorship (Rule 4.17(iv))

[Continued on next page]

(54) Title: MULTI FINNED HELICALLY TWISTED VERTICAL AXIS WIND TURBINE

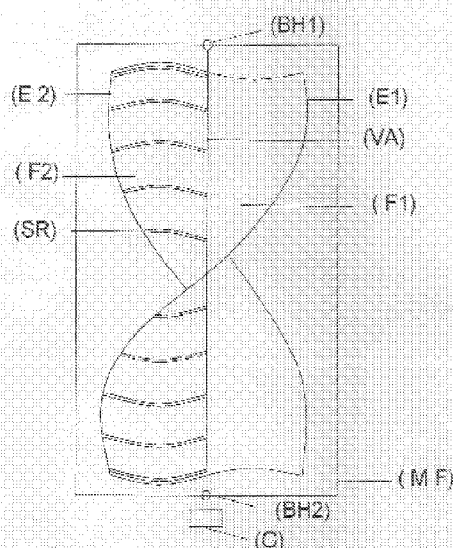


Fig-1. Multi Finned Turbine Assembly

(57) Abstract: The present invention provides for a novel rotor section of a vertical axis wind turbine by having at least one flexible helically twisted blade. The blade includes at least two fins (F1, F2) joined along the vertical longitudinal axis. The fins (F1, F2) are imparted with a flexible and predetermined pitch angle from their bottom edge to the top edge to render them with a helical twist along the vertical axis shaft (VA) of the rotor section (R) of the wind turbine around which they rotate. The invention provides lightweight fins (F1, F2) that can be easily assembled into blades. These can be helically twisted to the precise pitch angle required after reading the wind situation at the place of installation. These are also easy to transport from the place of manufacture to the place of installation. The accurate determination of the pitch angle of the fins (F1, F2) also contributes to significant harnessing of wind power in even lower wind regime.



Published:

— with international search report (Art. 21(3))

— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

TITLE

Multi finned helically twisted vertical axis wind turbine

FIELD OF THE INVENTION

- 5 The present invention relates to the field of wind turbines, and in particular, relates to multi-finned helically twisted vertical axis wind turbine.

BACKGROUND ART:

- 10 With rising concerns over global warming and increased demands for power, much emphasis has been placed on the generation of clean energy. One such source of clean and long term alternative source of energy is by way of harnessing the wind energy through the use of wind machines. Wind machines or wind mills as they are popularly called have been used for centuries. However, in the recent decades they have been the subject of enhanced efforts to improve efficiency, usability, safety and
- 15 durability. Modern wind turbines can be broadly categorized into two constructional types namely, large horizontal axis wind turbines and the vertical axis wind turbines.

The conventional horizontal axis wind turbines are generally based on airfoil design principles to harness the wind power. Large horizontal axis wind turbines can operate effectively in moderate winds, and are efficient at capturing energy. Relatively high percentage of the wind energy can be converted to mechanical energy in terms of wind turbine blade rotation and by coupling this wind turbine to an aero generator leads to generation of electrical energy. However, in order to efficiently capture energy from the wind, the horizontal axis wind turbines requires blade lengths in excess of 15 meters as huge weight or bulk inertia of the wind turbine shaft needs to be displaced, which in turn requires large tracts of land for installation. Due to their large size, horizontal axis wind turbines, which can be over 50 meters tall, are mechanically complex and can be dangerous to operate near populated areas because of the huge length of the blades which when subjected to high speeds and large stresses can be unsafe for installation in populated areas.

Vertical axis wind turbines on the other hand are mechanically less complex and provide practically safe wind turbine design. The most common or famous of such vertical axis wind turbines is the Savonius-type wind turbine. Savonius-type wind turbines have two or more elongated blades rotating about a vertical axis. Instead of the blades radiating from a hub like an aircraft propeller, Savonius-type wind turbine blades are arranged so that the long axis of each blade generally extends along the axis of blade rotation.

Savonius-type wind turbines started out being pure drag machines that is, operating only due to the differential drag on the curved elongate blades. When wind encounters a Savonius-type blade set, the "cupping" effect of the wind on the concave side of one blade produces greater drag than the impact of the wind on the convex side of the other blade. The greater drag from the "cupped" wind causes the blade set to rotate and is used to harness power from the wind.

Compared to large horizontal axis wind turbines, Savonius-type wind turbines are relatively small, and operate in a broad spectrum of wind speeds. Savonius type wind turbines are therefore well suited for use near and in populated areas, as well as remote locations.

Attempts to improve traditional Savonius-type wind turbines have been made. With non-twisted blade designs, attempts to increase the amount of power extracted from the wind were not very successful as, they exhibit a differential wind load which causes a pulsating torque. This differential wind load is due to the fact that the entire length of each non-twisted blade alternately moves into and out of the wind as the blade assembly rotates and therefore the non-twisted blades introduce a pulsating torque profile which can lead to vibrations.

Twisted blades present a substantially constant surface area to the wind as the rotor assembly turns and thereby exhibit a lesser pulsing torque. However, twisted blades are complex to fabricate as they have a twist along a longitudinal axis. Many twisted

blades are made from a flat material which is twisted into a helical shape. Other blades exhibit a curved cross section which is generally symmetric about the longitudinal axis before a twist is introduced along the longitudinal axis and thus the blades are difficult to fabricate as a single unit. This also poses a considerable challenge for their safe transportation and installation at the location site which increases their transportation and logistics cost.

Another major problem faced during transportation and assembly has to do with the blade. Since the blade is fabricated as a single unit, it is quite difficult to vary the pitch angle or the twist imparted to the blade during fabrication process irrespective of light weight flexible material being used in the present state of the art. This drawback becomes quite prominent in low or moderate wind conditions as it hampers maximum wind harvesting because the pitch angle isn't optimized according to the wind regime prevailing at such installation sites.

SUMMARY OF THE INVENTION:

The object of the instant invention is to obviate the drawbacks of the existing state-of-the-art.

The present invention provides for a novel rotor section of a vertical axis wind turbine by having at least one flexible helically twisted blade. The blade includes at least two fins joined along the vertical longitudinal axis. The fins are imparted with a flexible and predetermined pitch angle from their bottom edge to the top edge to render them with a helical twist along the vertical axis shaft of the rotor section of the wind turbine around which they rotate.

The invention provides lightweight fins that can be easily assembled into blades. These can be helically twisted to the precise pitch angle required after reading the wind situation at the place of installation. These are also easy to transport from the place of manufacture to the place of installation. The accurate determination of the pitch angle of the fins also contributes to significant harnessing of wind power in

even lower wind regime.

BRIEF DESCRIPTION OF THE DRAWINGS :

Fig 1 illustrates a multi-finned wind turbine assembly in accordance with an embodiment of the instant invention.

Fig 2 provides a diagrammatic representation of a single fin in accordance with an embodiment of the instant invention.

Fig 3 provides a diagrammatic representation of a cluster of the multi-finned wind turbine assembly in accordance with an embodiment of the instant invention.

Fig 4A illustrates the top view a wind turbine rotor assembly using two fins (F1, F2) in accordance with an embodiment of the present invention.

Fig 4B illustrates a wind turbine rotor assembly using three fins (F1, F2, F3) in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention, which can be embodied in various forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention in virtually any appropriately detailed structure. Further, the terms and phrases used herein are not intended to be limiting; but rather, to provide an understandable description of the invention.

The terms "a" or "an", as used herein, are defined as one or more than one. The term plurality, as used herein, is defined as two or more than two. The terms including and/or containing, as used herein, are defined as comprising (i.e., open language). The term coupled / communicates, as used herein, is defined as connected, although not necessarily directly, and not necessarily mechanically.

In the present application, a rotor assembly of a vertical axis wind turbine is provided that is intended to be used in the optimized generation of electrical energy as a result of the rotation of the rotor section. While specific details of the rotor section will be herein described, the use and conversion of the rotation energy to create electrical energy is believed to be within the scope of the prior art, and therefore will not be specifically described herein.

Fig 1 illustrates a multi-finned wind turbine assembly in accordance with an embodiment of the instant invention. The wind turbine comprises a rotor section (R) and a generator section (G) such that the rotor section (R) is operatively configured to the generator section (G). The rotor section comprises of at least one rotor blade. The rotor blade comprises a vertical shaft (VA), a plurality of supporting ribs (SR), and at least two fins (F1, F2) mounted on the supporting ribs (SR). The rotor section (R) is mounted on a frame (MF) which in turn is anchored firmly on bearings (BH1 and BH2) for smooth rotation around the vertical axis. The embodiment shown in Fig 1 is illustrated with the help of two fins (F1, F2) for exemplary purposes. Further, the instant invention can be practiced using more than two fins (F1, F2) in various embodiments. In an embodiment of the instant invention, the wind turbine is a dual finned Savonious type vertical axis wind turbine.

The rotor section (R) comprises of the rotor blade having a helically twisted shape mounted on the vertical shaft (VA) running through the centre of the rotor blade. The helically twisted shape comprises a pair of fins (F1, F2) which are twisted on their vertical axis and mounted on the supporting ribs (SR). Mounting refers to a fixing arrangement between the ribs and the fins such that the ribs support the fins. In an embodiment, mounting implies fixing the fins (F1, F2) on the supporting ribs (SR) using a screw. The vertical shaft (VA) acts as a pivot for the rotor section (R) thus enabling rotation of the rotor blade when it encounters wind. The number of fins (F1, F2, ... Fn) and the angle of twist or pitch angle imparted to the fins (F1, F2, ...Fn) are flexible. In an embodiment, the number of fins (F1, F2) and the angle of twist are determined according to the wind regime prevailing at the site of the

installation for each such said vertical axis wind turbine in order to harness optimum wind power at that location. The angle of twist and the number of fins (F1, F2) is directly proportional to the wind speeds normally prevailing at the site of installation.

The twisted fins (F1, F2) are co-joined along the vertical shaft (VA) with the help of the supporting ribs (SR) to form the desired helical shaped blade. Each fin (F1 or F2), which may be fabricated separately, has two vertical edges of which one edge (E1) (as can be seen from Fig. 1) forms one half of the helically twisted shape of the rotor blade. The other edge of the fin (F1) is attached to the vertical shaft (VA) and is thus hidden from the view. Similarly, for the second fin (F2), its outward edge (E2) is depicted which forms the other half of the helically twisted rotor blade. Therefore, the rotor blade construction can be summarized by taking the inner edges of each fins (F1, F2) to be maintained as a straight one while their respective outer edges (E1 & E2) are twisted or bent in such a manner so that when the two inner edges of the two fins (F1, F2) are mounted in a vertical alignment on the vertical shaft (VA), their outer twisted edges (E1 & E2) constitute a rotor blade having a continuous helical strand which appears to be wound around the vertical shaft VA.

The fins (F1, F2) are made up of flexible lightweight material such that they can be twisted or a desired angle can be imparted to the fins (F1, F2) at the time of their fabrication. In an embodiment, the lightweight material can be fibre glass. The fins (F1, F2) have a constant length and breadth and are identical in these x and y axis specifications such that the rotor blade appears to comprise of a single strip of constant length and width but is made of two or more fins. Alternately, the fins (F1, F2,... Fn) may have a varying thickness such that the ends are thinner compared to the central portion of the fin. However, the embodiment with uniform thickness demonstrates better results due to lower inertial forces. The fins (F1, F2) are twisted from their bottom edges BE along their z-plane to its top edge (TE) to impart a pre-calculated pitch angle during fabrication. The two twisted fins (F1, F2) are mounted on the vertical shaft (VA) and result in the rotor blade which appears to be helical

strand wound around the vertical shaft (VA).

The pre-calculated pitch angle which is imparted along the z plane on the fins (F1, F2) is established depending upon the wind regime prevailing at that particular installation site. The pitch angle bears a directly proportional relationship with the wind regime of an installation site. The lower the wind speed, lower is the value of the pitch angle. Similarly, higher wind speed results in higher value of the pitch angle. In accordance with an exemplary embodiment, for an average wind speed of 5.5 meter per second, the pitch angle which gives optimal power generation may be 30°. In accordance with another exemplary embodiment, where the wind speed is between 5.5 meter per second and 4 meter per second, the optimal pitch angle may be between 175° - 180°.

In an embodiment, this pitch angle of the rotor blades along with the number of fins (F1, F2) required to construct a rotor blade together determine the number and placement of the supporting ribs (SR = SR1, SR2, SR3 ... SRn) on the vertical shaft (VA) after careful study of the wind regime at the site of the installation. The supporting ribs are small rods fabricated along with its respective fins (F1, F2) and their quantity and dimensions are also dependent upon the pitch angle to be imparted to their respective said fins (F1, F2). The rods and the vertical shaft may be fabricated using preferably a rigid material, for example a metal or stainless steel. The vertical, horizontal and the angular placement of the supporting ribs (SR) on the vertical shaft (VA) is also determined and configured during the time of fabrication of the fins (F1, F2) and is thus also a dependant attribute of the pitch angle.

The rotor section is held in desired position with suitable bearings (BH1, BH2) and its corresponding housing on both top and bottom edges respectively of the vertical shaft (VA) to enable its smooth rotation in response to the wind encountered by the rotor blade. This entire assembly as described above is housed in a modular support structure, namely frame (MF) to eliminate vibrations and provide stability during its operation. In an embodiment, the frame (MF) comprises of a metal or stainless steel.

The vertical shaft (VA) is further extended beyond the bottom bush housing (BH2) to operatively connect the rotor section (R) with the generator portion (G) of the proposed vertical axis wind turbine.

Therefore, a calculated customization in the alignment of the blade structure enables a smooth and constant non pulsating torque output power from the vertical axis wind turbine at the same time.

Fig 2 provides a diagrammatic representation of the single fin (F1 or F2) which has an outer edge (OE), inner edge (IE), bottom edge (BE) and top edge (TE). The inner edge (IE) of the fin is aligned to the inner edge of another fin to form a blade.

Each fin (F1 or F2) of the rotor blade is made up of light weight flexible material strip having a constant width along its vertically extending longitudinal direction. The fin may comprise a uniform or varying thickness which is selected based upon the area of deployment of the wind turbine. The opposite ends of each such fin are capable of being longitudinally disposed to have a minimum pitch angle from bottom edge (BE) to top edge (TE) for all the blades depending on the wind regime at a given location of installation. This disposition imparts a helical twist to the multi-finned blade at a pitch angle that can be pre-calculated according to the wind conditions normally encountered at the installation site in order to reduce the wind resistance provided by the assembly and thus optimize the wind harnessing capacity of the vertical axis wind turbine at that installation site. The pitch angle shares a directionally proportional relation to the average quantum of wind speeds prevailing at any installation site. Therefore, for an installation site where lower magnitude wind speeds are encountered, the helical twist or the pitch angle imparted to the fin at the time of fabrication is less so that maximum longitudinal surface area of the fin constituting the blade is exposed to the low range wind whereas the fin is twisted more for an installation site where it is more windy so that the wind encounters a minimal surface area of the blade. In accordance with an exemplary embodiment, for an average wind speed of 5.5 meter per second, the

pitch angle which gives optimal power generation may be 30° . In accordance with another exemplary embodiment, where the wind speed is between 5.5 meter per second and 4 meter per second, the optimal pitch angle may be between 175° - 180° . Thus, in all kinds of scenarios, wind harnessing capability of the proposed wind turbine is optimized.

In fact, not only the pitch angle but also the number of fins (F1, F2) required to construct the multi-finned blade along with supporting ribs (SR) are configured according to the pitch angle. Subsequently, the desired numbers of fins (F1, F2,... Fn) imparted with the predetermined pitch angle, the number and the type of supporting ribs required along with the vertical shaft (VA) on which all of these components are to be mounted are fabricated as separate units and carried over to the desired installation site. This facilitates low transportation and logistics cost and also enables easy installation by the end user itself.

Owing to the modular nature of the vertical axis wind turbine as shown in Fig. 1, a number of such modules can be clustered together in various permutations and combinations depending upon factors like output power requirements, and the nature of the installation site eg. area available for such installations at that site as is depicted in Fig 3. This horizontal or the vertical clustering of such modules is dependent on the footprint of specific installation site in order to optimize wind harnessing capacity of the installed modules. This modular arrangement provides a major advantage for people involved in design and maintenance of such equipment.

This ability to customize the pitch angle and the number of fins (F1, F2) to suit the wind regime at any installation site gives the capability to harness optimum wind power at any site and this modular arrangement enables low transportation and logistics cost for installation and subsequent maintenance of the proposed vertical axis wind turbine and thus is a big improvement over the existing state of the art.

For example, for a given installation site, annual wind regime is studied. Based on

the wind regime data, the fin configuration is determined. For example, in India the average annual wind speed is about 5.5 meter per second while in Europe / US the annual wind speed is about 7 meter per second. Using this wind speed and other characteristics of the wind regime, the pitch angle is computed. In addition, the number of fins, supporting ribs, configuration of the assembly – individual or clustered is determined. Thereafter, the fins are manufactured preferably of uniform thickness using any light weight material like fibre glass. The fin is manufactured as per the predetermined pitch angle. In addition, the vertical shaft, the frame, the supporting ribs and the fins are fabricated and transported to the installation site of the assembly. The rotor assembly is coupled with appropriately designed generators that best harness energy from the vertical blade configuration.

Fig 4A illustrates the top view a wind turbine rotor assembly using two fins (F1, F2) in accordance with an embodiment of the present invention.

Fig 4B illustrates a wind turbine rotor assembly using three fins (F1, F2, F3) in accordance with an embodiment of the present invention. The figure depicts the top view of the wind turbine. It is advisable to increase the number of fins employed as the wind speed drops. For example, when the average wind speed for a site drops below 5.5 meter per second, a third fin is required to be added to maintain the desired / steady power output. The increase in number of fins increases the torque and thereby the rotation speed that results in increased power output as opposed to the power output if two fin wind turbine would be deployed at such a location.

I claim:

1. A vertical axis wind turbine comprising at least one rotor section, each rotor section comprising:
 - a. a vertical shaft;
 - b. a plurality of supporting ribs mounted on the vertical shaft; and
 - c. two or more fins mounted on the supporting ribs, wherein the opposite ends of each fin are twisted longitudinally at a predetermined pitch angle.
2. The vertical axis wind turbine of claim 1 wherein the fin comprises of uniform thickness.
3. The vertical axis wind turbine of claim 1 wherein the fin comprises of varying thickness.
4. The vertical axis wind turbine of claim 1 further comprising a frame for hosting the shaft, the supporting ribs and the fins.
5. The vertical axis wind turbine of claim 1 further comprising a plurality of bearings for anchoring the frame for smooth rotation around a vertical axis.
6. The vertical axis wind turbine of claim 1 wherein the rotor section is operatively connected to a generator.
7. The vertical axis wind turbine of claim 1 wherein the material of the fins comprises fibre glass.
8. The vertical axis wind turbine of claim 1 wherein the material of the shaft and the supporting ribs comprises a metal.
9. The vertical axis wind turbine of claim 1 wherein the pitch angle is determined based upon the wind regime of the place of deployment of the wind turbine.

10. The vertical axis wind turbine of claim 1 wherein the number of supporting ribs is determined on the basis of number of fins and the predetermined pitch angle of the fins.

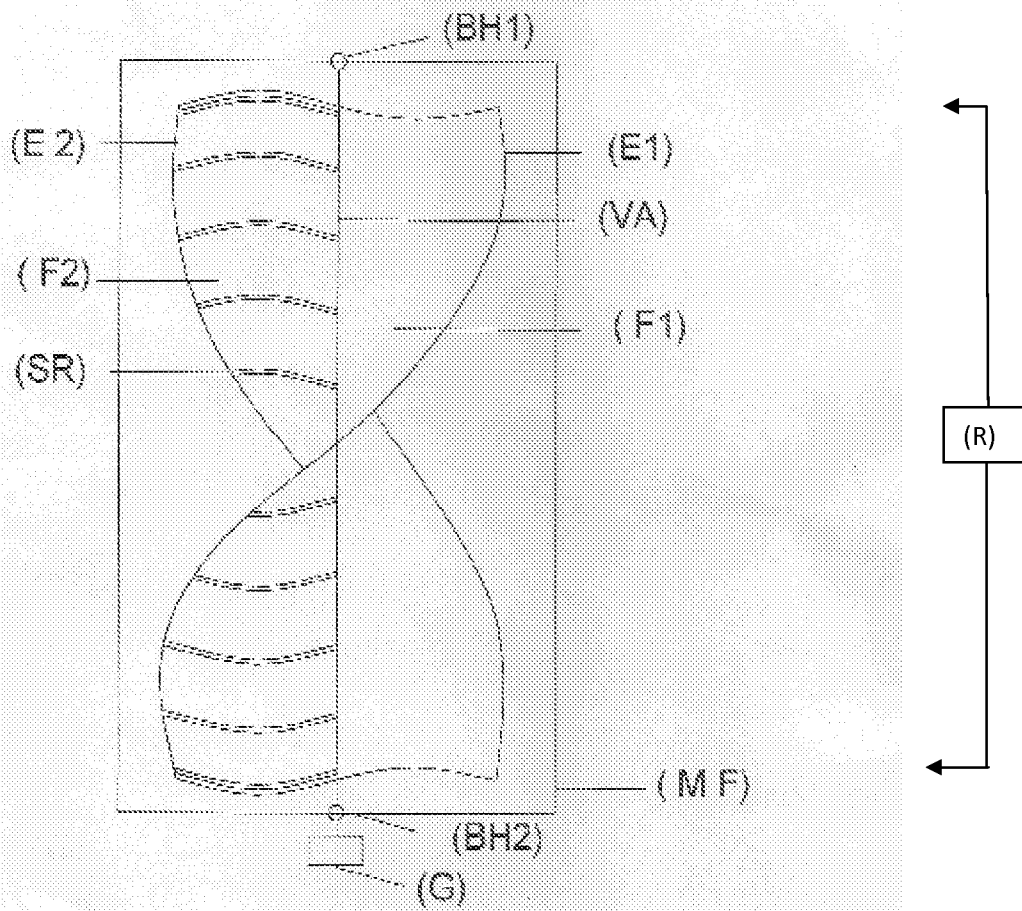


Fig-1. Multi Finned Turbine Assembly

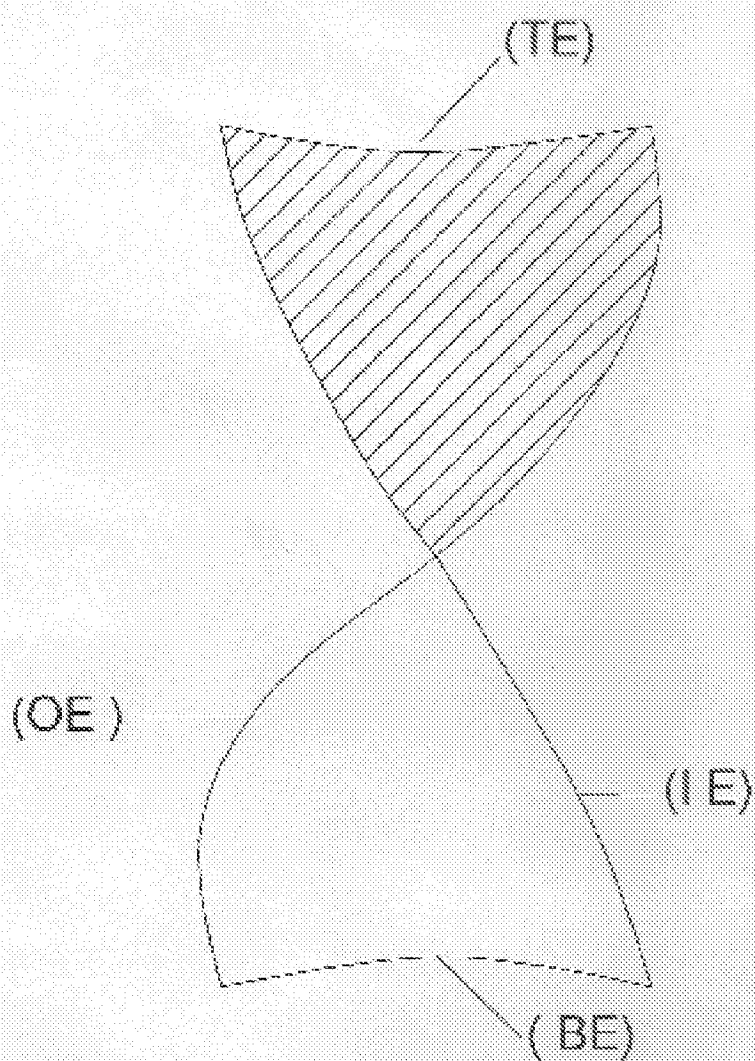


Fig-2. Single Fin

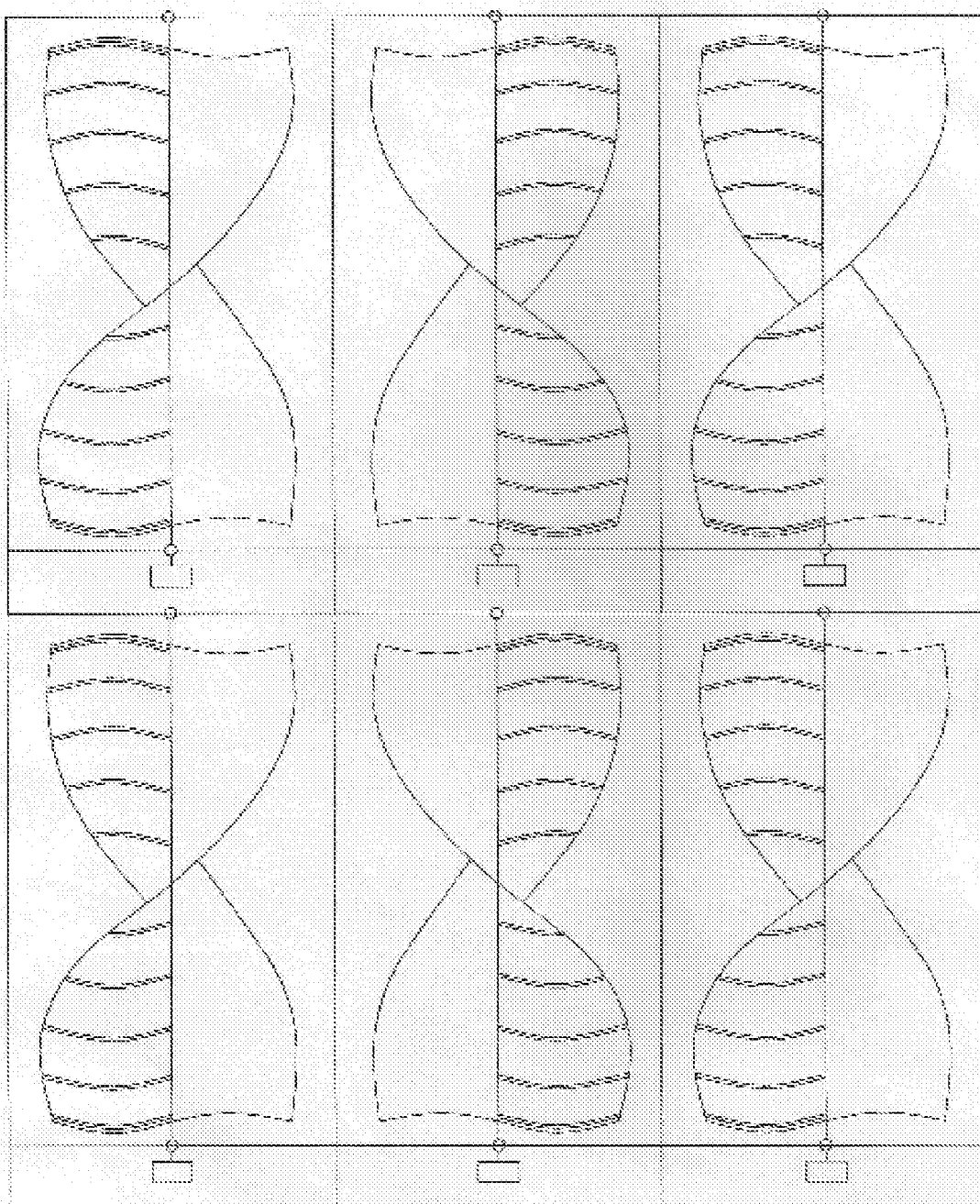


Fig-3. Multi Finned Turbine Assembly Cluster

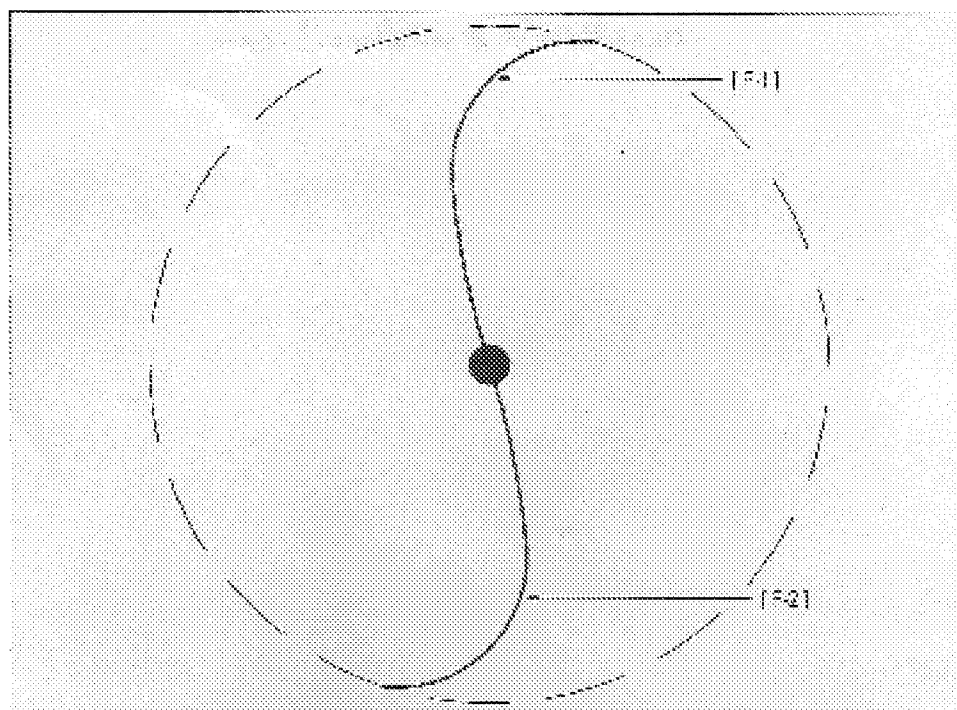


FIG. 4A

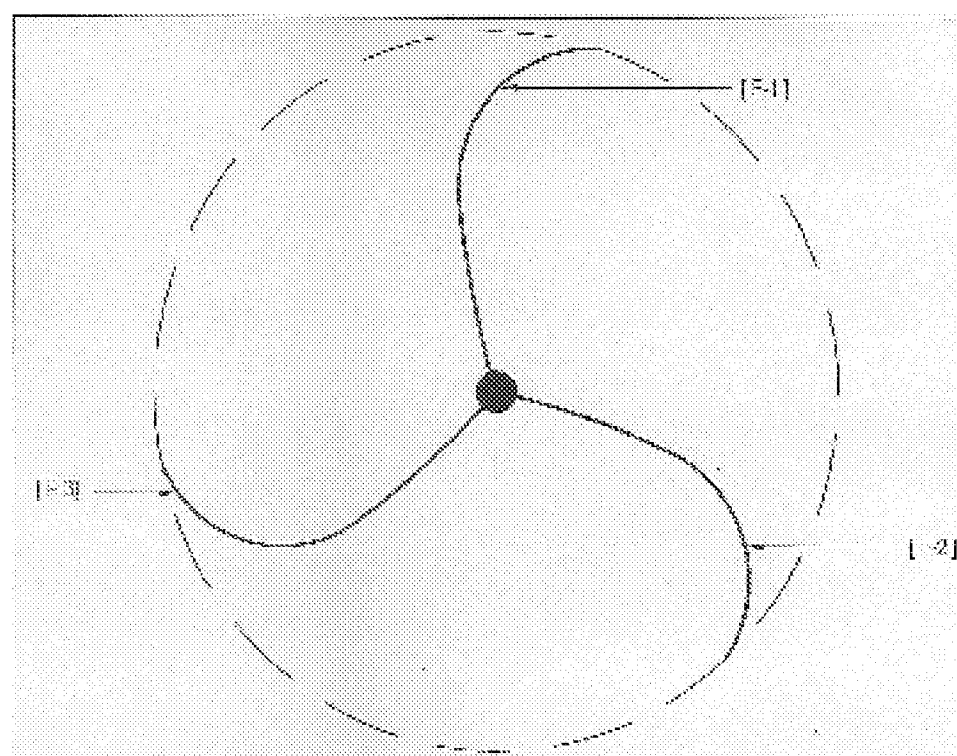


FIG. 4B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 2010/053013

A. CLASSIFICATION OF SUBJECT MATTER

IPC⁸: **F03D 3/06** (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)

IPC⁸: 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)

EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/061 337 A1 (BECKER) 01 April 2004 (01.04.2004) <i>Fig. 10, 17, paragraphs [0035], [0037], [0045], claims 1, 6, 8</i> --	1-10
X	CA 1 236 030 A1 (JOUTSINIEMI) 03 May 1988 (03.05.1988) <i>Fig. 1, 5, page 4 last paragraph, claim 1</i> --	1-10
A	WO 2006/119 648 A1 (ARROWIND CORP) 16 November 2006 (16.11.2006) <i>Fig. 1, page 11 lines 8-10</i> ----	2, 3

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

"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
10 November 2010 (10.11.2010)Date of mailing of the international search report
19 November 2010 (19.11.2010)Name and mailing address of the ISA/ AT
Austrian Patent Office
Dresdner Straße 87, A-1200 Vienna

Facsimile No. +43 / 1 / 534 24 / 535

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/IB 2010/053013

Patent document cited in search report			Publication date		Patent family member(s)	Publication date
US	A	2004061337			US A1 2008273974	2008-11-06
					US A1 2007018464	2007-01-25
					WO A2 2004011798	2004-02-05
					US A1 2004061337	2004-04-01
					AU A1 2003256960	2004-02-16
CA	A	1236030			CA A1 1236030	1988-05-03
					AU A 2006183	1984-04-19
					FI A 823501	1984-04-15
WO	A	2006119648			WO A1 2006119648	2006-11-16
					CA A1 2608284	2006-11-16
					US A1 2006257240	2006-11-16