

Rotatable Blade Apparatus with individually adjustable blades

EnergYield LLC.
1007 Goldeneye View
Carlsbad CA 92011
Robert Hotto
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Executive Overview:

The **Rotatable Blade Apparatus** is a patented adjustable blade control technology applicable to wind turbines and propulsion systems. Applications for wind turbines cover medium sized to large sized wind turbines especially in wind farms. Applications include propellers for marine propulsion systems such a large and medium ships.

Key innovations gained by this technology are the individually adjustable pitch and the individually adjustable chord for each blade. These adjustments can be actuated based on sensor input continuously during a revolution.

Intellectual Property:

The Rotatable Blade Apparatus with Individually Adjustable Blades, US patent 8,608,441, described here is assigned to **EnergYield LLC**. A continuation patent application is on file and there are no international patent applications.

The patent filing date, June 12, 2006 and the issue date Dec 17, 2013 has triggered the USPTO to extend the life of the patent by approximately 4.7 years.

Wind turbine applications:

Several research groups, studying next generation wind turbines such as the UpWind project group, and the Energy Research Centre of the Netherlands (ECN), have reported that Individual Pitch Control, IPC, is recommended as a significant technology for advancing the performance, and increasing the service life of wind turbines and wind farms.

The following are quotes taken from the UpWind report:

“The UpWind project demonstrated that individual pitching of the blades could lower fatigue loads by 20-30%. Dual pitch as the first step towards a more continuous distributed blade control (pitching the blade in two sections) could lead

to load reductions of 15%. In addition, the future smart turbine will use advanced features to perform site adaptation of its controller in order to adapt to local conditions (WP5).

Advanced control strategies are particularly relevant for large offshore arrays, where UpWind demonstrated that 20% of the power output can be lost due to wake effects between turbines.”

“Larger turbines need to reduce their mass, and intelligent control is the key. UpWind demonstrated it is better to control the loads with intelligence rather than building stronger, heavier structures able to withstand those loads. Smart control of blade pitch can achieve large load reductions, and this has been confirmed in field tests on actual turbines. We can now re-optimize the whole design to improve cost effectiveness.” Ervin Bossanyi, Work Package Leader, Garrad Hassan and Partners Ltd. (GL-Garrad Hassan)

Individual pitch control Reports

The UpWind report is available at:

http://www.ewea.org/fileadmin/ewea_documents/documents/upwind/21895_UpWind_Report_low_web.pdf

The Energy research Centre of the Netherlands (ECN) report is available at:

<http://www.ecn.nl/docs/library/report/2007/e07053.pdf>

The United States Department of Energy predicts that the US will obtain 25 percent of its energy generation capacity from wind in the next 15 to 20 years. The European Energy Commission expects to achieve 30 to 40 percent of their energy generating capacity from wind energy also within the next 15 to 20 years.

Therefore the optimization that this, individually adjustable pitch technology achieves will be a necessary component for reaching these goals.

Propulsion applications:

Individual pitch control applied to propulsion systems for boats and ships has the potential to more than double the energy efficiency of the boat propulsion and to double the attainable speed.

A transformative technological advancement is that the individual blades on the propeller are selectively pitch controlled, during a single revolution to create the optimal vector for propelling and steering the boat. This contrasts with current technology that uses a rudder, which inhibits motion and accounts for a large portion of the system drag.

In certain cases the vessel would not require a rudder or the rudder size could be reduced eliminating or reducing the rudder drag component for the vessel.