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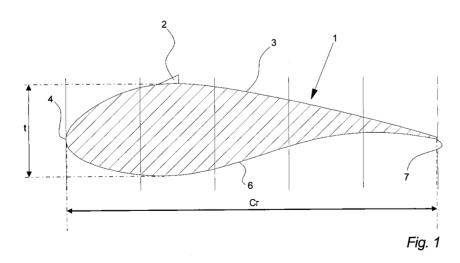
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(57) Abstract: An advantageous new design of a wind turbine blade and rotor is obtained by providing one, two or more parallel rows of sub-boundary layer vortex generators, whereby a blade is obtained, which is resistant to stall and provides for a high maximum lift coefficient $C_{L,max}$ of the blades and a slender blade design, a low socalled radius specific solidity of the rotor. The very high lift coefficient C_L can reduce the necessary blade area and loads or/and increase the length of the blade and maintain the original loads with higher production. The row or rows of sub-boundary layer vortex generators are in a preferred embodiment of the invention provided in combination with Gurney Flaps generating a very high lift coefficient C_L with a relative gentle stall at very high angle of attack.





INTERNATIONAL SEARCH REPORT

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CLASSIFICATION OF SUBJECT MATTER INV. F03D1/06 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) 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 practical, search terms used) EPO-Internal C. DOCUMENTS CONSIDERED TO BE RELEVANT Citation of document, with indication, where appropriate, of the relevant passages Category* Relevant to claim No. Α WO 2006/122547 A (VESTAS WIND SYS AS [DK]; 1 GODSK KRISTIAN BALSCHMIDT [DK]; NIELSEN THOMA) 23 November 2006 (2006-11-23) the whole document WO 01/16482 A (STICHTING ENERGIE [NL]: A 1 CORTEN G C [NL]) 8 March 2001 (2001-03-08) the whole document WO 90/11929 A (WHEELER GARY O [US]) Α 1 18 October 1990 (1990-10-18) the whole document Further documents are listed in the continuation of Box C. See patent family annex. Special categories of cited documents: "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 "A" document defining the general state of the art which is not considered to be of particular relevance invention "E" earlier document but published on or after the international "X" document of particular relevance; the claimed invention filing date cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "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. "O" document referring to an oral disclosure, use, exhibition or other means document published prior to the international filing date but later than the priority date claimed *&* document member of the same patent family Date of the actual completion of the international search Date of mailing of the international search report 5 December 2008 17/12/2008 Name and mailing address of the ISA/ Authorized officer European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Giorgini, Gabriele Fax: (+31-70) 340-3016

INTERNATIONAL SEARCH REPORT

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Category*	Citation of document, with indication, where appropriate, of the relevant passages		Relevant to claim No.
,	WETZEL K K ET AL: "INFLUENCE OF VORTEX GENERATORS ON NREL S807 AIRFOIL AERODYNAMIC CHARACTERISTICS AND WIND TURBINE PERFORMANCE"		1
	WIND ENGINEERING, MULTI-SCIENCE PUBLISHING CO., BRENTWOOD, ESSEX, GB, vol. 19, no. 3, 1 January 1995 (1995-01-01), pages		
	157-165, XP000516437 ISSN: 0309-524X the whole document 		
	EP 1 674 723 A (GEN ELECTRIC [US]) 28 June 2006 (2006-06-28) the whole document		1
	FUGLSANG P ET AL: "DEVELOPMENT OF THE RISO WIND TURBINE AIRFOILS" WIND ENERGY, WILEY, CHICHESTER, GB, vol. 7, no. 2,		1
	1 January 2004 (2004-01-01), pages 145-162, XP008068651 ISSN: 1099-1824 the whole document		
		·	
			,

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/DK2008/000103

Patent document cited in search report		Publication date	Patent family member(s)		Publication date	
WO 2006122547	À	23-11-2006	CN EP US	101223356 A 1886016 A1 2008175711 A1	16-07-2008 13-02-2008 24-07-2008	
WO 0116482	·A	08-03-2001	AU NL	7324300 A 1012949 C2	26-03-2001 06-03-2001	
WO 9011929	A	18-10-1990	CA EP US	2014014 A1 0466826 A1 5058837 A	07-10-1990 22-01-1992 22-10-1991	
EP 1674723	Α	28-06-2006	CA CN JP MX US	2530196 A1 1793643 A 2006177354 A PA05013934 A 2006140760 A1	23-06-2006 28-06-2006 . 06-07-2006 10-07-2006 29-06-2006	