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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))*

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(54) Title: ADAPTIVE VOLTAGE CONTROL FOR WIND TURBINES

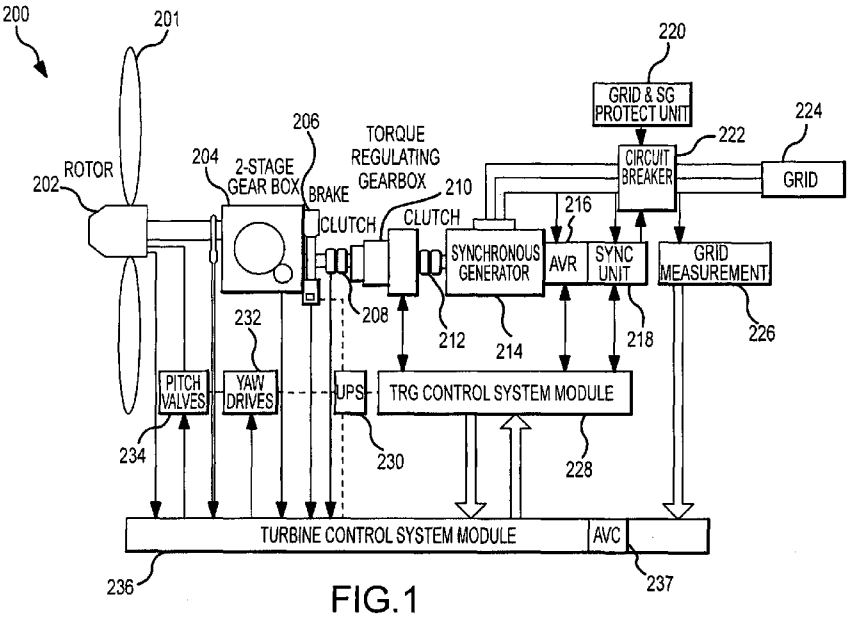

FIG.1

(57) Abstract: Systems and methods are provided herein for configuring and/or operating a wind turbine to adaptively control a voltage of a power grid. In one or more embodiments, a method and system for recognizing a condition of a power grid (e.g., fluctuations caused by variable consumer loads on a weak grid), and adaptively adjusting a voltage control scheme to "ignore" voltage changes caused by the condition are provided. Additionally, other features of the present invention includes a voltage control with active power derating for wind turbines and power factor control with active power derating for wind turbines. The active power derating features of the present invention may be dependent upon physical characteristics of a synchronous generator associated with the wind turbine.

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INTERNATIONAL SEARCH REPORT

International application No.
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Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/003139

A. CLASSIFICATION OF SUBJECT MATTER
INV. H02J3/18 F03D7/04
ADD.

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 H02J

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

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 225 712 A (ERDMAN WILLIAM L [US]) 6 July 1993 (1993-07-06) abstract; claims 30-51; figures 19-25 the whole document	1-14, 94-107, 138,139

X	US 2008/106099 A1 (ICHINOSE MASAYA [JP] ET AL) 8 May 2008 (2008-05-08)	1-8, 94-101, 138,139
Y	abstract; claims 1,5-10; figures 3-9 page 3, paragraph 52 - page 7, paragraph 102	9-14, 102-107

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"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)

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"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	Date of mailing of the international search report
8 June 2011	16/06/2011

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/003139

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2006/082936 A1 (YE ZHIHONG [US] ET AL YE ZHIHONG [US] ET AL) 20 April 2006 (2006-04-20)	41-48, 134
Y	abstract; claims 1-7; figures 1-3 page 2, paragraph 15 - page 3, paragraph 29	9-14, 102-107

X	US 2006/028025 A1 (KIKUCHI AKIRA [JP] ET AL) 9 February 2006 (2006-02-09)	15-63, 108,135
A	abstract; claims 8-11; figures 1-8 page 2, paragraph 20 - page 3, paragraph 36 page 5, paragraph 61	77-93, 137

X	US 2005/042098 A1 (WOBBEN ALOYS [DE]) 24 February 2005 (2005-02-24)	64-76, 136
A	abstract; claims 1-6,15-25; figures 1-13 page 2, paragraph 34 - page 6, paragraph 88	77-93, 137

A	EP 1 914 419 A1 (SIEMENS AG [DE]) 23 April 2008 (2008-04-23) the whole document	15-40, 49-93, 108-133, 135-137

X	EP 1 512 869 A1 (GEN ELECTRIC [US]) 9 March 2005 (2005-03-09) abstract; claims 1-9; figures 1-3 column 2, paragraph 7 - column 5, paragraph 28	41-48, 134

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Information on patent family members

International application No
PCT/EP2009/003139

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		US 2005046196 A1	03-03-2005

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-14, 94-107, 138, 139

   Wind turbine and operation method thereof, said turbine comprising a synchronous generator. Said wind turbine remains connected to the grid and its Q characteristic is controlled. When a certain grid condition is identified, the control scheme is modified to reduce the Q absorbed by the generator.

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2. claims: 15-40, 49-93, 108-133, 135-137

   Wind turbine and method for active power control thereof, said turbine comprising a synchronous generator.Said wind turbine remains connected to the grid and its active power output is controlled.

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3. claims: 41-48, 134

   Wind turbine and operation method thereof, said turbine comprising a synchronous generator. The Q characteristic of said generator is measured over time, and based thereon a corrected voltage factor is generated and added to the nominal voltage reference to generate an adapted voltage reference, which is provided to the AVR of the wind turbine.
