**Title:** IMPROVING RELIABILITY IN MOTORS AND COOLING FANS

**Abstract:** A method of controlling a motor speed for a fan assembly includes receiving a duty cycle value at a microcontroller (120). The microcontroller (120) receives a measured fan speed from a speed sensor (116). An expected fan speed is determined, where the expected fan speed corresponds to the duty cycle value. The measured fan speed is compared with the expected fan speed. A duty cycle of a motor driving signal is reduced if the measured fan speed is less than a predetermined fraction of the expected fan speed.
Declaration under Rule 4.17:
— as to applicant’s entitlement to apply for and be granted a patent (Rule 4.17(ii))

Published:
— with international search report
## INTERNATIONAL SEARCH REPORT

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC:  
- **G05D 23/00** (2006.01); **G05B 5/00** (2006.01); **G06F 1/20** (2006.01); **H05K 7/20** (2006.01); **H05K 5/00** (2006.01)

USPC:  
- 702/99,132; 700/299,300; 361/687,688,695; 318/471,472,473

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)  

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)

EAST

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>US 5,727,928 (BROWN) 17 March 1998 (17.03.1998), entire document</td>
<td>1-9</td>
</tr>
<tr>
<td>A</td>
<td>US 6,194,858 (CHEN) 27 February 2001 (27.02.2001), entire document</td>
<td>1-9</td>
</tr>
<tr>
<td>A</td>
<td>US 6,643,128 (CHU et al) 04 November 2003 (04.11.2003), entire document</td>
<td>1-9</td>
</tr>
<tr>
<td>A</td>
<td>US 6,735,499 B2 (OHKI et al) 11 May 2004 (11.05.2004), entire document</td>
<td>1-9</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of Box C.  
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 application or patent 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)
- **"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
- 29 September 2007 (29.09.2007)

Date of mailing of the international search report
- 31 JAN 2008

Name and mailing address of the ISA/US
- Mail Stop PCT, Attn: ISA/US
- Commissioner for Patents
- P.O. Box 1450
- Alexandria, Virginia 22313-1450
- Facsimile No. (571) 273-3201

Authorized officer
- Ronald D Hatman Jr
- Telephone No. 571-272-3684

Form PCT/ISA/210 (second sheet) (April 2005)
INTERNATIONAL SEARCH REPORT

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:
Please See Continuation 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 additional fees, this Authority did not invite payment of any 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.: 1-9

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.

Form PCT/ISA/210 (continuation of first sheet(2)) (April 2005)
BOX III. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING

This application contains claims directed to more than one species of the generic invention. These species are deemed to lack unity of invention because they are not so linked as to form a single general inventive concept under PCT Rule 13.1.

In order for more than one species to be examined, the appropriate additional examination fees must be paid. The species are as follows:

I. Claims 1-9, drawn to a method for use on a fan, wherein a duty cycle and fan speed is determined, and wherein the duty cycle is reduced if the fan speed is less than a predetermined fraction of an expected fan speed;

II. Claims 10-14 and 21, drawn to a method for use on a fan, wherein temperature is monitored, and a determination is made as to whether the temperature is within a window, then multiplying a weighting factor based on the temperature by a \( 1^{\text{st}} \) \# of revolutions to aid in forming a total weighted \# of revolutions;

III. Claims 15-17, drawn to a method for monitoring a cooling fan, wherein points are measured, captured and stored and transmitted to an external receiver; and

IV. Claims 18-20, drawn to a method for controlling a fan, wherein points are measured and if the points are above thresholds the operation of the fan is modified.

The species listed above do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, the species lack the same or corresponding special technical features for the following reasons:

The species are independent or distinct because the technical features of one are not required by the others. Also, it is worth noting that several of the preambles are misleading since they claim "operating or controlling a fan", per se, but provide no real steps which equate to actually operating or controlling the fan, but rather, merely provide steps that the method utilizes to determine data. For instance, species I does not require the particulars of species II, III and IV. The same can be said for species II, III and IV, with respect to the other species, and vice versa.