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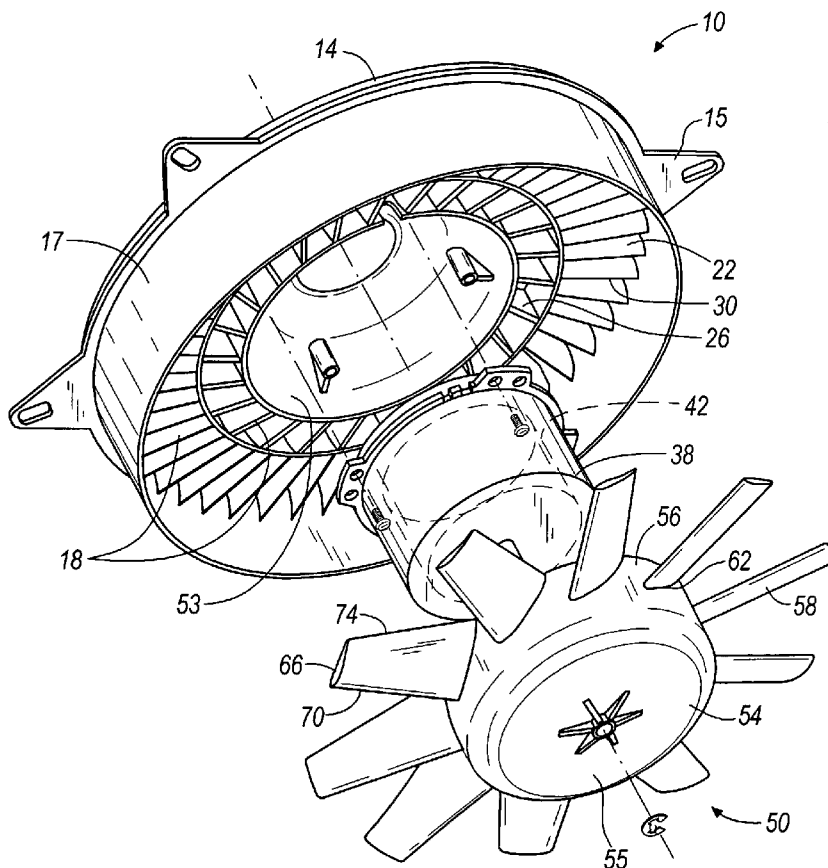
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[Continued on next page]

(54) Title: FAN ASSEMBLY AND METHOD



(57) Abstract: The axial fan assembly according to some embodiments of the present invention has a shroud, a motor coupled to the shroud, and a fan coupled to the motor. By employing selected vane-to-blade ratios, blade twist angles, blade pitch angles, blade-to-shroud axial gaps, shroud solidities, vane swept angles, and vane inlet and outlet angles of specified amounts or falling within specified ranges, desirable fan performance is achieved. Any one or more of these parameters can be utilized alone or in combination with other parameters as desired.

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**INTERNATIONAL SEARCH REPORT**

International application No.

PCT/US05/05760

**A. CLASSIFICATION OF SUBJECT MATTER**  
 IPC: **F04D 29/38( 2006.01),29/54( 2006.01)**  
  
 USPC: 415/211.2  
 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)  
 U.S. : 415/191, 192, 208.2, 209.4, 210.1, 211.2, 220, 223; 416/247R  
 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)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

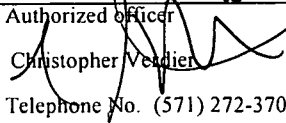
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2,962,260 A (FOLEY) 29 November 1960 (29.11.1960), see entire document.	1-15, 25-26 ----- 16-24
Y	US 2,955,746 A (STALKER) 11 October 1960 (11.10.1960), column 4, lines 69-75 and column 5, lines 1-5.	22-24
A	US 3,652,184 A (CONRAD) 28 March 1972 (28.03.1972).	

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	"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
"E" earlier application or patent published on or after the international filing date	"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
"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	
"P" document published prior to the international filing date but later than the priority date claimed	"&" document member of the same patent family

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**INTERNATIONAL SEARCH REPORT**

International application No.

PCT/US05/05760

**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.: 1-26

- 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.

**BOX III. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING**

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claim(s) 1-26, drawn to a fan having a rearward swept angle defined between a first straight line extending through the radially inner and outer ends of the vane and a second straight line extending from the axis of the fan to the radially inner end of the vane, with the rearward swept angle being no less than about 5 degrees and no greater than about 45 degrees.

Group II, claim(s) 27-49, drawn to a fan having an inlet angle defined between a straight line tangent to the vane at the leading edge of the vane and a plane orthogonal to the axis of the fan, with the straight line lying in a plane tangent to an imaginary cylinder centered at the axis of the fan, the inlet angle being no less than about 20 degrees and no greater than about 70 degrees

Group III, claim(s) 50-69, drawn to a fan having an outlet angle defined between a straight line tangent to the vane at the trailing edge of the vane and a line parallel to the axis of the fan, with the straight line lying in a plane tangent to an imaginary cylinder centered at the axis of the fan, and the outlet angle being no less than about 30 degrees in a direction counter to rotation of the fan and no greater than about 30 degrees in a rotational direction of the fan

Group IV, claim(s) 70-78, drawn to a fan having a shroud separated from the fan by an axial gap between the leading edges of the vanes and the trailing edges of the fan blades, with the gap being no less than about 0.15 inches and no greater than about 1.5 inches.

Group V, claim(s) 79-81, drawn to a fan having vanes with a chord length at a first point measured from a vane leading edge to a vane trailing edge, the fan assembly having a ratio of chord length to vane gap of no less than about 0.2 and no greater than about 2.5.

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 feature of a fan assembly, comprising a motor, a fan rotatably coupled to the motor for rotation about an axis, the fan having a plurality of fan blades, each fan blade having a leading edge with respect to a rotational direction of the fan blade and a trailing edge with respect to the rotational direction of the fan blade, and a shroud including a plurality of vanes extending transversely with respect to fluid flow through the fan assembly and through which fluid flows through the fan assembly, the vanes being located downstream of the fan and oriented to extend away from a central area of the shroud, each vane having a leading edge and a trailing edge downstream of the leading edge with respect to fluid flow through the fan assembly, each of the vanes spaced from an adjacent vane by a gap measured from a first point on a first vane to a corresponding point on an adjacent vane, each vane also having a chord length at the first point measured from the vane leading edge to the vane trailing edge, is known in the prior art, as shown by U.S. Patent 3,144,201.

Therefore, there is a lack of unity *a posteriori*, since the above feature is not a technical feature that defines a contribution over the prior art, and the inventions along with their technical features listed above as Groups I-V above do not have the same or corresponding technical features.