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(54) **Finger guards for air moving devices**

(57) A low noise finger guard for air moving systems that reduces noise created by air flow through the finger guard (90) is configured with an aerodynamically

shaped cross-sectional area in the direction of air flow therethrough.

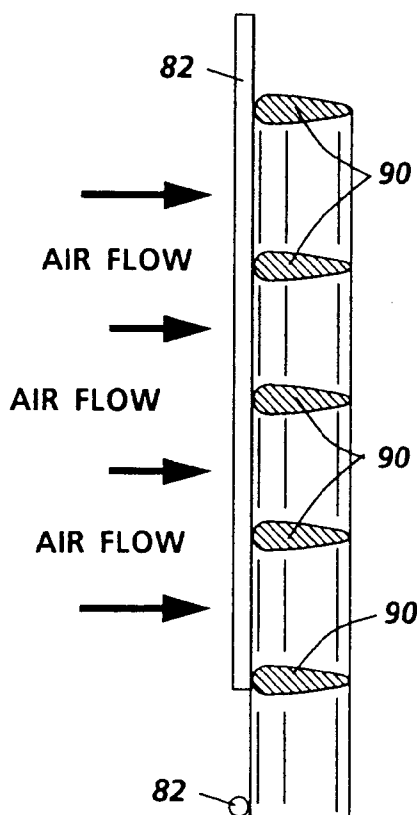


FIG. 2A

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Description

This invention relates to a finger guard for air moving devices, and more particularly, but not exclusively, to fan systems with low noise generating finger guards, for use in a wide variety of machines, for example, copier/printers.

Excessive noise from machines, such as, copier/printers in working environments has been an irritant to users from the advent of such machines until the present day. One of the major contributors to machine noise has been found to be fans and blowers. Observations from a recent study indicate that: (1) air flowing through finger guards can generate more noise than that of a fan; and (2) noise can vary drastically with different finger guard configurations. Typically, some conventional printing machines employ cooling fans that emit noise at 48 dBA. In testing a copier for fan noise level, the fan was operated at 3000 rpm and delivered 100 cfm of air. With the finger guard installed, the combined noise level increased to 55 dBA. The noise level of the finger guard alone as calculated was 54 dBA. For middle and low volume copier/printers, a finger guard generating noise at this level is unacceptable. The noise level of the finger guard was obtained by subtracting the fan noise from the overall noise level. By comparison, an off-the-shelf finger guard from Howard Industries' fan catalog was 50 dBA.

Spiral finger guard in Howard Industries Fan Catalog, No. 2.5M-DP-592, page 15 is an example of a prior art finger guard.

In accordance with one aspect of the invention, there is provided a finger guard for air moving devices which reduces noise generated by air moving therethrough, comprising: a finger guard member having aerodynamically shaped cross-sections in the direction of air flow therethrough; and support members adapted to support said finger guard in front of the blades of the air moving device.

In another aspect of the invention, finger guard configurations for controlling noise in an air moving system is disclosed that comprises improved low noise finger guards which reduce the noise that is generated by drag induced by conventional finger guards. Noise improvement is obtained by utilizing asymmetric, non-concentric, and/or random designs. Also, noise improvement is achieved with "airfoil - like" cross-sections that significantly reduce fluid drag.

The present invention will now be described by way of example with reference to the accompanying drawings, in which:

FIG. 1 is a chart showing test results of the noise level of finger guard configurations of the present invention in comparison to the prior art,

FIG. 2 is a schematic front view illustrating an aerodynamic shaped low noise finger guard in accordance with the present invention, and

FIGS. 2A -2D are cross-section views of alternative aerodynamic shaped low noise finger guards employed in the apparatus of FIG. 2.

Copier/printers in the past that incorporated cooling fans and the like have experienced noise problems. Thus, an increased understanding of the acoustic noise creation mechanism in fans was necessitated. Through research and investigation, it has been found that air flowing through finger guards can generate more noise than that of a fan and that a new set of finger guard configurations disclosed herein reduced noise considerably. Test results indicate that significant noise improvement is obtained when fans are equipped with finger guards that are asymmetric, non-concentric, and/or random in shape.

In FIG. 1, finger guard configurations in accordance with the present invention are compared against conventional finger guards. The noise level is in dBA. As seen in FIG. 1, the noise level of a fan only is 48 dBA while the noise level of a conventional finger guard is 54 dBA and the noise level of a Howard Industries finger guard is 50 dBA. In contrast, the asymmetric, non-concentric, non-coaxial finger guard configuration A has a noise level of 47 dBA. Configurations B, C and D have noise levels of only 44 dBA. As shown in the chart, up to 90% (10 dBA) improvement in noise level is obtained when the finger guard configurations A, B, C and D are compared with the conventional finger guard and 75% (6 dBA) improvement when measured against the Howard Industries "spiral" finger guard. Also, noise level is reduced by the use of randomly spaced finger guard supports including support members 8 in finger configuration A, support member 10 in finger guard configuration B, support members 12 in finger configuration C and support members 16 that are configured in configuration D in a fashion which is opposite to the curvature of fan blades on the fan which the finger guard is used.

Alternative embodiments of finger guard configurations of the present invention that can be employed in the finger guard 80 of FIG. 2 are shown in FIGS. 2A-2D. In FIG. 2, a Stealth finger guard 80 which is attachable to a fan comprises mounting supports 82 with the finger guard members 90. The finger guard members 90 are preferably molded with aerodynamically shaped or "airfoil - like" cross-sections. The cross-sections of finger guard 80 are in the form of a tear drop 90 in FIG. 2A, a dual wedge 96 in FIG. 2B, an air foil 97 in FIG. 2C, and a saucer 98 in FIG. 2D. These "airfoil - like" cross-sections of the Stealth finger guards reduce fluid drag on the surfaces of the finger guards, thereby reducing the audible noise level. The result is confirmed by test data as shown in Table 1 below:

Table I

	Stealth finger guard with 7 blade fan	Stealth finger guard with 5 blade fan	Conventional finger guard	Howard spiral guard	Stealth finger guard
Fan + finger guard	51	50	55	52	49
Fan only	51	50	49	49	49
Noise (dBA) generated by the finger guard	negligible	negligible	53	49	negligible

As the test results in Table 1 indicate, the Stealth finger guard 80 is better than some existing finger guards by over 99% (20 dBA). This is true for the most adverse situation when tested against a 7 blade fan at a higher flow rate where the noise level generated by the Stealth finger guard was negligible. The noise generated by the Stealth finger guard with a 5 blade fan was also negligible.

While the low noise finger guards of this invention have been described in a preferred environment of a fan cover for safety purposes, the configurations of the invention can be used in any system that requires the use of covers for open areas in machines through which air must flow, such as, for example, grills for the back of machines or any place where noise from air flow due to finger guards is a problem.

In the present invention, noise abatement is attained by configuring fan finger guards so that they are low in fluid drag and asymmetric, non-concentric, and/or randomly shaped. The design is applicable to most air moving devices that encounter noise.

Claims

1. A finger guard (80) for air moving devices which reduces noise generated by air moving therethrough, comprising:
 - a finger guard member (90) having aerodynamically shaped cross-sections in the direction of air flow therethrough; and
 - support members adapted to support said finger guard in front of the blades of the air moving device.
2. The finger guard of claim 1 for use with a cooling fan for a printing apparatus that includes means for forming a latent electrostatic image on a charge retentive surface, transferring that image to a copy sheet, fusing the image to the copy sheet, and transporting the copy sheet out of the printing apparatus.
3. The finger guard of claim 2, wherein the cooling fan has a plurality of blades;
 - wherein said finger guard is configured such that at no time during rotation of the blades do similar locations of different blades intersect the guard at the same time; and
 - wherein support members (82) support said finger guard with respect to said cooling fan.
4. The finger guard of claim 1, wherein the cross-sectional shape of finger guard member (90) is in the form of a tear drop.
5. The finger guard of claim 1, wherein the cross-sectional shape of the finger guard member (90) is in the form of a dual wedge (96).
6. The finger guard of claim 1, wherein the cross-sectional shape of finger guard member (90) is in the form of an air foil (97).
7. The finger guard of claim 1, wherein the cross-sectional shape of finger guard member (90) is in the form of a saucer (98).

8. A finger guard (80) to reduce noise generated by an air moving device having blades for generating air flow, comprising:

5 at least one finger guard member 90 configured asymmetrically with respect to symmetry of the fan blades of the air moving device such that at no time during rotation of the blades do similar locations of different blades intersect the guard at the same time; and
support members (82) supporting said finger guard(s) in front of the blades of the air moving device.

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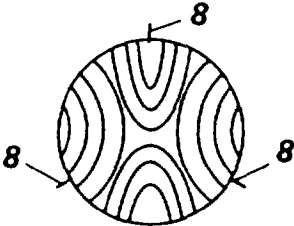
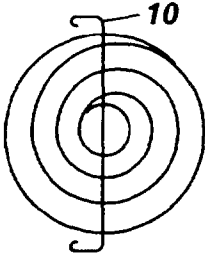
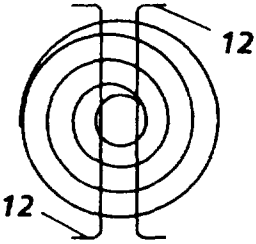
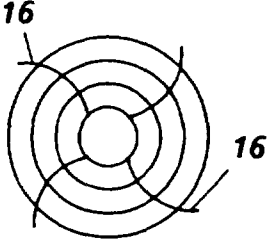
	NOISE LEVEL IN dba	NONCONVENTIONAL CONFIGURATIONS
FAN ONLY	48	
CONVENTIONAL GUARD	54	
HOWARD INDUSTRIES GUARD	50	
A	47	
B	44	
C	44	
D	44	

FIG. 1

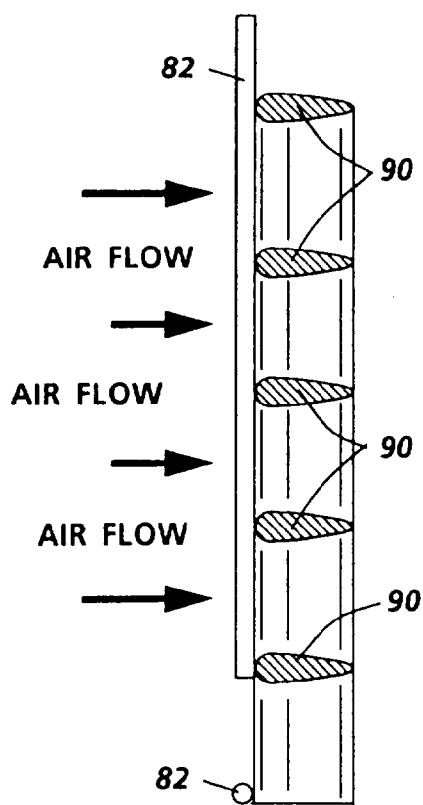
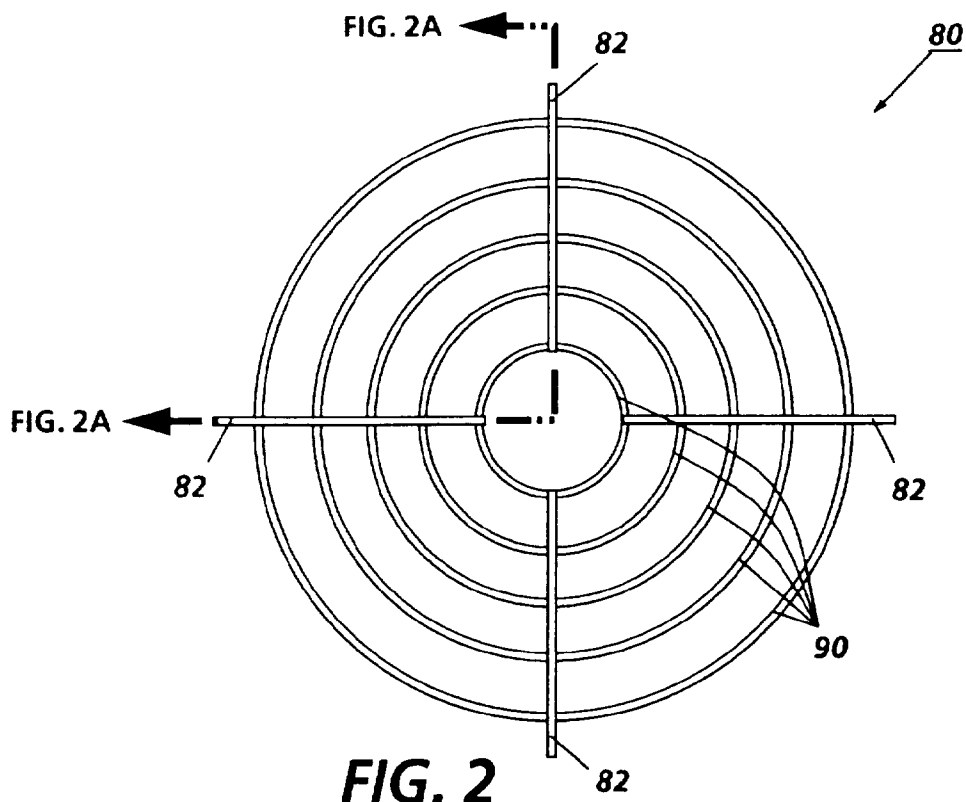


FIG. 2A

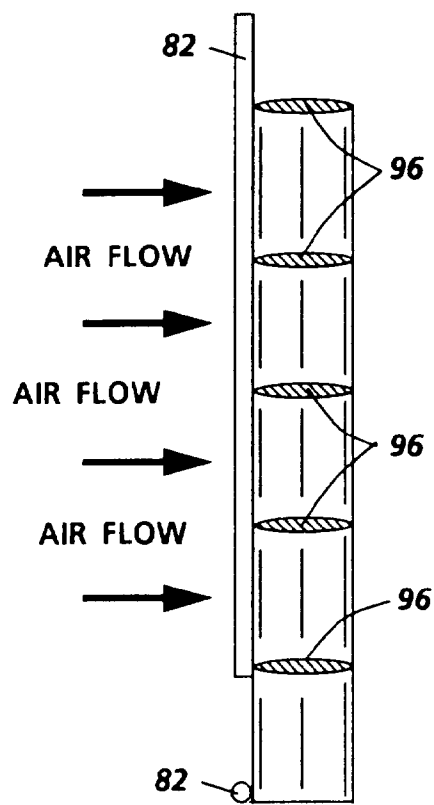


FIG. 2B

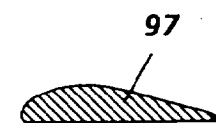


FIG. 2C

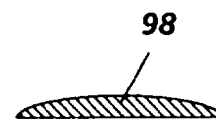


FIG. 2D



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EUROPEAN SEARCH REPORT

Application Number
EP 95 30 7731

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	GB-A-368 858 (ADAMCIKAS) * the whole document *	1,5	F04D29/70 F04D29/66
A	---	2,8	
X	US-A-5 259 726 (BACRIA) * the whole document *	1,5,6	
A	---	2	
A	DE-C-688 833 (EYSER) * the whole document *	1,2,4,8	
A	US-A-2 100 994 (COHEN) * the whole document *	1-3,8	
A	DE-A-23 45 539 (SIEMENS) * figure 3 *	1,2,6	
A	DE-U-90 17 417 (WILHELM) * the whole document *	1-3,8	
A	DE-A-22 27 460 (SÜDDEUTSCHE KÜHLERFABRIK JULIUS FR. BEHR) * the whole document *	1,2,6	TECHNICAL FIELDS SEARCHED (Int.Cl.6) F04D
A	CH-A-417 836 (PHILIPS' GLOEILAMPENFABRIEK) * the whole document *	1,2,6	

The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 1 March 1996	Examiner Teerling, J
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background U : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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