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(54) Fan with blades having integral rotating venturi

Gebläse mit integrierter mitdrehenden Venturidüse

Ventilateur avec venturi intégré tournant

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(56) References cited:

EP-A- 0 531 025	EP-A- 0 541 429
DE-A- 1 628 257	US-A- 2 030 993
US-A- 4 685 513	US-A- 5 423 660

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Description

Background Of The Invention

[0001] An item of electronic equipment that dissipates more power than can easily be cooled with heat sinks alone generally uses fans to supplement natural convection. This works well enough, but as anyone who has labored in a room full of fan cooled equipment can attest, the noise from the fans themselves can be rather annoying. This is especially so in an office setting, where there arise issues of decorum, in addition to the more pragmatic issues of productivity reduction owing to distractions caused by noise.

[0002] A significant amount of fan noise appears to originate with the production of turbulent vortices of air at the tips of the fan blades as they rotate about the fan's axis. The tips pass sideways, as it were, through low pressure air located between the stationary venturi and the moving blade tips. As the blades rotate high pressure air spills over the tips of the blades and imparts an off axis spinning motion in the low pressure air (vortices) whose turbulent behavior results in the production of acoustic energy (noise).

[0003] It would be desirable if fan noise could be reduced without sacrificing the air flow the fan is intended to supply.

[0004] US 5,423,660 discloses a fan comprising a frame, a hub rotatably mounted to the frame for rotation about an axis; a plurality of pitched blades attached at inner ends thereof to the hub and that in a direction toward outer ends thereof project away from the hub; and annular venturi centered about the hub and having an inlet, an outlet, an inner surface that generally faces the hub and that a location proximate the inlet has a diameter less than the diameter at the outlet, the annular venturi attached at that inner surface to the outer ends of the plurality of blades, the annular venturi rotating about the axis of the hub as the hub rotates.

Summary Of The Invention

[0005] A solution to the problem of fan noise is to reduce the production of turbulent vortices. This may be done by providing an outer surface of the rotating venturi with a close fit against the inner surface of an outer annular stationary housing of the fan, to minimize any acoustic or mechanical mischief created by the otherwise exposed outer surface of the rotating venturi.

Brief Description Of The Drawings

[0006]

Figure 1 is a simplified top view of a fan having a rotating venturi attached to the blades of the fan; Figure 2 is a simplified cross sectional view of the fan of Figure 1,

Figure 3 is a simplified top view of a fan similar to the one in Figure 1, but having an additional annular housing surrounding the rotating venturi; and Figure 4 is a simplified cross sectional view of the fan of Figure 2.

Description Of A Preferred Embodiment

[0007] Refer now to Figures 1 and 2, wherein are shown a top view and a cross sectional side view of a fan 1 constructed in accordance with the invention. In particular, a hub 2 is rotatably mounted on a base 5 that includes an open interior region spanned by struts 6. The struts 6 support a central location 7 within the base

5, onto which the hub 2 is mounted. A plurality of blades 3 are attached to the hub 2. A small motor (not shown) under the hub 2 causes the hub and the blades 3 attached thereto to rotate. The direction of airflow is shown by the heavy arrow 8.

[0008] An annular venturi 4 is attached to the distal ends of the blades 3, and rotates about the hub as do the blades 3. The annular venturi 4 has an outer surface 9 that may, if desired, be parallel to the axis about which the hub 2 rotates, and has an inner surface 10 that, in a known manner, may resemble an airfoil.

[0009] Finally, note that the open interior region (not itself readily depicted) has an outer edge 11. This edge 11 is visible because the diameter of the interior region it represents is slightly larger than the outer diameter of the rotating annular venturi 4. The relative sizes of these diameters is a matter of choice, and it may be desirable for the diameter associated with edge 11 to be greater than the inside diameter of the rotating annular venturi 4 and less than its outer diameter.

[0010] Now consider the embodiment for fan 12 of Figures 3 and 4, where similar or unchanged elements have the same reference characters. Note in Figures 3 and 4 the stationary housing, or collar, 14. It is essentially a section of a cylinder that is either simply a molded part of, or is attached to, the base 13. There are many possible reasons for wanting such a housing or collar 14, and they include protecting the rotating annular venturi 4 from inadvertent contact with other objects, acting as a stiffener for the base 13 and serving as a location for mounting a screen.

[0011] As before, the exact diameter of the interior region represented by edge 11 is a matter of choice.

[0012] The rotating annular venturi 4 of both embodiments described above reduces fan noise by eliminating the vortices created by the passage of the tips of the blades 3 through low pressure air, and by the subsequent spilling of higher pressure air outward in a radial direction into that low pressure air. In the embodiment of Figures 3 and 4 it may be desirable to minimize the gap between the outer surface of the rotating annular venturi 4 and the inner surface of the stationary housing or collar 14 to a practical minimum, say, a few hundredths of an inch. A compromise may be necessary

between turbulence and drag.

Claims

1. A fan (1) comprising:

a frame (5),
a hub (2) rotatably mounted to the frame for rotation about an axis;
a plurality of pitched blades (3) attached at inner ends thereof to the hub and that in a direction toward outer ends thereof project away from the hub;
an annular venturi (4) centered about the hub and having an inlet, an outlet, an inner surface (10) that generally faces the hub and that a location proximate the inlet has a diameter less than at the outlet, the annular venturi attached at the inner surface to the outer ends of the plurality of blades, and the annular venturi rotating about the axis of the hub as the hub rotates;

characterized in that

the annular venturi (4) has an outer surface (9) parallel to the axis of the hub (2), and
the fan (1) further comprises an outer annular stationary housing (14) having an inner surface (11), wherein the outer surface (9) of the rotating venturi (4) having a close fit against the inner surface (11) of the outer annular stationary housing (14), to minimize any acoustic or mechanical mischief created by the otherwise exposed outer surface of the rotating venturi (4).

2. A fan as in claim 1, **characterized in that** the frame (5) further comprises an open interior region allowing the passage of air therethrough, the interior region is bounded by a peripheral surface from which struts (6) converge toward and meet at a central location (7) within the open interior region, and the hub is rotatably mounted at the central location.
3. A fan as in claim 2, **characterized in that** the surface is generally square and has mounting holes near its corners for attaching the fan to a surface.
4. A fan as in claim 2, **characterized in that** the frame further comprises a stationary housing (14) disposed about the annular venturi (4) and enclosing an outer surface thereof.

Patentansprüche

1. Ein Lüfter (1), der folgende Merkmale umfaßt:

einen Rahmen (5);

5 eine Nabe (2), die für die Drehung um eine Achse drehbar an dem Rahmen befestigt ist;
eine Mehrzahl von schräggestellten Blättern (3), die an inneren Enden derselben an der Nabe befestigt sind, und die in einer Richtung zu äußerer Enden derselben weg von der Nabe hervorstehen;

10 einen ringförmigen Lufttrichter (4), der um die Nabe zentriert ist und einen Einlaß, einen Auslaß, eine innere Oberfläche (10) umfaßt, die im allgemeinen der Nabe zugewandt ist, und die an einer Position in der Nähe des Einlasses einen Durchmesser aufweist, der geringer ist als an dem Auslaß, wobei der ringförmige Lufttrichter an der inneren Oberfläche an den äußeren Enden der Mehrzahl von Blättern befestigt ist, und wobei sich der ringförmige Lufttrichter um die Achse der Nabe dreht, während sich die Nabe dreht;

dadurch gekennzeichnet, daß

der ringförmige Lufttrichter (4) eine äußere Oberfläche (9) parallel zu der Achse der Nabe (2) aufweist, und
der Lüfter (1) ferner ein äußeres ringförmiges stationäres Gehäuse (14) mit einer Innenoberfläche (11) umfaßt, wobei die Außenoberfläche (9) des drehenden Lufttrichters (4) eine enge Passung gegen die Innenoberfläche (11) des äußeren ringförmigen stationären Gehäuses (14) aufweist, um jeden akustischen oder mechanischen Schaden zu minimieren, der durch die andernfalls freigelegte äußere Oberfläche des drehenden Lufttrichters (4) erzeugt würde.

- 25 35 40 45 50 55 2. Ein Lüfter gemäß Anspruch 1, **dadurch gekennzeichnet, daß** der Rahmen (5) ferner eine offene Innenregion umfaßt, die einen Luftdurchgang durch denselben ermöglicht, wobei die Innenregion durch eine Peripherieoberfläche begrenzt ist, von der Streben (6) zu einer zentralen Position (7) zusammenlaufend und sich an derselben innerhalb der offenen Innenregion treffen, und die Nabe drehbar an der Mittelposition befestigt ist.
3. Ein Lüfter gemäß Anspruch 2, der **dadurch gekennzeichnet ist, daß** die Oberfläche im allgemeinen quadratisch ist und in der Nähe ihrer Ecken Befestigungslöcher zum Befestigen des Lüfters an einer Oberfläche aufweist.
4. Ein Lüfter gemäß Anspruch 2, **dadurch gekennzeichnet, daß** der Rahmen ferner ein stationäres Gehäuse (14) umfaßt, das um den ringförmigen Lufttrichter (4) angeordnet ist und eine äußere Oberfläche desselben umfaßt.

Revendications**1. Ventilateur (1) comprenant :**

un cadre (5), 5
 un moyeu (2) monté sur le cadre de manière à pouvoir tourner dans une rotation autour d'un axe ;
 une pluralité de pales (3) disposées selon un pas, attachées en leurs extrémités intérieures au moyeu et qui, dans une direction vers leurs extrémités, saillent du moyeu ; 10
 un venturi annulaire (4) centré autour du moyeu et ayant une entrée, une sortie, une surface interne (10) qui fait face d'une manière générale au moyeu et qui, en un endroit proche de l'entrée, possède un diamètre inférieur à celui en la sortie, le venturi annulaire étant attaché à la surface interne aux extrémités externes de la pluralité de pales et le venturi annulaire tournant autour de l'axe du moyeu lorsque le moyeu tourne ; 15
 20

caractérisé en ce que

le venturi annulaire (4) possède une surface externe (9) parallèle à l'axe du moyeu (2), et
 le ventilateur (1) comprend en outre un capot annulaire externe fixe (14) ayant une surface interne (11), la surface externe (9) du venturi tournant (4) ayant un ajustement étroit contre la surface interne (11) du capot annulaire externe fixe (14), pour minimiser toute nuisance acoustique ou mécanique créée par la surface externe autrement exposée du venturi tournant (4). 35

2. Ventilateur comme dans la revendication 1, **caractérisé en ce que** le cadre (5) comprend en outre une région intérieure ouverte permettant le passage de l'air à travers celle-ci, la région intérieure étant limitée par une surface périphérique à partir de laquelle des piliers (6) convergent vers et se rencontrent en un emplacement central (7) à l'intérieur de la région intérieure ouverte, et le moyeu étant de manière à pouvoir tourner à l'emplacement central. 40
 45
3. Ventilateur comme dans la revendication 2, **caractérisé en ce que** la surface est d'une manière générale carrée et possède des trous pour le montage proche de ses coins pour fixer le ventilateur à une surface. 50
4. Ventilateur comme dans la revendication 2, **caractérisé en ce que** le cadre comprend en outre un capot fixe (14) disposé autour du venturi annulaire (4) et enfermant une surface externe de ce dernier. 55

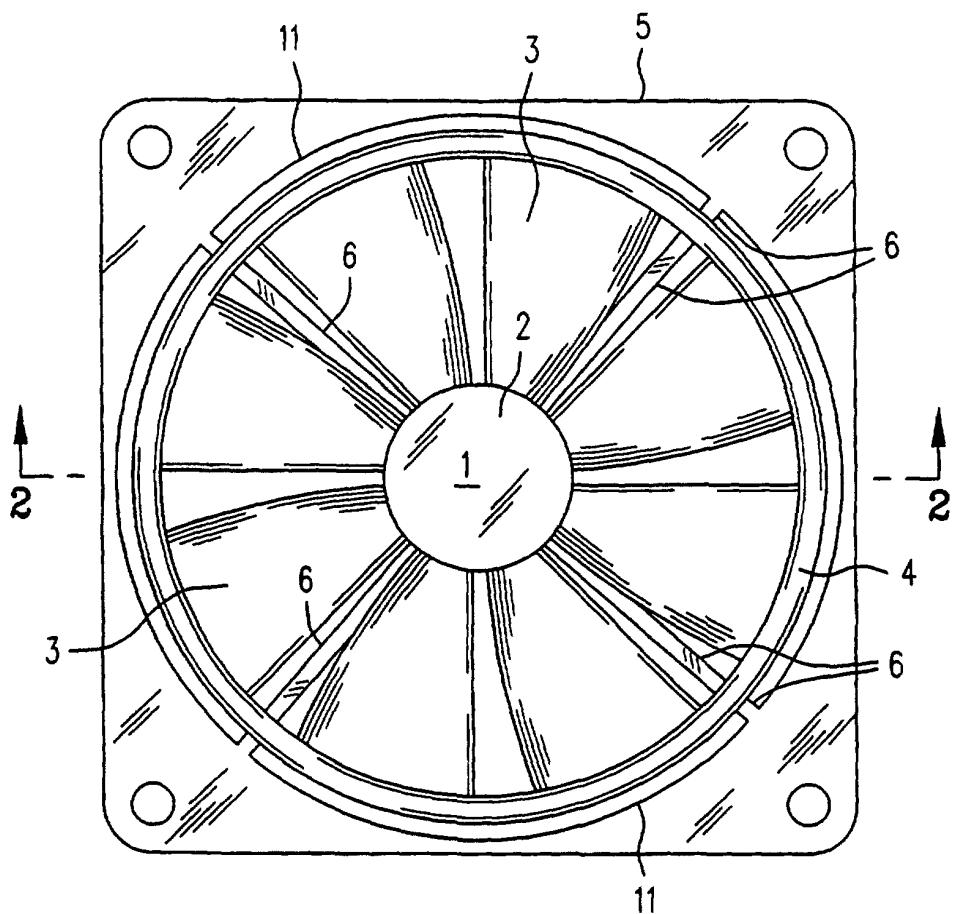


FIG. 1

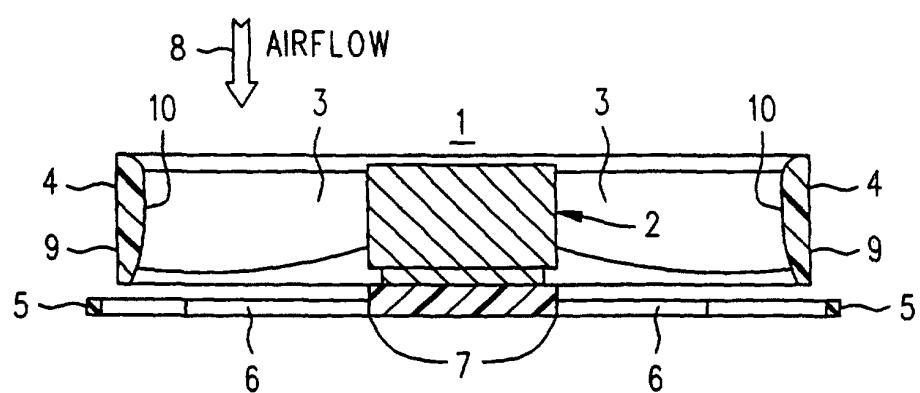


FIG. 2

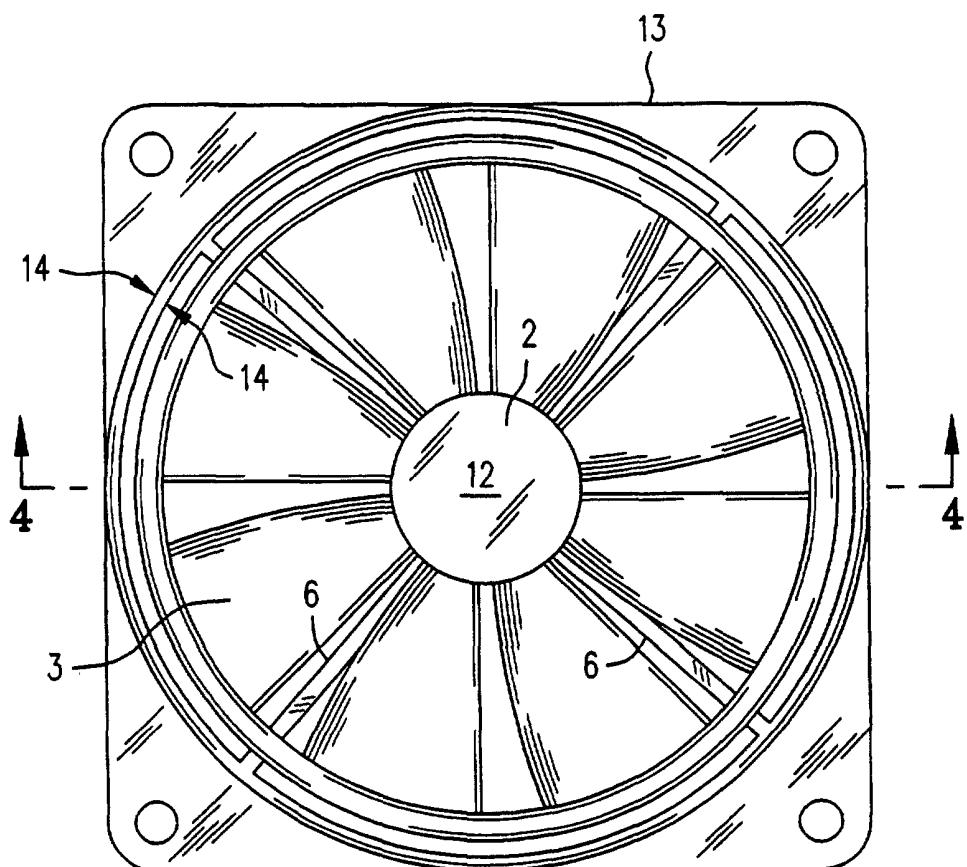


FIG. 3

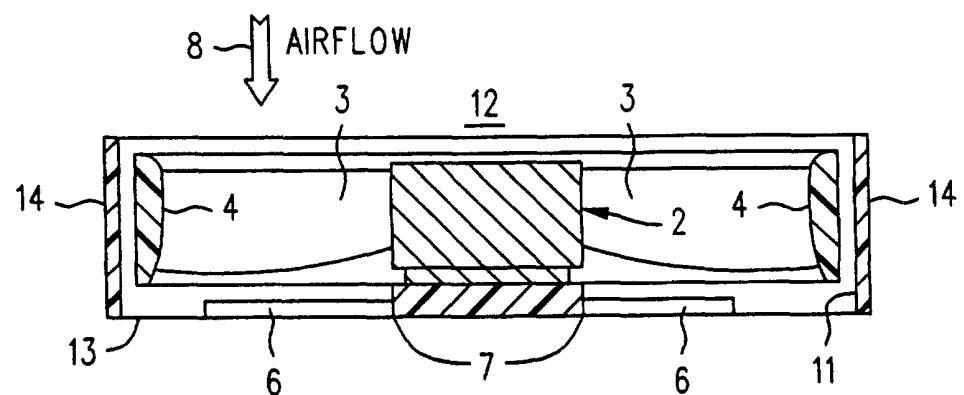


FIG. 4