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RADIAL FLOW FAN

Filed Dec. 16, 1960

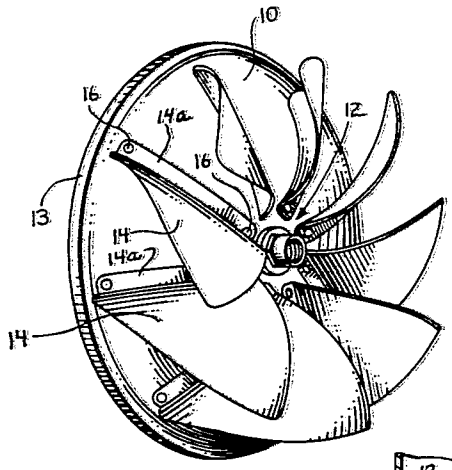


Fig. 1.

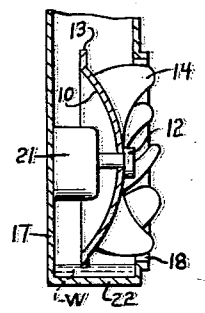


Fig.4.

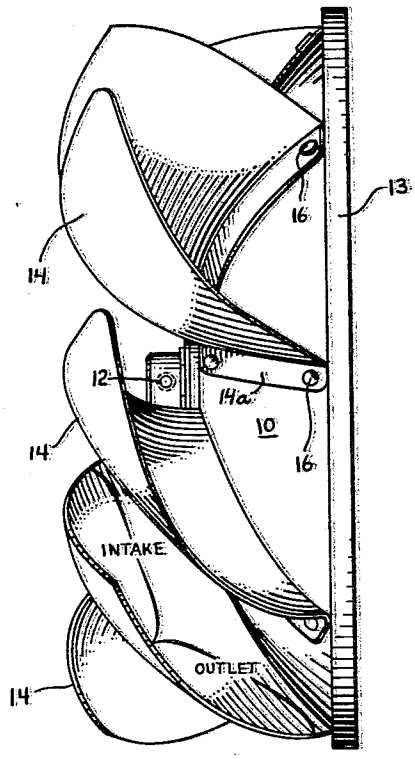


Fig. 2.

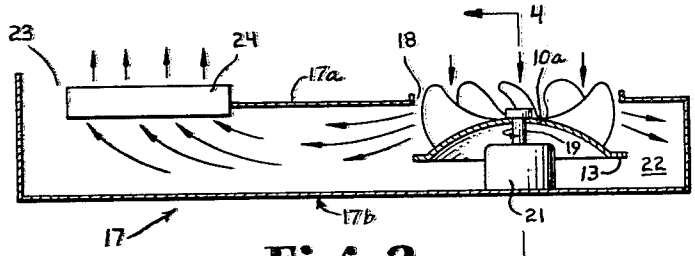


Fig. 3.

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RADIAL FLOW FAN

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3 Claims. (Cl. 261—28)

This invention relates generally to air moving impellers and in particular to a fan-type impeller adapted for use in modern air-conditioning units.

Modern mechanical refrigeration air conditioning devices require the presence of a means for inducing an air stream past the condenser component of the refrigeration system. In conventional installations this air stream is drawn from the outside or exterior of the room being air conditioned and, after it has moved through the condenser coils is again exhausted to the outside atmosphere. A separate air moving means or fan is conventionally used to direct an air stream from the room being air conditioned, past the evaporator component of the refrigeration system, and back to the room. The fan or air moving means of the present invention is particularly adapted for use in inducing the flow of outside air through the condenser coils of the system.

Centrifugal type blower wheels have certain characteristics which would recommend their use in the condenser air stream application. They provide a relatively non-turbulent flow and are therefore quiet in operation. They provide a radial flow output which is particularly useful in the relatively thin enclosures or housings into which modern air conditioning components must be fitted. The power input to the driving shaft of a centrifugal blower wheel decreases as the static pressure in the system increases, that is, should the air stream be constricted or blocked, the air moving means unloads. Because of their cost, and the relatively low velocities obtained for a given power input, however, centrifugal blower wheels are rarely used in these applications.

Axial flow type fans are conventionally used to move the required air stream through the condenser coils and their use generates several problems. The axial flow characteristic is unsuited for the relatively thin housings of modern wall-type air conditioning units. The use of axial flow fans to supply air in a radial pattern produces excessive turbulence and therefore a high noise level. Further, in the condenser air stream, it is necessary to provide a "slinger ring" on the fan which picks up condensate water from a suitably positioned sump and entrains droplets of this water in the air stream ahead of the condenser coils thereby eliminating the condensate water from the refrigeration unit and, simultaneously cooling the condenser coils. The fabrication of slinger rings to conventional axial flow propellers produces difficult problems in aligning the rings properly with the axis of rotation of the propeller and normally requires numerous additional parts and difficult assembly procedures. The proper relationship of the plane of the slinger ring and the propeller axis can be easily disturbed by only the normal amount of handling in assembling or in conveying the completed assemblies. Misalignment of the slinger ring, in addition to causing improper operation thereof, disrupts the balance of the fan or blower with consequent increase in the stressing of its components and in the vibrations and noises generated during the operation thereof. It is the primary object of the present invention to provide an air moving means which combines for use in modern air conditioning units the desirable features of both centrifugal type blower wheels and axial flow fans or propellers.

A further object of the present invention is to provide an air moving means comprising a concavo-convex disk having blades mounted on its convex surface and formed so as to provide an axially directed air intake and a radially directed air discharge.

A further object of the present invention is to provide a fan of the type referred to in which the peripheral margin of the concavo-convex disk is formed to provide an integral slinger ring which avoids the ring-axis alignment problem present in conventional assemblies.

A further object of the present invention is to provide a fan of the type referred to in which the driving motor (whose size may vary over a wide range) for the fan may be disposed at least partially within the area defined by the concave surface of the fan disk whereby the fan-drive motor assembly is reduced in over-all size and particularly adapted for use in the relatively small housing of modern air conditioning units.

A further object of the present invention is to provide an air moving fan or propeller producing an air flow of relatively low turbulence and, as compared to prior art structures, producing a given volume rate of flow with a reduced power input or drive motor loading.

A further object of the present invention is to provide an air moving means of the type referred to which unloads or requires reduced power input as the static pressure in the accompanying system increases.

The full nature of the invention will be understood from the accompanying drawings and the following description and the claims.

FIG. 1 is a perspective view of an air moving means embodying the present invention;

FIG. 2 is a side view of the structure shown in FIG. 1;

FIG. 3 is a schematic, top view of an air conditioning unit in which the air moving means of the present invention is installed; and

FIG. 4 is a sectional view essentially along the line 4—4 of FIG. 3 and illustrating the cooperation between the slinger ring and the housing.

Referring initially to FIGS. 1 and 2, the fan structure embodying the present invention includes a concavo-convex disk 10 preferably formed of aluminum. The disk is adapted to be mounted for rotation about its center by means of the hub structure indicated generally at 12. The hub structure may take any suitable form but is preferably that disclosed in the copending application of Richard F. Beehler for "Resilient Fan Hub Assembly," Serial No. 46,159, filed July 29, 1960, and assigned to the assignee of the present invention, now Patent No. 3,084,963, issued April 9, 1963. The peripheral marginal area of the disk 10 is flanged so as to extend radially therefrom in a direction perpendicular to the axis of rotation of the disk to provide a slinger ring 13 for hurling moisture into the air stream created by rotation of the fan.

Carried on the convex face of the disk 10 is a series of generally triangularly shaped fan blades 14. The bases 14*a* of the blades 14 are arranged radially on the disk surface and are rigidly attached thereto by any suitable means, such as rivets 16 and extend from near the outer periphery of the disk 10 to a point spaced from the hub 12 to define a smooth vaneless center area 10*a*. The plane of each of the blades is smoothly curved so that the apex thereof points generally in the direction of rotation of the fan. As indicated in FIG. 2, the blades 14 are shaped so that the intake and outlet areas are of substantially the same length when the blade is viewed in profile.

Referring now to FIG. 3, there is shown schematically a typical installation of the fan of the present invention in an air conditioning unit. It will be understood that, in a normal installation, a separate evaporator and evaporator air stream inducing means would also be present in the completed structure, this portion of a completed structure not being shown in FIG. 3. The structure may in-

clude an air conditioning unit housing **17** having a front wall **17***a* with an annular inlet aperture **18** communicating with the outside or exterior of the room or enclosure which is being air conditioned. Mounted at the inlet aperture adjacent the base wall **17***b* is the fan of the present invention which is supported on a drive shaft **19** and driven by a conventional electric motor **21**. It will be understood that the bottom wall **22** of the housing **17** may be formed so as to provide a sump for collecting condensate water W from the evaporator (not shown). The fan and its driving motor are mounted with relation to the sump so that the slinger ring **13** serves to entrain moisture or water droplets in the air stream induced by the fan. That is, the ring **13** is positioned for rotation above the bottom wall **22** of the housing **17** so that when condensate water accumulates therein and raises to a level wherein its contacts the ring **13**, it will be hurled in droplets into the air flowing through the housing by the action created when the ring is rotated at high speed. The droplets then evaporate and reduce the temperature of the air, thereby cooling the coils **24** as the air passes thereover.

The housing **17** is provided with an outlet aperture **23** laterally spaced from the intake aperture. Extending across the major portion of the outlet aperture **23** is a condenser coil assembly **24**. Since the structure shown in FIG. 3 is intended merely to be a schematic illustration of a typical installation, it will be understood that the housing **17** might take various configurations. Recently designed air conditioning units, however, are characterized by a housing which is relatively thin as indicated in FIG. 3. This contour characteristic requires that the air stream inducing fan be spaced laterally from the condenser through which the air stream is to pass. The conventional axial intake and axial discharge type of fan is thus unsuited for this type of installation.

In operation, with the fan rotating in the direction indicated in FIG. 3, air will be drawn in axially by the fan and will be discharged in a generally radial direction within the housing. In the aforesaid manner, the slinger ring **13** serves to entrain moisture in the air stream which then flows through the condenser coils **24** and is discharged to the exterior of the housing through the discharge aperture **23**. Hence the ring **13** serves the two important functions of eliminating the condensate from the housing **17** and cooling the coils **24**. These functions are accomplished without the possibility of misalignment of the ring **13** with respect to the disk **10** thus increasing the dependability and acceptability of the unit.

It will be noted that the concavo-convex configuration of the disk **10** and the arrangement of the blades **14** are such that the fan produces a generally radial air flow pattern which is particularly suitable for modern air-conditioning installations. Because of the concavo-convex configuration of the disk **10** the drive shaft **19** and at least a portion of the drive motor **21** are enclosed by the disk. This provides an obvious advantage of decreasing the axial length of the fan-motor assembly. The radial flow pattern induced by the fan reduces the turbulence in the air stream to a minimum with a corresponding decrease in the noise level. Because of the less turbulent flow, less power input to the drive motor **21** is required for a given volume rate of flow. If the static pressure within the system is increased, as for example, by the partial blocking of the air passages through the condenser coils, the power input to the shaft **19** decreases in the fashion characteristic of the centrifugal type blower wheel.

The slinger ring **13** is an integral part of the disk **10** and thus requires no extra parts or complicated assembly procedures. Further, there is no problem in maintaining the proper alignment of the slinger ring with the fan axis, the fan thus can be handled in assembly without fear of ring misalignment. The performance of the fan is not critically dependent on orifice location and any relatively simple orifice contour can be used. It will be understood that the blades might have a configuration other than triangular, and that they might be formed to extend at slightly different configurations from that shown without losing the primary advantages of the structure just described.

While the invention has been disclosed and described in some detail in the drawings and foregoing description, they are to be considered as illustrative and not restrictive in character, as other modifications may readily suggest themselves to persons skilled in this art and within the broad scope of the invention, reference being had to the appended claims.

What is claimed is:

1. An air moving device comprising, a housing having a base wall, a first wall in said housing parallel to said base wall and having an unobstructed annular inlet opening therein, a fan blade assembly supported adjacent said base wall within said housing and in alignment with said opening, said assembly including a support disk having a smooth convex surface on one side thereof and a rear side closely associated with said base wall, means mounting said disk for rotation about an axis extending through the center of said disk and parallel to the axis of said opening, a plurality of air movement inducing blades rigidly secured to said convex surface of said disk and extending partially through the opening, said blades each having a base portion and a generally triangular shaped body portion, each of said base portions extending generally radially from near the outer periphery of said support disk to a point spaced from the center of said disk to define a smooth vaneless center portion on said disk, said body portion of said blades being smoothly curved in the direction of rotation of said disk with the leading apex thereof extending generally in the direction of rotation of said disk, each of said body portions having a first section which extends through said opening from one side thereof for effecting axial air intake to said disk and a second section between said first section and said disk for cooperation with said smooth surface of said disk to effect the radial discharge of the air drawn into said housing in a direction between and parallel to said base and first walls and substantially perpendicular to said axis of rotation of said disk.

2. An air moving device as defined in claim 1 wherein said housing includes sump means for holding liquid below said fan blade assembly, and said disk has a radial extending slinger ring around said outer periphery thereof parallel to said base wall and extending partially into said sump means for throwing liquid from said sump means into the air being moved by said fan blade assembly.

3. An air moving device as defined in claim 1 wherein said rear side of said disk is convex, and a drive means secures said disk adjacent said base wall and is partially enclosed by said rear side to reduce the thickness of said housing.

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