

United States Patent

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[72] Inventor **Gunther Zoehfeld**
West Hurley, N.Y.
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 [73] Assignee **Rotorn Incorporated**
Woodstock, N.Y.

2,430,225	11/1947	Hagler.....	230/259
3,431,978	3/1969	Papst.....	230/117
2,024,440	12/1935	Findley.....	416/188
2,264,071	11/1941	Dibovsky.....	415/206
3,003,484	10/1961	Rohrbacher.....	415/206
3,300,122	1/1967	Bowles et al.....	415/206

FOREIGN PATENTS

1,031,929	6/1958	Germany.....	230/117 A
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Primary Examiner—Carlton R. Croyle

Assistant Examiner—John J. Vrablik

Attorney—Brumbaugh, Graves, Donohue & Raymond

[54] **FAN FOR NARROW ENVIRONMENTS**
1 Claim, 3 Drawing Figs.

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 F04b 35/04, F04b 39/06

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[56] **References Cited**

UNITED STATES PATENTS

375,255	12/1887	Blades.....	230/117
1,921,218	8/1933	Colby.....	230/117 A

ABSTRACT: A centrifugal fan for narrow environments is described wherein a stator is mounted to a backplate and is surrounded by a cup-shaped rotor carrying a suitable impeller on its outer periphery to provide a centrifugal output from an axial input. The resultant assembly has a small axial length with a high air delivery and can be substantially enclosed in a housing and mounted in a narrow space.

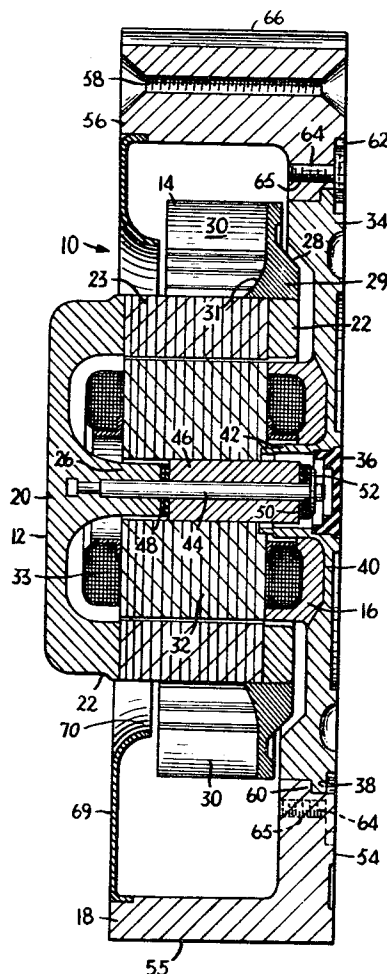
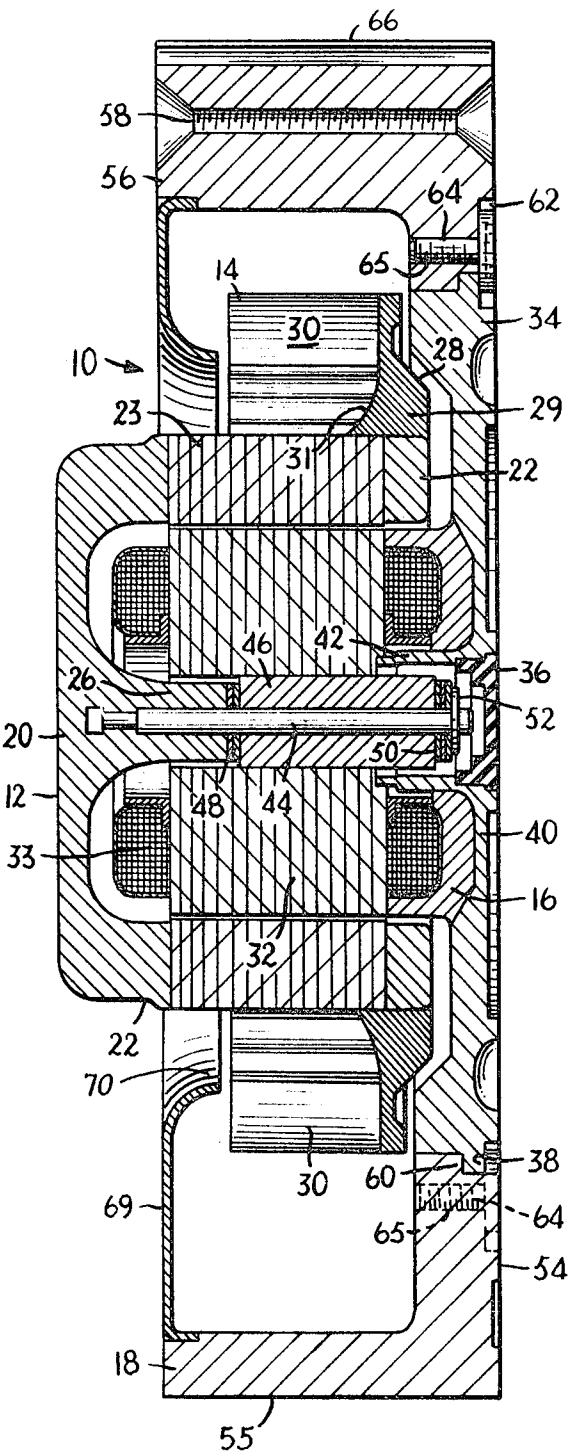


FIG. 1



INVENTOR.

GUNTHER ZOEHFELD

BY *Brumblough, Graves, Dushane Raymond*

his ATTORNEYS

FIG. 2

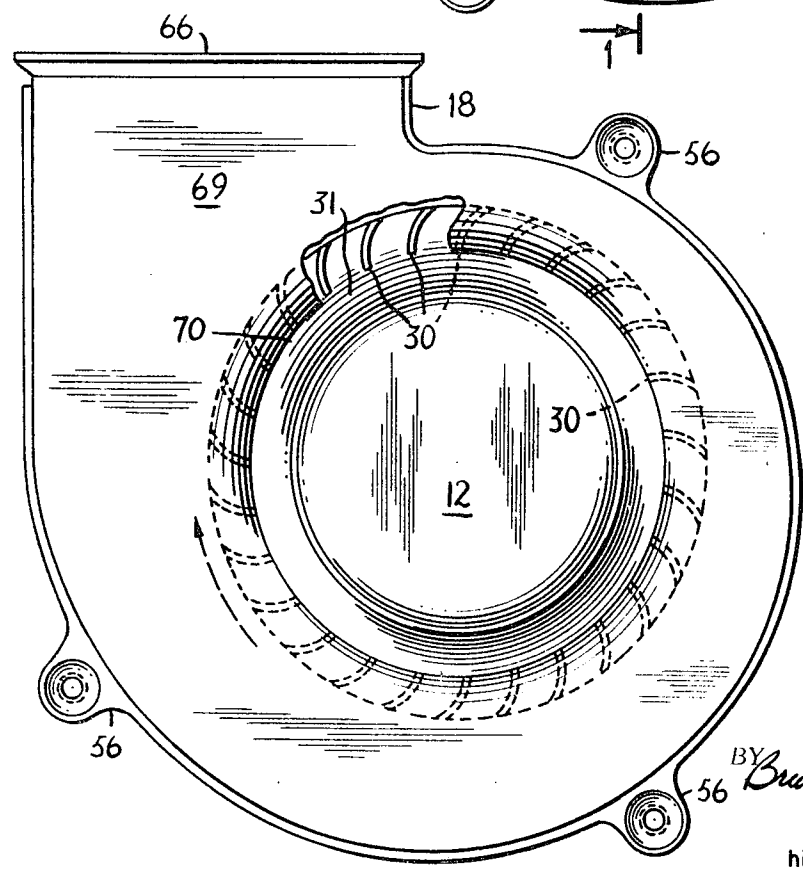
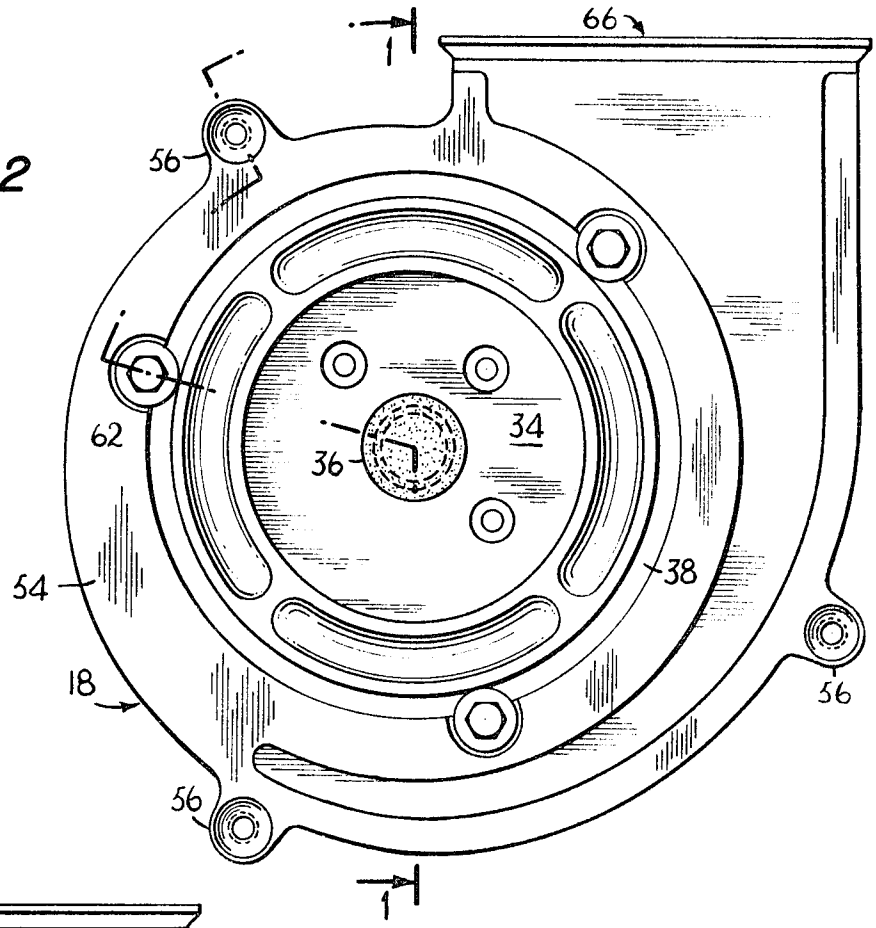


FIG. 3

INVENTOR.
GUNTHER ZOEHFELD

BY *Brambaugh, Graves, Reddick*
Raymond
his ATTORNEYS

FAN FOR NARROW ENVIRONMENTS

The trend toward the miniaturization of electronic components has resulted in the use of electronic packages that are extremely small and compact. Since these packages are generally enclosed, the heat generated by these components will cause extremely high temperatures to develop inside the package thereby distorting their operating characteristics. Due to the decreased size of the components, this problem is magnified since more and more of them are contained in each package and, therefore, more and more heat is generated. In order to remove this heat, it is desirable to use fans to exhaust the air inside the packages and carry away the heat. To be compatible with these packages, the fans must be extremely small in order to fit into the small environment provided and to maintain the package weight at a minimum. To be effective in these packages, they must be capable of a very high air delivery.

A major problem with the miniaturization of fans has been to provide a fan with a small axial length that is capable of meeting the high air delivery requirements of dense electronic packages. The provision of such a fan would allow for smaller electronic installations since the space required for fan mountings could be reduced and since fewer and denser packages could be used.

One solution to the problem of cooling electronic packages has been the tube axial fan, that is, one that moves air axially of the motor within an outer shroud or tube, and wherein the blades are mounted on the periphery of the rotor. While this kind of fan has the desired short axial length, it has a limited air delivery and is therefore restricted in its application to relatively low density packages.

Another solution to this problem has been to use a centrifugal fan, that is, one that has an axial intake and a radial exhaust. These fans meet the air delivery requirements of dense electronic packages, but since the impeller ordinarily is mounted on a shaft extending axially from the motor, they are relatively long in the axial direction and may not be usable where space is at a premium.

In addition, the prior art centrifugal fans are costly, since the impeller comprises a flat, thin backplate having a central opening which carries a mounting sleeve which, in use, is secured to the motor shaft. The blades are secured to the face of the backplate by some type of adhesive and/or mechanical interlock means. These impeller assemblies, therefore, consist of a number of separate parts that require elaborate and expensive manufacturing processes. These fans also require some type of support spider for the shaft and impeller at the inlet side thereof and this not only adds to their cost, but also impedes inlet airflow.

In addition to the problems described above, the prior art centrifugal fans suffer from short bearing life since the waste heat generated by the motor is not dissipated. This represents a costly maintenance problem since replacement of bearings or fans is a difficult and costly operation and sometimes requires the dismantling of the entire electronic installation.

This invention overcomes the above mentioned problems and provides a narrow fan with a high air delivery, comprising a stator assembly which can be mounted on the backwall of a blower housing which, in turn, can be mounted to an electronic package. A cup-shaped rotor assembly is mounted around the stator assembly and carries, on its outer periphery, an integral impeller that draws air from inside the associated package, over the motor, and exhausts it radially. Since the impeller is mounted directly to the rotor, the axial length of the fan is significantly reduced, waste heat from the motor is carried away, and inlet airflow is not impeded. The cost of the fan is reduced since the impeller can be cast as a unitary member and secured to the rotor or cast integrally therewith.

It should be understood, of course, that a fan according to this invention is not limited to use in electronic packages, but has utility wherever high air delivery, size and economy are critical, for example, in projector lamps, heat sinks, power supplies, instruments, and hand held heat guns.

For a better understanding of this invention, reference is made to the following description of an exemplary embodiment, and to the accompanying drawings in which:

FIG. 1 is a view in cross section of a fan according to this invention taken generally along the line 1-1 of FIG. 2 and looking generally in the direction of the arrows;

FIG. 2 is a rear view of a blower housing that can be used to mount the fan of this invention; and,

FIG. 3 is a front view of the blower housing shown in FIG. 2 with parts broken away to show the fan blades of this invention.

Referring now to FIG. 1 of the drawings, a fan assembly in accordance with this invention is shown generally at 10 and comprises, a rotor 12 carrying a centrifugal impeller 14 and rotatably carried by a stator 16 to provide a fan assembly. The fan assembly may be carried by and substantially enclosed in a snail-shaped housing 18 which may be secured to a suitable support structure, for example, the housing of an electronic package.

The rotor 12 comprises a cup-shaped member including a flat base portion 20 supporting the annular laminations 23 and end ring 22. Projecting axially from the inner face of the base portion 20 and interiorly of the rotor is a central boss member 26, the purpose of which will be explained hereinafter.

The impeller 14 comprises a backplate 28 that extends radially from the outer periphery of the end ring 22 near the free end thereof and includes a thickened inner portion 29 that adds rigidity to the joint between the backplate and the flange. In order to guide the air from an axial to a radial flow, the outer face of the thickened portion slopes as shown at 31. Projecting outwardly, as best seen in FIG. 1, and downwardly, as best seen in FIG. 3, from the backplate 28, there are a plurality of cantilevered blades 30 for exhausting the air centrifugally. This provides for the economical manufacture of the impeller since the blades may be cast integral with the backplate and this may be carried further by casting the entire impeller integral with the rotor. If the backplate is not cast integral with the rotor, it may be secured thereto by any suitable fastener means.

The stator assembly 16 comprises a laminated core 32 and suitable windings 33 around the core 32 to produce the revolving magnetic field when connected to an alternating current source.

A suitable base member carries the stator 16 and comprises a circular plate portion 34 having a central opening 36 therein and a lip portion 38 around its outer periphery, the purpose of which will be more fully explained hereinafter. On its inner face, the plate 34 contains an annular grooved portion 40 that mates with the inner face of stator 16. Projecting inwardly from the central opening 36, there is provided a flange member 42 that cooperates with the groove 40 to adhesively secure the stator to the plate.

The rotor 12 is rotatably secured to the stator by a shaft 44 which is keyed to the boss 26 on the inner face of the base plate 20 and which is received in a cylindrical bearing 46 carried by the inner periphery of the stator 12 in any suitable manner, as for example, by a press fit. Suitable thrust washers 48 and 50 are carried, respectively, on the shaft between the boss 26 and the bearing and between a retaining ring 52 and the bearing. The retaining ring 52 snaps over the shaft and prevents longitudinal movement thereof.

It is to be understood that the above-described fan assembly could be used by itself or, as previously mentioned, could be placed in a housing 18. One such housing is herein described and comprises a cup-shaped member having a rear wall 54 with a central opening 60 therein and a forwardly extending sidewall 55 around its periphery. Preferably, opening 60 is of a sufficient size to receive the fan assembly when it is installed in the housing. Extending around the central opening 60 is a shoulder portion that receives the lip portion 38 of the plate portion 34. In order to secure the plate portion to the housing, the rear wall includes a plurality of depressions 62 that extend to the same depth as the lip 38. Flat-headed fasteners 64 are then inserted into openings 65 spaced below the depressions

62 and when the fasteners are tightened they clamp the plate portion 34 to the housing.

A front wall member is secured to the sidewall 55 to complete the housing and comprises a plate 69 having a central opening 70 therein which allows for the passage of air. As can best be seen in FIG. 2 and 3, the housing is of the usual snail shape so as to provide a centrifugal exhaust 66.

The backwall 54 of the housing carries a plurality of mounting lugs 56 projecting radially beyond the edge thereof and extending throughout its width. These lugs have suitable apertures therethrough for the receipt of fasteners for attachment to an electronic package.

It should be clear from the preceding description that a fan in accordance with this invention can be mounted in extremely narrow environments, will provide a high air delivery, and will be more economical to make and maintain. It should also be clear that many modifications of this invention will occur to those skilled in the art to which this invention relates. Accordingly, all such modifications are included within the intended scope of the invention as defined by the appended claims.

I claim:

1. A blower assembly for use in narrow environments comprising, a housing; a stator assembly; a rotor assembly in operative relation with said stator assembly to form a motor and including an outer portion concentrically surrounding the stator assembly; and an impeller carried on the periphery of said outer portion of the rotor assembly for converting an axial airflow to a radial airflow, said impeller including a plurality of blades and means for supporting the blades and guiding an axial input airflow to a radial output flow, said means being integrally formed with said blades and including a radially extending support plate coupled to said rotor assembly adjacent

one end thereof, the surface of said plate facing the other end of said rotor assembly being gradually curved from its inner periphery near the one end of the rotor assembly towards its outer edge to guide the axial input airflow to a radial output flow while permitting cooling airflow near the rotor outer portion for a substantial axial distance, said support plate being thickened from its inner periphery toward its outer edge for a substantial portion of the distance between said inner periphery and said outer edge to add rigidity to said support plate, and said plate supporting said blades in cantilever fashion from said surface, the thickening of the support plate forming a rearward projecting reinforcing annular section where the plate joins the rotor assembly to provide means resisting stresses applied by operation of the impeller to the plate near its joinder with the rotor assembly, the housing having a central opening for admitting said axial airflow to the interior of the housing substantially adjacent to the inner periphery of said impeller, and an exhaust opening for said radial output flow, and wherein said motor and impeller are mounted within said housing in an operative relationship to said openings, the central opening is substantially concentric with and larger than the rotor assembly and defines a substantially annular axial flow opening adjacent the outer surface of the rotor assembly aligned with the gradually curved portion of the plate to introduce air into the blower assembly toward the curved plate portion, and said housing includes a rearward section supporting the stator assembly, rotor assembly and impeller within the housing and defining an outer planar mounting surface adapted for cooperation with fastening means for mounting flush against an exterior planar surface to support the blower assembly thereon.

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