Aug. 12, 1958 F. BLEIER 2,847,156

FAN ASSEMBLY

Filed May 10, 1954 3 Sheets-Sheet 1

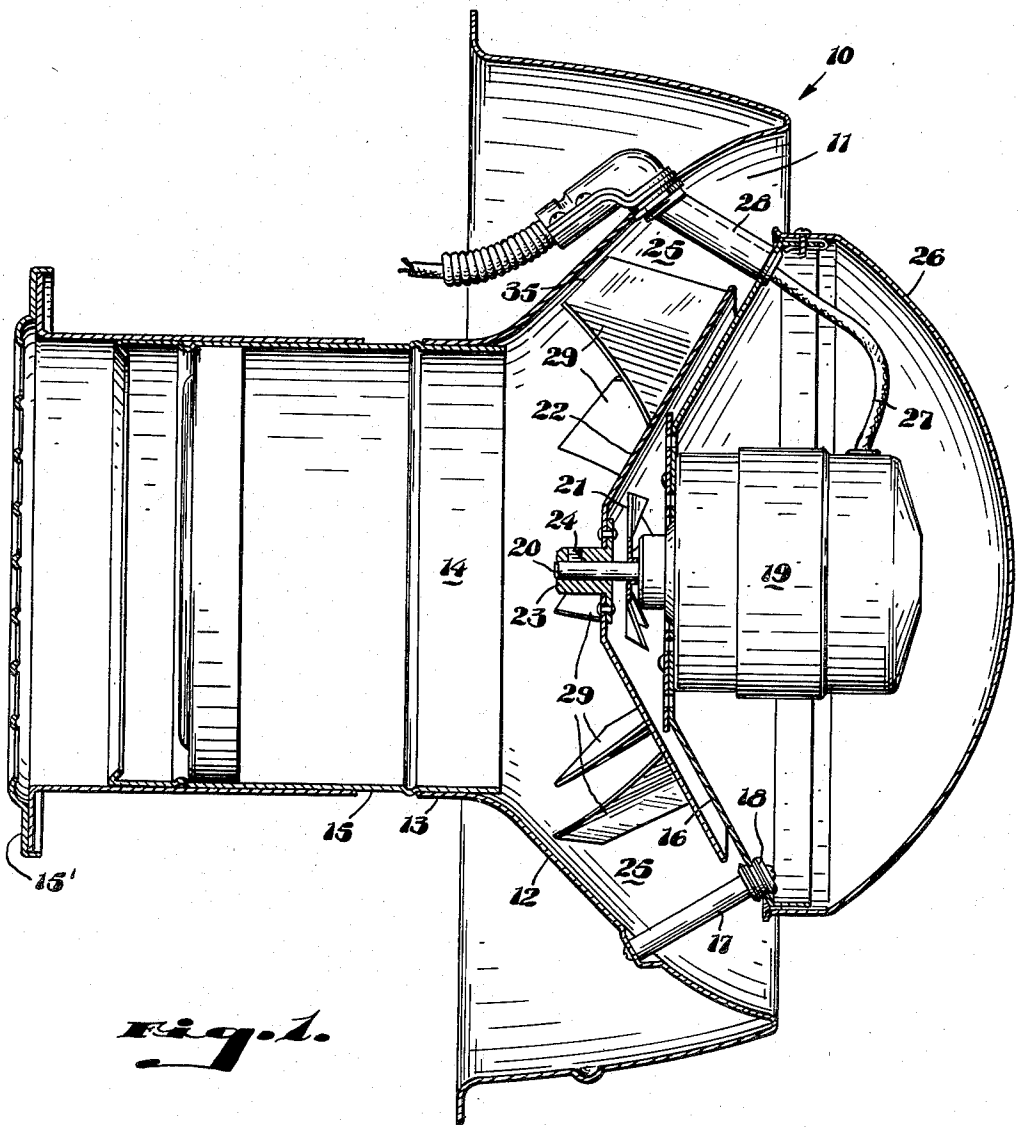


Fig. 1.

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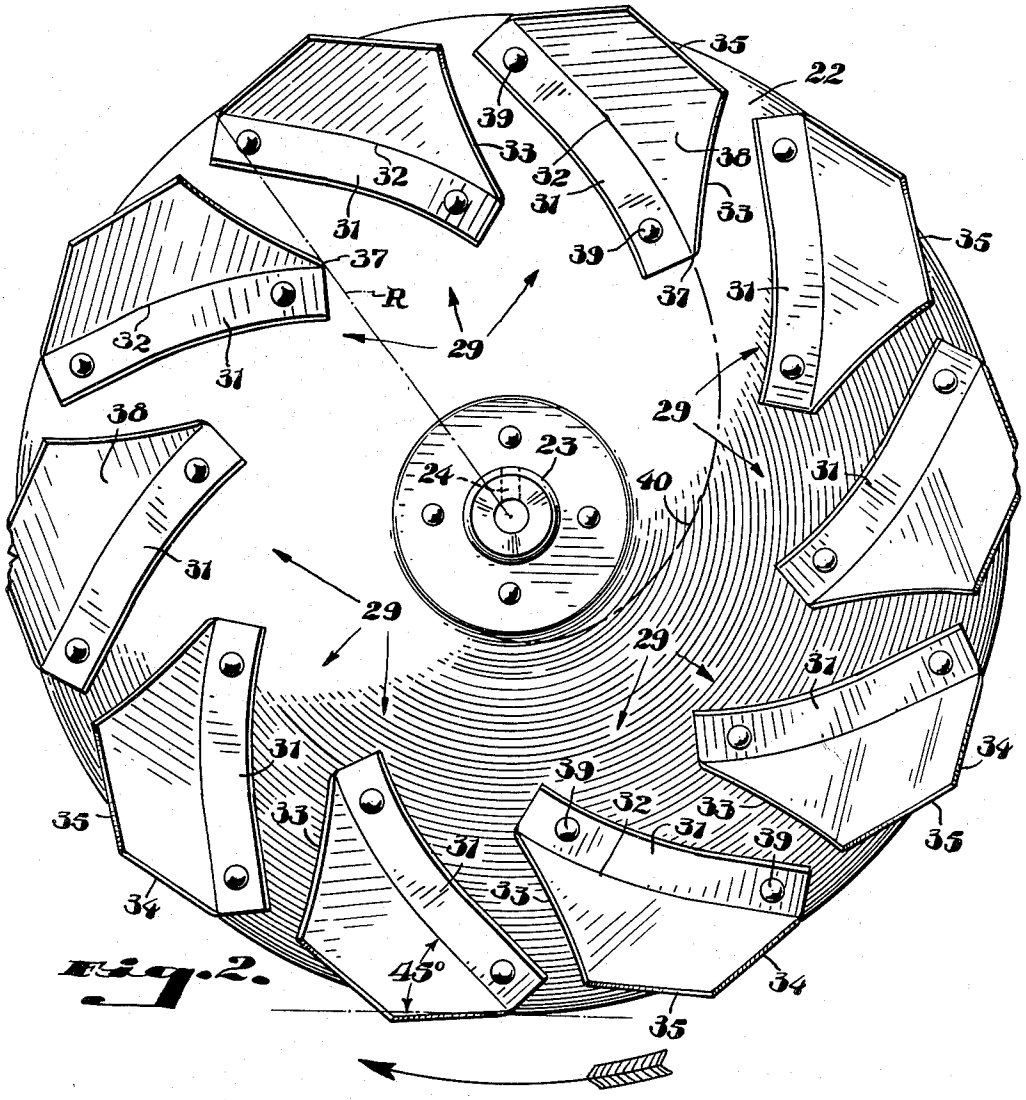


Fig. 2.

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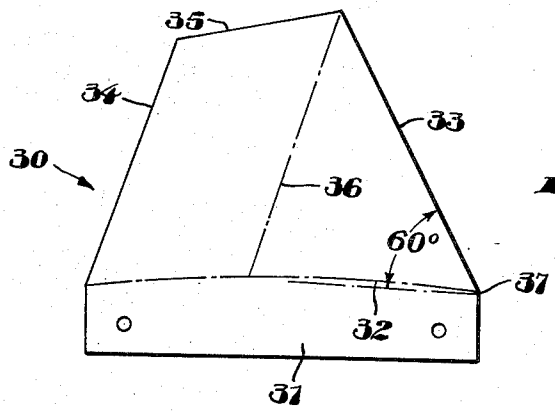


Fig. 3.

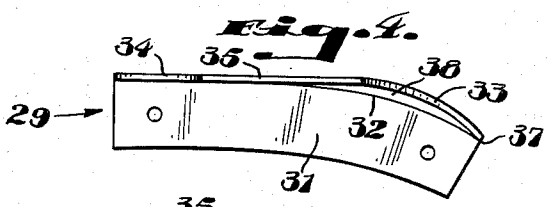


Fig. 4.

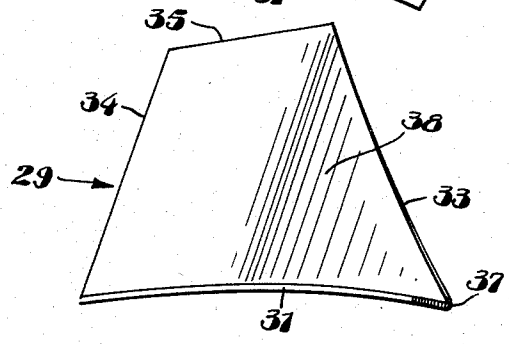


Fig. 5.

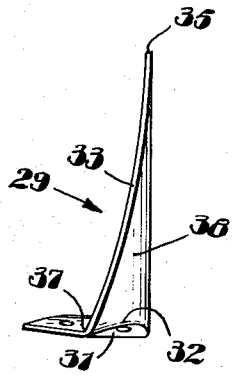


Fig. 6.

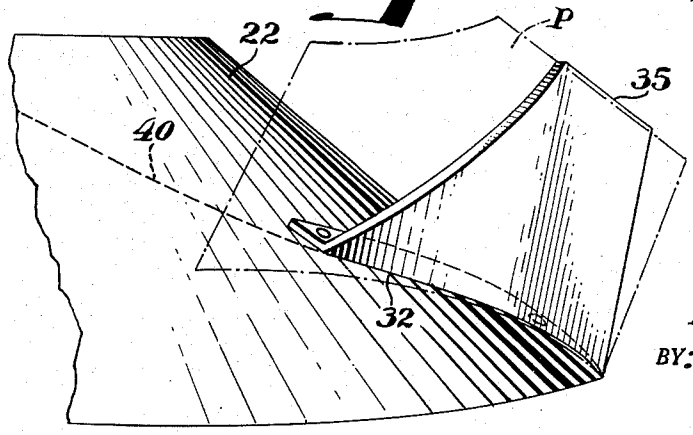


Fig. 7.

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FAN ASSEMBLY

Frank Bleier, Chicago, Ill., assignor to Stewart Industries, Inc., Indianapolis, Ind., a corporation of Indiana

Application May 10, 1954, Serial No. 428,695

11 Claims. (Cl. 230—117)

The present invention relates to improvements in fans and particularly to that type referred to as "exhaust" fans.

The primary object of the invention is to provide a fan assembly of the above type having greatly improved operational efficiencies over conventional fans of this type.

Another object is to provide a unique form of blade-carrying rotor for such a fan together with a novel blade form which offers a minimum of resistance to air-flow through the fan assembly while greatly increasing the volume of air which is moved by the fan.

Further objects will become apparent as the description proceeds.

To the accomplishment of the above and related objects, my invention may be embodied in the form illustrated in the accompanying drawings, attention being called to the fact, however, that the drawings are illustrative only, and that change may be made in the specific construction illustrated and described, so long as the scope of the appended claims is not violated.

Fig. 1 is a longitudinal sectional view through a preferred form of fan assembly constructed in accordance with my invention;

Fig. 2 is an enlarged plan view of the rotor member constituting a part of my invention;

Fig. 3 is a plan view of a blank from which a preferred form of the blade, used in my fan, is formed;

Fig. 4 is a top plan of the blade formed from the blank of Fig. 3;

Fig. 5 is a side elevation of the blade of Fig. 4;

Fig. 6 is an end elevation of the blade of Fig. 5; and

Fig. 7 is a diagram indicating the location of each blade upon the rotor.

Referring more particularly to the drawings, and especially to Fig. 1, my fan assembly comprises a housing 10 formed to provide a chamber 11. The walls 12 of said chamber are substantially conical in cross section and are formed to provide a tubular collar 13 defining an inlet port 14 at the apex of chamber 11. Suitable ducting 15 can be telescopically associated with collar 13 for communication with a grill 15'.

A frusto-conical shell member 16 is supported in chamber 11 by means of posts 17 fixed at one end to the walls 12 and at the opposite ends to said member through the medium of shock resistant elements 18. It will be noted that the angularity of the walls of the member 16 is slightly shallower than the angularity of the walls 12 of chamber 11, for a purpose later to become apparent. A motor 19 is fixed to the member 16 with the spindle 20 thereof substantially coaxial with chamber 11 and projecting beyond the end of member 16 toward the inlet port 14.

A small fan wheel 21 is preferably fixed to the spindle 20, closely adjacent motor 19, for the purpose of forcing cooling air over said motor.

A conical rotor 22 is fixed to spindle 20 by means of a hub 23 and a set screw 24, or the like. It will be noted that the angularity of member 22 conforms closely to that of the member 16. The periphery of the rotor member 22 partially overlies the member 16 and together, members 16 and 22 define an annular passage 25 from inlet port 14 through chamber 11, the passage becoming progressively narrower due to the difference in angularity between the walls 12 of chamber 11 and the member 16 and 22. This progressive reduction of the radial dimension of the passage is so proportioned and designed as substantially to compensate for the progressive peripheral enlargement thereof; so that the effective area of the passage 25 remains constant (or increases very slightly) throughout its axial length. This tends to reduce the turbulence (and thereby the flow resistance) in the air leaving the passage 25.

A domed shaped hood 26 is fixed to the periphery of member 16 to provide a weather-tight enclosure for motor 19. Said motor is energized through conductors 27 led into the interior of member 16 through a hollow post 28 traversing the passage 25.

Referring now to Fig. 2, it will be seen that the rotor member 22 is provided with a plurality of blade means referred to generally by the reference numeral 29. Each of said blade means is formed preferably from a blank indicated generally by the reference numeral 30 (see Fig. 3). This blank comprises a base portion 31 defined by a fold line 32 which, after the blade has been formed, constitutes the root line of said blade. It will be noted that the root line 32 is curved slightly toward the body of the blank 30 so that when the blank is folded about said line, the base 31 will be curved slightly, as indicated in Fig. 5, to conform to the curvature of the rotor member 22.

The blank 30 is formed to provide a leading edge 33 which is inclined toward the trailing edge 34 at an angle of approximately 60° relative to the root line 32. Preferably, but not necessarily, the trailing edge 34 may be inclined slightly toward the leading edge 33, so that the tip 35 of the blade will be substantially shorter than the root of said blade.

After the blank 30 has been folded about the curved line 32 to bring the base 31 into substantial perpendicularity with the body of blade 29, the leading end 37 of the root line 32 is then bent out of the plane of the blade body substantially about the line 36, while the tip of the blade is held substantially in a straight line. This provides a dished portion 38 in the forward edge of the blade 29. I have found that by so dishing the forward blade end, the blade 29 is thereby materially strengthened and the air-flow past the blade 29 is much freer of turbulence than with a similar blade without such dished form.

The blades 29 are fixed to the outer surface of the rotor member 22 by means of rivets 39, or the like, and they are so arranged on said member that the root line 32 of each blade forms an angle of approximately 45° with a line tangent to the periphery of member 22 at the point of intersection of the root line 32 with said periphery. Because of the curvature of the root line 32, as explained above, the root of each blade will lie substantially along a spiral curve 40 having its origin at the apex of the member 22 and retreating toward the periphery of said member in the direction opposite that in which the member 22 is intended to be rotated. As is perhaps most clearly shown in Figs. 4 and 7, when considered in connection with Fig. 2, the straight-line tip 35 of each blade will lie in a plane P perpendicular to the surface of rotor 22 and tangent to the spiral 40 at the trailing end of the root line 32, which lies substantially at the periphery of the rotor.

The blades 29 are, of course, equally spaced about the periphery of rotor 22 and I have found that, with this arrangement of blade angles and blade lengths, optimum results are obtained by having the leading end 37 of each of the root lines 32 located substantially at the radial line,

such as R, on the member 22 passing through the trailing end of the root line 32 of the adjacent blade.

It will be noted in Fig. 1 that the tips 35 of the blades 29 terminate just short of the chamber walls 12.

Conventional fans of the type here under consideration normally draw in the air along an axial path and then turn the air stream at right angles by means of a centrifugal rotor member. The air is discharged either radially from the fan, or axially by again imparting a right angle turn to the air stream by means of suitable baffles, or the like.

I have found that by constructing such a fan in accordance with the principles of my invention a much more compact and efficient fan assembly is had. The compactness results, partially, from the use of the frusto-conical shell member for supporting the motor since the motor can, thereby, be recessed within the fan housing. The conical fan motor also contributes to the compactness of the fan assembly.

The increase in fan efficiency results from the use of the conical rotor member as well as from the particular blade shape used. Because of the use of the conical rotor member together with the conical chamber walls, the air stream is caused to flow around the motor at a much less abrupt angle than in conventional structures. This results in a reduction of loss due to air turbulence and, therefore, an increase in overall efficiency.

The particular shape of the blades 29 carried by the conical rotor member 22 results in a tangential flow of air relative to the blades, thereby greatly reducing the shock imposed on the blades resulting in a minimum of air turbulence. I have found, also, that the particular shape which I have given to the blades 29 results in a decided increase in blade strength tending to reduce blade vibration. Both these features result in a fan assembly which is much quieter in operation than have been conventional fans of this type heretofore known.

In connection with the fact that a fan of this type is usually installed with a long run of ducting, I have found that my fan will operate against the ducting resistance with a comparatively small loss in C. F. M.

I claim as my invention:

1. A fan of the character described comprising a substantially conical, non-rotatable housing having an inlet port at the apex thereof, a substantially conical rotor member, means supporting said rotor member in said housing for axial rotation substantially about the axis of said housing, said rotor member being spaced from the inner wall of said housing to define an open, annular passage from said inlet port through said housing, motor means operatively connected to rotate said rotor member in one direction, and a plurality of peripherally spaced blade means supported from said rotor member and projecting toward the inner wall of said housing, the root of each of such blade means conforming substantially to a spiral curve having its origin at the apex of said rotor member and retreating therefrom toward the periphery of said rotor means in the direction opposite the direction of rotor rotation, while the tip of each such blade means terminates just short of the inner wall of said housing and lies in a plane substantially perpendicular to the surface of said rotor means and tangent to said spiral curve at the point of intersection of said curve with the periphery of said rotor means.

2. The fan of claim 1 in which the root of the leading edge of each of such blade means terminates near a radial line on said rotor member passing through the root of the trailing edge of an adjacent blade member.

3. A fan of the character described comprising a substantially conical, non-rotatable housing having an inlet port at the apex thereof, a substantially conical rotor member, means supporting said rotor member in said housing for axial rotation substantially about the axis of said housing, said rotor member being spaced from the inner wall of said housing to define an open, annular passage from said inlet port through said housing, motor means operatively connected to rotate said rotor member in one direction and a plurality of peripherally spaced blade means supported from said rotor member and projecting toward the inner wall of said housing, the root of each of such blade means conforming substantially to a spiral curve having its origin at the apex of said rotor member and retreating therefrom toward the periphery of said rotor means in the direction opposite the direction of rotor rotation, while the tip of each such blade means terminates just short of the inner wall of said housing and lies in a plane substantially perpendicular to the surface of said rotor means and tangent to said spiral curve at the point of intersection of said curve with the periphery of said rotor means, the leading edge of each of said blade means being inclined rearwardly from the root toward the tip of such blade means.

4. The fan of claim 3 in which said rearwardly inclined leading edge of each such blade means forms an angle of approximately 60° with the root of said blade means.

5. A fan of the character described comprising a housing formed to provide a substantially conical chamber having an inlet port at the apex thereof, a frusto-conical shell member, means carried by said housing and supporting said shell member in said chamber substantially coaxial with the chamber axis and spaced from the inner walls of said chamber to define an open, annular passage from said inlet port through said chamber, motor means supported within said shell member with the spindle thereof substantially coaxial with said chamber axis and projecting toward said inlet port beyond the end of said shell member, a substantially conical rotor member fixed for rotation on said spindle at the apex of said member and with the periphery of said rotor member partially overlying said shell member, the angularity of said rotor member conforming closely to the angularity of said shell member, and a plurality of blades fixed to said rotor member and projecting substantially perpendicularly from the surface thereof toward the wall of said chamber, the root of each of such blades forming an acute angle with the periphery of said rotor member at the forward side of such blade.

6. A fan of the character described comprising a housing formed to provide a substantially conical chamber having an inlet port at the apex thereof, a frusto-conical shell member, means carried by said housing and supporting said shell member in said chamber substantially coaxial with the chamber axis and spaced from the inner walls of said chamber to define an open, annular passage from said inlet port through said chamber, motor means supported within said shell member with the spindle thereof substantially coaxial with said chamber axis and projecting toward said inlet port beyond the end of said shell member, a substantially conical rotor member fixed for rotation on said spindle at the apex of said member and with the periphery of said rotor member partially overlying said shell member, the angularity of said rotor member conforming closely to the angularity of said shell member, and a plurality of blades fixed to said rotor member and projecting substantially perpendicularly from the surface thereof toward the wall of said chamber, the root of each of such blades forming an acute angle with the periphery of said rotor member at the forward side of such blade, the leading end of the root of each of such blades being turned out of the plane of the remainder of such blade toward the axis of said rotor member, while the tip of said blade remains rectilinear, to provide a dished portion in said blade at the forward end thereof.

7. The fan of claim 6 in which the leading edge of each of such blades is inclined rearwardly from the root toward the tip of such blade.

8. The fan of claim 7 in which the angle of such

inclination of said blade leading edge is approximately 60° relative to the root of such blade.

9. A fan rotor comprising a conical member adapted for rotation about its own axis, and a plurality of peripherally arranged blades supported on the outer surface of said conical member, each of such blades lying substantially in a plane substantially perpendicular to the surface of said conical member and forming an acute angle with a line tangent to the periphery of said conical member at the point of intersection of said periphery and said plane, the edge of each blade, nearest the axis of said conical member, being turned at the root only out of the plane of said blade toward the axis of said conical member to form a dished portion in the forward portion of each blade.

10. The device of claim 9 in which said blade edge is inclined between the root of the blade and the tip of the blade toward the opposite edge of such blade.

11. The device of claim 10 in which the first-said edge of said blade forms an angle of approximately 60° with the root of the blade.

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