Dec. 25, 1962 B. ECK 3,070,287

DRUM ROTOR FOR RADIAL BLOWER

Filed July 16, 1959 2 Sheets-Sheet 1

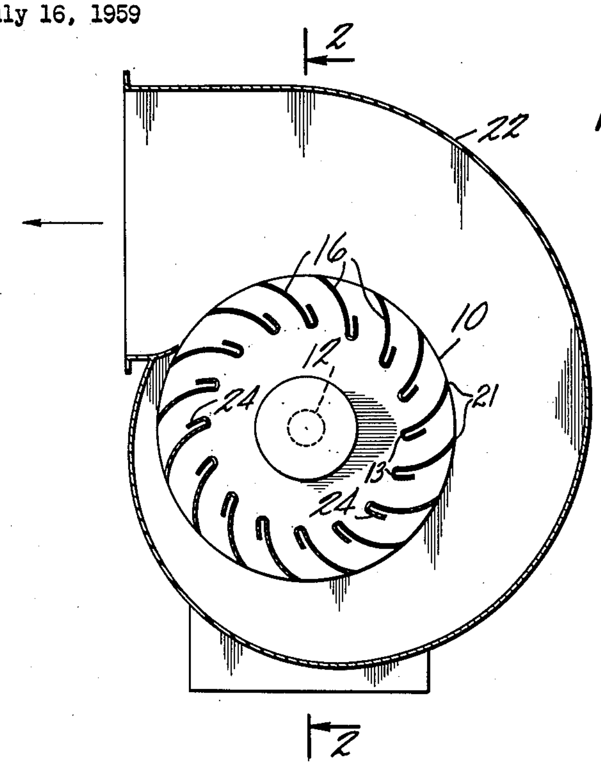

FIG. 1

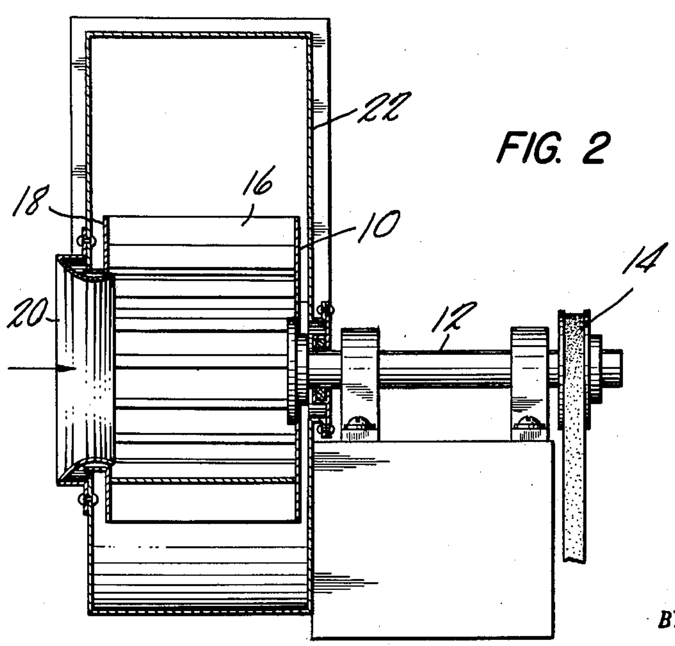

FIG. 2

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DRUM ROTOR FOR RADIAL BLOWER

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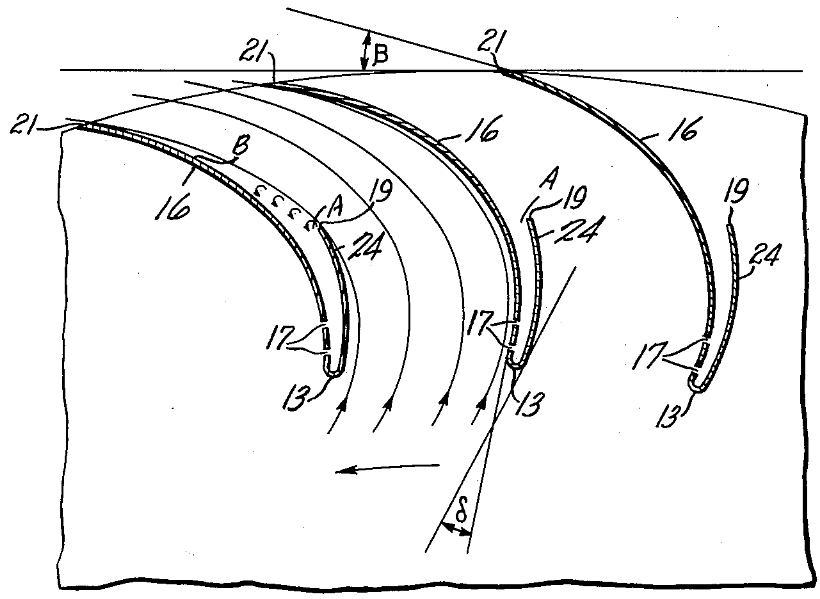

FIG. 3

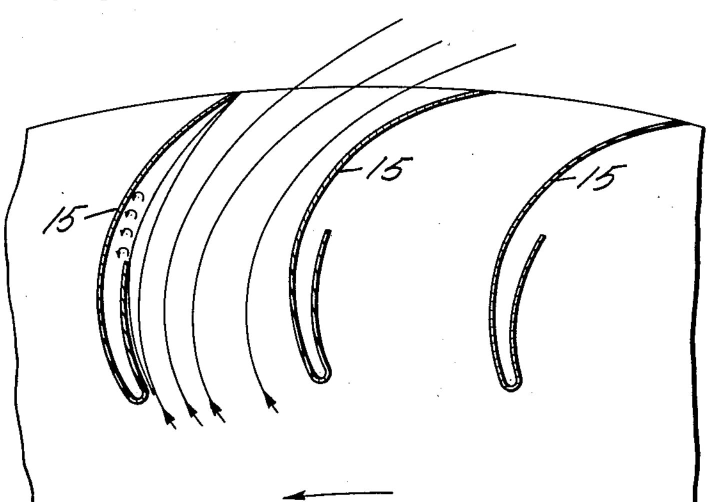

FIG. 4

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United States Patent Office

3,070,287
Patented Dec. 25, 1962

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3,070,287

DRUM ROTOR FOR RADIAL BLOWER

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Filed July 16, 1959, Ser. No. 827,649
1 Claim. (Cl. 230—134)

Radial blowers with drum rotors conventionally differ from ordinary radial blowers in that their blades are relatively large in the axial direction but are narrow, that is they are small radially. Such drum rotors are distinguished by low noise, high pressure indexes and high intake capacity. They admit of comparatively small designs which can be manufactured quite inexpensively. On the other hand, they have the great disadvantage of very low efficiency. A variety of proposals have been made to improve these rotors in this respect. For example, it has been suggested that the blades be contoured or that the exit cross section of the passages between the blades be made smaller than the entrance cross section. Even in the last case mentioned it has unfortunately proved that a parasitic deceleration continues to occur in the passage between the blades. Also, and of primary importance there has been no way of overcoming the further disadvantage that as the unit becomes smaller, that is, when it is made with a small Reynolds number, the efficiency of drum rotors is drastically reduced.

The present invention relates to means for overcoming these disadvantages and producing a drum rotor of much improved efficiency. This application is based upon my discovery that greatly improved results may be obtained if the usual plain sheet metal blades be bent back at the inner leading edge thereof on a small radius to define an inner trailing face portion and such bending should be made contrary to the direction of rotation of the drum rotor. This bent inner trailing face portion extends from the inner leading edge of the blade toward the outer trailing edge of the blade along a curvature throughout its length approximately the same as that of the body portion of the blade but spaced away from the body portion of the blade and terminating in a free outer edge spaced a substantial distance short of the outer trailing edge of the blade proper, thereby defining an axial space between the body portion and the bent inner trailing face portion of the blade. Because of this the passage between the blades is somewhat restricted at the inner leading edges thereof and then enlarges suddenly behind the free outer edge of the bent inner trailing face portion. This sudden enlargement of the passage between the blades has the result of producing a boundary flow line of turbulent air with small vortices in the area immediately behind the inner trailing face portion. In other words, at this point the flow is released from direct contact with the wall on one side. As a result the flow of air along this line is speeded up or stimulated by the small vortices. In order to eliminate the small vortices of turbulent flow, at least one slot is positioned to extend through that part of the body portion of the blade which is immediately opposite and overlapped by the bent inner trailing face portion of the blade. This slot provides for the entry of pressurized air into the axial space between the body portion and the bent inner trailing face portion of the blade whereby the pressurized air so admitted is directed by the axial space toward the outer trailing edge of the blade. Consequently, the turbulent vortices are distintegrated or prevented from forming and the air flow smoothly meets the surface of the blade and conforms to the curvature thereof all the way out to the outer trailing edge of the blade. Thus the air flow is deflected in the desired manner without being broken up and interrupted. It is also advantageous to so curve the blades by increasing the radius of curvature towards the outer trailing edge, that the area of the passage between adjacent blade is gradually reduced. In the structure of the present invention, where the area of the passage is suddenly increased at an intermediate point, this subsequent, gradual reduction in area assists in giving the flow of air the desired direction of movement without setting up improper turbulence that may impede the flow.

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It is observed that even at small Reynolds values the flow through the blades will take place quite smoothly without being broken up by undue turbulence so that the invention affords the possibility of building drum rotors with small diameter but high efficiency. The drum rotors according to my invention are further distinguished by an astonishing reduction in noise.

One advantage of my invention is that the form of blades described makes it possible to obtain high circumferential velocities with plain sheet-metal blades. Heretofore a serious disadvantage of the previous designs has been that the low resistance of the blade against bending has meant that where they were made of substantial length, only moderate circumferential velocities could be used. It has been found that blades made according to the present invention will permit about 100% higher pressures without undue bending.

This invention may be readily understood by reference to the accompanying drawings in which

FIG. 1 is a sectional view through a device embodying the invention;

FIG. 2 is a section on line 2—2 of FIG. 1, and

FIGS. 3 and 4 are enlarged views of a diagrammatic nature showing particular arrangements of the blades of the rotor.

In the drawings 10 represents a rotating circular end member mounted on a shaft 12 which may be driven in any desired way as by the pulley 14. Mounted on rotating circular end member 10 are the series of blades 16 which at their other end are connected to another rotating end member 18. 20 is the inlet duct and the casing 22 surrounds the rotor and collects and deflects the air thrown out by the rotating drum.

As indicated specifically in FIG. 3, the blades each have a bent inner trailing face portion which is immediately opposite and overlaps part of the body portion of the blade. For example, in FIG. 3, the blades 16, which in this case are bent forward, have a bent inner trailing face portion as indicated at 24. This bent inner trailing face portion extends from the inner trailing edge 13 of the blades and is bent away from the direction of rotation of the drum rotor. The length of this bent inner trailing face portion 24 should be such that a substantial radial distance exists between the free outer edge 19 thereof and the outer trailing edge 21 of the blade. For example, the bent inner trailing face portion may be between 10% and 50% of the radial extent of the blades proper. It is further advantageous that the angle of the mean camber line between the body portion of the blade and the bent inner trailing face portion of the blade be such that the angle δ as indicated in FIG. 3 is such that this angle is greater than 0 but less than 40°. Also the thickness of the air foil formed by the body portions 16 and bent inner trailing face portions 24 should be not less than 5% nor more than 20% of the radial length of the blades proper.

Since the bent inner trailing face portion 24 of the blade terminates at a substantial distance short of the outer trailing edge of the blade proper, there is an abrupt enlargement of the passage between two adjacent blades at the point A where the bent inner trailing face portion terminates. At this point it has been found that there is a boundary flow of air set up with small vortices. As a result of this the stream of air passing between the blades is no longer compressed against the wall at the area just beyond the point A. Because of this lack of skin friction the flow along this area is substantially enlivened or speeded up and then further along for example, approximately at the point B, the flow of air again resumes contact with the surface of the body portion of the blade. It then remains in contact with the surface of the blade, all the way to the outer trailing edge of the blades (which it may be noted are so curved that they slightly converge) and therefore the flow of air follows the desired path without leaving the blade surface. In order to eliminate the vortices in the boundary flow of air downstream of the free outer edge of the bent inner trailing face portion at point A, at least one slot, two being illustrated in FIG. 3, is provided in that part of the body portion of the blade which is immediately opposite and overlapped by the bent inner trailing face portion. This slot provides for the entry of pressurized air into the axial space between the body portion of the blade and the bent inner trailing face portion. As will be seen, this axial space controls and directs the pressurized air to flow toward the outer trailing edge of the blade along the surface of the body portion thereof whereby the turbulent vortices of air immediately downstream of the bent inner trailing face portion are swept away by the pressurized air flowing out from the axial space and the boundary flow of air downstream of the inner trailing face portion is further accelerated. This is a great advantage over previously known designs in which the air flow has tended to leave the blade surface in the part of the blade indicated, with the area of detachment tending to move further towards the inner leading edge of the blade for the smaller Reynolds numbers.

The blade exit angle β can be kept very small or may sometimes be negative, particularly in the case of blades that are bent forward. It has been found advantageous for the blade angle to lie between $+50°$ and $-20°$.

In FIG. 4 the arrangement is similar to that of FIG. 3, but this drawing illustrates how the invention may be applied with the drum rotor with blades **15** bent backwardly. In each of FIGS. 3 and 4 the arrow indicates the direction of rotation.

It may be noted that the intake duct **20** is constructed in the form of a uniformly rounded nozzle. This very largely excludes vortex formation. It will also be noted, as shown particularly in FIG. 3, that the blades at the inner leading edges thereof are substantially radial, that is to say, the curvature of the blade near the inner leading edge thereof generally approximates a radial line extending toward the center of the rotor. On the other hand, the curvature of the blade near the outer trailing edge thereof is greater, approaching the curvature of the peripheries of the rotating end members. While the bending back of the inner trailing face portion of the blade preferably follows a small radius, the bend may, if desired, be sharp so that there is virtually no radius.

It is understood that the example given is intended only by way of illustration and may be modified in many particulars without departing from the spirit of my invention.

What I claim is:

In a drum rotor, a pair of rotating circular end members, a plurality of blades formed of sheet material and mounted between said end members in circumferentially spaced relationship with respect to each other, each of said blades having an outer trailing edge adjacent the peripheries of said end members, said blade having a body portion extending radially inward from said outer trailing edge and terminating in an inner leading edge spaced a substantial radial distance away from the axis of rotation of said rotor, each of said blades being curved throughout its radial extent and having a curvature near the outer trailing edge thereof approaching the curvature of the peripheries of said end members and near the inner leading edge thereof having less curvature approximating a radial line extending toward the center of the rotor, each of said blades having an inner portion bent backwardly away from the direction of rotation of the rotor to define a trailing face portion, said bent inner trailing face portion extending from the inner leading edge of said blade toward the outer trailing edge thereof along a curvature approximately the same throughout its length as that of said body portion but spaced from said body portion of said blade and terminating in a free outer edge spaced a substantial distance short of said outer trailing edge to define an axial space between said body portion and said bent inner trailing face portion, at least one slot extending through that part of the body portion of said blade which is immediately opposite and overlapped by said bent inner trailing face portion, said slot providing for the entry of pressurized air into said axial space between the body portion of said blade and said bent inner trailing face portion whereby the pressurized air so admitted is directed by said axial space toward the outer trailing edge of the blade along the surface of the body portion thereof to eliminate turbulent flow of air immediately downstream of said bent inner trailing face portion.

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