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CENTRIFUGAL FAN HOUSINGS

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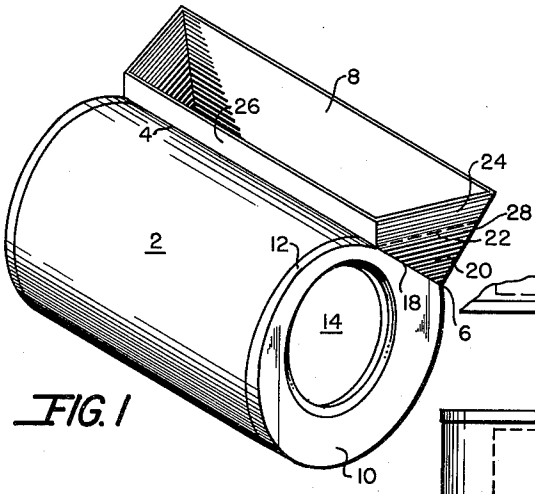


FIG. 1

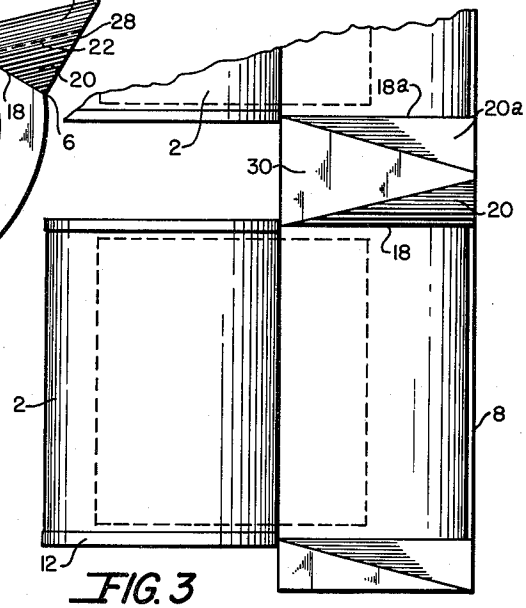


FIG. 3

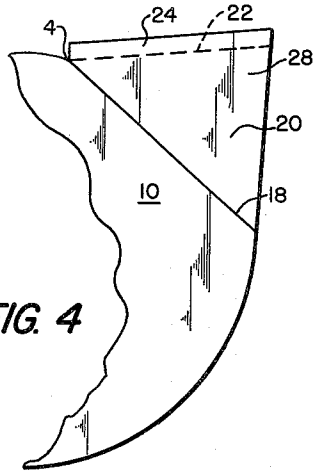


FIG. 4

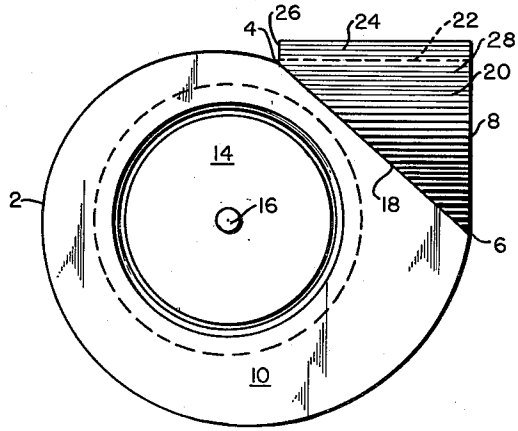


FIG. 2

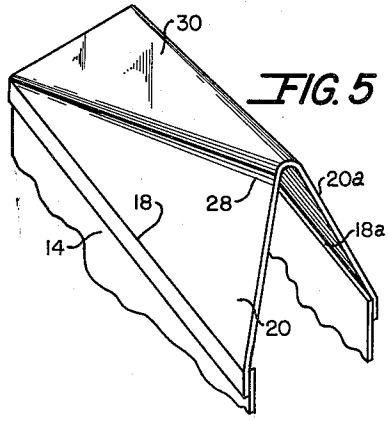


FIG. 5

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CENTRIFUGAL FAN HOUSINGS

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This invention relates generally to centrifugal fan housings, and in particular to improvements in the outlet portions thereof.

The invention is concerned with that type of double inlet centrifugal fan housing which is generally of a rectangular configuration in lateral cross section and is scroll shaped in longitudinal section. Such a housing is formed by a wrapper which is substantially flat in lateral cross section and which extends generally spirally with respect to its length; and a pair of opposite substantially flat side plates conforming peripherally to the spiral shape of the wrapper. Circular inlet openings in the side plates are provided for the introduction of air axially into the housing where the air is directed radially and in the direction of increasing area through the housing toward the outlet by rotation of the fan wheel or impeller. Such construction is conventional and is commonly used in fans employed for ventilation or other purposes wherein the discharge of a relatively large volume of air at a relatively high velocity and low static pressure is desired.

Fans of this general type are commonly used, in one instance, in school room unit ventilators where a number of such fans are commonly arranged in parallel side-by-side relation and their respective fan wheels are mounted on a common shaft for simultaneous rotation. In such an application, the unit ventilator fans normally discharge the air directly into the room at what is considered a relatively high velocity so as to obtain a good distribution of air throughout the room. Outlet ducts extending beyond the outlets of the fan housings proper are not used except under special circumstances, and diffusers and auxiliary discharge ducts are not desirable because the additional space required increases the height of the unit ventilator without improving performance. While the invention is not restricted to such apparatus, it finds one of its principal applications in this service because of the reduction in level and offensive quality of noise experienced with the fans of this invention as compared to the fans of the prior art used in the same environment to produce the same air delivery; a reduced and "more pleasant" noise in school rooms and the like being obviously desirable.

I have found that a centrifugal fan assembly constructed in accordance with the invention will provide an improvement, relative to the prior art centrifugal fan assemblies, of up to 10% in air delivery and in mechanical efficiency within the range of fan wheel speeds frequently used in unit ventilators. Consequently, to obtain the normally desired air delivery, the speed of the fan wheel used with this invention may be reduced sufficiently that a readily perceptible improvement in noise level and character is attained.

The invention includes the provision of a centrifugal fan housing of generally rectangular cross section having a generally triangular portion of each side plate adjacent the housing air outlet flared outwardly so that the discharge or outlet area of each housing is in the general form of an isosceles trapezoid with the longer side thereof being that side generally opposite, and parallel to, the cutoff of the housing. Each triangular portion is generally defined by one side being in the plane of the housing outlet and extending from the vicinity of the cutoff to the forward boundary of the outlet, another side

extending from the vicinity of the cutoff to a point on the forward wall of the housing in the vicinity of the end of the wrapper spiral, and the third side extending along the forward wall of the housing between the end of wrapper spiral and the forward boundary of the outlet. In other words, with the housing in an upblast disposition, and considering the upper forward corner of each side plate as the apex of the delineated triangular portion to which reference has been made, and considering a line extending from the vicinity of the cutoff to the vicinity of the end of the spiral of the wrapper as the base line of the triangular portion, these apexes are displaced outwardly to provide the trapezoidal shaped outlet of the housing.

I am aware that diffusers or outwardly flared discharge ducts have been suggested for use in attached relation to the outlet of centrifugal fan housings. However, the present invention contemplates the incorporation of the outward flare as a part of the fan housing proper, and further contemplates that this configuration be provided in the relatively simply constructed and inexpensive centrifugal fan housings of the type having a generally rectangular form in lateral cross section.

The invention will be described in connection with one embodiment incorporating the principles of the invention by way of example and illustrated in the drawing wherein:

FIGURE 1 is an isometric view of a single centrifugal fan housing constructed in accordance with the invention;

FIGURE 2 is a side view thereof;

FIGURE 3 is a top view of the fan housing of FIGURE 2 with an additional fragmentary portion of an adjacent parallel fan housing;

FIGURE 4 is a side elevational view of a fragmentary portion of a side plate in a blank form adapted for use in an embodiment of the invention wherein the side plate is to be formed from a single piece;

FIGURE 5 is an isometric view illustrating a structure, including a pair of opposed triangular portions, adapted for use between a pair of fan housings arranged in side-by-side relation for parallel operation.

The illustrated fan housing of FIGURES 1 and 2 is disposed in what is commonly termed a counterclockwise rotation, upblast discharge arrangement and any reference planes hereinafter mentioned in connection with the drawing will be based on such disposition. However, it will be understood that the disposition of the housing does not, in itself, affect the operating characteristics of the fan.

Referring to the drawing, the length of a wrapper sheet 2 is formed to extend in a generally spiral or scroll shape from the end thereof corresponding to the cutoff 4 to the opposite end 6 of the spiral to form the circumferential wall of the housing. As is frequently done in construction of such housings, the spiral form of the wrapper is discontinued at the point designated here as the end of spiral 6, and the circumferential wall continues to the outlet of the housing as a straight or only slightly curved portion, here designated 8 to differentiate it from the remainder of the wrapper sheet 2. This extended portion 8 of the wrapper 2 may, of course, be an integral part thereof, or a separate piece.

The spaced and parallel side walls or plates 10 of the housing are substantially flat throughout the major portions of their area (except for the triangular portions thereof to be hereinafter described) and have inwardly directed flanges 12 along their outer curved edges and to which the side marginal edges of the wrapper sheet 2 are suitably secured to form an integral housing unit. Each side plate has an inner circular opening 14 concentrically disposed relative to the axis of the shaft 16 carrying the fan wheels (illustrated in dotted line outline form in FIGURES 2 and 3); these openings serving as inlets for the

air drawn axially therethrough by the rotating fan wheel.

It will be observed in FIGURES 1 and 2 that a line designated 18 extends at a slope of about 45° between the vicinity of the cutoff 4 and the spiral wrapper end 6. This line 18 divides the main portion 10 of the side plate from the remaining portion, which has been termed herein the triangular portions and which is identified in the drawing by numeral 20. In this connection, the portion of the side plates above the dotted line 22 form sidewalls of a discharge collar 24, the front wall of which is the upper part of wrapper extension 8 and the rear wall of which is a stub flange 26 extending upwardly from adjacent the cutoff 4.

In accordance with the invention, the triangular part 20 of each side plate is flared outwardly, with the flare beginning along the base line 18 and continuing to the apex 28. Thus, the outlet area of the housing, in a horizontal plane intersecting the cutoff, will be in the general form of an isosceles trapezoid with the long side of the trapezoid being in the front and defined by the upper part of the wrapper extension 8. Preferably, the angle at which the triangular portion 20 flares outwardly from the plane in which the respective side plate 10 lies should be between 10° and 20°, this angle being measured in a plane perpendicular to the line 18. The angle of the line 18 relative to a horizontal plane (or the plane in which the housing outlet lies) is preferably about 45°. While from the standpoint of manufacturing economy it is apparently now preferable to use triangular portions 20 which are flat, they could be provided in curved surface form within the intended scope of this invention.

It will of course be appreciated that the principles of the invention may be followed whether the side plates, and wrapper sheet and extension portion thereof, are each formed of single or separate pieces. Thus, if it is desired that the side plates 10 be a single piece, the triangular portion 20 must be shaped generally as illustrated in FIGURE 4 so that when it is flared, i.e., rotated around the base line 18 to lie in a plane angularly displaced relative to the plane in which the corresponding side plate 10 lies, the sides which converge to form the apex 28 will be of the proper lengths to appear as in FIGURE 2, where the top side is in a horizontal plane and the front side is in a generally vertical plane.

When a plurality of fans are arranged in side-by-side relation for parallel operation, as they commonly are in a unit ventilator, the housings are hidden below outlet grilles and there is no necessity for structure comparable to the discharge collars. Consequently, the side plate main portions 10 and triangular portions 20 may conveniently be separate pieces to afford manufacturing economy. Likewise, the wrapper extension 8 may be seperate from the wrapper sheet 2 and of a length sufficient to extend along the front of several side-by-side housings.

The structure shown in FIGURE 5 provides the flared portions of adjacent side plates of a pair of side-by-side housings as well as an intermediate portion blanking off the top forward space between the housings. A flat blank of suitable peripheral shape is formed to provide the structure which includes the pair of triangular portions designated as 20 and 20*a* in FIGURES 3 and 5, and which serve as the flared portions of the two housings of FIGURE 3, with the flat horizontal triangular portion 30 connecting them along their top edges. Preferably the lower edges of the triangular portions 20 and 20*a* which lie along the respective base lines 18 and 18*a* of the housings lap the base line edges of the side plates so that the structure may be conveniently secured to the fan housings proper, and to a fan board (not shown) which serves as a frame for mounting the housings within the unit ventilator.

While all of the reasons that the structure of the fan housing of the present invention gives improved performance are not known, it is here noted that the new structure provides a more uniform distribution of air velocities over

the outlet area of the housing as compared to the conventional centrifugal fan housings. Testing on certain conventional housings developed that the ratio of average air velocities for the front and rear quadrants of the outlets was in the order of 2.2 to 1, while the ratio of average air velocities for comparable positions of the subject housing was in the order of 1.3 to 1, with the same fan wheel speed in both instances. It is believed that this more uniform distribution of air velocity from the outlets is one of the more important factors in the improved performance.

The invention claimed is:

1. A centrifugal fan housing, which is substantially scroll-shaped in longitudinal cross-section and is of generally rectangular-shape in lateral cross-section, said housing having a cutoff, an end of spiral, and an isosceles trapezoid-shaped outlet area, said outlet area having one boundary defined by said cutoff, and having an opposite boundary which is directly across said outlet area from said cutoff and which is the longer of the two parallel sides of said trapezoid, said housing including opposite housing sides having generally triangular-shaped portions adjacent said outlet area, each of said triangular-shaped portions including a base line side defined generally at opposite ends thereof by said cutoff and said end of spiral, each of said triangular-shaped portions further including an apex opposite said base line side, said triangular-shaped portions diverging from each other from said base lines to said apexes to form the non-parallel sides of said isosceles trapezoid-shaped outlet area.

2. The fan housing of claim 1 wherein each of said triangular-shaped portions diverges outwardly at an angle of about 15° from a plane in which the major portion of the respective housing side lies.

3. At least a pair of said fan housings as specified in claim 1 wherein the adjacent triangular-shaped portions of the respectively adjacent housings are formed of a single shaped piece, including an intermediate triangular portion lying in a plane common to the outlet area of said housings and integrally connected to said adjacent triangular-shaped portions.

4. A centrifugal fan housing, which is substantially scroll-shaped in longitudinal cross-section and is of generally rectangular shape in lateral cross-section, and which includes a cutoff, an air outlet having one boundary defined by said cutoff, and an opposite boundary which is directly across said outlet from said cutoff, and an end of spiral which is upstream, relative the direction of air flow in said housing, from said outlet, opposite sides for said housing, each of said sides including a generally triangular-shaped portion adjacent said air outlet, each said triangular-shaped portion being defined generally within an area of said side bounded by the intersection of said side with said cutoff, said end of spiral and said opposite boundary of said outlet, and said triangular-shaped portions diverge from each other.

5. In the fan housing of claim 4 the divergence of each of said triangular-shaped portions begins along a line having opposite ends generally in the vicinity of said cutoff and said end of spiral respectively.

6. In the fan housing of claim 4, each of said triangular-shaped portion diverges from the plane of the respective housing side in the range of 10 to 20 degrees.

7. At least a pair of said fan housings as specified in claim 4 wherein the adjacent triangular-shaped portions of respectively adjacent housings are formed of a single shaped piece, including an intermediate triangular portion lying in a plane common to said outlet of said housing and integrally connected to said adjacent triangular-shaped portions.

8. A centrifugal fan housing including a generally spirally-shaped wrapper wall which is substantially flat across its width, a cutoff corresponding generally with one end of said wrapper wall, an isosceles trapezoid-shaped air outlet having one parallel boundary defined by

said cutoff, and an opposite and longer parallel boundary which is directly across said outlet from said cutoff and corresponds with the other end of said wrapper wall, an end of spiral, a pair of opposite side walls for said housing, each side wall including a triangular-shaped portion immediately upstream from said outlet and defined within an area of said wall bounded by the intersection of said wall by said cutoff, said end of spiral, and said opposite boundary of said outlet, said triangular-shaped portions diverging with their edges which lie in the plane of said outlet defining the two non-parallel boundaries of said isosceles trapezoid-shaped outlet.

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