June 11, 1963 P. E. HAMMANN ETAL 3,093,299

CENTRIFUGAL FAN

Filed May 15, 1961 2 Sheets-Sheet 1

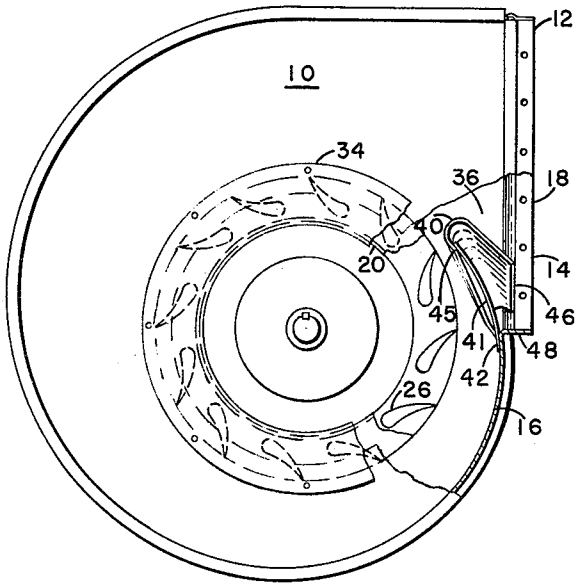

FIG. 1

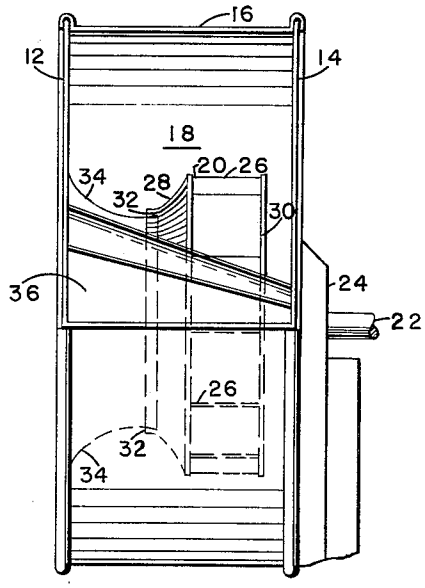

FIG. 2

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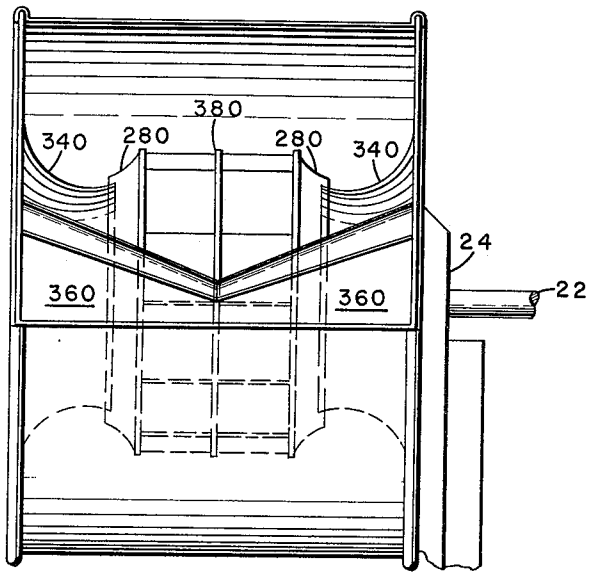

FIG. 4

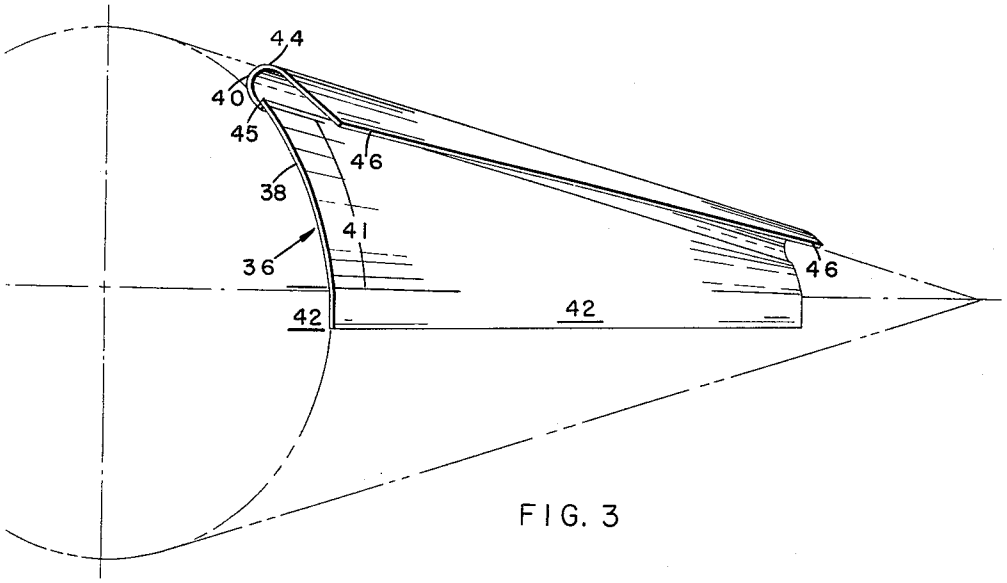

FIG. 3

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CENTRIFUGAL FAN

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This invention relates to centrifugal fans wherein an impeller is rotatably mounted in a scroll shaped housing for drawing air into the fan axially thereof and discharging air radially from the impeller into the housing from which it flows through a discharge opening.

In order to provide a relatively large discharge opening, the sides of the fan housing are disposed at some distance from the sides of the impeller and there is a tendency for the air to rotate continuously in the housing, particularly about the inlet throat of the housing and the inlet side plate of the impeller. This rotation of air in the housing produces losses which reduce the efficiency of the fan.

It is, therefore, an object of this invention to provide a fan cut-off for a centrifugal fan which will reduce recirculation of air about the inlet throat of the housing and the inlet side plate of the impeller thus increasing the efficiency of the fan.

Another object of the invention is to provide a sloping conically shaped cut-off for a centrifugal fan which will reduce recirculation of air within the fan housing and which will produce constant leaving air conditions thereby providing a more efficient fan.

A third object of the invention is to provide a fan cut-off which may be readily formed and installed and which when installed provides increased fan efficiency.

A still further object of the invention is to provide a fan cut-off which prevents recirculation of the discharged air back through the lower portion of the discharge opening.

Other objects and advantages of this invention will be readily apparent as the specification proceeds to describe the invention with reference to the accompanying drawings in which:

FIGURE 1 is a vertical view through a centrifugal air foil fan with part of the fan housing broken away to show features of the invention in cross-section;

FIGURE 2 is an end elevational view of the fan shown in FIGURE 1 as viewed from the right hand end thereof;

FIGURE 3 is a perspective view of the cut-off assembly of the fan in FIGURES 1 and 2; and

FIGURE 4 is an end elevational view of a double inlet centrifugal fan incorporating the features of this invention.

The invention has been illustrated as applied to a centrifugal air foil fan having an impeller positioned in a relatively large scroll housing to permit expansion of the air after passing through the impeller to obtain a low discharge of air and the accompanying quiet operation. The impeller shown preferably employs air foil blading for quiet operation but it is within the scope of the invention to employ other types of blade structure, if desired.

The fan of this invention consists of a housing 10 having parallel side walls 12 and 14 which are fastened to opposite edges of a scroll 16. The housing has a substantially rectangular discharge opening 18. The discharge opening 18 is spaced from and in a plane substantially parallel with a plane tangent to the periphery of the impeller 20. Two sides of the discharge opening 18 are substantially at the housing sides 12 and 14. A third side of the discharge opening is substantially at the scroll shaped wall 16. The fourth side 48 of the discharge opening 18 is substantially in a plane through the axis of rotation of the impeller 20 and normal to the plane of the discharge opening 18.

The impeller 20 is positioned within the scroll housing 10 and is mounted on a drive shaft 22 which is rotatably supported in an external bearing housing 24.

The impeller 20 has a plurality of air foil shaped blades 26 positioned about its periphery. The blades 26 extend between and are secured at their ends to the inlet side plate 28 and the back side plate 30 of the impeller in any suitable manner as by welding or riveting.

The inlet side plate 28 of the impeller 20 has an inlet opening 32 which forms the inlet plane of the impeller. An inlet throat 34 is secured to the well 12 in any suitable manner as by welding, riveting, or bolting, and has the end thereof extending within the inlet plane 32 of the impeller to conduct air through the inlet throat and thence directly into the interior of the impeller 20.

Mounted in the casing 10 between the side walls 12 and 14 is a sloping conically shaped cut-off member 36. This cut-off member 36 is an improvement over that shown in Davis Patent No. 2,841,326, July 1, 1958.

Basically cut-off member 36 consists of a conical cut-off member 38 and a nose piece 40. Conical cut-off member 38 is composed of a cone segment 41 and an integrally connected rectangular attachment strip 42 which is shaped to be tangent to the scroll member 16 so that it can be readily attached by any suitable means. Nose piece 40 is composed of a semicircular portion 44 welded, brazed, or otherwise secured at 45 to cone segment 40 to provide a smooth egress of the air from the fan without excessive noise and friction loss and a substantially flat portion 46 angularly displaced from a plane parallel to the discharge outlet portion 48 integrally connected to the scroll 16. The angular displacement of the flat portion 46 being dependent upon the angle of the impeller blades to provide maximum fan efficiency without excessive noise.

It should be noted that the cone segment 41 is taken from a cone in which the apex of the cone is located opposite to the inlet of the fan. This provides a cut-off member which is closer to the impeller 20 at the inlet side of the impeller than at the back side plate.

It has been found in centrifugal fans that the air in the fan scroll tends to circulate continuously around the inlet throat and inlet side plate of the impeller unless some means are provided to guide this air into the fan outlet. It has further been found in centrifugal fans when a large discharge opening is provided that a portion of the discharged air tends to be recirculated back into the lower portion of the blower housing through the lower region of the blower outlet. Cut-off member 36 described herein obviously solves the above problems. The conical shape of the cut-off provides a cut-off which not only prevents recirculation of the air through the lower region of the blower outlet but also places that portion of the cut-off adjacent the inlet throat 34 and inlet side plate closer to the fan wheel in order to intercept the air recirculating around the inlet throat and side plate in order to direct the air to the blower outlet. Further, the conical cut-off 36 provides a structure which places the cut-off portion adjacent the impeller the proper distance from the impeller to obtain maximum efficiency at a minimum noise level. Cut-off 36 further provides smooth and efficient leaving air condition with minimum friction losses.

As is readily seen, cut-off member 36 is very simple in design and is composed of only two pieces which are readily formed, joined, and installed in the desired fan.

In FIGURE 4 there is illustrated the use of the air cut-off member 36 as applied to a double inlet centrifugal fan. Basically the operation of the double inlet fan is the same except that there are two inlet throats 340, two inlet side plates 280, and two cut-off member 360 which

are joined at point in the plane of the center plate 380. The cut-off members perform in the same manner on the double inlet centrifugal fan as they do on the single width centrifugal fan.

While the apparatus disclosed and described herein constitutes the preferred form of the invention, yet it will be understood that the apparatus is capable of alteration without departing from the spirit of the invention, and that all modifications that fall within the scope of the appended claims are intended to be included herein.

We claim:

1. In a centrifugal fan, a housing of scroll form having spaced substantially parallel sides and a scroll shaped wall, inlet throat means attached to and extending within said housing, an impeller of the centrifugal type having flow passages therein and having said flow passages terminating in a peripheral air discharge surface, means rotatably mounting said impeller in said housing for drawing air through the inlet throat into said impeller and discharging the same from the fan housing, a substantially rectangular discharge opening in said housing, said opening being spaced from and in a plane substantially parallel with a plane tangent to the periphery of said impeller, two sides of said discharge opening being substantially at the housing sides, a third side of said discharge opening being substantially at the scroll shaped wall, a fourth side of said discharge opening extending between and being substantially normal to said substantially parallel sides of said housing and being located a predetermined distance from said third side of said opening, and a sloping substantially conical shaped cut-off means located in said discharge opening adjacent said fourth side to reduce the recirculation of air around said inlet throat and to prevent recirculation of discharged air back through the lower portion of said discharge opening.

2. In a centrifugal fan, a housing of scroll form having spaced substantially parallel sides and a scroll shaped wall, an inlet throat extending within said housing from one side thereof, a impeller of the centrifugal type having flow passages therein and having said flow passages terminating in a peripheral air discharge surface, means rotatably mounting said impeller in said housing for drawing air through the inlet throat into said impeller and discharging the same from the fan housing, a substantially rectangular discharge opening in said housing, said opening being spaced from and in a plane substantially parallel with a plane tangent to the periphery of said impeller, two sides of said discharge opening being substantially at the housing sides, a third side of said discharge opening being substantially at the scroll shaped wall, a fourth side of said discharge opening extending between and being substantially normal to said substantially parallel sides of said housing and being located a predetermined distance from said third side of said opening, and a sloping substantially conical shaped cut-off means located in said discharge opening adjacent said fourth side to reduce the recirculation of air around said inlet throat, said substantially conical shaped cut-off means having the apex opposite in direction to said inlet throat and inwardly of said cut-off means whereby said cut-off means curves in a direction towards said impeller.

3. The structure of claim 2 wherein said cut-off means slopes downwardly from said inlet throat towards the other of said parallel sides of said casing whereby the portion of the cut-off means adjacent the inlet throat will be radially closer to the axis of said impeller than the portion of said cut-off means remote from said inlet throat.

4. In a centrifugal fan, a housing of scroll form having spaced substantially parallel sides and a scroll shaped wall, an inlet throat extending within said housing from one side thereof, an impeller of the centrifugal type having flow passages therein and having said flow passages terminating in a peripheral air discharge surface, means rotatably mounting said impeller in said housing for drawing air through the inlet throat into said impeller and discharging the same from the fan housing, a substantially rectangular discharge opening in said housing, said opening being spaced from and in a plane substantially parallel with a plane tangent to the periphery of said impeller, two sides of said discharge opening being substantially at the housing sides, a third side of said discharge opening being substantially at the scroll shaped wall, a fourth side of said discharge opening extending between and being substantially normal to said substantially parallel sides of said housing and being located a predetermined distance from said third side of said opening, and a sloping substantially conical shaped cut-off means extending between said substantially parallel side walls and located in said discharge opening adjacent said fourth side, said cut-off means sloping downwardly from said inlet throat towards said other parallel side wall to reduce recirculation of air into the lower portion of said discharge opening.

5. The structure of claim 4 wherein the apex of said substantially conical shaped cut-off means is located in a direction opposite to said inlet throat and inwardly of said cut-off means whereby the portion of the cut-off means adjacent the inlet throat will be radially closer to the axis of said impeller than the portion of said cut-off means remote from said inlet throat.

6. In a centrifugal fan, a housing of scroll form having spaced substantially parallel sides and a scroll shaped wall, an inlet throat extending within said housing from each side thereof, an impeller of the centrifugal type having inlet side plates, each of said side plates having an air receiving opening in communication with one of said inlet throats, said impeller having flow passages therein and having said flow passages terminating a peripheral air discharge surface means rotatably mounting said impeller in said housing for drawing air through the inlet throat into said impeller and discharging the same from said housing, a substantially rectangular discharge opening in said housing, said opening being spaced from and in a plane substantially parallel with a plane tangent to the periphery of said impeller, two of the sides of said discharge opening being substantially at the housing sides, a third side of said discharge opening being substantially at the scroll shaped wall, a fourth side of said discharge opening extending between and being substantially normal to said substantially parallel sides of said housing and being located a predetermined distance from said third side of said opening, and a sloping substantially conical cut-off member extending and sloping downwardly from each of said inlet throats and being located in said discharge opening adjacent said fourth side, said cut-off members being joined at a point substantially at the cross-sectional center of said impeller to reduce recirculation of air into the lower portion of said discharge opening.

7. The structure of claim 6 wherein the apex of each of said substantially conically shaped cut-off members is located in a direction opposite to the inlet throat to which it extends from and is located inwardly of said cut-off member whereby the portion of each cut-off member adjacent its respective inlet throat will be radially closer to the axis of said impeller than the portion of the cut-off members adjacent the junction point of said cut-off members.

References Cited in the file of this patent

UNITED STATES PATENTS

353,994	Walker et al.	Dec. 7, 1886
1,250,681	Sheldon	Dec. 18, 1917
2,107,897	McMahon	Feb. 8, 1938
2,335,734	Caldwell	Nov. 30, 1943
2,460,370	Stauffer	Feb. 1, 1949
2,841,326	Davis	July 1, 1958

FOREIGN PATENTS

2,269	Great Britain	of 1888
579,770	Great Britain	Aug. 15, 1946
1,071,888	Germany	Dec. 24, 1959