

May 30, 1939.

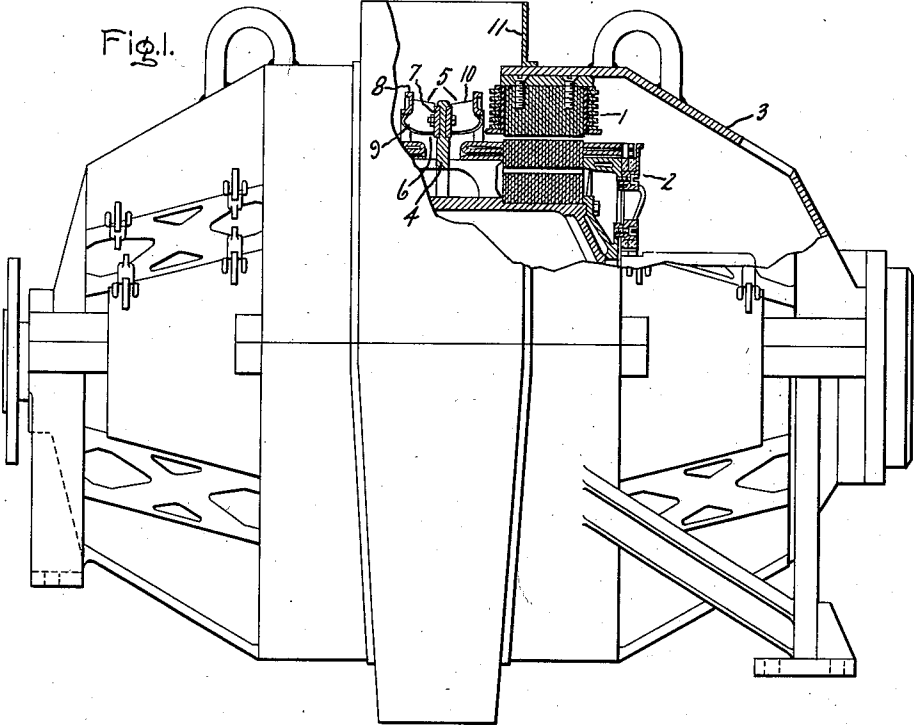
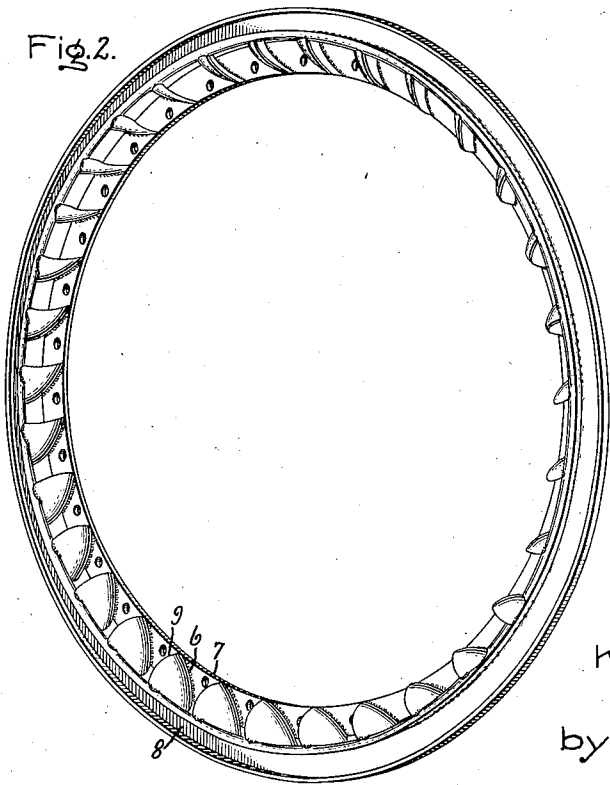
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2,160,667

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Inventor:
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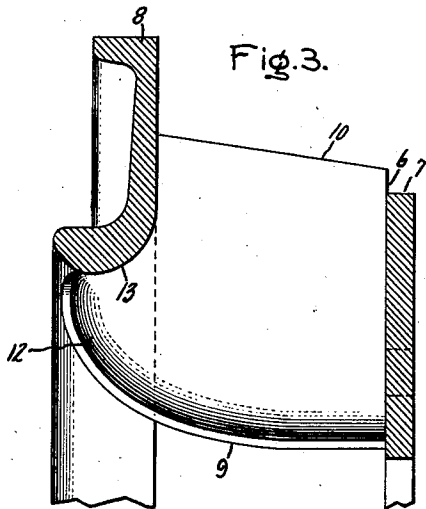
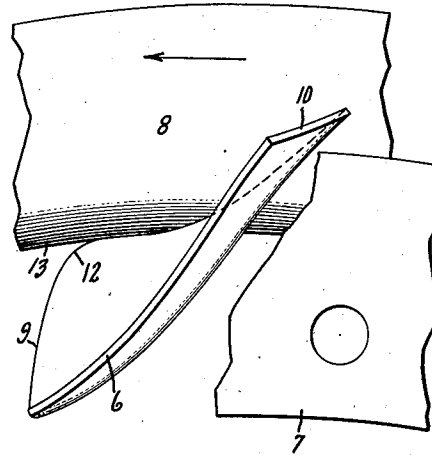
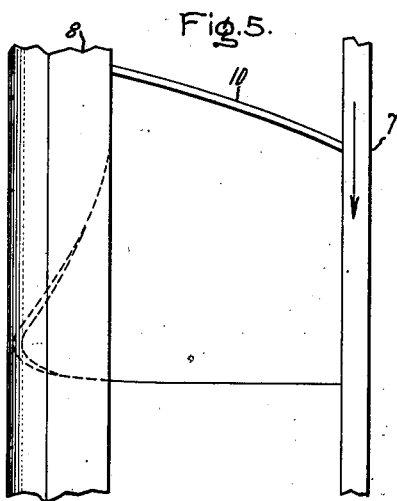
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Fig.4.



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Fig. 6.

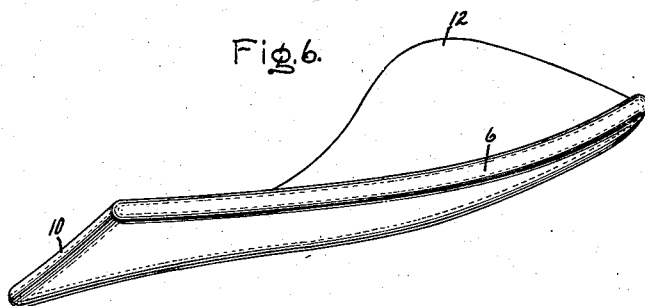


Fig. 7.

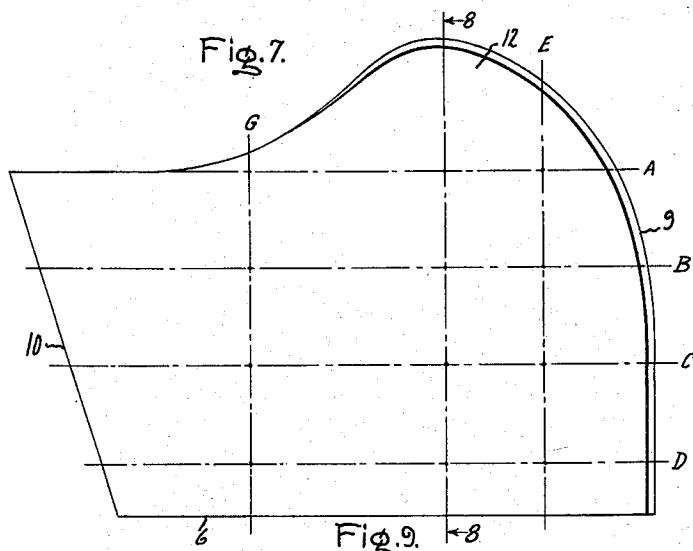


Fig. 8.

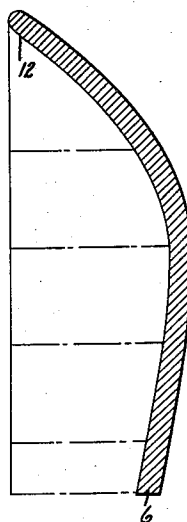


Fig. 9.

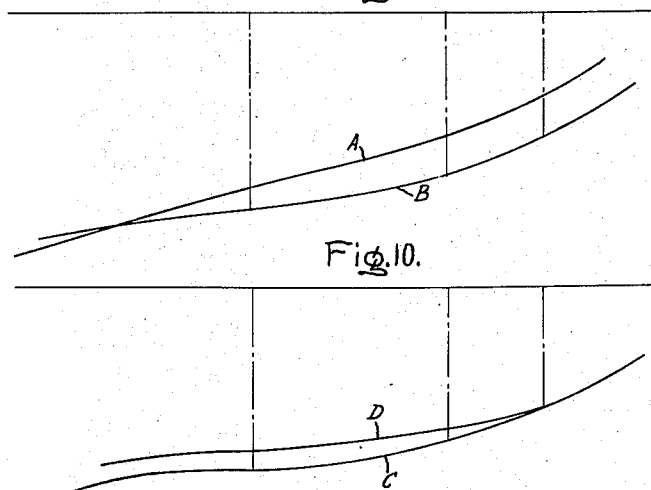


Fig. 11.

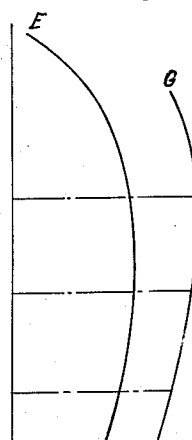


Fig. 10.

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UNITED STATES PATENT OFFICE

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to General Electric Company, a corporation of
New York

Application April 1, 1938, Serial No. 199,460

8 Claims. (Cl. 230—134)

The present invention relates to centrifugal fans and is an improvement on my application Serial No. 82,780, filed June 1, 1936.

The object of my invention is to provide an improved construction in centrifugal fans which will have quiet and efficient operation. For a consideration of what I believe to be novel and my invention, attention is directed to the following description and the claims appended thereto.

In the accompanying drawings, Fig. 1 is a side elevation, partly broken away, of a dynamo-electric machine equipped with a fan embodying my invention; Fig. 2 is a perspective view of the fan; Fig. 3 is a front elevation of one of the fan blades; Fig. 4 is a rear elevation of one of the fan blades; Fig. 5 is a top plan view of one of the fan blades; Fig. 6 is a perspective view of one of the fan blades; Fig. 7 is a plan view of one of the fan blades; Fig. 8 is a sectional view taken on line 8—8 of Fig. 7 showing the blade shape with reference to a datum plane passing through the front end of the blade and inclined backwardly with respect to the rotation of the fan through an angle of the order of 30°; Fig. 9 is a diagrammatic view showing the blade shape along lines A and B in Fig. 7 with respect to the same datum plane; Fig. 10 is a diagrammatic view showing the blade shape along lines C and D in Fig. 7 with respect to the same datum plane; and Fig. 11 is a diagrammatic view showing the blade shape along lines E and G with respect to the same datum plane.

Referring to the drawings, I have shown my invention used as a ventilating fan for a dynamo-electric machine having a stationary member 1 and a rotating member 2 carried in a frame 3. The stationary and rotating members are divided into two sections spaced apart along the longitudinal axis of the machine. In the space between the sections is a hub 4 which comprises an annular ring fixed to the rotating member on opposite sides of which are carried axially extending fan blades 5. The rear ends 6 of the blades are fixed to annular rings 7 which are fixed to opposite faces of the hub. Shroud rings 8 are fixed to the outer portions of the front ends of the blades. The inner edges 9 of the blades define a passage through which air flows axially to the fan blades. The air is discharged radially from the outer edges 10 of the blades. During the rotation of the fan, air is drawn axially into the inner edges of the fan and is discharged from the outer edges to a scroll casing 11.

The blade shape and the arrangement of the

fan blades is shown more clearly in Figs. 3 to 11, inclusive. As shown in Fig. 4, the fan blades are inclined backwardly with regard to the direction of rotation of the fan at an angle of the order of 45°. From the rear ends the blades are inclined rearwardly in an axial direction towards the front ends of the blades. The rearward inclination decreases gradually and finally reverses so that adjacent the front ends, the blades are curved forwardly. This change in inclination is clearly shown in Figs. 8 and 11. The net result is that the front faces of the blades are concave in an axial direction.

The inner edges 9 of the blades, as shown in Figs. 3 and 7, are curved radially outward an increasing amount from the rear end toward the front end of the blades. The inner edges terminate in a forwardly curved end 12 which projects within the inner edge of the shroud ring 8. The forwardly curved ends 12 serve as scoops or as propeller fan elements which increase the axial flow of air to the fan. This increases the effectiveness of the front ends of the blades. The shroud ring is provided with an inner curved edge 13 which guides the air from the forwardly curved front ends 12 toward the outer edges of the blades. The axial flow produced by the front ends 12, if unrestricted, would tend to overload the rear ends of the blades. This tendency to overloading is decreased by the concave front faces and rearward inclination of the blades described above. This is apparent from Figs. 8 and 11. The axial flow produced by the forward end 12 is resisted by the curvature of the rear ends of the blades. The net result is that the air between the blades is kept at a more nearly uniform pressure and eddying between the blades is decreased. Eddying is the source of noise. It also decreases the efficiency of the fan blades. The outer edges 10 of the blades are inclined radially outward from the rear ends toward the front ends. In other words, the diameter of the fan increases from the rear toward the front. This increases the blade width at the front ends and makes the discharge from the blades more uniform throughout the length of the blades. The shape of the fan blades from the inner edges toward the outer edges along radial lines is shown in Figs. 9 and 10. The outer or discharge edges are substantially plane. The inner edges are curved forwardly with respect to the outer edges as regards the direction of rotation of the fan. Intermediate the inner and outer edges the blades are slightly concave. From one aspect, the fan can be considered as a series of nozzles

having a width measured by a line perpendicular to the front face of the blades and extending to the rear face of the adjacent blade. The shape is chosen so that the velocity of the air between the blades will be substantially constant at each radius. The forward curving of the inner edges of the blades provides a greater effective width between the blades which is necessary for the slower moving air at this point. The velocity of the air increases with the radius, and accordingly, less effective space is required. This decrease in space is effected by the change in inclination in the blades, and the width between the annular ring 7 and shroud ring 8.

The fan of the present application is being claimed broadly in application Serial No. 82,780, filed June 1, 1936. The present application is directed to backwardly inclined blades.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In a fan, axially extending blades having inner intake edges defining a passage into which air flows axially and outer discharge edges from which the air is discharged radially, the discharge edges being inclined backwardly as regards the direction of rotation of the fan, the blades being inclined in an axial direction rearwardly as regards the direction of rotation of the fan from the rear toward the front ends, and the front ends of the blades being curved forwardly and projecting into the axially flowing air entering the fan and serving as scoops to increase the amount of air entering the fan.

2. In a fan, axially extending blades having inner intake edges defining a passage into which air flows axially and outer discharge edges from which the air is discharged radially, the discharge edges being inclined backwardly as regards the direction of rotation of the fan, the front faces of the blade being concave in an axial direction from the rear ends to the front ends along the inner and intermediate portions of the blades, and the front ends of the blades being curved forwardly and projecting into the axially flowing air entering the fan and serving as scoops to increase the amount of air entering the fan.

3. In a fan, axially extending blades having inner intake edges defining a passage into which air flows axially and outer discharge edges from which the air is discharged radially, the discharge edges being inclined backwardly as regards the direction of rotation of the fan, the blades being inclined in an axial direction rearwardly as regards the direction of rotation of the fan from the rear toward the front ends, the inclination changing from the rear toward the front ends so as to produce concave front faces on the blade, and the front ends of the blades being curved forwardly and projecting into the axially flowing air entering the fan and serving as scoops to increase the amount of air entering the fan.

4. In a fan, a hub, a shroud ring, axially extending blades therebetween having inner intake edges radially inward from the shroud ring defining a passage into which air flows axially and outer discharge edges between the hub and the shroud ring from which air is discharged radially, the discharge edges being inclined backwardly

as regards the direction of rotation of the fan, the front faces of the blades being concave in an axial direction from the rear toward the front ends, the front ends of the blades projecting within the inner edges of the shroud ring into the axially moving air entering the fan and serving to increase the amount of air entering the fan, and the shroud ring being curved to guide air from the front ends to the discharge edges of the blades.

5. In a fan, a hub, a shroud ring, axially extending blades therebetween having outer discharge edges between the hub and the shroud ring from which air is discharged radially and inner intake edges defining a passage into which air flows axially, said inner edges being curved radially outward from the rear toward the front ends and terminating in forwardly curved front ends projecting beneath the inner edge of the shroud ring into the axially moving air entering the fan and serving as scoops to increase the amount of air entering the fan, the discharge edges being inclined backwardly as regards the direction of rotation of the fan, the front faces of the blades being concave in an axial direction from the rear toward the front ends, and the shroud ring being curved to guide air from the front ends to the discharge edges of the blades.

6. In a fan, axially extending blades having inner intake edges defining a passage into which air flows axially and outer discharge edges from which the air is discharged radially, the discharge edges being inclined backwardly as regards the direction of rotation of the fan, the blades being inclined in an axial direction rearwardly as regards the direction of rotation of the fan from the rear toward the front ends, and the front faces of the blades being concave in a radial direction from the intake to the discharge edges.

7. In a fan, a hub, a shroud ring, axially extending blades therebetween having inner intake edges radially inward from the shroud ring defining a passage into which air flows axially and outer discharge edges between the hub and the shroud ring from which air is discharged radially, the discharge edges being inclined backwardly as regards the direction of rotation of the fan, the front faces of the blades being concave in a radial direction from the intake to the discharge edges, the front ends of the blades projecting within the inner edges of the shroud ring into the axially moving air entering the fan and serving to increase the amount of air entering the fan, and the shroud ring serving to guide air from the front ends to the discharge edges of the blades.

8. In a fan, axially extending blades having outer discharge edges from which air is discharged radially, the discharge edges being inclined backwardly as regards the direction of rotation of the fan, the blades being inclined in an axial direction rearwardly as regards the direction of rotation of the fan from the rear toward the front ends, and the front faces of the blades being concave in a radial direction toward the discharge edges and in an axial direction from the rear toward the front ends.

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