June 10, 1924. 1,497,408

A. E. SEELIG.

FAN BLOWER

Filed June 19, 1920

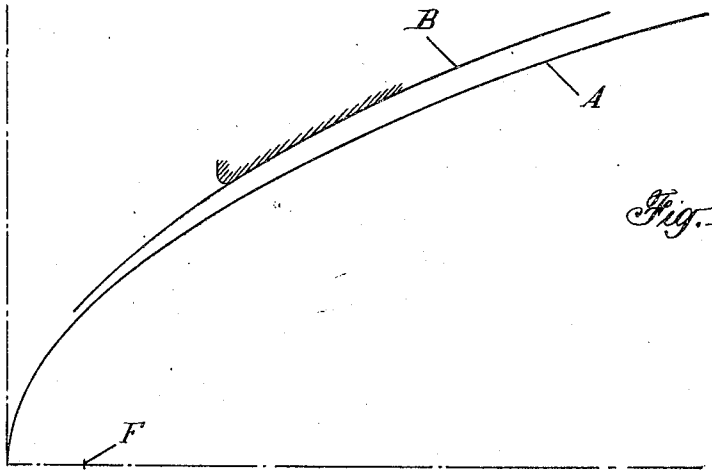


Fig. 1,

Fig. 2

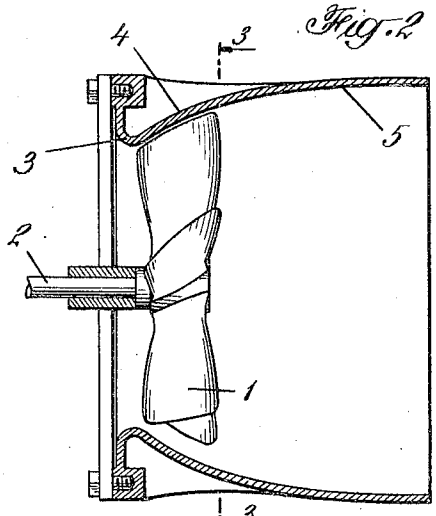
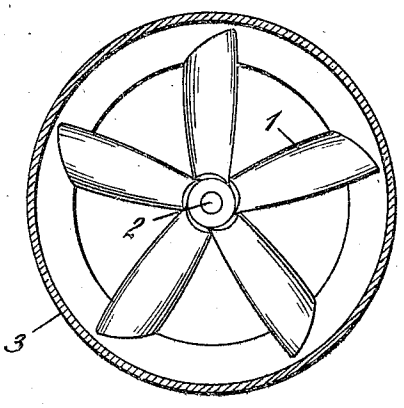


Fig. 3,



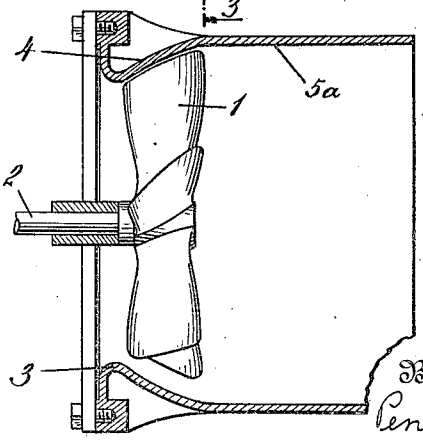


Fig. 4,

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By his Attorneys
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UNITED STATES PATENT OFFICE.

ALFRED E. SEELIG, OF NEW YORK, N. Y.

FAN BLOWER.

Application filed June 19, 1920. Serial No. 390,084.

To all whom it may concern:

Be it known that I, ALFRED E. SEELIG, a citizen of the United States, residing at New York city, in the county of New York, State of New York, have invented certain new and useful Improvements in Fan Blowers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to fan blowers of the kind employed for ventilation, forced drafts for furnaces, etc.

Fan blowers of this type usually embody a fan of the propeller blade type mounted for rotation in a casing or duct, through which the air is forced to the desired point of discharge. Such fans have usually been made with the casings of cylindrical bore and closely fitting the periphery of the fan blades.

In fans of this character there are certain losses of pressure and capacity sometimes attended with the production of eddy currents and a tendency for the air to blow back toward the suction side of the fan, and different methods have been proposed to overcome the difficulty.

The most successful method heretofore employed of which I am aware consists in enlarging the casing of the fan around the periphery of the fan blades on the delivery side to about half the depth or axial dimension of the fan, and curving the face of the casing where its small diameter merges into the larger diameter to provide a deflecting surface for directing the radially discharged air into an axial path of movement along with the air discharged from nearer the middle of the fan. This construction lessens the choking effect and back-blowing of the straight casing fan, but is open to the objection that the air which escapes radially from the periphery of the fan blades into the enlarged portion of the casing has not as high axial velocity as the air which leaves the blades from their radial edges, with the result that the ultimate or average velocity of the entire moving air column is reduced by the slower moving currents discharged from the periphery of the blades and deflected by the casing.

By the invention of this application I more effectually relieve the choking effect and blowing back and at the same time avoid the inherent defects of the blowers of the prior art.

My improved fan also provides a greater blade area for the same diameter of casing. This feature is of particular importance as the space available for the duct or casing frequently limits the size of the fan where greater capacity would be desirable.

With the above objects in view my invention consists in the construction shown in the accompanying drawing, wherein—

Figure 1 is a diagrammatic view showing a preferred curve for the fan casing in comparison with a true parabola;

Fig. 2 is a vertical sectional view of a fan embodying my invention;

Fig. 3 is a front view of the fan looking into the casing; and

Fig. 4 is a vertical sectional view of a modified construction.

Referring to the drawings, particularly to Fig. 2, 1 indicates the fan which is mounted for rotation on a shaft 2 driven from any suitable source of power, usually a steam turbine whose rotor is attached directly to the shaft.

The fan 1 is mounted in a casing 3 through which air is to be directed to the furnace fire box or other place of delivery. The portion 4 of the casing which encloses the fan is curved instead of cylindrical, the curve preferably conforming to the parabolic derivative hereinafter described. The ends of the fan blades are not cut off at their ends at right angles to the radius of the fan, but are curved to conform to the curvature of the casing, so as to allow more clearance between the blades and the inner surface of the casing. Beyond the delivery or front edge of the fan the casing is gradually curved into the cylindrical portion 5 which forms the duct for the delivery of the air and which may be itself inserted in the furnace wall or connected to a longer air line if the air is to be used at a distance from the blower.

I have found that the air in its passage through the fan is acted upon by forces tending to drive the air in three different directions. In the first place the air is forced axially away from the fan by the inclined faces of the fan blades. This axial movement is not in lines strictly parallel with the axis of the fan but, due to the pitch and rotation of the blades, there is a rotary or circumferential component which with the axial component gives to the air a tendency

to rotate in the casing as well as advance longitudinally, the tendency to rotate being gradually diminished by the friction of the stationary casing walls as the air advances toward the delivery end of the casing.

In addition to these two components the air has a radial component, due to the centrifugal force of the air from its rotation with the fan. In a fan of ordinary construction with a closely fitting cylindrical casing this tendency to radial movement sets up eddy currents in the volume of air, sometimes causing a blowing back of the air toward the suction side of the fan, due to the fact that the air impinging against the casing is thrown back by the casing into the path of the fan blades, and across the streams of air discharged directly from the fan blades.

To relieve the choking effect as completely as possible, the curve of the flaring portion of the casing is preferably determined in the manner indicated in Fig. 1. As here shown the curve A is a parabola with its focus at F, the proportions and dimensions of the parabola being determined from the resultant of the radial and axial components of the air current, which components vary chiefly with the speed of rotation, the diameter of the fan, and the pressure, but are also affected by the pitch. After the curve A is determined for the particular installation of fan a projection of the curve is made, the angle of projection being proportioned to the circumferential component of the air current which varies chiefly with the pitch of the fan. For the fan shown in the drawing the angle of projection is 30 degrees. In deriving the 30-degree projection from the curve A as plotted on the drawing board, the curve will be rotated on the perpendicular to its axis at the vertex through an angle of 30 degrees, and then projected back to the plane of the paper, forming the curve B, the effect being to foreshorten the parabola just as the air currents are foreshortened by a circumferential component of corresponding degree. Hence, a surface generated by the rotation of the projected parabola about its axis will produce a deflecting surface which will reflect air currents from the direction of the focus of the parabola which impinge against it in a generally axial direction.

The air discharged from the front of the fan does not leave the fan in the same direction with regard to its axis of rotation in all parts of the fan. The air discharged near the periphery of the blades has a greater centrifugal moment than the air discharged from points on the blades nearer the axis. Hence it may be said that the column of air leaving the fan, if uninfluenced by a casing of any description, would be of a flaring or conical configuration, that is, the air currents making up the column may be considered as having a direction proceeding generally from a common point on the axis of rotation. If this point is taken as the focus of the parabola A in designing the casing, the greater portion of the air column will be uniformly reflected by the casing into substantially parallel paths, and the tendency to the formation of eddy currents, the choking effect and the blowing back, will be materially reduced.

Instead of placing the focus at the apex of the conical air current the focus may be displaced slightly from this point, so that the air currents, insead of being reflected parallel to the axis of rotation, will still slightly diverge and follow the wall of the casing, being gradually brought into parallelism by the convergence of the parabola into the cylindrical casing.

Preferably the curve of the casing continues as shown in Fig. 2 beyond the delivery edge of the fan blades so as to gradually check the tendency to radial movement in the air and deflect the air into an axial moving air column of substantially uniform velocity throughout. In case, however, space does not permit the use of a casing of this size in proportion to the size of fan necessary for its volume of air required, I may construct the fan and casing as shown in Fig. 4. As here shown the curve of the expanded portion of the casing is so proportioned as to blend directly into the cylindrical portion of the casing at the delivery edge of the blades. By properly curving the surface of the casing any air reflected from the face of the casing would be deflected axially out of the fan instead of back in the path of the blades. With this type of fan it is advisable to have the parabola shaped to reflect the air currents slightly more than when the curve extends beyond the front of the fan to avoid too great a density at the casing wall.

It will be noted that with this type of fan the effective blade area is but little less than that of a straight casing fan with the same diameter of casing, while in a fan of the present expanded casing type, the same size casing would only accommodate a fan of a diameter equal to the reduced intake opening of the casing.

It will of course be understood that the direction of the air currents varies with the same fan under different operating conditions and that there is no definitely fixed point from which the air currents throughout the whole area of the fan can be said to originate, but an approximate point can be located for the focus of the parabola whereby the greater portion of the air column will be deflected substantially in the manner described.

It is also to be understood that the inven-

tion is not limited to a parabolic curve or to the disclosed arrangement of the fan in the casing except in so far as defined in the appended claims.

I claim:

1. In a blower, the combination of a fan of the propeller type having the ends of its blades diverging from the intake to the delivery side of the fan on a curve proportioned to the diameter and intended speed of the fan, and a casing having a portion enclosing the fan blades, said casing having its surface at the periphery of the blades diverging in conformity with the divergence of the fan blades.

2. In a blower the combination of a fan of the propeller type having the ends of its blades diverging from the intake to the delivery side of the fan on a curve proportioned to the diameter, pitch and intended speed of the fan, and a casing having a portion enclosing the fan blades, said casing having its surface at the periphery of the blades diverging in conformity with the divergence of the fan blades.

3. In a blower the combination of a fan of the propeller type, and a casing therefor having its surface enclosing the periphery of the fan blades curved to approximately parabolic shape, the factors of the parabola being proportioned to the diameter and intended speed of operation of the fan.

4. In a blower the combination of a fan of the propeller type, and a casing therefor having its surface enclosing the periphery of the fan blades curved to approximately parabolic shape, the factors of the parabola being proportioned to the diameter and intended speed of operation of the fan, said fan having the ends of its blades curved to conform to the curvature of the casing.

5. In a blower the combination of a fan of the propeller type, and a casing therefor having its surface enclosing the periphery of the fan blades curved to approximately parabolic shape, the factors of the parabola being proportioned to the diameter, pitch and intended speed of operation of the fan.

6. In a blower the combination of a fan of the propeller type, and a casing therefor having its surface enclosing the periphery of the fan blades curved to approximately parabolic shape, the factors of the parabola being proportioned to the diameter, pitch and intended speed of operation of the fan, said fan having the ends of its blades curved to conform to the curvature of the casing.

7. In a blower, the combination of a fan of the propeller type and a casing therefor having its surface enclosing the periphery of the fan blades curved to approximately parabolic shape, the deviation from a true parabolic section being in proportion approximately to the pitch of the fan.

8. In a blower the combination of a fan of the propeller type and a casing therefor having its surface enclosing the periphery of the fan blades curved to the shape derived from a parabola, the parabola being proportioned approximately to the diameter and intended speed of operation of the fan, and the curve of the casing being derived from the parabola by an angular projection of the parabola proportioned approximately to the pitch of the fan.

In testimony whereof I affix my signature.

ALFRED E. SEELIG.