July 23, 1935. H. C. HUEGLIN 2,008,957

VENTILATING FAN

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Fig. 1.

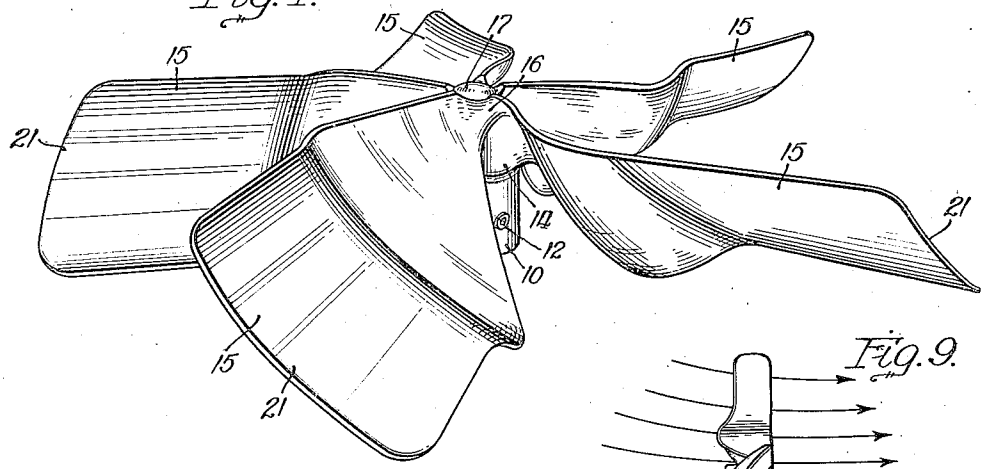



Fig. 9.

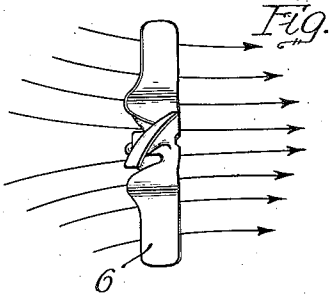
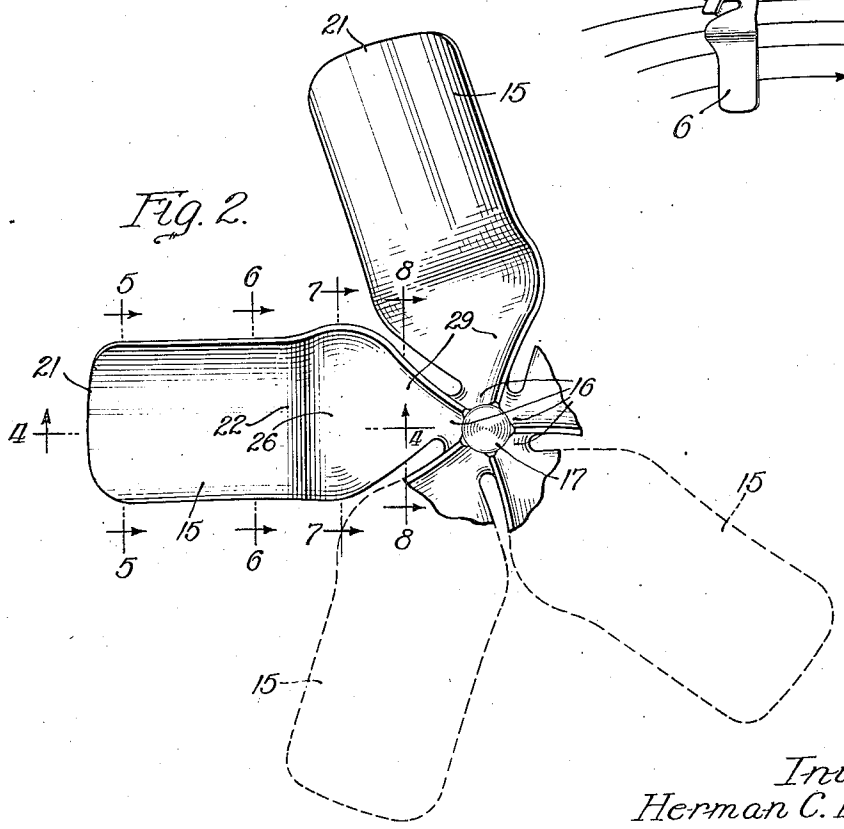



Fig. 2.




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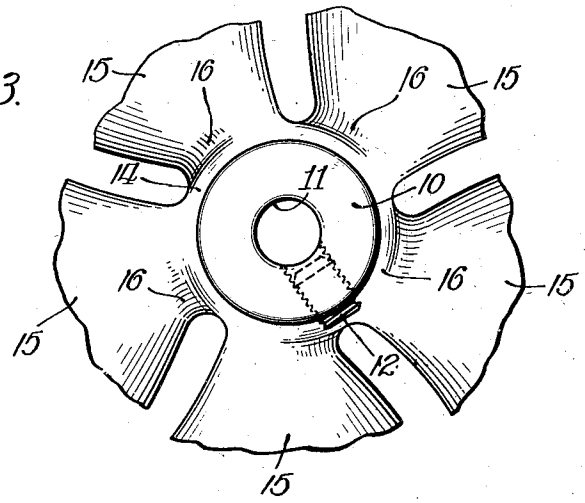
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Fig. 3.



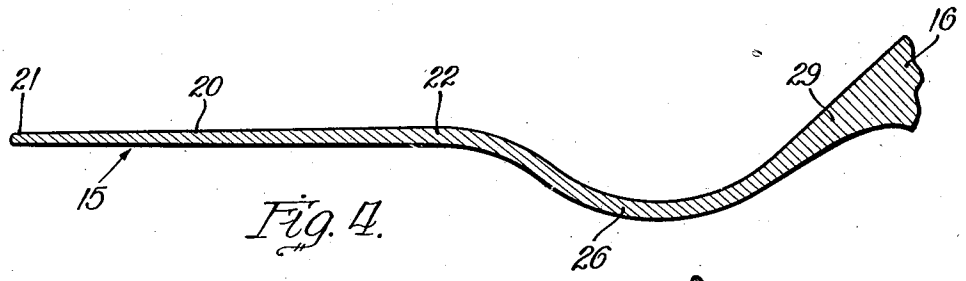




Fig. 4.

Fig. 8.

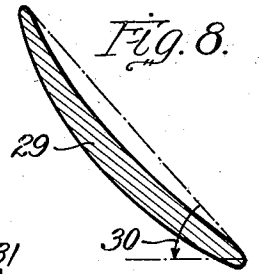



Fig. 5.

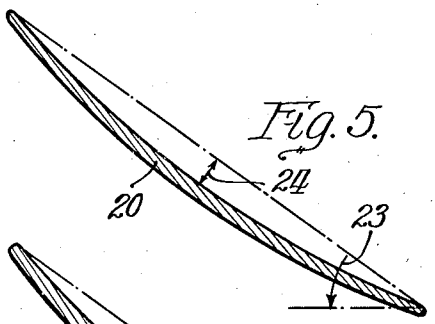






Fig. 7.

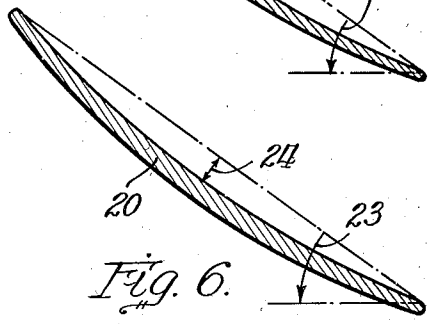



Fig. 6.

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# UNITED STATES PATENT OFFICE

2,008,957

## VENTILATING FAN

Herman C. Hueglin, Chicago, Ill., assignor to Federal Merchandise Company, Chicago, Ill., a corporation of Illinois

Application January 2, 1934, Serial No. 704,826

6 Claims. (Cl. 170—159)

This invention relates to fans or axial blowers. The purpose of a device of this character is to move air or other fluids as efficiently as possible. The particular device which I shall describe is employed as a ventilating fan, but the invention is obviously not to be limited to that specific use, nor to fans which operate only on air, gases or the like.

The efficient movement of fluids as by a fan can be accomplished in maximum degree only by securing a stream line flow. Consider a stream of air moving in a body of air, or a stream of water moving in a body of water. It is desirable that the stream have maximum velocity at the center, and that the cylindrical laminæ of the stream be of successively decreased velocities from the center outwardly, inasmuch as minimum relative motion betwen adjacent laminæ is essential for avoidance of eddy currents and consequently losses due thereto.

Fans, as heretofore constructed, have generally done the opposite, namely, instead of securing maximum velocity at the center of the moving stream with gradually decreasing velocity toward the maximum radii or outermost laminæ, they have projected the air or the fluid with maximum velocity at the outermost radii or laminæ of the stream somewhat in the shape of a hollow cylinder. This is the best that the prior art, so far as I am aware, could accomplish.

Less efficient fans have, of course, thrown the air out more or less in the shape of an outwardly expanding cone, due to the radial throw of the air by the blades acting more or less inefficiently, and constituting, when so inefficiently formed, paddles operating more like a radial blower.

In order to secure the desired stream line flow through the fan, a departure from the basic theory of fans as heretofore constructed is necessary. It is to be noted that, in a fan consisting of radial blades or vanes, the tips move at a velocity which is directly proportional to their radial length. Hence, it naturally occurs that the greatest absolute velocity is at the tips and the minmum is at the center. Inasmuch as it is desirable to secure maximum velocity at the center, the fan itself mechanically provides the wrong ratio of movement.

It is an object of the invention to provide a fan which will deliver a maximum amount of air with a given input of power. It is also an object of the invention to deliver a maximum amount of air with a given diameter of fan. I preferably accomplish this by providing a combination blade, the outer half of the blade having a substantially constant pitch and curvature, and the inner half of the blade being of an accentuated bucket shape, so that the blades will tend to produce a stream line flow through the fan delivery area, and no dead spots will be present in the central delivery area of the fan. This curvature can be such that a substantially flat surface is provided, and it is to be understood that the primary concept of the invention is the production of a combination blade, the outer half of which can be given any desired pitch and curvature, while the inner half is so formed as to attain, as far as possible, the object mentioned above.

Another object of the present invention is to provide a fan that requires less power to operate, and which at the same time effects a greater delivery for a given length of the blade.

Since it is a known fact that the resistance of a body moving through the air is a function of the speed, it is apparent that the tips of the blades moving at maximum velocity consume power at a high rate. By decreasing the diameter of a fan for a given output, the power may be materially decreased.

A still further object of the present invention is to reduce the size of the hub or collar by which the fan is secured to a rotating shaft, and to reduce also the weight of the fan by reducing the amount of metal therein. The latter result is obtained by providing a sharp taper to the inner end of the bucket-shaped portion of the blade adjacent the collar, reducing the cross sectional area of the blade materially as it joins the hub, and thus eliminating to a large extent any dead spots adjacent to or over the hub. The blades themselves also decrease in thickness outwardly from the hub.

Other objects and advantages of the present invention will appear more fully from the following detailed description, which, taken in connection to the accompanying drawings, will disclose to those skilled in the art the particular construction and operation of a preferred form of the invention.

In the drawings:

Figure 1 is a perspective view of the fan of the present invention;

Figure 2 is a plan view of the fan shown in Figure 1;

Figure 3 is a bottom plan view of a portion of the hub and collar of the fan;

Figure 4 is a longitudinal sectional view taken on the line 4—4 of Figure 2, showing the general curvature of the blade along its longitudinal axis;

Figure 5 is a sectional view of the outer tip portion of the blade, taken substantially on the line 5—5 of Figure 2;

Figure 6 is a corresponding sectional view taken just outwardly of the transverse center of the blade substantially on the line 6—6 of Figure 2;

Figure 7 is a sectional view taken on the line 7—7 of Figure 2, showing a section of the bucket portion of the blade;

Figure 8 is a sectional view taken substantially on the line 8—8 of Figure 2, showing the curvature of the blade as it approaches the hub of the fan; and

Figure 9 is a diagrammatic view showing the desired method of producing flow through a fan.

Referring first to Figure 9, it will be noted that the fan 6 is so constructed that the central portion thereof delivers the major portion of the fluid, with the successive outer portions progressively delivering smaller quantities of air, in order to produce a stream line flow, which is the most efficient manner of delivering fluid through the fan. Contrasted to this is the ordinary type of fan, in which the air or fluid is delivered in a substantially hollow cylinder, producing severe eddy currents in the center portion thereof, and also about the periphery thereof, which is undesirable and inefficient.

Referring now in detail to the drawings, the fan is shown as comprising a collar or hub portion 10, which is substantially cylindrical in form, and which is bored centrally thereof, as shown in Figure 3, to define a cylindrical bearing portion 11 adapted to receive a rotating shaft or the like to which the fan is secured.

A set screw 12 is threaded into the collar 10 radially thereof, and is provided with a polygonal recessed head opening for insertion of a suitable tool to thread the set screw with respect to the shaft to secure the fan in nonrotatable position upon the shaft. Extending upwardly from the collar 10 is the hub portion proper of the fan, indicated at 14, which has the integral fan blades indicated by the reference numerals 15 extending radially outwardly therefrom.

As shown in Figure 3, these blades are secured to the portion 14 of the hub by means of relatively small angularly extending tapered portions 16 of the blades, which produces a hub of relatively small area, and also reduces the quantity of metal necessary for the fan blades. The end of the portion 14 of the hub is preferably closed, as indicated at 17, although the opening 11 may extend entirely therethrough, if desired.

Referring now in detail to the fan blades, the particular curvature and pitch of these blades is shown in detail by the sectional views, Figures 4 to 8, inclusive.

In Figure 4, a section longitudinally of one of the blades is shown, and it will be noted that substantially the entire outer half of the blade, indicated by the reference numeral 20, is of the same curvature and pitch. Considering this figure, in connection with Figures 5 and 6, which are cross sectional views taken adjacent the outer tip of the blade and adjacent the transverse central portion thereof, it will be noted that the curvature of this portion 20 of the blade is substantially the same from the tip 21 thereof to the central portion or section indicated at 22 in Figures 2 and 4. The outer end of the blade is therefore of the same pitch and curvature throughout its entire section, as is also apparent from the perspective view of Figure 1, and thus may be easily manufactured at low cost. Also, the pitch of the blade, as indicated by the angle 23 in Figures 5 and 6, is the same throughout the entire outer half of the blade. The concavity of the outer half of the blade is indicated by the distance between the chord drawn across the peripheral edges of the blade, and the inner peripheral surface of the blade at the center, this distance being indicated by the numeral 24, in Figures 5 and 6. It is to be understood that this distance can be decreased to such an extent as to provide a substantially planar surface, if desired. It is thus apparent that all sections of the blade between the peripheral tip 21 and the central portion 22 thereof are substantially identical, and that the outer half of each of the blades is thus rendered uniform in pitch and curvature throughout its entire length.

The remainder of the blade, that is, the portion between the section 22, and the inner tapered end 16 is of scoop or bucket shape, as shown in detail in Figures 4, 7 and 8. From the point or section 22, which is approximately the transverse center of the blade, the blade is hollowed out, reaching its greatest concavity at a section approximately midway between the center 22 and the inner end 16 thereof, this section being indicated at 26 in Figure 4. A transverse section through this section 26 is indicated in Figure 7, and it will be noted that the pitch angle indicated at 27 is increased, so that the blade has a slightly warped effect at this point. This pitch angle continues to increase, and at a point indicated at 29, in Figures 2 and 3, the pitch angle has increased to an extent shown by the reference numeral 30.

In addition to this, it will be noted that at the point 26, the blade also has its greatest concavity in a transverse direction, as indicated by the distance 31 between the chord of the arc formed by the blade and the inner peripheral surface of the blade. It is thus apparent that from the section 22 to the section 16 of the blade, the blade is hollowed out, to give it a greater concavity, and at the same time is slightly warped to increase the pitch thereof. At the point 16, where the blade joins the fan, the pitch angle has increased to approximately 75 degrees, whereas the pitch angle at the outer tip portion 21 of the blade is approximately only 35 degrees, and remains at this angle until the section 22 is reached. From this point, there is a progressive increase of pitch, with a maximum increase in concavity at the section 26, and a decreasing concavity from there to the section 16.

It should also be noted that at the point 16, where the blade joins the hub, the blade is of relatively small lateral extent, as shown in Figures 1, 2 and 8. However, the metal has been thickened at this point to provide the necessary support and rigidity for the blade, but the surface adjacent the hub has been to a large extent eliminated by increasing the pitch angle and decreasing the lateral extent of the blade at the same time, there being a sharp taper from the section 26 to the section 16, as shown in Figures 1 and 2. The blade has its greatest lateral extent adjacent the section 26, which is the bottom or concave portion of the bucket-shaped inner half of the blade.

It will be apparent that the fan of the present invention is therefore composed of an outer portion, wherein the blade is of substantially constant curvature and constant pitch, which provides effective air propulsion from the surface thereof in an axial direction, and a bucket shaped inner portion of the blade, which provides for

effective air propulsion throughout the central portion of the fan eliminating any dead spots or suction effects being produced adjacent the hub of the fan and providing a fan in which stream line flow is more effectively attained than in devices of the prior art. Also, by decreasing the lateral extent of the fan as it joins the hub, and decreasing the diameter or surface of the hub, as shown, dead spots directly over the hub are avoided, and thus all of the fan blade delivery area is effected for propelling fluid or the like therethrough.

From an examination of Figures 5 to 8, inclusive, it will be apparent that the thickness of the blade progressively increases from the outer tip portion 21 to the point 16 where the blade is joined to the hub. This serves to provide the proper proportioning of the blade, and disposes the center of gravity at the hub, reducing the inertial movement of the fan, and less centrifugal force is produced.

While I am aware that many modifications and changes may be made in the structure herein disclosed, the invention is not to be limited to the exact details shown herein, as it is directed to the broad concept of incorporating two entirely distinct and different types of fan blades within a single blade in order to produce a greater propelling thrust from the surface of each blade, and to provide efficient air or fluid propulsion from all portions of the fan blade surfaces.

I therefore do not intend to be limited except as defined by the scope and spirit of the appended claims.

I claim:

1. A rotating fluid propeller having a plurality of blade members, the portions of said members having the higher peripheral speeds being of substantially constant pitch and uniform width, and the portions of said members having lower peripheral speeds being bucket-shaped.

2. A blade member extending radially from the hub of a rotatable fan and having an outer portion of substantially constant pitch and curvature extending from the blade tip to a point substantially midway between said tip and said hub, and having a bucket-shaped portion from said point to said hub.

3. A blade member for a rotatable fan having a portion of substantially constant pitch extending from the tip of said member to a point midway between the ends of said member, and having the remainder thereof of substantially progressively increasing pitch, the curvature of said remainder reaching a maximum intermediate its ends.

4. A blade member for a rotatable fan having substantially one-half of the length thereof of substantially constant pitch and curvature, and having the remainder thereof of constantly increasing pitch, said blade member increasing progressively in thickness throughout its entire length.

5. In combination, a blade member for a rotary impeller of the class described comprising an outer tip portion of constant pitch and curvature, said portion being of uniform width and extending inwardly to substantially the midpoint of the blade member, and an inner hub portion having a concaved scoop-shaped surface extending below the plane of said tip portion intermediate its ends.

6. A blade member for a rotary impeller extending radially outwardly from the hub thereof, comprising an outer portion extending from the tip of said member to a point midway between said tip and hub of substantially constant pitch and curvature and uniform breadth, and an inner portion of bucket-shape dipping below the level of said outer portion midway between said midpoint and said hub and extending upwardly above the level of said portion at said hub.

HERMAN C. HUEGLIN.