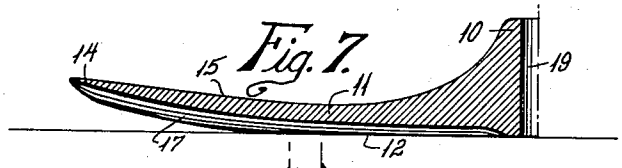
March 19, 1935. C. A. STILPHEN 1,995,193

PROPELLER FAN

Filed Aug. 5, 1933

Fig. 7.



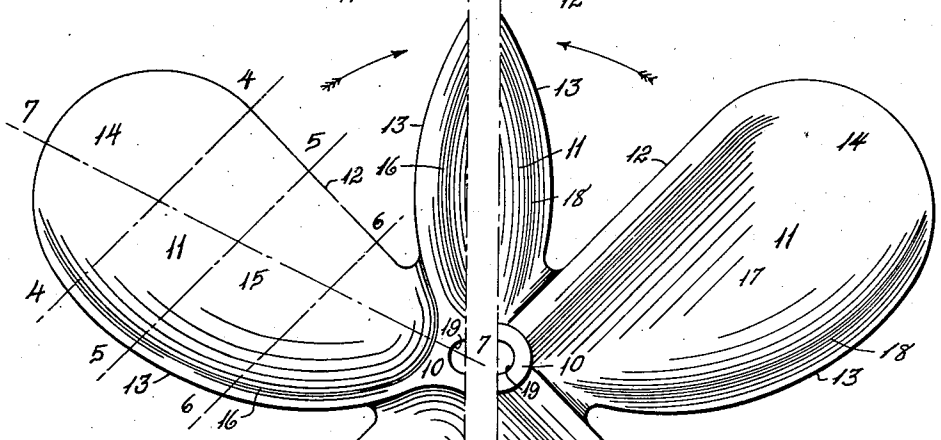


Fig. 1.

Fig. 2.

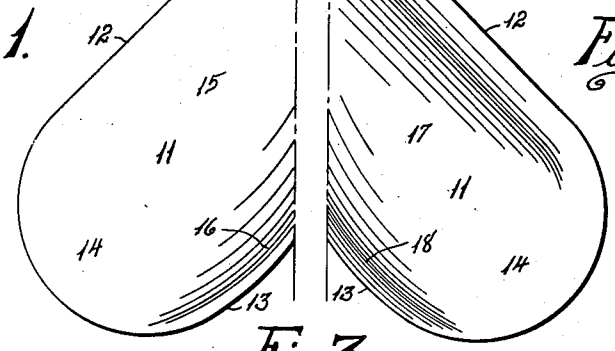


Fig. 3.

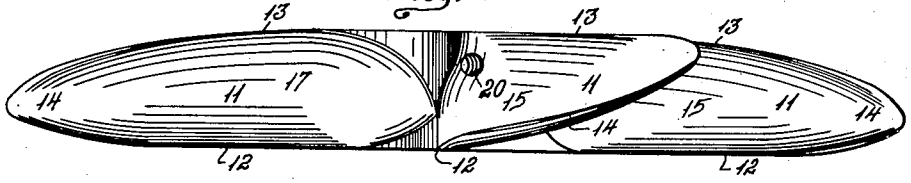


Fig. 4.

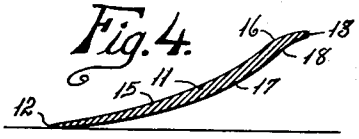


Fig. 6.

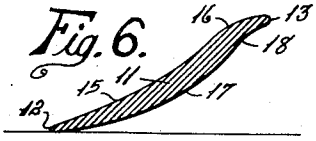
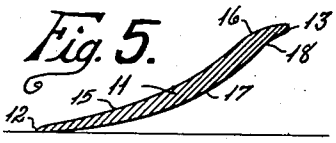


Fig. 5.



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UNITED STATES PATENT OFFICE

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PROPELLER FAN

Charles A. Stilphen, Denver, Colo.

Application August 5, 1933, Serial No. 683,768

9 Claims. (Cl. 170—159)

An object of this invention is to provide an improved propeller type fan.

A further object of the invention is to provide an improved propeller type fan which is substantially noiseless in operation.

A further object of the invention is to provide an improved propeller type fan susceptible of substantially noiseless operation at relatively high speeds.

A further object of the invention is to provide an improved propeller type fan which is particularly efficient in establishing and maintaining directed air circulation.

A further object of the invention is to provide an improved propeller type fan operable to establish and maintain non-whirling, directed air currents of well-defined cross-sectional area, which air currents are substantially uniform in pressure and intensity throughout a given cross-sectional area and of relatively high velocity in proportion to the speed of rotation of the fan element.

A further object of the invention is to provide an improved propeller type fan susceptible of efficient operation as either a blower or exhaust fan.

A further object of the invention is to provide an improved propeller type fan of rigid, integral construction which is susceptible of accurate static and dynamic balancing.

A further object of the invention is to provide an improved conformation of blade in a propeller type fan, whereby enhanced efficiency and noiseless operation may be attained.

My invention consists in the construction, conformation, arrangement and combination of elements hereinafter set forth, pointed out in my claims and illustrated by the accompanying drawing, in which—

Figure 1 is a half elevation of the front or blower face of my improved fan, the direction of rotation being as indicated by the arrow. Figure 2 is a half elevation of the rear or exhaust face of my improved fan. Figure 3 is an edge view of the complete fan assembly. Figure 4 is a cross section taken through one of the fan blades on the indicated line 4—4 of Figure 1. Figure 5 is a cross section similar to Figure 4 taken on the indicated line 5—5 of Figure 1. Figure 6 is a cross section similar to Figure 4 taken on the indicated line 6—6 of Figure 1. Figure 7 is a section radially of one of the fan blades on the indicated line 7—7 of Figure 1.

In the drawing my invention is illustrated as comprising a hub portion 10 formed integrally with and uniting four radially-disposed, equally-spaced, identical blades 11. It is of course obvious tht the number of blades 11 in a given fan may be varied to meet the conditions for which the fan is designed and that the principles of my invention may be applied to any and all multi-blade fans irrespective of the number of their blades, but experience has indicated that practical considerations can best be met and most efficient operation had through the use of the four blade design, save in certain specific installations wherein peculiar conditions are found. More than four blades grouped about one hub results in undesirably close spacing of the blades and consequent reduction of dynamic efficiency, while fewer than four blades fail to bring about maximum air movement in proportion to the power input.

Since the blades 11 are identical in every respect, but one of said blades will be specifically described. Certain proportions inherent in my blade design have been found to be productive of maximum efficiency regardless of the size of the fan and serve as a facile guide in the design and construction of a given fan; these proportions are not, however, immutable, and may be successfully varied within reasonable limits, it being preferred that the blade length be twice the maximum blade width and that the pitch of the blade, or the distance between leading and trailing edges of the blade measured perpendicular to the plane of rotation, be one-half the maximum blade width. Each blade 11 is of modified oval form in elevation, tapering from its wider outer end to a narrower inner end to present a substantially obovate outline, and has a leading or entering edge 12 coplanar with the rear face of the hub 10, which edge 12 is relatively thin, straight so long as it lies in the plane of the rear hub face and disposed parallel with and slightly in advance in the direction of rotation of a radius from the hub center. The rear or trailing edge 13 of each blade 11 is coplanar with the front face of the hub 10 throughout the greater portion of its length and is projected from the center of said hub in a smooth parabolic curve, diverging from the leading edge 12, until the maximum blade width has been attained, whereafter said trailing edge is curved forwardly and downwardly toward said leading edge to meet in a smooth curve with the upwardly and rearwardly curving leading edge, the length of the blade thus being defined by a smoothly curved end or tip 14. The maximum width of the blade is attained some two-thirds of the blade length radially from the hub center and the converging of the leading and trailing edges begins approximately at the line of

greatest width. The front and rear faces of the blade outlined as above described are not plane, but present, in each section perpendicular to the leading edge, similar, reversely-curved outlines diverging from the leading edge for a space and curring into convergence at the trailing edge. The front face 15 of the blade curves in section in a smooth parabolic line from the leading edge 12 toward the trailing edge 13 until it has traversed some four-fifths of the space between said edges, whereupon the curve is smoothly reversed, as indicated at 16, to merge with the said trailing edge in the plane of rotation of the latter. The curve of the rear face 17 of the blade is similar at each section to that of the front face 16, but has different constants, so that the blade body is thickened somewhat intermediate its edges, a curved depression 18 in the rear face 17 and following the trailing edge 13 complementing the curved ridge 16 of the front face 15. Radially of the blade 11 the front and rear faces are not plane, but present in section smooth parabolas of differing constants, as is clearly shown in Figure 7, said parabolic curves being so arranged as to converge to the tip edge of the blade and diverge as the blade merges into the hub. In radial section the blade does not lies in any one plane of rotation, but is so arranged as to permit the outer end of the tip portion 14 to rotate in a plane slightly in advance of that wherein the midportion of the blade rotates; in other words, the blade front face is cupped somewhat longitudinally, as well as laterally, which has the effect of minimizing eddies formed in the slip at the tip of the blade and directing air currents generated by said blade tip at an angle toward the axis of the composite current developed by the fan, thus intensifying the pressure and velocity in the peripheral portion of the generated current and more clearly defining the limits thereof. The edges of the blade 11 are all smoothly formed to streamline contour and all meeting edges of adjacent blades are smoothly curved to the end that eddy-forming angles and planes may be eliminated in the interest of quiet and efficient functioning of the fan. The fan may be independently mounted and operatively connected with a source of power in any desired manner, but the preferred installation is direct mounting on the shaft of an electric motor or other prime mover, in which event the hub 10 may be provided with an axial bore 19 adapted to receive the driven shaft to which said hub may be secured in any suitable manner, threaded holes 20 radially of said hub and intersecting said bore providing seats for set screws whereby the fan and shaft may be conveniently interlocked.

The fan hereinbefore described may be formed of any suitable metal, light metal alloys naturally being preferred, in a single moulding or casting operation, identity of blade curves and blade spacings assuring dynamic balance and static balance being readily had by slight removals of excess metal where indicated on test. Proper dynamic and static balance entirely eliminate noises deriving from vibration in operation and the smooth curves of the blade sections minimize the formation of air eddies, thereby enhancing quiet operation of the fan. Due to the small angle between the entering portion of the blade and the plane of its rotation, the coplanar relation between the trailing edge of the blade and its plane of rotation and the contour of the surface connecting the blade edges, the air acted upon by the blade is moved axially forward with a minimum of disturbance and receives a minimum of rotary impulse, so that the velocity of the generated air current is substantially rectilinear and unimpaired by whirls and eddies.

Since modifications and changes in the specific form, proportion, construction and arrangement of the elements shown and described may be had without departing from the principle and spirit of the invention, I wish to be understood as being limited solely by the scope of the appended claims rather than by any details of the illustrative showing and foregoing description.

I claim as my invention—

1. A propeller type fan comprising a hub, a plurality of blades integral with, radially of and spaced equally about said hub, each of said blades being substantially obovate in plan and arranged with its leading edge coplanar with one end of said hub and its trailing edge coplanar with the other end of said hub, and means for mounting said hub on and in axial alinement with a driven shaft.

2. A propeller type fan comprising a hub arranged for mounting on and in axial alinement with a driven shaft, a plurality of blades integral and in angular relation with, radially of and spaced equally about said hub, each of said blades being substantially obovate in plan and formed with a straight leading edge perpendicular to the axis of said hub and advanced in the direction of its rotation from its parallel radius.

3. A propeller type fan comprising a hub arranged for mounting on and in axial alinement with a driven shaft and, a plurality of identical, substantially obovate blades integral with and radiating in equally spaced relation from said hub, the leading and trailing edges of said blades lying in spaced, parallel planes perpendicular to the axis of said hub.

4. A propeller type fan comprising a hub arranged for mounting on and in axial alinement with a driven shaft and a plurality of identical, substantially obovate blades integral with and radiating in equally spaced relation from said hub and arranged with leading and trailing edges lying in spaced, parallel planes perpendicular to the axis of said hub, each of said blades having a maximum width approximately one-half of its length and a pitch distance approximately one-half of said maximum width.

5. A propeller type fan comprising a hub arranged for mounting on and in axial alinement with a driven shaft and a plurality of identical, substantially obovate blades integral with and radiating in equally spaced relation from said hub, each of said blades having a leading and a trailing edge lying in spaced, parallel planes perpendicular to the axis of said hub and spaced, parabolic surfaces smoothly reversely curved to converge at and interconnect said edges.

6. A propeller type fan comprising a hub arranged for mounting on and in axial alinement with a driven shaft and a plurality of identical, substantially obovate blades integral with and radiating in equally spaced relation from said hub, each of said blades having a leading and a trailing edge lying in spaced, parallel planes perpendicular to the axis of said hub and a concave effective surface curved longitudinally and transversely of said blade to parabolas of different constants interconnecting said edges.

7. A propeller type fan comprising a hub arranged for mounting on and in axial alinement

with a driven shaft and a plurality of identical, substantially obovate blades integral with and radiating in equally spaced relation from said hub, each of said blades having a leading and a trailing edge lying in spaced, parallel planes perpendicular to the axis of said hub and a concave effective surface curved longitudinally and transversely of said blade to parabolas of different constants interconnecting said edges, said concave surface being reversely-curved adjacent said trailing edge to merge therewith tangent to its plane of rotation.

8. A propeller type fan comprising a hub arranged for mounting on and in axial alinement with a driven shaft and a plurality of identical, substantially obovate blades integral with and radiating in equally spaced relation from said hub, each of said blades having a leading and a trailing edge lying in spaced, parallel planes perpendicular to the axis of said hub and spaced, similar, concave and convex surfaces curved longitudinally and laterally of said blade to converge along the margin of said blade and interconnect said edges.

9. A propeller type fan comprising a hub arranged for mounting on and in axial alinement with a driven shaft and a plurality of identical, substantially obovate blades integral with and radiating in equally spaced relation from said hub, each of said blades having a leading and a trailing edge lying in spaced, parallel planes perpendicular to the axis of said hub and spaced, similar, concave and convex surfaces curved longitudinally and laterally of said blade to converge along the margin of said blade and interconnect said edges, said surfaces being reversely-curved adjacent said trailing edge to merge therewith tangentially of its plane of rotation.

CHARLES A. STILPHEN.