

Aug. 9, 1938.

E. L. ANDERSON

2,126,599

FAN

Filed April 13, 1936

4 Sheets-Sheet 1

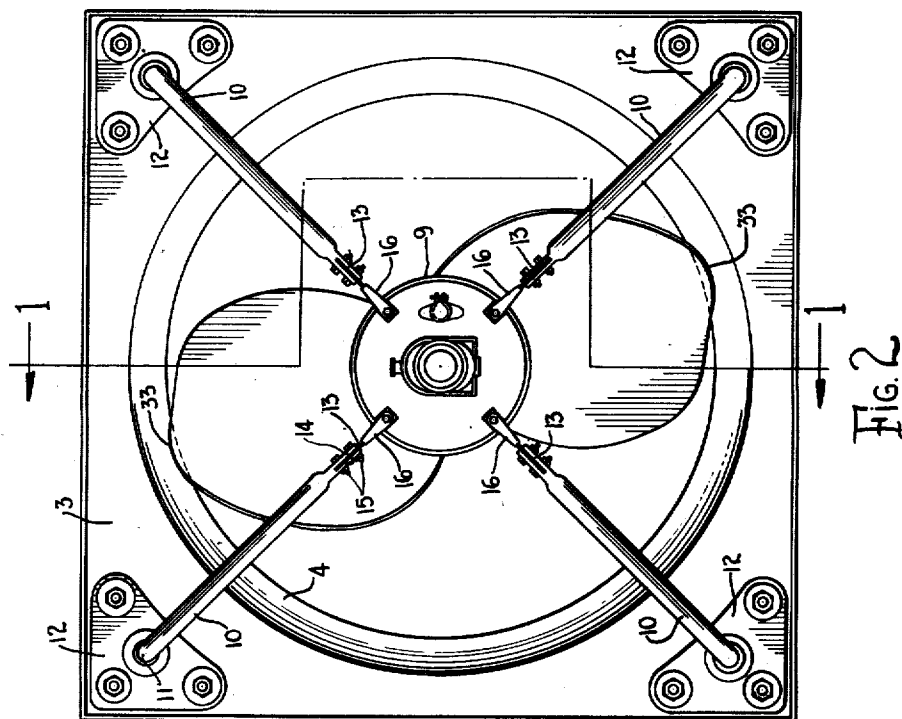


Fig. 2

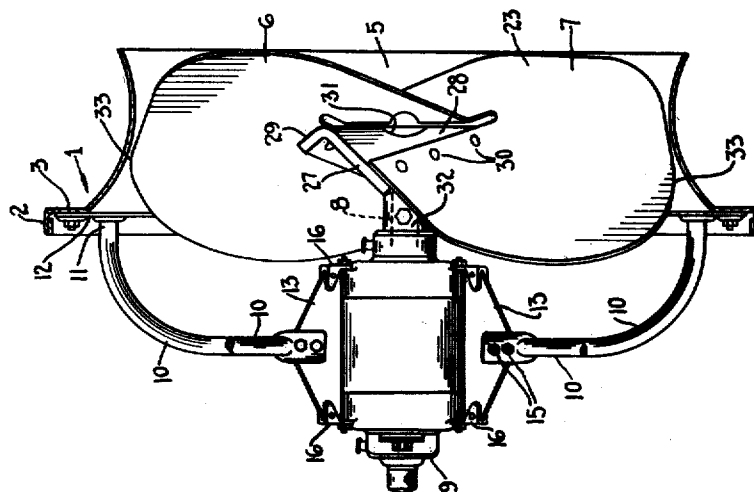


Fig. 1

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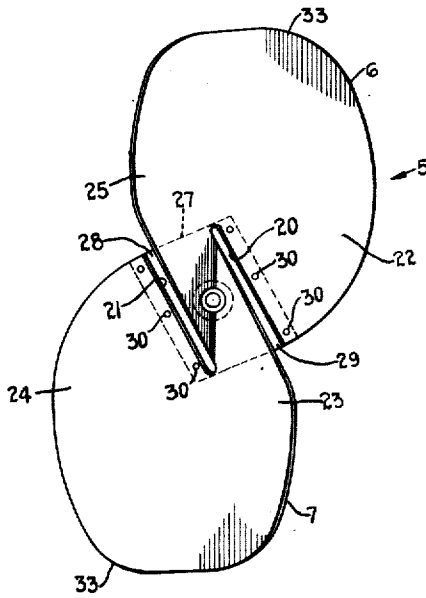


FIG. 3

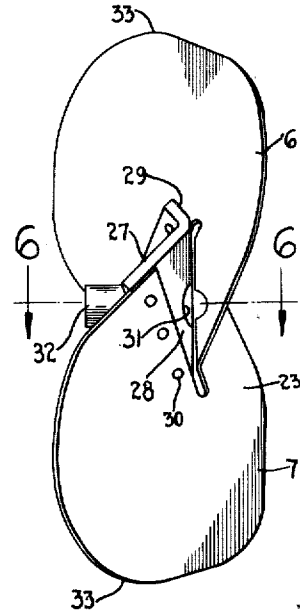


FIG. 4

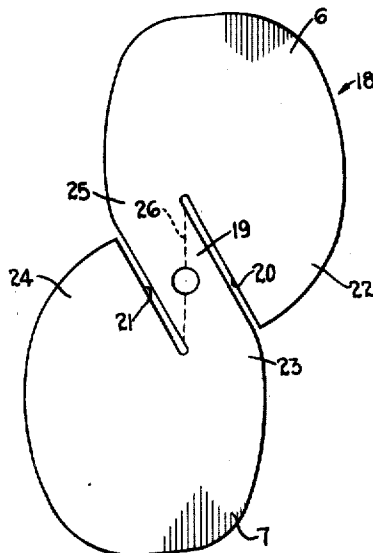


FIG. 7

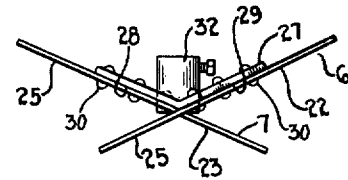


FIG. 5

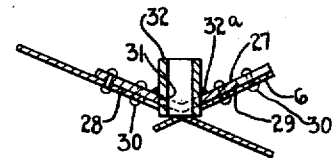


FIG. 6

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4 Sheets-Sheet 3

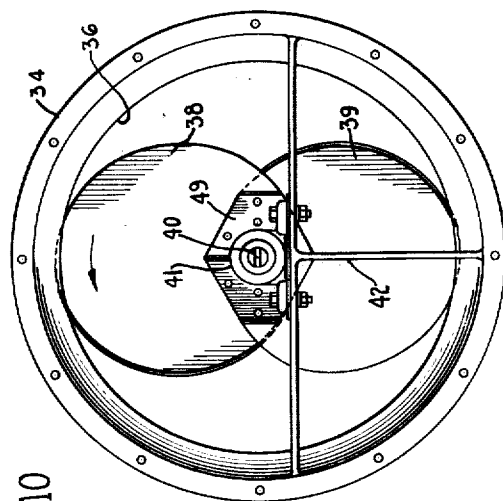


FIG. 9

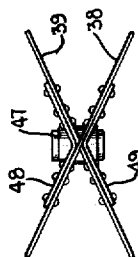


FIG. 10

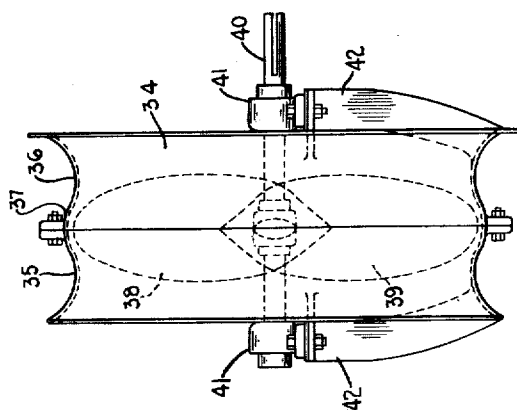


FIG. 8

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4 Sheets-Sheet 4

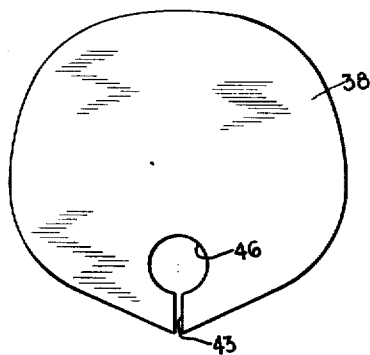


Fig. 11

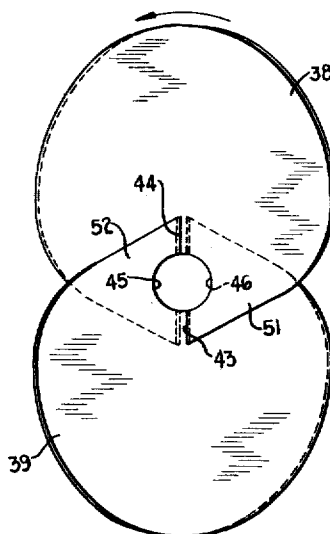


Fig. 12

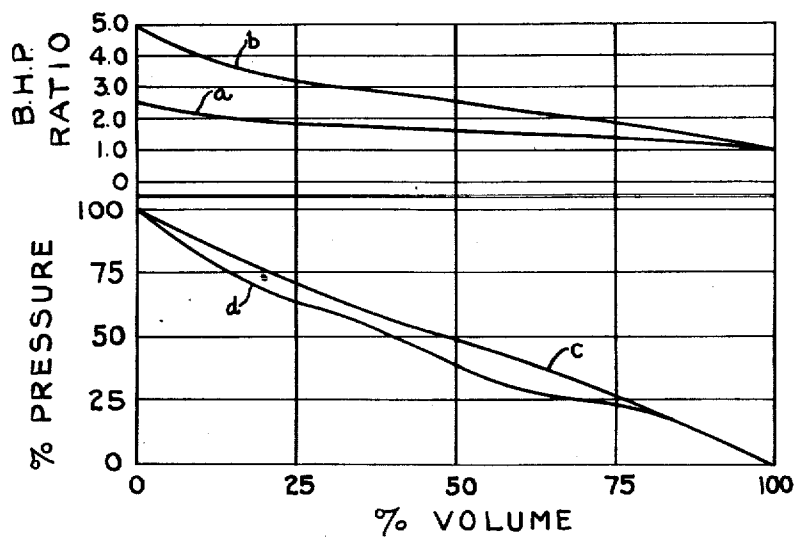


Fig. 14

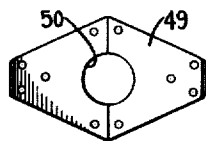


Fig. 13

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UNITED STATES PATENT OFFICE

2,126,599

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Application April 13, 1936, Serial No. 74,119

17 Claims. (Cl. 170-159)

My invention relates to new and useful improvements in fans, and more particularly to a fan of the disk or propeller type having radially extending blades.

5 An object of my invention is to provide a fan of novel construction which will operate with a high degree of efficiency and which can be manufactured at low cost.

10 Another object is to eliminate the occurrence of back suction between the fan blades and the fan ring so as to materially increase the range of air volumes which can be efficiently handled by the fan.

15 Another object is to provide a fan having an exceedingly low noise pitch.

Another object is to provide a fan in which the blades may be formed from a single blank of sheet material.

20 Another object is to provide a fan in which the direction of the discharging air may be reversed by reversal of rotation of the fan blades without impairing the efficiency of the fan.

25 The invention consists in the novel construction of the fan, the method of constructing the same and the cooperative relation between the fan blades and the fan ring, to be more fully described hereinafter and the novelty of which will be particularly pointed out and distinctly claimed.

30 In the accompanying drawings, to be taken as a part of this specification, I have fully and clearly illustrated certain fan structures embodying my invention, in which drawings—

35 Figure 1 is a view in vertical section through the fan ring or housing, taken on the line 1-1 of Fig. 2 and showing the fan proper in side elevation;

Fig. 2 is a view in elevation, looking from left to right facing Fig. 1;

40 Fig. 3 is a view in front elevation of the fan proper removed from the fan ring;

Fig. 4 is a view in side elevation of the fan proper, looking from left to right of Fig. 3;

Fig. 5 is a top plan view of the fan proper;

45 Fig. 6 is a view in horizontal section on the line 6-6 of Fig. 4;

Fig. 7 is a view in front elevation of a sheet material blank from which the fan proper is formed;

50 Fig. 8 is a view in side elevation of a fan housing containing a reversible type fan;

Fig. 9 is a view in end or front elevation, looking from right to left facing Fig. 8;

55 Fig. 10 is a top plan view of the fan proper of Figs. 8 and 9;

Fig. 11 is a view in front elevation of a fan blade forming a part of the fan of Fig. 10;

Fig. 12 is a view in front elevation showing two of the blades of Fig. 11 in cooperative relation;

Fig. 13 is a detail view of a pad or supporting member for securing the blades of Fig. 12 in fixed position, and

Fig. 14 is a chart showing graphically the characteristics of the fans of Figs. 1 and 8.

Referring to the drawings, Figs. 1 to 7, by characters of reference, the numeral 1 designates a fan housing preferably of sheet metal and of rectangular external contour having a marginal surrounding flange 2 which serves to reenforce the orifice plate 3. Extending from the inner periphery of the plate 3 in a direction opposite to flange 2 and in the direction of air flow, there is a fan ring or shroud 4 of converging-diverging form defining the fan orifice and having its inlet end of greater internal diameter than its outlet end. Positioned in the orifice, there is a fan proper 5 having radially and oppositely extending blades 6, 7 and which is mounted on the shaft 8 of the driving motor 9 which is supported by the housing 1. The motor is held in concentric relation to the ring 4 by radially extending supporting arms 10, preferably four in number and spaced equally about the motor shaft. Each of these arms is rigidly fixed at one end, as at 11, to a supporting pad or reinforcing plate 12 which is rigidly secured as by bolts or in other suitable manner to the corner portions of the plate 3 on the inlet side of the fan housing. The arms 10 are bent or curved so that their motor supporting ends lie in a common plane spaced from the inlet face of and parallel to the plane of the plate 3. The motor supporting ends of the arms 10 are flattened and bifurcated to provide end slots in planes radial to the motor shaft. Positioned in these slots and rigidly secured to the arms are resilient supporting plates 13. The plates 13 are rigidly clamped midway between their ends in the end slots 14 of the arms 10 by bolts 15. The opposite ends of the plates 13 are received by fastening members 16 which are rigidly secured to the opposite end faces of the motor 9. It will thus be seen that the motor 9 is rigidly held against movement radially or longitudinally of its shaft while being permitted a limited oscillatory movement about its shaft due to the resiliency of the plates 13.

The fan proper is formed from a single blank of sheet material as shown in Fig. 7 which is of 55

a substantially figure of eight external contour and having a portion of its midsection defining the hub portion which interconnects the blades. The blank, generally indicated by the numeral 18, has the side edges of the hub portion 19 defined by oppositely extending parallel slots 20, 21 which extend or open from opposite side edges of the blank such that the hub portion comprises an inclined neck joining the fan blades.

The slot 20 separates the leading edge portion 22 of blade 6 from the trailing edge portion 23 of blade 7, the slot 21 separating the leading edge portion 24 of blade 7 from the trailing edge portion 25 of blade 6. The blades 6, 7 are offset so that the width of the leading edge portions is greater than the width of the trailing edge portions. The leading portions are preferably substantially twice as wide as the trailing portions. The blades 6 and 7 or preferably one of them is moved out of the common plane of the blank so that the blades are positioned in planes transverse to each other. This is accomplished by bending the blank sharply along a straight line, indicated by the dotted line 26, which passes through the midpoint of the blank and joins the end portions of the slots 20, 21 so that the hub portions or neck 19 will be V-shaped in cross-section normal to the line of the bend 26. The blank having been thus bent, it is rigidly secured to a hub supporting member or pad 27 which is also bent or formed of V-shaped cross-section having inclined converging supporting faces 28, 29, with the angle formed by these faces being the angle formed between the trailing edge portions 23, 25. With the line of the bend 26 on the inlet side of the fan in opposed relation to and aligned with the meeting edge of the supporting faces 28, 29 of pad 27, the faces 28, 29 will be in abutting and overlapping relation to the inlet side of the leading edge portions 22, 24 respectively at the edges of slots 21, 20. The leading edge portions 22, 24 are rigidly secured by rivets or the like 30 to the pad faces 29, 28 respectively. The pad 27 has a central aperture 31 to receive a hub or sleeve 32 for securing the fan proper on the motor shaft 3. The hub 32 is preferably rigidly secured to the supporting plate 27 by welding, as at 32^a. The flat blades 6, 7 are thus rigidly connected to each other by their trailing edge portions 23, 25 which overlap longitudinally along the line 26, and by the plate 27 which reinforces and rigidly joins the leading edge portions 22, 24. The leading and trailing edge portions of each of the blades extend beyond the midpoint or axis of rotation of the fan proper and into the area at the hub portion of the opposite blade so as to provide a maximum blade surface for air movement. The leading edge portion of each blade is also preferably of greater radial length than its respective trailing edge portion so that the blades will cooperate with the fan ring to overcome back suction. The radial length of the blades on the line of the bend 26 which is in the plane normal to the axis of rotation separating the leading and trailing edge portions of each blade, is slightly less than the minimum internal diameter or the throat diameter of the ring 4 so that the tips 33 of the leading edge portions of the blades act to discharge air against the converging inlet side of the fan ring 4. The trailing edge portions 23 and 25 extend through the plane of minimum diameter of the ring 4 so that the blades can exert a maximum effort on the air stream. The portion of the plate 3 which extends around the

orifice and at right angles thereto serves to guide the air stream entering the orifice to maintain the lines of flow at the least angle of approach to the blades and to provide approximately uniform velocity.

Referring to Figs. 8 to 13 inclusive, the casing or housing 34 is of uniform internal contour with spaced, inwardly converging, annular portions 35, 36 forming spaced throats with an internal, outwardly concave portion 37 forming a channel to receive the fan proper. Positioned within the housing 34, there is a fan comprising the blades 38, 39 which are mounted on a driving shaft 40 supported in bearings 41 carried by frame members 42. The diameter of the fan between the tips of blades 38 and 39 is greater than the internal diameter of the throats 35 and 36 so that on rotation of the blades in either direction, air will be forced against the converging inlet side or surface of either the throat 35 or the throat 36, whichever is on the outlet side of the fan blades and thereby prevent back suction between the blade tips and the fan ring or housing. The blades 38 and 39 are similar in external contour and one of the blades is shown in flat or plan in Fig. 11. The leading and trailing portions of the blades are made symmetrical and of equal surface area so that the fan is reversible and can be rotated in either direction without change in efficiency of operation. Each of the blades is slotted from its hub edge on a line joining the blade tips or separating the leading and trailing edge portions, blade 38 being slotted at 43 and the blade 39 being slotted at 44 so that the blades can be interfitted in overlapping relation. The slot 44 opens into a circular aperture 45 and slot 43 opens into a circular aperture 46, the apertures being in registry and receiving a sleeve or hub 47 which locks the blades with their hub portions in overlapping intersecting relation. The blades 38 and 39 are rigidly fixed relative to each other by oppositely positioned, supporting pads or plates 48, 49 of which one is shown in detail in Fig. 13. These pads are bent or formed with inclined or converging supporting faces which determine the angle between the leading edge portions or the trailing edge portions of the blades. The pads 48 and 49 are apertured, as at 50, to receive the hub 47 and assuming the direction of rotation of the fan to be counter-clockwise or in the direction of the arrow, Figs. 9 and 12, the pad 48 is rigidly secured to and connects the leading edge portions of the blades and the pad 49 is rigidly secured to and connects the trailing edge portions of the blades. It will be noted that the blades 38, 39 have trailing edge portions 51, 52 respectively which form a part of the hub portion and which intersect each other; the portions extending beyond the axis of rotation of the fan and terminating within the surface area of the opposite blade.

In Fig. 14, the curve *a* shows the power consumed in the movement of air by my fan as compared to the power to move the same volume of air by fans now on the market, as indicated by curve *b*. Curve *c* shows graphically the relation of volume of air discharged relative to pressure by my fan as compared in curve *d* to the volume pressure characteristic of standard fans now on the market. From the curve *c*, it will be noted that my fan is capable of efficient operation over the full range of air displacement whereas standard fans as shown by curve *d* have a limited range of efficient operation and that the volumetric displacement falls off consider-

ably as the pressure against which they operate is increased.

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

1. A fan comprising a pair of blades positioned in intersecting planes, each of said blades having a hub portion forming a portion of its trailing edge portion, said hub portions conveying to a line separating the leading and trailing portions of said blades and having intersecting overlapping relation with each other, and a supporting member having converging supporting faces secured to said blades, said faces and said hub portions having converging-diverging relation and meeting substantially in said line.

2. A fan comprising a pair of flat sheet metal blades positioned in intersecting planes, each of said blades having a hub portion forming a portion of its trailing edge portion, said hub portions being inclined to each other and having intersecting overlapping relation with each other, part of the leading edge portion of each blade being separated from the trailing edge hub portion of the other blade, and a hub supporting member rigidly secured to and joining said parts of the leading edge portions of said blades.

3. A propeller fan comprising a pair of blades, a hub portion interconnecting and defining part of the trailing edge portion of each of said blades, said hub portion being bent to form a V-shaped trough having its ends extending on opposite sides of the center of rotation and longitudinally of said blades with the line of the bend separating the leading and trailing portions of the blades.

4. A fan comprising a pair of blades, one of said blades being slotted at its hub portion to receive the hub portion of the other blade, and a supporting member having converging supporting faces inclined to the axis of rotation, each of said faces receiving one of said blades and holding said blades transverse to each other.

5. A fan comprising a pair of blades, each of said blades having a longitudinal slot at its hub portion to receive the other of said blades, said slots each opening into a hub member receiving aperture, a hub member extending through said apertures and holding said blades in interlocked relation, and a V-shaped supporting member secured to said hub member and having inclined flat blade receiving faces extending from the hub member, one face being secured to one blade and the other face being secured to the other blade whereby to hold said blades rigidly in transverse relation.

6. A sheet material blank for a propeller fan comprising a pair of blades having an intermediate hub portion, said hub portion forming part of and interconnecting the trailing edge portions of said blades, a part of the leading edge portion of each blade being separated from a part of the trailing edge portion of the other blade by a slot, said slots defining the side edges of said hub portion, and a fan supporting member joining together the slot edges of the leading blade portions.

7. A new article of manufacture comprising a one-piece propeller fan of sheet material having oppositely extending offset blades interconnected by a neck portion bent along a longitudinal line separating the leading and trailing portions of said blades whereby said blades are positioned in intersecting planes, and a pad member having oppositely inclined faces forming with said neck portion converging-diverging surfaces, the faces

of said pad member being spaced from said neck portion and rigidly secured respectively to the leading portions of said blades.

8. A propeller fan having oppositely extending blades formed from a blank of sheet material, the blank having parallel slots extending inward from the opposite side edges of the blank and to a longitudinal line separating the leading and trailing portions of each of the blades, the blank being bent along said line between said slots so that the blades are in intersecting planes.

9. A propeller fan having oppositely extending blades formed from a blank of sheet material, the blank having parallel slots extending inward from the opposite side edges of the blank and to a longitudinal line separating the leading and trailing portions of each of the blades, the blank being bent along said line between said slots so that the blades are in intersecting planes, and a supporting member reenforcing the leading portions along said slots and joining the leading portions together.

10. A propeller fan having oppositely extending blades formed from a blank of sheet material, the blank having parallel slots extending inward from the opposite side edges of the blank and to a longitudinal line separating the leading and trailing portions of each of the blades, the blank being bent along said line between said slots so that the blades are in intersecting planes, and a supporting member reenforcing the leading portions along said slots and joining the leading portions together, said supporting member forming a continuation of each leading portion from its slot edge to the fan hub.

11. A fan comprising a pair of blades positioned in intersecting planes, each of said blades having a hub portion forming a portion of its trailing edge portion, said hub portions converging to a line separating the leading and trailing portions of said blades and having intersecting longitudinally overlapping relation with each other, and a supporting member having converging supporting faces secured to said blades, said supporting faces and said hub portions having converging-diverging relation.

12. A fan comprising a pair of blades positioned in intersecting planes, each of said blades having a hub portion forming a portion of its trailing edge portion, said hub portions converging to a line separating the leading and trailing portions of said blades and having intersecting longitudinally overlapping relation with each other, and a supporting member having converging supporting faces secured to said blades, said supporting faces and said hub portions having converging-diverging relation, the leading portion and the trailing portion of each of said blades being of substantially equal surface area.

13. A fan comprising a pair of blades positioned in intersecting planes, each of said blades having a hub portion forming a portion of its trailing edge portion, said hub portions converging to a line separating the leading and trailing portions of said blades and having intersecting longitudinally overlapping relation with each other, and a supporting member having converging supporting faces secured to said blades, said supporting faces and said hub portions having converging-diverging relation, the leading portion of each blade having substantially twice the surface area of its trailing portion.

14. A propeller fan comprising a pair of blades, a hub portion interconnecting and defining part of the trailing edge portion of each of said

blades, said hub portion having converging sides defining a V-shaped trough having its ends extending on opposite sides of the center of rotation and longitudinally of said blades with the junction line of the converging sides separating the leading and trailing portions of the blades.

15. A fan comprising a pair of blades, each of said blades having a longitudinal slot at its hub portion to receive the other of said blades, said slots each opening into a hub member receiving aperture, a hub member extending through said apertures and holding said blades in interlocked relation, and a V-shaped supporting member secured to said hub member and having inclined flat blade receiving faces extending from the hub member, one face being secured to the leading edge of one blade and the other face being secured to the leading edge of the other blade whereby to hold said blades rigidly in transverse relation.

16. A sheet material blank for a propeller fan comprising a flat plane surface of substantially

figure-of-eight peripheral contour defining blades, said blank being slotted along substantially parallel lines embracing the midpoint of said blank, said slots each extending from the edge of said blank to a line extending longitudinally of said blades and separating the leading and the trailing portions of said blades.

17. A sheet material blank for a propeller fan comprising a flat plane surface of substantially figure-of-eight peripheral contour defining blades, said blank being slotted along substantially parallel lines embracing the midpoint of said blank, said slots each extending from the edge of said blank to a line extending longitudinally of said blades and separating the leading and the trailing portions of said blades, said last-named line dividing said blades such that each leading blade portion will have substantially twice the surface area of each trailing blade portion.

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CERTIFICATE OF CORRECTION.

Patent No. 2,126,599.

August 9, 1938.

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It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, first column, line 27, for the word "portions" read portion; page 3, first column, line 8, claim 1, for "conveying" read converging; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 27th day of September, A. D. 1938.

Henry Van Arsdale

(Seal)

Acting Commissioner of Patents.

blades, said hub portion having converging sides defining a V-shaped trough having its ends extending on opposite sides of the center of rotation and longitudinally of said blades with the junction line of the converging sides separating the leading and trailing portions of the blades.

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17. A sheet material blank for a propeller fan comprising a flat plane surface of substantially figure-of-eight peripheral contour defining blades, said blank being slotted along substantially parallel lines embracing the midpoint of said blank, said slots each extending from the edge of said blank to a line extending longitudinally of said blades and separating the leading and the trailing portions of said blades, said last-named line dividing said blades such that each leading blade portion will have substantially twice the surface area of each trailing blade portion.

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