April 11, 1939. K. D. McMAHAN 2,154,313

DIRECTING VANE

Filed April 1, 1938

Fig. 2.

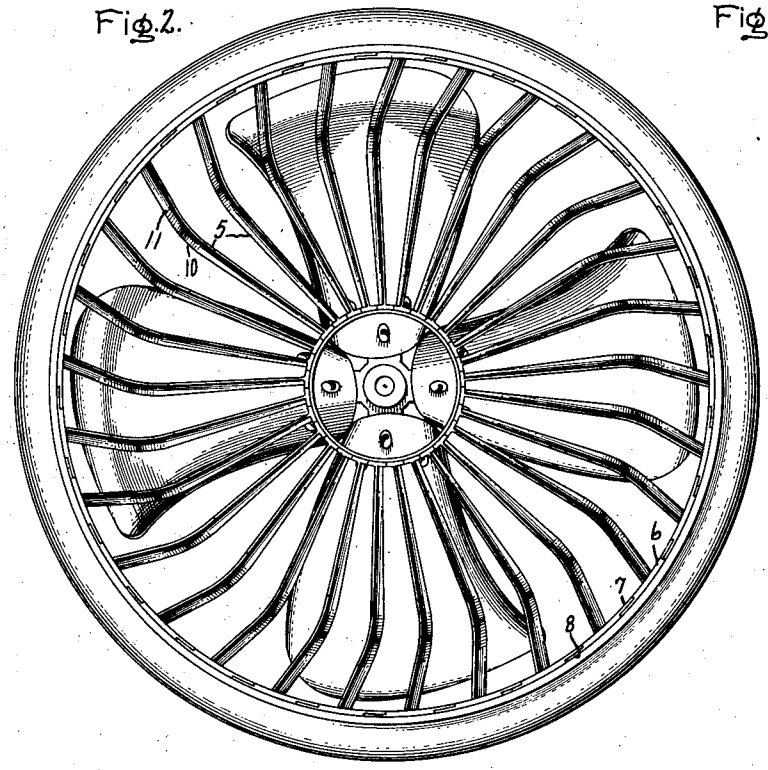


Fig. 1.

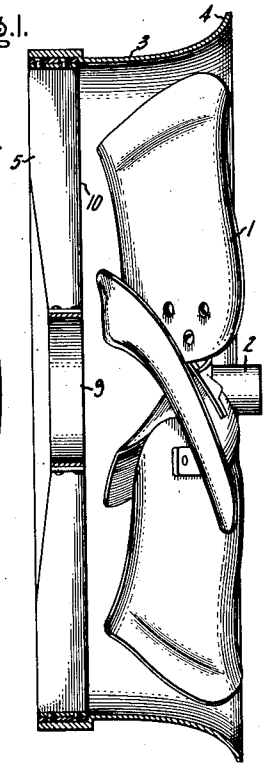


Fig. 3

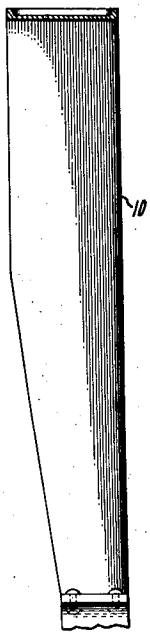


Fig. 4.

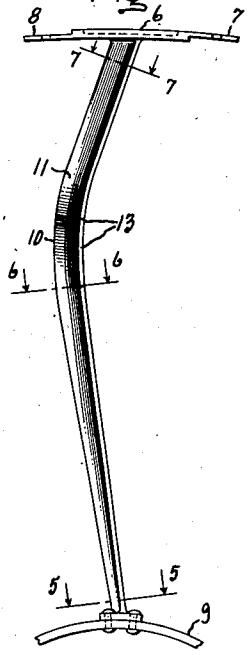


Fig. 7.

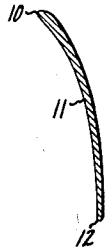


Fig. 6.

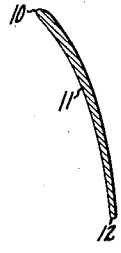
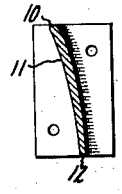


Fig. 5.



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His Attorney.

Patented Apr. 11, 1939

2,154,313

UNITED STATES PATENT OFFICE

2,154,313

DIRECTING VANE

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Application April 1, 1938, Serial No. 199,461

8 Claims. (Cl. 230—274)

The present invention relates to directing vanes for directing the air stream from propeller fans and the like.

The air stream moved by propeller fans is in the form of an axially moving column of air which has a velocity distribution in an axial direction which is a minimum at the center and increases to a maximum or peak velocity at a point near the outer surface. From this point the velocity decreases to substantially zero at the outer surface of the air column. In addition to the axial velocity the air column also has a rotational component produced by the fan blades.

For some purposes, for example when the air column is directed through a heat exchanger, it is desirable that the rotational component of the air be removed. It is also desirable that the variation in the velocity distribution be decreased.

The object of my invention is to provide an improved construction in directing vanes which will convert the rotational component of an axially moving column of air to an axial component in such a manner as to decrease the variation in velocity distribution.

In the accompanying drawing, Figure 1 is a sectional end elevation of a propeller fan equipped with directing vanes embodying my invention; Fig. 2 is a front elevation of the directing vanes; Fig. 3 is a side elevation of one of the vanes; Fig. 4 is an edge elevation of one of the vanes; Figs. 5, 6 and 7 are sectional views taken on lines 5—5, 6—6 and 7—7 of Fig. 4.

Referring to the drawing, there is shown a propeller fan having blades 1 of the construction shown in my Patent No. 1,964,525, issued June 26, 1934. The blades are attached to a hub 2 which is rotated in a clockwise direction, as viewed in Fig. 2 by suitable means (not shown). The fan blades are within a cylindrical housing 3 having an outwardly flaring rear edge 4 which provides an intake orifice for guiding the air to the fan blades. Within the front edge of the casing 3 are radially extending vanes 5. The outer edges of the vanes are fixed to segmental plates 6 having forward edges 7 extending over and riveted to the rear edge 8 of the succeeding segment. When assembled, the segmental sections 6 provide a ring which is secured to the inner surface of the casing. At the inner edges the vanes 5 are fixed to an annular ring or hub 9. The front edges 10 of the vanes are presented to the air stream of the fan. As shown in Figs. 5, 6 and 7, these edges are rounded so as to provide a minimum of interference with the air. The faces of the vanes extend axially providing passages therebetween through which the air column flows. At the front edges 10, the faces extend at substantially the angle in which the air stream is moving so as to reduce the losses due to impact of the air stream with the edges 10. The direction in which the air stream moves is that resulting from the summation of the axial velocity component and the rotational component.

The axial component of the air column flows between the vanes substantially without change. The rotational component of the air impinges against the front faces 11 of the blades and is deflected in an axial direction. By converting the rotational component of the air into an axial component the efficiency is increased since otherwise the energy contained in the rotational component would be dissipated in eddy currents. As shown in Figs. 5, 6 and 7 the front faces of the blades are concave in an axial direction. In other words, the rear edges 12 of the vanes extend substantially axially while the front faces 11 are curved axially with gradually increasing curvature toward the front edges 10 in a direction opposite to the rotation of the rotational component of the air. By this means the rotational component is more gradually converted to an axial component.

If the rotational component of the air column were merely changed to an axial component the velocity distribution throughout the air column would remain substantially unchanged. There would merely be an increase in efficiency due to the conversion of the rotational component into an axial component. For this reason the blades do not extend directly radially outward from the hub 9. From the hub to region 13, which is located in the region of maximum or peak velocity, the vanes extend radially backward as regards the direction of rotation of the rotational component of the air column. From the region 13 to the periphery, the vanes extend radially forward. From the hub 9 to the region 13 the vanes cooperate with the rotational component of the air to deflect it axially and radially inward. From the region 13 to the outer ends the vanes cooperate with the rotational component to deflect it axially and radially outward. As regards the rotational component of air, the surfaces of the vanes may be described as radially convex in that the blades present convex surfaces opposed to the rotational component of the air. By this means the rotational component of the air is converted into axial components deflected radial-

ly on opposite sides of the region of maximum axial velocity. This obviously decreases the normal variation in velocity distribution. Since the vanes utilize the rotational component to affect this change in velocity there is a substantial increase in efficiency. In actual practice increases in efficiency of more than ten per cent have been obtained. There has also been an increase in the air flow of the fan due to the decrease in resistance offered to an air stream having a more uniform velocity distribution.

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

1. Directing vanes for a column of air having a rotational component about the axis of flow and a velocity distribution varying with the radial distance from the axis of flow, comprising circumferentially spaced radially extending vanes having edges presented to the axial moving air and having faces extending axially, the faces of the vanes in a radial direction being conversely opposed to the rotational component of the air and cooperating with the rotational component of the air to deflect it axially and radially whereby the rotational component of the air is converted to an axial component decreasing the normal variation in velocity distribution.

2. Directing vanes for a column of air having a rotational component about the axis of flow and a velocity distribution increasing radially to a maximum at a region of peak velocity and decreasing therefrom radially to a minimum velocity at the outer edges, comprising circumferentially spaced radially extending vanes having edges presented to the axially moving air and having faces extending axially, the faces of the vanes radially inward from the region of peak velocity being inclined radially backward as regards the direction of rotation of the rotational component of the air stream and the faces of the vanes radially outward from the region of peak velocity being inclined radially forward as regards the direction of rotation of the rotational component whereby the rotational component is deflected axially and radially outward and inward so as to decrease the variation in velocity distribution of the air column.

3. Directing vanes for a column of air having a rotational component about the axis of flow and a velocity distribution increasing radially to a maximum at a region of peak velocity and decreasing therefrom radially to a minimum velocity at the outer edges, comprising circumferentially spaced radially extending vanes having edges presented to the axially moving air and having faces extending axially, the faces of the vanes in the region of peak velocity being convex in a radial direction and cooperating with the rotational component to deflect it axially and radially outward and inward whereby the rotational component of the air is converted to an axial component decreasing the normal variation in velocity distribution.

4. In combination, a propeller fan, radially extending vanes in front of the fan having edges presented to the axially moving air stream and faces extending axially, the faces of the vanes in the region of peak velocity being convexly opposed in a radial direction to the rotational component of the air whereby the rotational component of the air stream is deflected axially and radially so as to change the velocity distribution of the air stream.

5. In combination, a propeller fan, circumferentially spaced radially extending vanes in front of the fan, the edges of the vanes being presented to the axially moving air stream and the faces of the vanes extending axially, the faces of the vanes being convexly opposed in a radial direction to the rotational component of the air and cooperating with the rotational component of the air stream to deflect it axially and radially whereby the velocity distribution in front of the vanes is changed.

6. In combination, a propeller fan, circumferentially spaced radially extending vanes in front of the fan, the edges of the vanes being presented to the axially moving air stream and the faces of the vanes extending axially, the faces of the vanes in the region of peak velocity being inclined radially forward and backward with regards to the direction of rotation of the rotational component whereby the rotational component is deflected radially outward and inward as it is changed to an axial component so as to decrease the variation in velocity distribution of the air column.

7. In combination, a propeller fan, radially extending vanes in front of the fan having edges presented to the axially moving air stream and faces extending axially, the faces of the vanes radially inward from the region of peak velocity being inclined radially backward as regards the direction of rotation of the rotational component of the air stream and the faces of the vanes radially outward from the region of peak velocity being inclined radially forward as regards the direction of rotation of the rotational component of the air stream.

8. In combination, a propeller fan, circumferentially spaced radially extending vanes in front of the fan having edges presented to the axial moving air stream and faces extending axially, the faces of the vanes in the region of peak velocity being radially convex and cooperating with the rotational component of the air stream to deflect it axially and radially outward and inward so as to decrease the variation in velocity distribution.

KENTON D. McMAHAN.

CERTIFICATE OF CORRECTION.

Patent No. 2,154,313. April 11, 1939.

KENTON D. McMAHAN.

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 21, claim 1, for "conversely" read convexly; 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 6th day of June, A. D. 1939.

Henry Van Arsdale

(Seal)

Acting Commissioner of Patents.