No. 828,592. PATENTED AUG. 14, 1906.

W. E. ALLINGTON.

CENTRIFUGAL FAN.

APPLICATION FILED JAN. 30, 1905.

2 SHEETS—SHEET 1.

Fig. 1.

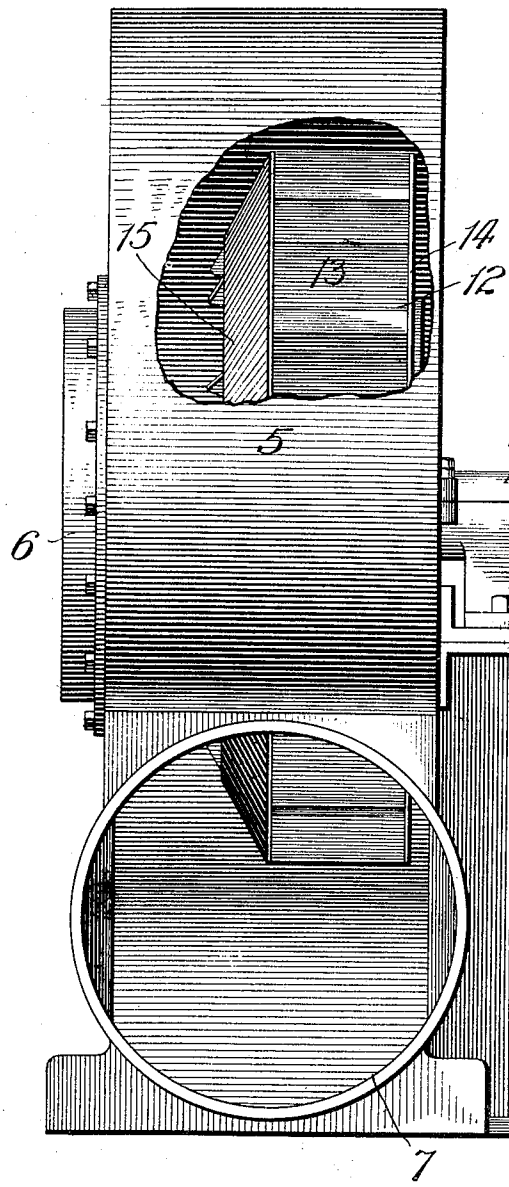
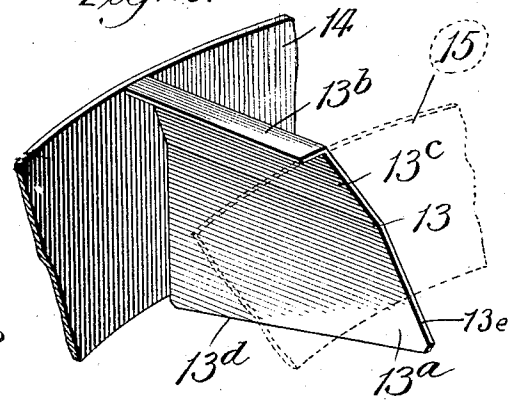


Fig. 2.



Witnesses:
Chas. E. Gaylord.
John Enders.

Inventor:
William E. Allington,
By Foster Bain
Atty

No. 828,592. PATENTED AUG. 14, 1906.

W. E. ALLINGTON.

CENTRIFUGAL FAN.

APPLICATION FILED JAN. 30, 1905.

2 SHEETS—SHEET 2.

Fig. 4.

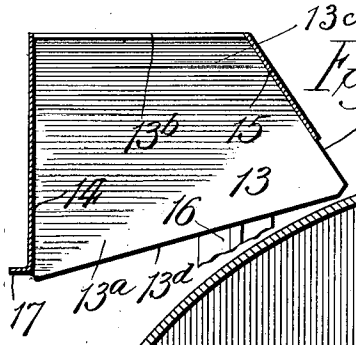


Fig. 3.

Witnesses:
Chas. E. Gaylord.
John Enders.

Inventor:
William E. Allington,
By Dovée Bain
Att'y

UNITED STATES PATENT OFFICE.

WILLIAM E. ALLINGTON, OF SAGINAW, MICHIGAN.

CENTRIFUGAL FAN.

No. 828,592. Specification of Letters Patent. Patented Aug. 14, 1906.

Application filed January 30, 1905. Serial No. 243,204.

To all whom it may concern:

Be it known that I, WILLIAM E. ALLINGTON, of Saginaw, in the county of Saginaw and State of Michigan, have invented certain new and useful Improvements in Centrifugal Fans; and I hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form part of this specification.

My invention relates to centrifugal fans or rotary fans providing for the axial introduction and peripheral expulsion of air and operating to rotate with its blades air bodies, which by virtue of centrifugal action escape peripherally and entrain fresh air supplies at the axial inlet, as distinguished from propeller-fans, or those rotary fans which propel air in the general direction of the axis of fan rotation and operate essentially upon a wedge or screw principle.

In general, the object of my invention is to produce a centrifugal fan which at comparatively low speeds of rotation will deliver air against considerable resistance and which will operate with higher efficiency (or, in other words, with less expenditure of power in ratio to the resistance to be overcome) than fans of the best heretofore known constructions.

Other and more specific objects which I attain may best be drawn from and will become apparent from the following description, taken in conjunction with the accompanying drawings, wherein—

Figure 1 is a front elevation, with parts broken away, of a complete fan embodying my invention. Fig. 2 is a detail in perspective of one of the blades of my fan. Fig. 3 is a side view with parts of the casing and part of a side frame of the fan-wheel broken away. Fig. 4 is a section on line 4 of Fig. 3.

Throughout the drawings, 5 indicates in general a fan-casing, which may be of any usual or preferred construction, providing a substantially axial inlet and a substantially tangential outlet. Preferably the casing is of the well-known scroll pattern, having the usual inlet-opening or eye 6, in what I will term its "front" side, and the usual tangential outlet 7.

8 indicates a convenient standard providing suitable bearings 9 9 for the fan-shaft 10, whereon is mounted the pulley 11 or other suitable means for transmitting power to the shaft. As is the customary practice, the shaft 10 enters the casing through the side remote from the inlet and is disposed in axial alinement with the eye or inlet-opening 6. For convenience of description I will hereinafter use the term "axially" as meaning a direction coincident with or parallel to that of the shaft-axis. It will be understood, of course, that the back wall of the casing, or that opposite the eye or inlet 6, offers no path of air-escape.

Upon the shaft 10, within the casing, is mounted the fan-wheel, generally indicated by the numeral 12. The said wheel I believe to be novel and advantageous in many of its features of detail, as will be gathered from further description hereinafter; but it may be generally described as comprising a plurality of blades disposed to sweep through an annular path, each of said blades comprising a radially-disposed portion, preferably of relatively great depth, and a substantially tangential lip portion preferably relatively shallow, projecting forward with reference to the direction of revolution of the wheel, there preferably being one or more intermediate blade portions affording connection between said radially-disposed blade portion and said lip portion, said intermediate portion or portions being arranged angularly relative to the adjoining blade portions on both sides thereof.

The blades (indicated in general by the numeral 13) are suitably associated and spaced apart as by connection with the side plates 14 and 15, respectively located remote from and adjacent the inlet-opening 6, and which for convenience I will refer to, respectively, as the "back" side plate 14 and the "front" side plate 15. The whole annular structure is suitably supported, as upon the spider 16, the arms whereof are secured to certain of the blades 13, and the hub whereof is affixed to the shaft 10.

While certain details to be hereinafter described relate particularly to this style of mounting of the fan-wheel, it will be understood that in so far as the blade construction is concerned such construction might be embodied in a wheel wherein the blades are supported in any manner and is independent of the particular style of mounting. In the style of wheel shown, however, I prefer that the back side plate 14 be a flat annular plate, preferably (though not essentially) having a flange 17 projecting outward from and surrounding the central aperture of the annulus,

which said aperture is preferably substantially equal in size to and arranged coaxially with the eye or inlet-opening 6 of the casing. The front side plate 15 is preferably of the same exterior diameter as the back side plate, but is preferably of greater interior diameter and is preferably of a dished or truncated cone shape. The blades 13, secured at opposite sides to the said side plates, are shown as each comprising a radially-disposed portion 13^a, which is preferably of considerable depth, (by which I mean a measurement taken in a direction traversed by the air in making an escape under the influence of centrifugal force,) a relatively shallow, substantially tangential lip 13^b, and an intermediate portion 13^c, preferably of greater depth than the lip and making a slight deflection from the direction of the radial portion 13^a and making a less obtuse angle with the lip 13^b than with the radial portion 13^a. The effect of this construction is to produce in each blade a forwardly-opening pocket, the function of which will hereinafter become apparent. Preferably the back edge of each blade is deeper than the front edge thereof, both with reference to the eye or inlet-opening, so that the radially inner edge 13^d of the blade is inclined from a maximum distance from the axis at the side of the wheel nearest the inlet to a minimum distance from the axis of the back side of the wheel. The blades are of course beveled or cut on their front edges at an angle coinciding with that of the coniform side plate 15, and preferably the front edges of the blades are deeper than the radial extent of the side plate 15, so that a portion 13^e of the blade projects radially inward beyond the side plate 15. In its association with the fan-casing I prefer that the wheel be mounted as near the back side of the casing as is practical and that the sweep of the blade shall intersect to a greater or less degree an area within the casing alining with the eduction-opening 7, which said area I will call for convenience the "escape area" of the casing, or, in other words, that a tangent to a suitable point of the fan-wheel should pass through the eduction-opening 7 in the direction of escape of the air.

I have found from practical test that a fan constructed as herein described shows a high efficiency when either venting freely or working against resistance, the advantage of my fan being particularly evident when operating against resistance—as, for example, when delivering dust-laden air to a centrifugal dust-separator. This high efficiency I believe to be primarily due to the fact that the blades deliver the air impelled through the ports between said blades as a result of centrifugal action into the clearance-space between the wheel and casing and to the escape area alining with air-outlet in a direction substantially tangential to the periphery of the wheel, and I believe the efficiency to be further augmented by the fact that the construction of blade herein shown permits the air to make its own path or curve relative to the blade and escape from the blade in a generally tangential direction with the least possible frictional resistance. To this end the pocket in the blade formed by the lip and intermediate angular section while shallow as compared with the depth of the radial portion of the blade is of sufficient depth to at all times retain a volume of dead, or substantially dead, air, which, I believe, serves as a cushion for the air in its flow through the ports in front of the blade and permits the flow of air to take from the outer end of the radial portion of the blade to the point of delivery at the edge of the lip a natural curve, not arbitrarily determined, but variable to suit the conditions of operation of the fan. It is to be noted, further, that the air delivered at the bottom of the wheel or at the point thereof adjacent the outlet is delivered directly into the outlet in alinement with the path of air-escape through said outlet, and this arrangement, it is my belief, further augments the efficiency.

It is to be noted that the blade arrangement is such that there is left within the annular path of motion of the blade a free area, which I will term the "intake-chamber," the minimum diameter of which is substantially equal to the diameter of the intake-opening 6. Thus the air entering the fan-wheel is not at once positively set in motion in a direction at right angles to its path of entry, but is entrained or induced to flow between the blades, changing its direction of motion more gradually than if directly introduced between the blades, and thereby, it is my belief, reducing the resistance and increasing the efficiency of the fan. Furthermore, it is to be noted that my fan-wheel is located at the back side of the casing with reference to the inlet-opening and that the blades are of maximum depth at their back edges, their back edges being straight or at right angles to the axis of rotation of the wheel. My preference for this arrangement is due to the fact that I find that the efficiency of a fan-blade varies throughout its length or axial dimension, the efficiency being greater at the end remote from the inlet and least at the end adjacent the inlet. Therefore I utilize to the fullest extent practicable the efficiency of the remote end and with this aim in view make deepest the radial portion of the blade at the back end with reference to the inlet, the front end of the blade being decreased in depth to reduce resistance. For the same reason the front ends of the blade are beveled, as shown in Fig. 4, and the side plate 15 arranged at a corresponding angle.

The precise number of blades employed may vary in the construction of machines of

different sizes and capacities or in machines of any given size; but it will be understood that I prefer to employ relatively numerous blades, preferably at least from twelve to eighteen, it being my observation that the greater the number of blades within reasonable limits the better the work of the fan.

For purposes of a full disclosure of my invention I have herein described in some detail a specific fan construction which I have found by experience to be of high efficiency and of advantageous construction and many of the minor features of which I claim as of my invention; but it will be understood that in its broadest aspect my invention is not limited to the exact construction shown and described, but that various changes may be made therein without departure from the spirit and scope of my invention.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In a centrifugal fan, a casing providing an axial inlet and a peripheral outlet, and a wheel comprising a plurality of blades, arranged to sweep through an annular path, each of said blades comprising a relatively-deep radial portion, and a pocket-forming portion of angular cross-section, said pocket-forming portion comprising a lip, forming the outer edge of the blade, and projecting forwardly with reference to the direction of rotation of the wheel.

2. In a centrifugal fan, a fan-wheel adapted to receive air axially and to deliver it peripherally, and comprising a plurality of blades, disposed to sweep through an annular path, each of said blades having a relatively-deep radial portion nearest the axis, a relatively-shallow peripheral lip portion projecting forward, with reference to the direction of rotation of the wheel, in an approximately tangential direction, and an intermediate portion of depth greater than the lip portion and shallower than the radial portion, arranged at an angle to and connecting the lip and radial portions, said forwardly-bent parts forming a pocket wherein substantially-dead air may be retained to form a cushion whereon the flowing air may form its own delivery curve from a radial direction to a peripheral direction approximately tangential.

3. In a fan-wheel, adapted to receive air axially and deliver it peripherally, a series of blades arranged to sweep through an annular path, each blade providing an inner straight radial portion of relatively great depth, and a deflected outer portion, extending forward with reference to the direction of wheel rotation, said deflected blade portion being angular in cross-section and providing an inner part of less depth than the radial part, arranged at a relatively-obtuse angle thereto, and a yet shallower peripheral lip portion, at a less obtuse angle to the first said deflected part, said deflected parts constituting, when the wheel is in rotation, a pocket for air, whereon the flowing air may form its natural delivery curve.

4. In a centrifugal fan, the combination of a casing provided with an inlet and an outlet, and a fan-wheel having blades disposed to sweep through an annular path, each of said blades comprising a relatively-deep, inner, radial portion, and a pocket-forming peripheral portion, comprising a substantially-tangential lip forming the outer edge of the blade, and projecting forward with reference to the direction of rotation of the wheel, the path of said blades entering the escape area of the casing alining with the outlet, and said outlet being substantially tangential to and in front of said portion of the blades path with reference to the direction of rotation of the wheel.

5. In a centrifugal fan, the combination with a casing providing an inlet near the axis and a peripheral outlet, of a fan-wheel comprising a dozen or more blades, each narrower at the edge near the inlet than at the edge remote from the inlet, and each having a relatively-deep, radial, inner portion, and a relatively-shallow, substantially-tangential, peripheral lip portion projecting forward, with reference to the direction of rotation of the wheel, to deliver air from the wheel in a substantially-tangential direction, and to form with the rest of the blade structure an air-pocket, for carrying a body of substantially-dead air whereon the flowing air may form its own delivery curve in turning from radial to approximately-tangential flow.

6. In a centrifugal fan, the combination with a casing having in its side an air-inlet and in its periphery an air-outlet, of a fan-wheel comprising blades, each providing a relatively-deep radial portion, and an angular deflected portion terminating peripherally in a substantially-tangential air-delivering lip, said deflected portion forming a pocket for dead air whereon the air in flow may make its own delivery curve, and said wheel comprising also a side plate, on the side remote from the inlet, extending radially sufficiently far to close said side of the air-pockets formed by the deflected blade portions.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

WILLIAM E. ALLINGTON.

In presence of—
GEORGE T. MAY, Jr.,
MARY F. ALLEN.