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FAN.

APPLICATION FILED DEC. 12, 1908.

978,397.

Patented Dec. 13, 1910.

2 SHEETS—SHEET 1.

Fig. 1.

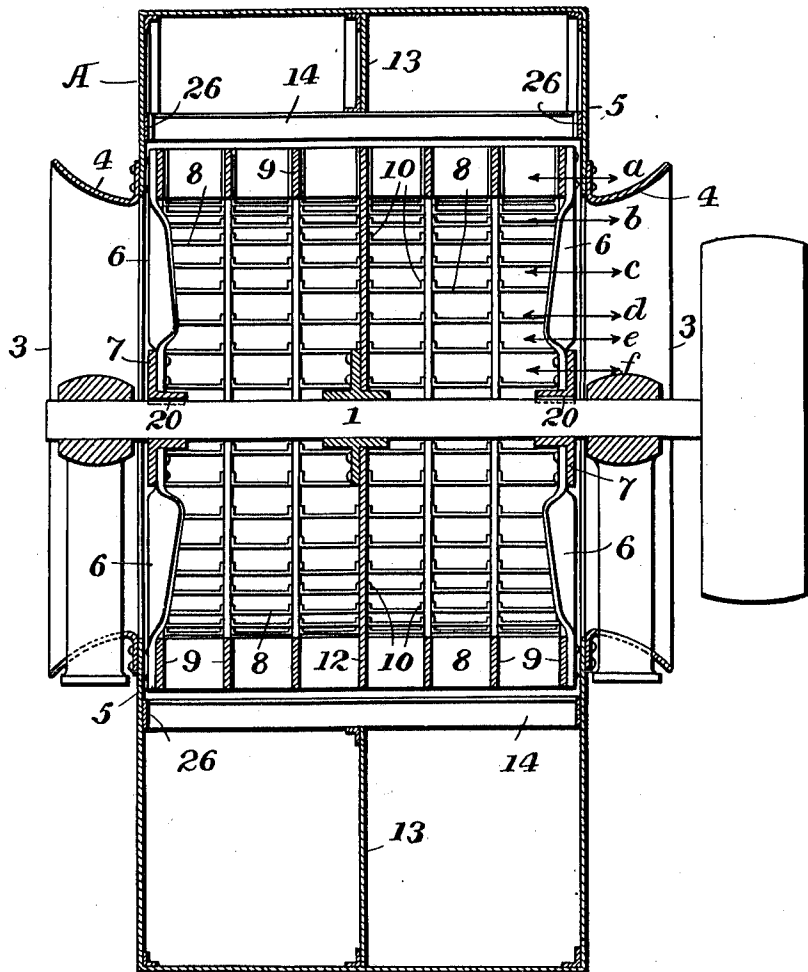
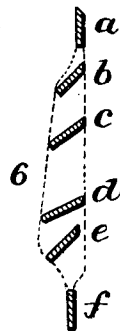


Fig. 3



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2 SHEETS-SHEET 2.

Fig. 2.

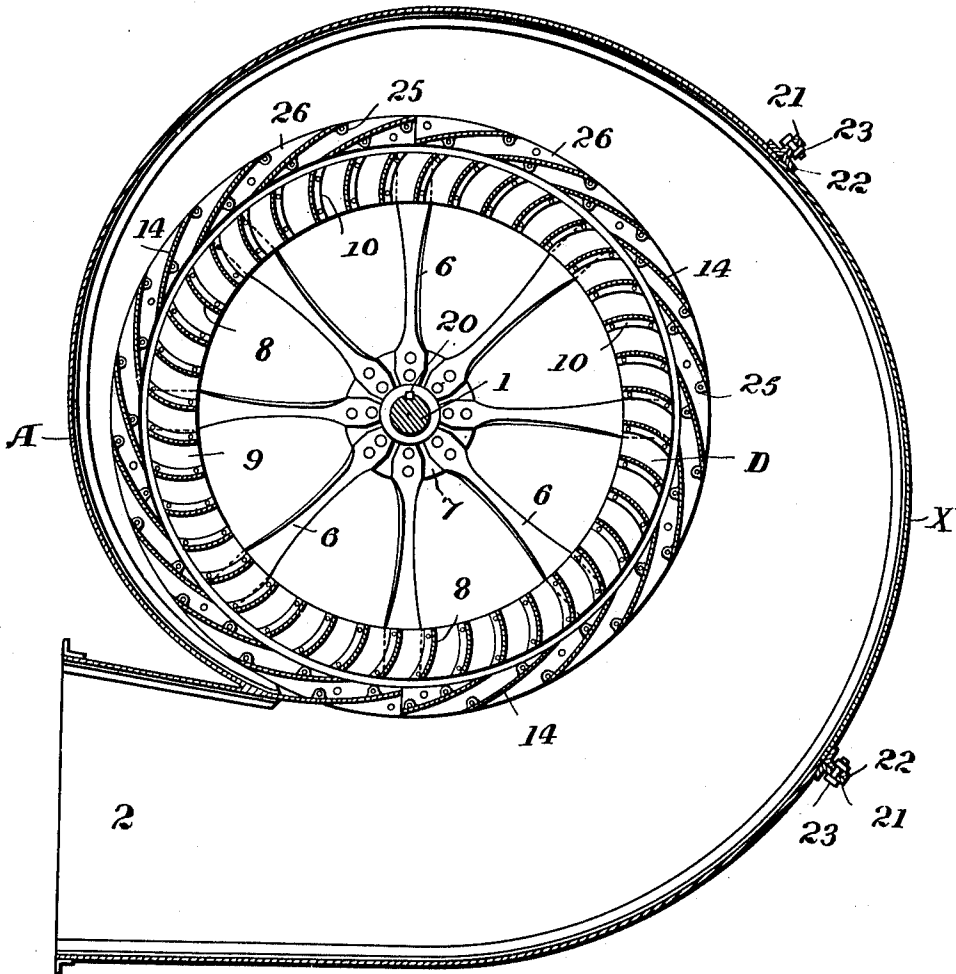
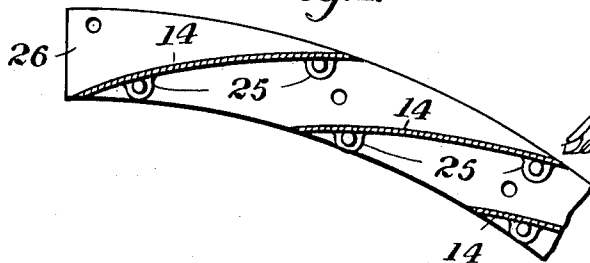


Fig. 4.



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UNITED STATES PATENT OFFICE.

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978,397.

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To all whom it may concern:

Be it known that I, GEORGE S. RICE, a citizen of the United States, and resident of Evanston, Cook county, Illinois, have invented certain new and useful Improvements in Fans, of which the following is a specification.

My invention relates to certain improvements in ventilating fans whereby to simplify the construction, secure greater strength and rigidity, enable the parts to be connected and disconnected, and otherwise improve the efficiency of the same, as fully set forth hereinafter and as illustrated in the accompanying drawing, in which:

Figure 1 is a sectional elevation of a fan or blower embodying my improvement; Fig. 2 is a transverse sectional elevation; Fig. 3 illustrates the cross sectional form of one of the spokes at different parts of its length, as indicated by the letters *a, b, c, d, e, f* Fig. 2; and Fig. 4 is a detached view of part of the apparatus.

The shaft 1 of the fan is eccentrically disposed within the casing A, of general spiral outline such as is usual in this class of apparatus, and carries the fan D, the casing having side openings for the entrance of the air, and a discharge neck 2.

To facilitate the inflow of the air the walls 3 of the side openings constituting the inlets expand outward in a gradual curve, preferably constituting the flange 4 of a metal plate 5 which constitutes the side of the casing, or when the casing is of masonry the said walls may be formed in the masonry itself of brick, stone or concrete. The curve thus given to these walls is of a character known in hydraulics as a vena contracta curve, inasmuch as this proportion of curvature is one which will best insure the inflow of the air without any eddies or counter-acting currents.

The periphery of the fan, whatever may be its character, is supported by arms 6 which meet the hub 7 of the wheel 1 radially, and extend on said radial lines outward to the periphery or rim, and, instead of being in the form of bars of substantially uniform cross-section as usual, they consist each of a plate which is bent or twisted to an increasing angle toward the rim of the wheel; thus, the inner end of each plate in its cross-section corresponding to an angle which is acute to the axis of the shaft, and this angle gradually increases, as shown by the cross

sections Fig. 3, toward an angle approximating at the outer end about 45° to the axis. This gives to each plate a propeller-like form so that as the fan rotates the blades, instead of constituting an obstruction and producing eddies which interfere with the inflow of the air current, actually serve as propellers to insure a steady and continuous and unbroken inflow. The plates are twisted inwardly so that the outside edges are straight and radial and, therefore, present an even surface.

The periphery or rim of the fan consists of a series of curved blades 8, the curvature of each blade being forward and the blades being pitched in a forward direction with a sufficient space between the blades to permit the ready passage of the air drawn in as aforesaid by the action of the propeller arms and carried outward by the centrifugal action resulting from the further driving of the air by the blades 8 themselves, the curvature and inclination of the said blades insuring a hold upon the air so that there is no possible back current or eddies. These blades are preferably short and arranged between a series of circular plates 9 concentric with the shaft, each blade having at each end a side flange 10 which is bolted or otherwise secured to the adjacent plate or ring 9, and when the whole are thus secured together the rim of the wheel possesses great stiffness and rigidity so that the fan may be rotated at a high speed without undue strain or breakage. In some cases the fan may be double and in this case there is a central partition 12 to the fan and a corresponding partition 13 in the casing, the air admitted to the opposite sides being thrown outward by the different sections of the fan.

Coacting with the blades of the fan are other blades 14 arranged in a circle about the fan and supported by the casing and slightly curved inward, each blade extending forward approximately at right angles to the radius of the fan and overlapping the heel of the next forward blade, as shown in Fig. 2. These blades are properly supported in the casing, and as the fan rotates, the air which is thrown from the fan is projected approximately tangentially to the periphery of the fan and, meeting the inner curved surfaces of the blades 14 is directed in lines substantially parallel to the outline of the casing A so as to flow, without counter currents or eddies, freely toward the outlet of

the casing. The overlapping arrangement of these blades 14, while it insures the ready outflow of the currents and without any obstruction to the line of flow in which the air is projected by the fan, effectually serves to prevent any counter-flow or back flow toward the wheel.

The division of the blades of the wheel into small sections by means of the rings 9 also compels the air to take a course at right angles to the shaft, preventing side deflections, and also aids in preventing any counter currents as each portion of the air carried outward by centrifugal force under the action of these blades or vanes is itself so small in volume that counter currents cannot be generated as in fans of ordinary construction where the blades which act upon the air are of extended size and each act on a large volume of air. There is also a reduction in the friction of the air from the blades being narrow or short radially.

A ready means of applying the deflecting plates or blades 14 is to provide them with ears 25 at the ends, and bolt them to segmental plates 26, which in turn are bolted to the sides of the fan casing. One of these segments with its blades may be so arranged as when removed to permit the fan to be carried to an opening in the casing closed by a section X. This section may have edge angle bars 22 coinciding with similar bars 21 on the casing, securing bolts 23 passing through the two meeting bars. To facilitate such removal of the fan the hubs of the wheel and the shaft are keyed together by keys 20, on the removal of which the shaft can be withdrawn, and it will be seen that the sides of the hubs do not project beyond the plane of the sides of the fan, so the latter may be almost equal to the full width of the casing without its withdrawal being interfered with.

The internal diameter of the rings is substantially the same as the diameter of the side opening or the mouth. It is, therefore, insured that the lines of flow will be uniform throughout the fan and, therefore, the formation of eddies will be prevented. The rings are also flat and of uniform depth. Therefore, it is insured that each unit shall receive the same impetus. Where the rings are not of uniform depth one set of vanes or blades is liable to receive more than its share of the work, and, therefore, eddies are liable to be formed, causing loss in efficiency. By constructing the rings and the vanes in this manner, and giving the mouthpiece an outwardly flaring form, the air will enter the fan at a uniform rate, will be given a uniform rotative motion as it enters the fan, and will be received by the fan blades without shock, and thus all eddies will be prevented.

Without limiting myself to the precise con-

struction and arrangement of parts shown, I claim:

1. The combination with a shaft and casing of a centrifugal fan, of a wheel having peripheral blades, and side spokes consisting of blades to act as propellers to carry the air into the fan, each of the blades being twisted radially, the angle of the twist, measured with respect to a plane at right angles to the fan shaft, decreasing toward the rim of the wheel.

2. The combination with a shaft and casing of a centrifugal fan, of a wheel having peripheral blades, and supporting spokes at each side consisting of blades bent or twisted radially to secure a progressive decrease of the angle of twist, measured with respect to a plane at right angles to the fan shaft, toward the rim of the wheel.

3. The combination with a fan shaft, of a series of flat rings concentric with said shaft, a series of sets of radial blades provided with side flanges, fastening means passing through the flanges and rings so as to secure said parts into a rigid structure, and side spokes for connecting said end rings to said shaft.

4. The combination with the casing and shaft of a centrifugal blower, of a fan the periphery of which consists of a series of parallel rings and intermediate flanged curved blades, the flanges secured to said rings and with spokes at each side, each spoke twisted radially with a decreasing angle, measured with respect to a plane at right angles to the fan shaft, toward the rim as set forth.

5. The combination of the shaft, a fan having forwardly curved radial blades at the periphery, and casing having a series of overlapping curved blades arranged in a circle about the fan, and propeller arms for driving the air into the fan, each arm being twisted radially to a gradually decreasing angle of twist, measured with respect to a plane at right angles to the fan shaft, toward the rim of the fan.

6. The combination of a casing having side and peripheral walls, said walls having side openings and said peripheral wall having a removable peripheral section, a shaft, and a fan greater in diameter than the side openings, the said fan detachably secured to said shaft, whereby said fan may be moved through the opening formed in the peripheral wall by the removal of the section.

7. The combination of a centrifugal blower, of a casing having side openings, a removable peripheral section and circular series of blades, of segments supporting sections of the blades and connected detachably to the casing, a fan, and a shaft connected detachably to the fan.

8. The combination of a shaft and a fan detachably secured thereto, a casing having

a removable peripheral section, a series of blades arranged in a circle around the fan, and supports for those blades between the fan and said section, detachably connected to the casing.

9. The combination with a shaft and casing of a centrifugal fan, of a wheel having peripheral blades, and side spokes consisting of blades to act as propellers to carry the air into the fan, the blades being twisted radially and inwardly so that the outside edges of the blades are straight and radial.

10. The combination of a fan shaft, a series of parallel flat rings concentric with said shaft, an intermediate series of sets forwardly curved radial blades securing said rings together, and side spokes securing the end rings to the shaft.

11. The combination with a casing having side inlets of a fan shaft in said casing, a series of parallel flat rings concentric with said shaft and mounted in said casing, intermediate series of sets of forwardly curved

radial blades securing said rings together, side spokes securing the end rings to the shaft, and a partition plate securing an intermediate ring to said shaft.

12. In a centrifugal fan, the combination with a casing having a side inlet opening of curved cross section and flaring outwardly, of a fan wheel rotatable in said casing and comprising a series of concentric and parallel rings, the internal diameter of said rings being substantially equal to the inner diameter of said inlet, and blades between said rings and secured thereto, said rings dividing the part of the wheel open to said inlet into a plurality of annular sections extending longitudinally of the wheel, for the purpose set forth.

In testimony whereof I affix my signature in presence of two witnesses.

GEORGE S. RICE.

Witnesses:

W. R. JOHNSTON,

J. C. ROBERT.