F. R. STILL.

CENTRIFUGAL FAN.

APPLICATION FILED APR. 18, 1911.

1,094,031.

Patented Apr. 21, 1914.

2 SHEETS—SHEET 1.

Fig. 2.

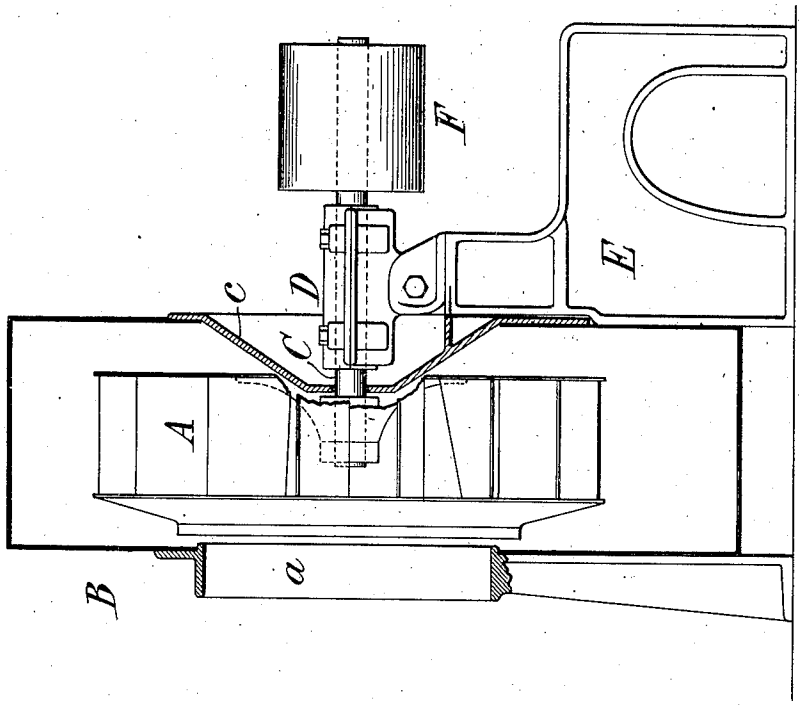
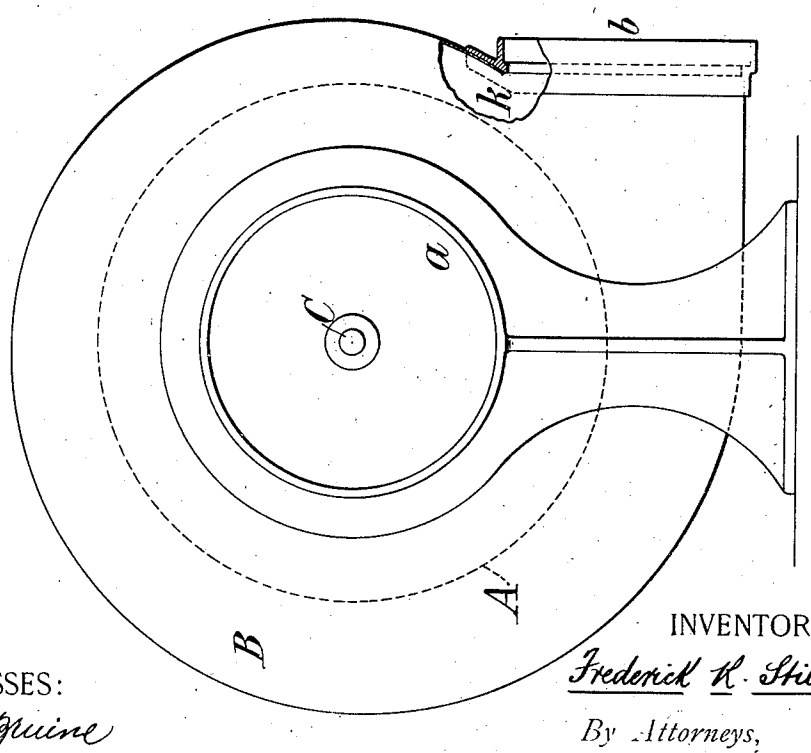


Fig. 1.



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2 SHEETS—SHEET 2.

Fig. 3.

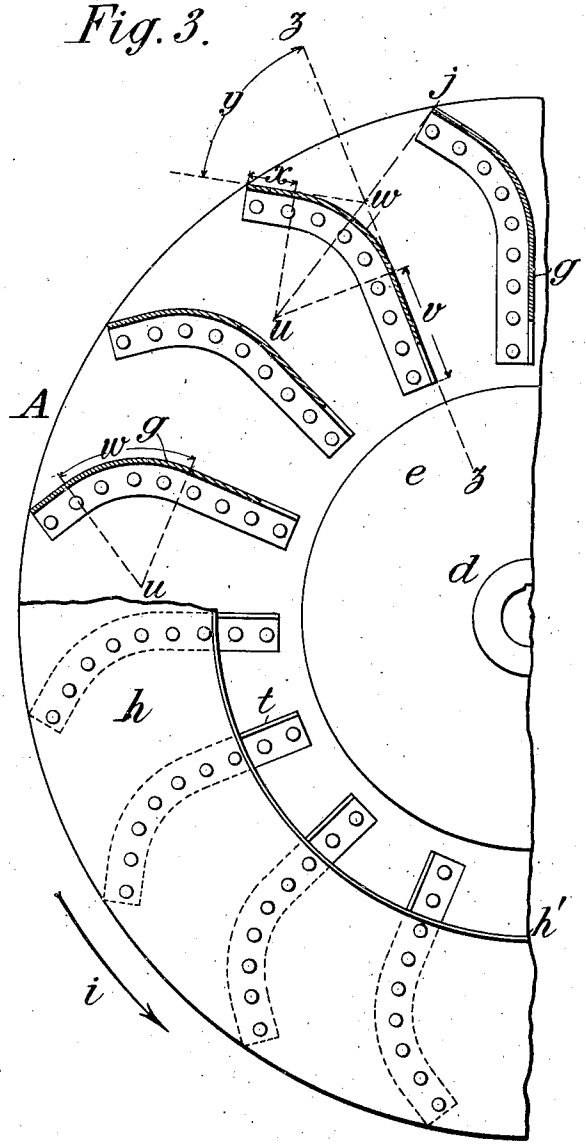
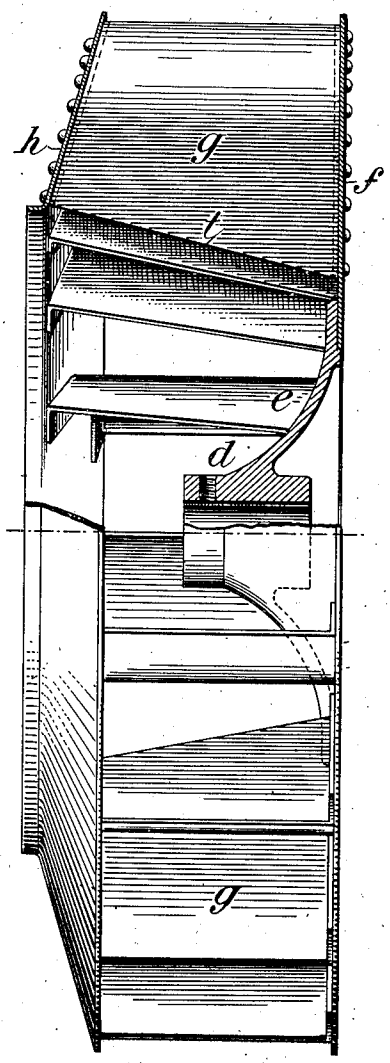


Fig. 4.



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UNITED STATES PATENT OFFICE.

FREDERICK R. STILL, OF DETROIT, MICHIGAN, ASSIGNOR TO AMERICAN BLOWER COMPANY, OF DETROIT, MICHIGAN, A CORPORATION OF NEW YORK.

CENTRIFUGAL FAN.

1,094,031. Specification of Letters Patent. **Patented Apr. 21, 1914.**

Application filed April 18, 1911. Serial No. 621,756.

To all whom it may concern:

Be it known that I, FREDERICK R. STILL, a citizen of the United States, and resident of Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Centrifugal Fans, of which the following is a specification.

This invention relates to centrifugal fans, applicable either as blowers or exhausters. Its object is to produce a fan which, for a given duty, will operate at lower speed and with higher mechanical efficiency than fans heretofore constructed.

It is especially adapted for handling or conveying cotton or other light fibrous materials by means of a blast or current of air, although applicable to other purposes.

The novel features of the invention reside in the shape and proportions of the blades and other parts of the fan wheel or impeller, and in the proportions of the casing or housing relatively thereto, as will be explained.

The accompanying drawings show a fan of single inlet, horizontal discharge type.

Figure 1 is a side elevation looking toward the inlet or eye. Fig. 2 is a vertical transverse section through the casing in a plane coincident with the axis of rotation, the wheel being shown in elevation. Fig. 3 is a front view of one-half of the wheel, the upper half of the view being in vertical section in a plane transverse to the axis. Fig. 4 is a side view of the wheel, the upper half of the figure being in vertical mid section.

Referring to the drawings, A is the wheel or impeller, B is the casing, C is the shaft, turning in a bearing D mounted on a frame or pedestal E, and F is a belt pulley.

The casing is in general of usual construction, having an inlet opening or eye *a* and an outlet *b*. Preferably it is fitted at its rear side with a cone *c*, partially entering the rear side of the wheel, and having a central opening to admit the shaft C.

The fan wheel A for a single inlet fan comprises a cast hub *d* having the usual conoidal flange *e*, to which is attached the usual flat sheet steel disk *f*. To this disk are attached the blades *g*, *g*, and to the front edges of these blades is attached a coned disk *h*, the inner edge *h'* of which is preferably turned outward to form a flange, being of larger diameter than the eye *a*. The front and rear edges of the blades are flanged and are attached to the disks *f*, *h* by riveting, as usual.

The blades are of shape, arrangement and proportions different from those commonly used in centrifugal fans. In the construction shown the blades are sixteen in number, although the number of blades may be varied somewhat according to the size of the fan. The inner part *v* of each blade is radial, or closely approximates to a plane radiating from the axis. The blade is then curved in preferably a segment of a cylinder, this curved portion being lettered *w*, and the outer portion *x* is plane or approximately so, and extends in a direction diverging by an angle *y* from the plane *z*, *z* of the radial portion *v* of the blade. The curved portion *w* is a segment of a cylinder developed around a center or axis *u* (Fig. 3). The inner edge *t* of each blade is oblique to the axis, as shown in Fig. 4, so that the blade widens as it recedes from the inlet. The wheel is designed to revolve in the direction of the arrow *i* in Fig. 3; hence, the blades are curved forwardly, so that their outer or discharging end portions *x* occupy planes tangential to a circle smaller than the circumference of the wheel.

The proportions to which the best efficiency of the fan are due are as follows, being stated with relation to the radius of the fan wheel as unity. The axial width of the blade at its inner or inlet side is .57, and at its outer or discharge side is from .40 to .50; the radial dimension of the blade is .32 at the front or inlet side and .50 at the rear or disk side. The radial portion *v* of the blade has an extreme length of .22; the portion *x* has a length of .0625; the radius of the curved portion *w* is .25. A feature of great importance is the angle *y* which should closely approximate 60 degrees. The distance from the tip of one blade to the back of the next preceding one (measured on the line *j u*, Fig. 3) should approximate the space between the blades at their inner front edges. The area of the inlet opening or eye *a* should be 31% of the area of the side of the wheel. The area of the outlet *b* should be 25% of the area of the side of the wheel. Thus the proportion of area of inlet to area of outlet is as 100 to 80. The radius from the axis to the point of cut off of the

fan housing (being the point *k* in Fig. 1) should be not less than 20% nor more than 25% in excess of the radius of the wheel. The height of the casing should be not materially less than 3 times the radius of the wheel, and from the bottom of the casing to the axis or shaft center should not be less than 1.5 times the radius of the wheel.

Each of the proportions given is of importance in attaining the desired performance of the fan. These proportions are for single-inlet fans.

It is not to be understood that my invention is limited rigidly to the proportions stated, but these proportions are those which give the best results. Departures may be made from the proportions stated without necessarily impairing the performance of the fan and without necessarily departing from my invention.

This new fan has developed in practical use an efficiency which involves a very notable improvement over prior types of fans for similar duties. For example, as compared with a previously constructed fan of old design, but especially good efficiency, which ran at a speed of 1850 turns per minute and consumed 29.2 horse power (as measured on a watt meter), this new fan, of the same size and delivering exactly the same quantity of air, developed the same pressure at a speed of 1300 revolutions and required only 22.15 horse power. As another example, this new fan was compared with a specially designed fan used for elevating cotton, distributing it to the gins, and blowing the seed to the seedhouse, which fan had proven to be far superior for this work to anything previously on the market, and which ran at a speed of 1620 revolutions and required 15.3 horse power; while the new fan of the same size handled the same amount of cotton at a speed of 1010 revolutions, required only 11.38 horse power, and produced 1⅛ greater vacuum.

My new fan is susceptible of such modifications in arrangement, and constructional features, as are commonly resorted to by fan constructors, according to the precise duty to be performed, and the location in which the fan is to work.

I claim as my invention:

1. A centrifugal fan wheel comprising a back disk, a front coned ring, and numerous blades fastened between said disk and ring, their inner portions occupying radial planes, their outer or tip portions occupying planes at an angle approximating sixty degrees to said radial planes, and their intermediate portions curved in approximately the segment of a cylinder having a radius about one-fourth the radius of the fan wheel.

2. A centrifugal fan wheel having approximately sixteen blades fastened between a back disk and front ring, the inner portions of the blades occupying radial planes for a distance of approximately one-fifth the radius of the wheel, their outer or tip portions occupying oblique planes for a distance approximating one-sixteenth the radial dimension of the wheel, said planes being approximately sixty degrees from said radial planes, and the intermediate portions of the blades curved in approximately the segment of a cylinder having a radius about one-fourth the radius of the fan wheel.

3. A centrifugal fan wheel comprising a back disk, a front coned ring, and numerous blades fastened between said disk and ring, their radial dimension at said disk approximating one-half the radius of the wheel and at said ring approximating one-third such radius, their inner edges being inclined to the axis and their outer edges approximately parallel therewith, their inner axial dimension being approximately seven-tenths, and their outer axial dimension being from four to five-tenths the radial dimension of the wheel, the inner portions of the blades occupying radial planes, and the blades being thence curved forwardly, and terminating in oblique tip portions.

4. A centrifugal fan comprising a spiral casing having a central inlet on one side and a tangential outlet, and a fan wheel revoluble therein, having a back disk opposite said inlet and a front ring adjacent said inlet, with approximately sixteen blades fastened between said disk and ring, the inner edges of the blades being inclined to the axis and approaching it most closely at the disk side, their inner portions occupying radial planes, the blades being thence curved forwardly, and terminating in oblique tip portions, with their outer edges of shorter axial dimension than their inner edges, and the casing having its cut-off at a distance beyond the periphery of the wheel approximating one-fourth to one-fifth the radial dimension of the wheel.

5. A centrifugal fan comprising a spiral casing and a fan wheel revoluble therein, the casing having an inlet of an area approximating one-third of the area of the side of the wheel and an outlet having an area approximating four-fifths the area of the inlet, and the wheel having approximately sixteen blades with their inner portions occupying radial planes, their outer portions occupying oblique planes at an angle of approximately sixty degrees to said radial planes, and their intermediate portions curved between said respective planes.

6. A centrifugal fan wheel comprising numerous blades their inner portions occupying radial planes, their outer or tip portions occupying planes at an angle approximating 60 degrees to said radial planes, and their intermediate portions curved in approximately the segment of a cylinder having a

radius about one-fourth the radius of the fan wheel.

7. A centrifugal fan wheel comprising numerous blades their inner portions occupying approximately radial planes, their outer or tip portions directed at an angle approximating 60 degrees to said radial planes, and their intermediate portions curved in approximately the segment of a cylinder.

8. A centrifugal fan wheel comprising numerous blades their inner portions approximating to radial planes, their outer or tip portions occupying oblique planes for a distance approximating one-sixteenth the radial dimension of the wheel, and their intermediate portions curved in approximately the segment of a cylinder.

9. A centrifugal fan wheel comprising numerous blades their inner portions occupying approximately radial planes for a distance of approximately one-fifth the radius of the wheel, their outer or tip portions occupying oblique planes, and their intermediate portions curved in approximately the segment of a cylinder.

10. A centrifugal fan wheel having approximately 16 blades, the inner portions of the blades occupying approximately radial planes, their outer or tip portions occupying oblique planes, and their intermediate portions curved in approximately the segment of a cylinder having a radius approximating one-fourth the radius of the fan wheel.

11. A centrifugal fan wheel comprising numerous blades with their outer edges approximately parallel to the axis and their inner edges inclined thereto, their radial dimensions at the inlet approximating one-third the radius of the wheel and at the point remote from the inlet approximating one-half such radius, the inner portions of the blades occupying approximately radial planes, the blades being thence curved forwardly and terminating in oblique tip portions.

12. A centrifugal fan comprising a spiral casing having a central inlet and a tangential outlet, with a fan wheel revoluble therein having numerous blades with their inner edges inclined toward the axis and approaching it as they recede from the inlet, the inner portions of the blades occupying approximately radial planes, the blades being thence curved forwardly and terminating in oblique tip portions.

13. A centrifugal fan comprising a spiral casing having a central inlet and a tangential outlet, and a fan wheel revoluble therein having numerous blades curved forwardly with their outer portions planes inclined at approximately 60 degrees to radii tangenting their curved portions.

14. A centrifugal fan comprising a spiral casing having a central inlet and a tangential outlet, and a fan wheel revoluble therein having numerous blades curved forwardly with their outer or tip portions directed to an angle approximating 60 degrees from a radius tangenting such curved portion of the blade.

15. A centrifugal fan comprising a spiral casing and a fan wheel revoluble therein, said casing having an inlet of an area approximating one-third the area of the side of the wheel, and an outlet having an area approximating four-fifths the area of the inlet, and the wheel having numerous blades curved forwardly with their outer portions occupying oblique planes.

16. A centrifugal fan wheel comprising numerous blades, their inner and outer portions approximating planes, with a curved intermediate portion, the outer portions turned forwardly at an angle approximating 60 degrees to the radius.

17. A centrifugal fan wheel comprising numerous blades, their inner and outer portions approximating planes, with a curved intermediate portion approximating the segment of a cylinder of a radius one-fourth the radius of the wheel, and the outer portions turned forwardly.

18. A centrifugal fan wheel comprising numerous blades, their inner portions approximating to radial planes for a distance approximating one-fifth the radius of the wheel, their outer portions turned forwardly and their intermediate portions curved in the segment of a cylinder.

19. A centrifugal fan wheel comprising numerous blades, their inner portions approximating to radial planes, their outer portions turned forwardly for a distance approximating one-sixteenth the radius of the wheel, and their intermediate portions curved in the segment of a cylinder.

20. A centrifugal fan wheel comprising numerous blades, their inner portions approximating to radial planes for a distance approximating one-fifth the radius of the wheel, their outer portions turned forwardly for a distance approximating one-sixteenth the radius of the wheel, and their intermediate portions curved in the segment of a cylinder.

21. A centrifugal fan wheel comprising numerous blades, their inner portions approximating to radial planes for a distance approximating one-fifth the radius of the wheel, their outer portions turned forwardly for a distance approximating one-sixteenth such radius, and their intermediate portions curved in the segment of a cylinder.

22. A centrifugal fan wheel comprising numerous blades, their inner portions approximating planes, their outer portions approximating planes turned forwardly at an angle approximating 60 degrees to the radius, and their intermediate portions curved in the segment of a cylinder having a radius

approximately one-fourth the radius of the wheel.

23. A centrifugal fan wheel comprising numerous blades having approximately plane inner and outer portions at angles of approximately 60 degrees to each other, and an intervening curved portion, the outer portions projecting obliquely forward.

24. A centrifugal fan wheel comprising numerous blades, their outer portions approximating planes turned forwardly at an angle of approximately 60 degrees to the radius, and their intermediate portions curved thence toward a radial plane.

25. A centrifugal fan wheel comprising numerous blades, their outer portions approximating planes turned forwardly at an angle of approximately 60 degrees to the radius, and their intermediate portions curved on a radius approximating one-fourth the radius of the wheel.

26. A centrifugal fan wheel comprising numerous blades, their outer portions approximating planes turned forwardly for a distance approximating one-sixteenth the radius of the wheel at an angle of approximately 60 degrees to the radius, and their intermediate portions curved on a radius approximating one-fourth the radius of the wheel.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

FREDERICK R. STILL.

Witnesses:
E. H. VITALIUS,
G. A. SNELLING.