S. C. DAVIDSON.

CENTRIFUGAL FAN AND PUMP.

APPLICATION FILED DEC. 16, 1907.

1,143,365.

Patented June 15, 1915.

3 SHEETS—SHEET 1.

Fig. 3.

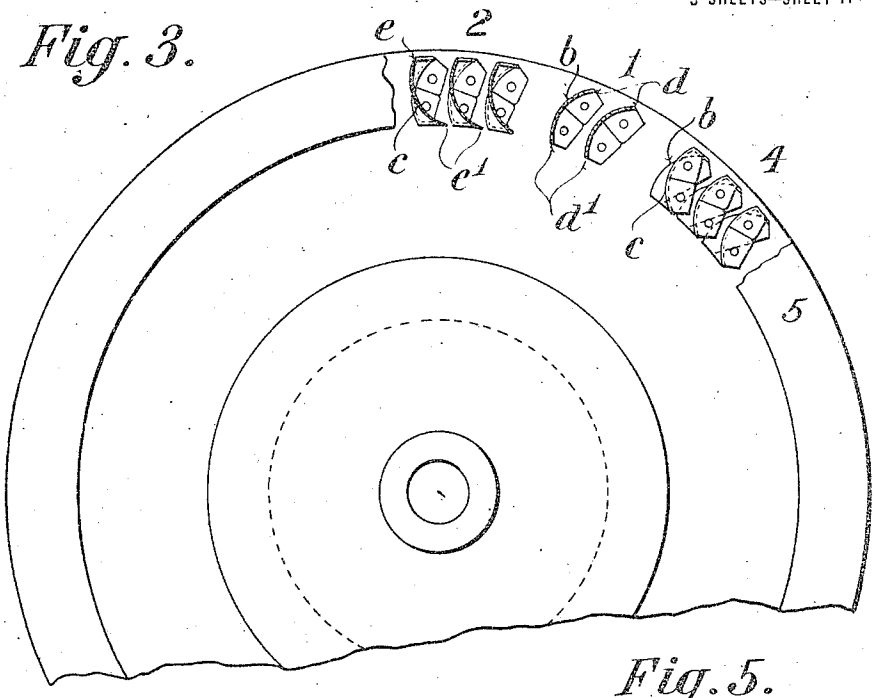
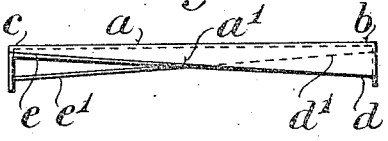


Fig. 5.



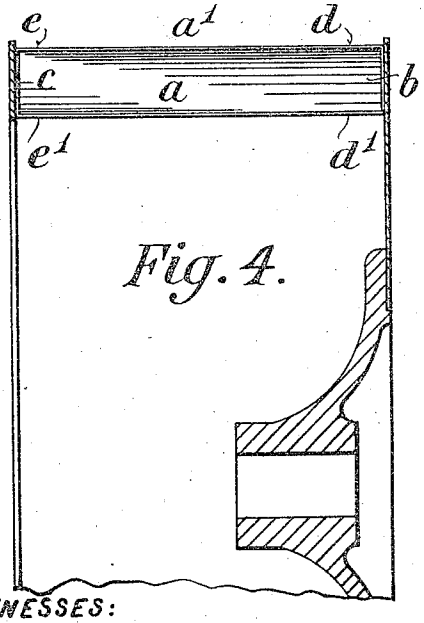
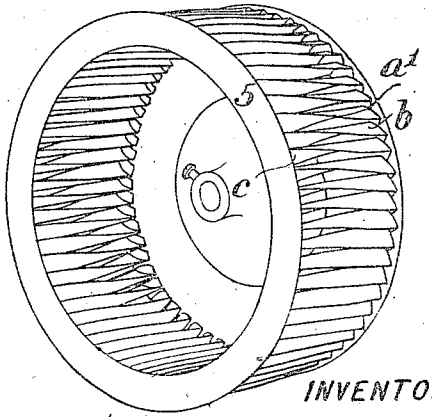


Fig. 4.

Fig. 1.



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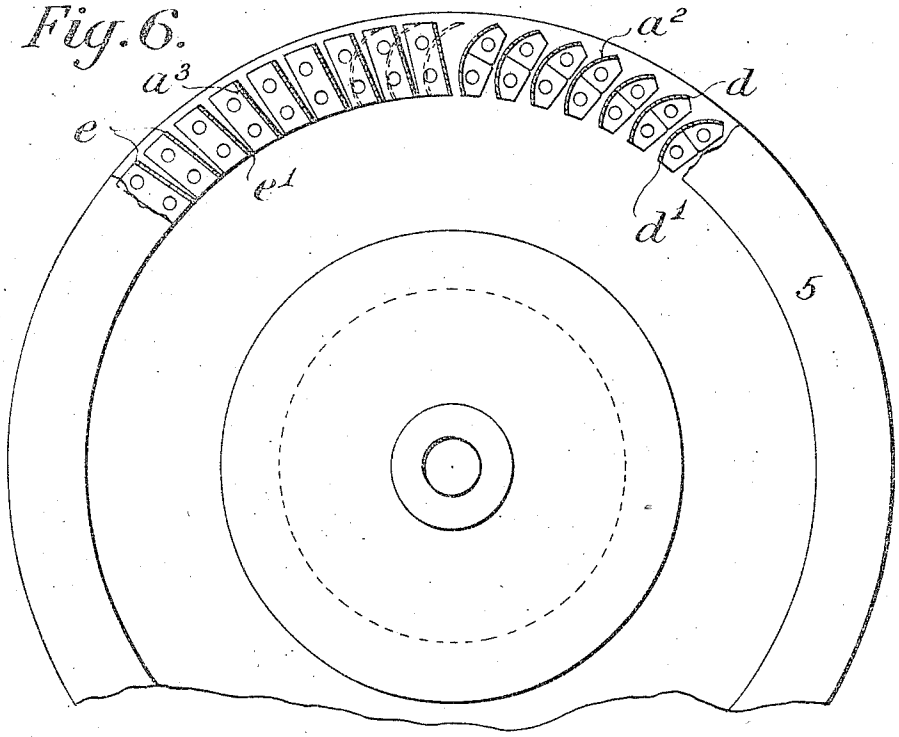
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3 SHEETS—SHEET 2.

Fig. 6.



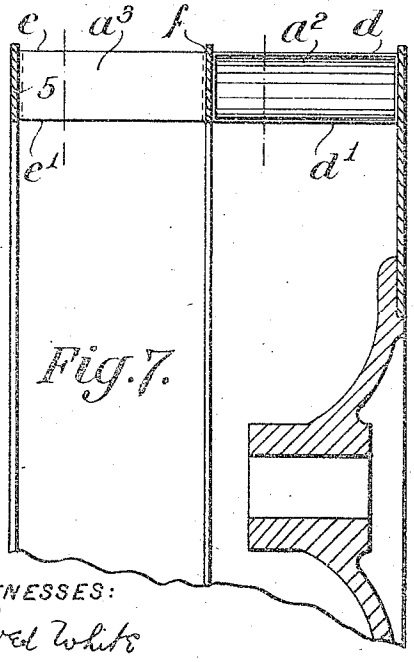
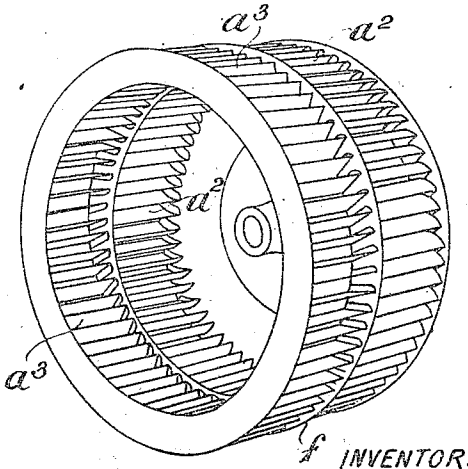


Fig. 7.

Fig. 2.



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3 SHEETS—SHEET 3.

Fig. 8.

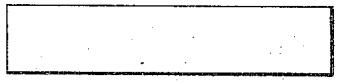


Fig. 9.



Fig. 10.

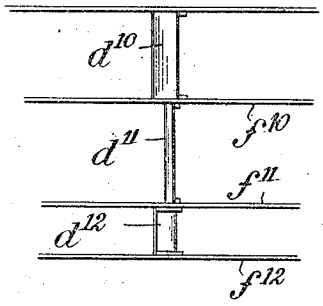


Fig. 12.

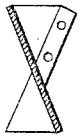
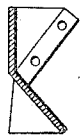


Fig. 11.



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UNITED STATES PATENT OFFICE.

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CENTRIFUGAL FAN AND PUMP.

1,143,365. Specification of Letters Patent. Patented June 15, 1915.

Application filed December 16, 1907. Serial No. 406,653.

To all whom it may concern:

Be it known that I, SAMUEL CLELAND DAVIDSON, of Sirocco Engineering Works, Belfast, Ireland, merchant, have invented certain new and useful Improvements in Centrifugal Fans and Pumps, of which the following is a specification.

My improvements relate to the blades or vanes of centrifugal fans or pumps (hereinafter called fans) wherein the fluid operated on enters axially and centrally and is discharged circumferentially, and said improvements are more particularly applicable to fans of the type described and shown in the specification of my prior United States Patent No. 662,395, dated 27th, November, 1900.

I have found in practice that in centrifugal fans and particularly in those of the multi-bladed type there is a tendency to set up a centripetal movement of the air at that end of the fan into which the fluid enters (hereinafter called the intake end of the fan). This tendency is particularly noticeable when the blades are given the best shape to produce the maximum centrifugal effect, namely, when the outer edges are inclined forwardly in the direction of rotation. At the intake ends of the blade this forward inclination is apt to increase the centripetal action by cutting into the stream of fluid and wedging it inward. I have found that, if the disk end of the blade (or that end of the blade which is opposite the intake end) has its outer edge extended in the direction of rotation in advance of the same edge at the intake end, this tendency is to a considerable extent counteracted. The best results are obtained, however, when the disk end of the blade is inclined forwardly in the direction of rotation to a greater extent than the intake end of the blade. By preference the intake end of the blade has its outer edge inclined even to a certain extent rearwardly in a direction opposite the direction of rotation, so that a distinct outwardly wedging action takes place at the intake end of the fan, entirely counteracting the tendency to centripetal flow at the end of the fan where this tendency exists; while the remaining parts of the blades are shaped to carry the air with them and discharge it centrifugally as set forth in the previously mentioned patent. The invention is applicable to any of the types of blade illustrated in such patent which are flat, curved or bent in cross section. It is also applicable to those blades which are parallel sided or tapered either in their original flattened or blank form or in their completed form. The blades are preferably twisted or extended in a helical or curved line, so that the disk end of the blade extends forwardly in the direction of rotation, while preferably the intake end extends rearwardly, that is to say, with its inner edge leading its outer edge.

Reference to the following drawings will more fully explain the nature of my invention, and how same is carried into effect.

Figure 1 is a perspective view of the improved fan wheel. Fig. 2 is a similar view to Fig. 1 having the blades formed in two parts in alinement. Fig. 3 is a part elevation of the improved fan wheel shown in Fig. 1 looking into the intake end showing some of the blades in section and others in end elevation. Fig. 4 is a part view of Fig. 1 in section. Fig. 5 is a plan view of one of the blades shown in Fig. 1. Fig. 6 is a part sectional elevation of the improved fan wheel shown in Fig. 2. Fig. 7 is a part sectional view of Fig. 2. Fig. 8 is a plan of a blank form showing a parallel sided blade. Fig. 9 is a similar plan showing a tapered blade. Fig. 10 is a plan view of a single blade composed of several sections mounted upon suitable rings. Fig. 11 is a section of a bent or angular blade taken close to the intake end, and showing the disk end extended forwardly in the direction of rotation. Fig. 12 is a similar view of a warped blade made of flat plate showing the disk end extended forwardly, and the intake end extended rearwardly.

That part of the blades which is farthest from the intake will be referred to as the "disk end" being usually attached to a disk as shown; that end of the blades which is nearest the intake end of the fan will be referred to as the "intake end".

Referring to Figs. 1, 3, 4 and 5, the blades here shown are of considerable axial length and small radial depth, and inclose a central cylindrical intake chamber. The line of the outer, and that of the inner edges of the blades *a* instead of being substantially

parallel to one another, and to the axis of the fan as in the prior patent referred to, cross one another at about the center of their length at a', (Figs. 4 and 5), in opposite directions, through a plane at right angles to the axis so that the body of the blade between the two extreme ends thereof is twisted to this extent like an Archimedean screw. b is the part of the blade which is at the disk end, and farthest away from the intake end of the fan and c the part nearest the intake end. d is the outer edge or tip of the blade at the part b while e is the outer edge of the blade at the part c. d' and e' are respectively the inner edges of the respective ends of the blades. The blades are so set that the part d of the outer edge is farther forward in the direction of rotation than the corresponding part e at the intake end, and the inner edge at d' is behind the corresponding edge at e'.

In Fig. 3 at 1 is shown the section of the blades at or near the disk ends and at 2 is shown the section of the blades at the intake end at 4 is shown an end view of the blades looking from the intake end with the connecting ring (5) broken away. This said ring is employed to connect the intake ends of the blades together. Other forms of this ring may be employed as described in the said prior patent.

Referring to Figs. 2, 6 and 7, which illustrate another modification of the blades, f is an annular disk dividing the blades into two sections a^2 and a^3, a^2 being the section which is at the disk end and farthest away from the intake end of the fan. The outer and inner edges d e and d' e' of the blades a^2 and a^3 respectively are approximately parallel but so set in relation to each other that the outer edges d of the sections a^2 at the disk end project in advance of the inner edges d' in the direction of rotation, while the inner edges e' on the other section at the intake end of the blades is in advance of the outer edge e. These figures show a fan wheel with two sections of blades of equal lengths, but they may be of unequal lengths or more than two sections may be employed; all the sections may be in alinement, and the outer edge of each section may be set forward relatively to the preceding one in step-like formation, progressively advancing from the eye end toward the disk end thus giving the screw effect previously described; an annular disk such as f will preferably be fitted between each pair of sections, and the ends of the blade sections attached thereto, but it will be obvious that the several sections in alinement may, if required, be fastened the one to the other. Such a construction is shown in Fig. 10. In this construction the blade is formed in three sections, one of which d^{10} is next to the disk end of the fan and is tilted forwardly in the direction of rotation. The second d^{11} approximates one of the radii of the fan, and a third section d^{12} is tilted rearwardly. The disks f^{10} f^{11} and f^{12} serve to support the ends of the various sections.

The cross section of the blades in the above described Figs. 1, 3, 4 and 5, is curved, but my invention is also applicable to blades which are so angled in cross section as to form a shallow trough, an example being shown in Fig. 11, or to blades which in cross section are approximately flat or radial (see Fig. 12), or as shown by the cross sections of blades in Fig. 6, that part of the combined blade a^2 farthest from the intake end may be curved in cross section while the part of the blade nearest the intake end may be flat or warped from a flat plate.

The above description refers to fans in which the fluid operated on enters on one side only, but said description also applies to fans wherein it enters at both or opposite ends of the fan wheel, and which construction is known as "double intake", by merely considering each double intake fan as consisting of two separate single intake fans so connected together that their intake ends point oppositely, with the blades suitably adjusted for clockwise rotation in the one, and for anti-clockwise rotation in the other.

What I claim and desire to secure by Letters Patent is:—

1. A centrifugal fan wheel of the multi-blade drum type, comprising twisted blades the outer edges of which extend forwardly in a helical curve from the inlet end to the opposite end.

2. A centrifugal fan wheel of the multi-blade drum type, comprising blades which at the disk end have their outer edges in advance of their inner edges, and twisted so that in approaching the inlet end such advance progressively diminishes.

3. A centrifugal fan wheel of the multi-blade drum type, comprising blades curved in cross section with their concave sides in advance, and their outer edges leading at the disk end, and twisted to progressively diminish such lead toward the intake end.

4. A centrifugal fan wheel of the multi-blade drum type, comprising twisted blades the outer portions of which at the intake end are approximately radial, and at the disk end approximately tangential and project forwardly.

5. A centrifugal fan wheel of the multi-blade drum type, comprising twisted blades curved in cross-section the outer portions of which at the intake end are approximately radial, and at the disk end are approximately tangential and project forwardly.

6. A centrifugal fan wheel of the multi-blade drum type, comprising twisted blades curved in cross-section, their intake ends

having their inner edges in advance, and their disk ends having their outer edges in advance.

7. A centrifugal fan wheel of the multi-blade drum type, comprising twisted blades curved in cross-section, their intake ends having their inner edges in advance and their outer portions approximately radial, and their disk ends having their outer edges in advance.

8. A centrifugal fan or pump wherein the fluid is drawn in axially and discharged circumferentially, comprising a fan shaft, a disk mounted thereon, and blades extending substantially parallel with the axis so as to form a drum-like structure inclosing a central intake chamber, said blades having their outer edges toward the disk end advanced beyond that portion of the outer edge which is nearest the intake end.

9. A centrifugal fan or pump wherein the fluid is drawn in axially and discharged circumferentially, comprising a fan shaft, a disk mounted thereon, and blades extending substantially parallel with the axis so as to form a drum-like structure inclosing a central intake chamber, the outer edges of said blades being inclined forwardly progressively from the intake toward the disk end.

10. A centrifugal fan or pump wherein the fluid is drawn in axially and discharged circumferentially, comprising a fan shaft, a disk mounted thereon, and blades extending substantially parallel with the axis so as to form a drum-like structure inclosing a central intake chamber, the outer edges of said blades being inclined forwardly progressively from the intake toward the disk end, and said blades twisted so that their inner edges are inclined at a different angle.

11. A centrifugal fan or pump wherein the fluid is drawn in axially and discharged circumferentially, comprising a fan shaft, a disk mounted thereon, and blades extending substantially parallel with the axis so as to form a drum-like structure inclosing a central intake chamber, the outer and inner edges of the blades being inclined relatively to the axis from one end to the other at opposite angles.

12. A centrifugal fan or pump wherein the fluid is drawn in axially and discharged circumferentially, comprising a fan shaft, a disk mounted thereon, and blades extending substantially parallel with the axis so as to form a drum-like structure inclosing a central intake chamber, the outer and inner edges of the blades being inclined relatively to the axis from one end of the blade to the other at opposite angles, the opposite inclinations meeting and crossing midway of the blade.

13. A centrifugal fan or pump wherein the fluid is drawn in axially and discharged circumferentially, comprising a fan shaft, a disk mounted thereon, and blades extending substantially parallel with the axis so as to form a drum-like structure inclosing a central intake chamber, and said blades being of helical formation.

14. A centrifugal fan or pump comprising a series of elongated blades arranged in drum form to form a central intake chamber, and adapted to draw in the fluid axially and discharge it circumferentially, such blades having their disk ends inclined in the direction of rotation to a greater extent than their intake ends.

15. In a centrifugal fan or pump comprising a rotary member having numerous elongated blades arranged lengthwise in approximately axial direction and in substantially drum form so as to inclose within them a relatively large intake chamber, said blades having their outer edges at the disk end extended in the direction of rotation in advance of the same edges at the intake end of the blades.

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

SAMUEL CLELAND DAVIDSON.

Witnesses:

WILLIAM AUGUSTUS BENEY,

WILLIAM WATSON.