No. 662,525. Patented Nov. 27, 1900.

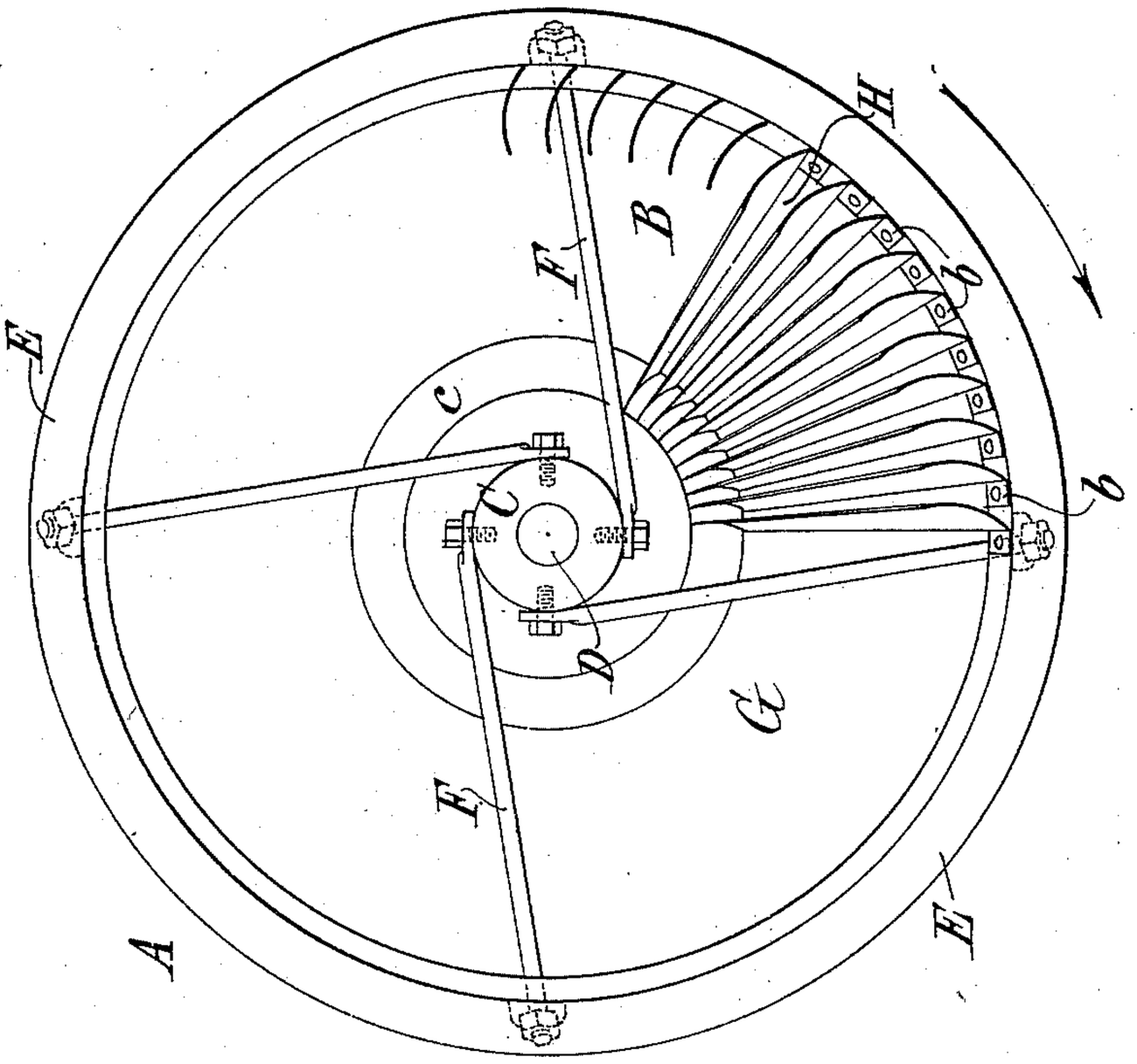
S. C. DAVIDSON.

CENTRIFUGAL FAN OR PUMP.

(Application filed Nov. 28, 1899.)

(No Model.) 2 Sheets—Sheet 1.

FIG. 2.



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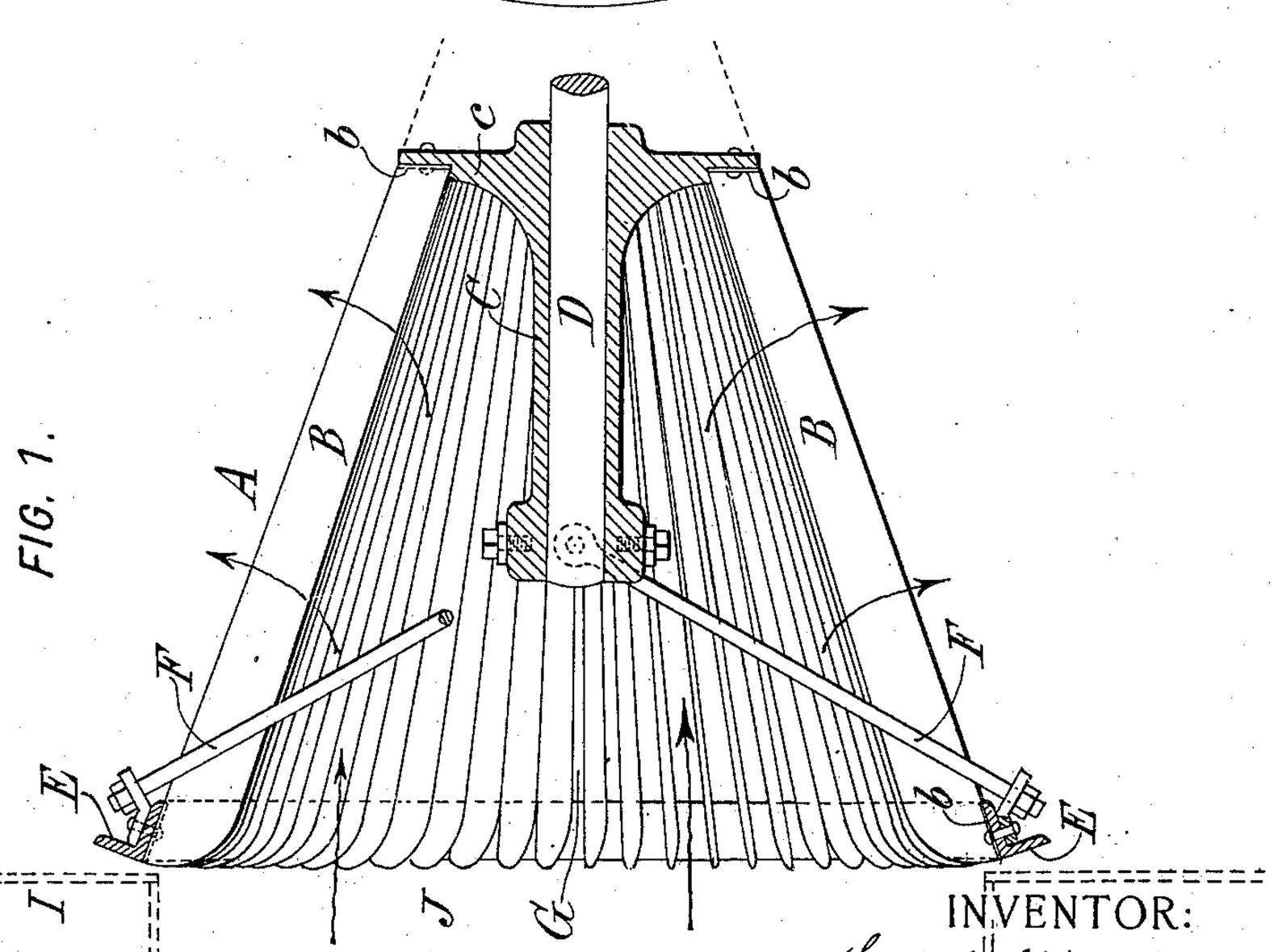

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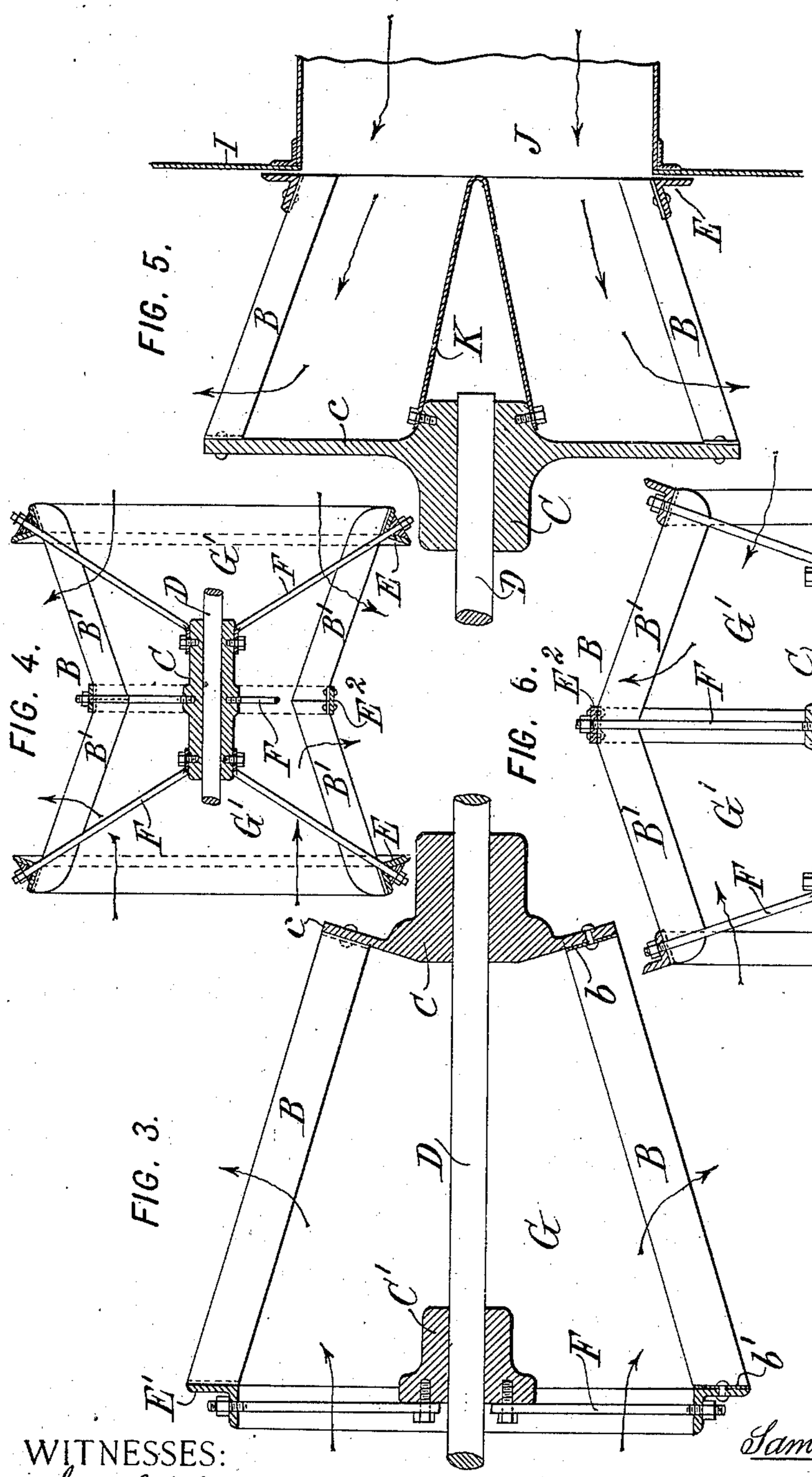

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UNITED STATES PATENT OFFICE.

SAMUEL CLELAND DAVIDSON, OF BELFAST, IRELAND.

CENTRIFUGAL FAN OR PUMP.

SPECIFICATION forming part of Letters Patent No. 662,525, dated November 27, 1900.

Application filed November 28, 1899. Serial No. 738,506. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL CLELAND DAVIDSON, a subject of the Queen of Great Britain, residing in Belfast, Ireland, have invented certain new and useful Improvements in Centrifugal Fans or Pumps, of which the following is a specification.

My invention relates to that class of centrifugal fans or pumps in which the fluid operated on is taken in axially and discharged circumferentially.

My present application is supplementary to my application filed September 21, 1898, Serial No. 691,495, and is designed to protect a construction covered generically by said application, but involving certain deviations from the constructions therein shown. In my said application I have described and claimed a fan or pump the rotary member of which is constructed with numerous thin elongated blades arranged in substantially drum form, being extended in approximately axial direction, so as to inclose within them a relatively large and practically-unobstructed intake-chamber, and said blades in transverse section being arranged relatively to the axis and direction of rotation to carry the fluid with them rotatively and discharge it tangentially, and said rotary member is so mounted as to permit the tangential escape of the fluid discharged from its blades. The blades, which are preferably made of thin sheet metal, are so numerous as to follow each other in close succession, being spaced apart preferably a distance approximating two-thirds of their radial depth, or it may be as much as twice such depth. The blades may be flat and arranged in radial planes, or they may be made in two or more planes at an angle to each other, or they may be formed as curved plates, their concaves being on the forward or advancing side. In the constructions shown in my said application the blades are extended in a direction parallel to the axis of rotation. According to my present invention the blades while still arranged in approximately axial direction are extended obliquely to the axis of rotation, so as to be materially out of parallel therewith.

In this specification the word "fan" is understood as including a pump. The word "axially" means in a direction coincident with or parallel with the axis of rotation. The word "blades" is used to indicate the vanes or wings which impart motion to the fluid. The expression "intake-chamber" is employed to indicate a chamber or space inclosed within the series of blades. The word "eye" is used to designate the inlet-opening in the casing or stationary member of the fan, through which opening the fluid enters the intake-chamber. By the "intake end" of the blades is understood that end which is nearest the eye. The "length" of the blades is their axial measurement, the "depth" of the blades is their width measured radially from the inner to the outer edge, and the "ports" are the intervening spaces between the blades.

One purpose of my present invention is to provide means by which the efficiency of any portion of the blades may be increased or diminished. When the blades are arranged parallel to the axis of rotation, as shown in my said application, I have found in practice that those portions of the blades which are nearest the intake end of the fan show the least efficiency and that the efficiency rises rapidly toward the opposite ends of the blades. The efficiency of the blades also increases or diminishes with their speed. According to my present invention I provide for varying the efficiency of different portions of the blades by so arranging the blades obliquely to the axis of rotation as to impart varying speeds to their different portions. My invention also provides for varying the efficiency of different portions of the blades by making them of varying width or depth and also by varying the widths of the ports between the blades.

My present invention provides a fan the intake-chamber of which is in the form of a truncated cone.

I will proceed to describe certain forms of my invention with reference to the accompanying drawings, wherein—

Figure 1 is a diametrical section of the preferred form of my improved fan. Fig. 2 is an end view looking into the intake-chamber, only a few of the blades being shown; and Figs. 3 to 6 are diametrical sections showing modified forms of my device.

Referring first to Figs. 1 and 2, let A indi-

cate the rotary member of the fan as a whole; B, the blades; C, the hub, and D the operating-shaft. A casing may be used or not. A partial casing or fixed member of the fan is shown in dotted lines at I in Fig. 1, the eye or opening through it being lettered J. Any suitable means for supporting the blades may be employed. The blades are shown as supported at their inner ends by a disk *c*, formed integrally with the hub, and at their outer ends by an annular support E, which is shown as connected to the hub C by adjustable stays F. The blades B are formed at each end with suitable flanges *b*, by means of which they are riveted or otherwise fixed to the supports *c* and E. As shown, the blades B extend obliquely to the axis of rotation and inclose within them an intake-chamber G of the form of a truncated cone. This arrangement has the effect of increasing the speed of the blades at the larger end of the fan, the speed gradually decreasing toward the smaller end thereof. This increase of speed is accompanied by a proportionate rise in efficiency of the larger end of the fan, and when this end is open, as in Figs. 1 and 2, the loss of efficiency experienced at this end of a cylindrical fan is reduced. Thus in a fan of substantially the proportions shown in Figs. 1 and 2 the discharge is equalized to such an extent that an approximately uniform efficiency is maintained at all points between the ends of the fan. Another effect of this arrangement is that the ports H between the blades are wider at the end of the fan having the greater diameter and diminish gradually toward the smaller end of the fan, and in the construction of Figs. 1 and 2 the intake ends of the ports are correspondingly widened. This effect is advantageous within certain limits and to an extent also increases the efficiency of the intake end of the fan.

Another feature of my invention resides in making the blades of varying depth, as shown in Fig. 1, the blades being widest in radial direction at the larger end of the fan and tapering toward the smaller end.

In Fig. 3 is shown a modification of Figs. 1 and 2, in which the ports between the blades are closed at their intake ends by the support E′, the stays F being in this case connected to a supplemental hub C′, fixed to the operating-shaft, as shown. The blades B B are here shown as parallel-sided, with square ends, which are formed with flanges *b*′, which are riveted to the support E′. The ends of the blades are thus rigidly supported, this construction being suitable for use at high speeds or with heavy fluids.

My invention is applicable to a fan which is open at both ends, so that the fluid operated on is taken in axially through both ends thereof. This form of fan is set forth in my application filed November 20, 1899, Serial No. 737,597. With a fan of this construction I preferably arrange the blades in such manner that practically two intake-chambers G′ G′ are formed, each of approximately the shape of a truncated cone. In Fig. 4 the intake-chambers are formed so that their smaller ends meet, the blades B being formed in two parts B′ B′, and at their junction these parts may be supported by a middle support E^2. In this form of fan two supports E E are used in addition to the middle support, and each support is connected by stay-rods F F to the hub, which is shown as fixed to the operating-shaft about midway between the ends of the fan. The effect of the construction shown in this figure is to increase the efficiency at the ends of the fan, and thus substantially equalize the discharge from all points of the circumference.

In the forms thus far described the circumferential discharge is modified by increasing the efficiency of the intake end or ends of the fan, thereby tending to equalize the discharge. This is an important advantage, for the reason that the volumetric discharge of the fan as a whole is increased. It is, however, within my invention to increase the efficiency of the inner end of the fan by increasing the diameter of that end, thereby forming the intake-chamber as a truncated cone open at its smaller end. This form is shown in Fig. 5, the intake end being shown as facing a casing I. A part of the space of the intake-chamber may be filled, if desired, by a conical member K. In this form of fan the disk *c* is enlarged and the annular support E is reduced in diameter. Practically the same effect may be obtained in a fan which is open at both ends, this form being shown in Fig. 6. In this figure the intake-chambers G′ G′ are each in the form of a truncated cone, the two chambers connecting, with their larger ends adjacent. The effect of this construction is that the efficiency is greatest at the middle portion of the fan and falls rapidly toward the ends.

It will be observed that in all of the forms shown the intake-chamber is of conical shape, or, more properly, it is in the form of a truncated cone. The exact degree of obliquity of the blades to the axis of rotation is not essential. In practice I prefer it should be such if the medial lines of two diametrically-opposite blades were prolonged to a meeting-point that the angle thus formed should be considerably less than a right angle. In other words, it is essential that the space inclosed within the series of blades should be, practically, a chamber and not a mere depression. In the preferred form the length of the chamber is greater than its diameter.

The rotary member may be supported from its operating-shaft in any suitable manner, that shown being preferred, because of the strength and lightness of construction and because it allows a practically-unobstructed intake-chamber, which is a very important feature in the construction of centrifugal fan shown.

It is essential to my invention that the fan-

blades shall be adapted to carry the fluid with them rotatively, so that it shall be thrown outward by centrifugal force and be discharged tangentially, in contradistinction to merely exerting a wedge-like action upon the fluid, tending to thrust it outwardly in radial direction unaccompanied by any material rotation or whirling of the fluid. The operation of my fan when propelling air is accompanied by the existence of a thin shell or film of rapidly-whirling air immediately surrounding the drum-like series of blades, which air is apparently compressed, and outside of this shell the air passing through the fan discharges tangentially.

To realize the advantages of my invention, it is practically essential that the inflow of fluid to the intake-chamber be unobstructed and that the inlet-opening be of the full diameter of said chamber, as any throttling of this opening results in a proportionate diminution of volumetric efficiency. It is also practically essential that the whirling fluid discharged from the fan-blades shall be permitted to escape tangentially outward therefrom, as any attempt to divert the revolving fluid inwardly results in a rapid diminution of efficiency; but the whirling fluid can be collected in a casing, and if the outlet from this casing be arranged beyond the radius of the circle described by the outer edges of the blades the fluid will freely escape through said outlet, its whirling motion being thereby resolved into a direct motion, after which it can be led through a suitable conduit in any desired direction.

I claim as my invention the following-defined novel features, substantially as hereinbefore specified, namely:

1. A centrifugal fan or pump, comprising a rotary member having numerous elongated blades arranged obliquely to the axis of rotation, and in substantially drum form, so as to inclose within them a relatively large and practically-unobstructed conical intake-chamber, and in transverse section arranged, relatively to the axis and direction of rotation, to carry the fluid with them rotatively and discharge it tangentially, and a means for so mounting said rotary member as to permit the tangential escape of the fluid discharged from said blades.

2. A centrifugal fan or pump, comprising a rotary member having numerous elongated blades arranged obliquely to the axis of rotation, in conical order and in substantially drum form, with their outer edges converging toward the apex of a cone, and inclosing within their inner edges a relatively large and practically-unobstructed intake-chamber, and in transverse section arranged, relatively to the axis and direction of rotation, to carry the fluid with them rotatively and discharge it tangentially, and a means for so mounting said rotary member as to permit the tangential escape of the fluid discharged from said blades.

3. A centrifugal fan or pump, comprising a rotary member having numerous elongated blades arranged obliquely to the axis of rotation, and in substantially drum form, so as to inclose within them a relatively large and practically-unobstructed truncated conical intake-chamber, open at one end, and in transverse section arranged, relatively to the axis and direction of rotation, to carry the fluid with them rotatively and discharge it tangentially, and a means for so mounting said rotary member as to permit the tangential escape of the fluid discharged from said blades.

4. A centrifugal fan or pump, comprising a rotary member having numerous elongated blades arranged obliquely to the axis of rotation, and in substantially drum form, so as to inclose within them a relatively large and practically-unobstructed truncated conical intake-chamber, open at the end having the greater diameter, and in transverse section arranged, relatively to the axis and direction of rotation, to carry the fluid with them rotatively and discharge it tangentially, and a means for so mounting said rotary member as to permit the tangential escape of the fluid discharged from said blades.

5. A centrifugal fan or pump, comprising a rotary member having numerous elongated blades arranged obliquely to the axis of rotation, and in substantially drum form, so as to inclose within them a relatively large and practically-unobstructed truncated conical intake-chamber, and in transverse section arranged, relatively to the axis and direction of rotation, to carry the fluid with them rotatively and discharge it tangentially, an operating-shaft, and a support for said rotary member connected to said shaft, and a means for so mounting said rotary member as to permit the tangential escape of the fluid discharged from said blades.

6. A centrifugal fan or pump, comprising a rotary member having numerous elongated blades arranged obliquely to the axis of rotation, and in substantially drum form, so as to inclose within them a relatively large and practically-unobstructed conical intake-chamber, and in transverse section arranged, relatively to the axis and direction of rotation, to carry the fluid with them rotatively and discharge it tangentially, a hub, a support for one end of said rotary member fixed to said hub, and an annular support for the other end of said member connected to said hub, and a means for so mounting said rotary member as to permit the tangential escape of the fluid discharged from said blades.

7. A centrifugal fan or pump, comprising a rotary member having numerous elongated blades arranged obliquely to the axis of rotation, and in substantially drum form, so as to inclose within them a relatively large and practically-unobstructed conical intake-chamber, and in transverse section arranged, relatively to the axis and direction of rota-

tion, to carry the fluid with them rotatively and discharge it tangentially, a hub, a support for the smaller end of said rotary member fixed to said hub, and an annular support for the larger end of said member connected to said hub, and a means for so mounting said rotary member as to permit the tangential escape of the fluid discharged from said blades.

8. A centrifugal fan or pump, comprising a rotary member having numerous elongated blades arranged obliquely to the axis of rotation, and in substantially drum form so as to inclose within them a relatively large and practically-unobstructed conical intake-chamber, and in transverse section arranged, relatively to the axis and direction of rotation, to carry the fluid with them rotatively and discharge it tangentially, and said blades varying in width so as to form between them ports of varying depth, and a means for so mounting said rotary member as to permit the tangential escape of the fluid discharged from said blades.

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

SAMUEL CLELAND DAVIDSON.

Witnesses:

ARTHUR C. FRASER,

FRED WHITE.