No. 673,244. Patented Apr. 30, 1901.

S. C. DAVIDSON.

CENTRIFUGAL FAN OR PUMP.

(Application filed Oct. 11, 1899. Renewed Oct. 22, 1900.)

(No Model.) 2 Sheets—Sheet 1.

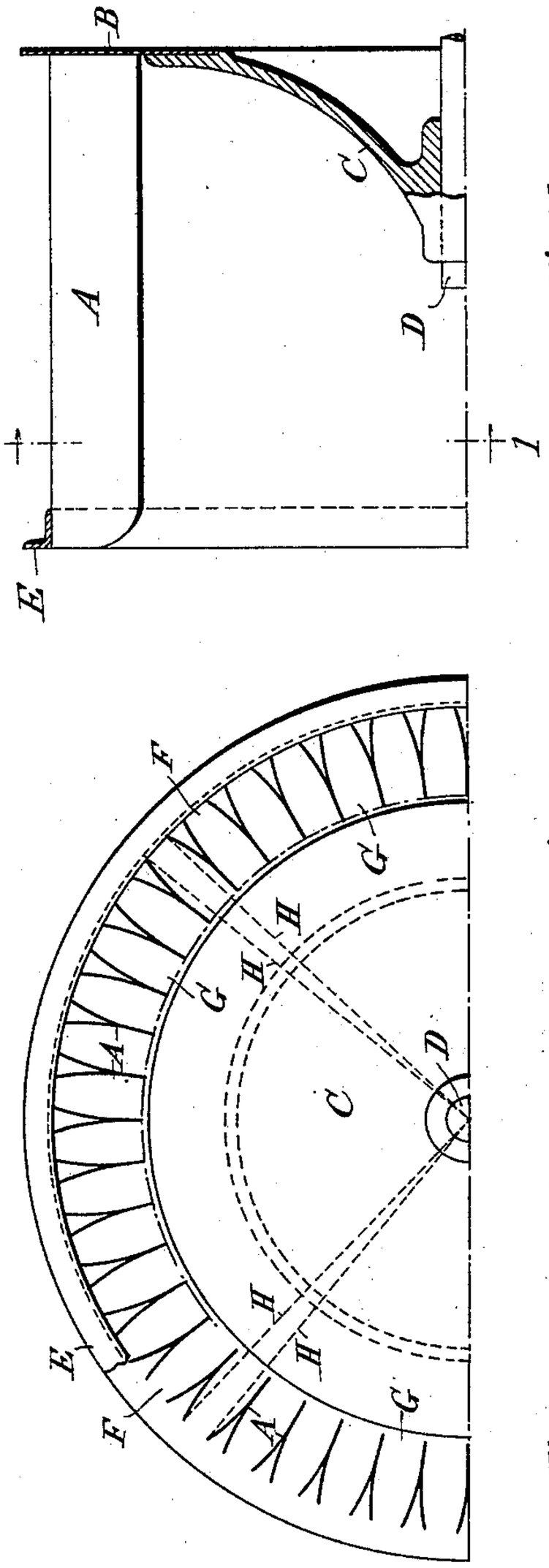

Fig. 2.

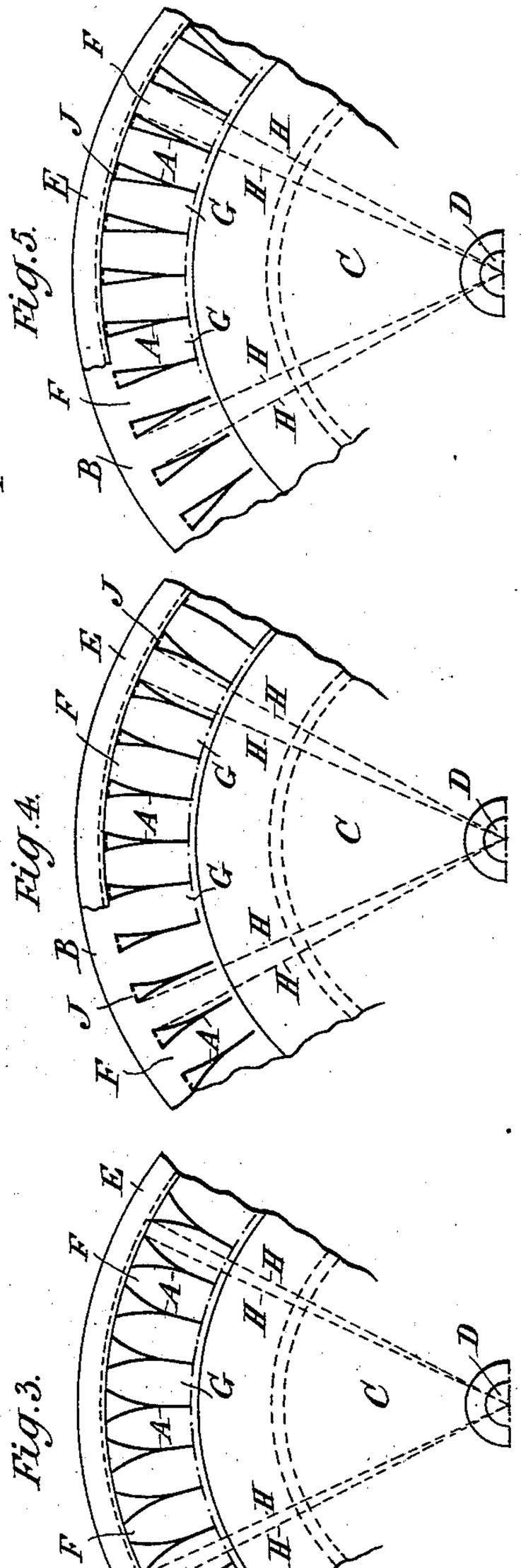

Fig. 5.

Fig. 1.

Fig. 4.

Fig. 3.

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Fig. 8.

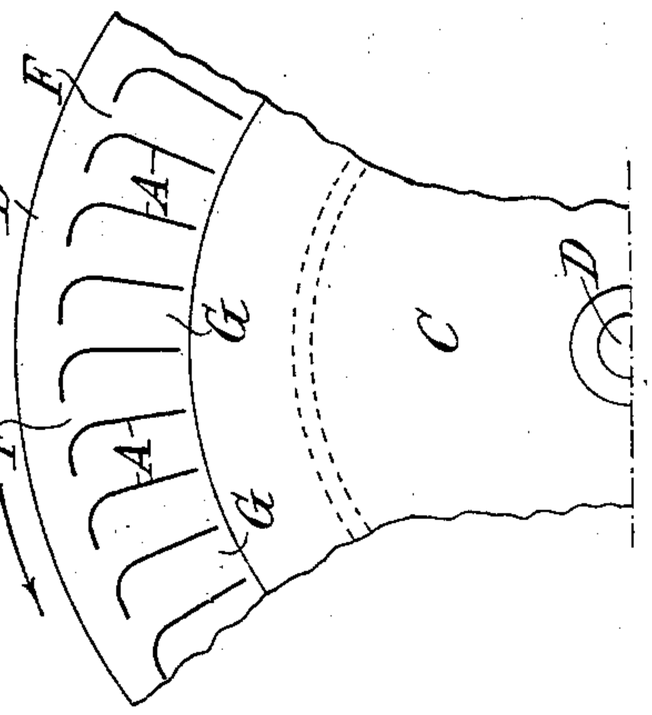


Fig. 7.

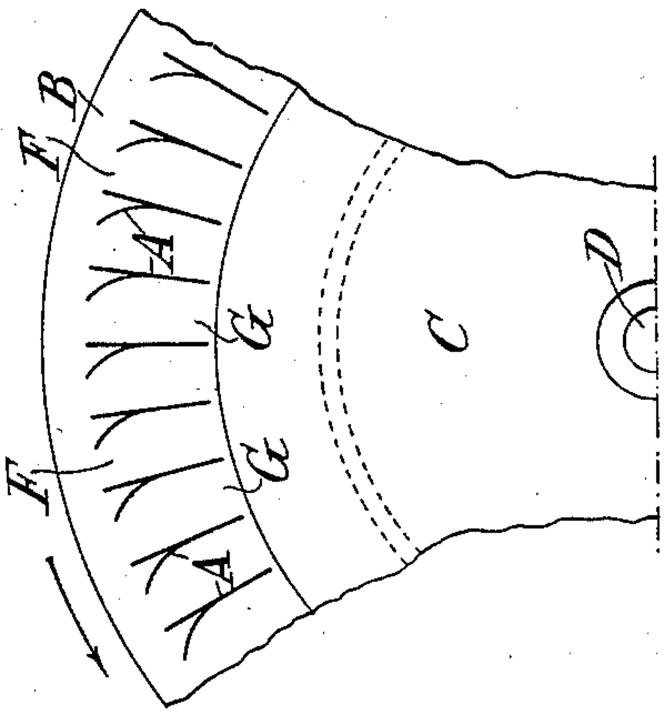


Fig. 10.

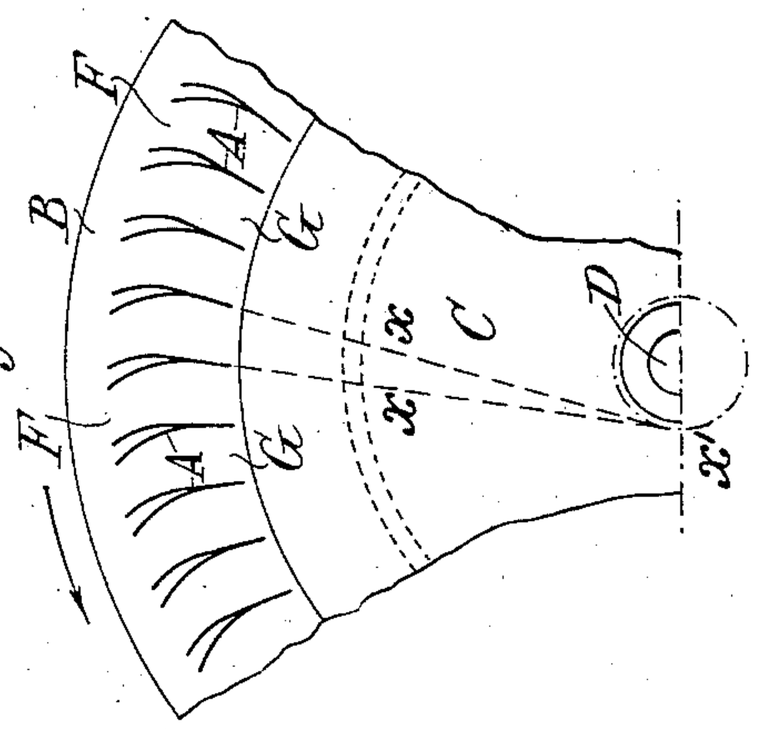


Fig. 9.

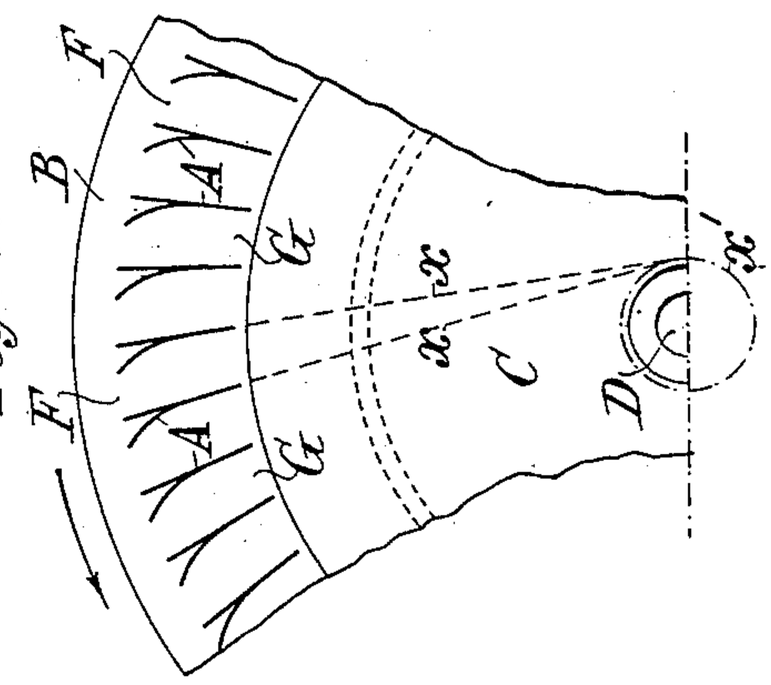
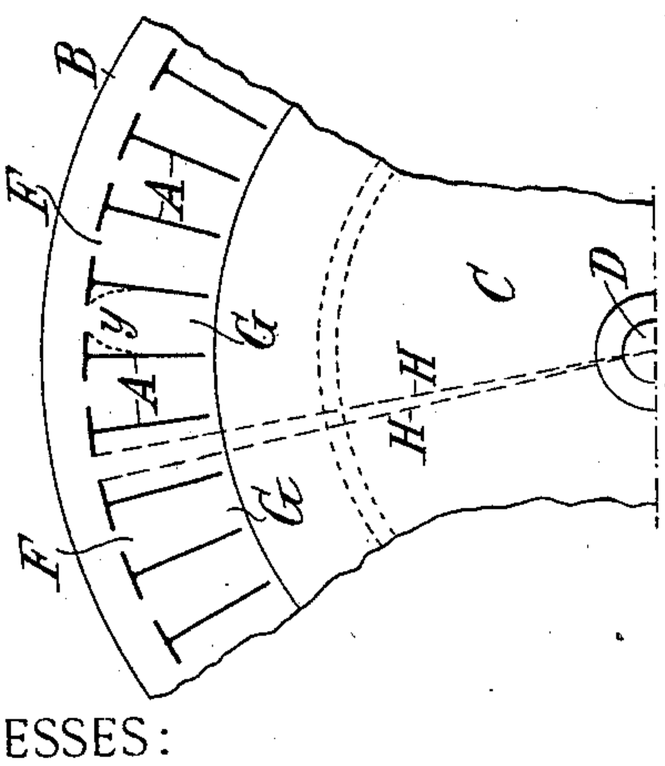


Fig. 6.



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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. 673,244, dated April 30, 1901.

Application filed October 11, 1899. Renewed October 22, 1900. Serial No. 33,901. (No model.)

To all whom it may concern:

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

This invention has reference to the type of centrifugal fans or pumps (hereinafter referred to as "fans") in which air, gases, vapor, or liquid (such, for instance, as air or water and which are hereinafter referred to as the "fluid") is drawn in axially and discharged circumferentially.

My improvements relate to the form and construction of the blades employed therein; and one of the chief objects thereof is to increase the operative efficiency of the fan, more especially in regard to its capability to either exhaust or propel the fluid dealt with against resistances or back pressures in order that a larger volume of the fluid operated on shall be drawn into the fan and discharged therefrom and at higher pressure relatively to the diameter of the fan and its speed of revolution than in fans as hitherto constructed, and a further object is to render the fan capable of operating with equal efficiency when rotated in either direction.

My invention is hereinafter described and shown as applied to fans in which the opening for admitting the fluid into the fan (hereinafter called the "eye") is approximately of equal diameter to that of the fan and in which the blades employed are of considerably greater axial length than radial depth and mounted on the fan at right angles to its plane of revolution, with the intermediate spaces or ports for the passage of the fluid between the blades of a not greater circumferential width than twice the radial depth of the blades and having the intake chamber or space, which is inclosed within the inner edges of the blades, substantially free from obstructions and of a diameter and axial measurement of, respectively, at least four and three times the radial width of the blades.

In making fans of the construction above referred to I have hitherto fitted them with blades formed either as planes approximately radial and axial to the fan or so curved or angled through an axially radial plane that one face thereof is concave and the other convex.

In the improved fans which are the subject of the present invention the blades are so shaped that the ports or outflow-passages for the fluid between them are reduced in width at their discharge or exterior sides to less than their width at their inlet or interior sides, (the width being their dimension as measured circumferentially around the fan.) In the preferred form of my invention the shape of the blades is such that the space between two radial lines drawn from the center of the fan to the two edges, respectively, of the outer sides of any port is unobstructed by any part of the blades forming the sides of the port. This construction and arrangement much improve the working efficiency of the fans, more particularly of the larger sizes, and, further, allow of the fan being driven with maximum efficiency in either direction as required.

In the accompanying drawings, Figure 1 is a fragmentary and elevation looking at the left side of Fig. 2 of a fan or pump with the blades constructed and arranged in accordance with one modification of my invention. Fig. 2 is a sectional elevation on the line 2 2 of Fig. 1. Figs. 3 to 10 are fragmentary end elevations, respectively illustrating further modifications of my invention.

Referring to the several figures, let A A designate the blades or wings of the fan, and let D designate the revolving shaft. The blades are numerous and are arranged on a more or less close approximation to drum form, so as to inclose within them an intake or supply chamber, which is preferably approximately cylindrical and is unobstructed, or practically so, by blades or other parts. The blades are preferably elongated to a length equaling at least three times their width or depth measured radially of the axis of rotation, and they are so far separated from the axis of rotation that the intake-chamber, which they inclose, has a diameter preferably equal to four times the radial depth of the individual blades. The blades are supported in any suitable manner upon the shaft D, as by means of the supports shown, consisting of a disk B, to which the blades are attached at one end and which is

carried by a boss or center piece C, keyed on the shaft, and of a ring E, encircling the opposite ends of the blades and to which they are suitably attached. The spaces between the blades constitute the passages for the outflow of the fluid, which passages are herein referred to as "ports." The blades are preferably arranged in such close succession that these ports have a width, measured circumferentially, not greater than twice their depth, measured radially, and preferably less than such depth.

Referring to the preferred form shown in Figs. 1 and 2, the blades are arranged on approximately axially radial planes. The blades are, however, curved on both faces relatively to such axially radial plane, so that the outer edges of each two succeeding blades converge toward one another to such extent that the width of the port F between them is reduced at its outer side F to less than its width at its interior or intake side G.

The modification shown in Fig. 3 represents the same construction and arrangement of the blades A as in Fig. 1, except that the width of the exterior sides F of the ports is only about one-half of that of the interior sides G.

In the modification shown in Fig. 4 both faces of the blades A are concavely curved, as in Fig. 1, and their outer edges are bent back, as shown at J, to meet one another, and thereby inclose the inactive space between them.

In the modification shown in Fig. 5 both faces of the blades A are flat from their point of divergence from one another to their outer edges, and, as in Fig. 4, their outer edges are bent back at J to meet one another, and thereby inclose the inactive space between them.

In the modification shown in Fig. 6 the blades A are radial and their outer edges are bent over in opposite directions circumferentially, as shown, in approximately the form of the letter T, whereby the width of the exterior sides F of the ports is made less than the interior sides G thereof. This construction presents abrupt portions of the blades, which would apparently obstruct the outflow of the fluid; but in practice this obstruction is minimized by a cushion of dead air, which is held in the angles of the blades, as indicated in dotted lines at y.

In the modification shown in Figs. 1 to 6, inclusive, the blades are symmetrical—that is, their deviation from an axially radial plane is equal on opposite sides thereof. It results from this that the rotary member of the fan can be revolved or driven with equal efficiency in either direction, which in practice often proves an important desideratum. Hence in all these forms of my invention the space between two radial lines, such as shown at H H, drawn from the center or rotative axis of the fan to the two edges, respectively, of the exterior or outlet side F of any port is unobstructed by any portion of the blades forming such port.

In the modification shown in Fig. 8 the blades are radial and the outer edge is bent forward, thereby reducing the width of the exterior sides F of the ports.

In the modification shown in Fig. 9 the blades instead of occupying mainly axially radial planes are tilted so as to occupy tangential planes, which, as indicated by the dotted lines $x\,x$, tangent a circle (or more accurately a cylinder) indicated at x'.

In the modification shown in Fig. 10 the blades are in part formed in planes tangenting a circle (or cylinder) x', while the outer portion of each blade is curved forward or in the direction of rotation, the opposite sides of the blade being given different curves in such manner that the blade is in effect thickened toward its outer edge, whereby the ports formed between the blades are narrowed toward and at their exterior or outlet sides F relatively to their inner or inlet sides G.

In the construction shown in Figs. 7, 8, 9, and 10 the fan is adapted to operate efficiently only when revolved in one direction, being that indicated by the arrow.

My present invention is in part an improvement upon that set forth in my application for United States patent for centrifugal fans filed September 21, 1898, Serial No. 691,495.

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

1. A centrifugal fan or pump, the rotary member of which has blades arranged in substantially drum form, said blades forming ports between them for the outflow of the fluid and the blades in effect thickened toward their outer sides to reduce the exterior sides of the ports to less width than their interior sides.

2. A centrifugal fan or pump the rotary member of which consists of numerous elongated approximately radial blades arranged in drum form to inclose within them an intake-chamber of relatively large diameter, said blades arranged to form between them ports for the outflow of the fluid, and shaped to reduce the width of said ports at their exterior sides to less than at their interior sides.

3. A centrifugal fan or pump the rotary member of which consists of numerous approximately radial blades arranged to inclose within them a practically unobstructed intake-chamber, of a diameter equal to at least four times the radial depth of the individual blades, and of an axial length equal to at least three times the radial depth of such blades, and said blades arranged to form between them ports for the outflow of the fluid, and shaped to reduce the width of said ports at their exterior sides to less than at their interior sides.

4. A centrifugal fan or pump the rotary member of which consists of numerous approximately radial blades arranged to inclose within them a practically unobstructed intake-chamber, of a diameter equal to at least four times the radial depth of the individual

blades, and of an axial length equal to at least three times the radial depth of such blades, said blades spaced apart a distance no greater than twice their radial depth, and shaped to reduce the width of the ports between them at their exterior sides to less than at their interior sides.

5. A centrifugal fan or pump the rotary member of which consists of numerous approximately radial blades arranged to form between them ports for the outflow of the fluid, and shaped to reduce the width of said ports at their exterior sides to less than at their interior sides, and said blades so shaped that the space between two radial lines drawn from the center of the fan to the two edges respectively of the exterior side of any port is unobstructed by any part of the blades forming such port.

6. A centrifugal fan or pump the rotary member of which consists of numerous blades arranged to form between them ports for the outflow of the fluid, said blades arranged in approximate coincidence with axially radial planes, and shaped to reduce the width of said ports at their exterior sides to less than at their interior sides, such reduction in width being approximately symmetrical, whereby the fan may be efficiently driven in either direction.

7. A centrifugal fan or pump the rotary member of which consists of numerous blades arranged to form between them ports for the outflow of the fluid, said blades arranged in approximate coincidence with axially radial planes, and formed on their opposite faces to diverge from such planes toward their outer edges in such manner as in effect to gradually thicken the blades, and thereby progressively reduce the width of the ports toward and at their exterior sides relatively to their interior sides.

8. A centrifugal fan or pump the rotary member of which consists of numerous blades arranged to form between them ports for the outflow of the fluid, said blades arranged in approximate coincidence with axially radial planes, and having both faces curved relatively to such planes, whereby the outer edges of any two successive blades converge toward one another in such manner as to progressively reduce the width of the ports toward and at their exterior sides relatively to their interior sides.

9. A centrifugal fan or pump the rotary member of which consists of numerous blades arranged to form between them ports for the outflow of the fluid, said blades arranged in approximate coincidence with axially radial planes, and formed on their opposite faces to diverge from such planes toward their outer edges in such manner as in effect to gradually thicken the blades, and the outer edges of the blades bent back to inclose the inactive space formed by such divergence.

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

SAMUEL CLELAND DAVIDSON.

Witnesses:

FRED WHITE,

THOMAS F. WALLACE.