(No Model.) 2 Sheets—Sheet 1.

A. RATEAU.

CENTRIFUGAL PUMP OR VENTILATOR.

No. 494,890. Patented Apr. 4, 1893.

FIG. 2.

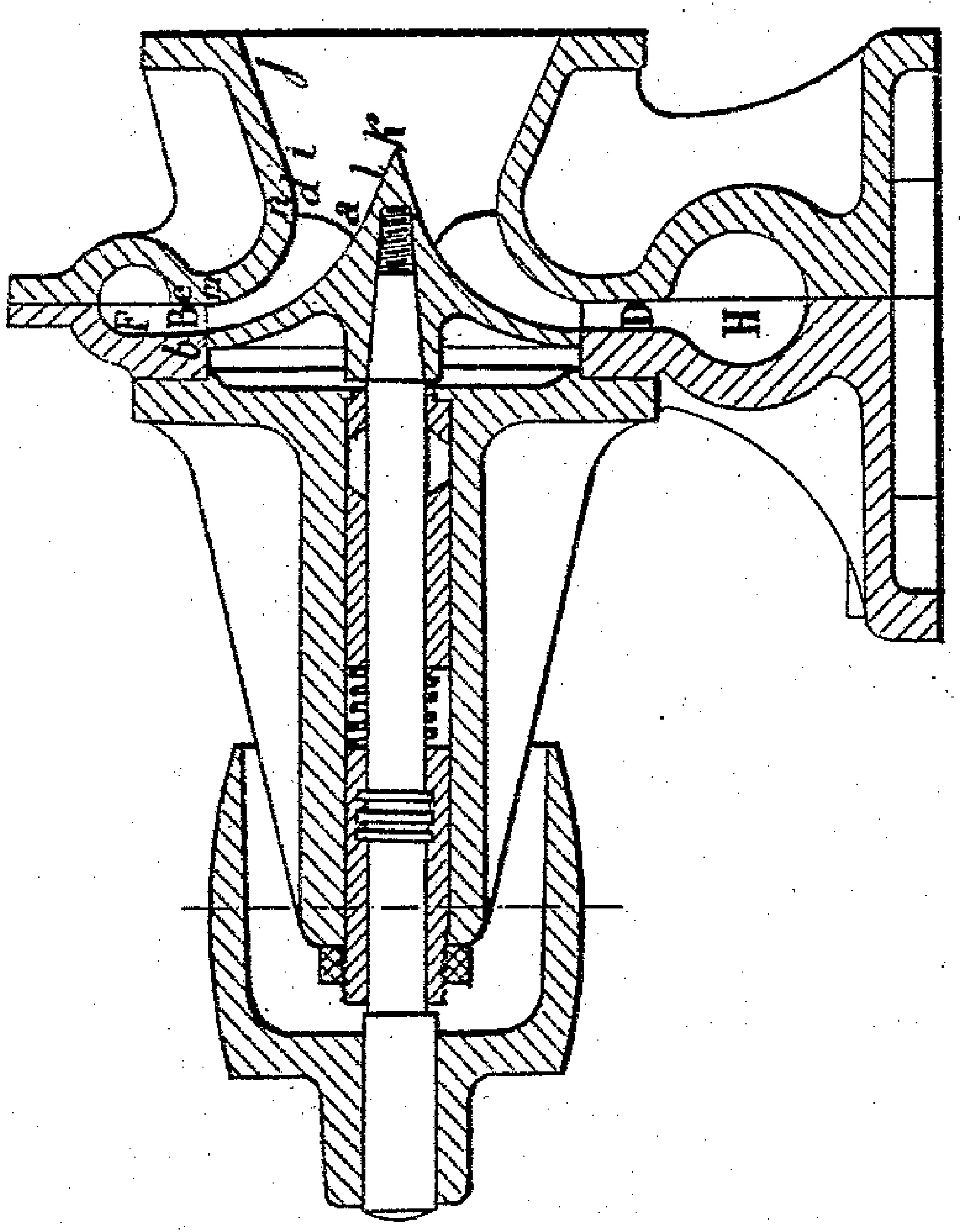


FIG. 3.

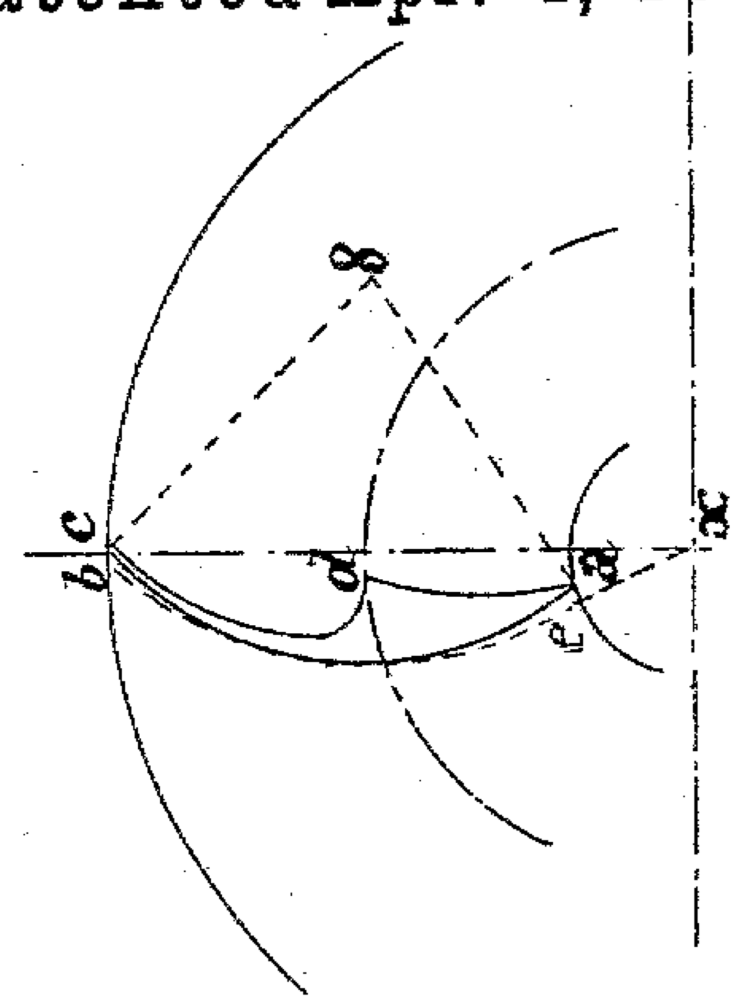


FIG. 4.

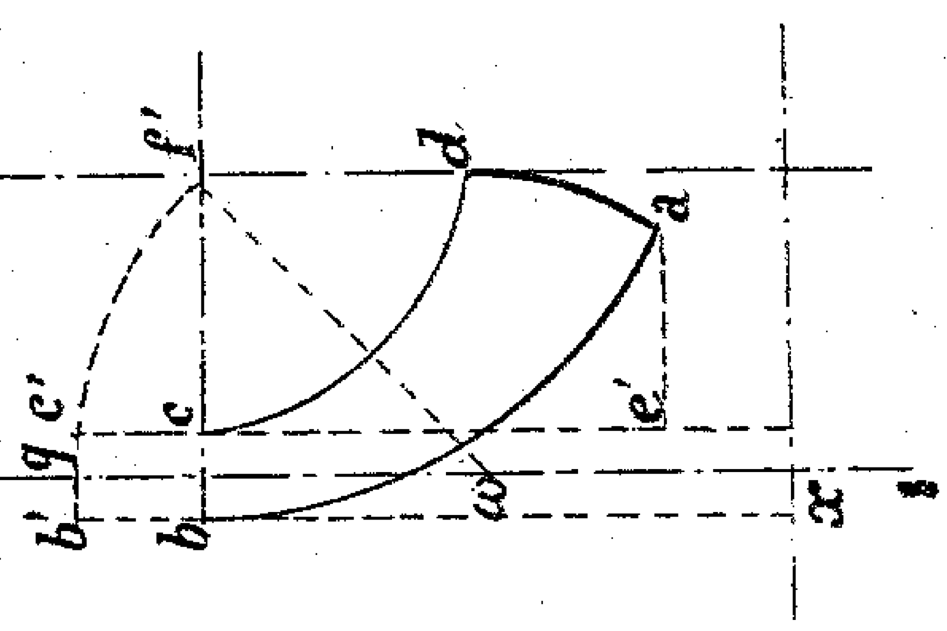


FIG. 1.

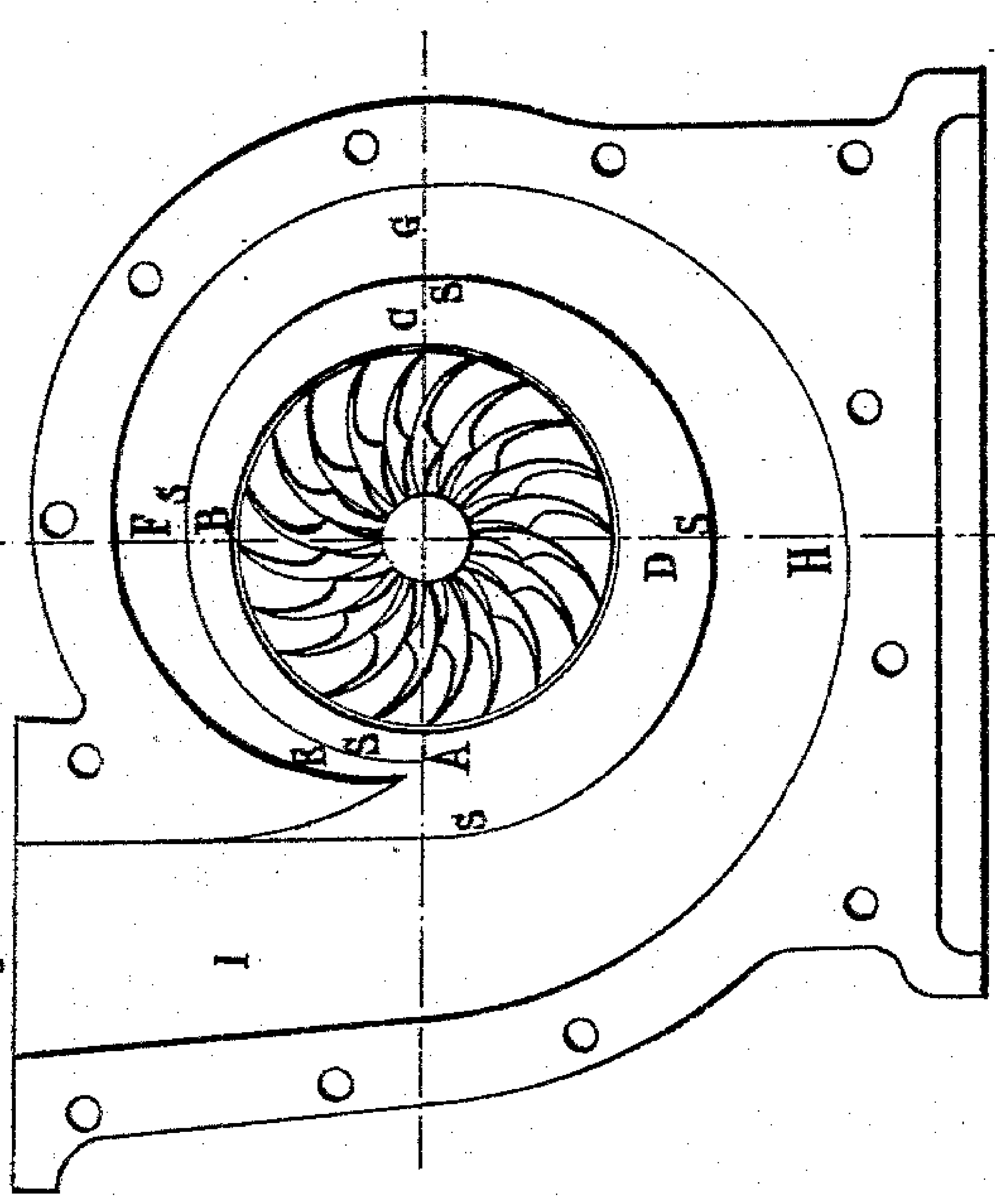
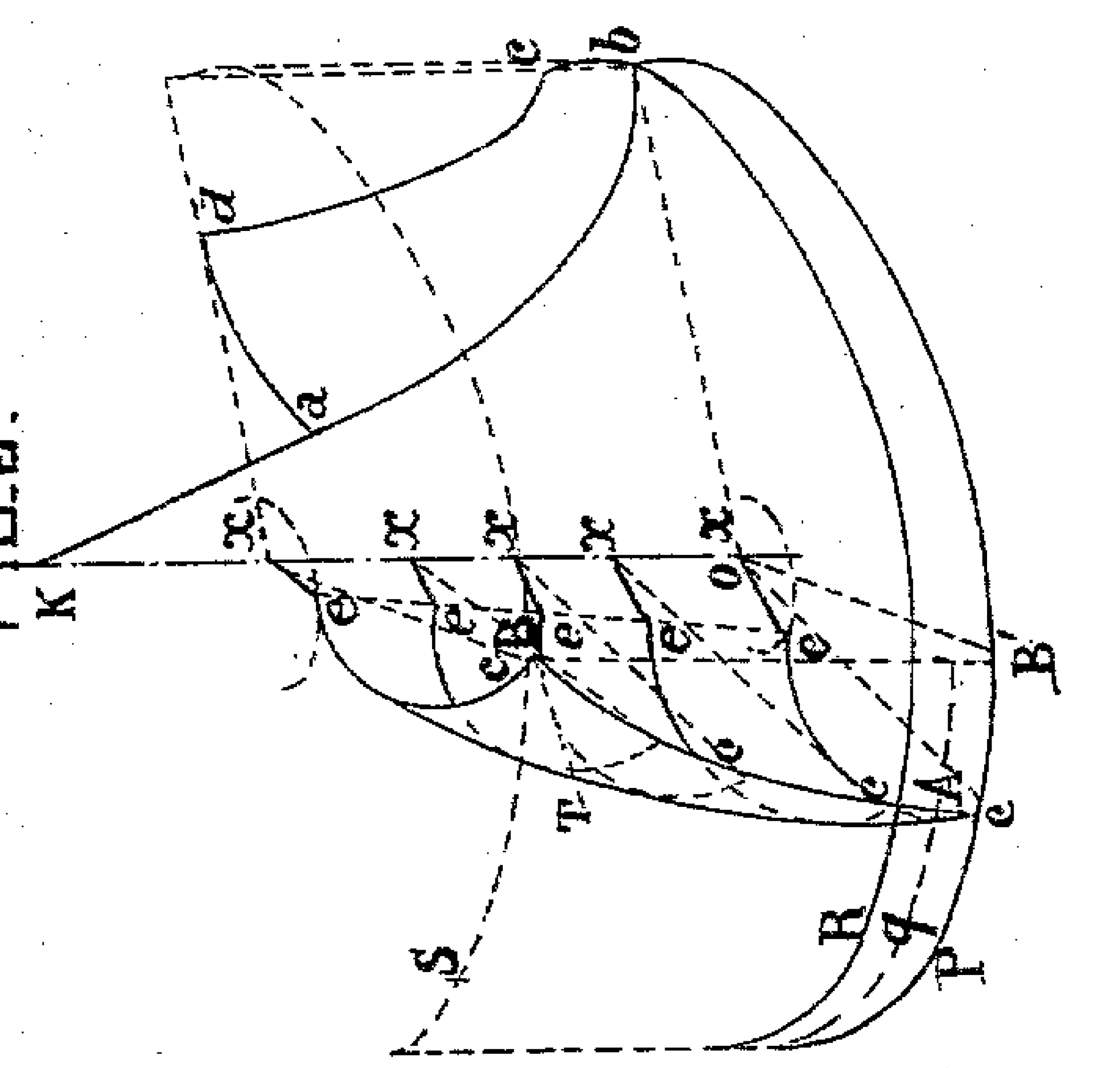


FIG. 5.



Witnesses.

E. M. Clark

Edgar Tate

Inventor.

Auguste Rateau

By Munn & Co

Attorneys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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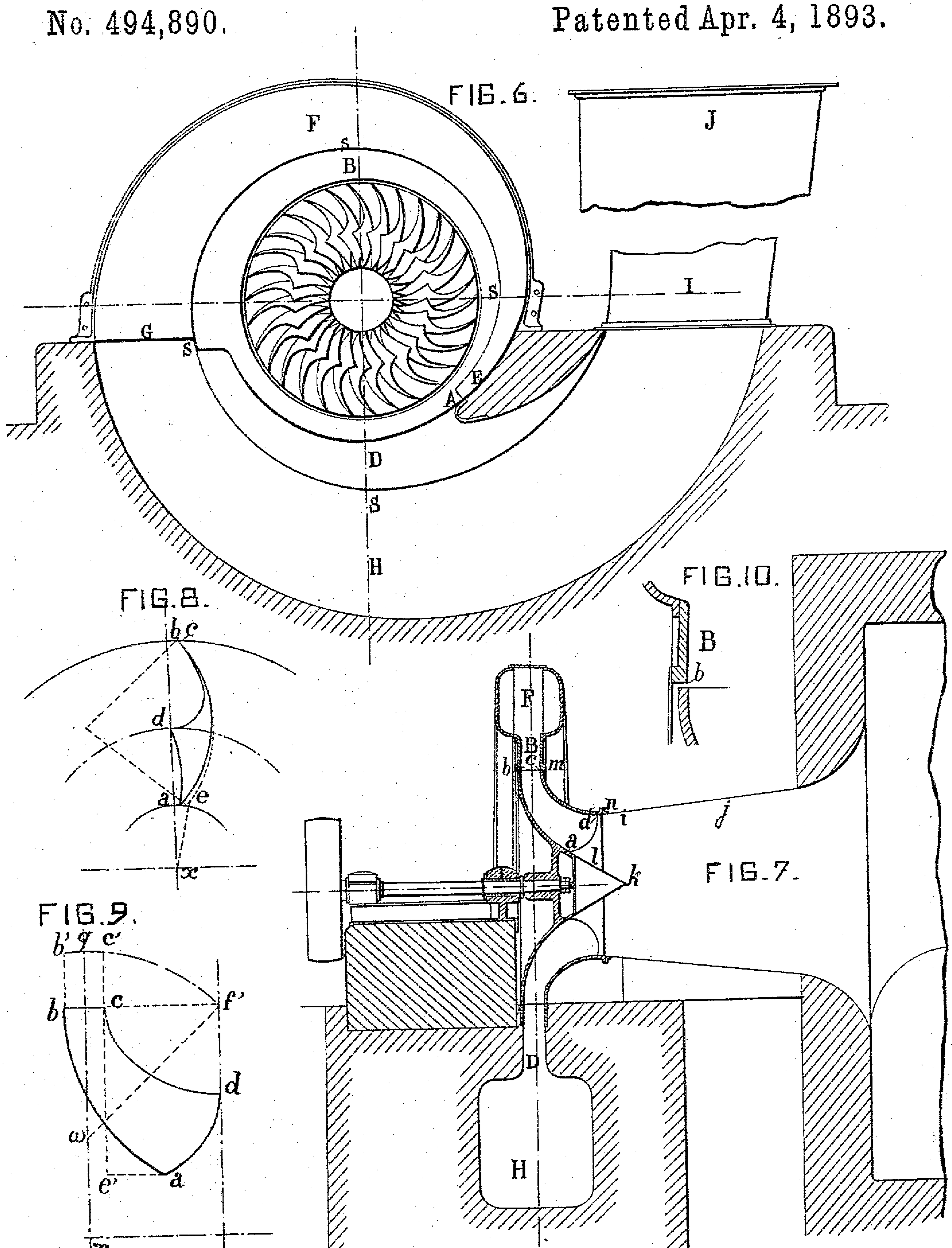

Witnesses.

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Attorneys

UNITED STATES PATENT OFFICE.

AUGUSTE RATEAU, OF ST. ETIENNE, FRANCE.

CENTRIFUGAL PUMP OR VENTILATOR.

SPECIFICATION forming part of Letters Patent No. 494,890, dated April 4, 1893.

Application filed April 2, 1891. Serial No. 387,453. (No model.) Patented in France July 19, 1890, No. 207,048; in Belgium August 1, 1890, No. 91,478; in Germany September 1, 1890, No. 57,626, and in England October 4, 1890, No. 15,755.

To all whom it may concern:

Be it known that I, AUGUSTE RATEAU, a citizen of France, residing at St. Etienne, in the Department of the Loire, France, have invented a new and useful Improvement in Centrifugal Pumps or Ventilators, (for which I have obtained Letters Patent in France, No. 207,048, dated July 19, 1890; in Great Britain, No. 15,755, dated October 4, 1890; in Germany, No. 57,626, dated September 1, 1890, and in Belgium, No. 91,478, dated August 1, 1890,) of which the following is a specification.

The centrifugal ventilators and pumps which form the subject of the present application for patent are represented in the two sheets of drawings hereto annexed.

All the parts of this apparatus are so arranged as to permit the fluid, air or water, to circulate rapidly, and to avoid, as much as possible, all loss of the charge by force and shock. Thus, powerful apparatus of greatly reduced dimensions are obtained which give excellent monometric and mechanical results.

The invention consists in the particular construction and combination of parts as hereinafter fully described and pointed out in the claims.

In order that my invention may be well understood, I have represented, in the annexed drawings, a ventilator and a pump constructed according to my invention.

Figure 1 is an elevation showing the interior of the pump. Fig. 2 is a vertical longitudinal section through the axis of the pump. Fig. 3 is a diagram showing the form of one of the wings of the pump, as seen from the end. Fig. 4 explains the directing curve of the wings. Fig. 5 shows, in perspective, the mode of generating the wing. Fig. 6 is an elevation showing the interior of the ventilator. Fig. 7 is a vertical, longitudinal section through the axis of the ventilator. Fig. 8 is a diagram showing the form of one of the wings of the ventilator, seen from the end. Fig. 9 explains the diagram of the construction curve of the wing of the ventilator. Fig. 10 represents, on an enlarged scale, the construction which is so arranged that the walls of the casing shall correspond exactly with the toro-conical walls of the suction wheel of the ventilator or the pump.

The suction wheel consists of a toro-conical base on which are secured the fliers or wings of special form, there being thirty of the latter for the ventilator and twenty for the pump. The toro-conical base is formed of part of a tore generated by the arc of the circle *a b* (Figs. 2 and 7) turning around the axis of the wheel, and of the portion of the cone generated by the straight line *a l k* (Figs. 2 and 7) also turning around the axis. At the opening it is conical, and at the periphery it is perpendicular to the axis. Each wing or flier has four edges. One of these edges *a b* is fixed on the base of the wheel; another *b c* is a generating line of the peripheral cylinder of the wheel; a third *c d* grazes, in the movement of rotation, a fixed wall *m n* which forms a continuation of the bell, as described hereinafter; finally, the fourth edge *d a* is in the opening. The wing catches the fluid by the edge *d a* and throws it out by the edge *b c*. In the interval the fluid is guided, on the one hand by the base of the wheel, and on the other hand by the fixed wall of the casing. The meridian curve of the latter is so calculated that the relative velocity of the fluid between the wings remains nearly constant, or increases slightly. The result is that the rapidity of the flow at any point in the canal or passage is inversely proportional to the cross section of such portion. The surface of the wing, excepting the edges which bound it, is generated or produced in the following manner:

Let us represent, by a perspective, Fig. 5, *o x x*—K the axis of the ventilator (or of the pump), at P *q* R S the straight sections of the peripheral cylinder of the wheel; P and R being the planes limiting the crown of the wheel, *q* being the middle plane of this crown, S being the plane of the opening. The surface of this wing is generated by the arc of a circle *c e* and 8 Fig. 3, traced on a plane perpendicular to the axis, and which cuts the circumference of the straight section of the peripheral cylinder at an angle which is slightly variable according to circumstances, but always near forty-five degrees. This arc of a circle *c e* is connected invariably with an element *e x* which is represented only to facilitate the comprehension of the manner of generating the wing. This is the manner in which it is generated or produced. The arc c e and the straight line e x receive a movement which is called conoidal. It is displaced while in a plane perpendicular to the axis so that the point x describes the axis, while its end c traces the curve A B on the peripheral cylinder. In the perspective, five positions of this arc are shown. The generating curve A B, developed on a plane tangential to the cylinder is an arc of a circle, the projection of which is shown in Figs. 4 and 9 at b' c' f' on a diametrical plane. This arc of a circle is tangential to a generating line of the cylinder at the point q Figs. 4 and 9, where it cuts the middle plane q of the crown; at the extreme point f' its tangent forms an angle of fifty to sixty degrees with the generating line b, c f'. In the double movement explained above, the arc of the generating circle c e turns at an angle A, O B' (Fig. 5), equal to about fifteen degrees while it slides on the axis. The generating arc of a circle c e of the surface of the wing has a radius equal to fifty-four ohms for the ventilator represented in Sheet 1 (having a wheel two meters in diameter) and five to six centimeters for the pump represented in Sheet 2 (having a wheel eighteen centimeters in diameter). In apparatus of different sizes these radii remain proportional to the diameter of the wheel. The generating arc of a circle A B of the surface of the wing has a radius which is slightly variable according to the purpose for which the apparatus is to be used. In apparatus which discharge large quantities at a low pressure, like those shown, this radius is equal to seventy ohms for the two meter ventilator and six to four centimeters for the eighteen centimeter pump. If, on the other hand, the apparatus are to discharge small quantities at high pressure, these radii will be smaller, about sixty ohms to five centimeters. In ventilators and pumps of different sizes these radii remain proportional to the diameter of the wheel.

The surface described, to really constitute a wing, should afterward be limited by the curves resulting from its intersection with the surface produced by the profile a b c d (Figs. 2, 5, and 7) turning around the axis; profile formed as described above, by the arc of a circle a b, a generating element b c, an arc of a curve c d (nearly a quarter of an ellipse), and an arc of a circle a d.

The wing thus obtained combines the following properties: It is attached to the base of the wheel almost normally throughout and by its longest edge. It is very rigid because of the curves which it presents in all its parts. The fluid, which comes in the opening parallel to the axis, is seized by the edge a d of the wing and it is driven back at the periphery, with the greatest velocity possible, for the wing is curved back at an angle of about forty-five degrees, more or less according to circumstances. Between their entrance and their exit, the different particles of the fluid are carried along by the wings. The trajectories which they describe are the radii of the curvature, almost constant, and at any rate gradually variable. The wheel is fixed on the end of the shaft by a conical sleeve. A conical cap l, k, Figs. 2 and 7 caps the end of this shaft and guides the fluid before it passes into the opening. The fluid is guided, besides, by the walls of the casing which precede the opening and which is generated by a straight line i j turning about the axis, or by a slightly different curve.

Within the casing is the flat spiral throat or passage A B C D (see Figs. 1 and 6) formed by two parallel plates limited by the circumference of the wheel and an Archimedean screw or spiral S S S S, the radial diameter of which increases progressively from its point of inception. Surrounding the throat or passage A B C D is the volute passage E F G H I having a circular or square section and increasing in diameter as the spiral increases in height. The volute passage E F G H I terminates in a conical outlet tube or flue J. The throat or passage A B C D serves to spread or diffuse the fluid and the main feature thereof is the combination of the flat part of the spiral with the rising part. The object of this is to permit the almost complete transformation of the live force of the fluid into pressure before entering the tube at the same time avoiding the shock of the current which passes from the wheel with that which has already been diffused. The height of the spiral part increasing in proportion to the arc of the scroll, it is the same with the outlet which it offers to the current. On the contrary, the sections of the volute passage E F G H I follow the parabolic law so that the end part I of the section is almost triple what it would be if there were no flat part interposed, that is to say, triple what it would be if it were desirable to have the fluid retain the absolute velocity which it has when it leaves the wheel.

The apparatus represented by the drawings hereto annexed are specially suitable for great results and low pressures. If a ventilator giving strong pressure is desired, or a pump for raising the fluid to a great height, the wheel will, necessarily, have to turn very rapidly, for the pressure obtained is proportional to the square of the number of revolutions. Then, so as not to have to transmit too great an amount of mechanical work to the shaft, it is best to reduce the work by diminishing the sections of the passages running through the apparatus. This is done by bringing the profiles a b and c d closer together, these profiles generating the base of the wheel and the fixed wall. The height of the wings is thus reduced, as well as of all the sections offered to the fluid, for the size of the flat, spiral throat and the sections of the volute passage should be diminished proportionally.

In the present application I claim the arrangements indicated on the annexed sheets of drawings for centrifugal ventilators and pumps, composed—

1. In a machine of the character described, the combination with a conical wheel, of a casing having a passage or throat whose radial diameter progressively increases from its inception, and surrounding the wheel, and an exterior volute passage adjacent to and surrounding the said throat or passage, the said volute passage being of progressively greater cubical capacity from its inception, which is opposite the inception of the aforesaid throat or passage, substantially as described.

2. The combination of a casing having a central flaring side opening, a throat or passage leading from the said opening, the radial diameter of the throat or passage increasing progressively from its inception, and a volute passage surrounding the said throat or passage, and being of progressively greater cubical capacity from its inception, and a wheel mounted in the casing and having a toro-conical base and provided with curved and tapering wings, said wings having concave upper longitudinal edges, substantially as herein shown and described.

3. A suction wheel, consisting of a toro-conical base, and a series of wings, each tapering in width, curved throughout its entire length and having a concave upper-edge, the wings all being of a uniform length, and arranged on the base with their wider ends next to the apex of the base, the narrower ends of the wings being straight and the wider ends curved, substantially as herein shown and described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

A. RATEAU.

Witnesses:

M. J. DUQUEREL,
Ingénieur des Ponts et Chaussées.

C. SEGUINE,
Capitaine d'Artillerie.