(No Model.)

2 Sheets—Sheet 1.

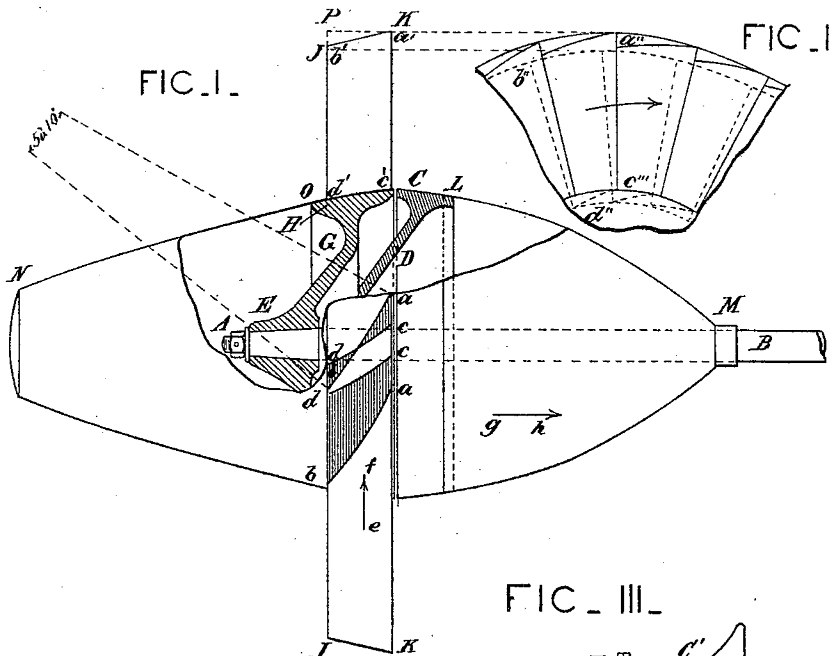
C. E. A. RATEAU.

PROPELLER OR BLOWER.

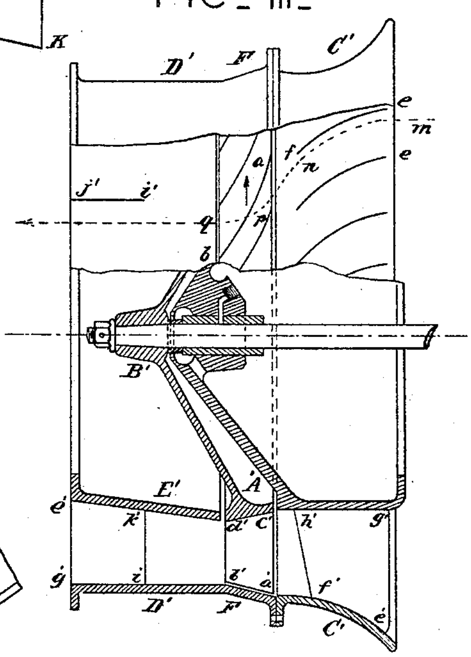
No. 500,080. Patented June 20, 1893.

FIG_I_

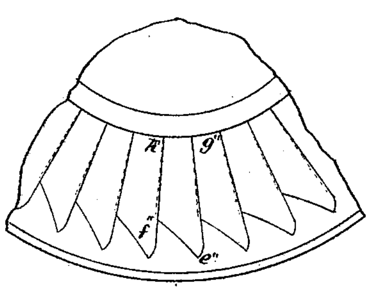
FIG_II_



FIG_III_



FIG_IV_



Attest:
Arthur A. Erb.
Remo Lewis.

Inventor:
Camille Edmond Auguste Rateau
by Pollok & Mauro
his attorneys.

(No Model.) 2 Sheets—Sheet 2.

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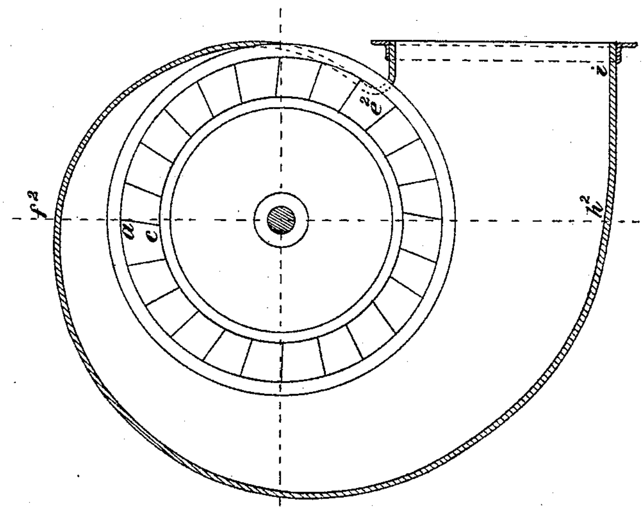
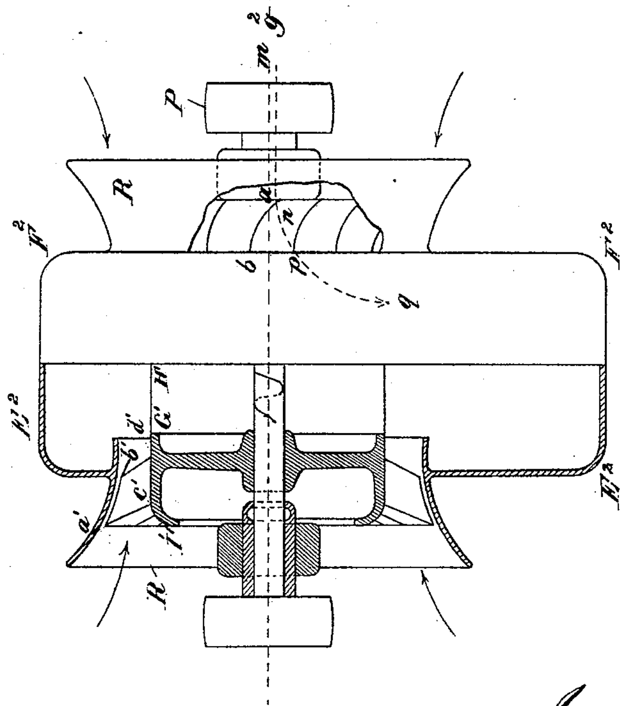
FIG_VI_



FIG_V_



Attest:

Arthur A. Erb.

Reeve Lewis.

Inventor:

Camille Edmond Auguste Rateau

by Pollok & Mauro

his attorneys.

UNITED STATES PATENT OFFICE.

CAMILLE EDMOND AUGUSTE RATEAU, OF ST. ETIENNE, FRANCE.

PROPELLER OR BLOWER.

SPECIFICATION forming part of Letters Patent No. 500,080, dated June 20, 1893.

Application filed September 2, 1892. Serial No. 444,899. (No model.)

To all whom it may concern:

Be it known that I, CAMILLE EDMOND AUGUSTE RATEAU, of St. Etienne, in the Department of the Loire, France, have invented new and useful Improvements in Propellers or Blowers, which are fully set forth in the following specification.

This invention has reference to the construction of screw-propellers or helices for the propulsion of boats, or balloons, or for use as ventilators and pumps to propel aeriform and liquid fluids. In the first case the helices have their opposition or resistance in the fluid (water or air), and push the vessel. In the second case they bear upon a stationary support, and propel the fluid. The helices now in use for these purposes, are generally formed of blades, few in number (four, six, or sometimes eight) fixed upon a hub of greater or less diameter. Each blade or wing is usually a part of a right helicoid, *i. e.*, its section when cut by a cylinder concentric with the axis is in every portion a helix. The extremities of the wings are generally free. Sometimes they may have secured to them a cylindrical flange flaring into a diverging cone. It is easy to conceive that helices thus made cannot have a great working capacity, because they work by a succession of shocks or concussions.

If it is desired to approach theoretical perfection it is necessary to realize the following conditions. (First.) The wings must take the fluid without any shock at the outer edge. (Second.) The wings must then progressively push the fluid, and to this end it is necessary that its section when cut by a cylinder concentric with the axis should be an arc of a circle. (Third.) The wings should be sufficiently close together to effect a regular flow of fluid between them, and thus avoid swirls and eddies, which produce retardation. (Fourth.) As the compound centrifugal force is directed toward the axis, and is generally greater than the impelling centrifugal force (force centrifugal d'entrainement) it is necessary that the channels formed by the wings or blades should converge instead of diverge. (The terms "compound centrifugal force," and "impelling centrifugal force" are used in accordance with the well known theory of Coriolis—and are expressions of accelerations rather than of forces. By calculation it is found that the former is nearly twice as great as the latter.) In order to conform to these theoretical conditions, which I have only outlined, I form my helices in the following manner: The wings or blades are made of steel sheets, and are cut from right conoids or out of right or oblique cylinders. They are fixed upon a large hub, whose radius comprises between one half and four fifths of the exterior radius of the helix. They are from twenty-four to thirty-six in number, and their extremities may be free, or may be riveted to a flange. The peripheral surface of the helix, is a cone converging toward the issue, that is in the direction which the fluid takes.

In the accompanying drawings, Figure I, represents in elevation, partly in section a propeller for vessels embodying the invention. Fig. II is a partial end view of the same. Fig. III represents partly in elevation and partly in section, a helicoidal ventilator with annular diffuser. Fig. IV is a partial end view thereof. Fig. V is an elevation partly in section of a duplex helicoidal ventilator and a volute diffuser; and Fig. VI is a section thereof transverse to the axis.

Helix for propelling boats.—This helix is formed of a hub E G upon the flange H of which are fixed the sheet-steel wings or blades *a b c d* (Fig. I). The extremities of these wings are riveted to the inner face of a frustum of a cone formed of sheet iron, represented in section (Fig. I) by the line J. K. In front of the hub is an ogive C L M, which is fastened to the boat and designed to displace without two great resistance, the liquid streams, and to carry them to the working portion of the helix. This ogive carries, by means of the web D, the bearing through which passes the shaft A B of the helix. In the rear of the hub and attached to the flange H thereof, is another ogive O N, also of sheet iron, the object being to avoid the seething or violent agitation of the water discharged behind the screw. The wing or blade seen endwise at *a b c d*, and in profile at *a' b' c' d'* (Fig. I), and in face view in Fig. II, at *a'' b''*, &c., is part of a right conoid, engendered by a straight line resting at one end upon the axis A B and perpendicular thereto, and at the other upon a curve *a b* traced upon a cylinder P K, which passes through the extremity of the wing. This curve is an arc of a circle traced upon the cylinder. At its origin, it makes with the plane of entrance K K of the helix an angle, of which the tangent is equal to the ratio between the speed $g\ h$ of the boat, and the peripheral speed of the helix. From the entrance a to exit b the curvature is from five to ten degrees as the case may be.

Helicoidal ventilating fan with annular diffuser, (*Figs.* III *and* IV.)—The ventilator is composed of three parts, the distributer C′, the turbine A′ B′, and the diffuser D′ E′. The distributer is analogous to those of parallel turbines of the Fontaine type, and is formed of twenty-four wings of sheet iron curved in arcs of circles $e\ f$ sustained between two walls of cast iron. These wings are fixed, and their object is to give the streams or currents of air a direction inclined about forty-five degrees to the axis, as indicated by the trajectory $m\ n$. The current of air is then seized by the turbine. This is composed of twenty-four blades or wings formed from cylindrical iron sheets, $a'\ b'\ c'\ d'$, supported on the flange of a hub A′ B′. These wings will be seen endwise at $a\ b$, forming an angle of about twenty degrees with the plane of rotation. They seize the air emerging from the distributer, and bring it parallel with the axis, propelling it forward along the trajectory p—q. The passage without shock from one end to the other of the edge $a'\ b'$ is effected by means of the edge $f'\ h'$ of the wing of the distributer, said edge being cut obliquely with respect to the generatrix, so that the trajectory of the air is the more deflected as it approaches the axis. The outer edge $a'\ b'$ of the wings or blades is brought as close as possible to the casing F so as to leave a minimum space for escape of air. The said casing F is in the form of a frustum of a cone converging toward the exit of the fluid. At the exit of the turbine the current enters the annular diffuser E′ D′, where the velocity is diminished by giving rise to increase of pressure. This diffuser is composed of two casings or shells, one conical and the other cylindrical, united by means of radial wings $i'\ j'\ k'\ l'$. The air trajectory $m\ n\ p\ q$ is shown in dotted lines. The turbine could be used without the diffuser, but the working capacity would not be as great. A greater pressure may be obtained by arranging several apparatus one behind the other on the same shaft with or without the interposition of the winged distributer.

When the ventilator is used as a blower the casing C′ is open to the atmosphere. When it is used as an aspirator the air is brought to the distributer by a cylindrical tubing whose axis may coincide with that of the ventilator, but it would be better to arrange this delivery tube perpendicular to the axis of the ventilator, so that it may be tangent to the periphery of the casing C′. The current is then thrown obliquely to the axis, and the partitions of the distributer may be planes. They may also be entirely omitted by forming the channel of admission into a volute around the annular orifice of the shell or casing.

The helicoidal ventilator with volute diffuser.—Figs. V. and VI. represent in elevation and section a duplex ventilator symmetrically arranged with two helicoidal turbines, and a diffuser in the volute form. There is no distributer in this case, or rather it is reduced to a shell R contracting toward the turbine. The latter is formed by twenty four wings $a'\ b'\ c'\ d'$ made of sheet metal, in the manner already explained and secured upon the flange I′ G′ of a hub of cast iron. At $a\ b$ will be seen the section of a wing in an arc of a circle to allow of the entrance of air without shock. The edge of the wing is cut obliquely with reference to the generatrix, as seen at $a'\ b'$. The two turbines are coupled by means of a sheet iron cylinder G′ H′. At the exit of the turbines the air enters a volute $E^2\ F^2$ of rectangular section, inclosed by the casing $E^2\ E^2\ F^2\ F^2$. And on the surface which, is seen in section in Fig. VI, it has the spiral form $e^2\ f^2\ g^2\ h^2$. The trajectory of the air is shown by dotted lines $m\ n\ p\ q$. The shaft A has pulley P.

The two systems of ventilation herein described may also be used as pumps to elevate liquids, in which case the shaft is usually placed in a vertical position.

I claim as my invention—

1. A propelling screw or helix comprising numerous blades secured to a hub of relatively large diameter, the form of each blade being described by a straight line moved with its inner end in contact with the hub, so that both ends describe arcs of circles, said line being at all times substantially perpendicular to the axis of the hub, substantially as described.

2. A propelling screw or helix comprising numerous blades secured to a hub of relatively large radius, each blade being cut from a right conoid, or from a right or oblique cylinder, so that a section of the blade when cut by any cylinder concentric with the axis is a circular arc, substantially as described.

3. A propelling screw or helix comprising blades set close together upon a hub of relatively large diameter, said blades presenting in section an arc of a circle when cut at any point by a cylinder concentric with the axis, the peripheral surface of the screw being a portion of a cone converging toward the exit of the fluid, substantially as described.

4. The combination with the propelling helix or screw formed of numerous blades upon a hub of relatively large diameter, as specified, of a distributer having fixed guiding or deflecting partitions, whereby the fluid is delivered to the helix obliquely to the axis thereof, substantially as set forth.

5. The combination with the helix or screw

formed of numerous blades each curved in an arc of a circle, upon a hub of relatively large diameter, of a distributer having guiding or deflecting partitions or blades, curved in a direction opposite to the curve of the blades of the helix, and a diffuser, substantially as described.

6. The combination with the propelling helix or screw, formed of numerous blades set upon a hub of relatively large diameter, of a distributer and a volute diffuser, substantially as set forth.

7. The combination of a plurality of propelling screws or helices upon the same shaft each screw or helix being composed of numerous blades set upon a hub of relatively large diameter and curved in profile or section in the arc of a circle, substantially as described.

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

CAMILLE EDMOND AUGUSTE RATEAU.

Witnesses:
ANTHONY POLLOK,
R. M. HOOPER.