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(*Under International Convention.*)

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*Date of Application (in the United Kingdom), 26th May, 1911*

*At the expiration of twelve months from the date of the first Foreign Application, the provision of Section 91 (3) (a) of the Patents and Designs Act, 1907, as to inspection of Specification, became operative*

*Accepted, 18th Jan., 1912*

## COMPLETE SPECIFICATION.

### Improvements in or relating to Propellers.

I, HENRI CÓANDA, Engineer, of 15, Avenue Mercedès, Paris, France, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

Propellers mostly used for driving movable bodies travelling in a fluid ensuring their support, and in which they are entirely or partly immersed, are screws working, as regards their position on the said movable bodies, either by traction or by thrust. These screws, which can be of large dimensions and rotate slowly, or of smaller dimensions and have high circumferential speed, work in the well known manner.

Nevertheless, the working of all these screws is based on the resistance offered by the air to the blades rotating about an axis, the said air driven in a direction parallel to the propeller, exercising a pressure on the blade, in such manner that the sum of the whole of these pressures produces the thrust of the propeller. This phenomenon being in proportion to the square of the speed, will be therefore produced chiefly at the circumference of the screw, whilst in the centre there will be produced a comparative vacuum which is called the "cavitation" phenomenon. These propellers working direct in the fluid, can be compared to screws. They are therefore limited to their pitch which corresponds to an efficiency of 100%. If, therefore, these propellers are secured to a properly designed movable apparatus, the acceleration that could be communicated to the apparatus, will be limited by the screw which cannot move more quickly than it is allowed to do by its pitch.

Propellers have also been made in the form of turbines, the blade rotor of which, controlled by the motor, moves between two circles of blades forming, one the inlet distributor for the fluid which is drawn in by the rotor, and the other the outlet distributor for the fluid which is forced back by the movable blade. But generally the surfaces which limit the rotor and the surfaces on which the blades of the distributors are set, are parallel and perpendicular to the axis of rotation of the movable part so that the translation of the movable body on which the said propeller is arranged, is determined by the vacuum resulting from the displacement of the fluid produced by the rotor of the pro-

peller system and by the suction of the said movable body which tends to fill up the zone of reduced pressure.

The present invention relates to a propeller of the latter type, but it differs from the known ones inasmuch as the surfaces which limit the blades of the rotor and which move between the corresponding blades of the supply and outlet distributors, are concentric and cylindrical with regard to the axis of rotation on which the motor acts; the outer surfaces on which the blades of the said distributors are set being, moreover, perpendicular to the said cylindrical surfaces and parallel to each other.

In these conditions, the fluid drawn in by the rotor is subjected, on entering the movable blades, to a change of direction so that the direction of its movement becomes opposite to that of entering the propeller. The kinetic energy of the flow of the fluid is therefore changed, owing to the suppression of its own velocity, to potential energy giving rise to an axial reaction which gives rise to propulsion.

This propeller differs from the existing propeller by the fact that it is independent of the movement or of the speed of the movable body, and that it acts by reaction. By producing a comparative vacuum, by increasing on the other hand the pressure of the air which it utilises, this propeller produces a fall of pressure which will follow the shortest path. If the direction of the fluid in movement, is suddenly changed, its speed disappears, and its pressure becomes maximum. By designing the propeller so that this pressure is an axial one, the addition of the parallel pressures will produce a resultant in the direction of the axis of the said propeller, producing the propelling power of the latter.

Owing to the modifications of the said axial pressure, it is possible moreover to obtain variations in the propelling power, and consequently, in the speed of advance of the movable body driven by the propeller. Moreover, by causing an identical propeller to act in such a manner that its variable axis pressure is of opposite direction to that of the propeller bringing about the advance, a progressive or gradual braking can be obtained. In order to obtain such a propeller, the fluid jets escaping from the centre of the propeller towards its circumference, pass through fixed or movable conduits of suitable direction of variable cross-section, which can be compared to the constituent elements of a turbine or of a fan, but differ from the same by the fluid which is compressed in the said propeller, having to transmit its kinetic energy to the apparatus in the form of an axial reaction and to escape from the diffusing apparatus.

In the accompanying drawings given by way of example,

Figure 1 is a vertical section of the whole of the propeller, in which the axis of action and of advance is assumed to be vertical, but can be any desired.

Figure 2 is an outside half-view of the movable blades and of the distributor.

Figures 3 and 4 are respectively a cross-section and front elevation of one element of the distributor.

According to this invention the propeller comprises, following the direction of the fluid jets circulating in the apparatus; (*a*) a distributor, (*b*) movable blade, (*c*) a discharge diffuser.

*a*. The distributor is constituted by an inlet 1 in the shape of a bell-mouth, the inner flange of which constitutes the casing of the distributing conduits proper, and of the movable blades. The circular chamber 2 in which the blades move, is comprised between two concentric surfaces, the axis of revolution of which coincides with the axis of the propeller.

On the minimum cross-section of the inlet, at which terminate the distributing conduits, is arranged the bottom of a hollow semi-spherical body 3, to the upper portion of which is secured a socket 4, also hollow, constituting the point of the propeller.

The semi-spherical body 3 which produces, between it and the outer surface of the bell-mouth 1, a circular section for the passage of the fluid, is provided with hollow radial extensions 5, the upper wall of which, tangential to that

of the spherical body 3 on which the said extensions are inserted, extends to the wall of the inlet into which they fit.

The radial extensions 5, the lower openings of which terminate in the plane of the minimum section of the inlet 1, are arranged between the distributing conduits proper 6 provided with thin walls which are good conductors of heat. These conduits 6 are made in the shape of boxes with rectangular cross-section gradually increasing in width and in height (Figures 3 and 4) from the inlet 1 towards the movable blades. The outlet cross-section of the distributing conduits is parallel to the axis of the propeller, because it terminates at the chamber of the movable blades and is consequently at a right angle to that of the inlet, the walls of the conduits rising after having been suitably curved, so that the direction of the jets, tangential to the said walls, at their escape from the distributor, is directed towards the front of the propeller and forms an angle with the direction of the axis.

For erecting, the distributing conduits have the flanges of the opening facing the inlet 1, bent over, so as to form fasteners 7 engaging under the edges of the openings of the radial extensions 5 of the central body 3, between which the said distributing conduits 6 are arranged. Moreover, their curved faces are provided respectively with a stamped helical groove 8 engaging with projections 9 of corresponding shape, provided on the wall of the casing of the conduit of the inlet 1, and on the corresponding outer wall of a body 9 in the shape of a bell-mouth inverted relatively to the inlet 1, the base of the said bell-mouth terminating also at the wall of the movable blades.

In the bell-mouth 1 of the inlet, are moreover arranged radial blades 10, whether helical or not, intended to divide the fluid jets and to give them a suitable direction for their admission to the distributing conduits.

*b*. The movable blades are mounted on a disc 11 at a right angle to the axis of rotation, and are comprised between two concentric cylindrical surfaces, the axis of which coincides with that of the rotation.

The blades through which the jets of fluid pass from the interior outwards, are constituted by a series of helical partitions 12 forming passages 13, the circumferential cross-sections of which gradually increase. The radial cross-section fits that section of the distributor, which is determined by the walls 1 and 9. The upper outline continues that of the distributor, and is then curved backwards and connected to the diffuser, the bottom outline also continues the corresponding outline of the distributor, is curved towards the centre of the cross-section of the blades and also connected to the diffuser by an arc of a great radius of curvature approaching the tangent in profile.

The disc 11 supporting the blades, the inlet and outlet openings of which are thus parallel to the axis of rotation, is driven by the engine either direct or by means of any suitable reducing gear 14.

*c*. The diffuser 15 is constituted by the extension of the casing forming the inlet 1—this portion not being provided with any guide blades and corresponding directly to the outlet of the movable blades—and by a ring 16 provided with a conduit of gradually increasing cross-section arranged obliquely in the direction opposite to that of the inlet and provided with guide blades 17 directing the liquid jets to the exhaust after utilisation.

The working of the propeller thus constructed, is as follows.

The fluid in which the propeller acts, under the suction produced by the rotation of the movable blades 12, rushes into the inlet 1 and passes into the distributing conduits 6 which direct it, after contraction of the fluid vein and expansion, towards the said blades 12.

The fluid which is brought back to the front of the propeller, impinges against the upper outline of the blades where it is stopped, whereby its kinetic energy is converted into potential energy, the work absorbed by the blades constituting the axial reaction which acts in a direction parallel to the axis

of rotation, in order to communicate its speed to the movable body. The liquid is thence directed, with the residual speed, to the diffuser 15 which discharges it.

In order to improve the efficiency, the distributing conduits 6 are heated so as to bring about an increase of pressure of the fluid vein passing through them, which can be recovered on the movable blades 12. To that end, any thermic agent, for instance cooling water of the engine, can be circulated round the distributing conduits 6, thus avoiding the use of a radiator.

But, more particularly in the case of aerial propellers, it is preferable to utilize the exhaust gases from the engine, which are supplied to the socket 4 forming the hollow point of the propeller. These gases collected by the semi-spherical body 3, are distributed by the hollow radial extensions 5 between the walls of the conduits 6, so that, in addition to the exchange of heat obtained, these hot gases under pressure act also on the movable blades 12 and produce a depression which assists the escape of the fluid at the orifice of the distributor. As a result of the reverse action due to the suction produced by the escape of the fluid, the exhaust gases are also drawn in by the movable blades, so that the back pressure in the engine does not exist, and can be even transformed into a fall of exhaust pressure, similar to the vacuum produced by the condenser of steam engines, which improves the efficiency of the propeller and motor group.

In order to avoid an excessive fall of temperature of the exhaust gases in the collector, before their utilization by injection in the distributor, the body 3 could be provided with a non-conducting covering, for instance protected by a circulation chamber for the cooling water of the engine, surrounding the same wholly or in part.

The propeller described can be, of course, applied to any movable body such as an aeroplane, ship, motor-car or the like.

It can equally well act by traction or thrust, and be combined with a diaphragm having an adjustable opening or cross-section, mounted in the bell mouth of the inlet, or in any other suitable manner, so as to vary the volume of the fluid admitted, the corresponding value of the axial reaction, and consequently the speed of driving of the corresponding movable body, on which the propeller is mounted. The propeller acts then as a gradual change speed gear.

By arranging as indicated an identical propeller on the movable body, in such manner that its axial pressure should be in the direction opposite to that of the propeller bringing about the movement forward, a gradual braking can be obtained. These arrangements can be more particularly applied to motor vehicles. The motor group and the transmitter of movement are then reduced to an ordinary engine driving a front propeller which brings about the movement at variable speeds, and a stern propeller rotating idly normally behind its closed diaphragm without producing any reaction. The more or less great opening of the diaphragm of the said propeller, makes it possible to produce axial reactions of variable value opposing the movement forward. In that way, the transmission of movement to the wheels, the differential, the brakes on the rear wheels, the cooling fan and the like, are done away with.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A propeller of the kind having the form of a controlled turbine, in which the blades of the rotor which move between the inlet and outlet distributing blades, are limited between two cylindrical and concentric surfaces, the axis of which is that of the motor; the outer surfaces of the said rigid blades being parallel to each other and perpendicular to the driving axis so that the fluid which is drawn in by the rotor is subjected therein to such a change of direction that it gives rise to an axial reaction which is directed parallelly to the axis of rotation of the said propeller and which propels the movable body on which the said propeller is mounted.

2. A propeller of the kind set forth in Claim 1, in which the suction of the fluid is effected through an inlet in the shape of a bell mouth, at the base of which terminates the distributor with fixed guide blades feeding the movable blades of the turbine, and in which the movable bladé wheel of the turbine, the inlet and outlet sections of which are arranged on two concentric cylindrical surfaces the axis of which coincides with the axis of the propeller, is mounted on a disc driven by the engine either direct, or by means of any suitable reducing gear, and co-operates with a mixed circular diffuser provided with partial exhaust blades, bringing the jets of fluid towards the back of the turbine and parallel to their direction of inlet into the distributor.

3. A propeller of the kind set forth in Claim 1 in which the distributor is constituted by a series of boxes with helical walls leaving between their respective partitions, passages for the circulation of a heating agent such as the cooling water of the engine cylinders or exhaust gases, the exhaust gases in the latter case being collected by a hollow body arranged in the centre of the bell mouth of the inlet and provided with radial distributing conduits terminating between the boxes of the distributor, so that the said gases act direct on the movable blades and produce, owing to their speed of flow and to the heat exchanged, an increase of the kinetic energy of the fluid jets drawn in, as well as a reduction of the back pressure at the exhaust of the engine.

4. A propeller of the kind set forth in Claim 3, in which the bell mouth of the suction inlet is provided with a diaphragm of adjustable area, by means of which the section of suction and consequently the volume of the fluid drawn in can be varied, which results in a corresponding modification in the value of the axial reaction, and consequently, in the speed of driving of the movable body carrying the said propeller which can be moreover arranged so as to act as a brake.

5. The propeller substantially as described or as illustrated in the accompanying drawing.

Dated this 26th day of May, 1911.

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Chartered Patent Agents.

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[This Drawing is a reproduction of the Original on a reduced scale.]

Fig. 1.

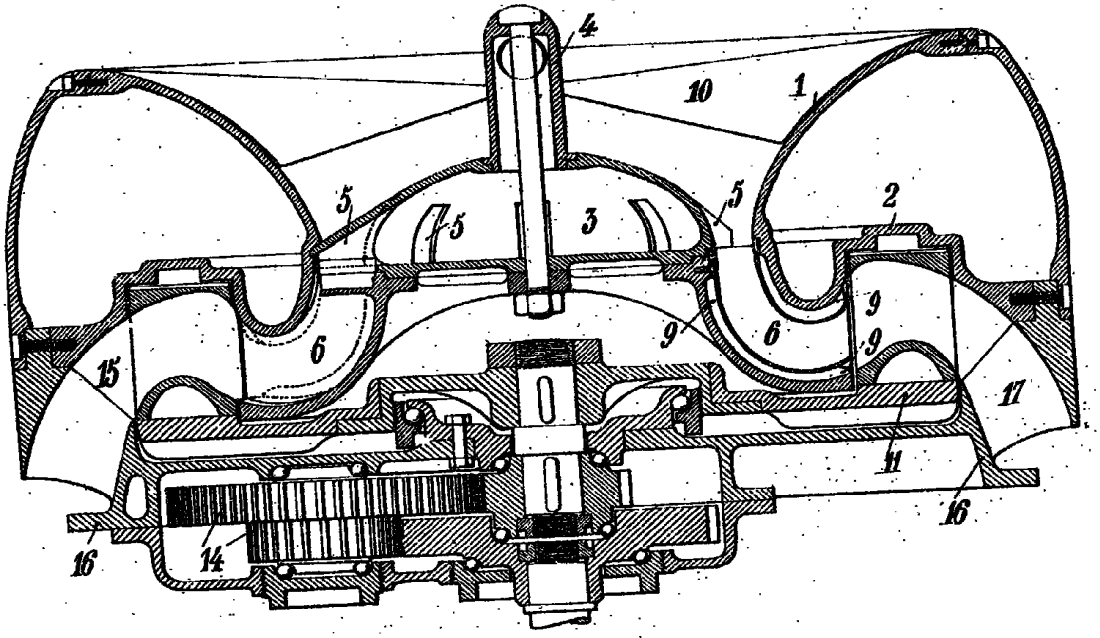



Fig. 2.

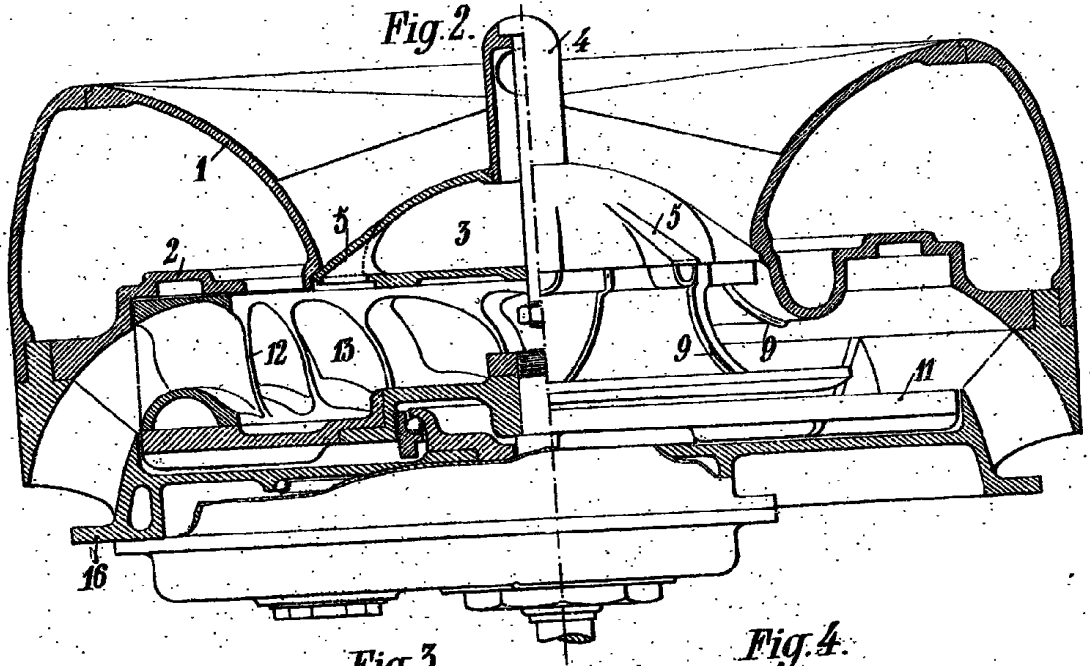



Fig. 3.

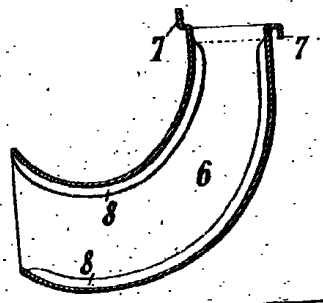
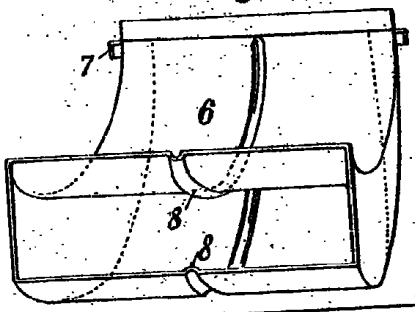



Fig. 4.



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