PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in or relating to the Propulsion of Solid Bodies in Fluid Media

I, HENRI COANDA, of 10, rue Bardin Clichy (Seine), Roumanian subject, 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:—

This invention relates to methods of and means for producing thrust forces within a fluid applicable to the propulsion of bodies or to the transmission of power.

The usual methods hitherto employed for propelling bodies have utilised devices which have transformed heat energy into a mechanical form of energy, thus facilitating the production of forces which move the body upwardly or along in a surrounding medium with a more or less high efficiency. Such devices have included screw propellers, beating vanes, vane wheels and also devices setting up reactive forces produced by outflowing fluid media which, as in the known type of rockets, can be produced directly by gases without any intermediate transmission devices as a result of suitable combustion processes.

All these constructions have one thing in common, namely that the propulsion of a body in a fluid medium is effected by the production of a point of interaction in said medium by a backwardly directed pressure which acts in the opposite direction on the body thus forcing it to move forward from this point of action. This counter-action corresponds to an original opposite movement of the fluid medium, corresponding in a screw or propeller to the movement of the air stream produced thereby. From the co-operation of the corresponding resistances which the fluid medium opposes to the driven propeller in an axial direction there results the thrust or tractive force which is transferred by said propeller to the body to be propelled to which it is connected.

Suggestions have also been made to create air streams by various forms of air impellers which act on aerofoil surfaces so as to produce on the upper or leading face of the aerofoil a depression and on the lower or rear face a pressure above atmospheric, such aerofoils being of normal wing form or of annular form but in all such cases the action of the air stream has been such as to produce pressures which are respectively negative and positive relatively to the ambient (or atmospheric) pressure.

The method of the present invention of producing thrust forces within a fluid which as abovementioned are applicable to the propulsion of bodies or to the transmission of power consists in projecting a fluid layer at high velocity over the upper leading face of an inclined member of aerofoil character the aerodynamic resultant of which substantially coincides with the desired direction of thrust to produce a depression adjacent said face, utilising the ambient pressure on the reverse face of said member to tend to propel said member into said depression and maintaining by replacement fluid streams said ambient pressure on said reverse face.

According to the present invention the device for producing thrust forces within a fluid includes means for producing a fluid stream of high velocity, a pressure regulating chamber for said fluid stream, one or more aerofoils disposed in such manner that the fluid stream issuing from the regulating chamber passes during its sub-ambient expansion over the face of the aerofoil facing the intended direction of movement or thrust and air channels to maintain the ambient pressure on the reverse face of said aerofoil.

The above described operation results in a momentum of the ambient fluid opposite in direction and equal to the thrust force exerted on the body.

For the purpose of producing the motive fluid layers which are caused to act on the aerofoils so as to set up the forces required to move large amounts of the ambient fluid in a direction substantially at right angles to the direction or projection of said layers, there can be utilised the products of combustion of bodies possessing the required amount of combined energy. For example, the motive fluid in one or more

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layers may be generated within torpedo shaped bodies by means of devices such as nozzles or the like, the said layers streaming out laterally against one or more aerofoils inclined at definite angles.

The low pressure produced on the upper leading face in conjunction with the ambient pressure maintained on the other face produces a movement of the ambient fluid medium in much larger amounts in a direction substantially at right angles to that of the projected layers. The efficiency of the propulsive force depends on the velocity of the motive fluid, the form of the aerofoil and the dimensioning of the path of flow intermediate the nozzle and said aerofoil.

Instead of using nozzles one or more burners of a suitable fuel may be substituted. Alternatively, the motive fluid layers may be produced by mechanical or other devices serving the same purpose, such as for example a centrifugal fan.

The invention will be hereinafter more fully described with reference to the accompanying drawings illustrating the method of operation and several embodiments for carrying the same into effect. In these drawings:—

Fig. 1 shows diagrammatically a longitudinal section through a device illustrating the principle of the invention, which is symmetrical about the axis O—O.

Figs. 2, 3 and 4 show modifications also in longitudinal section.

The body denoted by *b* on which the propulsive force is to act is surrounded by a fluid medium *a*. This body contains a burner nozzle *c* and a chamber *d* into which the ambient fluid is sucked through apertures *e*. The chamber *d* forms a pressure regulating chamber within which the products of combustion together with the added ambient fluid are allowed to expand and from which the fluids pass through openings *f*. The chamber is formed so that the issuing fluid stream has a reduced velocity and the desired direction.

On the body *b* are provided a number of aerofoils *g* the leading faces *h* of which are formed and arranged so as to be swept by the stream of fluid flowing out through the openings *f*. This fluid stream expanding to a sub-ambient pressure produces on the leading faces *h* a depression or low pressure. A part of the outflowing fluid stream as illustrated may pass along the reverse face of the aerofoil *g* being diverted along the stream line face *i* in order to facilitate the flow of the ambient fluid hereinafter mentioned.

Channels *s* communicating with the under or reverse face *i* of the aerofoils *g* are provided in the body *b* through which the ambient fluid *k* moves on movement of the body to maintain the ambient pressure on the reverse face. The flow of the ambient fluid produced by the low pressure at *h* is denoted by *l*; *p* and *q* denote the force components which act on the aerofoils *g*.

When in operation the burner *c* is ignited, it projects the products of combustion at high velocity into the regulating chamber *d* where on the introduction of the stream through the openings *e* the amount of fluid is considerably increased but its velocity, however, is reduced. The gas stream expanding according to the shape of the regulating chamber *d* leaves the latter at the openings *f* and then during its sub-ambient expansion streams over the upper leading face of the aerofoil and there produces as a result the forces *p* and *q*. The suction action of the depression adjacent the face *h* acts on the ambient fluid as at *l* and produces a movement thereof which corresponds in dimension $(M \times V)$ and is opposite in direction to the trust exerted on the body. The ambient pressure on the reverse face *i* is maintained by the stream of ambient fluid *k*.

Fig. 2 also shows a construction wherein a combustion nozzle *c* is provided but instead of one inlet *e* for the additional amounts of the ambient fluid a plurality of such inlets e^1 and e^2 etc. are provided, as well as guide vanes or if desired additional burner nozzles in the pressure regulating chamber. The subsequent action of the fluid streams at the outlet openings *f* and on the symmetrically arranged aerofoils *g* correspond to that of Fig. 1.

Fig. 3 shows a modification wherein instead of the additional burner *s* of Fig. 2, a fan *v* driven by a suitable motor *m* is provided, whilst the burner nozzle *c* is dispensed with.

Fig. 4 shows an embodiment wherein the details of the burner nozzle and of the pressure regulating chamber correspond to the description of the previous figures. After the fluid stream issues from the openings *f* it flows along the upper leading face of pivotal aerofoils *g* which form an angle α with the perpendicular to the axis of the body and the direction of the movement of the said body. The resultant depression on the leading face of the aerofoils *g* has components *q*; the sum of all these components *q* results in the production of a propelling force in the direction of the central axis of the body *b*. The adjustment of the angle α may be effected by axial displacement of

the lower ends of struts z by means of a threaded spindle through the intermediary of a nut r and hand wheel u.

In Figs. 2 and 4 the flow of the ambient fluid to maintain the ambient pressure on the reverse face of the aerofoil is denoted by arrows k, the said fluid passing through channels (not shown) to said reverse face as in Fig. 1.

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 method of producing thrust forces within a fluid applicable to the propulsion of bodies or to the transmission of power which consists in projecting a fluid layer at high velocity over the upper leading face of an inclined member of aerofoil character the aerodynamic resultant of which substantially coincides with the desired direction of thrust to produce a depression adjacent said face, utilising the ambient pressure on the reverse face of said member to tend to propel said member into said depression and maintaining by replacement fluid streams said ambient pressure on said reverse face.

(2) A device for producing thrust forces within a fluid applicable to the propulsion of bodies or to the transmission of power which comprises means for producing a fluid stream at high velocity, a pressure regulating chamber for said fluid stream, one or more aerofoils disposed in such manner that the fluid stream issuing from the regulating chamber passes during its sub-ambient expansion over the face of the aerofoil facing the intended direction of movement and air channels to maintain the ambient pressure on the reverse face of said aerofoil.

(3) A device according to claim 2 in which the means producing the fluid stream and the regulating chamber are arranged within the body to be acted on while the aerofoils are disposed laterally of said body.

(4) A device according to claim 2 or 3 in which one or more channels are provided in the body leading from the front of the same to the reverse face of each aerofoil in order to maintain the ambient fluid pressure on said face.

(5) A device according to any of claims 2—4 in which the constituents of the fluid layer projected out of the body are generated wholly or in part from the combustion or vaporisation or expansion of a substance disposed in the interior of the body.

(6) A device according to any of claims 2—4 in which the constituents of the fluid projected in the form of a layer are set in movement in the interior of the body by mechanical devices.

(7) A device according to any of claims 2—6 in which the individual members such as the motive fluid generator, the regulating chamber or the aerofoils, are constructed so as to be adjustable thus producing an action which is variable in nature and magnitude.

(8) Methods of producing thrust forces within fluid media substantially as hereinbefore described and illustrated.

(9) Devices for producing thrust forces on bodies located in fluid media constructed, arranged and operating substantially as described with reference to the accompanying diagrammatic drawings.

Dated the 8th day of January, 1934.

FRANK WATSON,
Aldwych House, Aldwych, W.C. 2,
Agent for the Applicant.

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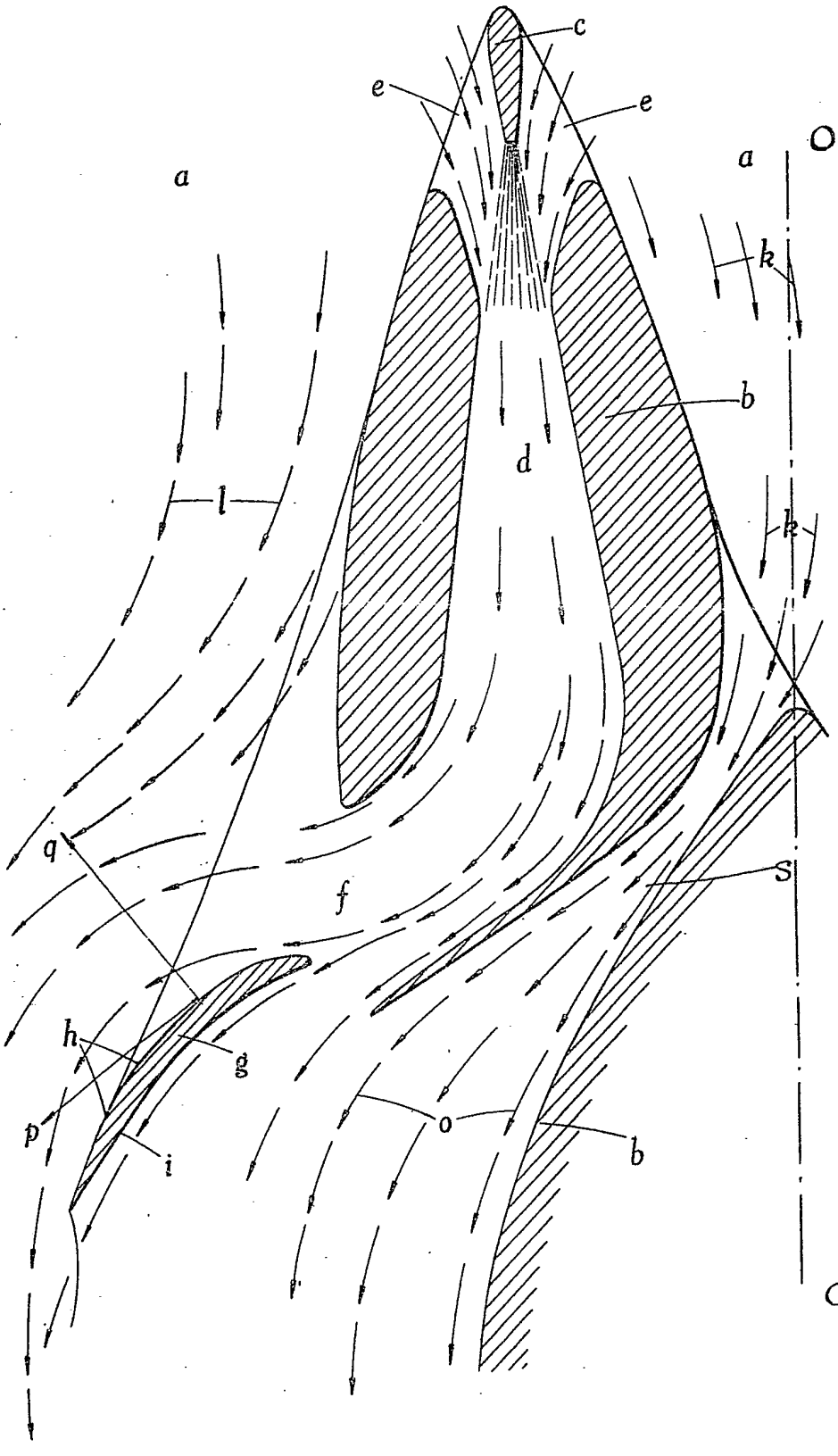
SHEET 1

Fig. 1.



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

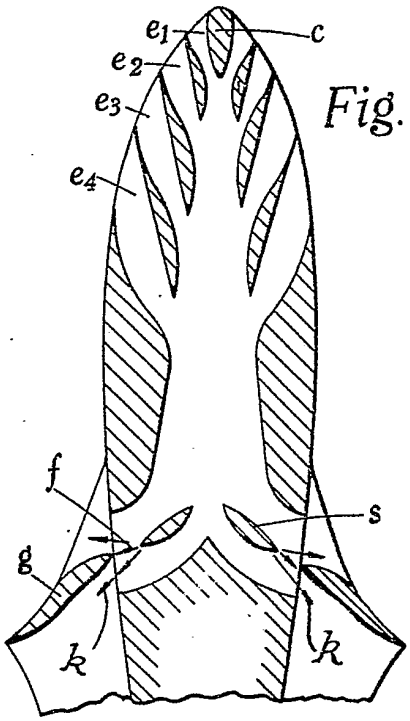


Fig. 2.

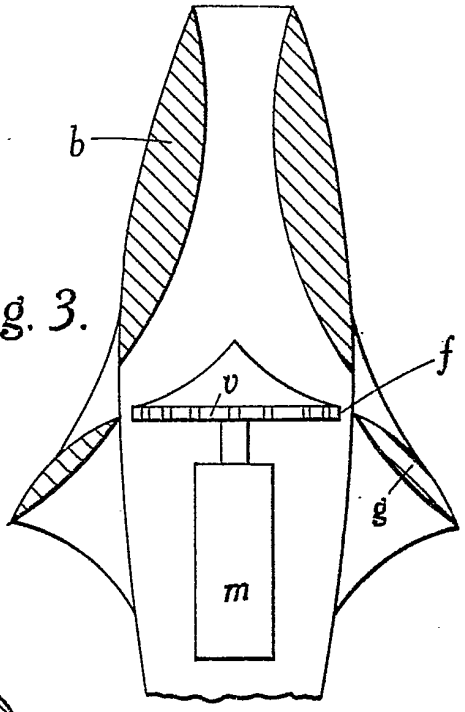


Fig. 3.

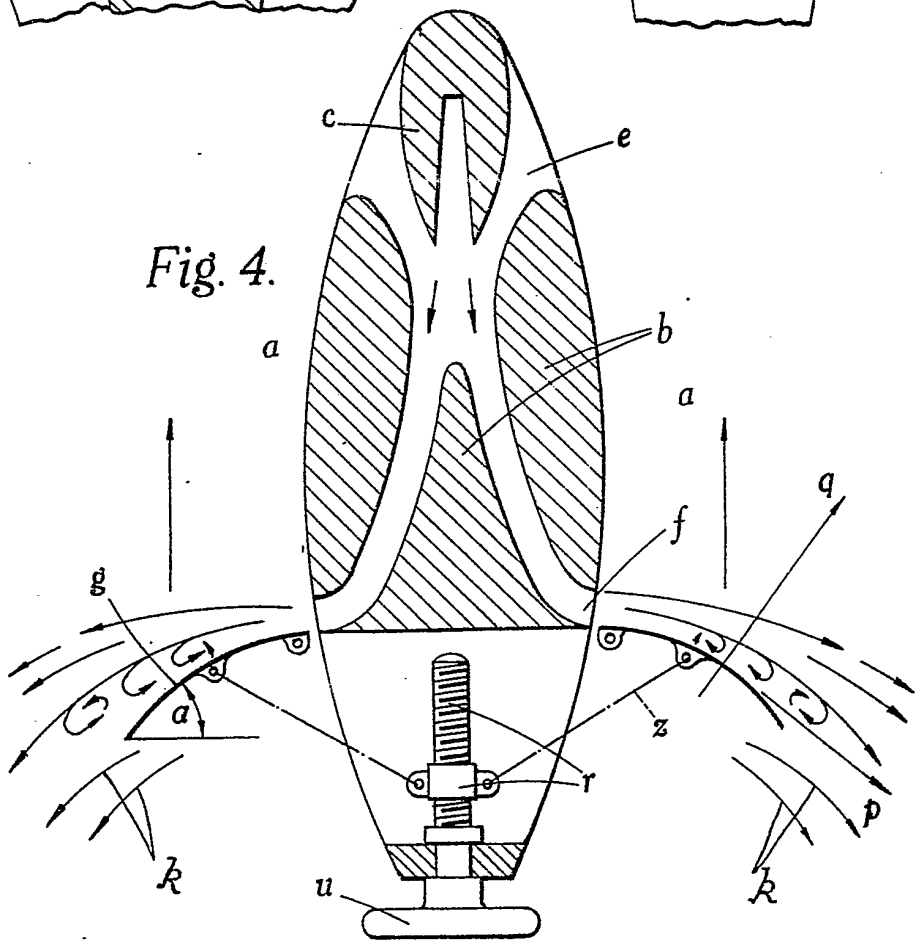


Fig. 4.

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Fig. 1.

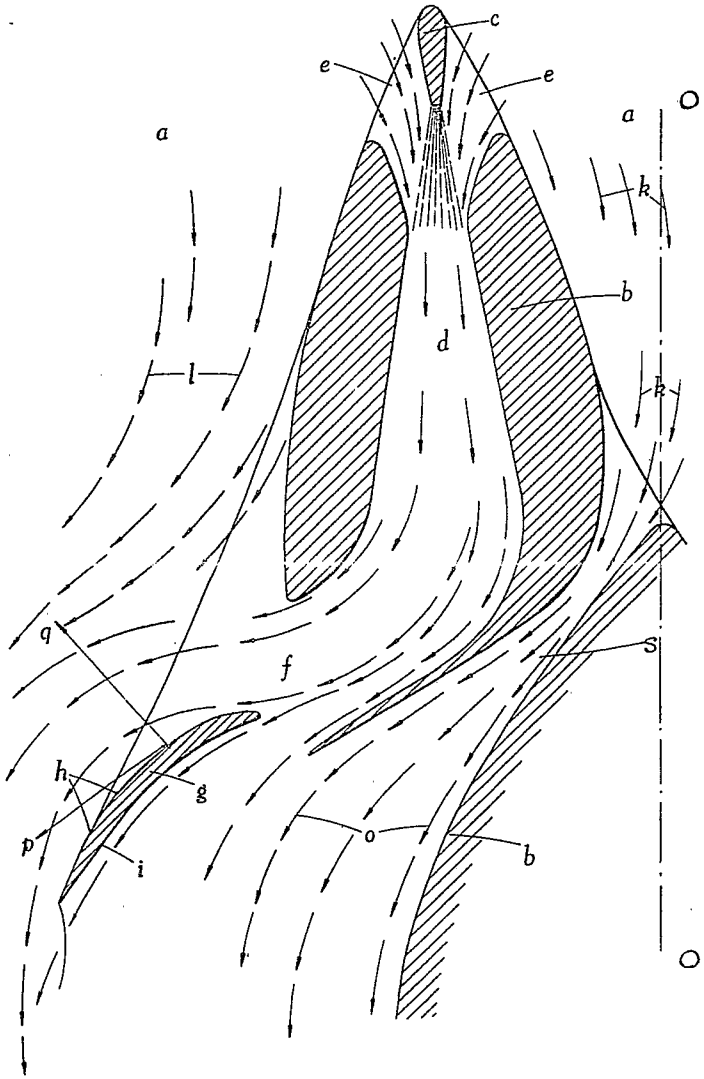


Fig. 2.

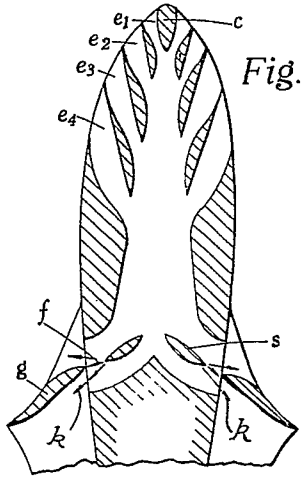


Fig. 3.

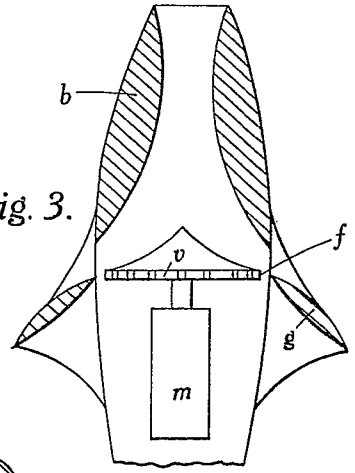
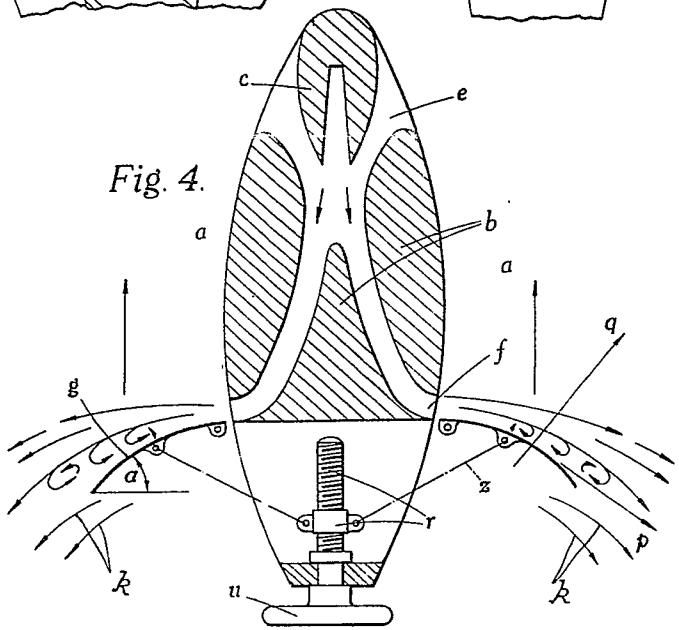


Fig. 4.



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