PATENT SPECIFICATION

157,781

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COMPLETE SPECIFICATION.

Internal Combustion Unit for use as a Propeller or Tractor.

I, ALFREDO GUAITA, an Italian subject, of Via Nazini, 27, Voghira, Italy, 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:—

My invention which relates to an internal combustion unit for use as a propeller or tractor for propulsion in the air, or in water, or in other suitable medium, is directed to the kind of apparatus having no moving parts, and based upon the principle of completely converting the thermic energy of a fluid under pressure into kinetic energy and utilizing the latter energy for propulsion by creating a depression, suction, or partial vacuum in the side towards which movement is required, and a reaction or compression on the opposite side, both simultaneously producing forward movement.

My invention has for its object the improved arrangement of apparatus of the above nature, as hereinafter described, pointed out in the appended claims, and illustrated by the accompanying sheets of diagrammatic drawings, wherein:—

Figure 1 is a sectional plan view illustrative of an apparatus provided with a single vane or deflecting surface.

Figure 2 is a plan view of an apparatus, similar to Figure 1, but provided with a multiplicity of vanes or deflecting surfaces.

Figure 3 is a plan view of an apparatus provided with a multiplicity of vanes or deflecting surfaces, and also a series of aspirator vanes.

Figure 3ª is a sectional view taken on line x—y of Figure 3.

Figure 4 is a view illustrative of the application of primary and secondary vanes or deflecting surfaces.

Figure 5 is a sectional end view of the device shown in said Figure 4.

Figure 6 is a view illustrative of the adaptation of the various devices, hereinafter described, to a single apparatus.

In carrying out the invention, and for propulsion, the requisite pressure of motor fluid will be obtained, generally, by burning a suitable mixture under constant pressure in a combustion chamber. Any other means of obtaining the required pressure may be utilized, including systems in which water or steam are employed.

The terms "motor fluid" and "ambient fluid" are used to express, respectively, the products of combustion issuing from a combustion chamber, and the surrounding medium (air, water or other medium) in which the movement of the apparatus takes place.

Referring first of all to Figure 1, compressed air, from any suitable compressor enters, by way of tube a into a jacket formed by the external casing a^1 and the combustion chamber a^2, the walls of the casing a^1 being fire proof. The air, after filling the jacket, passes, through openings a^3, into the combustion chamber a^2, where it meets with a jet of some suitable fuel, which is atomised by the atomiser a^4, and burns in contact with the air under pressure. Combustion is started "in the cold" by injecting a fuel of low flash point and using an auxiliary electric ignition. As soon as the chamber has been raised to a high heat the combustion becomes spontaneous and the igniter is no longer necessary, and any usual fuel is used.

In the chamber a^2, the pressure is that of the compressed air introduced, as combustion takes place under a condition of constant pressure though with variable volume, hence it follows that the exhaust

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of the products of combustion will be continuous, and consequently no valves or mechanically operated parts will be required. Durability and strength are ensured by the equality of the pressures which prevail in the chamber a^2 and in the casing surrounding it.

The flow of the products of combustion passes through the contracted neck a^5 into a divering expansion tube a^6 which constitutes the means by which thermic energy is converted into kinetic energy.

At the mouth of the tube a^6, which is of suitable dimension, there obtains a mass "m", per second, of products of combustion at approximately atmospheric pressure, and possessing the velocity V, and the available energy is represented in the formula $\frac{mV^2}{2}$, which will comprise the whole of the thermic energy of combustion, less the slight loss, due to radiation of heat, or friction on the walls of the tube a^6 and reduction or degradation of energy.

The question is how to utilize for the purpose of propulsion the kinetic energy created in the method above described. For this purpose various methods are proposed, said methods being used together or separately.

The development of movement from energy can be obtained by attaching to the end of the expansion tube a^6 a deflecting surface or deflecting surfaces b, of suitable shape, constituting a surface of revolution. Taking the velocity "V" of the motor fluid, with regard to the apparatus, to be equal to v, the velocity imparted to the apparatus, *i.e.* $V=v$, then since the vanes or deflectors b are curved backwards, to the direction of movement of the apparatus, the exiting fluid will have a velocity, *nil*, in relation to the surrounding fluid, and thus all the energy will be converted into "thrust".

Under certain conditions, a multiple system of vanes or deflectors, of increasing area as in Figure 2, may be employed, consisting of two, three or more series of vanes.

In an application of this type of tractor under conditions of highest efficiency, the velocity "V" with which the products of combustion impinge upon the vane or vanes b may have to be considerably reduced, as otherwise speeds would be obtained considerably in excess of all possible factors of safety.

Therefore, in order to eliminate this drawback, I may proceed in two different ways, which may be used either separately or together. These methods are examined under the following heads 1 and 2.

1. One method consists, in employing the velocity of the combustion gases on a multiple aspirator system, on the same lines as the steam injector, to draw in the required volume of the surrounding fluid, thus producing a great decrease of velocity, the action taking place after the pressure of the combustion gases has been completely converted into velocity.

If, as shown in Figure 3, a succession of aspirator vanes, c be fitted to the outside surface of the expansion tube a^6, the surrounding fluid will be drawn in to mix with the exhaust gases, and the mixture thus formed, will pass to the mouth of the tube a^6 with a velocity "V^1", less than the original velocity "V".

By applying a requisite formula the quantity of surrounding fluid required can be ascertained, but the following points must be observed:—

(*a*) In order that the suction produced, in the surrounding fluid, may contribute towards propulsion or traction, some system must be employed, in combination with the multiple aspirators, to regulate the direction of inflow of the ambient fluid, as for instance a bell mouth d turned in the direction of movement of the apparatus.

(*b*) As the ratio of the inflow of the surrounding fluid, must always bear a definite relation to the speed imparted to the apparatus, some system of regulation of this inflow must be embodied in the apparatus. In one embodiment (Figure 3) it is proposed to form the multiple aspirators c with ports or slots and in such a manner, that their outer peripheries form a cylindrical or conical surface, upon which a cylindrical or conical sleeve c^2 may turn or slide. By any suitable system of control, for instance, rack and pinion c^3 this sleeve c^2, which will be slotted, as shown in Figure 3^a will regulate the amount of opening exposed for each separate aspirator.

2. The other method consists in adapting the vane or system of vanes in such a way, that its purpose is, not to utilize the whole of the velocity of the fluid (formed by the products of combustion alone or mixed with external fluid), as stated under head "1", but to utilise the surface velocity which remains at the discharge end of the vane for producing a condition of depression or partial vacuum in the direction of forward motion, and, consequently a pressure at the rear as indicated in the diagram, Figure 4 hereinafter referred to.

The streams of fluid thus set in motion have a velocity which is the resultant of the exit velocity from the vanes b, and of the forward speed of the machine, and after a certain period of free movement are again deflected by the vanes z, Figures 4 and 5, to a course parallel with the tube h which encloses the system. During the period of free passage between the primary vanes b and the secondary vanes z (and if desired even after being deviated by the vanes z) the streams set up a reaction on the ambient fluid, entraining it in the direction indicated by the arrows. There will then be suction in the forward part f of the tube h, and compression in the rear part f^1 of said tube h, both contributing towards the forward movement of the apparatus.

Naturally, in order that the induction of air should be effective, it is necessary that the fluid mass should not emerge from the group of vanes in a continuous circular crown as takes place in type Figure 3, but it must be split up into elements leaving free the space for induction and aspiration of ambient fluid as indicated in Figure 5. For instance, a series of peripheral-formed openings (the number of which may vary) may be used, and such an elemental deflector is shown in Figure 5, where suitably arranged partitions allow of the fluid mass being split up into the elements 1 to 12 along the dotted line g to effect the induction of surrounding fluid.

Adapting all the devices to a single apparatus, there obtains, a single group, such as that shown in Figure 6, of which the following is a brief explanation, it being noted that the letters of reference correspond with those of the preceding figures.

a^2 is a combustion chamber which is followed by the expansion tube a^6. Along the length of the above tube multiple aspirators, are provided, the object of which is to introduce the ambient fluid to be mixed with the products of combustion. The streams of products of combustion mixed with ambient fluid emerge after impinging on vanes of the Pelton type, single or multiple, shaped in such a way as to give rise to a series of jets which draw or entrain air as above described.

An apparatus, of the above kind, requires the simultaneous operation of a compressor, (isothermic or almost so for its better efficiency) which compressor will produce the necessary compressed air for combustion. In case of high powers, and especially where it is a question of large installations with several propulsion appliances, a suitable power unit, designed so as to give with the least possible weight the same volume of air under the required pressure, will drive the compressor; the air obtained will then be distributed to the several propulsion appliances. In the case of low powers, (when the total efficiency of the apparatus allows), recourse may be had for compression to small wind-driven propellers which operate the compressors direct. The efficiency of the propellers, as shown by the Eiffel Tunnel experiments can be raised to 70 and 75%. By such arrangements there would no longer be motors of the current type on the apparatus. But as these propellers only operate when the apparatus is in motion it is necessary to provide for the apparatus a starting compressed air tank. A small motor, of 2 to 4 h.p., with a small compressor attached, can supply the tank with the necessary pressure for starting, and furnish provision against any mishap in order to restart the apparatus when necessary. It is to be understood, that the motor or motors, driving the compressor or compressors, must likewise provide for the movement of all necessary pumps to inject the fuel into the combustion chambers.

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. An internal combustion unit of the kind set forth characterized by a diverging expansion tube, which constitutes the means by which thermic energy is converted into kinetic energy, and a deflecting surface or vane, said surface or vane, which is of suitable shape and constitutes a surface of revolution, being curved backwards, to the direction of movement of the apparatus, so that the exiting fluid will have a velocity, *nil*, in relation to the ambient fluid, thus converting all the energy into "thrust".

2. An internal combustion unit as claimed by Claim 1, characterized by a multiple system of surfaces or vanes of increasing areas, said surfaces or vanes, which constitute surfaces of revolution, being curved backwards to the direction of movement of the apparatus.

3. An internal combustion unit as claimed by Claim 2, characterized by a multiple aspirator system located in the expansion tube to draw in the required volume of ambient fluid to effect decrease of velocity.

4. An internal combustion unit as claimed by Claim 3, characterized by the combination with the aspirator vanes of means, such as a bell mouth, turned in the direction of the movement of the apparatus, to regulate the inflow of the ambient fluid.

5. In an internal combustion unit as claimed by Claim 4, regulating the inflow of the ambient fluid, by forming the multiple aspirator vanes with ports and slots and in such a manner that their outer peripheries form a cylindrical or conical surface on which a slotted sleeve can be turned to increase or decrease the amount of opening exposed for each separate aspirator.

6. An internal combustion unit as claimed by Claim 5, characterized in that the whole of the velocity of the motor fluid is not utilized, and that the surface velocity remaining at the discharge ends of the deflecting surfaces is utilized to produce a condition of depression or partial vacuum in the direction of forward motion and consequently a rear pressure, the streams of fluid thus set in motion, which streams have a velocity, which is the resultant of the exit velocity from the primary vanes and the speed of the apparatus, being again deflected by a system of secondary vanes, to a course parallel to a tube enclosing the whole unit, setting up a reaction on the ambient fluid, and entraining it in a backward direction, thus producing suction in the forward part of the tube and compression in the rear part thereof, both contributing to the forward movement of the apparatus.

7. An internal combustion unit as claimed by Claim 6, characterized in that to obtain effective induction of ambient fluid, the fluid mass is, as it leaves the deflector vanes, split up into elements by means of peripheral-formed openings and partitions in said deflector vanes, leaving free spaces therein for induction and aspiration.

Dated the 5th day of January, 1921.

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Fig.1.

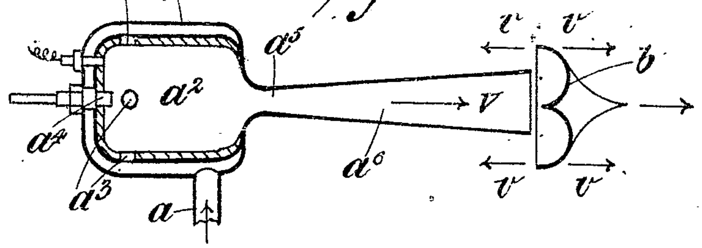


Fig.2.

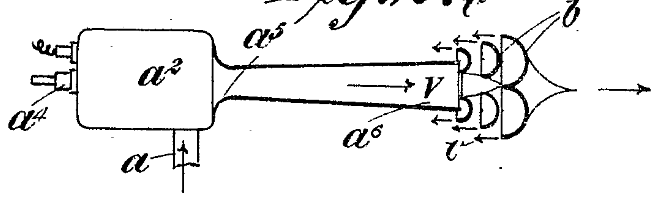
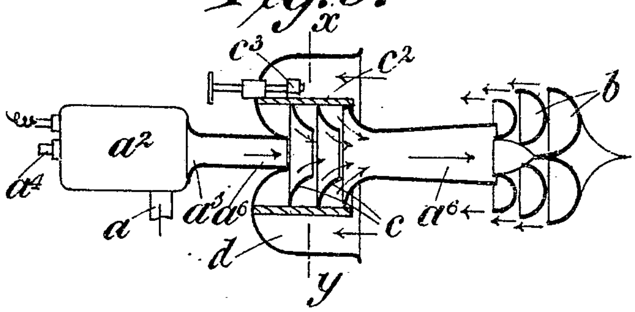


Fig.3.



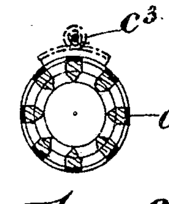


Fig.3ª.

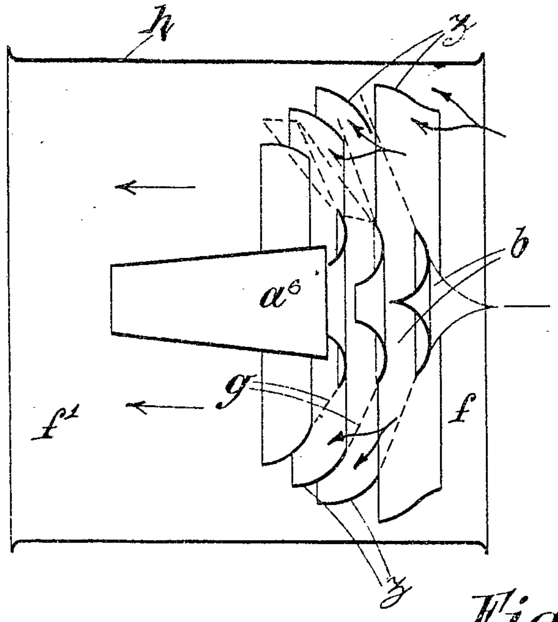


Fig. 4.

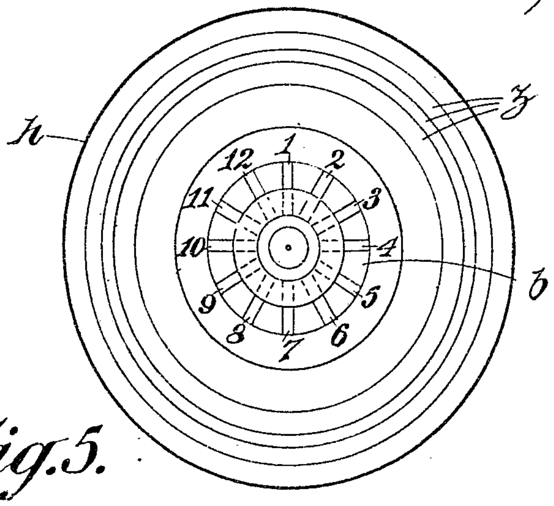


Fig. 5.

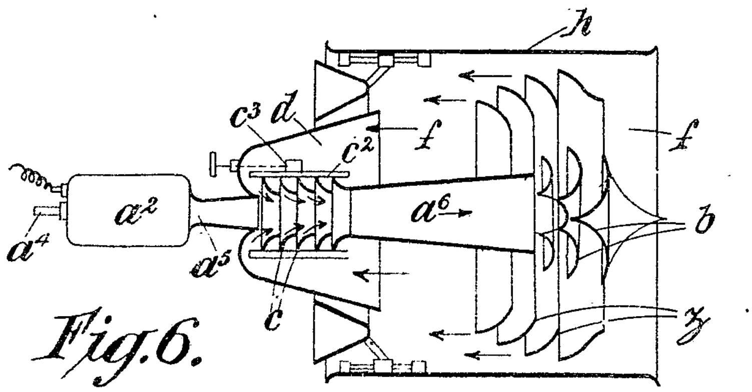


Fig. 6.