PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Improved Method of Producing Motive Forces for the Propulsion of Vehicles or Aircraft.

I, PAUL SCHMIDT, of Arcostrasse 10, Munchen, Germany, a German citizen, 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 a method of producing motive forces (reaction forces) on vehicles or aircraft by periodically exploding inflammable mixtures of substances. The invention is particularly applicable to aircraft in order to lift them out of their position of rest on the ground or to cause them to descend slowly with reduced flying speed. For this purpose, the force of expansion of inflammable mixtures of substances is utilised in a novel and technically very advantageous manner.

According to the invention each explosion is adapted to accelerate by the force of the excess pressure of the exploded mixture, a mass of air the weight of which exceeds by many times that of the inflammable mixture, which air is introduced after each explosion.

In the known method of propulsion by rocket effect wherein inflammable mixtures of substances are periodically exploded in a reaction chamber, the first explosion accelerates in the chamber a mass of air which is several times greater than that of the inflammable mixture, but subsequently the chamber is always filled with combustion gases formed by the explosions and the force of the reaction is then correspondingly reduced.

In contradistinction thereto, according to the present invention, a special additional mass of air which does not take any part in the ignition or combustion of the inflammable substance is also employed apart from the inflammable mixture of substances. This additional mass of air results in a better utilisation of the energy of the inflammable substance as compared with the rocket method, the high pressure produced on the ignition of the inflammable substance accelerating and expelling not only the combustion gases themselves but also the additional mass of air.

The method according to the invention may be carried out, for example, in a very simple form in known substantially tubular reaction chambers which are open at one end. The reaction chamber is charged with air, after charging, a small portion of that mass of air which is most remote from the outlet opening of the reaction chamber is mixed with combustible substances and thereupon this mixture, which for example may only amount to 5% of the total contents of the reaction chamber, is exploded. The expansion of the explosion gases causes the expulsion of the entire mass from the reaction chamber, whereby the mass of air which has not been mixed with fuel is pushed by the force of the excess pressure of the expanding gases like an air piston in front of the said gases. A particularly good efficiency for the transmission of energy is secured by means of the displacement effect of the expanding gases.

For the purpose of securing an almost continuous effect of the reaction force, the process may be repeated in rapid succession and carried out in a plurality of reaction chambers working in parallel.

The simplest means of transmitting the force of the excess pressure of expanded gases directly to a mass of air for the purpose of accelerating the said mass of air is undoubtedly the displacement of the air from a chamber by the expansion of the gases. Many special means have become known, however, for receiving, transmitting and utilising for special purposes, for example for producing the rotary motion of a shaft, the force of the pressure of expanding gases. A far-reaching transformation, on these lines, of the pressure forces, for example, by means of an internal combustion engine and a propeller driven by the said engine, does not come into consideration as regards the method according to the invention. On the other hand, however, much knowledge and many constructions are already available in the relevant art for receiving the explosion pressure of inflammable substances, which may be applied at once, by anyone skilled in the art, to the direct and technically extremely simple transmission of the forces of pressure to the large masses of air according to the invention.

In the known methods of producing large reaction forces, solid or liquid mixtures of inflammable substances, without admixture with air, are employed, or fuel-air mixtures are employed. The use of additional masses of air, not intended for the combustion but for the purpose of increasing the mass effect in the explosion by means of the direct utilisation of the explosion pressure, has not become known heretofore. The method according to the invention is not affected by a method, described in the literature, of utilising the velocity at which explosion gases issue from a reaction chamber for the purpose of aspirating air. The said known method is based on an ejector-like suction and pumping action of flowing combustion gases which have already expanded, but on the contrary does not utilise the pressure effect produced during the explosion.

For the purpose of producing motive forces, the utilisation of the pressure effect for accelerating additional masses is however, generally and fundamentally more advantageous than the utilisation of the energy of flow by mixing, because it follows from the laws of mechanics on which the ejector effect is based, that an increase in the reaction force by means of the ejector effect is not possible.

In an ejector (jet apparatus) the acceleration of the admixed masses takes place according to the laws of plastic impact, and therefore the momentum (mass times velocity) of the whole of the mass leaving the ejector is always equal to the momentum of the power jet working the ejector. As, however, the momentum is also equal to the reaction force which may be produced by the flow of a mass, the reaction force is not changed by inserting a jet apparatus. On the contrary, due to the mixing process, there is such a considerable loss of energy that the increase in mass is outweighed by the reduction in velocity.

In the method according to the invention, on the contrary, no loss of energy takes place and the new method therefore provides a very substantial and economical increase in the reaction forces. As is known, the said forces depend upon the mass and velocity of the expelled substances, and the magnitude of the reaction force which is produced is proportional to the said mass and its velocity. The energy which must be spent in accelerating the mass depends in like manner upon the mass but also upon the square of the velocity, so that maximum economy is attained in the production of reaction forces in the case of relatively small velocities and relative large masses which are subjected to the said velocities.

By the method according to the invention, relatively large masses of air are subjected to relatively small velocities by the transmission of the expansion pressure, so that an outstanding economy is attained in the production of force. In addition to the small consumption of inflammable substances or fuel which the method according to the invention involves, there is, inter alia, the advantage that satisfactory cooling of the parts exposed to heat is secured in the simplest manner by means of the large, unburnt masses of air.

A particularly advantageous effect of the new method is secured when the weight of the mass of air is about ten to fifty times the weight of the inflammable mixture of substances. Such a ratio of the masses or weights provides, on the one hand, a small, technically readily controllable, initial pressure of the mixture which is exploded, and on the other hand, of course, an economically satisfactory efficiency in the production of motive forces in comparatively small apparatus. The apparatus for carrying out the method according to the invention would be very large, for example, if the production of the reaction force were to occur for a ratio by weight of the accelerated masses of air to the masses of the inflammable mixture, as is employed in the known petrol engine-propeller units. As is known, in the latter, at least 300—400 times as much air is accelerated by the propeller as is burnt in the cylinders of the engine. On the other hand, however, in the utilisation of the energy of inflammable mixtures, without the simultaneous use of substantial quantities of additional reaction masses, and more particularly, however, in the utilisation of the reaction forces of explosion gases alone, there are, in addition to a very uneconomical utilisation of the energy, also heating effects which are technically very difficult to control.

The use of air as additional mass for increasing the reaction effect of explosion gases renders it obvious to constitute the inflammable mixture of substances in known manner of air and a fuel. The necessary excess of air required will be attained in each case without appreciable increase in the apparatus, and in certain cases, due to the homogeneity of additional mass of air and the inflammable air-fuel mixture, there will even be on the whole a simplification in apparatus, and more particularly the method will be easier to carry out technically.

In order to effect re-charging of a reaction chamber after the masses of air and gas have been expelled, preferably a portion of the energy of the mass of air and gas issuing from the reaction chamber at a high speed will be utilised. This may be accomplished for example, by employing a portion of the expelled masses to drive a suction blower which, in the case of a rapid succession of explosions or a plurality of reaction chambers working in parallel, may be driven continuously. On the other hand, the aspiration of fresh masses of air for charging the reaction chamber may be attained directly by means of the force of suction of the masses issuing with a high velocity from the reaction chamber. If, for example, as shown in Figures 1 to 4, the reaction chamber, extending in tubular form, is made comparatively long, the accelerated masses, towards the end of the expulsion process, produce a partial vacuum in the reaction chamber, and the supply of fresh masses of air may be effected, for example, by opening a valve. Figures 1 to 4 of the drawings illustrates the entire working apparatus and in addition a few details are shown which are particularly useful for carrying out the method.

The device substantially comprises a tubular reaction chamber 1, having its inlet end 2 so provided with flaps or valves 2^1 that the said end can be alternately closed and opened. The outlet end 3 is open.

In Figure 1 is shown the first phase of the working process. The combustible mixture is introduced through the open valves 2^1 at the inlet end of the tubular body 1, or is formed by injecting petrol into the first part of the tube. As will be seen from the drawing, this mixture only occupies a very small fraction of the total space.

In Figure 2, the inlet end of the tube is closed by closing the rear valves. As the valves are constructed as check or non-return valves, they close automatically on explosion in the present case. Expansion then occurs after explosion of the explosive mixture, as indicated in this Figure, the expanded mixture still constituting a comparatively small fraction of the contents of the tube. The column of air filling the remaining portion of the tube then begins to flow in the direction of the arrow 4.

In Figure 3, the non-return valves at the inlet end of the tube 1 are again open and the expanded combustion gases are advancing in the direction of the pressure flow (arrow 4). A suction flow is thereby produced behind the expanded combustion gases in the direction of the arrow 5. The expanded combustion gases and the air column in the flow tube 1 thus draw in by suction a fresh column of air at the inlet end.

In Figure 4, the expanded mixture is on the point of leaving the outlet end of the flow tube, while the latter has been filled by suction with a fresh column of air. Finally, an inflammable mixture is drawn in at the rear end of the air column or is formed afresh by the injection of petrol, and thereupon the cycle recommences.

As already follows from the Figures 1 to 4, it is necessary in carrying out the method according to the invention, to employ reaction chambers which are made comparatively long, so as to contain, in addition to the mass of inflammable mixture, masses of air many times greater. This very long extension of the reaction chambers, when the latter are employed as motive means for aeroplanes, requires in its turn that the tubular chambers should extend substantially along the fuselage of the aeroplane or along the supporting surfaces, in the latter case therefore, at right angles to the direction of flight, in order that the shape of the aeroplane will be satisfactory from the point of view of aerodynamics. In the arrangement of the tubular reaction chambers in the direction of the supporting surfaces, the reaction chambers may be advantageously placed within the supporting surfaces. As the direction of flow of the reaction masses, with the arrangement of the reaction tube in the direction of the supporting surfaces, runs substantially transversely to the direction of flight, deflection of the streaming masses at the outlet end of the reaction chambers will in general be necessary.

In one application of the method according to the invention for the purpose, for example, of lifting an aeroplane from the position of rest on the ground in a vertical direction or generally, with reduced aerodynamic lift, to keep the aeroplane hovering, to lift it or to lower it, it is necessary to effect, at the outlet for the reaction masses, a downward deflection of the flow by there providing means as for example guide blades or bends.

It is also preferable in those cases where vertically acting forces are to be transmitted to an aeroplane by the devices according to the invention, to expel the reaction masses at at least three places on the aeroplane. The said places will preferably be arranged in a substantially horizontal plane so as to form the corners of a triangle. Stability of the normal flying position cannot be attained by using less than three places of support constituted by the reaction forces of the expelled masses of gas and air, whereas, on the contrary, stability can be attained with certainty by the arrangement of three or more places of expulsion.

When using a plurality of reaction tubes, it is also possible, by varying the effect of the several reaction tubes, to control the aeroplane for the purpose of maintaining a definite position or direction of motion. In order to attain this object, the quantity or the velocity of the masses expelled from the reaction chambers will be varied with respect to one another in the simplest manner by varying the propellant quantity of inflammable substance supplied to the different reaction chambers, whereby automatic regulation, for example of the equilibrium position of an aeroplane, may be secured with particular advantage by varying the quantity of inflammable substance or fuel in accordance with known instruments, indicating, for example, the equilibrium position of an aeroplane.

The method according to the invention may be arranged together with a normal propeller drive, i.e. as supplementary drive, or also alone for propelling aeroplanes. In many cases, it will be particularly economical to arrange the propulsion device according to the invention in conjunction with a propeller drive, the propulsion device according to the invention being employed substantially only for the production of very particularly great efforts. The production of very particularly great efforts is chiefly to be desired at starting or in order to attain particularly high climbing powers and flying speeds. Moreover, it is preferable in many cases to provide the device according to the invention on aeroplanes as a safety reserve, which may be used as a substitute for the propeller drive in case of engine failure, while normally only the propeller will be used for driving the aeroplane. All these forms of application of the reaction drive according to the invention, which have been mentioned in the foregoing, increase the economy of flying to a particular extent, because remarkably high reaction forces may be obtained with an extremely small weight of apparatus by suitable selection of the additional quantities of air.

The devices required for carrying out the method according to the invention may be located at any place on aeroplanes or vehicles, since moving parts are avoided to a considerable extent, and almost completely with some constructional forms. The space they occupy is small in comparison with the effort attained, and their safety in working is excellent.

The explosion chambers of the inflammable mixture may either be separated from, or combined to form one unit with, the reaction chambers from which the masses of air and gas are expelled. Further, a plurality of reaction chambers may be fed by one explosion chamber, and also the reaction chambers may be provided with very large additional masses of air from a central point.

The method may be used both for aeroplanes which are to be moved very slowly (ascending and descending) as also for aeroplanes or vehicles which are to be moved very rapidly. In aeroplanes or the like which are to be moved very rapidly, the method according to the invention exhibits very advantageous effects chiefly for initiating the rapid motion, because very great accelerating forces can be produced with an economical consumption of inflammable agents. Moreover, however, the method according to the invention may also possess considerable advantages when it is a question of continuously maintaining a body in very rapid movement.

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 motive forces (reaction forces) on vehicles or aircraft, by periodically exploding inflammable mixtures of substances, characterised in that each explosion is adapted to accelerate by the force of the excess pressure of the exploded mixture, a mass of air the weight of which exceeds by many times that of the inflammable mixture, which air is introduced after each explosion.

2. A method as claimed in claim 1, characterised in that the mass of air which is subjected to acceleration is greater by about ten to fifty times that of the inflammable mixture of substances.

3. A form of carrying out the method as claimed in claims 1 or 2, characterised in that the mass of air introduced at one end of a tubular reaction chamber is expelled, by the explosion of the inflammable mixture, from the opening situated at the other end of the reaction chamber.

4. A form of carrying out the method as claimed in claim 1 or sub-claims, characterised in that the charging of a reaction chamber with fresh masses of air, after explosion, is effected by means of the energy of the masses of air and gas issuing with a great velocity from the reaction chamber.

5. A form of carrying out the method as claimed in claim 4, characterised in that the charging of a reaction chamber with fresh masses of air is effected directly (by piston action) by the force of

suction of the masses of air and gas leaving the reaction chamber.

6. A method as claimed in claim 1, characterised in that the direct acceleration of a mass of air, the weight of which exceeds by many times the weight of the inflammable mixture is effected by the force of the excess pressure of the exploded mixture in reaction chambers, which, extending in tubular form, and running substantially in the direction of the aeroplane fuselage or the supporting surfaces, are constructed with a capacity which is sufficient to contain, in addition to the inflammable mixture, a mass of air, the weight of which exceeds by many times that of the inflammable mixture.

7. A method as claimed in claim 6, characterised in that a downward deflection of the reaction masses is effected at the outlets of the tubular reaction chambers by guiding means arranged there, such as guide blades, bends or the like.

8. A method as claimed in claim 6, characterised in that the acceleration of the masses of air by explosion is effected at at least three places of the aeroplane, which places are so arranged that they preferably form the corners of a triangle extending in a horizontal plane.

9. A method as claimed in claim 8, characterised in that the quantities of mixture supplied each time to the individual reaction chambers are regulated with respect to one another by preferably automatic regulating means in accordance with the varying flying conditions.

10. The method of producing motive forces on vehicles or aircraft, substantially as described.

Dated this 15th day of April, 1931.

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

Fig. 1

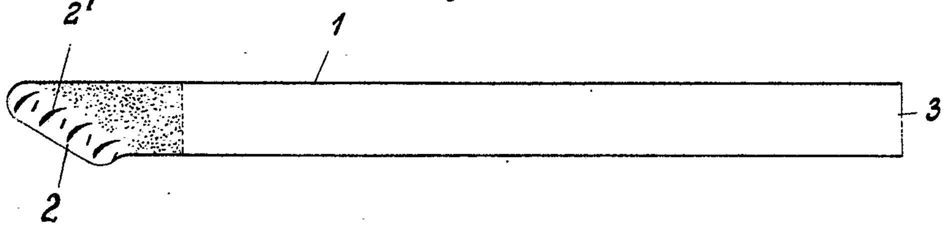

Fig. 2

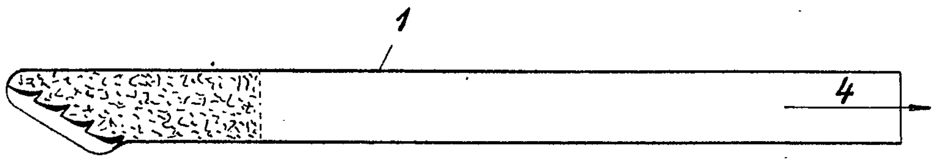

Fig. 3

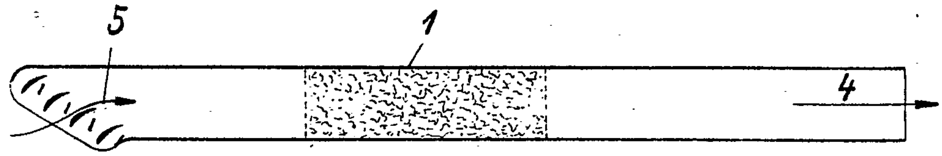

Fig. 4