Original Research Paper

About Aircraft's New Power and Propulsion

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Abstract: Even though the current classical methods of aerospace propulsion are much improved, some of the most modern methods have already been introduced, including propulsion with electric motors. Energy can be obtained from hydrogen burners, honeycomb burners to protect the combustion of hydrogen that burns 10 times faster than conventional fuels or alcohols. Hydrogen storage is also done in honeycomb cell reservoirs. Getting solar photovoltaic energy even during flight is not yet effective, but maybe proposed in the future for lighter and/or space vehicles. A great desire is to pour water into hydrogen and oxygen directly on the aircraft so that the stored fuel is actually water and the hydrogen used is extracted from the water. In this case, it is no longer necessary to store hydrogen. And other modern methods of energy propulsion and acquisition are briefly presented in the paper.

Keywords: Aerospace Propulsion, Electric Motors, Hydrogen Burners, Hydrogen Storage, Honeycomb Cell Reservoirs, Solar Photovoltaic Power, Modern Propulsions, Robots, Mechatronic Systems

Introduction

We consider the flight extremely important to humanity today more than ever, so any new or old fuel that is still used (before the planet's oil reserves run out as planned again) is welcome.

Under current conditions, testing and introducing an upgraded aviation gas turbine would be warranted as huge reserves of shale gas (depth) have been discovered, which today can be exploited due to advanced technologies.

Commercial aircraft business is booming, using all methods of market seizure. Airbus delivered 635 commercial aircraft in 2015, while Boeing sales reached 762 in the same year. In recent years, the two huge aircraft manufacturers have honored about 1,800 orders each year and still receive delivery orders for orders already exceeding 12,000 aircraft and the number of orders is steadily increasing as commercial flights increase at the expense of others. types of transport, not only because we are living the century of speed and the world is advancing more and more, but also because this mode of transport has proved the fastest, the most comfortable and the safest. Given the current production rate, it will take about ten years to recover delays to existing orders and they are growing steadily.

Given the fact that an aircraft can be used for decades without problems, it is curious how all airline users rush to renew their commercial fleets, the real justification for

this is precisely the modernization of new aircraft, with increased comfort and high flights, higher quality, great, safety, but especially new turbocharged engines, based on the latest technologies. The new turbocharged engines produced and marketed are quieter and more fuel-efficient compared to previous generations and in the end, quick response to the energy crisis and the suspected depletion of oil reserves is also the economy of fuel. Already the fuel consumption of new turbocharged engines is less than 15% (and promises specialists a 20% reduction in the future) and for an airline with direct operating costs, this reduced consumption quickly compensates for the purchases of new aircraft, justifying thus change the aircraft well before their wear.

The construction of engines for commercial aircraft equipped with turbojet engines is the largest market segment for the gas turbine industry, but it is far from unique; The IF financial report shows that the total value of gas turbine production was $ 81.4 billion in 2014 and $ 63 billion in 2015. To get a complete picture of orders for aviation gas turbine engines: In 2015, for example, $ 8.1 billion was their output for the military segment and $ 54.9 billion was spent on commercial aviation engines. General Electric (GE) and Pratt & Whitney (P&W) have both new high-performance engines for the modern aircraft market, equipped with a GE turbocharger called abbreviated from Leading Edge Aviation Propulsion (LEAP), provided from the start with a compression

ratio. much larger, with a fan built with carbon-fiber with a slightly larger diameter, these engines are already pre-ordered today by more than 10,000 requests orders. LEAP is actually the first gas turbine engine that uses new types of ceramic matrix composite materials along the gas path. Typical fiber materials include silicon carbide and are mainly used as ceramic matrix components (CMC = Ceramic Matrix Composites), being practically a matrix that is embedded between fibers as a novelty in the art. In addition to other advantages offered by composite materials and here as in other fields, a great advantage, in this case, is that of weight reduction by two-thirds compared to conventional systems and their very high-temperature resistance is even higher than alloys, the metal they replace. GE wants to extend the application of CMCs to the next-generation GE9X engine, 100,000 kilograms, now being developed for Boeing 777X and scheduled to be operational by 2020. In the first phase, it will contain some combustion tubes, stators with high turbines, pressure and CMC coatings (Langston, 2015; 2016).

Pratt & Whitney has been developing a new gas turbine engine since 1980, which in the meanwhile remained top-notch but was still upgraded with a planetary gearbox turbocharger with a planetary gearbox capable of reducing fan speed, thus leading to a lower, much lower noise level of the final engine but also to a real fuel economy, an objective increasingly sought after today. The first user of such an engine (PW1100-G) is Lufthansa, which flies with Airbus A320neo passenger aircraft between German cities. Initial reports indicate that turbochargers perfectly meet fuel economy requirements and are also much quieter in operation (Antonescu and Petrescu, 1985; 1989; Antonescu *et al*., 1985a; 1985b; 1986; 1987; 1988; 1994; 1997; 2000a; 2000b; 2001; Aversa *et al*., 2017a; 2017b; 2017c; 2017d; 2016a; 2016b; 2016c; 2016d; Cao *et al*., 2013; Dong *et al*., 2013; Franklin, 1930; He *et al*., 2013; Lee, 2013; Lin *et al*., 2013; Liu *et al*., 2013; Padula and Perdereau, 2013; Perumaal and Jawahar, 2013; Petrescu, 2011; 2012; 2019; Petrescu and Petrescu, 1995a; 1995b; 1997a; 1997b; 1997c; 2000a; 2000b; 2002a; 2002b; 2003; 2005a; 2005b; 2005c; 2005d; 2005e; 2011a; 2011b; 2012a; 2012b; 2013a; 2013b; 2016a; 2016b; 2016c; Petrescu *et al*., 2009; 2016; 2017a; 2017b; 2017c; 2017d; 2017e; 2017f; 2017g; 2017h; 2017i; 2017j; 2017k; 2017l; 2017m; 2017n; 2017o; 2017p; 2017q; 2017r; 2017s; 2017t; 2017u; 2017v; 2017w; 2017x; 2018a; 2018b; 2018c; 2018d; 2018e; 2018f).

Materials and Methods

When there is no more oil and gas, hydrogen will become a major fuel as an inexhaustible fuel, but it can be introduced long before, just to have a different fuel source than the classic one, another variant that will guarantee the future and, also, the reduction of the consumption of classic fuels due to air pollution with greenhouse effects and global warming. Here it would be necessary to make a little clarification. In the years 1870-1980, the depletion of oil and gas resources was expected to be immediate. In fact, at a constant balanced consumption, the oil resources and especially natural gas have no way of being exhausted because they come from the depths of the earth where they were created with it or they are produced permanently there, having the conditions necessary for their permanent restoration. 160 years ago, an oil and gas reserve was expected for at most 100 or 150 years of the planet, but today after 160 years of consumption the forecast has been restored and indicates exhaustion of them over exactly 160 years and so on.

If we all waited with emotion the depletion of the planet's hydrocarbon resources but during this time we used them hardly adapting the planet in the situation of polluting its atmosphere with too much carbon or its combinations from the combustion of the hydrocarbon, from an ethical point of view we do not have much let us play a lot more, because over 160 years when we are told now that the hydrocarbon stocks of the planet will be depleted, pollution will not be double but it will grow exponentially, making life on Earth very difficult. So we burned 160 years of oil and gas and brought the planet already to a limit of pollution that cannot be exceeded and if now with increased consumption needs we will continue to burn another 160 years of hydrocarbons in an uncontrolled way sure the pollution will increase much faster with disastrous global effects. So logically here we have to slow down the rate of hydrocarbon burning and even in a short time, we stop it not because they have run out but because it cannot be done anymore.

MA hydrogen aircraft is an aircraft that uses hydrogen fuel as an energy source. Hydrogen can be burned in a jet engine or other type of internal combustion engine or it can be used to provide a combustion cell to generate electricity to propel a propeller.

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The European Union research project, in collaboration with Airbus and 34 other partner companies, called CRYOPLANE, evaluated the technical feasibility, safety, environmental compatibility and economic viability of using liquid hydrogen as aviation fuel (Svensson *et al*., 2004).

If the 19th century was the steam engine century, the 20th century was the internal combustion engine century, many say that the 21st century is very likely to be the

combustion cell century. Combustion cells are increasingly being researched, considering that they are revolutionizing the ways of producing energy. They use hydrogen as a fuel, while also ensuring the possibility of generating a "clean" electricity, with the protection and even improvement of the environmental parameters. By definition, the combustion cell is an electric cell, which, unlike battery cells, can be continuously fed with fuel, so that the electrical power from the output of this cell, electric cells can be maintained indefinitely. The combustion cell converts hydrogen or hydrogen-based fuels directly into electricity and heat through the electrochemical reaction of hydrogen with oxygen.

Due to the fact that in the combustion cell the hydrogen and oxygen gases are transformed by an electrochemical reaction in water, this has considerable advantages over the thermal engines: Higher efficiency, practically silent operation, lack of pollutant emissions where the fuel is even hydrogen. And if hydrogen is produced from renewable energy sources, the electrical power thus obtained is indeed sustainable.

Hydrogen is the most present element in the Universe and is also the element that has the highest energy per unit of weight. However, hydrogen gas does not exist naturally on Earth naturally. Else is found only in compounds, such as water. Hydrogen is, therefore, a synthetic fuel - it is necessary to synthesize it, to obtain it, so that we can then use it as a fuel. The synthesis of hydrogen by electrolysis involves the investment of an amount of energy at least equal to the heat (enthalpy) of formation.

The first combustion cell was built in 1839 by the lawyer and amateur scientist Sir William Groove, who accidentally discovered the combustion cell principle during an electrolysis experience, when he disconnected the battery from the electrolysis device and touched the two electrodes. He called this cell "gas battery", which consisted of platinum electrodes placed in tubes containing hydrogen gas and oxygen tubes respectively immersed in dilute sulfuric acid. The voltage generated was around 1 V. Sometime later, Groovea bound several more such gas batteries and used this voltage source thus obtained to supply the electrolyzer that separates the hydrogen from oxygen. Due to electrode corrosion problems and the instability of the materials used, Groove's combustion cell did not give practical results. Precisely for this reason, the researches in the field have been left for many years.

The more serious study of combustion cells continued in the 1930s, which after years of research produced the first practical combustion cell, using an alkaline electrolyte (KOH) instead of dilute sulfuric acid and electrodes made of sintered porous nickel, which allowed the diffusion of gas. Later the research was deepened and in the 1960s the first combustion cells for the spacecraft were developed. Alkaline fuel cells have the advantage of a better power/weight ratio, but they have the disadvantage of carbon dioxide poisoning the electrolyte. Carbon dioxide reacts with the hydroxide ions in the electrolyte and forms a carbonate, a process by which the concentration of hydroxide ions in the electrolyte is reduced and is lost from the combustion cell yield.

Due to the complexity of the process of isolation of carbon dioxide from the alkaline electrolyte, within the combustion cells for terrestrial applications, non-alkaline electrolytes are used: Solid Oxide Combustion cells (SOFC), Phosphoric Acid Combustion cells (PAFC), molten carbonate (MCFC) combustion cells and Proton Exchange Membrane (PEM) combustion cells.

Given the fact that the fuel cell converts the fuel directly into electricity, it is, by definition, a technology for hybrid-electric vehicles. The fuel-energy conversion efficiency is expected to be about 50% in the field of motor vehicles. Currently, however, fuel cells are very expensive because they are not produced in mass production and the infrastructure for refueling hydrogen vehicles is not widespread. A combustion cell vehicle can either transport its own hydrogen reserves in a pressure reservoir or bleed hydrogen on the required metering unit, into a chemical-reforming reactor. The hydrogen engine is equipped with nickel-cadmium batteries that provide the best performance in what it concerns the protection of the environment and the capacity of energy storage on the volume unit. The cadmium-nickel battery is made up of three well-protected separate cells and the vehicle will be able to continue to function if the three cells fail, previous predominantly mechanical steering control, braking, acceleration, etc., resulting in space gain in the engine compartment, increased performance, which can be programmed by software. General Motors, identifying these new opportunities, exhibited in September 2002, at the Paris Motor Show, a motor vehicle representing the new concept they called Autonomy. In Europe, Mercedes announced that it has spent over € 20 million to develop automotive hydrogen fuel cell technology, filing no fewer than 200 patents. A combustion cell converted approximately 50-60% of hydrogen energy into electricity, producing as a second product hot water, at the temperature of about 250-300°C, considered as an ideal temperature for heating the buildings. Each vehicle equipped with combustion cells could become a mobile power station of about 30-40 kW. Since the vehicle is parked approximately 90-95% of the time during inhabited spaces, it could be connected to the building network, to supply electricity to the grid. Electricity generation through fuel cells and the use of water to heat buildings could become so cheap as long as it could compete with the energy produced in thermal power plants or nuclear power plants, heating plants based on combustion cells. The mini-boiler of the size of a

refrigerator produces 4 kWh of electricity and 9 kWh of equivalent thermal energy. Of course, the applications are multiple and - without the demand for exhaustiveness or detail, we list only a few of them: The space program, the military field, energy storage systems, power generation, electricity and heat stationary decentralized energy systems, portable energy sources, etc.

Combustion cells are usually classified according to the type of electrolyte used. An exception is Direct Methanol Fuel Cell (DMFC) direct combustion cell which is a combustion cell in which methanol is directly introduced into the anode. The electrolyte of this combustion cell does not determine the class of which it belongs. Another classification can be made based on the operating temperature. There are also low-temperature and high-temperature combustion cells. Low-temperature combustion cells include alkaline Alkaline Fuel Cell (AFC), Polymer Electrolyte Fuel Cell (PEMFC) proton membrane fuel cells, Direct Methanol Fuel Cell (DMFC) direct combustion cells and acid combustion cells, phosphoric Phosphoric Acid Fuel Cell (PAFC). High-temperature combustion cells operate at 600-1000°C. These are of two types: Combustion cells with molten carbonate Molten Carbonate Fuel Cell (MCFC) and solid oxide fuel cells Solid Oxide Fuel Cell (SOFC).

Hydrogen is obtained by the electrolysis reaction. However, it is observed that the energy balance is not positive - it is necessary to invest more energy in the synthesis process of hydrogen than the energy obtained from the use of hydrogen in the combustion cell. However, why is it worthwhile to study the development of combustion cells and hydrogen as a fuel of the future? What would be the methods by which the use of hydrogen could become efficient and what would be the advantages of this use? One of the possibilities that the author recommends to be researched and put into practice is to obtain hydrogen on the basis of unconventional energies, for example by feeding the process of electrolysis, synthesis of hydrogen from solar cells, from systems of electricity generation based on wind energy. Thus, the investment is only the initial one, in the generation and transport infrastructure of the synthesized hydrogen. The advantage of the use of hydrogen, in this case, the insertion in the process of the two reactions - that of electrolysis for the synthesis of hydrogen and that of the combustion cell of hydrogen comes only from the fact that hydrogen can be transported. If the solar cells and the wind systems are fixed and do not allow the stored energy itself, the introduction of hydrogen into the process makes it possible to produce and use unconventional energies as long as they are available, bottling the synthesized hydrogen by electrolysis and then using it elsewhere, for example. what not even in vehicles, mobile machines. If we take the example of a vehicle and suppose that the

hydrogen storage facility introduces a further reduction of efficiency by 10%, reaching 30%, however, we can conclude that from 12 h of generation we obtain the necessary energy for 4 h of burning hydrogen in cells combustion. Of course, this is an approximate calculation that assumes that the hydrogen generating and combustion plants, using the electricity produced by the combustion cell, have the same capacity. But, obviously, in the case of the use of unconventional energies for the synthesis of hydrogen by electrolysis, only the price of the equipment limits us in the dimensioning of this hydrogen manufacturing system.

In terms of obtaining hydrogen using unconventional energy sources, it should be remembered that a group of American researchers at Pennsylvania State University created a prototype of solar cells capable of detecting hydrogen from water, in a process that mimics photosynthesis. Photosynthesis is the fundamental natural process of capturing and using solar energy to separate oxygen from water and carbon dioxide from the air. In addition to oxygen, photosynthesis also results in hydrogen, which is then combined to obtain glucose, which is essential in plant nutrition. solar cell type does not generate potential difference electrons are removed pigment and introduced into a catalyst, where they are used to decompose water molecules into oxygen and hydrogen ions, in a reaction similar to that of photosynthesis. Youngblood was the creation of a complex of molecules made of iridium oxide molecules as a central catalyst, surrounded by orange-red pigment molecules, the color chosen by ability. to absorb light with the wavelength corresponds to the blue color, which has the highest amount of energy. Such a complex of molecules, with a diameter of 2 nm, has a ratio of about half-molecules of catalyst and half-molecules of pigment. Water molecules age in this complex of molecules and when it absorbs sunlight, the energy excites electrons in the pigment, which, due to the presence of the catalyst, pigments are removed, avoiding the recombination and leading, with the help of the catalyst, to the decomposition of water into hydrogen and oxygen. The process is a very fast one, each surface iridium atom passing through the oxidation reaction of the water about 50 times per second, i.e., almost 1000 times faster than the best existing synthetic catalysts and very close to the rate obtained in the natural process of photosynthesis. The researchers impregnated a titanium oxide electrode with the catalytic complex described above, which was used as an anode and used a platinum cathode. The electrodes are submerged in one saline solution but separate from the other to avoid the problem of recombination between oxygen and hydrogen. In order for the resulting system to work, sunlight must be at the anode. The efficiency of this type of cell is still low, by almost 0.3%, but it can be improved over the

natural process, reaching up to 10% or even 15%, comparable to that of solar cells.

Hydrogen also has the great advantage of being easily extracted from water and by combustion, it produces water back, so that by using it, a natural circuit is made without the known pollution of conventional fossil fuels.

The great advantage of using such a system is that we will be ready to use hydrogen extracted directly from the water, without having to store it. This will be possible when modern extraction systems (the dissociation of water into its oxygen and hydrogen components) will be developed with the use of a smaller amount of energy than that obtained by burning hydrogen. This will allow the use of water as a storage device for electricity. Modern water dissociation systems use nano cellular filters through which water is pressed to break, platinum or other noble metal catalysts and an environment with ultraviolet radiation regulated at certain intensity.

In addition to gas and hydrogen complementary to petroleum fuels, it is necessary to experiment with the introduction of modern propulsion systems with the acceleration of elementary particles, so that the jet has a very high impulse. Such propulsion systems, either with positive accelerated ions, or photons with a high energy beam, are absolutely necessary for the spacecraft to leave behind the classic systems that were practically the propulsion of "space carts", yet having the merit of pioneers in space, at that time (Petrescu, 2012; Petrescu and Calautit, 2016a; 2016b; Petrescu et al., 2016; 2018a; 2018b).

Modern propulsion means usually use positive ions most commonly accelerated with a circular particle accelerator (Petrescu et al., 2017r).

It should be noted that particle accelerators are today the future of advanced technologies on the planet, they are needed to obtain massive concentrated energy, including spacecraft, but are used here and to accelerate emitted particles to propel ships. Used relatively recently in physics, medicine and more and more fields, stationary particle accelerators will have to be adapted as mobile, spacecraft-related accelerators, either to produce nuclear fusion energy or to obtain accelerated particle jet, elementary, basically you get the propulsion of the ship. And for these reasons, particle accelerators that have grown so much in the last 50 years need massive funding for their development and to meet new space and energy challenges, especially those in fusion nuclear energy.

A positive (usually circular) ion accelerator has the great advantage of being able to accelerate ions to unprecedented growth, greatly increasing their energy and momentum. Electrons cannot be accelerated so much because they leave the accelerator uncontrolled or they will lose energy through photon (usually gamma) emissions. A linear accelerator could increase the energy of electrons without losing it, but the space needed for such an accelerator should be very long, representing a major disadvantage for a spacecraft and often even for stationary accelerators, which is why it is preferable either circularly, where accelerated particles can often pass along the same path to increase their energy and momentum.

Lasers or synchrotrons that produce light energy have smaller dimensional advantages and the fact that some lasers can produce much more pulses per second compared to particle accelerators, thus stimulating the pulse due to a large number of pulses generated in a second. If a modern circular accelerator can generate a pulse per second and accelerate the pace in the near future, there is already a laser capable of donating 10^{15} pulses per second.

Today's ionic engine (ionic propellant) has 2 major advantages (a) and 2 disadvantages (b) compared to chemical propulsion; (a) the impulse and energy per unit of fuel used are much higher; 1 - The increased momentum generates a higher speed (speed, so we can travel greater distances in a short time); 2 - High energy reduces fuel consumption and increases ship autonomy; (b) energy generation and acceleration are very small; it cannot overcome the forces of resistance to travel through the atmosphere and has no chance to overcome the gravitational forces - the ship will not leave a planet using efficient ion propulsion (requires an additional engine). The acceleration speed of the ship is possible, but only with very little acceleration. The increase of more energies (and also the pulse) can reach the required forces and accelerations (The increase will have to be very high, 100 PeV-1000 PeV). Particle energy growth can be done with circular or modern linear accelerators. The increase of the particle energy will be enormous and, in addition, the accelerated flow of the particles will have to increase (and the torque diameter, if the sufficient flow increases, the required energy will be 10 GeV-10 TeV).

Efficiency can be further improved 10-50 times using positive accelerated ionic impulses in a ship-mounted cyclotron; the efficiency can easily increase 1000 times if the positive ions will be accelerated in a high energy synchrotron, synchrocyclotron or isochronic cyclotron (1-100 GeV). The future (ionic) motor will have a circular particle accelerator (high or very high energy). Thus, it can increase the speed and autonomy of the ship using a smaller amount of fuel and power. It can also use synchrotron radiation (synchrotron light, high-intensity beams), such as high-intensity radiation (X-ray or Gamma-ray). In this case, it will be a beam motor (not an ionic motor), it will only use energy (energy, which can be solar, nuclear or both) and so we will eliminate the fuel.

A linear particle accelerator (also called LINAC) is an electrical device for accelerating subatomic particles. This type of particle accelerator has many applications. It has recently been used as an injector in a

higher energy synchrotron at a particle physics lab. In this sense, the large classical synchrotron is reduced to a surface of the ring (magnetic core).

Since today we talk a lot about electric motors used in the aerospace industry, it must be mentioned that they themselves are only a means of propulsion, not an energy one and, for this reason a large aircraft cannot supply electricity required only for engines, by capturing it through photovoltaic cells, so that the ship will need a source of energy. Storage of batteries allows only a small amount of autonomy for a light aircraft, so for passenger aircraft, electrically powered, it will be necessary to burn conventional fuels, gas or hydrogen into cells to obtain the thermal energy, then transformed into the ship's electricity. For this reason, propulsion with electric motors must be developed together with the hydrogen system.

The main objective of this paper is to specify the design and use of the elementary accelerators in order to efficiently achieve the modern propulsion of an aircraft.

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Theory/Calculation

The kinetic energy of an elementary particle in the translational movement has the known form (1):

$$E_C = \frac{1}{2} \cdot m \cdot v^2 \tag{1}$$

The classic impulse has a known form (relationship 2):

$$K = m \cdot v \tag{2}$$

The elementary particles generally move at high or very high speeds, which can be compared with the speed of light, it is very important that in calculations for greater accuracy a more complete original relation (3) is used to determine the momentum of an elementary particle, knowing that the impulse is the derivative of kinetic energy in relation to the speed of movement:

$$p = \frac{dE_c}{dv} = \frac{dm}{dv} \cdot \frac{v^2}{2} + \frac{m}{2} \cdot \frac{dv^2}{dv}$$
$$= \frac{m \cdot v \cdot \left(2 \cdot c^2 - v^2\right)}{\left(2 \cdot c^2 - 2 \cdot v^2\right)} = m \cdot v \cdot \frac{2 \cdot c^2 - v^2}{2 \cdot c^2 - 2 \cdot v^2} \tag{3}$$

To obtain relationship (3), one also used formula (4) obtained by derivation Lorentz Equation (5) in relation to velocity:

$$\frac{dm}{dv} = \frac{m \cdot v}{c^2 - v^2} \tag{4}$$

$$m = m_0 \cdot \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{m_0 \cdot c}{\sqrt{c^2 - v^2}} \tag{5}$$

To write the impulse according to the particle rest mass, one uses the Lorentz relationship (5) and the expression (3) thus acquires the forms of the system (6):

$$\begin{cases} \Rightarrow p = \dfrac{m_0 \cdot c \cdot v \cdot \left(2 \cdot c^2 - v^2\right)}{2 \cdot \sqrt{c^2 - v^2} \cdot \left(c^2 - v^2\right)} = \dfrac{m_0 \cdot c \cdot v \cdot \left(2 \cdot c^2 - v^2\right)}{2 \cdot \left(c^2 - v^2\right)^{3/2}} \\[4mm] = m_0 \cdot v \cdot \dfrac{c \cdot \left(2 \cdot c^2 - v^2\right)}{2 \cdot \left(c^2 - v^2\right)^{3/2}} \\[4mm] \Rightarrow \begin{cases} p = m_0 \cdot v \cdot \dfrac{c \cdot (2 \cdot c^2 - v^2)}{2 \cdot (c^2 - v^2)^{3/2}} \quad when \ \ v \neq c \\[4mm] p = \dfrac{h}{\lambda} \quad when \ \ v \equiv c \end{cases} \end{cases} \qquad (6)$$

For accelerated positive ions no matter how near the speed of light (they can practically not touch it), the relation (7) can be used to express the impulse:

$$p = m_0 \cdot v \cdot \dfrac{c \cdot \left(2 \cdot c^2 - v^2\right)}{2 \cdot \left(c^2 - v^2\right)^{3/2}} \quad when \ \ v \neq c; v < c \qquad (7)$$

The total impulse of the particle jet, i.e., the impulse that will actually act on the spacecraft, can be determined by the relationship (8), where n represents the number of pulses generated in one second by an ionic engine, N is the average number of particles per one pulse and M represents the number of ionic engines operating simultaneously the ship:

$$k = M \cdot n \cdot N \cdot p \qquad (8)$$

The average ship's speed can be obtained with the relationship (9):

$$\begin{cases} v_s \cdot M_s = k \Rightarrow v_s = \dfrac{k}{M_s} \quad \begin{cases} v_s = the\ speed\ of\ the\ ship \\ M_s = the\ mass\ of\ the\ ship \end{cases} \\[4mm] v_s = \dfrac{M \cdot n \cdot N \cdot m_0}{M_s} \cdot \dfrac{c \cdot \left(2 \cdot c^2 - v^2\right)}{2 \cdot \left(c^2 - v^2\right)^{3/2}} \cdot v \end{cases} \qquad (9)$$

If we note with B the velocity ratio v / c (relationship 10) the expression (9) gets the form (11) and expression (7) takes the new form (12):

$$\beta = \dfrac{v}{c} \qquad (10)$$

$$v_s = \dfrac{M \cdot n \cdot N \cdot m_0}{M_s} \cdot \dfrac{\left(1 - \dfrac{1}{2}\beta^2\right)}{\left(1 - \beta^2\right)^{3/2}} \cdot v \qquad (11)$$

$$p = m_0 \cdot v \cdot \dfrac{\left(1 - \dfrac{1}{2}\beta^2\right)}{\left(1 - \beta^2\right)^{3/2}} \quad when \ \ v \neq c; v < c \qquad (12)$$

Next, it will determine the acceleration of the elementary particle, an expression obtained through system relations (13), knowing that the acceleration is practically derived from the impulse in relation to time; where c is the speed of light in vacuum, h is Plank's constant and m_0 is the resting mass of that particle:

$$\begin{cases} a = \dfrac{dp}{dt} = \dfrac{3p \cdot (c^2 - v^2)^{1/2} \cdot v + m_0 \cdot c \cdot \left(c^2 - \dfrac{3}{2}v^2\right)}{\left(c^2 - v^2\right)^{3/2}} \cdot \\[4mm] \dfrac{dv}{dt} \quad when \ \ v \neq c; v < c \\[4mm] a - \dfrac{dp}{dt} = \dfrac{h}{c} \cdot \dfrac{d\gamma}{dt} \quad when \ \ v \equiv c; \\[4mm] where \ \ \gamma = particle \ \ frequency \end{cases} \qquad (13)$$

Expression (12) shows that the impulse of an elementary particle moving at very high velocity is amplified compared to the classical impulse known by a factor F (15) and the relation (12) embraces the aspect (14):

$$p = m_0 \cdot v \cdot F \quad when \ \ v \neq c; v < c \qquad (14)$$

$$F = \dfrac{\left(1 - \dfrac{1}{2}\beta^2\right)}{\left(1 - \beta^2\right)^{3/2}} \qquad (15)$$

Results and Discussion

Next, one will analyze the value of F in relation to different values of β (see the table 1 and expression 15).

Table 1. Factor F values depending on β

Current number	β	F
1	0.1	1.010113764
2	0.2	1.041883658
3	0.3	1.100123098
4	0.4	1.195002732
5	0.5	1.347150628
6	0.6	1.6015625
7	0.7	2.072963654
8	0.8	3.148148148
9	0.9	7.184334824
10	0.99	181.6552616
11	0.999	5605.548329
12	0.9999	176825.3106
13	0.99999	5590323.674
14	0.999999	176777181.4
15	0.9999999	5590171485
16	0.99999999	1.76777E+11
17	0.999999999	5.59017E+12
18	0.9999999999	1.76777E+14
19	0.99999999999	5.59017E+15

It is easy to notice that the first real variations of this factor arise from $\beta = 4$. For a $\beta = 7$, the classical impulse is virtually doubled because the amplification factor is 2. Beginning with beta 0.99, the gain factor values increase greatly, so the real (dynamic) impulse becomes much higher than the classic (when elementary particles move at low speeds). In order to gain a very high impulse boost, it is necessary to accelerate an elementary particle at very high speeds approaching the speed of light.

One can use the phenomenon described above by trying to exploit it to the maximum possible, because it has no limits of use precisely because of the existing limit given by the relativity of the process, being able to bring this phenomenon to unforeseen limits for the obvious purpose of increasing the momentum of a particle. The actual limitation of the actual processes, although smaller than in the past, refers only to the technical possibilities of a (usually circular) particle accelerator to greatly increase its particle acceleration limits.

In order to obtain a very high impulse, it is necessary to accelerate an elementary particle at very high speeds which are getting closer to the speed of light without touching it.

If we try to use the relationship (11) to determine the velocity of a ship with its 10-tonne mass for a circular accelerator with a relatively small diameter, which can today easily get a pulse per second (n = 1) and an average number of particles per pulse of (N) 10^{11}, considering a single ionic motor (M = 1), it will be obtained for the ship speed v_s, a theoretically calculated value of 28000 [m / s]= 100800 [km/h], only at box 19 of Table 1 (the last row in Table 1), if one can accelerate the elementary particles (here being protons, i.e., hydrogen ions) up to a beta factor of 0.99999999999.

This limit of reaching the speed of light, as near as we can actually, allow us to try to accelerate positive ions to unprecedented limits in the past, making future circular particle accelerators an extremely precious tool for humanity. It is possible to obtain very large pulses and energies on the elementary particle, which make the pulse (comprising as many elementary accelerated particles) become a true propulsion jet of modern spacecraft.

The calculations can also be refurbished for high-powered lasers, which additionally have the advantage of being able to produce a lot of pulses per second (even n = 10^{15}).

Conclusion

The flight is so important to humanity that any kind of fuel used earlier, even before the planet's oil reserves are depleted, is welcome.

Under current conditions, testing and introducing an upgraded aviation gas turbine would be warranted, as huge reserves of shale gas (depth) have been discovered, which today can be exploited due to advanced technologies.

When there is no more oil and gas, hydrogen will become a major fuel as an inexhaustible fuel, but it can be introduced long before, just to have a different fuel source than the classic one, another variant that will guarantee the future and, also, the diminution of the consumption of classic fuels that are anyway on the way to extinction.

The great advantage of using such a system is that we will be ready to use hydrogen immediately from the water, without having to store it. This will be possible when modern extraction systems (the dissociation of water into its oxygen and hydrogen components) will be developed with the use of a smaller amount of energy than that obtained by burning hydrogen. This will allow the use of water as a storage device for electricity.

Today, we can use circular particle accelerators to obtain very high energies to achieve controlled nuclear fusion or to make modern propulsions to future spacecraft, to achieve almost unlimited autonomy of the aircraft and very fast speeds. The paper introduces a new original relationship to determine the momentum of the particle when the elementary particles are accelerated at very high speeds, close to that of light.

If this new theory, the physical hypothesis, proves to be real, it will have a very large impact in various fields, with major changes, such as physics, quantum physics, nuclear physics, nuclear energy, materials science, and especially aerospace.

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Ethics

This article is original and contains unpublished material. Authors declare that are not ethical issues and no conflict of interest that may arise after the publication of this manuscript.

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