Review of new ideas, innovations of non-rocket propulsion systems for Space Launch and Flight (Part 2)

Abstract

In the past years the author and other scientists have published a series of new methods which promise to revolutionize the space propulsion systems, space launching and flight. These include the electrostatic AB-ramjet space propulsion, beam space propulsion, MagSail, high speed AB-solar sail, transfer electricity in outer space, simplest AB-thermonuclear space propulsion, electrostatic linear engine and cable space launcher, AB-levitrons, electrostatic climber, AB-space propulsion, convertor any matter in nuclear energy, femtotechnology, wireless transfer of energy, magnetic space launcher, railgun, superconductivity rail gun, etc.

Some of them have the potential to decrease launch costs thousands of time, other allow to change the speed and direction of space apparatus without the spending of fuel.

The author reviews and summarizes some revolutionary propulsion systems for scientists, engineers, inventors, students and the public.

Key words: Non-rocket propulsion, non-rocket space launching, non-rocket space flight, electrostatic AB-ramjet space propulsion, beam space propulsion, MagSail, high speed AB-solar sail, transfer electricity in outer space, simplest AB-thermonuclear space propulsion, electrostatic linear engine and launcher, AB-levitrons, electrostatic climber, AB-space propulsion, convertor any matter in nuclear energy, femtotechnology, wireless transfer of energy, magnetic space launcher, railgun, superconductivity railgun.

Introduction

Brief history. Rockets for military and recreational uses date back to at least 13th century China. Modern rockets were born when Goddard attached a supersonic (de Laval) nozzle to a liquid-fueled rocket engine's combustion chamber. These nozzles turn the hot gas from the combustion chamber into a cooler, hypersonic, highly directed jet of gas, more than doubling the thrust and raising the engine efficiency from 2% to 64%. In 1926, Robert Goddard launched the world's first liquid-fueled rocket in Auburn, Massachusetts.

After World War 2 the missile systems have received the great progress and achieved a great success. But rockets are very expensive and have limited possibilities. In the beginning 21th century the researches of non-rocket launch and flight started [1],[5]-[22]. The non-rocket systems which promise to decrease the space launch and flight cost in hundreds times. Some of them are described in this review.

Current status of non-rocket space launch and flight systems. Over recent years interference-fit joining technology including the application of space methods has become important in the achievement of space propulsion system. Part results in the area of non-rocket space launch and flight methods have been patented recently or are patenting now.

Professor Bolonkin made a significant contribution to the study of the different types of non-rocket space launch and flight in recent years [1]-[22] (1982-2011). Some of them are presented in given

review.
Electrostatic AB-ramjet space propulsion is researched in [2, Ch.2];
Beam space propulsion is described in [2, Ch. 3];
Magnetic Space Sail is presented in [2, Ch. 4];
High speed AB-solar sail is developed in [2, Ch.5];
Transfer electricity in outer space is offered in [2, Ch. 6];
Simplest AB-thermonuclear space propulsion is suggested in [2, Ch.7];
Electrostatic linear engine and cable space launcher is presented in [2, Ch.10];
AB-levitrons are in [2, Ch. 12];
Electrostatic climber is researched in [3, Ch. 4];
AB-space propulsion is presented in [16] and [3, Ch.10];
Wireless transfer of energy is described in [4, Part A, Ch.3];
Magnetic space launcher is offered in [4, Part A, Ch.6];
Railgun Launch System is suggested in [4, Part A, Ch.7];
Superconductivity rail gun is presented in [6] and in [4, Part A, Ch.3];
Convertor any matter in nuclear energy and photon rocket is offered and researched in [4, Part A, Ch.1], [7], [19];
Femtotechnology and its application into aerospace technology is suggested and researched in [4, Part A, Ch.2], [8],[18]. Some of these system were developed in [9]-[23].

Significant scientific, interplanetary and industrial use did not occur until the 20th century, when rocketry was the enabling technology of the Space Age, including setting foot on the Moon.
But rockets are very expensive and have limited possibilities. In the beginning 21th century the researches of non-rocket launch and flight started [1], [5]-[8].Some of them are described in this review.

Main types of Non-Rocket Space Propulsion System

Contents:

1. Electrostatic AB-ramjet space propulsion*

A new electrostatic ramjet space engine is proposed and analyzed. The upper atmosphere (85 - 1000 km) is extremely dense in ions (millions per cubic cm). The interplanetary medium contains positive protons from the solar wind. A charged ball collects the ions (protons) from the surrounding area and a special electric engine accelerates the ions to achieve thrust or decelerates the ions to achieve drag. The thrust may have a magnitude of several Newtons. If the ions are decelerated, the engine produces a drag and generates electrical energy. The theory of the new engine is developed. It is shown that the proposed engine driven by a solar battery (or other energy source) can not only support satellites in their orbit for a very long time but can also work as a launcher of space apparatus. The latter capability includes launch to high orbit, to the Moon, to far space, or to the Earth atmosphere (as a return thruster for space apparatus or as a killer of space debris). The proposed ramjet is very useful in interplanetary trips to far planets because it can simultaneously produce thrust or drag and large electric energy using the solar wind. Two scenarios, launch into the upper Earth atmosphere and an interplanetary trip, are simulated and the results illustrate the excellent possibilities of the new concept.

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* Presented as paper AIAA-2006-6173 to AIAA/AAS Astrodynamics Specialist Conference, 21-24 August 2006, USA. See also http://arxiv.org/ftp/physics/papers/0701/0701073.pdf

Introduction

Brief information about space particles and space environment. In Earth's atmosphere at altitudes between 200 - 400 km, the concentration of ions reaches several million per cubic cm. In the interplanetary medium at Earth orbit, the concentration of protons from the Solar Wind reaches 3 - 70 particles per cubic cm. In an interstellar medium the average concentration of protons is about one particle in 1 cm^3, but in the space zones HII (planetary nebulas), which occupy about 5% of interstellar space, the average particle density may be 10^{-20} g/cm^3 (10^6 particles in 1 cм^3). If we can collect these space particles from a large area, accelerate and brake them, we can get the high speed and braking of space apparatus and to generate energy. The author is suggesting the method of collection and implementations of it for propulsion and braking systems and electric generators. He developed the initial theory of these systems.

Short Description of the Implémentation

A *Primary Ramjet* propulsion engine is shown in Figure 1-1. Such an engine can work in one charge environment. For example, the surrounding region of space medium contains the positive charge particles (protons, ions). The engine has two plates 1, 2, and a source of electric voltage and energy (storage) 3. The plates are made from a thin dielectric film covered by a conducting layer. As the plates may be a net. The source can create an electric voltage U and electric field (electric intensity E) between the plates. One also can collect the electric energy from plate as an accumulator.

The engine works in the following way. Apparatus are moving (in left direction) with velocity V (or particles 4 are moving in right direction). If voltage U is applied to the plates, it is well-known that main electric field is only between plates. If the particles are charged positive (protons, positive ions) and the first and second plate are charged positive and negative, respectively, then the particles are accelerated between the plates and achieve the additional velocity $v > 0$. The total velocity will be $V+v$ behind the engine (Figure 1a). This means that the apparatus will have thrust $T > 0$ and spend electric energy $W < 0$ (bias, displacement current). If the voltage $U = 0$, then $v = 0$, $T = 0$, and $W = 0$ (Figure 1-1b).

If the first and second plates are charged negative and positive, respectively, the voltage changes sign Assume the velocity v is satisfying $-V < v < 0$. Thus the particles will be broken and the engine (apparatus) will have drag and will also be broken. The engine transfers broke vehicle energy into electric (bias, displacement) current. That energy can be collected and used. Note that velocity v cannot equal $-V$. If v were equal to $-V$, that would mean that the apparatus collected positive particles, accumulated a big positive charge and then repelled the positive charged particles.

If the voltage is enough high, the brake is the highest (Figure 1-1d). Maximum braking is achieved when $v = -2V$ ($T < 0$, $W = 0$). Note, the v cannot be more then $-2V$, because it is full reflected speed.

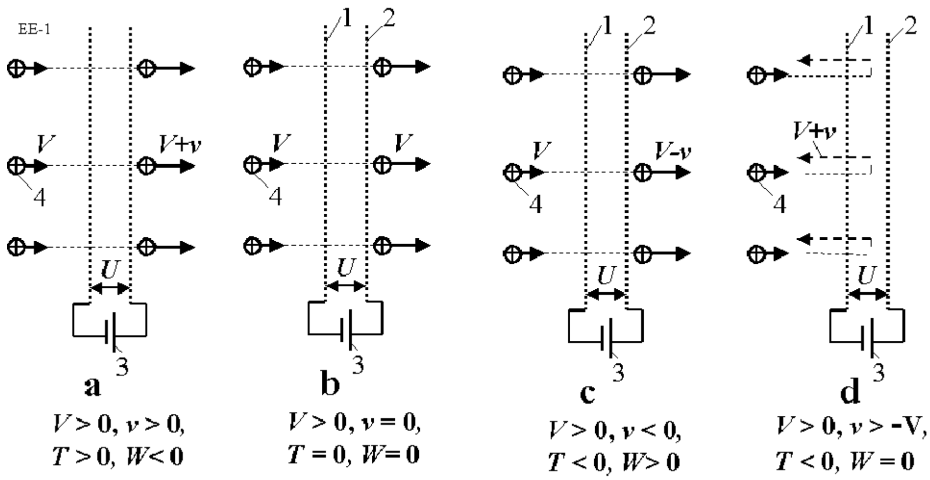

Figure 1-1. Explanation of primary Space Ramjet propulsion (engine) and electric generator (in braking),a) Work in regime thrust; b) Idle; c) Work in regime brake. d) Work in regime strong brake (full reflection). Notation: 1, 2 - plate (film, thin net) of engine; 3 - source of electric energy (voltage U); 4 - charged particles (protons, ions); V - speed of apparatus or particles before engine (solar wind); v - additional speed of particles into engine plates; T - thrust of engine; W - energy (if W < 0 we spend energy).

AB-Ramjet engine. The suggested Ramjet is different from the primary ramjet. The suggested ramjet has specific electrostatic collector 5 (Figure 1-2a,c,d,e,f,g). Other authors said the idea of space matter collection. But they did not give the principal design of collector. Their electrostatic collector cannot work. Really, for charging of collector we must move away from apparatus the charges. The charged collector attracts the same amount of the charged particles (charged protons, ions, electrons) from space medium. They discharged collector. All your work will be idle. That cannot work.

The electrostatic collector cannot absorb a matter (as offered some inventors) because it can absorb ONLY opposed charges particles, which will be discharged the initial charge of collector. Physic law of conservation of charges does not allow changing the charges of particles.

The suggested collector and ramjet engine have a special design (thin film, net, special form of charge collector, particle accelerator). The collector/engine passes the charged particles ACROSS (through) the installation and changes their energy (speed), deflecting and focusing them. That is why we refer to this engine as the *AB-Ramjet engine*. It can create thrust or drag, extract energy from the kinetic energy of particles or convert the apparatus' kinetic energy into electric energy, and deflect and focus the particle beam. The collector creates a local environment in space because it deletes (repeals) the same charged particles (electrons) from apparatus and allows the Ramjet to work when the apparatus speed is close to zero. The author developed the theory of the electrostatic collector. The conventional electric engine cannot work in usual plasma without the main part of the AB-engine - the special pervious electrostatic collector.

The plates of the suggested engine are different from the primary engine. They have a concentrically septa (partitions) which create additional radial electric fields (electric intensity) (Figure 1-2b). They straighten, deflect and focus the particle beams and improve the efficiency coefficient of the engine.

The central charge can have a different form (core) and design (Figure2 c,d,e,f,g,h). It may be:

(1) a sphere (Figure 1-2c) having a thin cover of plastic film and a very thin (some nanometers) conducting layer (aluminum), with the concentrically spheres inserted one into the other (Figure 1-2d),
(2) a net formed from thin wires (Figure 1-2e);
(3) a cylinder (without butt-end)(Figure 1-2f); or
(4) a plate (Figure 1-2g).

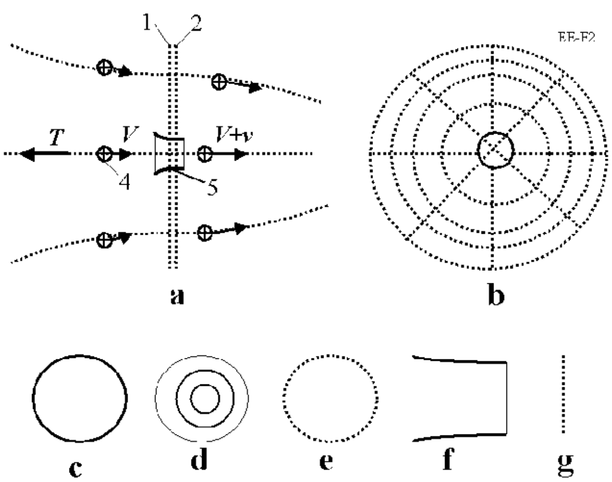

Figure 1-2. Space AB-Ramjet engine with electrostatic collector (core). a) Side view; b) Front view; c) Spherical electrostatic collector (ball); d) Concentric collector; e) cellular (net) collector; f) cylindrical collector without cover butt-ends; g) plate collector (film or net).

The design is chosen to produce minimum energy loss (maximum particle transparency). The safety (from discharging, emission of electrons) electric intensity in a vacuum is 10^8 V/m for an outer conducting layer and negative charge. The electric intensity is more for an inside conducting layer and thousands of times more for positive charge.

The engine plates are attracted one to the other. They can have different designs (Figure 1-3a - 3d). In the rotating film or net design (Figure 1-3a), the centrifugal force prevents contact between the plates. In the inflatable design (Figure 1-3b), the low pressure gas prevents plate contact. A third design has (inflatable) rods supporting the film or net (Figure 1-3c). The fourth design is an inflatable toroid which supports the distance between plates or nets (Figure 1-3d).

Electric gun. The simplest electric gun (linear particle accelerator) for charging an apparatus ball is presented in Figure 1-4. The design is a long tube (up 10 m) which creates a strong electric field along the tube axis (100 MV/m and more). The gun consists of the tube with electrical isolated cylindrical electrodes, ion source, microwave frequency energy source, and voltage multiplier. This electric gun can accelerate charged particles up 1000 MeV. Electrostatic lens and special conditions allow the creation of a focusing and self-focusing beam which can transfer the charge and energy long distances into space. The engine can be charged from a satellite, a space ship, the Moon, or a top atmosphere station. The beam may also be used as a particle beam weapon.

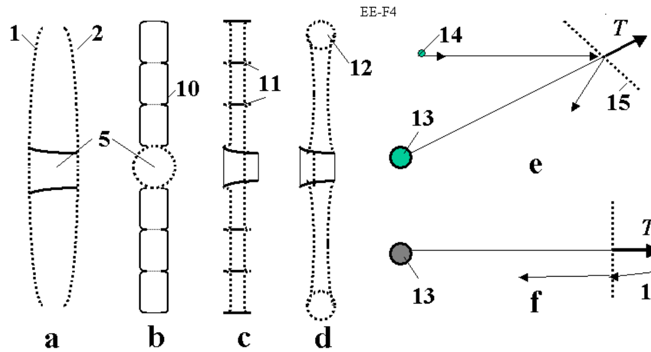

Figure 1-3. Possible design of the main part of ramjet engine. a) Rotating engine; b) Inflatable engine (filled by gas); c) Rod engine; d) Toroidal shell engine, e) AB-Ramjet engine in brake regime, f) AB-Ramjet engine in thrust regime. Notation: 10 - film shells (fibers) for support thin film and creating a radial electric field; 11 - Rods for a support the film or net; 12 - inflatable toroid for support engine plates; 13 - space apparatus; 14 - particles; 15 - AB-Ramjet.

Approximately tens years ago, the conventional linear pipe accelerated protons up to 40 MeV with a beam divergence of 10^{-3} radian. However, acceleration of the multi-charged heavy ions may result in significantly more energy.

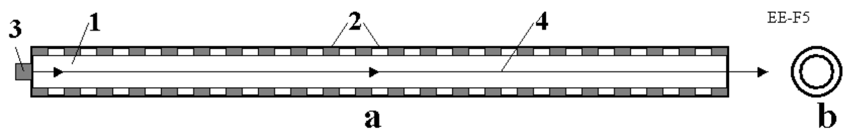

Figure 1-4. Electric gun for charging AB-Ramjet engine and transfer charges (energy) in long distance. a) Side view, b) Front view. *Notations:* 1 - gun tube, 2 - opposed charged electrodes, 3 - source of charged particles (ions, electrons), 4 - particles beam.

At present, the energy gradients as steep as 200 GeV/m have been achieved over millimeter-scale distances using laser pulsars. Gradients approaching 1 GeV/m are being produced on the multi-centimeter-scale with electron-beam systems, in contrast to a limit of about 0.1 GeV/m for radio-frequency acceleration alone. Existing electron accelerators such as SLAC <http://en.wikipedia.org/wiki/SLAC> could use electron-beam afterburners to increase the intensity of their particle beams. Electron systems in general can provide tightly collimated, reliable beams while laser systems may offer more power and compactness.

Conclusion

The primary research and computations of the suggested AB-engine show the numerous possibilities and perspectives of the space AB-ramjet engines. The density of the charged space particles is very small. But the proposed electrostatic collector can effectively gather the particles from a huge surrounding area and accelerate or brake them, generating thrust or braking on the order of several Newtons. The high speed solar wind allows simultaneously obtainment of useful drag (thrust) and great electrical energy. The simplest electrostatic gatherer accelerates a 100 kg probe up to a velocity of 100 km/s. The probe offers flights into Mars orbit of about 70 days, to Jupiter orbit in about 150 days, to

Saturn orbit in about 250 days, to Uranus orbit in about 450 days, to Neptune orbit in about 650 days, and to Pluto orbit in about 850 days.

The suggested electric gun is simple and can transfer energy (charge by electron beam) over a long distance to other space apparatus.

The author has developed the initial theory and the initial computations to show the possibility of the offered concepts. He calls on scientists, engineers, space organizations, and companies to research and develop the proposed perspective concepts.

2. BEAM SPACE PROPULSION*

The author offers a revolutionary method - non-rocket transfer of energy and thrust into Space with distance of millions kilometers. The author has developed theory and made the computations. The method is more efficient than transmission of energy by high-frequency waves. The method may be used for space launch and for acceleration the spaceship and probes for very high speeds, up to relativistic speed by current technology. Research also contains prospective projects which illustrate the possibilities of the suggested method.

Description of Innovation

Innovative installation for transfer energy and impulse includes (Figure 2-1): the ultra-cold plasma injector, electrostatic collector, electrostatic electro-generator-thruster-reflector, and space apparatus. The plasma injector creates and accelerates the ultra-cold low density plasma.

The Installation works the following way: the injector-accelerator forms and injects the cold neutral plasma beam with high speed in spaceship direction. When the beam reaches the ship, the electrostatic collector of spaceship collects and separates the beam ions from large area and passes them through the engine-electric generator or reflects them by electrostatic mirror. If we want to receive the thrust in the near beam direction ($\pm 90^o$) and electric energy, the engine works as thruster (accelerator of spaceship and braker of beam) in beam direction and electric generator. If we want to get thrust in opposed beam direction, the space engine must accelerate the beam ions and spend energy. If we want to have maximum thrust in beam direction, the engine works as full electrostatic mirror and produces double thrust in the beam direction (full reflection of beam back to injector). The engine does not spend energy for full reflection.

The thrust is controlled by the electric voltage between engine nets, the thrust direction is controlled by the engine nets angle to beam direction. Note, the trust can brake the ship (decrease the tangential ship speed) and far ship (located out of Earth orbit) can return to the Earth by Sun gravity.

Note also, the Earth atmosphere absorbs and scatters the plasma beam and the beam injector must be located on Earth space mast or tower (up $40 \div 60$ km) or the Moon. Only high energy beam can break through atmosphere with small divergence. The advantage: the injector has a reflector and when the ship locates not far from the injector the beam will be reflected a lot of times and thrust increases in thousand times at start (Figure 2-2).

The proposed engine may be also used as AB-ramjet engine, utilizing the Solar wind or interstellar particles.

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* Presented as paper AIAA-2006-7492 to Conference "Space-2006", 19-21 September, 2006, San-Jose, CA, USA. See also http://arxiv.org/ftp/physics/papers/0701/0701057.pdf

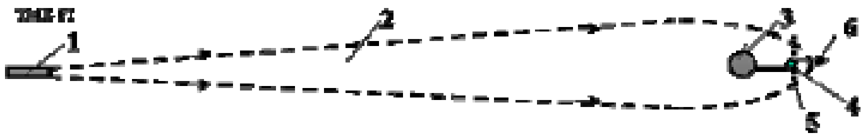

Figure 2-1. Long distance space transfer of electric energy, matter, and momentum (thrust). Notation are: 1 - injector-accelerator of neutral ultra-cold plasma (ions and electrons), 2 - plasma beam, 3 - space ship or planetary team, 4 - electrostatic ions collector (or magnetic collector), 5 - braking electric nets (electrostatic electro-generator-thruster-reflector), 6 - thrust.

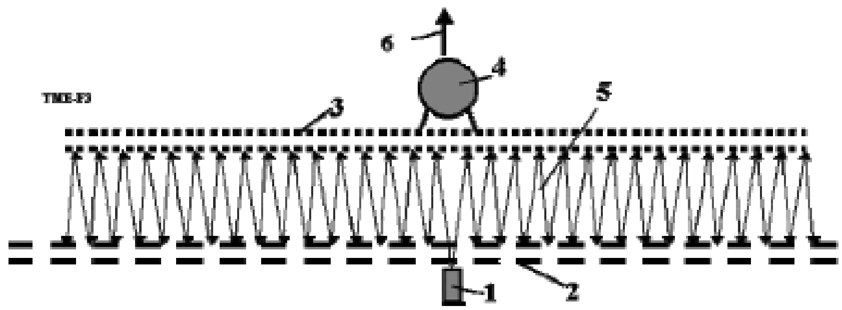

Figure 2-2. Multi-reflection start of the spaceship having proposed engine. Notation are: 1 - injector-accelerator of cold ions or plasma, 2 , 3 - electrostatic reflectors, 4 - space ship, 5 - plasma beam, 6 - the thrust.

The electrostatic collector and electrostatic generator-thruster-reflector proposed and described in chapter 1 above. The main parts are presented below.

A *Primary Ramjet* propulsion engine is shown in Figure 2-1 Chapter 1. Such an engine can work in charged environment. For example, the surrounding region of space medium contains positive charge particles (protons, ions). The engine has two plates 1, 2, and a source of electric voltage and energy (storage) 3. The plates are made from a thin dielectric film covered by a conducting layer. The plates may be a net. The source can create an electric voltage U and electric field (electric intensity E) between the plates. One also can collect the electric energy from plate as an accumulator.

The engine works in the following way. Apparatus are moving (in left direction) with velocity V (or particles 4 are moving in right direction). If voltage U is applied to the plates, it is well-known that main electric field is only between plates. If the particles are charged positive (protons, positive ions) and the first and second plate are charged positive and negative, respectively, then the particles are accelerated between the plates and achieve the additional velocity $v > 0$. The total velocity will be $V+v$ behind the engine (Figure 2-1a, Ch. 2). This means that the apparatus will have thrust $T > 0$ and spend electric energy $W < 0$ (bias, displacement current). If the voltage $U = 0$, then $v = 0$, $T = 0$, and $W = 0$ (Figure 1-1b, Ch.1).

If the first and second plates are charged negative and positive, respectively, the voltage changes sign. Assume the velocity v is satisfying $-V < v < 0$. Thus the particles will be braked and the engine (apparatus) will have drag and will also be braked. The engine transfers braked vehicle energy into electric (bias, displacement) current. That energy can be collected and used. Note that velocity v cannot equal $-V$. If v were equal to $-V$, that would mean that the apparatus collected positive particles, accumulated a big positive charge and then repelled the positive charged particles.

If the voltage is high enough, the brake is the highest (Figure1-1d, Ch.1). Maximum braking is achieved when $v = -2V$ ($T < 0$, $W = 0$). Note, the v cannot be more then $-2V$, because it is full reflected speed.

AB-Ramjet engine. The suggested Ramjet is different from the primary ramjet. The suggested ramjet has specific electrostatic collector 5 (Figure 1-2a,c,d,e,f,g, Ch. 1). Other authors have outline the idea of space matter collection, but they did not describe and not research the principal design of collector. Really, for charging of collector we must move away from apparatus the charges. The charged collector attracts the same amount of the charged particles (charged protons, ions, electrons) from space medium. They discharged collector, work will be idle. That cannot be useful.

The electrostatic collector cannot adsorb matter (as offered some inventors) because it can adsorb ONLY opposed charges particles, which will be discharged the initial charge of collector. Physic law of conservation of charges does not allow to change charges of particles.

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The plates of the suggested engine are different from the primary engine. They have concentric partitions which create additional radial electric fields (electric intensity) (Figure 1-2b, Ch.1). They straighten, deflect and focus the particle beams and improve the efficiency coefficient of the engine.

The central charge can have a different form (core) and design (Figure 2-2 c,d,e,f,g,h, Ch.2). It may be:

(1) a sphere (Figure 1-2c, Ch. 1) having a thin cover of plastic film and a very thin (some nanometers) conducting layer (aluminum), with the concentric spheres inserted one into the other (Figure 1-2d, Ch. 1),
(2) a net formed from thin wires (Figure 1-2e, Ch. 1);
(3) a cylinder (without butt-end)(Figure 1-2f, Ch. 1); or
(4) a plate (Figure 1-2g, Ch. 1).

The design is chosen to produce minimum energy loss (maximum particle transparency - see section "Theory" in [2] Ch.3). The safety (from discharging, emission of electrons) electric intensity in a vacuum is 10^8 V/m for an outer conducting layer and negative charge. The electric intensity is more for an inside conducting layer and thousands of times more for positive charge.

The engine plates are attracted one to the other (see theoretical section in [2] Ch.3). They can have various designs (Figure 1-3a - 3d, Ch. 1). In the rotating film or net design (Figure 1-3a, Ch. 1), the centrifugal force prevents contact between the plates. In the inflatable design (Figure 1-3b, Ch. 1), the low pressure gas prevents plate contact. A third design has (inflatable) rods supporting the film or net (Figure 1-3c, Ch. 1). The fourth design is an inflatable toroid which supports the distance between plates or nets (Figure 1-3d, Ch.1).

Note, the AB-ramjet engine can work using the neutral plasma. The ions will be accelerated or braked, the electrons will be conversely braked or accelerated. But the mass of the electrons is less then the mass of ions in thousands times and AB-engine will produce same thrust or drag.

Plasma accelerator. The simplest linear plasma accelerator (principle scheme of linear particle accelerator) for plasma beam is presented in Figure 1-4, Ch. 1. The design is a long tube (up 10 m) which creates a strong electric field along the tube axis (100 MV/m and more). The accelerator consists of the tube with electrical isolated cylindrical electrodes, ion source, and voltage multiplier. The accelerator increases speed of ions, but in end of tube into ion beam the electrons are injected. This plasma accelerator can accelerate charged particles up 1000 MeV. Electrostatic lens and special conditions allow the creation of a focusing and self-focusing beam which can transfer the charge and energy long distances into space. The engine can be charged from a satellite, a spaceship, the Moon, or a top atmosphere station. The beam may also be used as a particle beam weapon.

Approximately ten years ago, the conventional linear pipe accelerated protons up to 40 MeV with a beam divergence of 10^{-3} radian. However, acceleration of the multi-charged heavy ions may result in significantly more energy.

At present, the energy gradients as steep as 200 GeV/m have been achieved over millimeter-scale distances using laser pulsers. Gradients approaching 1 GeV/m are being produced on the multi-centimeter-scale with electron-beam systems, in contrast to a limit of about 0.1 GeV/m for radio-frequency acceleration alone. Existing electron accelerators such as SLAC <http://en.wikipedia.org/wiki/SLAC> could use electron-beam afterburners to increase the intensity of their particle beams. Electron systems in general can provide tightly collimated, reliable beams while laser systems may offer more power and compactness.

The cool plasma beam carries three types of energy: kinetic energy of particles, ionization, and dissociation energy of ions and molecules. That carries also particle mass and momentum. The AB-Ramjet engine (described over) can utilize only kinetic energy of plasma particles and momentum. The particles are broken and produce an electric current and thrust or reflected and produce only thrust in the beam direction. If we want to collect a plasma matter and to utilize also the ionization energy of plasma (or space environment) ions and dissociation energy of plasma molecules we must use the modified AB-Ramjet engine described below (Figure 2-3).

The modified AB-engine has magnetic collector (option), three nets (two last nets may be films), and issue voltage (that also may be an electric load). The voltage, U, must be enough for full braking of charged particles. The first two nets brake the electrons and precipitate (collect) the electrons on the film 2 (Figure 2-3). The last couple of film (2, 3 in Figure 2-3) brakes and collects the ions. The first couple of nets accelerate the ions that are way the voltage between them must be double.

The collected ions and electrons have the ionized and dissociation energy. This energy is significantly (up 20 - 150 times) more powerful then chemical energy of rocket fuel but significantly less then kinetic energy of particles (ions) equal U (in eV) (U may be millions volts). But that may be used by ship. The ionization energy conventionally pick out in photons (light, radiation) which easy are converted in a heat (in closed vessel), the dissociation energy conventionally pick out in heat.

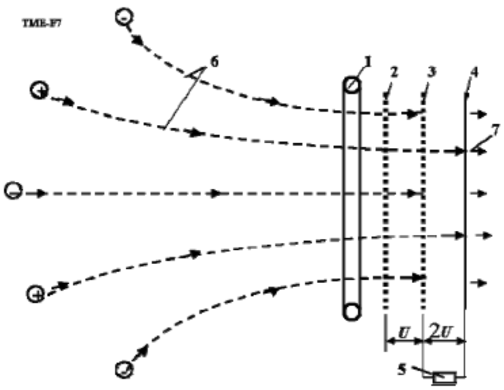

Figure 2-3. AB-engine which collected matter of plasma beam, kinetic energy of particles, energy ionization and dissociation. Notations: 1 - magnetic collector; 2 - 4 - plates (films, nets) of engine; 5 - electric load; 6 - particles of plasma; 7 - radiation. *U* - voltage between plates (nets).

The light energy may be used in the photon engine as thrust (Figure 2-4a) or in a new power laser (Figure 2-4b). The heat energy may be utilized conventional way (Figure 2-4c). The offered new power laser (Figure 4b) works the following way. The ultra-cool rare plasma with short period of life time located into cylinder. If we press it (decrease density of plasma) the electrons and ions will connect and produce photons of very closed energy (laser beam). If we compress very quickly by explosion the power of beam will be high. The power is only limited amount of plasma energy.

After recombination ions and electrons we receive the conventional matter. This matter may be used as nuclear fuel (in thermonuclear reactor), medicine, food, drink, oxidizer for breathing, etc.

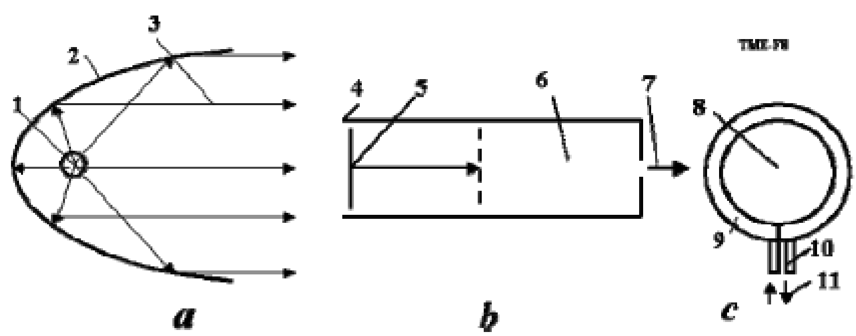

Figure 2-4. Conversion of ionization energy into radiation and heat. ***a*** - photon engine; ***b*** - power laser (light beamer); ***c*** - heater. Notations: 1 - recombination reactor; 2 - mirror; 3 - radiation (light) beam; 5 - piston; 6 - volume filled by cold rare plasma; 7 - beam; 8 - plasma; 9 - heat exchanger; 10 - enter and exit of hear carrier; 11 - heat carrier.

Conclusion

The offered idea and method use the AB-Ramjet engine suggested by author in 1982 [2- 4] and detail developed in [2]. The installation contains an electrostatic particle collector suggested in 1982 and detail developed in [2]. The propulsion-reflected system is light net from thin wire, which can have a large area (tens km) and allows to control thrust and thrust direction without turning of net (Figure1). This new method uses the ultra-cold full neutral relativistic plasma and having small divergence. The method may be used for acceleration space apparatus (up relativistic speed) for launch and landing Space apparatus to small planets (asteroids, satellites) without atmosphere. For Earth offered method will be efficiency if we built the tower (mast) about 40 ÷ 80 km height. At present time that is the most realistic method for relativistic probe.

3. Space Magnetic Sail*

The first reports on the "Space Magnetic Sail" concept appeared more 30 years ago. During the period since some hundreds of research and scientific works have been published, including hundreds of research report by professors at major famous universities. The author herein shows that all these works related to Space Magnetic Sail concept are technically incorrect because their authors did not take into consideration that solar wind impinging a MagSail magnetic field creates a particle magnetic field opposed to the MagSail field. In the incorrect works, the particle magnetic field is hundreds times stronger than a MagSail magnetic field. That means all the laborious and costly computations in revealed in such technology discussions are useless: the impractical findings on sail thrust (drag), time of flight within the Solar System and speed of interstellar trips are essentially worthless working data! The author reveals the correct equations for any estimated performance of a Magnetic Sail as well as a new type of Magnetic Sail (without a matter ring).

New Electrostatique MagSail (EMS)

The conventional MagSail with super-conductive ring has big drawbacks:

1. It is very difficult to locate gigantic (tens of km radius) ring in outer space.
2. It is difficult to insert a big energy into superconductive ring.
3. Super-conductive ring needs a low temperature to function at all. The Sun heats all bodies in the Solar System to a temperature higher then temperature of super-conductive materials.
4. The super-conductive ring explodes if temperature is decreased over critical value.
5. It is difficult to control the value of MagSail thrust and the thrust direction.

The author offers new Electrostatic MagSail (EMS). The innovation includes the central positive charged small ball and a negative electronic equal density ring rotated around the ball (Figure 3-1).

The suggested EMS has the following significant advantages in comparison with conventional MagSail:

(1) No heavy super-conductive large ring.
(2) No cooling system for ring is required.
(3) Electronic ring is safe.
(4) The thrust (ring radius) easy changes by changing of ball charge.

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* Presented as paper AIAA-2006-8148 to 14th AIAA/AHI Space Planes and Hypersonic Systems and Technologies Conference, 6 - 9 Nov 2006 National Convention Centre, Canberra, Australia. See also [2, Ch.4], http://www.scribd.com/doc/24057071 .
http://www.archive.org/details/NewConceptsIfeasAndInnovationsInAerospaceTechnologyAndHumanSciences

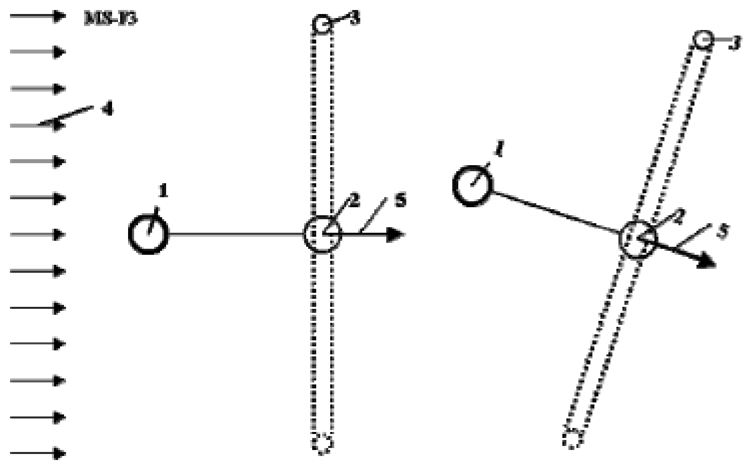

Figure 3-1. Electrostatic MagSail. Notations: 1-Spaceship; 2-Positive charged ball; 3–electrical ring; 4-solar wind; 5-EMS drag. In right side the EMS in turn position.

4. HIGH SPEED AB-SOLAR SAIL*

The Solar sail is a large thin film used to collect solar light pressure for moving of space apparatus. Unfortunately, the solar radiation pressure is very small about 9 μN/mm at Earth's orbit. However, the light force significantly increases up to 0.2 - 0.35 N/mm near the Sun. The author offers his research on a new revolutionary highly reflective solar sail which flyby (after special maneuver) near Sun and attains velocity up to 400 km/sec and reaching far planets of the Solar system in short time or enable flights out of Solar system. New, highly reflective sail-mirror allows avoiding the strong heating of the solar sail. It may be useful for probes close to the Sun and Mercury and Venus.

Description and Innovations

Description. The suggested AB space sail is presented in Figure 4-1. It consists of: a thin high reflection film (solar sail) supported by an inflatable ring (or other method), space apparatus connected to solar sail, a heat screen defends the apparatus from solar radiation.

The thin film includes millions of very small prisms (angle 45^o, side $3 \div 30$ μm). The solar light is totally reflected back into the incident medium. This effect is called total internal reflection. Total internal reflection is used in the proposed reflector. As it is shown in [1, Ch.12] the light absorption is very small ($10^{-5} \div 10^{-7}$) and radiation heating is small (see computation section).
Another possible design for the suggested solar sail is presented in Figure 4-2. Here solar sail has concave form (or that plate is made like Fresnel mirror).

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* This work is presented as paper AIAA-2006-4806 for 42 Joint Propulsion Conference, Sacramento, USA, 9-12 July, 2006. See also http://arxiv.org/ftp/physics/papers/0701/0701073.pdf or [2, Ch.5].

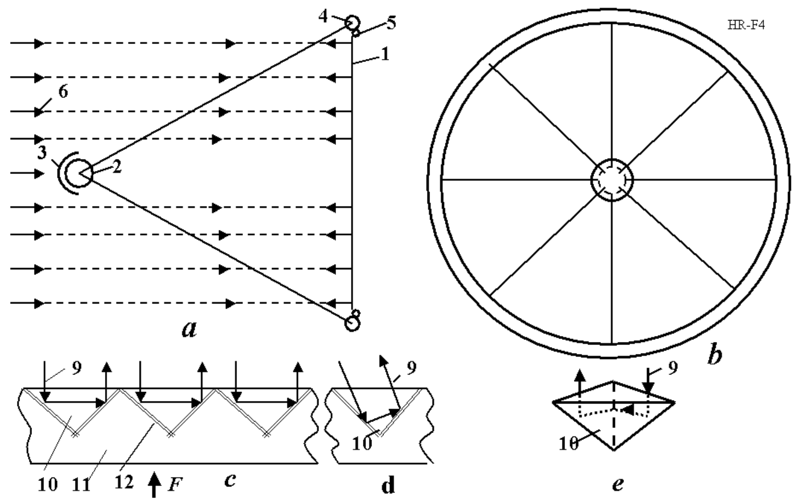

Figure 4-1. High reflective space AB-sail. (a) Side view of AB-sail; (b) Front view; (c) cross-section of sail surface; (d) case of non-perpendicular solar beam; (e) triangle reflective sell. Notation: 1 - thin film high reflective AB-mirror, 2 - space apparatus, 3 - high reflective heat screen (shield) of space apparatus, 4- inflatable support thin film ring, 5 - inflatable strain ring, 6 - solar light, 9 - solar beam, 10 - reflective sell, 11 - substrate, 12 - gap.

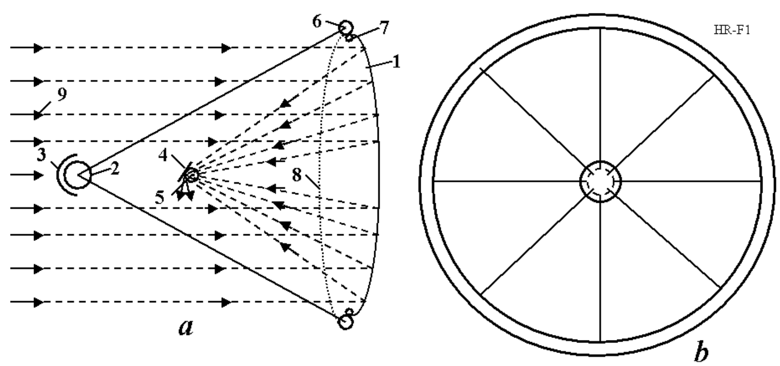

Figure 4-2. AB highly reflective solar sail with concentrator. (a) side view; (b) front view. Notation: 1 - highly reflective AB mirror (it may have a Fresnel form), 2 - space apparatus, 3 - high reflective heat screen, 4 - control mirror, 5 - reflected solar beam, 6 - inflatable support thin film ring, 7 - inflatable strain ring, 8 - thin transparent film, 9 - solar beam.

The sail concentrates solar light on a small control mirror 4. That mirror allows re-directed (reflected) solar beam and to change value and direction of the sail thrust without turning the large solar sail. Between thin films 1, 8 there is a small gas pressure which supports the concave form of reflector 1. Concentration of energy can reach $10^3 \div 10^4$ times, temperature greater than 5000 ^{o}K. This energy may be very large. For the sail of 200×200 m, at Earth orbit the energy is 5.6×10^4 kW. This energy may be used for apparatus propulsion or other possibilities (see [5]), for example, to generate electricity. The concave reflector may be also utilized for long-distance radio communication.

The trajectory of the high speed solar AB-sail is shown in Figure 4-3. The sail starts from Earth orbit. Then is accelerated by a solar light to up 11 km/s in opposed direction of Earth moving around Sun and leaves Earth gravitational field. The Earth has a speed about 29 km/s in its around Sun orbit. The sail will be have 29 -11=18 km/s. That is braked and moves to Sun (trajectory 4). Near the Sun the reflector is turned for acceleration to get a high speed (up to 400 km/s) from a powerful solar radiation. The second solar space speed is about 619 km/s. If AB sail makes three small revolutions around Sun, it can then reach speed of a 1000 km/s and leaves the Solar system with a speed about 400 km/s. Suggested highly reflective screen protects the apparatus from an excessive solar heating. Note, the offered AB sail allows also to brake an apparatus very efficiency from high speed to low speed. If we send AB sail to another star, it can brake at that star and became a satellite of the star (or a planet of that solar system).

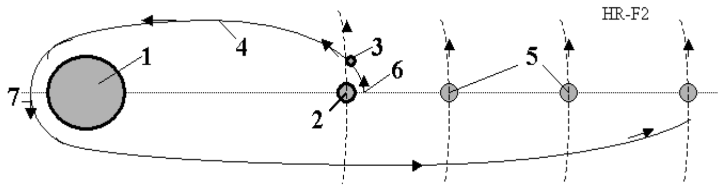

Figure 4-3. Maneuvers of AB solar sail for reaching a high speed: braking for flyby near Sun, great acceleration from strong solar radiation and flight away to far planets or out of our Solar system. Notation: 1 - Sun, 2 - Earth, 3 AB Solar sail, 4 - trajectory of solar sail to Sun, 5 - other planets, 6, 7 - speed of solar sail.

Conclusion

The suggested new AB sail can fly very close to the Sun's surface and get high speed which is enough for quick flight to far planets and out of our Solar System. Advantages allow: 1) to get very high speed up 400 km/s; 2) easy to control an amount and direction of thrust without turning a gigantic sail; 3) to utilize of the solar sail as a power generator (for example, electricity generator); 4) to use the solar sail for long-distance communication systems.

The same researches were made by author for solar wind sail and other propulsion [1]-[4].

5. Transfer of Electricity in Outer Space*

Author offers conclusions from his research of a revolutionary new idea - transferring electric energy in the hard vacuum of outer space wirelessly, using a plasma power cord as an electric cable (wire). He shows that a certain minimal electric currency creates a compressed force that supports the plasma cable in the compacted form. A large energy can be transferred hundreds of millions of kilometers by this method. The required mass of the plasma cable is only hundreds of grams. He computed the macroprojects: transference of hundreds kilowatts of energy to Earth's Space Station, transferring energy to the Moon or back, transferring energy to a spaceship at distance 100 million of kilometers, the transfer energy to Mars when one is located at opposed side of the distant Sun, transfer colossal energy from one of Earth's continents to another continent (for example, between Europe-USA) wirelessly—using Earth's ionosphere as cable, using Earth as gigantic storage of electric energy, using the plasma ring as huge MagSail for moving of spaceships. He also demonstrates that electric currency in a plasma cord can accelerate or brake spacecraft and space apparatus.

Innovations and Bref Descriptions

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* Presented as Bolonkin's paper AIAA-2007-0590 to 45th AIAA Aerospace Science Meeting, 8 - 11 January 2007, Reno, Nevada, USA. See also http://arxiv.org/ftp/physics/papers/0701/0701058.pdf .

The author offers the series of innovations that may solve the many macro-problems of transportation energy in space, and the transportation and storage energy within Earth's biosphere. Below are some of them.

(1) Transfer of electrical energy in outer space using the conductive cord from plasma. Author solved the main problem - how to keep plasma cord in compressed form. He developed theory of space electric transference, made computations that show the possibility of realization for these ideas with existing technology. The electric energy may be transferred in hundreds millions of kilometers in space (include Moon and Mars).
(2) Method of construction for space electric lines and electric devices.
(3) Method of utilization of the plasma cable electric energy.
(4) A new very perspective gigantic plasma MagSail for use in outer space as well as a new method for connection the plasma MagSail to spaceship.
(5) A new method of projecting a big electric energy through the Earth's ionosphere.
(6) A new method for storage of a big electric energy used Earth as a gigantic spherical condenser.
(7) A new propulsion system used longitudinal (cable axis) force of electric currency.

Below there are some succinct descriptions of some constructions made possible by these revolutionary ideas.

1. Transferring Electric Energy in Space

The electric source (generator, station) is connected to a space apparatus, space station or other planet by two artificial rare plasma cables (Figure 5-1a). These cables can be created by plasma beam [2] sent from the space station or other apparatus.

The plasma beam may be also made the space apparatus from an ultra-cold plasma [2] when apparatus starting from the source or a special rocket. The plasma cable is self-supported in cable form by magnetic field created by electric currency in plasma cable because the magnetic field produces a magnetic pressure opposed to a gas dynamic plasma pressure (teta-pinch)(Figure 5-2). The plasma has a good conductivity (equal silver and more) and the plasma cable can have a very big cross-section area (up thousands of square meter). The plasma conductivity does not depend on its density. That way the plasma cable has a no large resistance although the length of plasma cable is hundreds millions of kilometers. The needed minimum electric currency from parameters of a plasma cable researched in theoretical section of this article.

The parallel cables having opposed currency repels one from other (Figure 1a). They also can be separated by a special plasma reflector as it shown in figs. 5-1b, 5-1c. The electric cable of the plasma transfer can be made circular (Figure 5-1c).

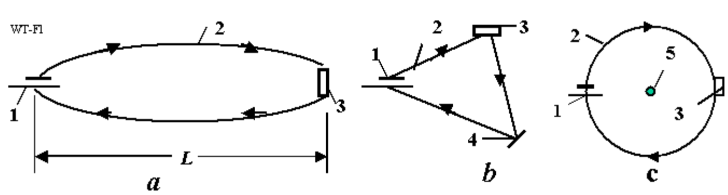

Figure 5-1. Long distance plasma transfer electric energy in outer space. a - Parallel plasma transfer, b - Triangle plasma transfer, c - circle plasma transfer. Notations: 1 - current source (generator), 2 - plasma wire (cable), 3 - spaceship, orbital station or other energy addresses, 4 - plasma reflector, 5 - central body.

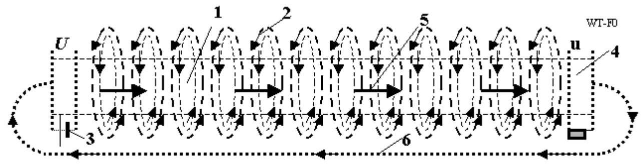

Figure 5-2. A plasma cable supported by self-magnetic field. Notations: 1 -plasma cable, 2 - compressing magnetic field, 3 - electric source, 4 - electric receiver, 5 - electric currency, 6 - back plasma line.

The radial magnetic force from a circle currency may be balanced electric charges of circle and control body or/and magnetic field of the space ship or central body (see theoretical section). The circle form is comfortable for building the big plasma cable lines for spaceship not having equipment for building own electric lines or before a space launch. We build small circle and gradually increase the diameter up to requisite value (or up spaceship). The spaceship connects to line in suitable point. Change the diameter and direction of plasma circle we support the energy of space apparatus. At any time the spaceship can disconnect from line and circle line can exist without user.

The electric tension (voltage) in a plasma cable is made two nets in issue electric station (electric generator). The author offers two methods for extraction of energy from the electric cable (Figure3) by customer (energy addresses). The plasma cable currency has two flows: electrons (negative) flow and opposed ions (positive) flow in one cable. These flows create an electric current. (It may be instances when ion flow is stopped and current is transferred only the electron flow as in a solid metal or by the ions flow as in a liquid electrolyte. It may be the case when electron-ion flow is moved in same direction but electrons and ions have different speeds). In the first method the two nets create the opposed electrostatic field in plasma cable (resistance in the electric cable) (figs. 5-1, 5-3b). This apparatus resistance utilizes the electric energy for the spaceship or space station. In the second method the charged particles are collected a set of thin films (Figure 3a) and emit (after utilization in apparatus) back into continued plasma cable (Figure 5-3a).

Figure 5-3c presents the plasma beam reflector. That has three charged nets. The first and second nets reflect (for example) positive particles, the second and third nets reflected the particles having an opposed charge.

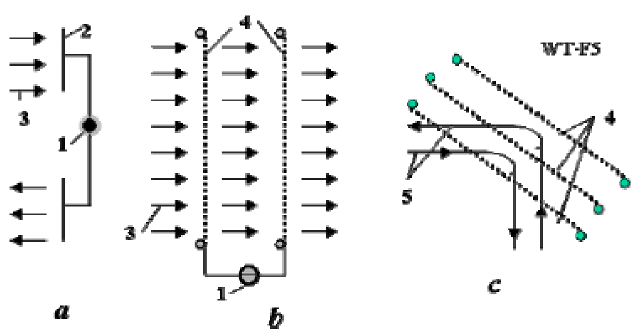

Figure 5-3. Getting the plasma currency energy from plasma cable. a - getting by two thin conducting films; b - getting two nets which brake the electric current flux; c - plasma reflector. Notations: 1 - spaceship or space station, 2 - set (films) for collect (emit) the charged particles, 3 - plasma cable, 4 - electrostatic nets.

2. Transmitting of the Electric Energy to Satellite, Earth's Space Station, or Moon.

The suggested method can be applied for transferring of electric energy to space satellites and the Moon. For transmitting energy from Earth we need a space tower of height up 100 km, because the Earth's atmosphere will wash out the plasma cable or we must spend a lot of energy for plasma support. The design of solid, inflatable, and kinetic space towers are revealed in [1]-[13]-[4] and in Review of Space Towers into this Collction.

It is possible this problem may be solved with an air balloon located at 30-45 km altitude and connected by conventional wire with Earth's electric generator. Further computation can make clear this possibility.

If transferring valid for one occasion only, that can be made as the straight plasma cable 4 (Figure 5-4). For multi-applications the elliptic closed-loop plasma cable 6 is better. For permanent transmission the Earth must have a minimum two space towers (Figure 5-4). Many solar panels can be located on Moon and Moon can transfer energy to Earth.

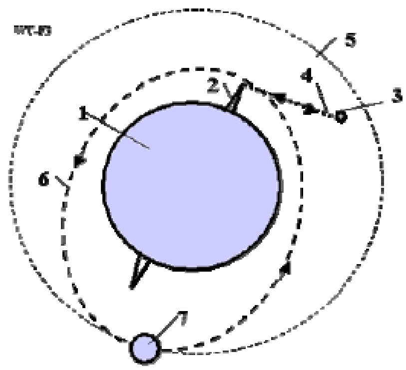

Figure 5-4. Transferring electric energy from Earth to satellite, Earth's International Space Station or to Moon (or back) by plasma cable. Notations: 1 - Earth, 2 - Earth's tower 100 km or more, 3 - satellite or Moon, 4 - plasma cable, 5 - Moon orbit, 6 - plasma cable to Moon, 7 - Moon.

3. Transferring Energy to Mars

The offered method may be applied for transferring energy to Mars including the case when Mars may be located in opposed place of Sun [2, Ch.6].

4. Plasma AB Magnetic Sail

Very interesting idea to build a gigantic plasma circle and use it as a Magnetic Sail (Figure 5-5) harnessing the Solar Wind. The computations show (see section "Macroproject") that the electric resistance of plasma cable is small and the big magnetic energy of plasma circle is enough for existence of a working circle in some years without external support. The connection of spaceship to plasma is also very easy. The space ship create own magnetic field and attracts to MagSail circle (if spacecraft is located behind the ring) or repels from MagSail circle (if spaceship located ahead of the ring). The control (turning of plasma circle) is also relatively easy. By moving the spaceship along the circle plate, we then create the asymmetric force and turning the circle. This easy method of building the any size plasma circle was discussed above.

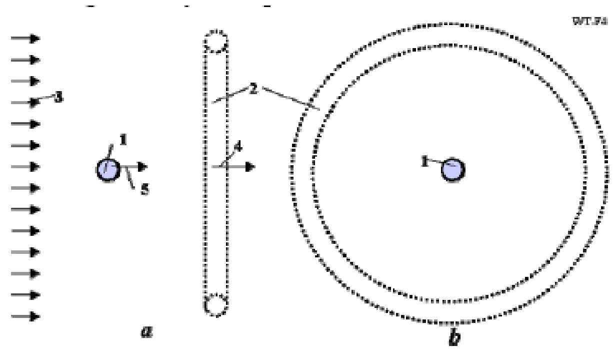

Figure 5-5. Plasma AB-MarSail. Notations: 1 - spaceship, 2 - plasma ring (circle), 3 - Solar wind, 4 - MagSail thrust, 5 - magnetic force of spaceship.

5. Wireless Transferring of Electric Energy in Earth

It is interesting the idea of energy transfer from one Earth continent to another continent without wires. As it is known the resistance of infinity (very large) conducting medium does not depend from distance. That is widely using in communication. The sender and receiver are connected by only one wire, the other wire is Earth. The author offers to use the Earth's ionosphere as the second plasma cable. It is known the Earth has the first ionosphere layer E at altitude about 100 km (Figure 5-6). The concentration of electrons in this layer reaches 5×104 1/cm3 in daytime and 3.1×103 1/cm3 at night. This layer can be used as a conducting medium for transfer electric energy and communication in any point of the Earth. We need minimum two space 100 km. towers. The cheap optimal inflatable, kinetic, and solid space towers are offered and researched by author in [1]-[4]. Additional innovations are a large inflatable conducting balloon at the end of the tower and big conducting plates in a sea (ocean) that would dramatically decrease the contact resistance of the electric system and conducting medium.

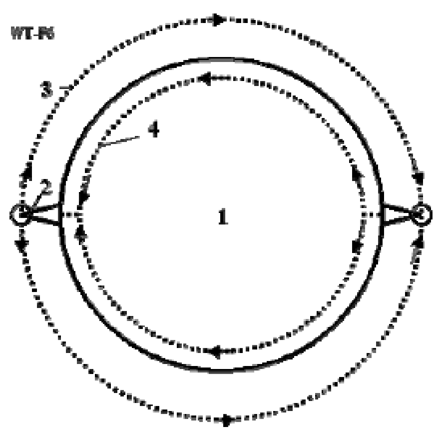

Figure 5-6. Using the ionosphere as conducting medium for transferring a huge electric energy between continents and as a large storage of the electric energy. Notations: 1 - Earth, 2 - space tower about 100 km of height, 3 - conducting E layer of Earth's ionosphere, 4 - back connection through Earth.

Conclusion

This new revolutionary idea - wireless transferring of electric energy in the hard vacuum of outer space is offered and researched. A rare plasma power cord as electric cable (wire) is used for it. It is shown that a certain minimal electric currency creates a compressed force that supports the plasma cable in the compacted form. Large amounts of energy can be transferred hundreds of millions of kilometers by this method. The requisite mass of plasma cable is merely hundreds of grams. It is computed that the macroprojects: transferring of hundreds of kilowatts of energy to Earth's International Space Station, transfer energy to Moon or back, transferring energy to a spaceship at distance of hundreds of millions of kilometers, transfer energy to Mars when it is on the other side of the Sun wirelessly. The transfer of colossal energy from one continent to another continent (for example, Europe to USA and back), using the Earth's ionosphere as a gigantic storage of electric energy, using the plasma ring as huge MagSail for moving of spaceships. It is also shown that electric currency in plasma cord can accelerate or slow various kinds of outer space apparatus.

6. Simplest AB-Thermonuclear Space Propulsion and Electric Generator*

The author applies, develops and researches mini-sized Micro- AB Thermonuclear Reactors for space propulsion and space power systems. These small engines directly convert the high speed charged particles produced in the thermonuclear reactor into vehicle thrust or vehicle electricity with maximum efficiency. The simplest AB-thermonuclear propulsion offered allows spaceships to reach speeds of 20,000 - 50,000 km/s (1/6 of light speed) for fuel ratio 0.1 and produces a huge amount of useful electric energy. Offered propulsion system permits flight to any planet of our Solar system in short time and to the nearest non-Sun stars by E-being or intellectual robots during a single human life period.

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* See: http://arxiv.org/ftp/arxiv/papers/0706/0706.2182.pdf (2006) or [2, Ch.7].

Description of Innovations

The AB thermonuclear propulsion and electric generator are presented in Figure 6-1. As it is shown in [2] the minimized, or micro-thermonuclear reactor 1 generates high-speed charged particles 2 and neutrons that leave the reactor. The emitted charged particles may be reflected by electrostatic reflector, 4, or adsorbed by a semi-spherical screen 3; the neutrons may only be adsorbed by screen 3.

In *screen* of the AB-thermonuclear reactor (Figure 6-1*a*) the forward semi-spherical screen 3 adsorbed particles that move forward. The particles, 2, of the back semi-sphere move freely and produce the vehicle's thrust. The forwarded particles may to warm one side of the screen (the other side is heat protected) and emit photons that then create additional thrust for the apparatus. That is the *photon* AB-thermonuclear thruster.

In *reflector* AB-thermonuclear reactor (Figure 6-1*b*) the neutrons fly to space, the charged particles 5 are reflected the electrostatic reflector 4 to the side opposed an apparatus moving and create thrust.

The *screen-reflector* AB-thermonuclear reactor (Figure 6-1*c*) has the screen and reflector.

The *spherical* AB-propulsion-generator (Figure 6-1*d*) has two nets which stop the charged particles and produced electricity same as in [1, Ch. 17]. Any part 8 of the sphere may be cut-off from voltage and particles 9 can leave the sphere through this section and, thusly, create the thrust. We can change direction of thrust without turning the whole apparatus.

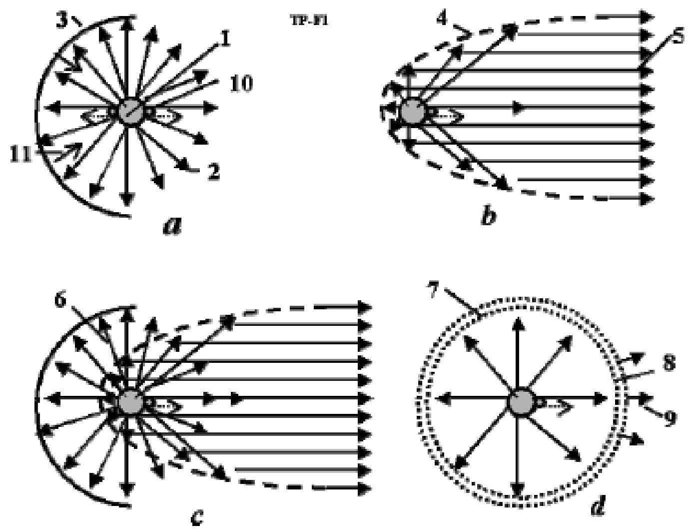

Figure 6-1. Types of the suggested propulsion and power system. (a) screen AB-thermonuclear propulsion and photon AB-thermonuclear propulsion ; (b) (electrostatic) reflector AB-thermonuclear propulsion; (c) screen-reflector AB-thermonuclear propulsion; (d) spherical AB-propulsion-generator. Notations: 1 - micro (mini) AB-thermonuclear reactor [15], 2 - particles (charged particles and neutrons) , 3 - screen for particles, 4 - electrostatic reflector; 5 - charged particles, 6 - neutrons, 7 - spherical net of electric generator, 8 - transparency (for charged particles) part of spherical net, 9 - charged particle are producing the thrust, 10 - electron discharger, 11 - photon radiation.

Conclusion

The author suggests the simplest maximally efficient thermonuclear AB-propulsion (and electric generators) based in the early offered size-minimized Micro-AB-thermonuclear reactor [2, Part B, Ch.1, p. 223]. These engines directly convert high-speed charged particles produced in thermonuclear reactor into vehicular thrust or onboard vehicle electricity resource. Offered propulsion system allows travel to any of our Solar System's planets in a short time as well as trips to the nearest stars by E-being or intellectual robot in during a single human life [2, Part C].

7. Electrostatic Linear Engine and Cable Space AB Launcher*

This is suggested a revolutionary new electrostatic engine. This engine can be used as a linear engine (accelerator), a strong space launcher, a high speed delivery system for space elevator, Earth-Moon, Earth-Mars, electrostatic train, levitation, conventional high voltage rotating engine, electrostatic electric generator, weapon, and so on. Author developed theory of this engine application and shows powerful possibility in space, transport and military industry. The projects are computed and show the good potential of the offered new concepts.

Description of Electrostatic Linear Engine

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* This work is presented as Bolonkin's paper AIAA-2006-5229 for 42 Joint Propulsion Conference, Sacramento, USA, 9-12 July, 2006. Work is published in Aircraft Engineering and Aerospace Technology: An International Journal, Vol 78, #6, 2006, pp.502-508. See also: http://arxiv.org/ftp/arxiv/papers/0705/0705.1943.pdf or [2, Ch.10].

The linear electrostatic engine (space accelerator) for launching of space ship [2] p.173 includes the following main parts (Figure 1): stator, thrust cable, charger of cable, high voltage electric alternating current line. As additional devices the engine can have a gas compaction, and vacuum pump.

The cable has a strong core (it keeps tensile stress - thrust) and dielectric cover contained electric charges. The conducting layer is very thin and we neglect its weight. A detailed linear engine (accelerator) for Cable Space Launcher is presented in Figure 7-2.

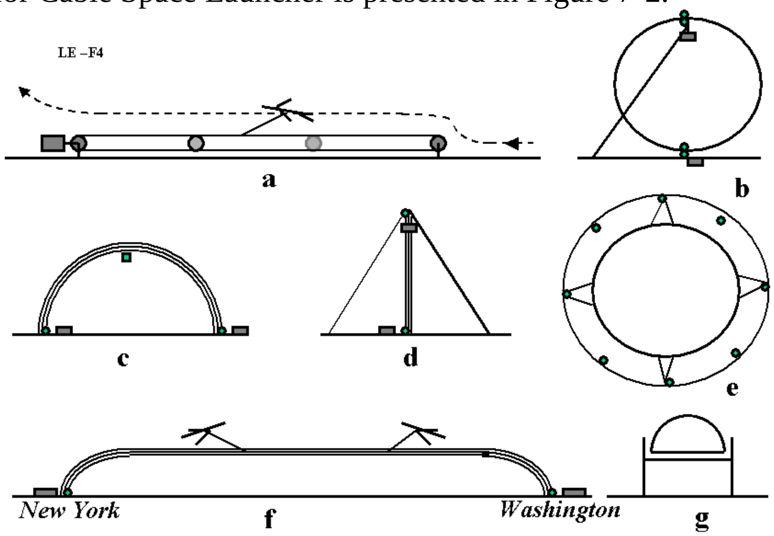

Figure 7-1. Installations needing the linear electrostatic engine. (a) Space cable launcher [2]; (b) Circle launcher; (c) Space keeper [1\; (d) Kinetic space tower[1]; (e) Earth round cable space keeper [1]; (f) Cable aviation [1]; (g) Levitation train [1].

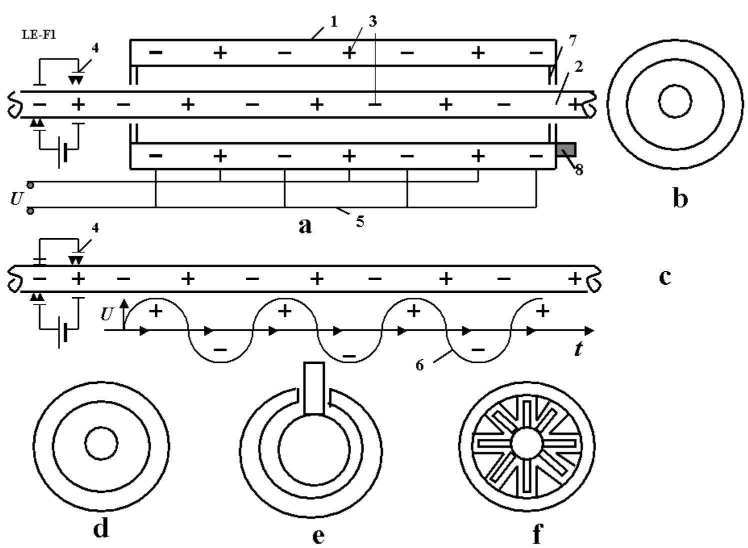

Figure 7-2. Electrostatic engine (accelerator) for Space Cable Launcher [23 -25]. (a) Engine (side view); (b) Engine (Forward view); (c) Running wave of voltage (charges) moves the charged cable; (d) - (f) Different cross-section areas of engine: (d) - conventional; (e) - for moving aircraft or space ship; (f) - for big thrust. *Notations*: 1 - stator of engine; 2 - thrust cable (rotor of engine); 3 - charges; 4 - recharger; 5 - high voltage line; 6 - alternating current (voltage); 7 - gas compaction; 8 - vacuum pump.

The engine works in the following mode. The cable has a set of stationary positive and negative charges. These charges can be restored if they are relaxed. Outer generator creates a running wave of voltage (charges) along stationary stator. This wave (charges) attracts the opposed charges in rotor (cable) and moves (thrusts) it.

Bottom and top parts of cable (or stator) have small different charge values. This difference creates a vertical electric field which supports the cable in suspended position inside stator non-contact bearing and zero friction. The cable position inside stator is controlled by electronic devices.

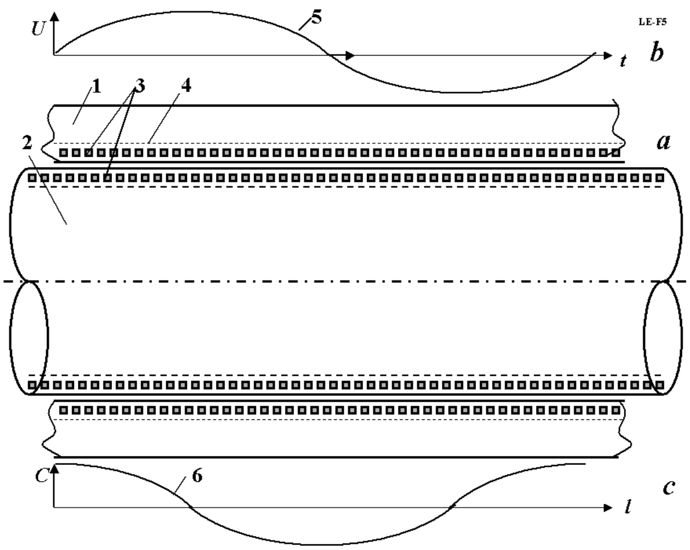

Figure 7-3. Detail electrostatic engine (accelerator) for Space Cable Launcher. (a) Accelerator, (b) Running voltage wave for stator, (c) Stationary charges into cable. *Notation*: 1 - stator; 2 - mobile rotor (cable); 3 - charges; 4 - dielectric (isolator); 5 - running wave of voltage; 6 - curve of stationary cable charges. U is voltage, C is charge. Lagging between voltage wave of stator (b) and charges of mobile cable (c) is 90 degree.

Charges have toroidal form (row of rings) and located inside a good dielectric having high disruptive voltage. The stator toroids have conducting layer which allows changing the charges with high frequency and produces a running high voltage wave. The offered engine creates a large thrust (see computation below), reaches a very high (not limited) variable speed of cable (km/s), to change the moving of cable in opposed direction, to fix a cable in given position. The engine can also to work as high voltage electric generator when cable is braking or moved by mechanical force. The space elevator climber (and many other mobile apparatus) has constant charge, the cable (stator) has running charge. The weight of electric wires is small because the voltage is very high.

Conclusion

The offered electrostatic engine could find wide application in many fields of technology. That can decrease the launch cost from hundreds to thousands times. The electrostatic engine needs a very high voltage but this voltage is located in small area inside of installations and not dangerous to people. The current technology does not have another way for reaching a high speed except may be rockets. But rockets and rocket launches are very expensive and we do not know ways to decrease the cost of rocket launch thousand times.

8. AB Levitrons and their Applications to Earth's Motionless Satellites*

Author offers the new and distinctly revolutionary method of levitation in artificial magnetic field. It is shown that a very big space station and small satellites may be suspended over the Earth's surface and used as motionless radio-TV translators, telecommunication boosters, absolute geographic position locators, personal and mass entertainment and as planet-observation platforms. Presented here is the theory of big AB artificial magnetic field and levitation in it is generally developed. Computation of three macro-projects: space station at altitude 100 km, TV-communication antenna at height 500 m, and multi-path magnetic highway.

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* Presented as Bolonkin's paper to http://arxiv.org Audust, 2007 (search "Bolonkin") or http://arxiv.org/ftp/arxiv/papers/0708/0708.2489.pdf or [2, Ch.12].

Innovations

The AB-Levitron uses two large conductivity rings with very high electric currency (fig.8-1). They create intense magnetic fields. Directions of electric currency are opposed one to the other and rings are repelling one from another. For obtaining enough force over a long distance, the electric currency must be very strong. The current superconductive technology allows us to get very high-density electric currency and enough artificial magnetic field in far space.

The superconductivity ring does not spend an electric energy and can work for a long time period, but it requires an integral cooling system because the current superconductivity materials have the critical temperature about 150-180 C.

For mobile vehicles the AB-Levitron can have a run-wave of magnetic intensity which can move the vehicle (produce electric currency), making it significantly mobile in the traveling medium.

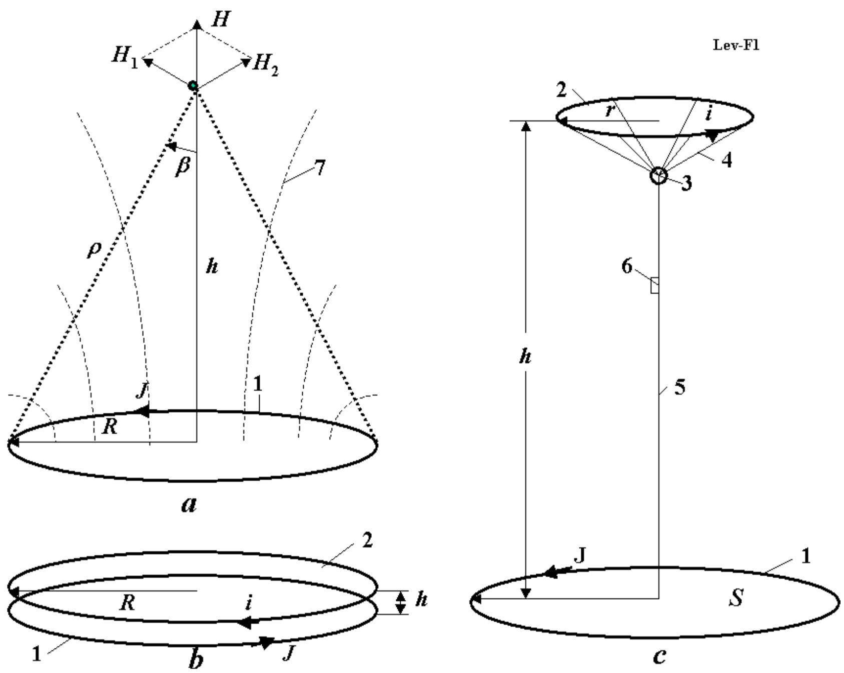

Figure 8-1. Explanation of AB-Levitron. (a) Artificial magnetic field; (b) AB-Levitron from two same closed superconductivity rings; (c) AB-Levitron - motionless satellite, space station or communication mast. Notation: 1- ground superconductivity ring; 2 - levitating ring; 3 - suspended stationary satellite (space station, communication equipment, etc.); 4 - suspension cable; 5 - elevator (climber) and electric cable; 6 - elevator cabin; 7 - magnetic lines of ground ring; *R* - radius of lover (ground) superconductivity ring; *r* - radius of top ring; *h* - altitude of top ring; *H* - magnetic intensity; *S* - ring area.

However, the present computation methods of heat defense are well developed (for example, by liquid nitrogen) and the induced expenses for cooling are small (fig. 8-2).

The ring located in space does not need any conventional cooling—that defense from Sun and Earth radiations is provided by high-reflectivity screens (fig.3). However, that must have parts open to outer space for radiating of its heat and support the maintaining of low ambient temperature. For variable direction of radiation, the mechanical screen defense system may be complex. However, there are thin layers of liquid crystals that permit the automatic control of their energy reflectivity and transparency and the useful application of such liquid crystals making it easier for appropriate space cooling system. This effect is used by new man-made glasses which grow dark in bright solar light.

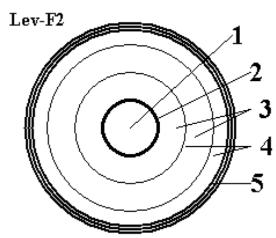

Figure 8-2. Cross-section of superconductivity ring. Notations: 1 - strong tube (internal part used for cooling of ring, external part is used for superconductive layer); 2 - superconductivity layer; 3 - vacuum; 4 – heat impact reduction high-reflectivity screens (roll of thin bright aluminum foil); 5 - protection and heat insulation.

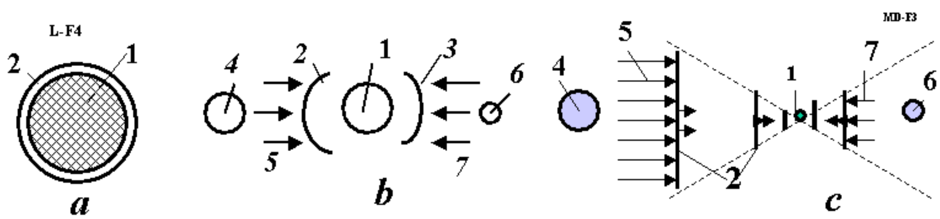

Figure 8-3. Methods of cooling (protection from Sun radiation) the superconductivity levitron ring in outer space. (***a***) Protection the ring by the super-reflectivity mirror [5]. (***b***) Protection by high-reflectivity screen (mirror) from impinging solar and planetary radiations. (***c***) Protection by usual multi-screens. Notations: 1 - superconductive wires (ring); 2 - heat protector (super-reflectivity mirror in Fig.3a and a usual mirror in Fig. 3c); 2, 3 – high-reflectivity mirrors (Fig. 3b); 4 - Sun; 5 -Sun radiation, 6 - Earth (planet); 7 - Earth's radiation.

The most important problem of AB-levitron is stability of top ring. The top ring is in equilibrium, but it is out of balance when it is not parallel to the ground ring. Author offers to suspend a load (satellite, space station, equipment, etc) lower then ring plate. In this case, a center of gravity is lower a summary lift force and system become stable.

Conclusion

We must research and develop these ideas. They may accelerate the technical progress and improve our life-styles. There are no known scientific obstacles in the development and design of the AB-Levitrons, levitation vehicles, high-speed aircraft, spaceship launches, low-aititude stationary tele-communication satellites, cheap space trip to Moon and Mars and other interesting destination-places in outer space.

9. Electrostatic Climber for Space Elevator and Launcher*

Here, the main author details laboratory and library research on the new, and intrinsically prospective, Electrostatic Space Elevator Climber. Based on a new electrostatic linear engine previously offered at the 42nd Joint Propulsion Conference (AIAA-2006-5229) and published in "AEAT", Vol.78, No.6, 2006, pp. 502-508, the electrostatic climber described below can have any speed (and braking), the energy for climber movement is delivered by a light-weight high-voltage line into a Space Elevator-holding cable from Earth-based electricity generator. This electric line can be used for delivery electric energy to a Geosynchronous Space Station. At present, the best solution of the climber problem, announced by NASA, is very problematic.

Shown also, the linear electrostatic engine may be used nowadays as a realistic power space launcher. Two macro-projects illustrate the efficacy of these new devices.

Description of Electrostatic Linear Climber and Launcher

The linear electrostatic engine [2, Ch.10], climber, for Space Elevator includes the following main parts (Figure 9-1): plate (type) stator 1 (special cable of Space elevator), cylinders 3 inside having conducting layer (or net) (cylinder may be vacuum or inflatable film), conducting layer insulator, chargers (switches 6) of cable cylinders, high-voltage electric current line 6, linear rotor 7.

Linear rotor has permanent charged cylinder 4. As additional devices, the engine can have a gas-pressurizing capability and a vacuum pump [1-2].

The cable (stator) has a strong cover 2 (it keeps tensile stress - thrust/braking) and variable cylindrical charges contained dielectric cover (insulator). The conducting layer is very thin and we neglect its weight. Cylinders of film are also very light-weight. The charges can be connected to high-voltage electric lines 6 that are linked to a high-voltage device (electric generator) located on the ground.

The electrostatic engine works in the following mode. The rotor has a stationary positive charge. The cable has the variable positive and negative charges. These charges can be received by connection to the positive or negative high-voltage electric line located in cable (in stator). When positive rotor charge is located over given stator cylinder this cylinder connected by switch to positive electric lines and cylinder is charged positive charge but simultaneously the next stator cylinder is charged by negative charge. As result the permanent positive rotor charge repels from given positive stator charge and attracts to the next negative stator charge. This force moves linear rotor (driver). When positive rotor charge reaches a position over the negative stator charge, that charge re-charges to positive charge and next cylinder is connected to the negative electric line and then the whole cycle is repeated. To increase

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* This work is presented as paper AIAA-2007-5838 for 43 Joint Propulsion Conference, Cincinnati, Ohio, USA, 9 -11 July, 2007. See also: http://arxiv.org/ftp/arxiv/papers/0705/0705.1943.pdf or [3, Ch.4].

its efficiency, the positive and negative stator charges, before the next cycle, can run down through a special device, and their energy is returned to the electric line. It is noteworthy that the linear electrostatic engine can have very high efficiency!

Earth-constant potential generator creates a running single wave of charges along the stationary stator. This wave (charges) attracts (repel) the opposed (same) charges in rotor (linear driver) and moves (thrust or brake use) climber.

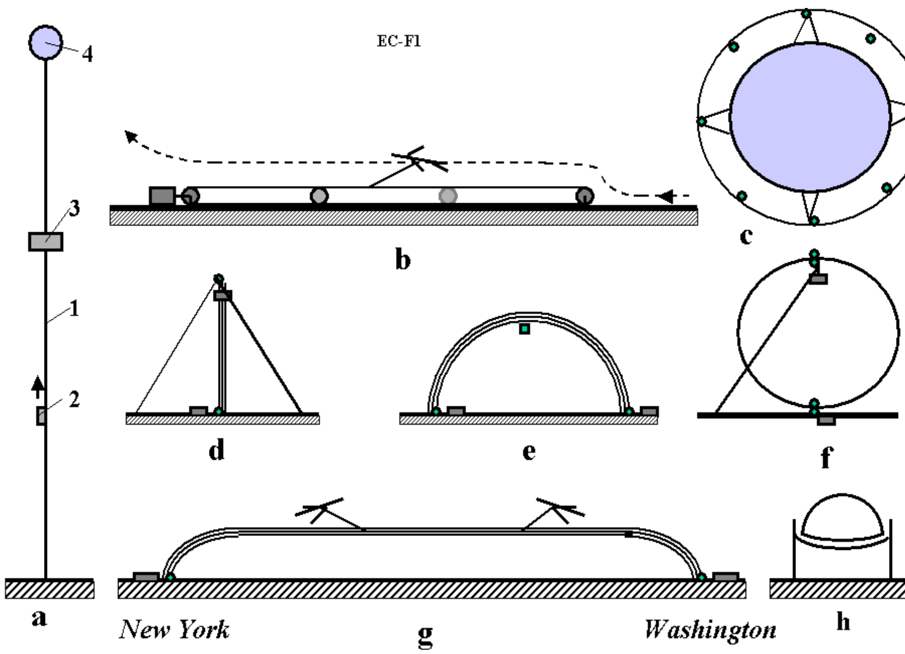

Figure 9-1. Installations needing the linear electrostatic engine. (a) Space elevator [36]. Notation: 1 - space elevator, 2 - climber, 3 - geosynchronous space station, 4 - balancer of space elevator. (b) Space cable launcher [3]; (b) Circle launcher [3]; (c) Earth round cable space keeper [38]; (d) Kinetic space tower [3]; (e - f) Space keeper [3]; (g) (f) Cable aviation [3]; (g) Levitation train [2-3].

The space launcher works same (Figure 9-2d, 2e). That has a stationary stator and mobile rotor (driver). The stationary stator (monorail) located upon the Earth's surface below the atmosphere. Driver is connected to space-aircraft and accelerates the aircraft to a needed speed (8 km/s and more) [2]. For increasing a thrust, the driver of the space launcher can have some charges (Figure 9-2d) separated by enough neutral non-charged stator cylinders.

Bottom and topmost parts of cable (or stator) have small different charge values. This difference creates a vertical electric field which supports the driver in its suspended position about the stator, non-contact bearing and zero friction. The driver position about the stator is controlled by electronic devices.

Charges have cylindrical form (row of cylinders), and are located within a good dielectric having high disruptive voltage. The cylinders have conducting layer which allows changing the charges with high frequency and produces a running high-voltage wave of charges. The engine creates a large thrust (see computation below), reaches a very high (practically speaking, virtually unlimited) variable speed of driver (km/s), to change the moving of driver in opposed direction, to fix a driver in selected given position. The electrostatic engine can also operate as a high-voltage electric generator when the climber (a cabin-style spaceship) is braking or is moved by some controlled mechanical force. The Space Elevator climber (and many other mobile apparatuses) has a constant charge; the cable (stator) has a running charge. The weight of electric wires is small, almost insignificant, because the voltage is very high.

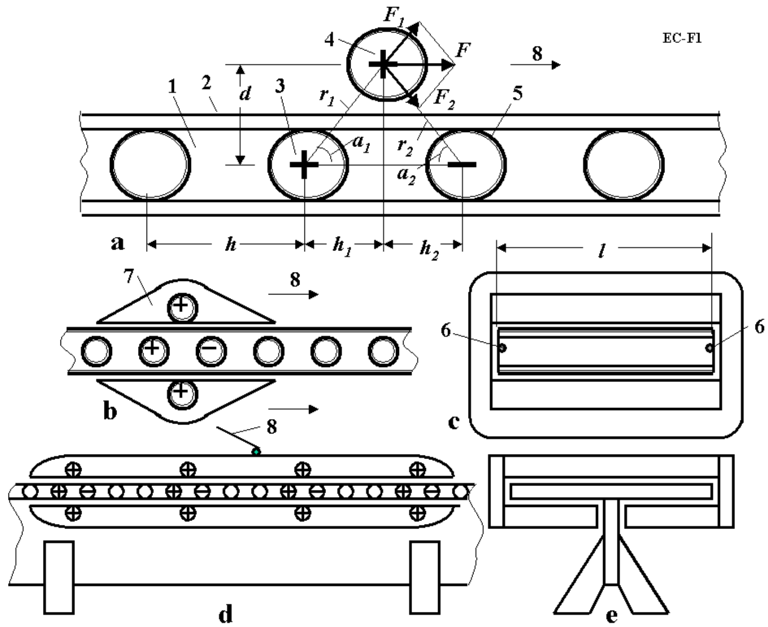

Figure 9-2. Electrostatic linear engine (accelerator) for Space Elevator and Space Launcher [23 -25, 40]. (a) Explanation of force in electrostatic engine; (b) Two cylindrical electrostatic engines for Space Elevator (here, a side view); (c) Two cylindrical electrostatic engine for Space Elevator (forward view); (d) Eight cylindrical electrostatic engine for Space Launcher (side view); (e) Eight cylindrical electrostatic engine for Space Launcher (forward view).
Notations: 1 - plate cable of Space Elevator with inserted variable cylindrical charges; 2 - part of cable-bearing tensile stress; 3 - insulated variable charging cylinder of stator; 4 - insulated permanent charging cylinder of rotor; 6 – high-voltage wires connected with Earth's generator and switch; 7 - mobile part of electrostatic linear engine; 8 - cable to space aircraft.

Conclusion

Presently, the suggested space climber is the single immediately buildable high-efficiency transport system for a space elevator. The electromagnetic beam transfer energy is very complex, expensive and has very low efficiency, especially at a long-distance from divergence of electromagnetic beam. The laser has similar operational disadvantages. The conventional electric line, equipped with conventional electric motor, is very heavy and decidedly unacceptable for outer space.

The offered electrostatic engine could find wide application in many fields of technology. It can drastically decrease the monetary costs of launch by hundreds to thousands of times. The electrostatic engine needs a very high-voltage but this voltage, however, is located in a small area inside of installations, and is not particularly dangerous to person living or working nearby. Currently used technology does not have any other way for reaching a high speed except by the use of rockets. But crewed or un-crewed rockets, and rocket launches for expensive-to-maintain-and-operate Earth bases, are very expensive and space businesses do not know ways to cut the cost of rocket launch by hundreds to thousands of times.

10. AB-Space Propulsion*

On 4 January 2007 the article "Wireless Transfer of Electricity in Outer Space" in http://arxiv.org was published wherein was offered and researched a new revolutionary method of transferring electric energy in space. In next article (see http://arxiv.org) was developed the theory of new engine.

That Chapter describes a new engine which produces a large thrust without throwing away large amounts of reaction mass (unlike the conventional rocket engine). A sample computed project shows the big possibilities opened by this new "AB-Space Engine". The AB-Space Engine gets the energy from ground-mounted power; a planet's electric station can transfer electricity up to 1000 millions (and more) of kilometers by plasma wires. Author shows that AB-Space Engine can produce thrust of 10 tons (and more). That can accelerate a spaceship to some thousands of kilometers/second. AB-Space Engine has a staggering specific impulse owing to the very small mass expended. The AB-Space Engine reacts not by expulsion of its own mass (unlike rocket engine) but against the mass of its planet of origin (located perhaps a thousand of millions of kilometers away) through the magnetic field of it's plasma cable. For creating this plasma cable the AB-Space Engine spends only some kg of hydrogen.

Offered Innovations and Brief Descriptions

1. Transfer of electricity by plasma cable. The author offers a series of innovations that may solve the many macro-problems of transportation, energy and thrust in space. Below are some of them.

1. Transfer of electrical energy in outer space using a conductive cord from plasma. Author has solved the main problem - how to keep the plasma cord from dissipation, and in compressed form. He has developed the theory of space electric transference, made computations that show the possibility of realization for these ideas with existing technology. The electric energy may be transferred for hundreds millions of kilometers in space (including Moon and Mars) [1].
2. Method of construction of space electric lines and electric devices.
3. Method of utilization and tapping of the plasma cable electric energy.
4. Two methods of converting the electric energy to impulse (thrust) motion of a spacecraft (these two means are utilization of the magnetic field and of the kinetic energy of ions and electrons of the electric current).
5. Design of a triple electrostatic mirror (plasma reflector), which can reflect the plasma flow [1].

Below are some succinct descriptions of some constructions made possible by these revolutionary macro-engineering ideas.

1. Transferring electric energy in Space. The electric source (generator, station) is connected to the distant location in space by two artificially generated rarefied plasma cables (Figure 10-1a). These

* Presented in http://arxiv.org of Cornel University (1 March, 2008). http://arxiv.org/ftp/arxiv/papers/0803/0803.0089.pdf , or [3] Ch.10.

cables can be created by a plasma beam [1, 2] sent from the Moon, Earth mounted super high tower, or from a space station in low Earth orbit, or a local base at the target location. If the plasma beam is sent remotely from the Earth, a local reflector station is required at the target site or at a third location to turn the circuit back toward its' starting point and closure.

The plasma cable, in radial direction, may also be constructed of ultra-cold plasma.
The plasma cable is self-supported in cable form by the magnetic field created by the electric current going through the plasma cable. The axial electric current produces an contracting magnetic pressure opposed to an expansive gas dynamic plasma pressure (the well-known theta-pinch effect)(Figure 10-2b). The plasma has a good conductivity (equal to that of silver and more) and the plasma cable can have a very big cross-section area (up to thousands of square meters cross-section). The plasma conductivity does not depend on its' density. That way the plasma cable has no large resistance although the length of plasma cable is hundreds of millions of kilometers. The needed minimum electric current is derived from parameters of a plasma cable researched in the theoretical section of this article.

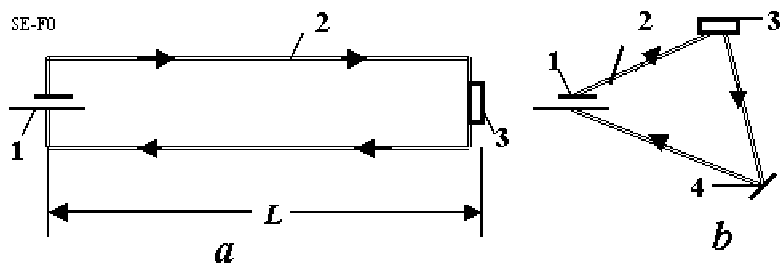

Figure 10-1. Long distance plasma transfer electric energy and thrust in outer space. ***a*** - plasma transfer with parallel plasma cable, ***b*** - plasma transfer with triangular (three-wire) plasma cable. *Notations*: 1 - current source (generator), 2 - plasma wire (cable), 3 - spaceship, orbital station or other energy destinations, 4 - plasma reflector located at planet, asteroid or space station.

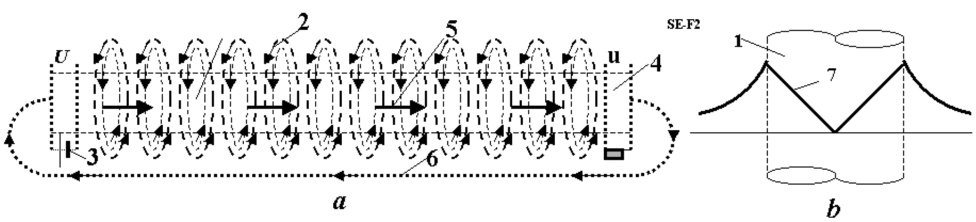

Figure 10-2. ***a***. A plasma cable supported by its' own magnetic field, ***b***. Magnetic intensity into and out of plasma cable. *Notations*: 1 -plasma cable, 2 - compressing magnetic field, 3 - electric source, 4 - electric receiver, 5 - electric current, 6 - back plasma line; 7 – magnetic intensity into and out of plasma cable.

The parallel cables having opposed currents repel each other (Figure 10-2a)(by magnetic force). This force may be balanced by attractive electric force if we charge the cables by electric charges (see theoretical section). They also can be separated by a special plasma reflector as it shown in figures 10-2b. The electric line can be created and exist independently. The spaceship connects to this line at a suitable point. By altering the diameter and direction of the plasma cable we can supply energy to a spacecraft. Though we must supply energy to accelerate the spacecraft we can also regenerate energy by its braking activity. At any time, the spaceship can disconnect from the line and can exist without line support (propulsion, electricity, etc). The apparatus can hook up to or disconnect from the plasma cable at will. But breaking (loss of continuity) of the plasma cable itself destroys the plasma cable line to the remote location! We must have additional (parallel) plasma lines and apparatus must disconnect from a damaged or occulted (for example on the far side of a remote planet) plasma line and connect to another line to keep the connection in existence. The same situation is true in a conventional electric net. The apparatus can also restore the damaged part of plasma line by own injected plasma, but the time for repairing is limited (by tens of minutes or a few hours). The original station can also to send the plasma beam which connects the ends of damaged part of the line.

The electric tension (voltage) in a plasma cable is between two ends (for example, as cathode- anode) of the conductor in the issuing electric station (electric generator) [1-4]. The plasma cable current has two flows: Electron (negative) flow and opposed ions (positive) flow in the same cable.

These flows create an electric current. (In metal we have only electron flow, in liquid electrolytes we have ions flowing).

The author offers methods (for extraction and inserting) of energy from the plasma electric cable (Figure 3) by customer (spacecraft, other energy destination or end user).

The double net can accelerate the charged particles and insert energy into plasma cable (fig, 3a) or brakes charged particles and extract energy from electric current (figure 3b). In the first case the two nets create the straight electrostatic field, in the second case the two nets create the opposed electrostatic field in plasma cable (resistance in the electric cable [1- 4]) (figures 10-2, 10-3c). This apparatus resistance utilizes the electric energy for the spaceship or space station. In the second case the charged particles may be collected into a set of thin films and emit (after utilization in apparatus) back into continued plasma cable (see [1- 4]).

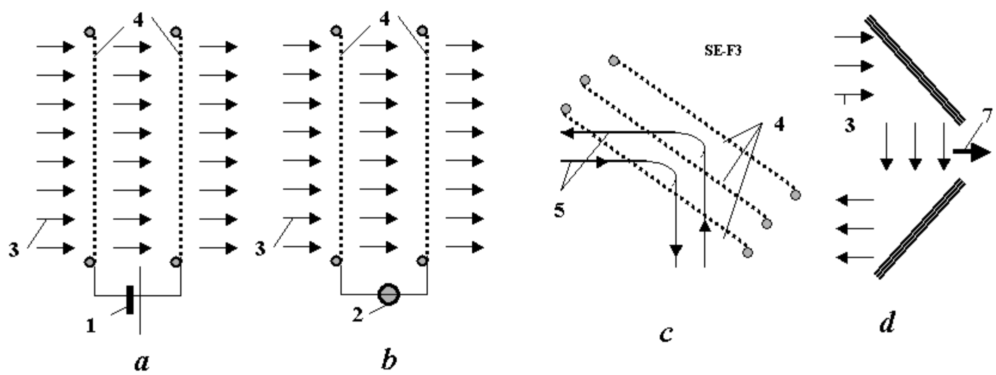

Figure 10-3. Getting and inserting in (off) plasma cable the energy and turning of plasma cable. ***a*** – inserting electric energy into plasma cable by means of two thin conducting nets or films; ***b*** - getting the energy from plasma cable by means of two thin conducting nets or films; ***c*** – offered triple net plasma reflector; ***d*** – double triple net plasma reflectors - the simplest AB thruster. *Notations*: 1 - spaceship or space station, 2 – receiver of energy, 3 - plasma cable, 4 - electrostatic nets, 5 – two opposed flows of charged plasma particles (negative and positive: electron and ions), 7 – thrust of AB-Space Engine.

Figure 10-3c presents the plasma beam reflector [1-4]. That has three charged nets. The first and second nets reflect (for example) positive particles, the second and third nets reflected the particles having an opposed charge.

Figure 10-4 shows the different design the plasma cable in space.

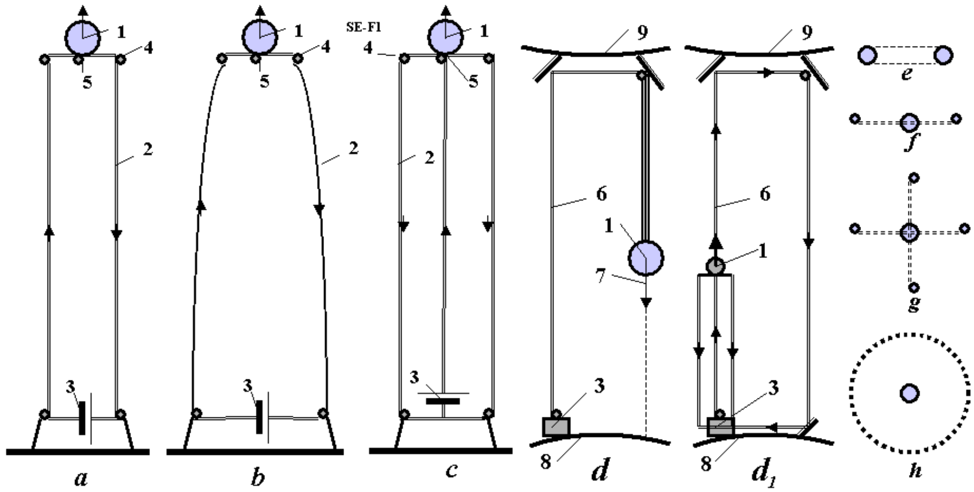

Figure 10-4. Transfer electricity and thrust by AB-Space Engine: ***a***. Two plasma parallel cables; ***b***. Curved cable; ***c.*** Plasma multi-cables; ***d***. Transfer of back thrust through planet or asteroid; $\boldsymbol{d}_1$. Using of ready plasma line; ***e – h***. Forms of straight and back plasma cables (cross-sections of cables). *Notations*: 1 – Space ship; 2 – plasma cable; 3 – source electricity; 4 - plasma injector; 5 – user of energy; 6 – double plasma line; 7 - thrust; 8 – Earth; 9 – planet or asteroid.

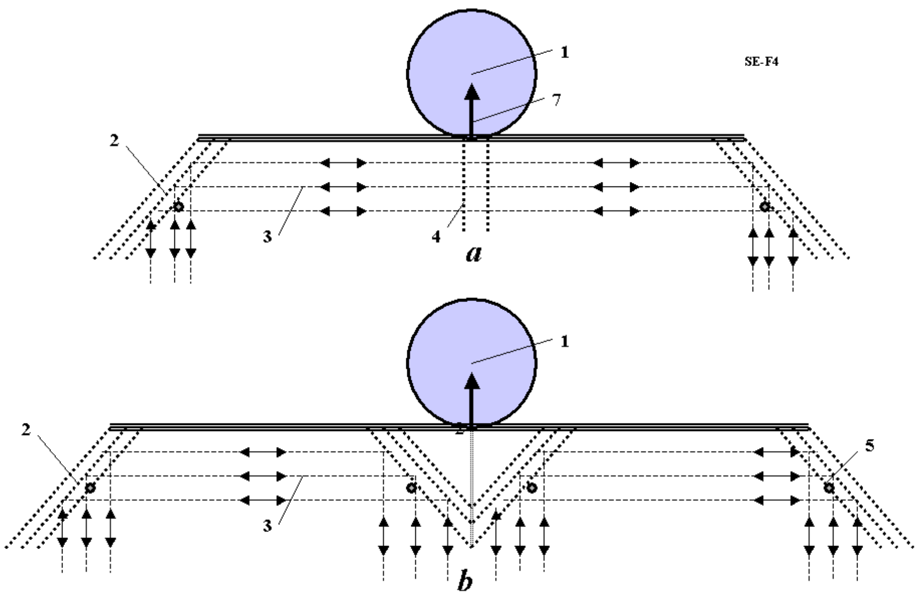

Figure 10-5. Some versions of AB-Space Engine (thruster). a. two cable AB-Space Engine; b. Three cable AB-Space Engine. Notations; 1 – space ship; 2 – offered special (three nets) electrostatic reflector; 3 – plasma cable; 4 – receiver or source of energy; 5 – injector of plasma, 7 – thrust.

Figure 10-4a shows two plasma parallel cables. Figure 4b two shows plasma parallel cables of a curved form of line. Figure 10-4c presents three plasma parallel cables, one to space ship and two for back (return) current. Figure 10-4d shows the transfer of the reverse impulse (or braking) thrust to space ship through planet or asteroid. Figures 10-5e-h shows the different forms of the straight and back plasma cables (cross-section of cables).

2. AB-Space Engine. The offered simplest AB-Space Engine is shown in Figure 10-4d and more details in Figures 10-5, 6. That includes two new triple electrostatic reflectors 2 which turn the plasma cables' (flow), (electric current 3) in back direction. The engine may also contain (optional) the plasma injectors 5 and electric generator (user) 4.

As feed material for the plasma may be used hydrogen gas, as plasma reflector may be used three conductivity nets connected to voltage sources, as generator - the double conductivity nets located into plasma flow and connected to voltage sources or users.

The other design of AB-Space Engine is shown in figure 10-6b. Here the central plasma flow divides in two side flows which go back to the electric station.

The AB-Space Engine works as follows. The electric current (voltage) produced by electric station (that may be located far from AB-Space Engine, for example, in orbit around the Earth or mounted on the Moon, Phobos or another space body) transfers by plasma cable to the AB-Space Engine. The power of the electric current in the plasma produces the power plasma flow of electrons and ions. The engine turns back the plasma flow (electric current) and returns it to the source electric station by the other plasma cable. The magnetic and centrifugal forces appear at the point of turning from outgoing to ingoing plasma paths place and create the thrust which can be used for movement (acceleration, braking) the space apparatus (or conventional vehicle or projectile).

Long-time readers of proposed space drive papers may suspect something fishy here. Don't worry: The AB-Space Engine doesn't violate Newton's third law of action and reaction. The AB-Space Engine reacts against the (planet or station mounted) electric station which may be located hundreds of millions of kilometers away! No other engine has the same capability.

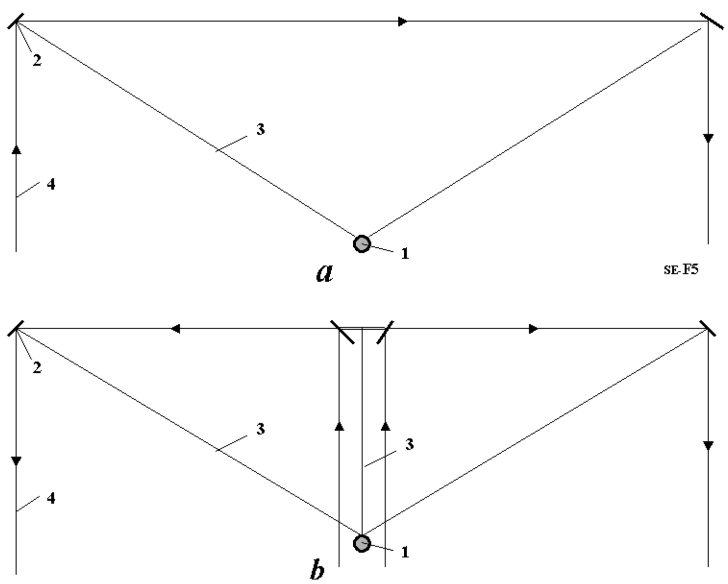

Figure 10-6. Some versions of widely (many km) AB-Space Engine (thruster). a. two cable AB-Space Engine; b. Three cable AB-Space Engine. Notations; 1 – space ship; 2 – offered special (three nets) electrostatic reflector; 3 – thin space cable connected the ship and reflector; 4 – plasma cable.

Your attention is also directed to the following differences between a railgun and an AB-Space Engine:

1) The railgun uses SOLID physical rails for delivery the electric current to conductivity projectile. These are easily damaged by huge electric current. The AB-Space Engine uses flexible plasma cables which can self-repair.

2) The railgun uses the rails which are of fixed construction (unalterable) and a spacecraft so launched can move solely in the rail direction. The AB-Space Engine creates the plasma cable in the course of apparatus movement and can select and change the apparatus' future direction.
3) Even a theoretical railgun girdling the globe of the Moon in vacuum (for star probe launch) would have a possible length of only some kilometers (as any solid construction). The plasma electric line (used byAB-Space Engine) can have a length (an acceleration path) of millions of kilometers (and thus may someday power manned craft on missions to near interplanetary space).

Discussion

Advantages of AB-engine

1) The offered AB-Space Engine is very light, simple, safe, and reliable with comparison to any likely nuclear engine.
2) The AB-Space Engine has a gigantic 'virtual specific impulse', being more capable of realistic operation in a projectable near-future environment, than virtually any proposed means of thermonuclear or light-propulsion scheme the author is aware of.
3) The AB-Space Engine can accelerate a near-term space apparatus to very high speed (approaching light speed). At present time this is the single real method to be able to approach this 'ultimate' velocity.
4) At least part of the needed injected plasma cable mass and nearly all of the energy needed (and the cooling facilities needed to maintain that energy supply) can be from the planet-bound energy-supplying station, further improving the on-board ship 'mass ratio'.
5) The AB-Space Engine can use far cheaper energy from a planet-bound electric station.

The offered ideas and innovations may create a jump in space and energy industries. Author has made initial base researches that conclusively show the big possibilities offered by the methods and installations proposed. Further research and testing are necessary. Those tests are not expensive. As that is in science, the obstacles can slow, even stop, applications of these revolutionary innovations. For example, the plasma cable may be unstable. The instability mega-problem of a plasma cable was found in tokomak R&D, but it is successfully solved at the present time. The same method (rotation of plasma cable) can be applied in our case.

The other problem is production of the plasma cable in Earth's atmosphere. This problem may be sidestepped by operations from a suitably high super-stratospheric tower such as outlined in others of the author's works, or is no problem at all if the electric station of the plasma cables' origin is located on the Moon [3].

The author has ideas on how to solve this problem with today's technologies and to use the readily available electric stations found on this planet Earth. Inquiries from serious parties are invited.

Summary

This new revolutionary idea – The AB-Space Engine and wireless transferring of electric energy in the hard vacuum of outer space – is offered and researched. A rarefied plasma power cord in the function of electric cable (wire) is used for it. It is shown that a certain minimal electric current creates a compression force that supports and maintains the plasma cable in its compacted form. Large amounts of energy can be transferred hundreds of millions of kilometers by this method. The requisite mass of plasma cable is merely hundreds of grams (some kg). A sample macroproject is computed: An AB-Space Engine having thrust = 10 tons. It is also shown that electric current in plasma cord can accelerate or slow various kinds of outer space apparatus.

11. Wireless Transfer of Electricity from Continent to Continent*

Author offers collections from his previous research of the revolutionary new ideas: wireless transferring electric energy in long distance – from one continent to other continent through Earth ionosphere and storage the electric energy into ionosphere. Early he also offered the electronic tubes as the method of transportation of electricity into outer space and the electrostatic space 100 km towers for connection to Earth ionosphere.

Early it is offered connection to Earth ionosphere by 100 km solid or inflatable towers. There are difficult for current technology. In given work the research this connection by thin plastic tubes supported in atmosphere by electron gas and electrostatic force. Building this system is cheap and easy for current technology.

The computed project allows to estimate the possibility of the suggested method.

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*See: http://www.scribd.com/doc/42721638/ or [4].

Wireless transferring of electric energy in Earth.

It is interesting the idea of energy transfer from one Earth continent to another continent without wires. As it is known the resistance of infinity (very large) conducting medium does not depend from distance. That is widely using in communication. The sender and receiver are connected by only one wire, the other wire is Earth. The author offers to use the Earth's ionosphere as the second plasma cable. It is known the Earth has the first ionosphere layer *E* at altitude about 100 km (Fig. 1). The concentration of electrons in this layer reaches 5×10^4 1/cm^3 in daytime and 3.1×10^3 1/cm^3 at night (Fig. 11-1). This layer can be used as a conducting medium for transfer electric energy and communication in any point of the Earth. We need minimum two space 100 km. towers (Fig. 11-2). The cheap optimal inflatable, kinetic, and solid space towers are offered and researched by author in [4]. Additional innovations are a large inflatable conducting balloon at the end of the tower and big conducting plates in a sea (ocean) that would dramatically decrease the contact resistance of the electric system and conducting medium.

Theory and computation of these ideas are presented in Macroprojects section [4].

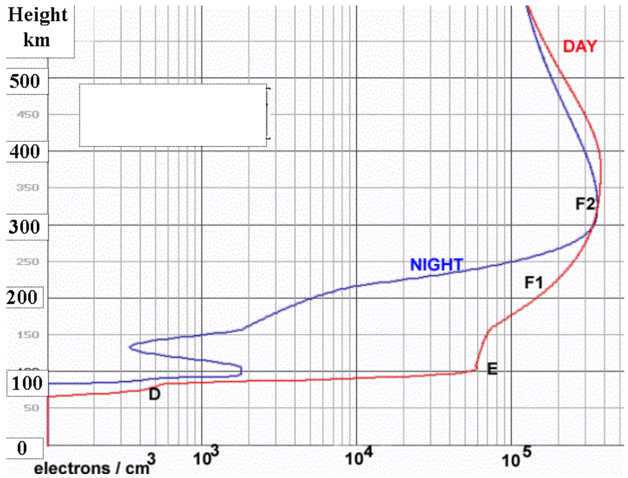

Fig. 11-1. Consentration/cm^3 of electrons (= ions) in Earth's atmosphere in the day and night time in the D, E, F1, and F2 layers of ionosphere.

However the solid 100 km space towers are very expensive. Main innovation in this work is connection to ionosphere by cheap film tube filled by electron gas.

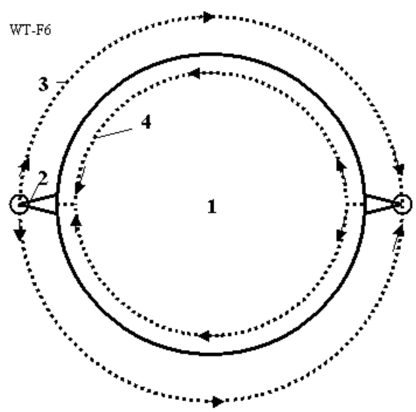

Fig. 11-2. Using the ionosphere as conducting medium for transferring a huge electric energy between continents and as a large storage of the electric energy. Notations: 1 - Earth, 2 - space tower (or electron tube) about 100 km of height, 3 - conducting *E* layer of Earth's ionosphere, 4 - back connection through Earth.

Electronic tubes

The author's first innovations in electrostatic applications were developed in 1982-1983 [1]-[4], [3, p.497].Later the series articles of this topic were published in [2, Ch.6]. In particular, in the work [4-5] was developed theory of electronic gas and its application to building (without space flight!) inflatable electrostatic space tower up to the stationary orbit of Earth's satellite (GEO) [2, Ch.11].

In given work this theory applied to special inflatable electronic tubes made from thin insulator film. It is shown the charged tube filled by electron gas is electrically neutral, that can has a high internal pressure of the electron gas.

The main property of AB electronic tube is a very low electric resistance because electrons have small friction on tube wall. (In conventional solid (metal) conductors, the electrons strike against the immobile ions located in the full volume of the conductor.). The abnormally low electric resistance was found along the lateral axis only in nanotubes (they have a tube structure!). In theory, metallic nanotubes can have an electric current density (along the axis) more than 1,000 times greater than metals such as silver and copper. Nanotubes have excellent heat conductivity along axis up 6000 W/m·K. Copper, by contrast, has only 385 W/m·K. The electronic tubes explain why there is this effect. Nanotubes have the tube structure and electrons can free move along axis (they have only a friction on a tube wall).

More over, the moving electrons produce the magnetic field. The author shows - this magnetic field presses against the electron gas. When this magnetic pressure equals the electrostatic pressure, the electron gas may not remain in contact with the tube walls and their friction losses. The electron tube effectively becomes a superconductor for any surrounding temperature, even higher than room temperature! Author derives conditions for it and shows how we can significantly decrease the electric resistance.

Description, Innovations, and Applications of Electronic tubes.

An electronic AB-Tube is a tube filled by electron gas (fig.11-3). Electron gas is the lightest gas known in nature, far lighter than hydrogen. Therefore, tubes filled with this gas have the maximum possible lift force in atmosphere (equal essentially to the lift force of vacuum). The applications of electron gas are based on one little-known fact – the electrons located within a cylindrical tube having a positively charged cover (envelope) are in neutral-charge conditions – the total attractive force of the positive envelope plus negative contents equals zero. That means the electrons do not adhere to positive charged tube cover. They will freely fly into an AB-Tube**.** It is known, if the Earth (or other planet) would have, despite the massive pressures there, an empty space in Earth's very core, any matter in this (hypothetical!) cavity would be in a state of weightlessness (free fall). All around, attractions balance, leaving no vector 'down'.

Analogously, that means the AB-Tube is a conductor of electricity. Under electric tension (voltage) the electrons will collectively move without internal friction, with no vector 'down' to the walls, where friction might lie. In contrast to movement of electrons into metal (where moving electrons impact against a motionless ion grate). In the AB-Tube we have only electron friction about the tube wall. This friction is significantly less than the friction electrons would experience against ionic structures—and therefore so is the electrical resistance.

When the density of electron gas equals $n = 1.65\times10^{16}/r$ $1/\mathrm{m}^3$ (where r is radius of tube, m), the electron gas has pressure equals atmospheric pressure 1 atm (see research below). In this case the tube cover may be a very thin—though well-sealed-- insulator film. The outer surface of this film is charged positively by static charges equal the electron charges and AB-Tube is thus an electrically neutral body.

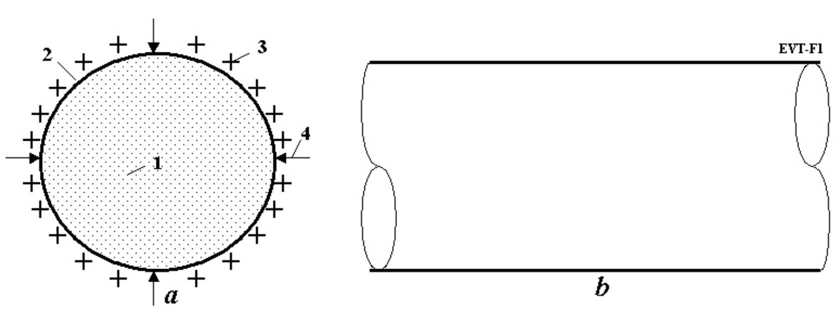

Fig. 11-3. Electronic vacuum AB-Tube**.** ***a***) Cross-section of tube. ***b***) Side view. *Notation*: 1 – Internal part of tube filled by free electrons; 2 – insulator envelope of tube; 3 – positive charges on the outer surface of envelope (over this may be an additional film-insulator); 4 – atmospheric pressure.

Moreover, when electrons move into the AB-Tube, the electric current produces a magnetic field (fig. 11-4). This magnetic field compresses the electron cord and decreases the contact (and friction, electric resistance) electrons to tube walls. In the theoretical section is received a simple relation between the electric current and linear tube charge when the magnetic pressure equals to electron gas pressure $i = c\tau$ (where i is electric current, A; $c = 3\times10^8$ m/s – is the light speed; τ is tube linear electric charge, C/m). In this case the electron friction equals zero and AB-Tube becomes **superconductive at any outer temperature**. Unfortunately, this condition requests the electron speed equals the light speed. It is, however, no problem to set the electron speed very close to light speed. That means we can make the electric conductivity of AB-Tubes very close to superconductivity almost regardless of the outer temperature.

Summary

This new revolutionary idea - wireless transferring of electric energy in long distance through the ionosphere or by the electronic tubes is offered and researched. A rare plasma power cord as electric cable (wire) is used for it. It is shown that a certain minimal electric currency creates a compressed force that supports the plasma cable in the compacted form. Large amounts of energy can be transferred many thousands of kilometers by this method. The requisite mass of plasma cable is merely hundreds of grams. It is computed that the macroproject: The transfer of colossal energy from one continent to another continent (for example, Europe to USA and back), using the Earth's ionosphere as a gigantic storage of electric energy.

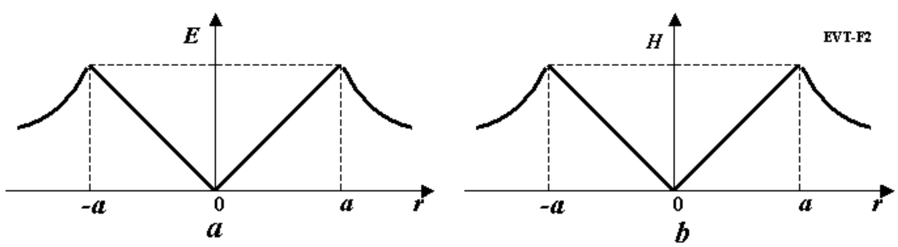

Fig. 11-4. Electrostatic and magnetic intensity into AB-Tube**.** ***a***) Electrostatic intensity (pressure) via tube radius. ***b***) Magnetic intensity (pressure) from electric current versus rube radius.

12. Magnetic Space Launcher*

A method and facilities for delivering payload and people into outer space are presented. This method uses, in general, engines located on a planetary surface. The installation consists of a space apparatus, power drive stations, which include a flywheel accumulator (for storage) of energy, a variable reducer, a powerful homopolar electric generator and electric rails. The drive stations accelerate the apparatus up to hypersonic speed.

The estimations and computations show the possibility of making this project a reality in a short period of time (for payloads which can tolerate high g-forces). The launch will be very cheap at a projected cost of \$3 - \$5 per pound. The authors developed a theory of this type of the launcher.

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*Presented as paper AIAA-2009-5261 to 45th AIAA Joint Propulsion Conference, 2-5 August 2009, Denver, CO, USA. See also http://www.scribd.com/doc/24051286/ or [4].

Description of Suggested Launcher

Brief Description. The installation includes (see notations in Figs. 12-1, 12-2): a gun, two electric rails 2, a space apparatus 3, and a drive station 4 (fig. 12-1). The drive station includes: a homopolar electric generator 1 (fig. 12-2), a variable reducer 3, a fly-wheel energy storage 5, an engine 6, and master drive clutches 2, 4, 6.

The system works in the following way:

The engine 7 accelerates the flywheel 5 to maximum safe rotation speed. At launch time, the fly wheel connects through the variable reducer 3 to the homopolar electric generator 1 which produces a high-amperage current. The gas gun takes a shot and accelerates the space apparatus "c" (fig. 12-3) up to the speed of 1500 – 2000 m/s. The apparatus leaves the gun and gains further motion on the rails 2 (fig. 12-3) where its body turns on the heavy electric current from the electric generator. The magnetic force of the electric rails accelerates the space apparatus up to speeds of 8000 m/s. (or more). The initial acceleration with a gas gun can decrease the size and cost of the installation when the final speed is not high. The gas gun cannot produce a projectile speed of more than about 2000 m/s. The railgun does not have this limit, but produces some engineering problems such as the required short (pulsed) gigantic surge of electric power, sliding contacts for some millions of amperes current, storage of energy, etc.

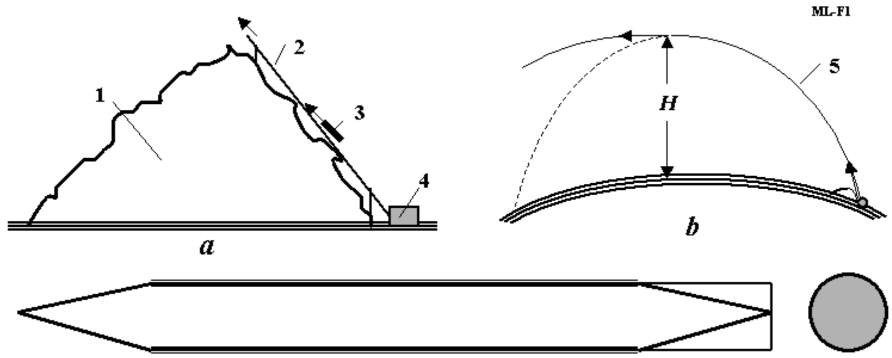

Fig. 12-1. Magnetic Launcher. (***a***) Side view; (***b***) Trajectory of space apparatus; (***c***) Hypersonic apparatus. *Notations*: 1 – hill (side view); 2 – railing; 3 – shell; 4 – drive station; 5 – space trajectory.

The current condensers have a small electric capacity 0.002 MJ/kg ([3, p.465)]. We would need about 10^{10} J energy and 5000 tons of these expensive condensers. The fly-wheels made of cheap artificial fiber have capacity about 0.5 MJ/kg ([3, p.464)]. The need mass of fly-wheel is decreased to a relatively small 25 – 30 tons. The unit mass of a fly-wheel is significantly cheaper then unit mass of the electric condenser.

The offered design of the magnetic launcher has many innovations which help to overcome the obstacles afforded by a conventional railgun. Itemizing some of them:

1. Fly-wheels from artificial fiber.
2. Small variable reducer with smooth change of turns and high variable rate.
3. Multi-stage monopolar electric generator having capacity of producing millions of amperes and a variable high voltage during a short time.

4. Sliding mercury (gallium) contact having high pass capacity.
5. Double switch having high capacity and short time switching.
6. Special design of projectile (conductor ring) having permanent contact with electric rail.
7. Thin (lead) film on projectile contacts that improve contact of projectile body and the conductor rail.
8. Homopolar generator has magnets inserted into a disk (wheel) form. That significantly simplifies the electric generator.
9. The rails and electric generator can have internal water-cooling.
10. The generator can return rotation energy back to a flywheel after shooting, while rails can return the electromagnetic energy to installation. That way a part of shot energy may be returned. This increases the coefficient of efficiency of the launch installation.

The fly-wheel has a disadvantage in that it decreases its' turning speed when one spends its energy. The prospective space apparatus and space launcher needs, on the contrary, an increase of voltage for accelerating the payload. The homopolar generator really would like to increase the number of revolutions thus increasing the voltage. The offered variable reducer approaches this ideal, keeping constant or even increasing the speed of rotation of the electric generator. In addition, the multi-stage electric generator can additionally increase its' voltage by chaining (concatenation of turning on in series mode) its stages or sections.

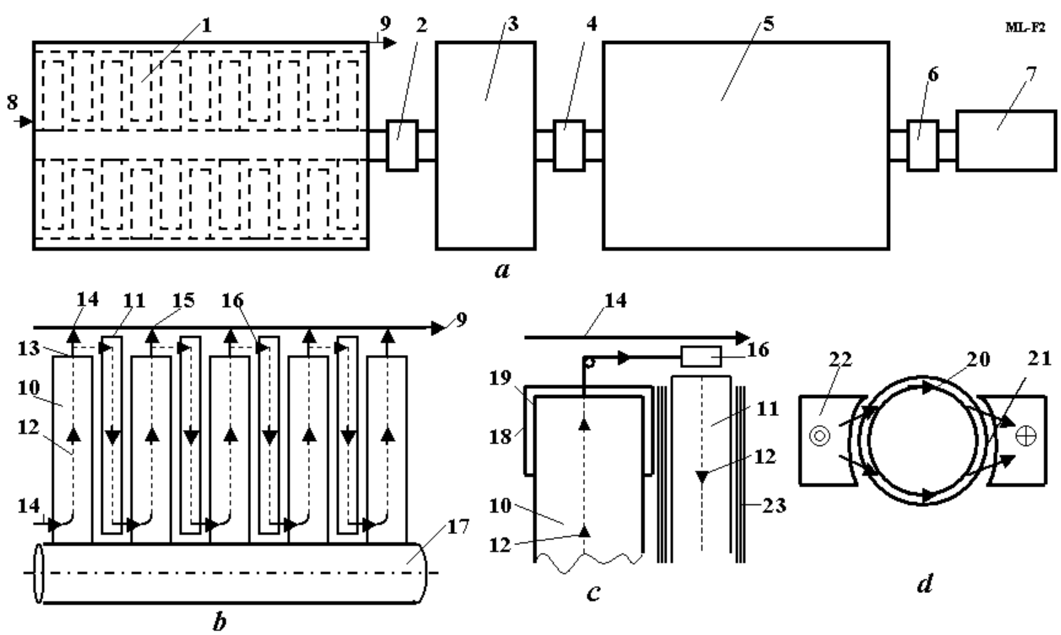

Fig. 12-2. Drive station. (***a***) Main components of drive station; (***b***) Rotors and connection disks (wheels); (***c***) Association of rotor and connection disk; (***d***) Association of shell and electric rails (plough or sled). *Notations:* 1 – Electric homogenerator; 2, 4, 6 – master drive clutch; 3 – variable reducer; 5 – fly-wheel; 7 – engine; 8 – enter of electric line; 9 – exit of electric line; 10 – disk (wheel) of rotor (rigid attachment to shaft 17); 11 – motionless conductor (rigid attachment to stator); 12 – electric current; 13 – sliding contact; 14, 15 – exit conductor; 16 – double switch from electric line 14 to conductor 11; 18 – sliding contact; 19 – mercury; 20 – electric ring; 21 – thin film; 22 – electric rail.

The sketch of the variable reducer is shown in fig. 12-3. The tape (inertial transfer roll) 3 rotates from shaft 1 (electric generator) to shaft 2 (fly-wheel). In starting position the tape (roll). diameter d_1 of shaft

1 is big while the tape (roll) diameter d_2 of the fly-wheel is small and rotation speed of electric generator is small. During the rotation, the tape (roll) diameter of shaft 1 decreases, while the corresponding diameter around shaft 2 increases and the rotation speed of the electric generator increases (assuming a correct design of the reducer). The total change of the rotation speed is $(d_1/d_2)^2$. For example, if $d_1/d_2 = 7$, the total change of rotary speed is 49. This way the rotation speed of the electric generator either increases or stays constant in spite of the fact that the rotary speed of the flywheel is decreasing. The multi-stage electric generator achieves the additional increasing of voltage. Its' sections turn on in series.

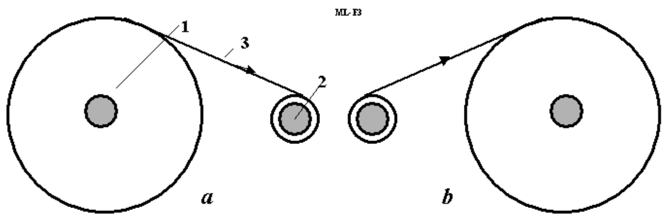

Fig. 12-3. Variable reducer. (***a***) Start position; (***b***) final position. *Notations*: 1 – shift of electric generator; 2 – shift of fly-wheel; 3 – tape (inertial transfer roll).

Conclusion

The research shows the magnetic launcher can be built by the current technology. This significantly (by a thousand times) decreases the cost of space launches. Unfortunately, if we want to use the short rail way (412 m), any launcher request a big acceleration about $7.5 \cdot 10^3 g$ and may be used only for unmanned, hardened payload. If we want design the manned launcher the rail way must be 1100 km for acceleration a = 3g (untrained passengers) and about 500 km (a = 6g) for trained cosmonauts.

Our design is not optimal. For example, the computation shows, if we increase our rail track only by 15 m, we do not need gas gun initial acceleration. That significantly decreases the cost of installation and simplifies its construction.

The reader can recalculate the installation for his own scenarios.

13. Lower Current and Plasma Magnetic Railguns*

It is well-known that the magnetic railgun theoretically allows a very high 'exhaust velocity' of projectile. The USA and England have tried to research and develop working railgun installations. However the researchers had considerable problems in testing. The railgun requests very high (millions of amperes,) electric current (but low voltage). As result the rails and contacts burn and melt. The railgun can make only ONE shot between repairs, cannot shoot a big and high speed projectile, and has low efficiency.

The heat and inductive losses of railgun depend upon the square of electric current. If we decrease electric current by ten times, we decrease the losses by one hundred times. But the current design of railgun does not allow decreasing the current because that leads to loss --also by the square-- of electromotive force.

In this article the author describes new ideas, theory and computations for design of new magnetic lower cost accelerators for railgun projectiles and space apparatus. This design decreases the requested electric current (and loss) in hundreds times. This design requires a similar increase in voltage (because the energy for acceleration is the same). But no super heating, burn and melting rails, contacts, or big losses. The power and mass of projectiles and space apparatus can be increased in a lot of times. High voltage current does not require special low voltage equipment and may be used directly from the electric stations, saving huge amounts of money.

Author also suggests a new plasma magnetic accelerator, which has no traditional sliding mechanical contacts, significantly decreases the mass of electrical contacts and increases the useful mass of projectile in comparison with a conventional railgun.

Important advantages of the offered design are the lower (up to some tens of times) usage of electric current of high voltage and a very high efficiency coefficient closeto 95% (compare with efficiency of the current railgun which equals 20 – 40%). The suggested accelerators may be produced by present technology.

The projects of railguns are computed herein.

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*See also [4], http://www.scribd.com/doc/24057930 . http://www.scribd.com/doc/31090728
http://www.archive.org/details/Macro**-projectsEnvironmentsAndTechnologies**

Description of Innovations and Problems in AB-Launchers

Low current multi-loop Railguns

Description of multi-loop Launchers . The conventional magnetic accelerator (railgun) is shown in fig. 13-1. That contains two the conductive rails connected by a **sliding** jumper. Electric current produces the magnetic field and magnetic force. The jumper accepts the magnetic force and accelerates the projectile. Main defects of conventional rail gun: The rail gun requires a gigantic current (millions of amperes) of low voltage, rails have large electric resistance, strongly heating up, contacts burn, installation is damaged and requires repair after every shot. The energy charge is high (small coefficient of efficiency). You see the gigantic plasma column behind the small projectile in fig.13-2 (left)). The repulsive force between rails is gigantic (thousands of tons) and installation is thus heavy and expensive if it is to survive a single shot.

Description.. The fig. 13-3a shows the principal scheme of the conventional railgun. The installation of fig.3a includes the long vertical wire 2, moved jumper 8, sliding contacts 7 and electric source 6. The electric current produces the magnetic field 3 (magnetic column), the magnetic field creates the vertical 4 and horizontal 5 forces. Vertical force 4 accelerates the useful load at top of the installation.

This design is used in a rail gun [4] but the author made many innovations that allow applying these ideas to this new application as the efficient magnetic accelerators. Some of them are listed below.

Innovations. The figs. 13-1b-1f show schemes of the suggested accelerators The author offers the following innovations having the next advantages:

1) *Version 1* (fig. 13-1b). The horizontal wire (fig. 13-1a, former sliding jumper 8 of fig. 13-1a) is made in a form of closed-loop spool (fig. 13-1b, #10). The lower part of this spool (fig. 13-1b, #11) located in place of former jumper near the magnetic field of vertical wire (fig. 13-1b). The top part of this spool (fig. 13-1b, #10) located at top – out of the magnetic field of vertical wire 2. As the result the magnetic field of the vertical wire 2 activates only on horizontal wires 11. But now we have here not one wire with current i, we have n wires and current ni. The magnetic force 4 and requested 4 voltage increases by n times! The force spool 10 can have some hundreds loops and force will be more in same times thanin case of fig. 13-1a. For same vertical force the electric current in the vertical connection wires 2 may be decreases in $n_1 = n$ times, where n_1 is number of horizontal loops. The electric current may be relatively small (only some tens of thousands of amperes, not millions) and of the high voltage. The request vertical wire may be relatively thin. The heating, contact and inductive losses decrease in n_1 times, where n_1 is number of horizontal loops. The number of contacts $N=2$ is same (not increases).

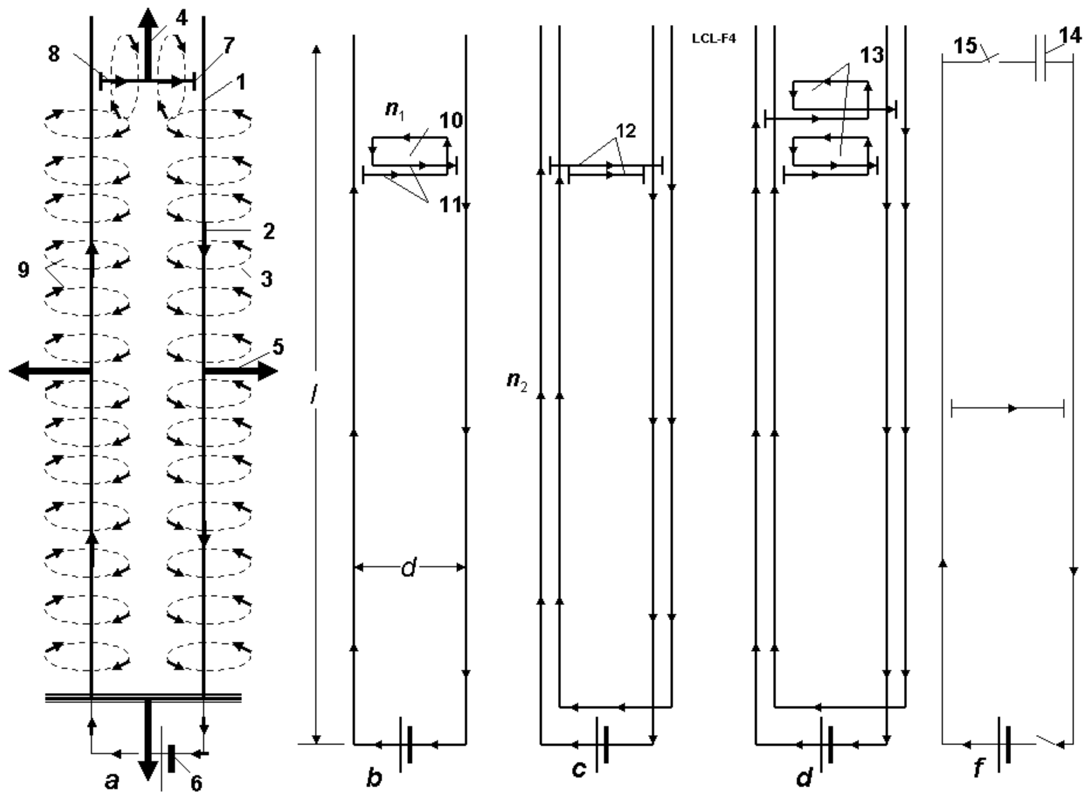

Fig. 13-1. Conventional and low current launchers. (*a*) Conventional high current and low voltage railgun; (*b*) Offered low current launcher with the wire horizontal multi-loops (version 1); (*c*) Offered low current launcher with the wire vertical multi-loops (version 2); (*d*) Offered low current launcher with the wire horizontal and vertical muiti-loops (version 3); (*f*) RailGun with condenser. (version 4). *Notations*: 1 – installation, 2 – vertical wire, 3 – magnetic field from vertical wire; 4 – moved vertical force from jumper; 5 – magnetic force from vertical electric wire, 6 – electric source, 7- sliding contact, 8 – horizontal jumper, 9 - magnetic column, 10 – multi-loop spool, 11, 12 – horizontal force wire connected in one bunch, 13 – force multi-loops spools connected in one spool, 14 – condenser, 15 – electric switch.

2) *Version 2* (fig.13-1c). Installation contains the vertical closed loops n_2. For same vertical force the electric current decreases in n_2 times, the voltage increases by n_2 times. The number of contacts N also increases by n_2 times. But heating of every contact decreases by n_2^2. Common electric heat, contact and inductive losses decrease by n_2 times.
3) *Version 3* (fig. 13-1d). That is composition of versions 1 and 2. For same vertical force the electric current decreases by n_1n_2 times. The number of contacts N increases in n_2 times. But heating of every contact decreases by n_1n_2. Common electric heat, contact and inductive losses decrease in n_1n_2 times.
4) *Version 4* (fig.13-1f). The main electric loss in conventional railgun is an inductive loss, which produces a gigantic inductive current and plasma flash. This loss may be significantly decreases by switching the condenser in the end of the projectile track.

The main innovation is a top loop 10 (right angle spool [4]), which increases the number of horizontal wires 11 (multi-loops), magnetic intensity in area under 11 and lift force 4. We can make a lot of loops up to some hundreds and increase the lift force by hundreds of times. For a given lift force we can decrease the required current in many times and decreases the mass of the source wire 2. That does not necessarily mean that we decrease the required electric energy (power) because the new installation needs a higher voltage.

Multi-loop Railguns with permanent magnets

Main function of the vertical wire 2 (fig. 13-1a) creates the magnetic field between wire 2. This field interacts with the magnetic field from a jumper 8 (fig. 13-1a) or the horizontal wires 11 (fig. 13-1b), 12 (fig. 13-1c) and creates the vertical force 4 (fig. 13-1a). For getting enough force requires a high electric current. However, the needed intensity magnetic field we can produce by means of conventional magnets.

This idea explored in multi-loop launcher (accelerator) is offered in fig. 13-2. The launcher has two strong magnets 2 and the multi-loop spool 6. The spool connects through the sliding contacts 5 (fig. 13-2a) to the electric source 3. The design of fig. 13-2c has the spring wires 9 and not has the sliding contacts 5. The suggested launcher has two the motive magnetic jumpers 7, which significantly increase and close the magnetic lines in the lower part 8 of the force spool 6. The top part of the force spool has not the magnetic jumper 7 and does not produce the opposing motive force.

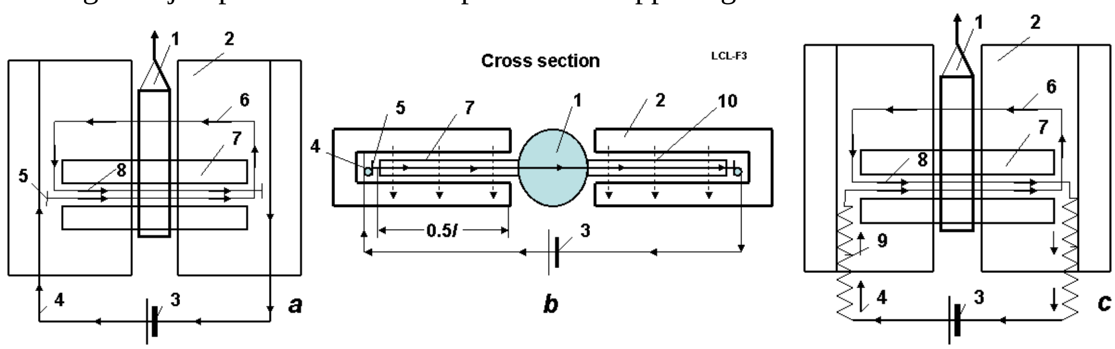

Fig. 13-2. Offered launcher with the permanent magnets. (***a***) Top view; (***b***) Cross section; (***c***) Launcher having the spring wires. *Notations*: 1 – projectile, 2 – magnet, 3 – electric source, 4 – electric current, 5 – sliding contact, 6 – force (jumper) multi-loop spool (top part); 7 - magnetic jumper; 8 – lower part of the multi-loop top (force) electric spool; 9 – the spring electric wire; 10 – magnetic lines; 0.5*l* is length of a magnetic active zone in one side of wire.

The offered accelerator is closest to the direct current linear electric engine but has four differing important features: It has a spool part of it located out of the strong magnetic lines, the installation has the motive magnetic jumpers, the installation uses constant non-interrupted current, launcher can omit the sliding contacts (fig. 13-4c).

This magnetic accelerator may be suitable for a space launcher having small accelerations.

Plasma magnetic launcher

The jumper 4 (fig. 13-1a), force spools 10, 12, 13 (figs. 13-1b,c,d), magnetic jumpers 7 (fig. 13-2) can have a big mass and significantly decrease the useful load (in 2 – 3 and more times). For decreasing of this imperfect the author offers the plasma jumper (fig. 13-3). Plasma in jumper has very small mass because plasma has a small density. The plasma can have a high conductivity closed to a metal conductor. But plasma conductor (jumper) can have a big cross-section area and a low electric resistance. Electric conductivity of plasma does not depend from its density. The plasma may be very rarefied. That means the head transfer to walls of a channel may be very small and so not damage them. For example the plasma of Earth radiation belts has a million degrees but spaceman and space apparatus not damage.

The thin wire may be initial initiator of a of plasma cable. Then a plasma conductor supports the big current.

The second advantage of plasma launcher is a gas sliding contact. That cannot burn and is more robust against damage.

The offered plasma cable may be used in other technical fields [2] –[4]. This problem needs further research.

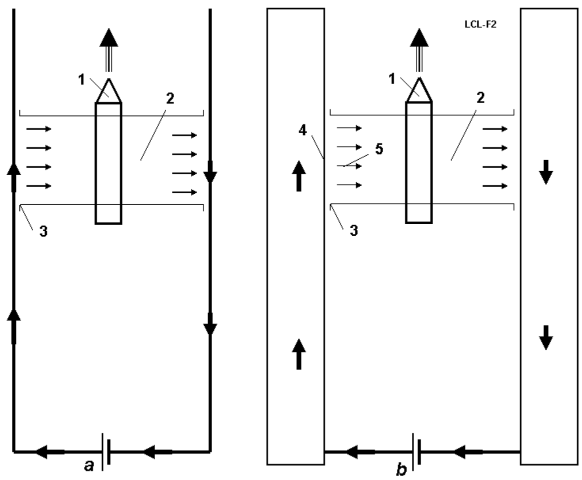

Fig.13-3. Offered plasma launchers. (***a***) Launcher having conventional vertical wire and plasma jumper; (***b***) Launcher having vertical and horizontal (jumper) plasma wires. *Notations:* 1- projectile, 2 – horizontal plasma jumper, 3 – gas sealing, 4 – conducting tube, 5 – electric current into plasma.

Conclusion

In this article the author describes the new ideas, theory and computations for design the new low electric current launchers for the railgun projectile and space apparatus.

Important advantage of the offered design is the lower (up some tens times) used electric current of high voltage and the very high inductive efficiency coefficient close to 0.9 (compared with efficiency of the current railgun equal to 20 – 40%). The suggested launchers may be produced by present technology.

The problems of needed electric energy become far simpler. At first, AB-Launchers have a high efficiency and spend in 2 – 3 times less energy than a conventional railgun; the second, AB-Launcher uses the high voltage energy closed to a voltage of the electric stations. That means the power electric station can be directly connected to AB-Launcher in period of acceleration without expensive transformers and condensers. The power of strong electric plant is enough for launching the space apparatus of some hundreds of kilograms.

The offered magnetic space launcher is a thousand times cheaper than the well-known cable space elevator. NASA is spending for research of space elevator hundreds of millions of dollars. A small part of this sum is enough for R&D of the magnetic launcher and to make a working model.

The proposed innovation (milti- electric AB-spool, permanent magnetic rails, plasma magnetic launcher) allows also solving the problem of the conventional railgun (having the projectile speed 3 -5 km/s). The current conventional railgun uses a very high ampere electric current (millions A) and low voltage. As the result the rails corrode, burn, melt The suggested AB-spool allows decreases the required the electric current by tens of times (simultaneously the required voltage is increased by the same factor).

Small cheap magnetic prototypes would be easily tested.

The computed projects are not optimal. That is only illustration of an estimation method. The reader can recalculate the AB-Launchers for his own scenarios (see also [1]-[4]).

14. Superconductivity Space Accelerator *

In this Chapter the author describes a new idea, theory and computations for design of a new magnetic low cost accelerator for railgun projectile and space apparatus. The suggested design does not have the traditional current rails and sliding contacts. This accelerates the projectile and space apparatus by a magnetic column which can have a length of some kilometers, produces a very high acceleration and projectile (apparatus) final speed of up to 8 - 10 km/s.

Important advantages of the offered design is the low (up to some thousands of times) used electric current of high voltage and very high efficiency coefficient close to 1 (compare with efficiency of the current railgun which equals 20 – 40%). The suggested accelerator may be produced by present technology.

The projects: railgun and space accelerator are computed in [4].

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* Magnetic Space AB-Accelerator. http://www.scribd.com/doc/26885058 , or [4].

Description of Innovations and Problems

New type of magnetic acceleration (magnetic AB-column)

1. **Description of Innovations.** The conventional magnetic accelerator (railgun) is shown in fig.1. That contains two the conductive rails connected by a **sliding** jumper. Electric currents produce the magnetic field and magnetic force. The jumper accepts the magnetic force and accelerates the projectile. Main defects of conventional rail gun: The rail gun requires a gigantic current (millions of amperes) of low voltage, rails have large electric resistance, strongly heating up, contacts burn, installation is damaged and requires repair after every shot. The energy charge is high (small coefficient of efficiency. You see the gigantic plasma column behind the small projectile in [4] Ch.6, fig.2). The repulsive force between rails is gigantic (thousands of tons) and installation is thus heavy and expensive if it is to survive a single shot.

Description. The fig.1a shows the suggested accelerator without the force and connection spools. Installation includes the long vertical loop from electric wire 1 and electric source 6. The electric current 2 produces the magnetic field 3 (magnetic column), the magnetic field creates the vertical 4 and horizontal 5 forces. These forces balance the film (or filament, fiber) connection 15. Vertical force 4 accelerates the useful load at top of the installation and supports wires and film connection).

This design is used in a rail gun [4] but the author made many innovations that allow applying this idea to this new application as an efficient magnetic accelerator. Some of them are listed below.

Innovations. The author offers the following innovations having the next advantages:

1) The horizontal wire (fig. 14-1a, #2a, former sliding jumper) is made in a form of closed-loop spool (fig. 14-1b, #11). The lower part of this spool (fig. 14-1b, #12) located in place of former jumper near the magnetic field of vertical wire (fig. 14-1b). The top part of this spool (fig. 14-1b, #13) located at top – out of the magnetic field of vertical wire 2. As the result the magnetic field of the vertical wire 2 activates only on horizontal wires 12. But now we have here not one wire 2a with current *i*, we have *n* wires and current *ni*. The magnetic force 17 and requested voltage increases by *n* times! The force spool 11 can have some thousands loops and force 17 will be more in same times then in case 2a of fig. 14- 3a. That means the electric current in the connection wires 2 may be relatively small (only

some thousands of amperes, not millions) and of high voltage. The request vertical wire may be relatively thin.

2) Application of special connection spool. The accelerator has the connection spool 7 (fig. 14-1, detail spool in fig. 14-2). That allows increases the acceleration distance up to some kilometers and deletes the sliding electric contacts.
3) The wire is superconductive and has special design (fig. 14-2). That allows simply cooling the wires in a short time (the superconductivity needs a low temperature). Their cooling time may be short because requested time of acceleration may be short. For example, rail gun shot lasts about 0.1 second, the space apparatus acceleration is about tens seconds.
4) Absence of long rails. ‘Confinement recoil’ of projectile is accepted by the magnetic columns 3a (fig. 14-1a) from vertical wires [4].

The main innovation is a top loop 11 (right angle spool [4]), which increases the number of horizontal wires 12, magnetic intensity in area 17 and lift force 16. We can make a lot of loops up to some thousands and increase the lift force by thousands of times. For a given lift force we can decrease the required current in many times and decreases the mass of source wire 2. That does not necessarily mean that we decrease the required electric power because the new installation needs a higher voltage. The proposed construction creates the MAGNETIC COLUMN 3a that produces a lift force some thousands of times more than a conventional rail gun.

The second important innovation is the connection spool, which increases the acceleration distance, deletes the sliding contacts and heavy rails.

*Quadratic magnetic column***.** The quadratic four wire magnetic column ([4], Fig.2) is more efficient, stable, safe, reliable and controlled than two wire magnetic column Fig. 14-1. It can control of space ship direction (by changing current in vertical wires). It is important for high altitude space apparatus.

2. Connection spools. The connection spools can be located at accelerator and at the ground. Every design has its advantages and limitations. Three constructions of the connection spools are presented in fig. 14-2. The first design (fig. 14-4a) has immobile vertical spools. That is simple but results in a limited safe high speed of the launched apparatus and requires the connection device 9. The second design (fig. 14-2b) has the horizontal spool rotated by an engine. This connection spool is limited by the safe rotary speed of the spool and also requires the connection device 9. The third design (fig. 14-2c) has engine and also limited by a safety rotary of spool, but it does not request the connection device 9 because the wires are connected by fiber before spooling in the connection spool.

The limitation is about 1 – 3 km/s for the current artificial fiber (whiskers) having a safe tensile stresses about 200 - 1000 kgf/mm^2. But if we use nanotubes, the limit is more by 5 -10 times.

3. Cooling system of superconductive wire. The current superconductive conductors do not spend electric energy and pass very large electric current densities, but they require an cooling system because the current superconductive materials have the critical temperature of about 100 - 180 K (see Table #1 below). The wire located into Earth’s atmosphere (up 50 – 80 km) needs cooling.

However, the present computational methods of heat transfer are well developed and the weight and the induced expenses for cooling are small (for example, cooling by liquid nitrogen) [4] (see also Computation and Projects sections).

The suggested design of a cooled superconductive wire is present in fig. 14-3. The wire contains two elastic tubes. The insulated internal tube is coated inside-- the superconductive layer, outside is coated-- the highly reflective layer. The outer tube is made from the strong artificial fiber and covered by the highly reflective layers. The space between tubes is vacuumed or filed by air (it is worse but may apply for short cooling time) or heat protection.

The wire works the following way. The liquid nitrogen (77 K) from special heat protection capsule is injected into the internal tube in many places (needles) and instantly cooling the superconductive layer to lower than the critical temperature.

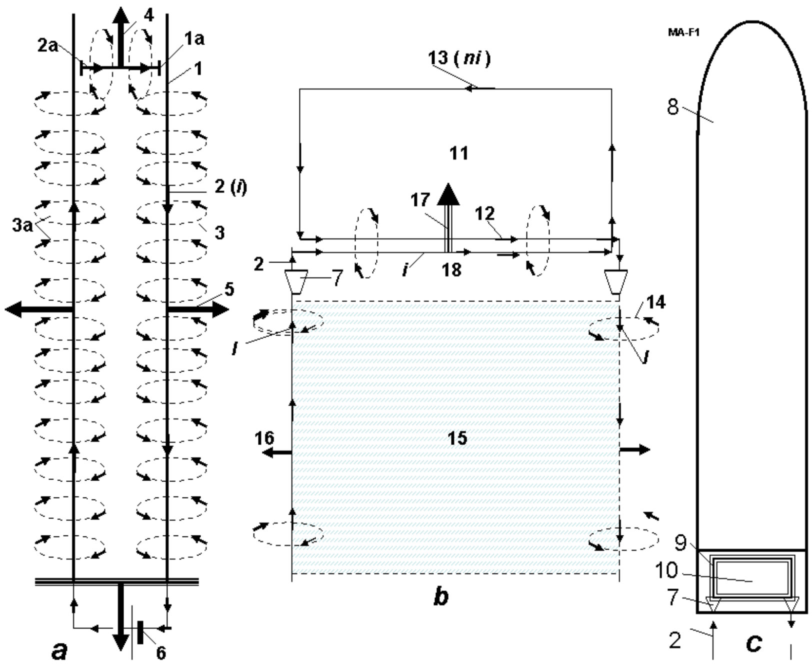

Fig. 14-1. Principal sketch of the Magnetic AB-Accelerator. *Notations*: (**a**) Principal sketch of conventional (one turn) magnetic accelerator, (**b**) – Multi-loop force spool at top of accelerator (same force spool located at ground), (**c**) – rocket (projectile) with detachable magnetic accelerator at bottom. *Parts*: 1 – magnetic installation with magnetic column, 1a – sliding contct, 2 – vertical wire and direction of electric current *i*, 2a – horizontal wire (jumper) and direction of electric current *i*, 3 – magnetic field from vertical electric wire, 3a – magnetic column, 4 – magnetic force from horizontal electric wire (jumper), 5 – magnetic force from vertical electric wire, 6 – electric source, 7 – connection spool, 8 – rocket (projectile), 9 – force spool, 10 – magnetic accelerator, 11 – wire multi-loop superconductive force spool at top (same spool located also on Earth surface), 12 – lower wires of loop (force spool), 13 – top wires of loop (force spool), 14 – magnetic field from vertical wire, 15 – thin film or artificial fiber connected the vertical wires for compensation the magnetic repulse force, 16 – repulsive magnetic force, 17 – acceleration force, 18 – area strong magnetic field, *i* – electric current in vertical wire, *ni* – electric current in the force spool.

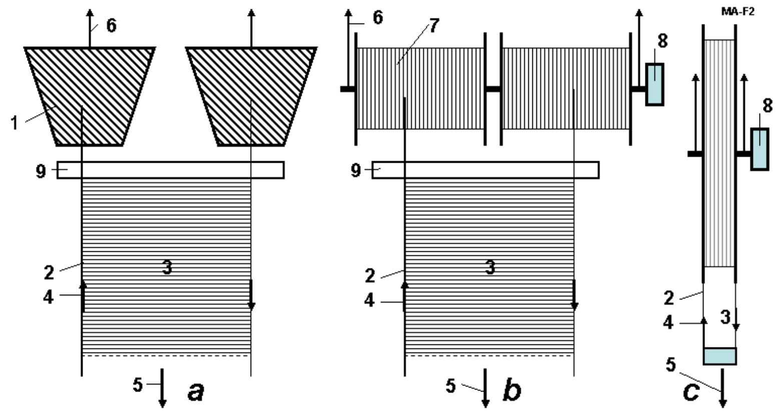

Fig. 14-2. Possible installations of connection spools for AB-Accelerator. *Notations*: (***a***) Immobile vertical connection spool, (***b***) Rotated horizontal connection spool, (***c***) Type connection spool. Parts: 1 – immobile vertical connection spool, 2 – vertical superconductive wire, 3 – filaments connected the vertical wire and keeping the repulsive magnetic force of vertical wires, 4 – electric current, 5 – motion of connection wire, 6 – vertical wire to the force spool, 7 – connection wire in connection spool, 8 – engine for rotation of the connection spool, 9 – device for connection the vertical wires by filaments.

While the nitrogen evaporates the temperature is 77 K and installation can accelerate the projectile or space apparatus. After acceleration the accelerator separates, wires are spooling and installation is ready for next shot.

4. Superconductive materials.

There are hundreds of new superconductive materials (type 2) having critical temperature 70 ÷ 120 K and more. Some of the superconductable materials are presented in Table 1 (2001). The widely used $YBa_2Cu_3O_7$ has mass density 7 g/cm^3.

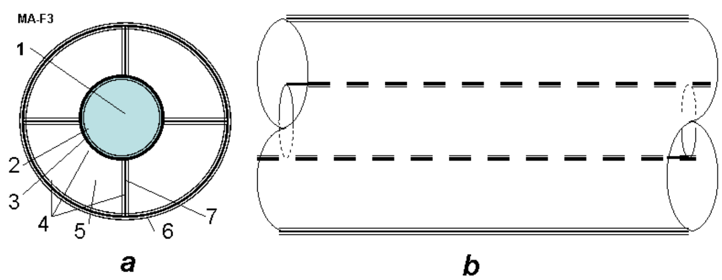

Fig. 14-3. Superconductive wires. (***a***) Cross-section of superconductive wires, (***b***) – side view. *Notations*: 1 - strong elastic tube (internal part is used for cooling of superconductive layer by liquid nitrogen, external part is used for reflective layer), 2 – superconductive layer, 3 - insulator, 4 – high reflective layer, 5 – vacuum or air, or heat-insulated material (fiber), 6 – strong outer tube (internal and external surface is covered by reflective coating), 7 – connection the internal and outer tubes.

Table 1. Transition temperature T_c and upper critical magnetic field $B = H_{c2}(0)$ of some examined superconductors AIP, Physics desk references, 3rd ed., p. 752.

Crystal	T_c (K)	H_{c2} (T)
$La_{2-x}Sr_xCuO_4$	38	≥80

$YBa_2Cu_3O_7$	92	≥150
$Bi_2Sr_2Ca_2Cu_3O_{10}$	110	≥250
$TlBa_2Ca_2Cu_3O_9$	110	≥100
$Tl_2Ba_2Ca_2Cu_3O_{10}$	125	≥150
$HgBa_2Ca_2Cu_3O_8$	133	≥150

The last decisions are: Critical temperature is 176 K, up to 183 K. Nanotube has critical temperature of 12 - 15 K,

Some organic matters have a temperature of up to 15 K. Polypropylene, for example, is normally an insulator. In 1985, however, researchers at the Russian Academy of Sciences discovered that as an oxidized thin-film, polypropylene have a conductivity 10^5 to 10^6 that is higher than the best refined metals.

Boiling temperature of liquid nitrogen is 77.3 K, air 81 K, oxygen 90.2 K, hydrogen 20.4 K, helium 4.2 K. Specific density of liquid air is 920 kg/m^3, nitrogen 804 kg/m^3; evaporation heat is liquid air is 213 kJ/kg, nitrogen 199 kJ/kg.

Unfortunately, most superconductive material is not strong and needs a strong covering for structural support.

5. Advantages. The offered magnetic accelerator has big advantages in comparison with railguns and other space launchers. Compare it with the space rocket.

1. The AB-Accelerator is very cheap. The cost is about one million USD (rail gun) to some millions (space launcher) [4].
2. The consumables cost is very small and primarily the needed electric energy (about 3 – 5 $/kg)[4].
3. The productivity is very high (tens launches in day).
4. The accelerator uses the current well developed technology and may be researched and developed in a short time.
5. The accelerator (special platform) may initially to accelerate current rockets up to speed 700 – 1000 m/s and lift them to the altitude 5 – 10 km. That increases the payload the current rockets up 50% .
6. Accelerator uses the high voltage (up to 1 MV) electric currency. That allows to directly connect accelerator to current power electric stations (in night time during periods of slack power use) and to launch a space apparatus without expensive electric energy storage in the form of capacitors (used in present time).
7. Accelerator has a coefficient of energy efficiency closed to 1. It is the most efficient among the known space launchers.

In comparison with current Railgun the suggested accelerator has the following advantages:

1. No problem with burn of rail and contact.
2. No damage and repair of installation after every shot.
3. Limit in speed of projectile is high (7 – 9 km/s).
4. No limit to mass of projectile.
5. Installation is cheaper.
6. Installation requires ~2 – 3 times less of energy than same output conventional railgun.

6. Application and further development. Idea of the magnetic AB-column may be applied to the suspending of houses, buildings, towns, multi-floor cities, to a small flying city-state located over ocean in the international water, (avoiding some of the liabilities of sea-surface communities during storms) to levitating space stations, to communication masts and towers [4]. This idea may be easily tested in small cheap magnetic constructions for simple projects, on a small scale.

Conclusion

In this chapter the author describes new idea, theory and computations for design the new magnetic low cost accelerator for railgun projectile and space apparatus. The suggested design does not have the traditional current rails and sliding contacts. That accelerates the projectile and space apparatus by a magnetic column which can have a length of some kilometers, produces the very high acceleration and the projectile (apparatus) speed up 8 km/s.

Important advantage of the offered design is the lower (up some thousands times) used electric current of high voltage and the very high efficiency coefficient close to 1 (compared with efficiency of the current railgun equal to 20 – 40%). The suggested accelerator may be produced by present technology.

The important advantage of the offered method for space apparatus is following: The method does not need designing new rockets. What is needed is to design only a simple accelerator (accelerate platform). Any current rocket may be installed on this platform and accelerated up high speed and lifted on high altitude before started. That radically increases payload and decreases the cost of launching. The platform (force spool) and wires disconnects from the rocket after acceleration. Platform returns by parachute, the wires reel back to start.

The problems of needed electric energy become far simpler. At first, AB-Accelerator has very high efficiency and spend in 2 – 3 times less energy then a conventional railgun; the second, AB-Accelerator uses the high voltage energy same with voltage the electric stations. That means the power electric station can be directly connected to AB-Accelerator in period of acceleration without expensive transformers and condensers. The power of strong electric plant is enough for launching the rocket (space apparatus) of some hundreds of tons.

The offered magnetic space accelerator is a thousand times cheaper than the well-known cable space elevator. NASA is spending for research of space elevator hundreds of millions of dollars. A small part of this sum is enough for R&D of the magnetic accelerator and make a working model!

The proposed innovation (upper electric AB-spool) allows also solving the problem of the conventional railgun (having the projectile speed 3 -5 km/s). The current conventional railgun uses a very high ampere electric current (millions A) and low voltage. As the result the rails burn. The suggested superconductive AB-spool allows decreases the required electric current by thousands of times (simultaneously the required voltage is increased by the same factor). No rails, therefore no damage to the rails.

Small cheap magnetic prototypes would be easily tested.

The computed projects (in [4]) are not optimal. That is only illustration of an estimation method. The reader can recalculate the AB-Accelerator for his own scenarios (see also [1]-[4]).

15. Converting of Matter to Nuclear Energy by AB-Generator and Photon Rocket*

Author offers a new nuclear generator which allows to convert any matter to nuclear energy in accordance with the Einstein equation $E=mc^2$. The method is based upon tapping the energy potential of a Micro Black Hole (MBH) and the Hawking radiation created by this MBH. As is well-known, the vacuum continuously produces virtual pairs of particles and antiparticles, in particular, the photons and anti-photons. The MBH event horizon allows separating them. Anti-photons can be moved to the MBH and be annihilated; decreasing the mass of the MBH, the resulting photons leave the MBH neighborhood as Hawking radiation. The offered nuclear generator (named by author as AB-Generator) utilizes the Hawking radiation and injects the matter into MBH and keeps MBH in a stable state with near-constant mass.

The AB-Generator can produce gigantic energy outputs and should be cheaper than a conventional electric station by a factor of hundreds of times. One also may be used in aerospace as a photon rocket or as a power source for many vehicles.

Many scientists expect the Large Hadron Collider at CERN will produce one MBH every second. A technology to capture them may follow; than they may be used for the AB-Generator.

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* Presented as Paper AIAA-2009-5342 in 45 Joint Propulsion Conferences, 2–5 August, 2009, Denver, CO, USA. See also Converting of Any Matter to Nuclear Energy by-AB-Generator
http://www.scribd.com/doc/24048466/,
http://www.scipub.org/fulltext/ajeas/ajeas24683-693.pdf
Converting of any Matter to Nuclear Energy by AB-Generator and Aerospace ,
http://www.archive.org/details/ConvertingOfAnyMatterToNuclearEnergyByAb-generatorAndAerospace ,

AB-Generator of Nuclear Energy and some Innovations

Simplified explanation of MBH radiation and work of AB-Generator ([7], Fig.5). As known, the vacuum continuously produces, virtual pairs of particles and antiparticles, in particular, photons and anti-photons. In conventional space they exist only for a very short time, then annihilate and return back to nothingness. The MBH event horizon, having very strong super-gravity, allows separation of the particles and anti particles, in particular, photons and anti-photons. Part of the anti-photons move into the MBH and annihilate with photons decreasing the mass of the MBH and return back a borrow energy to vacuum. The free photons leave from the MBH neighborhood as Hawking radiation. That way the MBH converts any conventional matter to Hawking radiation which may be converted to heat or electric energy by the AB- Generator. This AB- Generator utilizes the produced Hawking radiation and injects the matter into the MBH while maintaining the MBH in stable suspended state.

Note: The photon does NOT have rest mass. Therefore a photon can leave the MBH's neighborhood (if it is located beyond the event horizon). All other particles having a rest mass and speed less than light speed *cannot* leave the Black Hole. They cannot achieve light speed because their mass at light speed equals infinity and requests infinite energy for its' escape—an impossibility.

Description of AB- Generator. The offered nuclear energy AB- Generator is shown in fig. 15-1. That includes the Micro Black Hole (MBH) 1 suspended within a spherical radiation reflector and heater 5. The MBH is supported (and controlled) at the center of sphere by a fuel (plasma, proton, electron, matter) gun 7. This AB- Generator also contains the 9 – heat engine (for example, gas, vapor turbine), 10 – electric generator, 11 – coolant (heat transfer agent), an outer electric line 12, internal electric generator (5 as antenna) with customer 14.

Work. The generator works the following way. MBH, by selective directional input of matter, is levitated in captivity and produces radiation energy 4. That radiation heats the spherical reflector-heater 5. The coolant (heat transfer agent) 11 delivers the heat to a heat machine 9 (for example, gas, vapor turbine). The heat machine rotates an electric generator 10 that produces the electricity to the outer electric line 12. Part of MBH radiation may accept by sphere 5 (as antenna) in form of electricity.

The control fuel guns inject the matter into MBH and do not allow bursting of the MBH. This action also supports the MBH in isolation, suspended from dangerous contact with conventional matter. They also control the MBH size and the energy output.

Any matter may be used as the fuel, for example, accelerated plasma, ions, protons, electrons, micro particles, etc. The MBH may be charged and rotated. In this case the MBH may has an additional suspension by control charges located at the ends of fuel guns or (in case of the rotating charged MBH) may have an additional suspension by the control electric magnets located on the ends of fuel guns or at points along the reflector-heater sphere.

Innovations, features, advantages and same research results

Some problems and solutions offered by the author include the following:

1) A practical (the MBH being obtained and levitated, details of which are beyond the scope of this paper) method and installation for converting any conventional matter to energy in accordance with Einstein's equation $E = mc^2$.

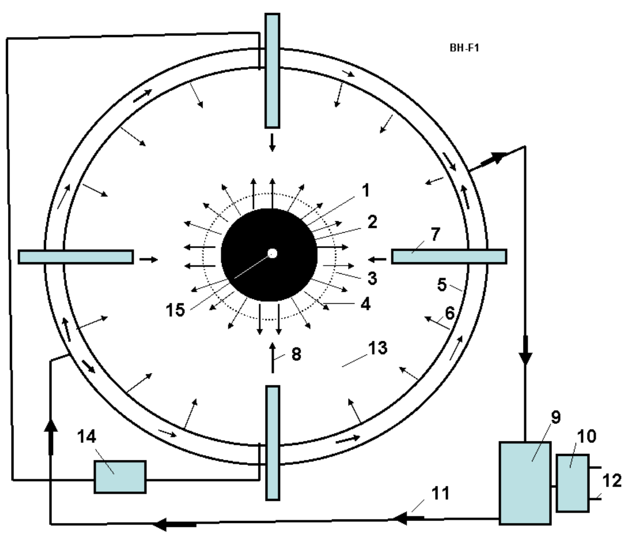

Fig. 15-1. Offered **nuclear-vacuum energy AB- Generator**. *Notations*: 1- Micro Black Hole (MBH), 2 - event horizon (Schwarzschild radius), 3 - photon sphere, 4 – black hole radiation, 5 – radiation reflector, antenna and heater (cover sphere), 6 – back (reflected) radiation from radiation reflector 5, 7 – fuel (plasma, protons, electrons, ions, matter) gun (focusing accelerator), 8 – matter injected to MBH (fuel for Micro Black hole), 9 – heat engine (for example, gas, vapor turbine), 10 – electric generator connected to heat engine 9, 11 – coolant (heat transfer agent to the heat machine 9), 12 – electric line, 13 – internal vacuum, 14 – customer of electricity from antenna 5, 15 – singularity.

2) MBHs may produce gigantic energy and this energy is in the form of dangerous gamma radiation. The author shows how this dangerous gamma radiation Doppler shifts when it moves against the MBH gravity and converts to safely tapped short radio waves.

3) The MBH of marginal mass has a tendency to explode (through quantum evaporation, very quickly radiating its mass in energy). The AB- Generator automatically injects metered amounts of matter into

the MBH and keeps the MGH in a stable state or grows the MBH to a needed size, or decreases that size, or temporarily turns off the AB- Generator (decreases the MBH to a Planck Black Hole).
4) Author shows the radiation flux exposure of AB- Generator (as result of MBH exposure) is not dangerous because the generator cover sphere has a vacuum, and the MBH gravity gradient decreases the radiation energy.
5) The MBH may be supported in a levitated (non-contact) state by generator fuel injectors.

AB-Generator as Photon Rocket

The offered AB- Generator may be used as the most efficient photon propulsion system (photon rocket). The photon rocket is the dream of all astronauts and space engineers, a unique vehicle) which would make practical interstellar travel. But a functioning photon rocket would require gigantic energy. The AB- Generator can convert any matter in energy (radiation) and gives the maximum theoretical efficiency.

The some possible photon propulsion system used the AB –Generator is shown in Fig.15-2. In simplest version (***a***) the cover of AB generator has window 3, the radiation goes out through window and produces the thrust. More complex version (***c***) has the parabolic reflector, which sends all radiation in one direction and increases the efficiency. If an insert in the AB- Generator covers the lens 6 which will focuses the radiation in a given direction, at the given point the temperature will be a billions degree (see Equation (2)) and AB-Generator may be used as a photon weapon.

The maximal thrust T of the photon engine having AB- Generator may be computed (estimated) by equation:

$$T = \dot{M}c\,, \quad \text{N}, \qquad (26)$$

For example, the AB-generator, which spends only 1 gram of matter per second, will produce a thrust 3×10^5 N or 30 tons.

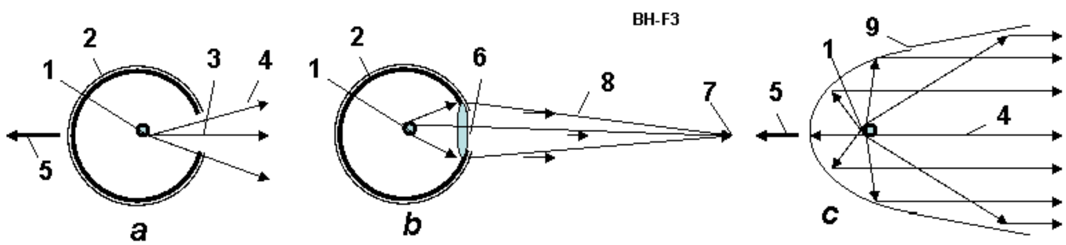

Fig. 15-2. AB-Generator as Photon Rocket and Radiation (Photon) Weapon. (***a***) AB- Generator as a Simplest Photon Rocket; (***b***) AB- Generator as focused Radiation (photon, light or laser) weapon; (***c***) Photon Rocket with Micro-Black Hole of AB-Generator. *Notations*: 1 – control MBH; 2 – spherical cover of AB-Generator; 3 – window in spherical cover; 4 – radiation of BH; 5 – thrust; 6 – lens in window of cover; 7 – aim; 8 - focused radiation; 9 – parabolic reflector.

Results:

1. Author has offered the method and installation for converting any conventional matter to energy according the Einstein's equation $E = mc^2$, where m is mass of matter, kg; $c = 3\cdot10^8$ is light speed, m/s.
2. The Micro Black Hole (MBH) is offered for this conversion.
3. Also is offered the control fuel guns and radiation reflector for explosion prevention of MBH.

4. Also is offered the control fuel guns and radiation reflector for the MBH control.
5. Also is offered the control fuel guns and radiation reflector for non-contact suspension (levitation) of the MBH.
6. For non contact levitation of MBH the author also offers:
   a) Controlled charging of MBH and of ends of the fuel guns.
   b) Control charging of rotating MBH and control of electric magnets located on the ends of the fuel guns or out of the reflector-heater sphere.
7. The author researches show the very important fact: A strong gamma radiation produced by Hawking radiation loses energy after passing through the very strong gravitational MBH field. The MBH radiation can reach the reflector-heater as the light or short-wave radio radiation. That is very important for safety of the operating crew of the AB- Generator.
8. The author researches show: The matter particles produced by the MBH cannot escape from MBH and can not influence the Hawking radiation.
9. The author researches show another very important fact: The MBH explosion (hundreds and thousands of TNT tons) in radiation form produces a small pressure on the reflector-heater (cover sphere) and does not destroys the AB-generator (in a correct design of AB-generator!). That is very important for safety of the operating crew of the AB-generator.
10. The author researches show another very important fact: the MBH cannot capture by oneself the surrounding matter and cannot automatically grow to consume the planet.
11. As the initial MBH can be used the Planck's (quantum) MBH which *may* be everywhere. The offered fuel gun may to grow them (or decrease them) to needed size or the initial MBH may be used the MBH produce Large Hadron Collider (LHC) at CERN. Some scientists assume LHC will produce one MBH every second (86,400 MBH in day). The cosmic radiation also produces about 100 MBH every year.
12. The spherical dome of MBH may convert part of the radiation energy to electricity.
13. A correct design of MBH generator does not produce the radioactive waste of environment.
14. The attempts of many astronomers find (detect) the MBH by a MBH exposure radiation will not be successful without knowing the following: The MBH radiation is small, may be detected only over a short distance, does not have specific frequency and has a variable long wavelength.

Discussing

We got our equations in assumption $\lambda/\lambda_o = r/r_o$. If $\lambda/\lambda_o = (r/r_o)^{0.5}$ or other relation, the all above equations may be easy modified.

The Hawking article was published 34 years ago (1974)[4]. After this time the hundreds of scientific works based in Hawking work appears. No facts are known which creates doubts in the possibility of Hawking radiation but it is not proven either. The Hawking radiation may not exist. The Large Hadron Collider has the main purpose to create the MBHs and detect the Hawking radiation.

Conclusion

The AB-Generator could create a revolution in many industries (electricity, car, ship, transportation, etc.). That allows designing photon rockets and flight to other star systems. The maximum possible efficiency is obtained and a full solution possible for the energy problem of humanity. These overwhelming prospects urge us to research and develop this achievement of science [4],[7].

16. Femtotechnology: the Strongest AB-Matter with Fantastic Properties and their Applications in Aerospace*

At present the term ‘nanotechnology’ is well known – in its’ ideal form, the flawless and completely controlled design of conventional molecular matter from molecules or atoms. Such a power over nature would offer routine achievement of remarkable properties in conventional matter, and creation of metamaterials where the structure not the composition brings forth new powers of matter.

But even this yet unachieved goal is not the end of material science possibilities. The author herein offers the idea of design of new forms of nuclear matter from nucleons (neutrons, protons), electrons, and other nuclear particles. He shows this new ‘AB-Matter’ has extraordinary properties (for example, tensile strength, stiffness, hardness, critical temperature, superconductivity, supertransparency, zero friction, etc.), which are up to millions of times better than corresponding properties of conventional molecular matter. He shows concepts of design for aircraft, ships, transportation, thermonuclear reactors, constructions, and so on from nuclear matter. These vehicles will have unbelievable possibilities (e.g., invisibility, ghost-like penetration through any walls and armour, protection from nuclear bomb explosions and any radiation flux, etc.)

People may think this fantasy. But fifteen years ago most people and many scientists thought – nanotechnology is fantasy. Now many groups and industrial labs, even startups, spend hundreds of millions of dollars for development of nanotechnological-range products (precise chemistry, patterned atoms, catalysts, metamaterials, etc) and we have nanotubes (a new material which does not exist in Nature!) and other achievements beginning to come out of the pipeline in prospect. Nanotubes are stronger than steel by a hundred times—surely an amazement to a 19th Century observer if he could behold them.

Nanotechnology, in near term prospect, operates with objects (molecules and atoms) having the size in nanometer (10^{-9} m). The author here outlines perhaps more distant operations with objects (nuclei) having size in the femtometer range, (10^{-15} m, millions of times less smaller than the nanometer scale). The name of this new technology is femtotechnology.

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*Femtotechnology: Design of the Strongest AB-Matter for Aerospace
http://www.archive.org/details/FemtotechnologyDesignOfTheStrongestAb-matterForAerospace or
American Journal of Engineering and Applied Science, Vol. 2, #2, 2009, pp.501-514.
http://www.scipub.org/fulltext/ajeas/ajeas22501-514.pdf

Innovations and computations

Short information about atom and nuclei. Conventional matter consists of atoms and molecules. Molecules are collection of atoms. The atom contains a nucleus with proton(s) and usually neutrons (Except for Hydrogen-1) and electrons revolve around this nucleus. Every particle may be characterized by parameters as mass, charge, spin, electric dipole, magnetic moment, etc. There are four forces active between particles: strong interaction, weak interaction, electromagnetic charge (Coulomb) force and gravitational force. The nuclear force dominates at distances up to 2 fm (femto, 1 fm = 10^{-15} m). They are hundreds of times more powerful than the charge (Coulomb force and million-millions of times more than gravitational force. Charge (Coulomb) force is effective at distances over 2 fm. Gravitational force is significant near and into big masses (astronomical objects such as planets, stars, white dwarfs, neutron stars and black holes). Strong force is so overwhelmingly powerful that it forces together the positively charged protons, which would repel one from the other and fly apart without it. The strong force is key to the relationship between protons, neutrons and electrons. They can keep electrons into or near nuclei. Scientists conventionally take into attention only of the strong force when they consider the nuclear and near nuclear size range, for the other forces on that scale are negligible by comparison for most purposes.

Strong nuclear forces are anisotropic (non spherical, force distribution not the same in all directions equally), which means that they depend on the relative orientation of the nucleus.

Typical nuclear energy (force) is presented in fig. 16-1. When it is positive the nuclear force repels the other atomic particles (protons, neutrons, electrons). When nuclear energy is negative, it attracts them up to a distance of about 2 fm. The value r_0 usually is taken as radius of nucleus. Average interaction energy between to nucleus is about 8 MeV, distance where the attractive strong nuclear force activates is at about 1 – 1.2 fm.

2. AB-Matter. In conventional matter made of atoms and molecules the nucleons (protons, neutrons) are located in the nucleus, but the electrons rotate in orbits around nucleus in distance in millions times more than diameter of nucleus. Therefore, in essence, what we think of as solid matter contains a --relatively! --'gigantic' vacuum (free space) where the matter (nuclei) occupies but a very small part of the available space. Despite this unearthly emptiness, when you compress this (normal, non-degenerate) matter the electrons located in their orbits repel atom from atom and resist any great increase of the matter's density. Thus it feels solid to the touch.

The form of matter containing and subsuming all the atom's particles into the nucleus is named *degenerate matter*. Degenerate matter found in white dwarfs, neutron stars and black holes. **Conventionally this matter in such large astronomical objects has a high temperature (as independent** particles!) and a high gravity adding a forcing, confining pressure in a very massive celestial objects. In nature, degenerate matter exists stably (as a big lump) to our knowledge only in large astronomical masses (include their surface where gravitation pressure is zero) and into big nuclei of conventional matter.

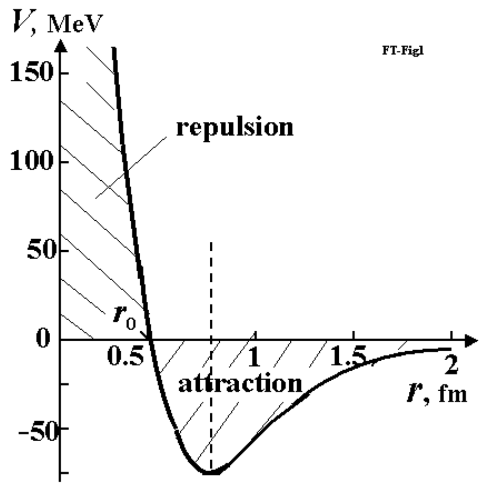

Fig. 16-1. Typical nuclear force of nucleus. When nucleon is at distance of less than 1.8 fm, it is attracted to nucleus. When nucleon is very close, it is repulsed from nucleus.
(Reference from http://www.physicum.narod.ru , Vol. 5 p. 670).

Our purpose is to design artificial small masses of synthetic degenerate matter in form of an extremely thin strong thread (fiber, filament, string), round bar (rod), tube, net (dense or non dense weave and mesh size) which can exist at Earth-normal temperatures and pressures. Note that such stabilized degenerate matter in small amounts does not exist in Nature as far as we know. Therefore I have named this matter **AB-Matter** (fig.16-2). Just as people now design by the thousands variants of artificial materials (for example, plastics) from usual matter, we soon (historically speaking) shall create many artificial, designer materials by nanotechnology (for example, nanotubes: SWNTs (amchair, zigzag, ahiral, graphen), MWNTs (fullorite, torus, nanobut), nanoribbon (plate), buckyballs (ball), fullerene). Sooner or later we may anticipate development of femtotechnology and create such AB-Matter. Some possible forms of AB-Matter are shown in fig.10. Offered technologies are шт [8]. The threads from AB-Matter are stronger by millions of times than normal materials. They can be inserted as reinforcements, into conventional materials, which serve as a matrix, and are thus strengthened by thousands of times (see computation section in [8]).

1. **Some offered technologies for producing** AB-Matter. One method of producing AB-Matter may use the technology reminiscent of computer chips ([8], fig.11). The stability and other method of production AB-matter considered in the article preparing for publication.

Various other means are under consideration for generation of AB-Matter, what is certain however that once the first small amounts have been achieved, larger and larger amounts will be produced with ever increasing ease. Consider for example, that once we have achieved the ability to make a solid AB-Matter film (a sliced plane through a solid block of AB-matter), and then developed the ability to place holes with precision through it one nucleon wide, a modified extrusion technique may produce AB-Matter strings (thin fiber), by passage of conventional matter in gas, liquid or solid state through the AB-Matter matrix (mask). This would be a ‘femto-die’ as Joseph Friedlander of Shave Shomron, Israel, has labeled it. Re-assembling these strings with perfect precision and alignment would produce more AB-matter film; leaving deliberate gaps would reproduce the ‘holes’ in the initial ‘femto-die’.

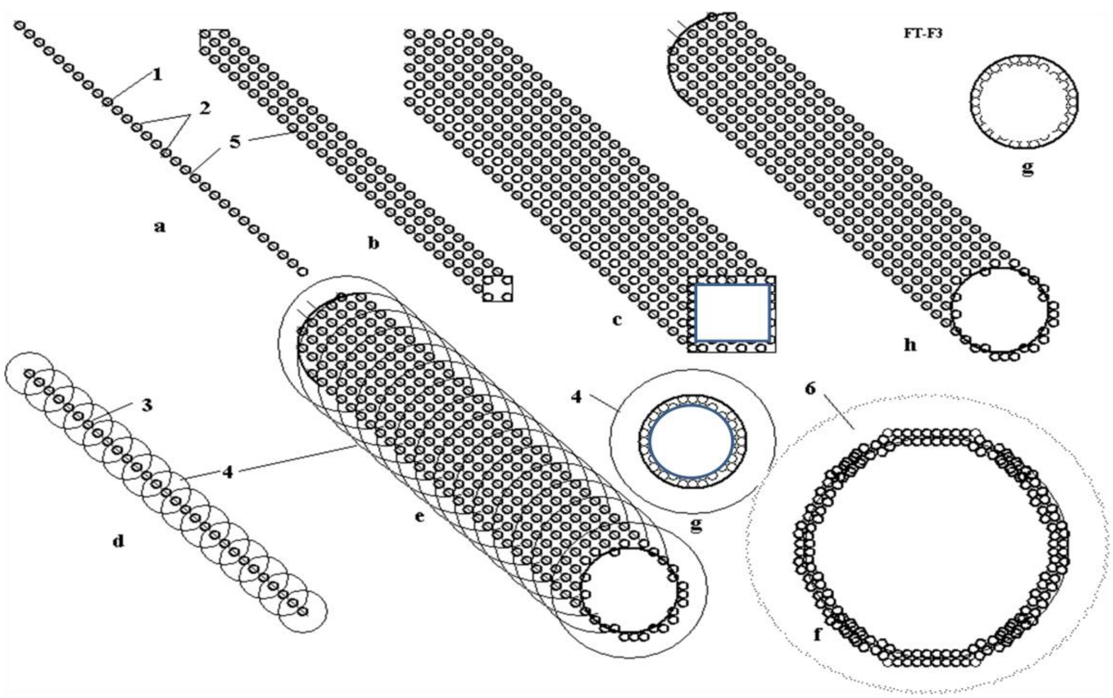

Fig. 16-2. Design of AB-Matter from nucleons (neutrons, protons, etc.) and electrons (**a**) linear one string (monofilament) (fiber, whisker, filament, thread); (**b**) ingot from four nuclear monofilaments; (**c**) multi-ingot from nuclear monofilament; (**d**) string made from protons and neutrons with electrons rotated around monofilament; (**e**)

single wall femto tube (SWFT) fiber with rotated electrons; (**f**) cross-section of multi wall femto tube (MWFT) string; (**g**) cross-section of rod; (**h**) **-** single wall femto tube (SWFT) string with electrons inserted into AB-Matter. *Notations*: 1 – nuclear string; 2 - nucleons (neutrons, protons, etc.). 3 – protons; 4 – orbit of electrons; 5 – electrons; 6 – cloud of electrons around tube.

The developing of femtotechnology is easier, in one sense, than the developing of fully controllable nanotechnology because we have only three main particles (protons, neutrons, their ready combination of nuclei $_2D$, $_3T$, $_4He$, etc., and electrons) as construction material and developed methods of their energy control, focusing and direction.

3. Using the AB-Matter (fig.16-3). The simplest use of AB-Matter is strengthening and reinforcing conventional material by AB-Matter fiber. As it is shown in the 'Computation' section [8], AB-Matter fiber is stronger (has a gigantic ultimate tensile stress) than conventional material by a factor of millions of times, can endure millions degrees of temperature, don't accept any attacking chemical reactions. We can insert (for example, by casting around the reinforcement) AB-Matter fiber (or net) into steel, aluminum, plastic and the resultant matrix of conventional material increases in strength by thousands of times—if precautions are taken that the reinforcement stays put! Because of the extreme strength disparity design tricks must be used to assure that the fibers stay 'rooted'. The matrix form of conventional artificial fiber reinforcement is used widely in current technology. This increases the tensile stress resistance of the reinforced matrix matter by typically 2 – 4 times. Engineers dream about a nanotube reinforcement of conventional matrix materials which might increase the tensile stress by 10 – 20 times, but nanotubes are very expensive and researchers cannot decrease its cost to acceptable values yet despite years of effort.

Another way is using a construct of AB-Matter as a continuous film or net (fig.16-4).

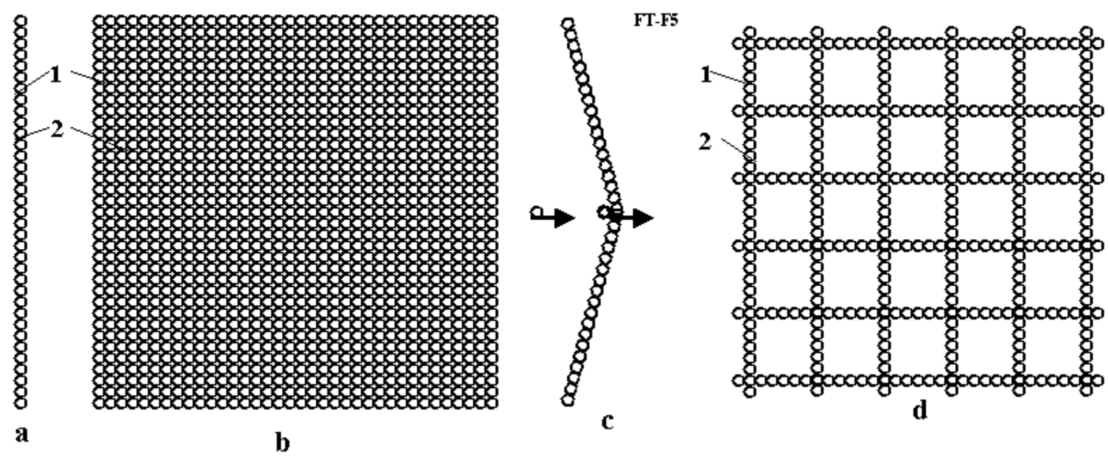

Fig. 16-3. Thin film from nuclear matter. (**a**) cross-section of a matter film from single strings (side view); (**b**) continuous film from nuclear matter; (**c**) AB film under blow from conventional molecular matter; (**d**) – net from single strings. Notations: 1 – nucleons; 2 – electrons inserted into AB-Matter; 3 – conventional atom.

These forms of AB-Matter have such miraculous properties as invisibility, superconductivity, zero friction, etc. The ultimate in camouflage, installations of a veritable Invisible World can be built from certain forms of AB-Matter with the possibility of being also interpenetable, literally allowing ghost-like passage through an apparently solid wall. Or the AB-Matter net (of different construction) can be designed as an impenetrable wall that even hugely destructive weapons cannot penetrate.

The AB-Matter film and net may be used for energy storage which can store up huge energy intensities and used also as rocket engines with gigantic impulse or weapon or absolute armor (see computation and application sections). Note that in the case of absolute armor, safeguards must be in place against buffering sudden accelerations; g-force shocks can kill even though nothing penetrates the armor!

The AB-Matter net (which can be designed to be gas-impermeable) may be used for inflatable construction of such strength and lightness as to be able to suspend the weight of a city over a vast span the width of a sea. AB-Matter may also be used for cubic or tower solid construction as it is shown in fig. 16-4.

Some Properties of AB-Matter

We spoke about the ***fantastic tensile and compressive strength, rigidity, hardness, specific strength, thermal (temperature) durability, thermal shock, and big elongation of*** AB-Matter which are more millions time then conventional matter (see [8]).

Short note about other miraculous AB-Matter properties:

1. *Zero heat/thermal capacity*. That follows because the mass of nucleons (AB-Matter string, film, net) is large in comparison with mass single atom or molecule and nucleons in AB-Matter have a very strong connection one to other. Conventional atoms and molecules cannot pass their paltry energy to AB-Matter! That would be equivalent to moving a huge dry-dock door of steel by impacting it with very light table tennis balls.

2. *Zero heat/thermal conductivity*. (See above).

3. *Absolute chemical stability*. *No corrosion, material fatigue*. *Infinity of lifetime*. All chemical reactions are acted through ORBITAL electron of atoms. The AB-Matter does not have orbital electrons (special cases will be considered later on). Nucleons cannot combine with usual atoms having electrons. In particular, the AB-Matter has *absolute corrosion resistance*. *No fatigue of material* because in conventional material fatigue is result of splits between material crystals. No crystals in AB-Matter. That means AB-Matter has lifetime equal to the lifetime of neutrons themselves. Finally a container for the universal solvent!

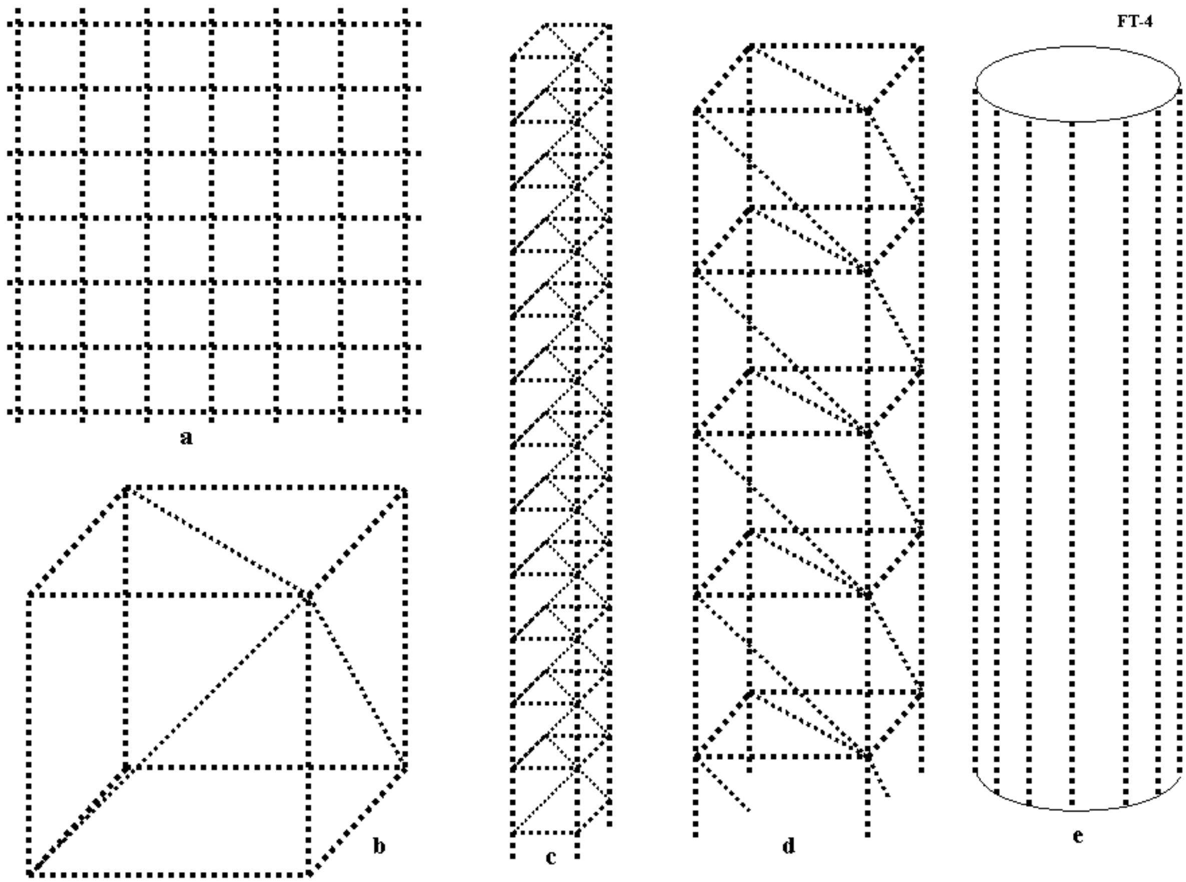

Fig.16-4. Structures from nuclear strings. (**a**) nuclear net (netting, gauze); (**b**) primary cube from matter string; (**c**) primary column from nuclear string; (**d**) large column where elements made from primary columns; (**e**) tubes from matter string or matter columns.

4. *Super-transparency, invisibility of special AB-Matter-nets.* An AB-Matter net having a step distance (mesh size) between strings or monofilaments of more than 100 fm = 10^{-13} m will pass visible light having the wave length $(400 - 800)\times10^{-9}$ m. You can make cars, aircraft, and space ships from such a permeable (for visible light) AB-Matter net and you will see a man (who is made from conventional matter) apparently sitting on nothing, traveling with high speed in atmosphere or space without visible means of support or any visible vehicle!

5. *Impenetrability for gas, liquids, and solid bodies*. When the AB-Matter net has a step size between strings of less than atomic size of 10^{-10} m, it became impenetrabile for conventional matter. Simultaneously it may be invisible for people and have gigantic strength. The AB-Matter net may –as armor--protect from gun, cannon shells and missiles.

6. *Super-impenetrability for radiation.* If the cell size of the AB-Matter net will be less than a wave length of a given radiation, the AB-Matter net does not pass this radiation. Because this cell size may be very small, AB net is perfect protection from any radiation up to soft gamma radiation (include radiation from nuclear bomb).

7. *Full reflectivity (super-reflectivity)*. If the cell size of an AB-Matter net will be less than a wavelength of a given radiation, the AB-Matter net will then fully reflect this radiation. With perfect reflection and perfect impenetrability remarkable optical systems are possible. A Fresnel like lens might also be constructible of AB-Matter.

8. *Permeable property (ghost-like intangibility power; super-passing capacity).* The AB-Matter net from single strings having mesh size between strings of more than 100 nm = 10^{-11} m will pass the atoms and molecules through itself because the diameter of the single string (2×10^{-15} m) is 100 thousand times less then diameter of atom (3×10^{-10} m). That means that specifically engineered constructions from AB-Matter can be built on the Earth, but people will not see and feel them. The power to phase through walls, vaults, and barriers has occasionally been portrayed in science fiction but here is a real life possibility of it happening.

9. *Zero friction*. If the AB-Matter net has a mesh size distance between strings equals or less to the atom (3×10^{-10} m), it has an ideal flat surface. That means the mechanical friction may be zero. It is very important for aircraft, sea ships and vehicles because about 90% of its energy they spend in friction. Such a perfect surface would be of vast value in optics, nanotech molecular assembly and prototyping, physics labs, etc.

10. *Super or quasi-super electric conductivity at any temperature*. As it is shown in previous section the AB-Matter string can have outer electrons in an arrangement similar to the electronic cloud into metal. But AB-Matter strings (threads) can be located along the direction of the electric intensity and they will not resist the electron flow. That means the electric resistance will be zero or very small.

11. *High dielectric strength* (see Equation (21) in [4] Ch.2).

AB-Matter may be used for devices to produce high magnetic intensity.

12. *Transfer pressure in long distance*. The pressure force of AB-string is very high and does NOT depend from its length (that will be shown in the next author research). That means we can penetrate into the human body without damage it from distance in hundreds kilometers, into the Earth (geological exploration), into other planets (Moon, Mars) without flight to them, keep the motion less satellites and build the Space Elevator from Earth surface.

Applications and new systems in Aerospace and aviation

The applications of the AB-Matter are encyclopedic in scope. This matter will create revolutions in many fields of human activity. We show only non-usual applications in aerospace, aviation that come to mind, and by no means all of these.

1. *Storage of gigantic energy*.

As it is shown in [3]-[7], the energy saved by flywheel equals the special mass density of material (17). As you see that is a gigantic value of stored energy because of the extreme values afforded by the strong nuclear force. Car having a pair of 1 gram counterspun fly-wheels (2 grams total) (20) charged at the factory can run all its life without benzene. Aircraft or sea ships having 100 gram (two 50 gram counterspun fly-wheels) can fly or swim all its life without additional fuel. The offered flywheel storage can has zero friction and indefinite energy storage time.

2. *New propulsion system of space ship*.

The most important characteristic of rocket engine is specific impulse (speed of gas or other material flow out from propulsion system). Let us compute the speed of a part of fly-wheel ejected from the offered rocket system

$$\frac{mV^2}{2}=E, \quad V=\sqrt{\frac{2E}{m}}=3.9\cdot10^7 \quad m/s. \qquad (1)$$

Here V is speed of nucleon, m/s; E = 12.8×10^{-13} J (1) is energy of one nucleon, J; m = $1,67\times10^{-27}$ kg is mass of one nucleon, kg. The value (1) is about 13% of light speed.

The chemical rocket engine has specific impulse about 3700 m/s. That value is 10 thousand times less.

The electric rocket system has a high specific impulse but requires a powerful compact and light source of energy. In the offered rocket engine the energy is saved in the flywheel. The current projects of a nuclear rocket are very complex, heavy, and dangerous for men (gamma and neutron radiation) and have specific impulse of thousands of times less (1). The offered AB-Matter rocket engine may be very small and produced any rocket thrust in any moment in any direction.

The offered flywheel rocket engine used the AB-matter is presented in fig.16-5a. That is flywheel made from AB-matter. It has a nozzle 3 having control of exit mass. The control allows to exit of work mass in given moment and in given position of flywheel. The flywheel rotates high speed and the exhaust mass leave the rocket engine with same speed when the nozzle is open. In result the engine has thrust 6. As exhaust mass may be used any mass: liquid (for example, water), sand, small stones and other suitable planet or space material (mass). The energy needed for engine and space ship is saved in the revolving flywheel. This energy may be received at started planet or from space ship engine.

The rocket used the suggested engine is shown in fig. 5b. That has a cabin 7, the offered propulsion system 8, undercarriage 9 and rotary mechanism 10 for turning the ship in need position.

Let us to estimate the possibility of offered rocket. Notate, the relation of the exhaust mass to AM-matter cover mass of flywheel are taken a = 10, the safety (strength) factor b = 4. About 20% of space ship is payload and construction and 80% is the exhaust mass. Then exhaust speed of throw away mass and receiving speed by space ship are:

$$V=\sqrt{\frac{k}{ab}}=2.12\cdot 10^6 \quad m/s, \quad m_s V_s = mV, \quad V_s=\frac{m}{m_s}V=\frac{0.8}{0.2}\cdot 2.12\cdot 10^6 = 8.48\cdot 10^6 \quad m/s, \quad (2)$$

where V speed of exhausted mass, m/s; $k = \sigma/d = 1.9\times 10^{14}$ (m/s)^2 is strength coefficient (16); m_s is final mass of rocket, kg; V_s = 8480 km/s is final speed of rocket, m/s; m is throw off mass, kg.

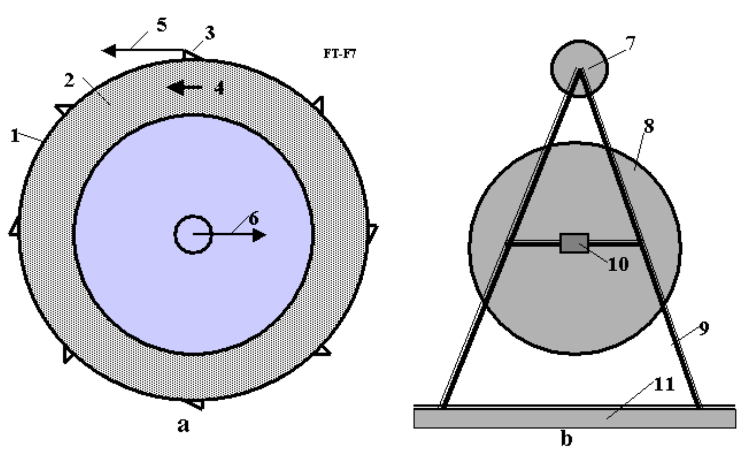

Fig. 16-5. Schema of new rocket and propulsion system. (**a**) Propulsion system from AB matter and storage energy. (**b**) Rocket with offered propulsion system.
Notations: 1 – cover (flywheel) from AB-matter; 2 – any work mass; 3 – nozzle with control of exit mass; 4 – direction of rotation; 5 – direction of exhaust mass; 6 – thrust; 7 – space ship; 8 – offered propulsion system; 9 – undercarriage; 10 – rotary mechanism; 11 – planet surface.

6. High efficiency rocket, jet and piston aviation engines.

The efficiency conventional jet and rocket engines are very limited by the temperature and safety limits of conventional matter (2000^{o}K). If we will design the rotor blades (in jet engine), combustion chamber (in rocket and piston engines) from AB-Matter, we radically improve their capacities and simplify their construction (for example, no necessary cooling system!).

7. Hypersonic aircraft.

The friction and heat which attacks conventional materials for hypersonic aircraft limits their speed. Using the AB-Matter deletes this problem. Many designs for aerospace planes could capture oxygen in flight, saving hauling oxidizer and carrying fuel alone—enabling airliner type geometries and payloads since the weight of the oxidizer and the tanks needed to hold it, and the airframe strengths required escalate the design and cascade through it until conventional materials today cannot build a single stage to orbit or antipodes aerospace plane. But that would be quite possible with AB-Matter.

8. Increasing efficiency of a conventional aviation and transport vehicles.

AB-Matter does not experience friction. The air drag in aviation is produced up 90% by air friction on aircraft surface. Using AB-Matter will make jump in flight characteristics of aircraft and other transport vehicles (including sea ships and cars).

9. Improving capabilities of all machines.

Appearance new high strength and high temperature AB-Matter will produce jump, technology revolution in machine and power industries.

10. Computer and computer memory.

The AB-Matter film allows to write in 1 cm^2 $N = 1/(4\times10^{-26}) = 2.5\times10^{25}$ 1/cm^2 bits information. The current 45 nanometer technology allows to write only $N = 2.5\times10^{14}$ 1/cm^2 bit. That means the main chip and memory of computer based in AB-Matter film may be a billion times smaller and presumably thousands of times faster (based on the lesser distance signals must travel).

The reader can imagine useful application of AB-Matter in any field he is familiar with.

11. Penetration in any body in long distance.

We can penetrate into the human body without damage it from distance in hundreds kilometers, into the interior of the Earth (geological exploration), into other planets (Moon, Mars) without flight to them, keep the motion less satellites and build the Space Elevator from Earth surface.

Discussion

1. Micro-World from AB-Matter: **An Amusing Thought-Experiment**. AB-Matter may have 10^{15} times more particles in a given volume than a single atom.. A human being, man made from conventional matter, contains about 5×10^{26} molecules. That means that 200 'femto-beings' of equal complexity from AB-Matter (having same number of components) could be located in the volume of one microbe having size 10 μ = 10^{-5} m. If this proved possible, we could not see them, they could not see us in terms of direct sensory input. Because of the wavelength of light it is questionable what they could learn of the observable macro-Universe. The implications, for transhuman scenarios, compact interstellar (microbe sized!) payloads, uploading and other such scenarios are profound. It is worth recalling that a single house and garden required to support a single conventional matter human is, for AB-Matter 'femto-beings', equivalent in relative vastness as the extended Solar system is for us. If such a future form could be created and minds 'uploaded' to it, the future theoretical population, knowledge base, and scholarly and knowledge-industries output of even a single planet so populated could rival that of a theoretical Kardashev Type III galactic civilization!

2. Stability of AB-matter.

Readers usually ask: what is the connection (proton to proton) given a new element when, after 92 protons, the connection is unstable?

Answer: That depends entirely on the type of connection. If we conventionally join the carbon atom to another carbon atom a lot of times, we then get the conventional piece of a coil. If we joint the carbon atom to another carbon atom by the indicated special methods, we then get the very strong single-wall nanotubes, graphene nano-ribbon (super-thin film), armchair, zigzag, chiral, fullerite, torus, nanobud and other forms of nano-materials. That outcome becomes possible because the atomic force (van der Waals force, named for the Dutch physicist Johannes Diderik van der Waals, 1837-1923, etc.) is NON-SPHERICAL and active in the short (one molecule) distance. The nucleon nuclear force also is NON-SPHERICAL and they may also be active about the one nucleon diameter distance (Fig. 16-1). That means we may also produce with them the strings, tubes, films, nets and other geometrical constructions.

The further studies (it will be published) are shown that AB-matter will be stability if:

1) The any sphere having radius $R \approx 6\times10^{-15}$ m in any point of structure figs. 1 – 4 must contain NOT more 238 nucleons (about 92 of them must be protons). That means any cross-section area of the solid rod, beam and so on of AB-structure (for example figs. 16-1b,c,g) must contain NOT more about 36 nucleons.

2) AB-matter must contains the proton in a certain order because the electrostatic repel forces of them give the stability of the given structure.

Conclusion

The author offers a design for a new form of nuclear matter from nucleons (neutrons, protons), electrons, and other nuclear particles. He shows that the new AB-Matter has most extraordinary properties (for example, (in varying circumstances) remarkable tensile strength, stiffness, hardness, critical temperature, superconductivity, super-transparency, ghostlike ability to pass through matter, zero friction, etc.), which are millions of times better than corresponded properties of conventional molecular matter. He shows how to design aircraft, ships, transportation, thermonuclear reactors, and constructions, and so on from this new nuclear matter. These vehicles will have correspondingly amazing possibilities (invisibility, passing through any walls and amour, protection from nuclear bombs and any radiation, etc).

People may think this fantasy. But fifteen years ago most people and many scientists thought – nanotechnology is fantasy. Now many groups and industrial labs, even startups, spend hundreds of millions of dollars for development of nanotechnological-range products (precise chemistry, patterned atoms, catalysts, metamaterials, etc) and we have nanotubes (a new material which does not exist in Nature!) and other achievements beginning to come out of the pipeline in prospect. Nanotubes are stronger than steel by a hundred times—surely an amazement to a 19th Century observer if he could behold them.

Nanotechnology, in near term prospect, operates with objects (molecules and atoms) having the size in nanometer (10^{-9} m). The author here outlines perhaps more distant operations with objects (nuclei) having size in the femtometer range, (10^{-15} m, millions of times less smaller than the nanometer scale). The name of this new technology is femtotechnology.

I want to explain the main thrust of this by analogy. Assume we live some thousands of years ago in a great river valley where there are no stones for building and only poor timber. In nature we notice that there are many types of clay (nuclei of atom—types of elemet). One man offers to people to make from clay bricks (AB-Matter) and build from these bricks a fantastic array of desirable structures too complex to make from naturally occuring mounds of mud. The bricks enable by increased precision and strength things impossible before. A new level of human civilization begins.

I call upon scientists and the technical community to to research and develop femtotechnology. I think we can reach in this field progress more quickly than in the further prospects of nanotechnology, because we have fewer (only 3) initial components (proton, neutron, electron) and interaction between them is well-known (3 main forces: strong, weak, electostatic). The different conventional atoms number about 100, most commone moleculs are tens thousands and interactions between them are very complex (e.g. Van der Waals force).

It may be however, that nano and femto technology enable each other as well, as tiny bits of AB-Matter would be marvellous tools for nanomechanical systems to wield to obtain effects unimaginable otherwise.

What time horizon might we face in this quest? The physicist Richard Feynman offeredhis idea to design artificial matter from atoms and molecules at an American Physical Society meeting at Caltech on December 29, 1959. But only in the last 15 years we have initial progress in nanotechnology. On the other hand progress is becoming swifter as more and better tools become common and as the technical community grows.

Now are in the position of trying to progress from the ancient ‘telega’ haywagon of rural Russia (in analogy, conventional matter composites) to a ‘luxury sport coupe’ (advanced tailored nanomaterials). The author suggests we have little to lose and literal worlds to gain by simultaneously researching how to leap from ‘telega’ to ‘hypersonic space plane’. (Femotech materials and technologies, enabling all the wonders outlined here).

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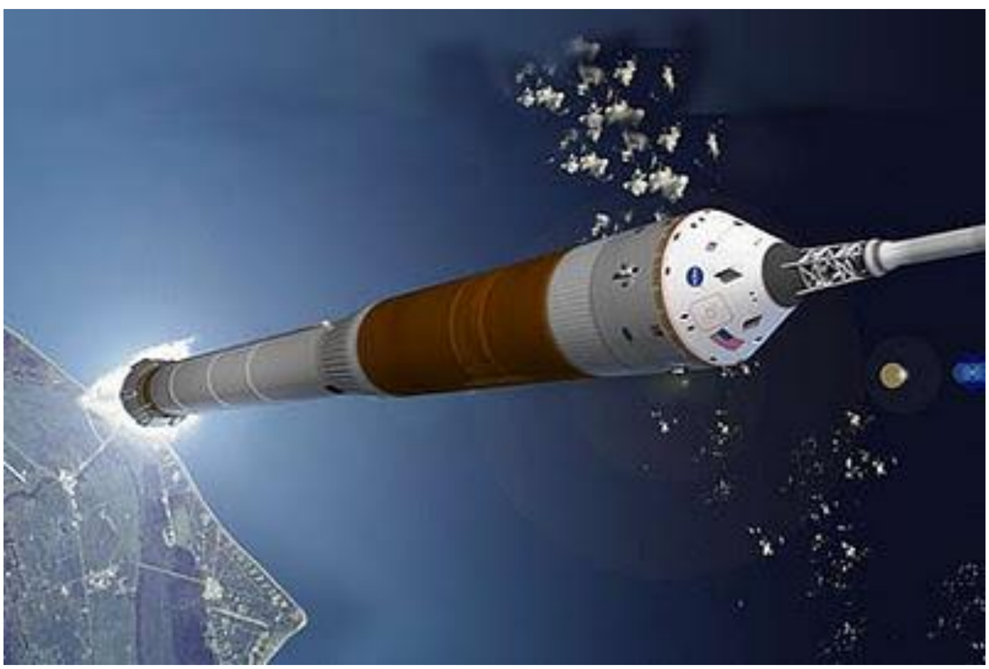
Hypersonic aircraft



Rocket Aries