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# PLANETARY MAGNETIC ENGINE
# ПЛАНЕТАРНЫЙ МАГНИТНЫЙ ДВИГАТЕЛЬ
# ПЛАНЕТАРНИЙ МАГНІТНИЙ ДВИГУН

***Summary.*** *The article provides a technology of placing cargo into orbit at middle and equatorial latitudes based on magnetic levitation in the Earth's magnetic field. A method for the implementation of Tsiolkovsky's space elevator using magnetic levitation in the Earth's magnetic field is proposed. A method for obtaining a significant acceleration in outer space, which would allow the spacecraft to reach other planets of the solar system and the nearest stars within the foreseeable future, is proposed.*

***Key words:*** *Earth electromagnetic fields, Magnetic levitation, Lorentz force, Surface charge redistribution, Placing cargo into orbit, Space elevator, Interstellar trip.*

***Аннотация.*** *В статье представлена технология вывода грузов на орбиту средних и экваториальных широт на основе магнитной левитации в магнитном поле Земли. Предложен способ реализации космического лифта Циолковского с использованием магнитной левитации в магнитном поле Земли. Предлагается метод получения значительного ускорения в космическом пространстве, который позволил бы космическому аппарату* *достичь других планет Солнечной системы и ближайших звезд в обозримом будущем.*

***Ключевые слова:*** *электромагнитные поля Земли, магнитная левитация, сила Лоренца, перераспределение поверхностного заряда, вывод груза на орбиту, космический лифт, межзвездное путешествие.*

***Анотація.*** *У статті представлена технологія виведення вантажів на орбіту середніх і екваторіальних широт на основі магнітної левітації в магнітному полі Землі. Запропоновано спосіб реалізації космічного ліфта Ціолковського з використанням магнітної левітації в магнітному полі Землі. Пропонується метод отримання значного прискорення в космічному просторі, який дозволив би космічному апарату досягти інших планет Сонячної системи і найближчих зірок в доступному для огляду майбутньому.*

***Ключові слова:*** *електромагнітні поля Землі, магнітна левітація, сила Лоренца, перерозподіл поверхневого заряду, розміщення вантажу на орбіті, космічний ліфт, міжзоряна подорож.*

The problem of space exploration is relevant in view of building an advanced technological society and the resolution of socio-demographic problems on the planet. This article proposes a method for placing cargo into orbit at middle and equatorial latitudes based on magnetic levitation in the Earth's magnetic field. It also proposes a way to obtain significant acceleration in outer space which would allow the spacecraft to reach other planets in the solar system and the nearest stars within the foreseeable future. Previously, a similar solution was given in [1; 2].

**Solution method**

According to [4], the Earth has a magnetic field with induction $3\times 10^{-5} T$ (this is an average value, it differs slightly in different places on the planet). The magnetic field lines leave the north magnetic pole and enter the south magnetic field, at the magnetic equator they are parallel to the surface of the planet.

The idea of placing cargo into orbit at middle and equatorial latitudes based on magnetic levitation in the Earth's magnetic field using the Lorentz force arises.

Let us consider the construction [*Fig. 1*]:

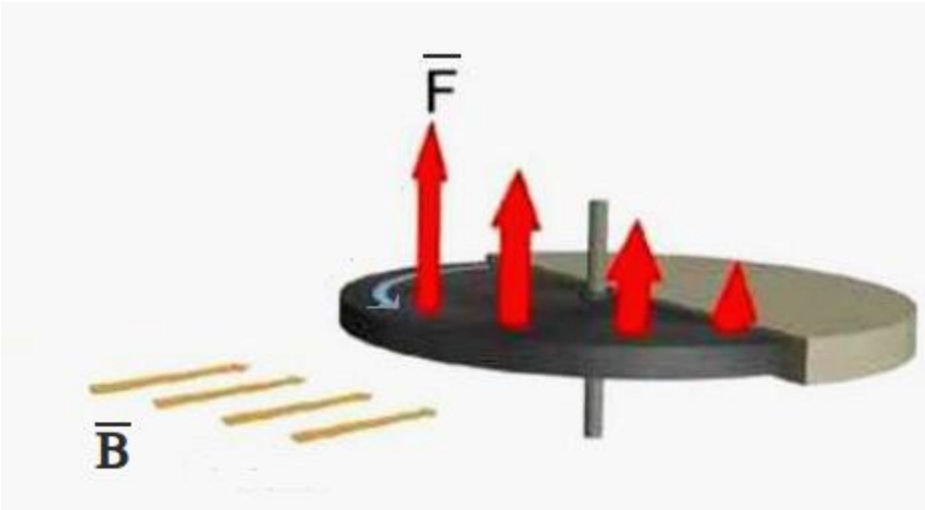


**Fig. 1.**

In *Fig. 1*: The lines of the magnetic induction vector $B$ are parallel to the surface of the planet, the rotating disk with a charge and a ferromagnetic casing on it are also parallel to the surface. The disk turns "towards us", the flat side of the casing is orthogonal to the lines of magnetic induction. Then due to the rotation of the disk we obtain a non-zero Lorentz force directed upward, which can be calculated by the formula [3]:

$$F_L = q(E + [v \times B])$$

Here: q is the total charge on the surface free of the casing, E is the electric component (let's take it conventionally equal to zero), v is the averaged speed of rotation of points on the disk surface, and $B$ is the magnetic field induction.

To stabilize the entire structure, 2 symmetrical disks with casings should be taken, as shown in *Fig. 2*:

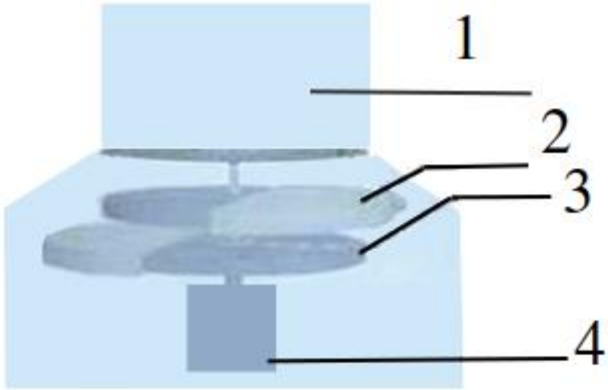


**Fig. 2.**

*Fig. 2*: 1 – cargo and/or astronaut compartment, 2, 3-rotating disks with casings, 4-engine.

Then, assuming that the mass of 2 disks with casings is 200 kilograms, the mass of the whole structure is 1,000 kilograms, rotation speed of the disks is 100 revolutions per second, diameter of the disks is 3 meters, we have the necessary charge on the surface to ensure levitation of the whole structure in the Earth's magnetic field:

$$q = \frac{mg}{[v \times B]} = \frac{10000}{100 * 3 * 3.1415 * 3 * 0.00001} Coulomb = 353688 \, Coulomb$$

And it is possible to obtain such a charge, basically. For example:

- The ionistors used in a modern uninterruptible power support system for powerful frequency converters permanently store approximately 18 MJ of energy (36 kilocoulombs);
- The battery of a car with a hybrid drive stores a charge of approximately 50 kWh (360 kilocoulombs)

By slightly increasing the charge, we obtain the lifting force, which will make it possible to place the structure into the Earth's orbit.

It should also be noted that this technology can be used for the practical implementation of Tsiolkovsky's idea of a space elevator. For example, each of the 1,000-kilogram elevator sections can be equipped with four disks with casings, as shown in Fig. 3. The total weight of the disks with the engines is 400 kilograms and another 600 kilograms will be used for the construction of the elevator itself.

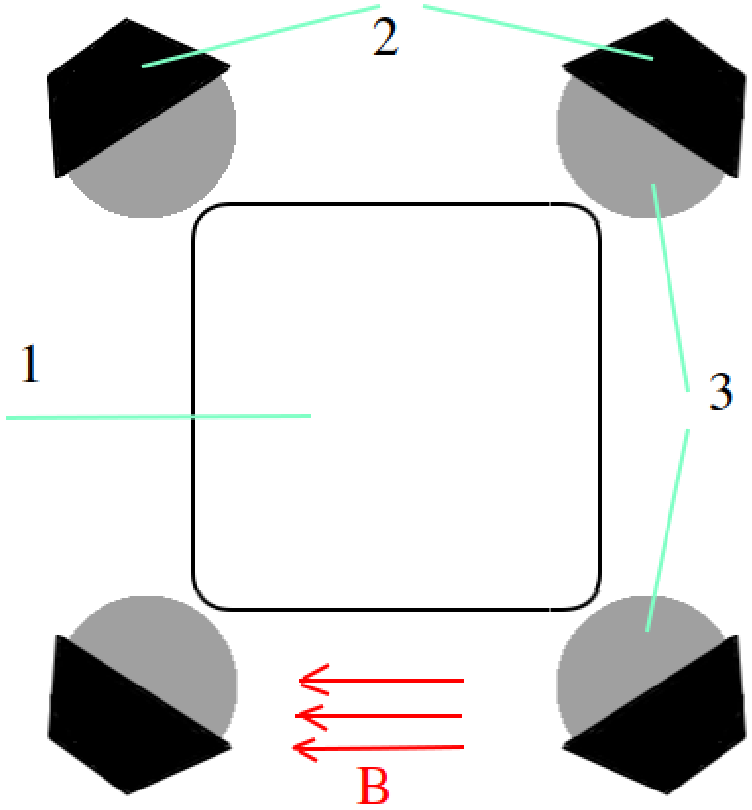


**Fig. 3.**

In *Fig. 3*: 1 - elevator shaft, 2 - casings, 3 - disks with a charge. The magnetic field induction lines are marked in red.

Consider a spaceship in outer space. As we know, the electromagnetic fields are much weaker there than on Earth. The magnetic field induction is:

$$3\times10^{-10}\,Тл$$

Consider the construction of the spaceship in Fig. 4:

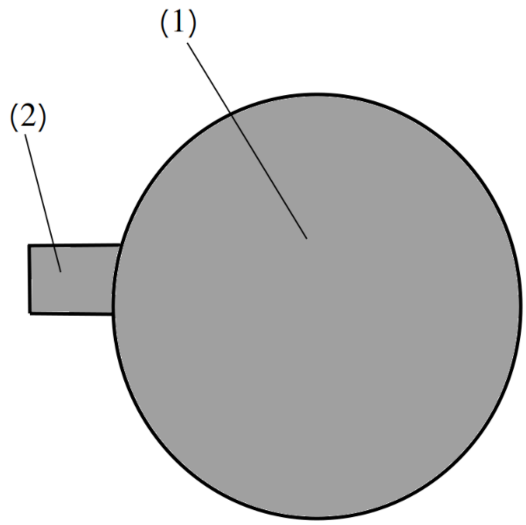


**Fig. 4.**

In this figure (1) is the compartment for the Lorentz force generating engines, (2) is the habitation module. Suppose diameter (1) is 30 meters, the mass is 500 tons, the mass (2) together with payload is 50 tons.

As we know, any galaxy has a magnetic field. The Milky Way and the Andromeda Nebula, the distance to which is 2.5 million light years, and its size is 220 thousand light years, also have it. Given the fact that, say, the diameter of the Earth is 12,742 kilometers, and the distance from the center of the planet to the boundaries of its magnetosphere is 70,000 kilometers, it can be assumed that the magnetic field of the Andromeda Nebula reaches those neighborhoods of space in which the Earth is located. This means that the magnetic field induction vector of the open space discussed above is the result of the superposition of the magnetic field induction vectors of the Andromeda Nebula and the Milky Way. And, therefore, with a certain construction of the ferromagnetic screen it is possible to obtain the Lorentz force separately for each of these two vectors

Consider the following construction:

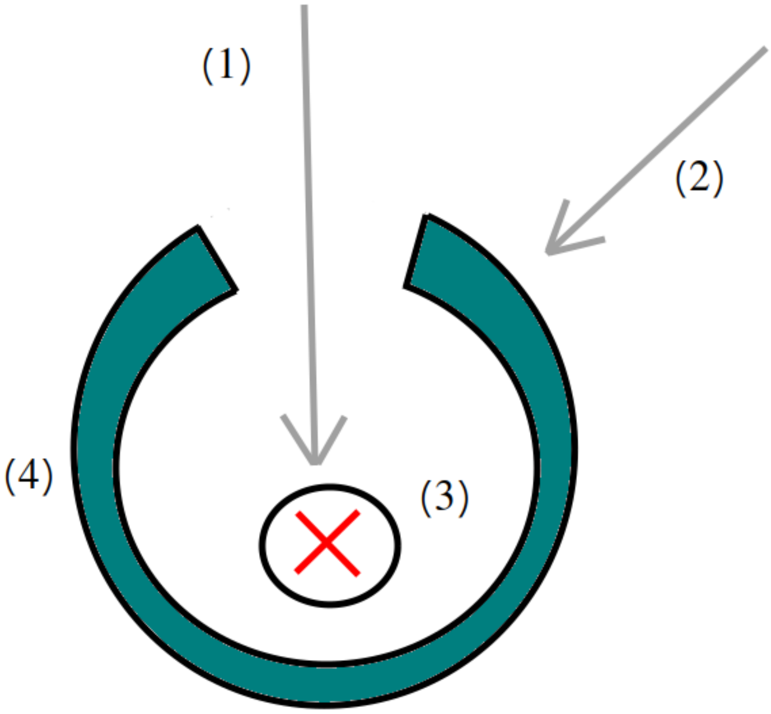


**Fig. 5.**

In Fig. 5: (1) is the magnetic field of the Milky Way with induction $B_1$ (interacts with the charged disk), (2) is the magnetic field of the Andromeda Nebula $B_2$ (does not interact with the charged disk), (3) is a charged disk in Fig. 2, (4) is a ferromagnetic screen.

Then, in this case, the Lorentz force of the magnetic field (1) does not equal zero: $F_{L1} \neq 0$, and the Lorentz force of the magnetic field (2) equals zero: $F_{L2} = 0$.

Then it is obviously possible to choose different positions of current-carrying conductors and ferromagnet holes separately for $B_1$ and separately for $B_2$, to obtain sets of vectors of Lorentz forces $F_{L1}$ and $F_{L2}$ in two non-parallel planes with different modulo values of vectors.

Then the sets of vector sums of vectors from the sets $F_{L1}$ and $F_{L2}$ will cover all space directions, which will solve the problem of obtaining acceleration in any direction in $R^3$ in space.

Similar reasoning can be applied to other galaxies nearby the Milky Way, such as the Large and Small Magellanic Clouds, which will give more than two non-parallel planes with different modulo vector values. For a complete list of nearby galaxies, see [5].

Calculate what acceleration can be obtained in open space using constructions in Fig. 2, Fig. 5. Considering that the induction of magnetic field in outer space is 5 orders less than the magnetic field induction of the Earth, it is enough to take 10 disks with total mass of 400 kilograms per each ton of spacecraft weight, rotation speed of 5,000 revolutions per second and charge of 700 kilocoulons each to get acceleration of 0.01g

$$q = \frac{mg}{[v \times B] * 10} = \frac{1000 * 0.1}{5000 * 3 * 3.1415 * 3 * 0.00001 * 0.00001 * 10} Coulomb = 707376\, Coulomb$$

Based on the article [6], a rotation speed of 1,000 revolutions per second can be achieved for a charged disk. With this rotation speed, a charge of 700 kilocoulons per disk, and 20 charged disks with a total mass of 800 kg per ton of spacecraft's weight, the acceleration will be 0.004g. It is easy to calculate that with such acceleration, taking half the way for acceleration and half the way for braking, the way to Mars will take about 27 days, to Jupiter – 120 days, to Saturn – 170 days, to Uranus – 240 days, to Neptune – just under a year, to Centauri Proxima – 64 years.

The rotation of the disks can be achieved in open space using superconductivity and electric drive technologies, which convert electrical energy into mechanical energy. In fact, it will be a nuclear plant and two converters: of nuclear energy into electrical energy and electrical energy into mechanical energy.

**Conclusions.** This article proposes a method for placing cargo into orbit at middle and equatorial latitudes based on magnetic levitation in the Earth's magnetic field. Such a way of placing into orbit could become a cheaper substitute for launch vehicles due to its technological simplicity, as well as relieve astronauts from excessive overloads. In addition, a method of obtaining significant acceleration in outer space, which will allow the spacecraft to reach other planets in the solar system and the nearest stars within the foreseeable future, is proposed.

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