Magnetic Engines For Low Orbit
Leading to Development of Deep Space Transport

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Abstract

Magnetic engines are proposed for saving energy in surface to orbit launches by interacting with the magnetic field of Earth. Difficulties are discussed with proposals for ways to overcome obstacles and mitigate risk. Stability and directional control are the main design parameters.

The components of the magnetic lifters are suitable for configuring a test of field effect propulsion, leading to the possibility of deep space transport.

Introduction

In principle a vehicle with three magnetic engines or more in a triangle pattern or other shape can be constructed to lift a stable platform into space with considerable savings for fuel and weight of launching a space vehicle. A substantial magnetic field of Earth creates the opportunity to economize on design and construction of lifting vehicles. The right hand rule applies to thrust and fields in ways that are beneficial to situations where flight path is not aligned with the local field. The types of orbits are limited by the magnetic field strength and direction.

Fundamentals of Magnetic Force and Power

Conventional science gives the relation of vector **F** force produced on an electric charge q moving in a magnetic field shown as vector **B** at velocity **v** in the vector cross product.

$$\mathbf{F} = q (\mathbf{v} \times \mathbf{B})$$

In this context the electric charge and velocity represent an electric current i moving in a wire of length vector **l**.

$$\mathbf{F} = i (\mathbf{l} \times \mathbf{B})$$

Then the force occurs on the wire which must be nonmagnetic to allow the field to pass through it. Note the cross product makes the force perpendicular to both the wire and the field.

A solenoid usually has more than one coil of wire. Force is given for a solenoid in which there are n wires.

$$\mathbf{F} = i (n) (\mathbf{l} \times \mathbf{B})$$

In practice a number of solenoids are required with variable current to make the lifting vehicle stable and controllable. The control system is complicated to compensate for strength, polarity, and direction of the magnetic field.

Field Strength and Current Required

Earth has a typical magnetic field strength of about half a gauss on the surface and in low orbit space, although it varies from place to place from 0.25 to 0.60 gauss. The dipping angle varies from ninety degrees at the magnetic poles to zero degrees at the magnetic equator, making higher latitudes more favorable for lifting vehicles.

10,000 gauss = 1 webber / square meter
Webber = 1 newton meter/amp
Gauss = 10^{-4} newton / amp meter

Example is a 100,000 Kilogram vehicle launched from mid-latitude, needing about 1,500,000 newtons of force where B is 0.5 gauss and directed such that the cross product has 50% efficiency. Suppose the current is designed for 10,000 amps and the effective length of conductor is 600 meters per turn. The number of turns required in the lifting coils is calculated.

$n = 10^5$

This design is equivalent to 10 solenoids of 10^4 turns each. The preferred shape is a short vehicle height with a long horizontal perimeter, or something like the disk shape or cigar shape of popular culture.

There are problems of balance, weight, and power supply, also materials of construction, which stretch the available technologies to the limit. Remedies are required.

First to build the coils from metal wire consumes all of the available weight and is not practical for any realistic sized vehicle. So instead of bundles of wires and cables, to save weight the solenoids may be made of ionized gas in non-magnetic metal tubes that have electrical insulation on the inside. In plasma the electrons and positive ions move in opposite directions doubling the effective current. Higher current can be contained in fewer turns of larger tubes, enough current to prevent the plasma from becoming neutralized electrically. The tube must be protected from erosion by the plasma.

It is noted that hydrogen gas is not chemically able to reduce aluminum oxide to metal, without an electrolytic process of molten metal. Aluminum oxide is an effective insulator of electricity. The ionized gas can be made from hydrogen mixed with water vapor to make plasma at lower voltage and reach chemical equilibrium with the oxidized surface, while minimizing the weight and maximizing the magnetic power. Then the aluminum tubes are insulated from the plasma by oxide and can also carry part of the current, especially during startup of the plasma generator. Now the design has about 100 aluminum tubes acting as solenoids with 10^7 amps in each tube.

How much ionized gas is needed to make so much current? Note that water is easier to ionize than hydrogen and will carry most of the current.

Amp = coulomb / second
Coulomb = $1 / (1.6 \times 10^{-19})$ electrons
Ionized water gives 2 electrons per molecule

Water Flow = $10^7 / [2 \times (1.6 \times 10^{-19}) \times (6.023 \times 10^{26})] = 0.05$ kg moles/s
Plus hydrogen flow = 1.0 kg moles/ second to keep the water vaporized.
Total flow is 0.9 kg of water per second and 2 kg of hydrogen per second in each tube.

Suppose the tube cross section area is 1250 square centimeters inside and carries 1,100 gram moles per second of cold plasma, at 2.24×10^4 cubic centimeters per gram mole. The velocity is about 196 meters per second which is acceptable for a gas. Now it appears that a smaller vehicle could be designed with less mass by using the economies and technical improvements that have been identified.

Next notice the force equations apply to solenoids that have air or vacuum in the core, which is seldom done in operational machinery. Efficiency is gained by adding metal cores like transformers have to the axis of each solenoid. The metal pole intensifies the solenoid strength by a factor of 1000. So the design becomes a variety of shapes and sizes with combination of aluminum plasma tubes and electric wires acting as electromagnets in solenoids.

By now the vehicles appears to be practical within the limits of existing technology, but also very much like descriptions of flying machines non-technical people claim to have seen in operation all over the world.

Field Effect Propulsion

The longer term objective is to test a field effect propulsion technology in space. First attempts at an engineering design look a lot like the same components of the magnetic lifter but configured differently in the electric power circuits, like two options in the same vehicle selected by switch settings.

In principle the field effect is proposed to be made from an interference pattern of magnetic fields, where the electric and magnetic vectors cancel out, but a localized stress energy curvature is induced in space. For efficiency of power consumption the curvature may be contained largely within the vehicle. Curvature is equivalent to a gravity field, and acceleration is expected to occur when the curved space region is displaced from the mass center of the vehicle.

The advantage of a localized curvature region is that it can move at less than light speed like an induced mass, giving more thrust for the same power than an electromagnetic field. Another benefit of local stress energy curvature is that the crew and the vehicle are in continual free fall like a gravity field such that the components and the people do not feel any acceleration, even if the vehicle starts and stops abruptly, changes speed, or turns sharp corners.

The future of space exploration appears to be connected to the magnetic lifters, and the field effect vehicles that logically follow from them. In principle the field effect vehicles could reach nearby stars in a life time for the crew.

Conclusions

A magnetic lifting vehicle can probably be built to reach low orbit with existing science and engineering technologies.

The same components used in the magnetic lifter are suitable for testing theories of field effect thrust.

Deep space transport appears to be within the capability of field effect propulsion.