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SPACE POWER SYMPOSIUM (C3)
Advanced Space Power Technologies and Concepts (3)

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THERMOMAGNETIC ENGINE (TME)

Abstract

Presently, humankind is forced to look for alternative sources of energy because of the limited amounts of hydrocarbon fuels and increasing environmental pollution. This study is devoted to one of the possible ways of using alternative energy sources based on an energy device (ED). This ED differs from traditional ones in that it utilizes low-potential thermal energy at temperatures compatible with our environment which has a number of advantages and applications in several fields including astronautics. The operating principle of this ED is based on the periodic magnetization and demagnetization of ferromagnets which possess strong temperature dependence near the magnetic phase transition in an external magnetic field. To overcome several problems related to designing the engine questions relating to various fields of physics (magnetostatics, hydrodynamics, thermal physics, hydraulics, aerodynamics, etc.) must be answered. Practical implementation of TME requires preliminary work with regards to the search for solutions of the engine taking into consideration the several variables. The following areas require optimization: the value of magnetic induction at the entrance of the magnetic system, the length of the magnetic field and gradient magnitude as well as the temperature of heating and cooling of the ferromagnet, the mass of the ferromagnetic element, the mass of the working assembly from these elements and the total mass of the rotor. Hence, it is necessary to pick up the linear dimensions of the active element in an optimal way, set its shape and relief, determine the thermal and magnetic parameters, and then all of these must agree with the characteristics of magnetic system. The heat exchange system and its casing must provide a quick input of thermal energy along with subsequent withdrawal of same for optimum thermodynamic cycle. Finally, it is necessary to allow opportunities for experimental verification with the aim of carrying out all of the required tests. All of these can be modeled and calculated using modern computers equipped with the proper software. Simulation helps to provide a relatively quick set of calculations, first in a two-dimensional format and then in three-dimensions to correctly identify the objectives of the research and to obtain the most optimal variants. Here we present the calculations of magnetic induction distribution dependence on the geometrical characteristics of a magnetic system and transient thermal analysis of the heating and cooling of working blades. All calculations described above were performed by FEM using the ANSYS software package.