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(54) **ELECTROMAGNETIC FIELD GENERATOR AND METHOD TO GENERATE AN ELECTROMAGNETIC FIELD**

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(57) **ABSTRACT**

The electromagnetic field generator includes a shell, an electrostatic generator, a power plant, a thermoelectric generator, and an electric motor. The shell has embedded polycrystalline ferroelectric ceramic material which is polarized such that the ceramic material exhibits strong Piezoelectric Effect properties thus inducing high frequency vibrations. The shell may be further doped with radioactive elements which under high frequency vibrations induce gamma ray emission. The electrostatic generator is for charging up the shell and is disposed within the shell. The power plant is to generate thermal power, and is disposed within the sphere. The thermoelectric generator is to convert the thermal power generated by the power plant to electrical energy. The electric motor powered by the electrical energy generated by the thermoelectric generator, and supplies input voltage such that the shell spins at high angular speeds, vibrates at high frequencies, and generates an electromagnetic field.
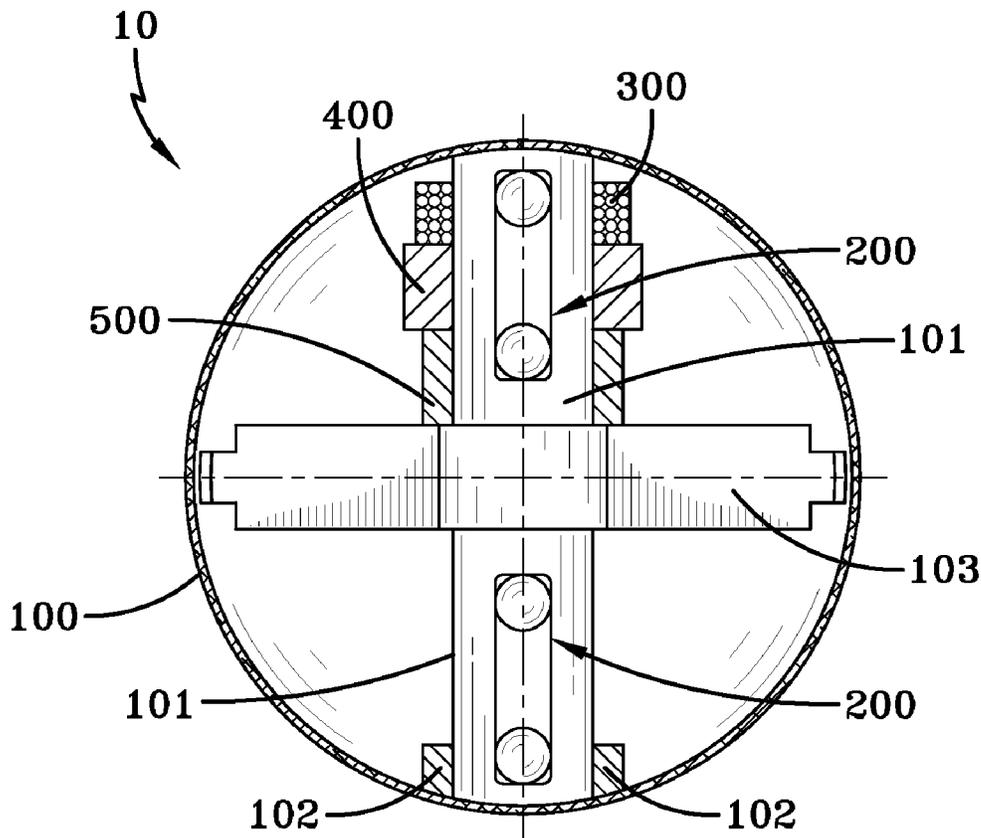
10

400

300

500

200

101

100

101

200

102

102

103

FIG-1

10

103

100

102

200

103

101

FIG-2

10

105

125

200

500   500

400   400

300

FIG-3

10

200

125

110

500   500

400   400

300

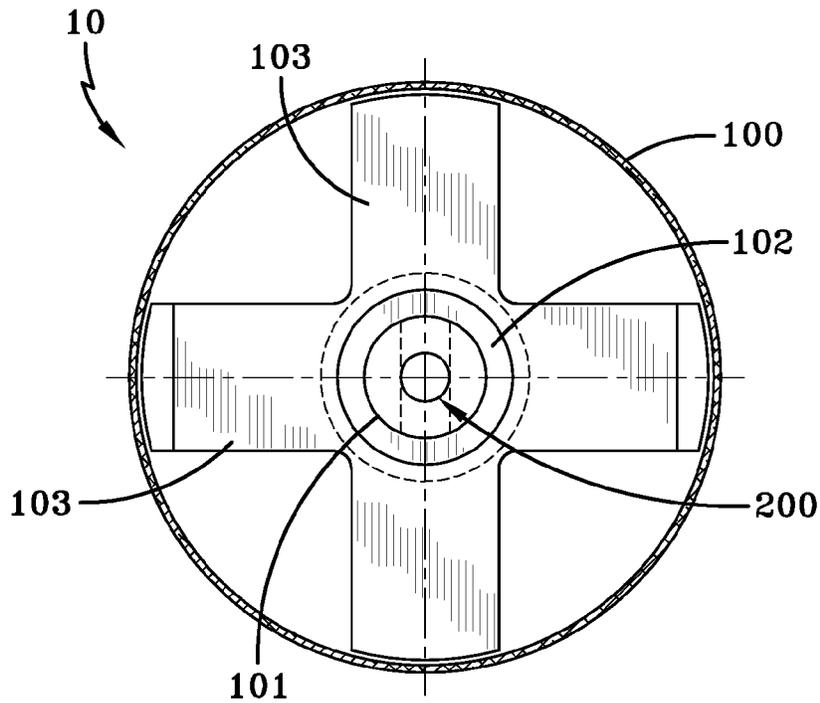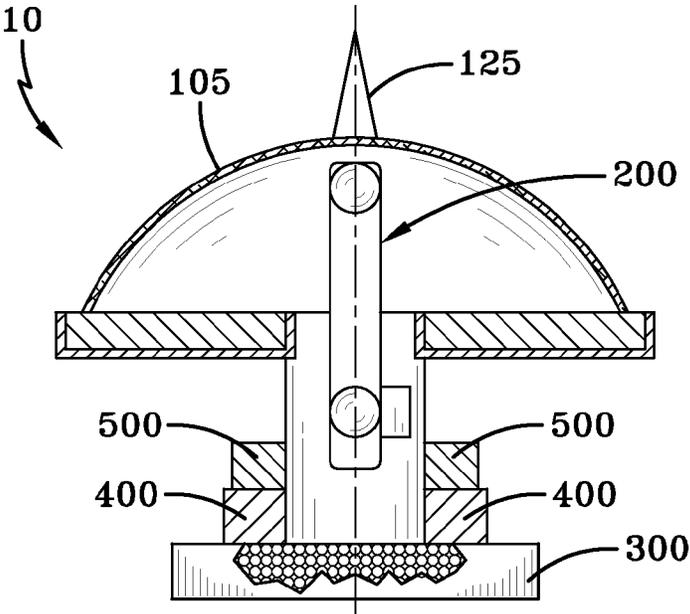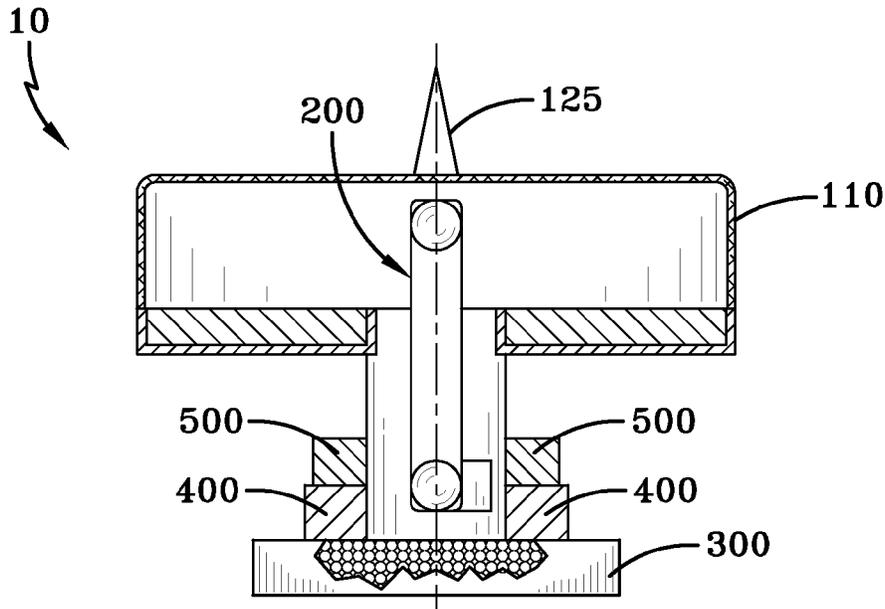**FIG-4**

ELECTROMAGNETIC FIELD GENERATOR AND METHOD TO GENERATE AN ELECTROMAGNETIC FIELD

STATEMENT OF GOVERNMENT INTEREST

[0001] The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without payment of any royalties thereon or therefor.

BACKGROUND

[0002] To date there are more than 100,000 potentially dangerous asteroids (Near Earth Objects) which cross the earth's orbit, with only 11,000 having been cataloged and currently tracked. Earth will be impacted again and again; it is only a matter of time and circumstance. Therefore, there is a need for an effective method to deflect or destroy these potentially dangerous asteroids.

[0003] Currently, several methods of asteroid deflection have been suggested. They include an electrostatic tractor, which utilizes two continuous voltage sources (20 kV each) placed on both a spacecraft and the asteroid itself (one source to each), and would use the produced electrostatic fields to either slowly attract or repel the asteroid, and a gravity tractor which would park a spacecraft close enough to the asteroid so that the gravitational attraction would in time affect its trajectory. Other methods suggested include possibly utilizing the earth's magnetic field (electrodynamic tethers) with an electrostatic tractor for further deflection capability, or shooting white paint pellets at the asteroid making it pale enough to couple with the solar radiation in a high reflectivity/photonic momentum 'push' mode. The kinetic method of deflection has also been suggested. This deflection method would propel a sizeable craft into a tangential trajectory to the asteroid, impacting it with a 10 km/s relative velocity (thus adding to its angular momentum and creating a deflecting spin). Thermonuclear warheads may also be used to destroy the incoming asteroid, which may, however, result in fragmentation and thermonuclear pollution.

[0004] The techniques described above would only affect "small" asteroids, on the average diameter levels of approximately 100 meters. Also, these deflection methods would need a great deal of time to affect the desired outcomes (10 to 20 years have been suggested), with the exception of the kinetic method, which has issues in accuracy of targeting and subsequent impact effectiveness.

[0005] There are four known fundamental forces which control matter and therefore control energy, namely strong nuclear force, weak nuclear force, electromagnetic force, and gravitational force. In this hierarchy of forces, the electromagnetic force is perfectly positioned to be able to manipulate the other three. A stationary electric charge gives rise to an electric (electrostatic) field, while a moving charge generates both an electric and a magnetic field (hence the electromagnetic field). Additionally, an accelerating charge induces electromagnetic radiation in the form of transverse waves, namely light. Mathematically, as well as physically, electromagnetic field intensity can be represented as the product of electric field strength and magnetic field strength. Electromagnetic fields act as carriers for both energy and momentum, thus interacting with physical entities at the most fundamental level (in this manner addressing the feasibility of countering the Earth-bound Asteroid Threat).

[0006] Artificially generated high energy electromagnetic fields interact strongly with the Vacuum Energy Field (an aggregate state composed of the superposition of all quantum fields' fluctuations permeating the fabric of Spacetime), thereby giving rise to Emergent Physical Phenomena (in other words revolutionary physics), such as Force and Matter Fields Unification. According to Quantum Field Theory, this strong interaction between the fields is based on the mechanism of transfer of vibrational energy between the fields, further inducing local fluctuations in adjacent quantum fields which permeate Spacetime (these fields may or may not be electromagnetic in nature).

[0007] Everything that surrounds us, ourselves included, can be described as macroscopic collections of fluctuations, vibrations, and/or oscillations in quantum mechanical fields. Therefore, under certain conditions (such as the coupling of hyper-frequency axial spin with hyper-frequency vibrations of electrically charged systems) the rules and special effects of quantum field behavior also apply to macroscopic physical entities. Along this line of thought, lightning can be explained as a Macroscopic Quantum Phenomenon which arises due to millions of ice particle collisions within storm clouds (thus giving rise to a sizeable electric charge), which generate electromagnetic fields locally interacting with the Vacuum Energy Field. Thus, the physics of lightning can be explained by extremely strong interactions between classical electromagnetic fields (storm clouds exhibiting 100 MV voltages and rapid air currents) and the quantum fields' superposition-induced Vacuum Energy Field.

[0008] Moreover, simultaneous coupling of hyper-frequency gyrational (axial rotation) and hyper-frequency vibrational electrodynamics (as used in the inventive concept herein disclosed) is conducive to a possible physical breakthrough (Force and Matter Fields Unification is feasible with the concept at hand) in the utilization of the Quantum Vacuum Plasma (part of the Vacuum Energy Field) as an energy source (or sink), an induced physical phenomenon, for which the technology readiness level has been considerably advanced by a team of research engineers from NASA JSC. Their research involves the use of high Radio frequency/Microwave driven resonant cavity Q-thruster technology within the context of Quantum Vacuum Plasma physics.

SUMMARY

[0009] The present invention is directed to an electromagnetic field generator and a method to generate an electromagnetic field with the needs enumerated above and below.

[0010] The present invention is directed to an electromagnetic field generator which includes a shell, an electrostatic generator, a power plant, a thermoelectric generator, and an electric motor. The shell has embedded polycrystalline ferroelectric ceramic material, which is polarized such that the ceramic material exhibits strong Piezoelectric Effect properties thus inducing high frequency vibrations. The electrostatic generator is for charging up the shell and is disposed within the shell. The power plant is to generate thermal power, and is disposed within the shell. The thermoelectric generator is to convert the thermal power generated by the power plant to electrical energy. The electric motor is powered by the electrical energy generated by the thermoelectric generator, and supplies input voltage such that the

shell spins at high angular speeds, vibrates at high frequencies, and generates an electromagnetic field.

[0011] It is a feature of the present invention to provide a method and apparatus for deflecting or destroying a large asteroid and preventing a possible collision with earth. The present invention may also deflect or destroy any other type of object.

[0012] It is a feature of the present invention to provide a method and apparatus for generating an impenetrable defensive shield to Sea and Land as well as Space-based military and civilian assets, protecting these assets from such threats as Anti-Ship Ballistic Missiles, Radar Evading Cruise Missiles, Top Attack for Main Battle Tanks (land and sea based systems), as well as counteracting the effects of solar-induced Coronal Mass Ejections or defending critical military satellites in an ASAT role (space based system). Furthermore, the design of energy generation machinery with power output levels much higher than those currently achievable by conventional means, is made possible with this invention.

DRAWINGS

[0013] These and other features, aspects and advantages of the present invention will become better understood with reference to the following description and appended claims, and accompanying drawings wherein

[0014] FIG. 1 is a cross-sectional side view of an electromagnetic field generator utilizing a spherical shell;

[0015] FIG. 2 is a cross-sectional bottom view of an electromagnetic field generator utilizing a spherical shell;

[0016] FIG. 3 is a cross-sectional side view of an electromagnetic field generator utilizing a hemispherical shell; and,

[0017] FIG. 4 is a cross-sectional side view of an electromagnetic field generator utilizing a disc shell.

DESCRIPTION

[0018] The preferred embodiments of the present invention are illustrated by way of example below and in FIGS. 1-4. The high energy electromagnetic field generator 10 includes a shell 100, an electrostatic generator 200, a nuclear pebble bed reactor 300 (a power plant), a thermoelectric generator 400, and an electric motor 500. The shell 100 has embedded polycrystalline ferroelectric ceramic material which is polarized such that the ceramic material exhibits strong Piezoelectric Effect properties thus inducing high frequency vibrations. It is important to decouple the shell's Piezoelectric vibrational frequency from any natural resonant frequency of the system's structural framework, which may cause diminution of structural integrity and possibly lead to destruction of the system. The electrostatic generator 200 is for charging up the shell 100 and is disposed within the shell 100. The nuclear fission pebble bed reactor 300 is to generate thermal power, and is disposed within the shell 100. The thermoelectric generator 400 is to convert the thermal power generated by the nuclear fission pebble bed reactor 300 to electrical energy. The electric motor 500 is powered by the electrical energy generated by the thermoelectric generator 400, and supplies input voltage such that the shell 100 spins at high angular speeds, vibrates at high frequencies, and generates an electromagnetic field.

[0019] In the description of the present invention, the invention will be discussed in a space, sea, or terrestrial environment; however, this invention can be utilized for any type of application that requires use of electromagnetic field generator.

[0020] The shell 100 may be spherical, hemispherical, or a disc. The spherical shell 100, shown in FIGS. 1 and 2, may be used when utilizing the apparatus in space (space based system). The hemispherical shell 105, shown in FIG. 3, may be utilized at sea (sea based system), while the disc shell 110, shown in FIG. 4, may be utilized on land (terrestrial system). As shown in FIGS. 1 and 2, in the space based system, the nuclear pebble bed reactor 300, the thermoelectric generator 400, and the electric motor 500 have an annular configuration.

[0021] Extremely high electromagnetic field intensity (rate of energy flow per unit area) values of 10^{24} Watts/m^2 (and higher) can be generated with the inventive concept at hand. Furthermore, using a specially engineered geometrical configuration (a sharp end protrusion 125 out of the shell) in conjunction with the terrestrial (land) or sea based systems, by coupling the Piezoelectric Effect with the Mossbauer Effect (the recoilless emission of gamma rays due to high frequency oscillations/vibrations of the shell), it is possible to generate a Cyclonic Plasma shield, which would greatly amplify the produced electromagnetic field intensity (hence the shielding effects).

[0022] The shell 100, 105, 110 may further include embedded radioactive elements, such that high frequency vibrations generate high energy gamma rays. The shell 100, 105, 110 may be fabricated from epoxy-ceramic composite embedded within an aluminum matrix. Embedded within the shell 100, 105, 110 are crystal modules that are made from polycrystalline ferroelectric ceramic material. In the preferred embodiment, the ceramic material is lead zirconate titanate (PZT) which has been polarized. In operation, voltage from the electric motor 500 is applied to the PZT crystal modules, which generates mechanical vibrations of the shell, further inducing an output voltage at the natural resonant frequency of the crystal modules. For optimal results, the inside of the shell is pressurized to about 20 bar with dry and purified sulfur hexafluoride or mixtures of nitrogen and carbon dioxide.

[0023] As shown in FIG. 1, in the spherical shell embodiment or space based configuration of the invention, all the elements of the electromagnetic field generator 10 may be housed or disposed within the shell 100. As a result, the elements of the electromagnetic field generator 10 with a spherical shell 100 do not exhibit or are affected by the electrostatic field which is built up on the shell surface due to the high voltage electrical charging. Therefore, the entire electromagnetic energy flux density is directed outward of the shell 100, for maximum EM linear momentum density-driven deflection of an object, such as, but without limitation, an earth bound asteroid or any type of incoming object or projectile.

[0024] As shown in FIGS. 1 and 2, the spherical shell embodiment may also include a support structure 101 to mount all the elements within the spherical sphere 100. The support structure 101 may be coupled using low friction bearings 102 so that the support structure 101 along with all the elements within the spherical sphere 100 can rotate within the spherical sphere 100. The electric motor 500 imparts mechanical power via its drive shaft to a cruciform strut framework 103, which is directly attached to the inside of the spherical shell 100. Since the spherical shell 100

exhibits a high electrical charge, in the preferred embodiment, the strut framework **103** is made out of non-electrically conducting material which possesses high yield strength, such as a tightly packed network of grapheme and carbon nanotubes or carbon reinforced graphite epoxy composite. However, any type of material that is practicable can be utilized. Additive manufacturing techniques may be used for fabricating this structure.

[0025] In another embodiment of the invention, the ceramic-aluminum composite material of the spherical shell **100** may be doped with radioactive elements, such as, but without limitation, Cobalt-57, Iron-57, or any other radioactive metal element that is practicable. High frequency vibrations of the shell will consequently induce the Mossbauer Effect, namely the recoilless emission of gamma rays. This embodiment may also be used with the hemispherical shell **105** and the disc shell **110**.

[0026] The spherical shell embodiment or space based configuration of the invention may also include an auxiliary propulsion unit (not shown) for guiding the apparatus to the region of perceived threat. The auxiliary propulsion unit may be chemical, nuclear based, or any type of propulsion unit practicable. The auxiliary propulsion unit may be housed or enclosed in a Faraday-type cage. Since there is no counter-torque mechanism provided for the spinning shell, the apparatus will experience a curvilinear translation (displacement due to conservation of angular momentum) similar to a spinning top. The auxiliary propulsion unit can take advantage of this motion in executing maneuvers. In another embodiment (not shown), it is also possible to eliminate the system's displacement from a fixed point in space, by having the spherical shell **100** be two counter-rotating hemispherical shells.

[0027] As shown in FIGS. **3** and **4**, in the preferred embodiments as described earlier, both the hemispherical shell **105** and the disc shell **110** may have a sharp point protrusion or spike **125** extending from the shell **105, 110**. In operation, in the immediate area of the protrusion or spike **125**, the air is subjected to a great deal of electrostatic stress, which then ionizes the air. The electromagnetic fields that are generated by the apparatus **10** then accelerate the ionized air, thus inducing corona (electric, ionic) winds, which are further augmented by the entrainment of neutral air around the ionized region. The ionized air and neutral air are mixed, and the mixed air starts to rotate resulting in a cyclonic plasma, which creates an additional shield for the shell **105, 110**. For the land and sea based systems the nuclear power plant may be replaced with a gas turbine engine. However, in all the embodiments of the current invention, any type of power plant practicable can be utilized.

[0028] The preferred electrostatic generator(s) **200** is a Pelletron type, and may be a modified Van de Graaff generator. In a Pelletron generator, the charging belt is replaced with a chain made of metal pellets or plates connected by insulating links, whereby the metal plates are charged using the effect of influence in an electrical field.

[0029] Quantum Vacuum Plasma (QVP) is the electric glue of our plasma Universe. The Casimir Effect, the Lamb Shift, and Spontaneous Emission, are specific confirmations of the existence of QVP. It is important to note that in region(s) where the apparatus-generated electromagnetic fields are strongest, the interactions with the QVP are more potent, therefore, the higher the induced energy density of the QVP particles which spring into existence (the Dirac Sea

of electrons and positrons). These QVP particles form an additional defensive layer around the system, thus augmenting the shielding effects (even though they are short-lived, these "virtual" particles have a real effect). In operation, the high energy electromagnetic fields, created by the system, interact strongly with the Vacuum Energy Field (the aggregate state of all quantum fields' fluctuations superposition), and locally disrupt Spacetime. Contributions to the Vacuum Energy Density are made by the Quantum Vacuum-Zero Point Fluctuations, the Quantum Chromo-Dynamics gluon and quark condensates, and the newly discovered Higgs Field (exhibiting massive 126 GeV particles), among other yet undiscovered fields (arising from Super-Symmetry).

[0030] The primary physical equation which describes the maximum intensity achieved by the system is described by the magnitude of the Poynting vector, and in relativistic form (derived using relativistic electrodynamics/electromagnetic field theory) can be written as

$$S_{max} = f_G \gamma^2 (\sigma^2/\epsilon_0)[R_r\omega + R_v v + v_R] \quad \text{(Equation 1)}$$

where f_G is the geometric shape factor (equal to $\frac{2}{3}$ for spherical shell, $\frac{1}{6}$ for hemispherical shell and 1 for disc), γ is the relativistic 'stretch' factor 'gamma,' σ is the surface charge density, (total charge divided by surface area), ϵ_0 is the electrical permittivity of free space, R_r is the radius of rotation, ω is the angular frequency of rotation in rads/s, R_v is the vibration (harmonic oscillation) amplitude, v is the angular frequency of vibration in Hertz, and the term v_R is the curvilinear translation speed (acquired via a propulsive unit attached to the system, or by the system itself if not equipped with a counter-torque mechanism, similar to the curvilinear motion of a spinning top). Therefore, for example, and without limitation, if we consider only rotation, given a spherical shell configuration, with σ=50,000 Coulombs/m^2, a spherical shell (spinning/axially rotating) radius of 2 m and an angular speed of 30,000 RPM, we can generate an electromagnetic (EM) field intensity (S_{max}=rate of energy flow per unit area) value of 10^{24} Watts/m^2 (this value does not account for any QVP interactions which would amplify it). Furthermore, if we simultaneously couple the high frequency of rotation with high vibration (abrupt pulsations/harmonic oscillations) frequencies in the range of 10^9 to 10^{18} Hertz (and above) we can obtain S_{max} intensity values in the range 10^{24} to 10^{28} Watts/m^2 (and beyond). These extremely high electromagnetic field intensity values emphasize the novelty of this concept, especially suited for deflection of Earth-bound asteroids.

[0031] For the case of an accelerating angular frequency of vibration (a_{max}=$R_v v^2$), neglecting rotation and curvilinear translation, Equation 1 becomes (note the intrinsic significance of angular vibration acceleration):

$$S_{max} = f_G \gamma^2 (\sigma^2/\epsilon_0)[(R_v v^2)t_{op}] \quad \text{(Equation 2)}$$

where t_{op} is the operational time for which the charged electrical system is accelerating. Strong local interaction with the high energetics of the Quantum Vacuum fields' fluctuations superposition (macroscopic Vacuum Energy state) is possible in a laboratory environment, by application of high frequency gyration and/or high frequency vibration of minimally charged objects (of unit order), in an acceleration mode. In this manner, a high degree of Vacuum Energy polarization can be achieved.

[0032] Force and Matter Fields Unification is feasible with the invention at hand, due to the extremely strong interactions (electromagnetic in nature) between ordinary matter

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and the Quantum Vacuum Plasma/Vacuum Energy Field (interactions which exhibit extremely high energies on Planck length scales in the immediate proximity of the shell surface). These interactions are induced by the simultaneous coupling of hyper-frequency of axial rotation (spin) and hyper-frequency of vibration (harmonic oscillations/pulsations) of electrically charged systems.

[0033] Up to this point in time, the method of choice to protect Earth from an impact or air-burst meteor event is a kinetic impactor. In the case of Apophis (a potentially dangerous known asteroid), consider its mass (M_A) on the order of 10^{10} kg, while the mass of the envisioned spacecraft (M_{KI}) which acts as kinetic impactor is on the order of 10^3 kg. From conservation of linear momentum we can write:

$$(M_A+M_{KI})\Delta v=k(M_{KI})(u_{KI}) \qquad \text{(Equation 3)}$$

where Δv is the deflection speed of the asteroid once the impactor spacecraft collides with it, while u_{KI} is the relative speed of the kinetic impactor with respect to the asteroid; and k is the impact coefficient (which is taken as 1, namely 100% impact effectiveness is considered). Using the nominal value for u_{KI} of 10 km/s, the deflection speed is calculated as 0.001 m/s. In case of the high energy EM field-generating system, the right hand side of Equation 3 becomes $[(S_{max}/c^2)Vol_S]$, where c is the speed of light in free space, therefore, using an S_{max} value of 10^{24} W/m^2 (readily achievable, as previously shown) and a system volume (Vol$_S$) of 10^3 m^3, the deflection speed becomes 1 m/s, a three orders of magnitude improvement.

[0034] The method for generating a ultrahigh intensity electromagnetic field includes charging a shell with embedded polycrystalline ferroelectric ceramic material such that the material has strong Piezoelectric Effect properties thus inducing high frequency vibrations, generating thermal power, converting the thermal power to electrical energy, and spinning the charged shell via the electrical energy such that an electromagnetic field is generated.

[0035] When introducing elements of the present invention or the preferred embodiment(s) thereof, the articles "a," "an," "the," and "said" are intended to mean there are one or more of the elements. The terms "comprising," "including," and "having" are intended to be inclusive and mean that there may be additional elements other than the listed elements.

[0036] Although the present invention has been described in considerable detail with reference to certain preferred embodiments thereof, other embodiments are possible. Therefore, the spirit and scope of the appended claims should not be limited to the description of the preferred embodiment(s) contained herein.

What is claimed is:

1. A high energy electromagnetic field generator, comprising:

a shell, the shell having embedded polycrystalline ferroelectric ceramic material, the material being polarized such that the ceramic material exhibits strong Piezoelectric Effect properties thus inducing high frequency vibrations;

an electrostatic generator for charging up the shell, the electrostatic generator disposed within the shell;

a power plant to generate thermal power;

a thermoelectric generator to convert the thermal power generated by the power plant to electrical energy;

an electric motor powered by the electrical energy generated by the thermoelectric generator, the electric motor supplying input voltage such that the shell spins at high angular speeds, vibrates at high frequencies, and generates an electromagnetic field.

2. The apparatus of claim 1, wherein the shell is spherical.

3. The apparatus of claim 2, wherein high energy electromagnetic field generator includes two electrostatic generators.

4. The apparatus of claim 3, wherein the two electrostatic generators, the power plant, the thermoelectric generator, and the electric motor are disposed within the spherical shell.

5. The apparatus of claim 3, wherein the shell further includes embedded radioactive elements, such that high frequency vibrations generate high energy gamma rays.

6. The apparatus of claim 1, wherein the shell is hemispherical.

7. The apparatus of claim 6, wherein the shell further includes embedded radioactive elements, such that high frequency vibrations generate high energy gamma rays.

8. The apparatus of claim 7, wherein the shell further includes a protrusion extending from the shell such that air around the protrusion is subjected to electrostatic stress and as a result becomes ionized.

9. The apparatus of claim 1, wherein the shell is a disc.

10. The apparatus of claim 9, wherein the shell further includes a protrusion extending from the shell such that air around the protrusion is subjected to electrostatic stress and as a result becomes ionized.

11. The apparatus of claim 9, wherein the shell further includes embedded radioactive elements, such that high frequency vibrations generate high energy gamma rays.

12. A method for generating a ultrahigh intensity electromagnetic field, the method comprising:

charging a shell with embedded polycrystalline ferroelectric ceramic material such that the material has strong Piezoelectric Effect properties thus inducing high frequency vibrations;

generating thermal power;

converting the thermal power to electrical energy; and,

spinning the charged shell via the electrical energy such that an electromagnetic field is generated.

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