(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
26 April 2012 (26.04.2012)

PCT

(10) International Publication Number
WO 2012/053921 A2

(51) International Patent Classification:
F03H 99/00 (2009.01)

(21) International Application Number:
PCT/PT2011/000035

(22) International Filing Date:
20 October 2011 (20.10.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
105347 22 October 2010 (22.10.2010) PT

(72) Inventor; and
(71) Applicant : BAPTISTA DE ALVES MARTINS, Alexandro Tiago [PT/PT]; Rua Cidade de Rabat, N 2, 1 Frente, 1500-161, Lisboa (PT).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:
— *of inventorship (Rule 4.17(iv))*

Published:
— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

WO 2012/053921 A2

(54) **Title**: ELECTROMAGNETIC PROPULSION SYSTEM AND APPLICATIONS

(57) **Abstract**: The present invention relates to a new form of aerial, terrestrial, underwater or space propulsion, achieved through the use of electromagnetic interactions. By using the well known Euler-Lagrange electromagnetic force equation many different concepts can be devised to transform electromagnetic forces and interactions into a useful propulsive force. In particular, this process can be used to propel a mass (21) that contains the propulsion units (16). A possible propulsion unit uses electromagnetic interactions between the longitudinal electric field emitted by a sphere (18) near a capacitor with cathode (10) connected to ground, a dielectric (3) and with anode (11) connected to any high voltage polarity.

Description

Electromagnetic Propulsion System and Applications

The present invention relates to a new form of aerial, terrestrial, underwater or space propulsion, achieved through the use of electromagnetic interactions. In order to better understand the workings of this invention, we will first supply the underlying theory that made possible this innovation.

In order to calculate the forces generated by the electromagnetic interactions that are part of this patent, we will use the well known Euler-Lagrange electromagnetic force equation:

$$\frac{d}{dt}(m\mathbf{v} + q\mathbf{A}) = -q\nabla V + \nabla_{\mathbf{A}}(q\mathbf{v} \cdot \mathbf{A}). \qquad (1)$$

Where m is the mass of the considered particle, $\mathbf{v}$ is its velocity, and q is its charge. In the last term on the right, the divergence operator $\nabla_{\mathbf{A}}$ acts only on the magnetic vector potential $\mathbf{A}$. The canonical momentum $m\mathbf{v}+q\mathbf{A}$ is the quantity of momentum generally associated directly with the particles and fields; it is the sum of the kinetic (Newtonian) momentum $m\mathbf{v}$ with the potential momentum $q\mathbf{A}$. The terms on the right depend on the gradient of the total interaction energy between the particle of interest and the surrounding particles and fields. Equation (1) can be rewritten as:

$$\frac{d}{dt}(m\mathbf{v}) = -q\nabla V + \nabla_{\mathbf{A}}(q\mathbf{v} \cdot \mathbf{A}) - \frac{d}{dt}(q\mathbf{A}). \qquad (2)$$

The first term on the right represents the electrostatic interaction force between electric charges, the second term on the right represents the magnetostatic interaction force between currents or magnets, and the third term represents a time dependent force which occurs whenever the magnetic vector potential or the charge vary in time.

Equations (1) and (2) represent the basic theory that will be the basis for the experimental ideas in electromagnetic propulsion proposed henceforth.

The present invention will now be described in detail, without a limited character and using preferred examples, presented in the accompanying drawings, where:

- Figure 1 depicts the first embodiment of this invention based on variations of the Feynman disk paradox.
- Figure 2 depicts an embodiment where the transient electric field separates the charges and causes propulsion.
- Figure 3 depicts an embodiment where propulsion is achieved through the interaction between currents and magnetic fields.
- Figure 4 depicts an embodiment where propulsion is achieved through the interaction between changing magnetic fields in space and induced currents in conductors.
- Figure 5 depicts an embodiment where propulsion is achieved through the induced electric fields generated by the rapid deceleration of electrons in vacuum tubes.
- Figure 6 depicts an embodiment where propulsion is achieved through the induced electric fields generated by electrodynamic longitudinal waves.
- Figure 7 depicts an embodiment where propulsion is achieved through the electrostatic and magnetic forces.
- Figure 8 depicts embodiments of different geometries.

Detailed description of the invention

We will now proceed with the description of the preferred embodiments of this invention which are illustrated in the accompanying figures. Like numerals in these figures correspond to corresponding parts in the different embodiments.

We will start by analyzing the well known Feynman disk paradox (figure 1.a)). It consists basically of a coil 1 at the center of a dielectric disk 3 with several metallic spheres 2 at the periphery. This coil (which can have a ferromagnetic or magnetic core 4) carries a current I which generates the represented magnetic vector potential A (upward perspective on figure 1.b)). When the current in the coil is removed the surrounding vector potential comes to zero and this generates a circular induced electric field E (figure 1.c)). If the metallic spheres 2 are charged positively, they will feel a force which will put the whole disk into rotation (because all spheres have the same charge). If all spheres had a negative charge the disk would rotate in the opposite direction. Interestingly, when we have a positive charge on the left side and a negative charge on the right side the generated force is in the same direction (figure 1.d)). And this can be used for propulsion purposes. Using Equation (2) the resulting force (applied to the whole system) would be:

$$\frac{d}{dt}(m\mathbf{v}) = -\frac{d}{dt}(q\mathbf{A}) = -\mathbf{A}\frac{dq}{dt} - q\frac{d\mathbf{A}}{dt} = -q\frac{d\mathbf{A}}{dt}. \quad (3)$$

Since the charge is constant only the term with the changing vector potential will remain. If we want to use this for a propulsion system we have to use currents (vector potentials) that have different rise and fall times (figure 1.e)). Let suppose that when the current rises from zero to its peak in 1 second, we have a value of qA of $10 kgms^{-1}$, then d/dt=1s and $F=10 kgms^{-2}$=10N. This produces a force of 10N on the particle in one direction. Now the current diminishes from its peak value to zero but in 10 seconds. The initial qA is 10 $kgms^{-1}$, but d/dt=10s, therefore $F=1 kgms^{-2}$=1N. This last change will produce a force of 1N (because of the smaller induced electric field) on the particle in the opposite direction than before. The particle will feel a resultant force (per cycle) of 9N in the first direction. This means that net propulsive forces must use asymmetric current or voltage pulses or both and augmented application of cycles (frequency). Since the charge accumulated in spheres is small (due to low capacitance) one has to use coils with ferromagnetic cores of high relative permeability.

This however is not a practical design due to the submission of the coil 1 to high voltage fields, which limits the magnitude of the applied high voltage. One way to avoid discharges between the coil 1 and electrodes 2 (spheres or any other) is to envelope the electrodes in a dielectric to insure no charge leakage.

Another solution is applying the charge to a metal surface that completely involves (figure 1.f)) coil 1 which can have cylindrical, toroidal, rectangular, or any other geometry). In this way the electrode 2 geometry composes a Faraday cage (figure 1.g)) around the coil (that can also be several independent coils distributed around the periphery like in figure 1.h) in order to vector the generated force) which will feel no electric field at all due to the Faraday cage protection. If this electrode 2 as an oval shape, the charge will be stronger on the geometries of higher curvature (periphery to the right and left in this case) and therefore an asymmetric force can be generated (figure 1.g)). The coil 1 can have any (magnetic or) ferromagnetic nucleus 4 or can even be a magnet 4 surrounded by a coil 1 (including any electric conductor, superconductor, fiber optic, or any other conducting material or channel).

Although not mentioned in the literature there exists a phenomenon which I choose to call the inverse Feynman paradox. In here instead of a coil at the center we have a magnet 4 with no coil around it, and we also have the conductive elements or electrodes (metallic spheres in this case) 2 in the periphery of a dielectric disk 3 (figure 1.i)). From an upward perspective we can clearly see the magnet 4 with the north pole N pointing upwards and the surrounding magnetic vector potential A, that involves elements 2. If now we introduce some charge into elements 2, the whole setup will also rotate. Using Equation (2) the force will now be:

$$\frac{d}{dt}(m\mathbf{v}) = -\frac{d}{dt}(q\mathbf{A}) = -\mathbf{A}\frac{dq}{dt} - q\frac{d\mathbf{A}}{dt} = -\mathbf{A}\frac{dq}{dt}. \qquad (4)$$

Since the vector potential is now constant then the force will only be $-\mathbf{A}dq/dt$. This means that when a positive charge increases, the force on the charge will have the opposite direction of the external vector potential. When we introduce and increase the positive charge on all spheres a force is produced that makes the whole setup rotate (figure 1.k)). If we increase a positive charge on the left side and increase a negative charge on the right side, then a force will be generated in the same direction capable of producing linear propulsion as before (figure 1.l)). Element 1 in figure 1.g) can also be a magnet 4 and the charge on the outside (of element 2) has to have asymmetric rise and fall times in order to produce an asymmetrical resultant force. The force can be vectored by using the segments like in figure 1.h) or by exciting with high voltage isolated portions of the surrounding electrodes 2.

The propulsion efficiency will increase if both force terms are used:

$$\frac{d}{dt}(m\mathbf{v}) = -\frac{d}{dt}(q\mathbf{A}) = -\mathbf{A}\frac{dq}{dt} - q\frac{d\mathbf{A}}{dt}. \qquad (5)$$

This can be accomplished if we use a magnet 4 surrounded by a coil 1. When coil 1 is off the propulsion force works like in the inverse Feynman paradox, by changing the potentials on electrodes 2. When coil 1 is on it can work as discussed in relation to Equation (3), or using both force terms at the same time. In this way a more flexible and efficient system is accomplished. We therefore have three different propulsion modes. First, charge constant and vector potential changing. Second, vector potential constant and changing charge. Third, simultaneously change of the charge and vector potential.

Using this same theory we can find many geometries and configurations that can work like discussed before. Several different geometries will now be introduced on the same principles. Electrodes 2 can be disposed around coil 1 (with or without magnet or ferromagnetic core 4) or magnet 4 in any fashion, and electrodes 2 can take any geometry. They can be disks or squares (figure 1.m)), connected to each other or not (figure 1.n)), and with any thickness (figure 1.o) and figure 1.p)). A capacitor can be placed in a proper position in relation to coil 1 or magnet 4 (or both) like in figure 1.q). If the bottom plate 2 is connected to ground then most of the charge will be concentrated in the upward plate 2 (positive or negative), and subject to a force by the induced electric field. In order to augment the generated force this capacitor can be made with a dielectric 3 that has embedded conductive or semi-conductive particles 5 or that promotes the existence of volume charge 5 (figure 1.r)). Alternatively a force can also be produced without a surrounding coil or magnet (figure 1.s)). In this case, the induced electric field generated by the capacitor’s charging and discharging current will induce a force on the volume charge.

In all the setups discussed before, one can use one or more coils of different geometries and in any relative position (figure 1.t) and figure 1.u)). Also the surrounding electrodes 2 can be one single piece or be differentiated in small independent sections (figure 1.v)) and can take any shape (figure 1.w)).

In all the setups discussed before, one can also use any type of (symmetric or asymmetric - with any dimension or relative dimension or shape) capacitor including (for example) any ultracapacitor that can be operated at any voltage level (low voltage or high voltage) in order to dramatically increase the generated force (due to the much higher accumulated charge on the electrodes). One possible configuration can be the use of one or more coils 1 (with or without a magnetic or ferromagnetic core 4) immersed in a (one or more equal or different) dielectric(s) 3 and with the electrodes (with any geometry or shape) 2 nearby (parallel or not) forming a capacitor and charged to opposing polarities (or the same polarity or any polarity) as can be seen in figure 1.x).

Instead of applying a voltage to external electrodes one can use the induced electric field to separate charges in conductors 2 (by moving the conduction electrons around). We can accomplish this by placing a coil 1 (with or without a magnetic or ferromagnetic core 4) into an electrode 2 in such a way that the coil is not in the center of the electrode, that is, the coil is in an asymmetric geometric relationship with electrode 2 (figure 2.a) and figure 2.b)). When the current changes, the induced electric field will separate the charges and generate an electromagnetic force in the points of charge accumulation (figure 2.c)). Instead of a square or rectangle electrode 2 one can use any other geometry (figure 2.d)). Coil 1 can be one or more coils (figure 2.g) and figure 2.h)) and can also have any geometry, like cylindrical, circular toroidal, rectangular toroidal (figure 2.e) and figure 2.f)), or any other. In the points of charge accumulation (figure 2.g)) one can also artificially augment the charge (figure 2.h)). In all the configurations mentioned in figure 2, coil(s) 1 can also be replaced by any other source of changing electric fields like radiofrequency tubes, microwave tubes or cavities, or any other equivalent electromagnetic tube (or cavity) or source that can function at any frequency.

Looking to a different embodiment now, we know that the force on a magnet caused by an external current depends on the relative position between the two. In the case of the situation represented in figure 3.a) the magnet will suffer an upward force if the current I is above or below the magnet. Recalling Equation (2), the force will be:

$$\frac{d}{dt}(m\mathbf{v}) = \nabla_{\mathbf{A}}(q\mathbf{v} \cdot \mathbf{A}). \qquad (6)$$

This represents the magnetostatic interaction term. This understanding allows one to see that if the current I is placed at the equatorial center of the magnet (figure 3.a)) it will be subject to an upward force but in this case the magnet will not feel any force from the current due to the symmetry of the vector potential at this position. This little loophole can be used for propulsion purposes as will be exemplified.

If we use an electrostatic motor like depicted in figure 3.b), we have a pointed electrode 2 charged positive, a ball electrode 2 charged negative placed at the periphery of a dielectric disc 3. This is a known electrostatic motor configuration (Ford, 1996), and can also function with only one electrode charged positive or negative (figure 3.c)). If we now place magnets 4 near the periphery (or on the disc 3 itself) of the dielectric disc 3 they will induce a force on the disc 3 because it is carrying a current I in its periphery. The force on the disc will be upwards or downwards according to the magnetic polarity used (figure 3.d)), and the magnet will not be subject to a counter force if the current is at its equator (but this current can be placed at any relative geometric position in relation to the magnets). Alternatively instead of a magnet one can use an arrangement of magnets that generates a magnetic beam (Bushman, 1999). This will improve propulsion efficiency and this magnet arrangement can be in a symmetric geometric position in relation to the disc 3 that carries current I, or not.

Eventually, the disc 3 can be rotated mechanically (not dependent of electrostatic acceleration) with appropriate magnets 4 placed at the periphery of disc 3 (physically connected to the disc and rotated by it or the magnets are at the disc periphery but disconnected and stationary) for force generation. In these cases one can use any ion source to charge (at the periphery, and/or on the top and/or on the bottom surface) the dielectric disc 3 while it rotates.

Eventually, the disc 3 can also be replaced by a conducting material 2 (with any shape - wire, disc, ring or other (interrupted or not in order to allow the passage of current) - or cross section) that transports a current (using an appropriate power source) in order to also generate in this way a useful force for propulsion.

A different embodiment using the same concept is to use a coil 1 (with or without a magnetic or ferromagnetic core 4) at the center (or near the center) of a conductive element 2 of any geometry (circular, square, rectangular, oval, etc.). When coil 1 is activated it will induce currents on element 2 due to the induced electric fields. If the induced electric fields are asymmetric, that is, they are stronger in one sense than in the other, they will generate a stronger current in one direction than in the other. If we now place magnets 4 at the periphery of electrode 2 (figure 3.f)) these will interact with the currents as discussed before and a propulsive force can be generated with a direction dependent of the magnetic polarity used (figure 3.g)). Once more the magnetic beam arrangement (Bushman, 1999) can be used to improve propulsion (figure 3.h)).

If we use coil or coils 1 around the magnets/ferromagnetic cores 4 at the periphery (figure 3.i)), we can adjust and generate the proper magnetic polarity (electromagnet) in time synchrony with the changing current I induced by coil 1 at the center, in order to obtain a unidirectional force on the system (figure 3.j)). Again the magnetic beam arrangement (Bushman, 1999) can be used to improve propulsion (figure 3.k)) with coil(s) 1 wrapped around one or more magnets 4. This arrangement can also be used in the center instead of coil 1 (figure 3.l)) in order to generate the induced currents on element 2. This last arrangement or coil 1 can be moved from the center and in this way change the force produced by the setup.

If we put two magnetic beam arrangements (or two magnets) face to face opposing the same magnetic pole, then the magnetic field lines will be deflected into an horizontal plane like depicted in figure 3.m). The magnetic vector potential is given by the right hand rule, were if the thumb of the right hand points in the direction of the magnetic field line then the rest of the hands fingers point the direction of the vector potential (circle). When the magnetic field of these arrangements varies by the use of coil(s) 1, it will induce changing electric fields and currents on a conductor 2 placed between both arrangements (figure 3.n)). When the magnetic field lines are horizontal and inducing asymmetric electric currents as before, they will generate a force on element 2 due to the interaction of the magnetic field from the magnetic beam arrangements (or opposing magnet pairs) and the induced currents. The generated force will depend on the vertical position assumed by element 2, were three different possibilities are depicted in figure 3.n).

Instead of element 2 we can have a dielectric disc 3 with conductive elements 2 (spheres or other) distributed at or near the periphery of the disc. By charging these electrodes, they will suffer a propulsion force as discussed before in relation to figure 1 and which will depend on the vertical position the disc presents relative to the magnet arrangement (figure 3.o)).

A different embodiment may be accomplished if a conducting disc 2 with magnet(s) 4 disposed at the periphery (or inside the disc itself) is put into angular rotation near other external magnet(s) 4 as shown in figure 3.p). When the disc is at constant angular velocity currents will be induced on it due to changing magnetic vector potentials due to the external magnets 4. Figure 3.q) shows a perspective view of what is happening were one external magnet 4 is shown from an upward perspective with its south pole pointing to the viewer. The vector potential of this magnet(s) induces symmetric electric fields (and currents) in the conducting disc 2 when it is spun at constant angular velocity (figure 3.q)) because the dA/dt has the same magnitude when approaching the magnet and when leaving it.

If the disc is spun with a changing acceleration da/dt then the disc's velocity change dv/dt will be higher on approach or on leaving external magnets 4. This different dv/dt will imply a different dA/dt in both situations, implying the induction of asymmetric electric fields E on disc 2 which put the conduction electrons in motion and induce currents I in the same direction as the induced electric fields (figure 3.r)). If the magnet(s) 4 that rotate with the disc have their north poles N turned toward the disc periphery (figure 3.r)), then the force on the current(s) I will be upward as represented in figure 3.r). The changing acceleration da/dt may be accomplished by directly manipulating the rotational angular speed of disc 2 or may be accomplished by using a constant angular velocity for the disc but with the addition of an eccentric axis of rotation which will constantly change the physical distance between the periphery of disc 2 and the external magnets 4 (in a non-linear manner) all along the 360° axis of rotation.

Any number of magnets 4 can be used around the periphery or at any position on the disc 2 (figure 3.s)). And also any number of external magnets 4 can be used around disc 2 that may be supported by any conducting or non-conducting frame 2. By using a metallic ring (annulus or any other) or electrode to support (or near) external magnets 4 (figure 3.t)) one can improve the generated force since the magnets 4 that rotate with the disc also induce currents on the external conductor 2, and the interaction between the induced currents I and the magnetic fields (of the external magnets) generates a propulsive force on this element also.

It is also possible to invert the magnet's orientation (external and on the disc) as shown on figure 3.u), and maintain propulsion force. One can also use magnets with both orientations (in alternate fashion or any other) on the disc and outside the disc (figure 3.v)). An instant of time is shown in figure 3.w) when an eccentric axis is used showing the disk approaching the upward section of external magnets.

In all of the setups of figure 3 element(s) 2 can be any type of conducting (including superconducting) or magnetic material (diamagnetic, ferromagnetic, paramagnetic, etc.). Element(s) 2 can also be a metal (or material or several different metals or materials connected side by side) with the atoms deliberately aligned magnetically (in a permanent way) in any (one or more directions) desired direction that may contribute substantially for the propulsion force if the interaction of the magnetic field of these atoms with the current I present (or induced) in element 2 is in a useful direction for force production or for developing a vertical (or other) force for propulsion.

Eventually, one can also pass deliberately a current (using an appropriate power source or also a homopolar generator) through one or more conducting materials 2 (with any shape - wire, disc, ring or other (interrupted or not in order to allow the passage of current) - or cross section) that can have its atoms magnetically aligned in order to also generate in this way a useful force for propulsion.

Using similar principles a different propulsion system may be accomplished as exemplified in figure 4.a). In this embodiment a magnetic beam arrangement (Bushman, 1999) with one or more coil(s) 1 around magnets 4 is placed near conductor(s) 2 (in any vertical or horizontal relative position) as shown in figure 4.a). When coils 1 are activated they will generate very high changing magnetic (and electric) fields in a very large surrounding space volume. These changing fields will induce opposing fields on conductor 2 (which can also be superconductor) causing a repulsion force between the volume changing fields and the induced opposed fields on conductor 2. In this way a propulsion force is generated as shown in figure 4.a). The higher the frequency of the changing fields the higher the propulsion force. According to Bushman (1999) when the coils are excited at ultraviolet frequencies an EMP (Electromagnetic Pulse) may be generated equivalent to that released by nuclear explosions. Therefore the resulting propulsion force may be very high with this setup.

If the section above element 2 is for human presence then one can use a conducting shielding material or a magnetic, ferromagnetic shielding material 6 (that will absorb the magnetic field lines into its interior) like shown in figure 4.b). If one does not wish to expose the magnetic beam assembly to the external elements a non-magnetic material shield 7 can be used as protection (figure 4.c)), or instead the magnet assembly may be all contained in the same plane as element(s) 2 in such a way so to not extend to the outside.

The magnetic beam assembly can be disposed in different geometric configurations. In figure 4.d) we can see a possible variation were the magnet assembly is rotated 90° degrees and extends a North pole N to the right and a South pole S to the left (it can radiate any number of poles in this planes). All magnets can be wrapped by coils 1 or just the center magnet as exemplified (figure 4.d)). The magnetic fields may be only changing or may be rotating (by using different coils 1 excited at different phases). Any number of magnet assembly units may be used (were adjoining fields may be attracting or repelling) around (or in) element(s) 2 in order to vector propulsion (figure 4.f) and figure 4.h)) and increase propulsion efficiency (figure 4.e)). If wished, an enclosure material 8 may be placed in any portion of the setup (figure 4.e)).

Additional force may be added if interaction with any external element 9 occurs. If the propulsion unit of figure 4.f) is above a body of water or humid (or conducting) earth 9 (figure 4.g)) then an additional repulsion or propulsion force will be added. The EMP generated by the magnetic beam assemblies may ionize the air rendering it conductor therefore inducing opposing currents on it, generating an additional repulsion force for propulsion in this fashion. If surrounded by water, this setup will also induce opposed currents in the conducting (salt) water which will also add propulsion force. Therefore this setup can move in a very different range of environments, from water, land, air and space.

In all of the setups of figure 4 described until now, element(s) 2 can be any type of conducting (including superconducting) or magnetic material (diamagnetic, ferromagnetic, paramagnetic, etc). Element(s) 2 can also be a metal (or material or several different metals or materials connected side by side) with the atoms deliberately aligned magnetically (in a permanent way) in any (one or more directions) desired direction that may contribute substantially for the propulsion force if the interaction of the magnetic field of these atoms with the current I present (or induced) in element 2 is in a useful direction for force production or for developing a vertical (horizontal or other) force for propulsion.

In different embodiments, an element 2 (conducting material) or 6 (magnetic, ferromagnetic shielding material) may represent one of the protective layers of a submarine hull (figure 4.i)). In this case one can use an additional coil 1 (Tesla coil for example), protected or not from external elements by a non-magnetic material 7, in order to induce opposed currents in the water and remove any resistance or skin friction to the motion of the vessel under water, allowing much better performance and the possibility to reach very high oceanic depths without having to worry about the mechanical structural integrity of the vessel. This electromagnetic repulsion force can also be used for propulsion and not just protection against the surrounding water high pressures.

Coil 1 can extend all around element 2 like shown in figure 4.j), or the added right and left sections in this figure may represent a second coil at a right angle to the first. The advantage of using two coils (at right angles) like this resides in the possibility of generating a rotating magnetic field that can also be used for the same purposes as discussed in the last paragraph. Any number of coils can be used and excited independently in order to vector propulsion. The same concept can also be applied to a boat (figure 4.k)) in order to generate propulsion or just repel water electromagnetically and remove friction from the movement. If applied to any air or land vehicle it is also possible to repel water from rain, lakes or any surrounding conducting element.

Another added advantage of this system is the possibility to create and maintain protected living spaces at the bottom of the ocean in order to conduct explorations or archaeological expeditions free of any presence of water independently of the depth (figure 4.l), were element 9 below the horizontal trace represents land, and element 9 above the trace represents water. Instead of using coil 1 one can simply connect element 2 (or 6) to an alternating current (AC) source (Tesla coil for example) like exemplified in figure 4.m). In order to limit the electromagnetic energy dissipation provided to element 2, one can use a protective element (dielectric 3 or non-magnetic material 7) like in figure 4.n). If needed, elements 3, 6 or 7 can be placed below element 2 as a further protective measure (figure 4.o)). Also instead of coil 1, only AC can be applied to element 2 or 6 in the submarine or boat (or other) cases discussed before (figure 4.p)).

An inspiration to other different embodiments that will now be referred is the work of Townsend Brown (1928, 1960, 1965) who on its turn has inspired others (Campbell, 2001, 2002, 2004a) to investigate his concepts. These patents are for systems that work in the atmosphere on the basis of high electric fields and volume ionization. They therefore don't work in a vacuum. Campbell as tested his systems in a vacuum and concluded that no remaining force was present (Campbell, 2004b), that's why in his latest patent (Campbell, 2004a) he introduced a cap that partially involve his capacitors and delivers a gas so that propulsion may be delivered in space in terms related to the known mechanical momentum conservation. Inspired by Brown and Campbell's work, Canning, Melcher and Winet (2004) and Talley (1991) made some vacuum experiments and detected some anomalous forces related to sparks. According to Talley (1991) however, force was only observed when the used dielectric was piezoelectric and no force was observed when the dielectric was acrylic, thereby relating the observed force (that inexplicably worked forwards and backwards) to the piezoelectric properties of the dielectric. Even if eventually the mentioned Brown and Campbell patents work in a vacuum by some means, their patented setups are not adequate for space propulsion due to exposure to space weather. It is worth noting that the first approach that Brown (1928) had with capacitors at atmospheric pressure also included the use of Coolidge tubes with electrodes in vacuum. For him it was a kind of electrogravitic effect that would function in the atmosphere and in vacuum. Unfortunately he didn't know what he was dealing with and all his posterior work diverged from this first approach. We will now present several improvements to the concepts discussed previously, which will allow the multiplication of the generated force in a way to make this approach useful for propulsion purposes.

Using electromagnetic principles a different propulsion system may be accomplished related to sparks or continuous electron emission between the negative (cathode 10; that may also be only ground) and positive (anode 11) electrodes in a vacuum, using or not a dielectric 3 whenever needed. The first embodiment uses a parallel plate capacitor (supported or not by supporting elements 15) inside an enclosure 13 (of any material) where a vacuum or a low pressure (of any gas) 14 is maintained (figure 5.a)). Whenever a spark or continuous electron current occurs from the cathode 10 to the anode 11 (where both can be parallel plates with symmetric or asymmetric dimensions or with any other shape including toroidal, tubular, circular, etc.) a force will be generated that puts the system into motion. The dielectric 3 can have any shape and does not need to encompass the whole space between the electrodes (figure 5.b)). One can use any combination of one or more element(s) 3 and/or 10 and/or 11 and/or 13 and/or 15 together (for example, using a sharp pointed element 10 together with a smooth element 10 for the purpose of facilitating electron emission or discharge through the sharp electrode).

We will now analyze a simple setup and calculate the force that is produced in this embodiment. The simplest (and less efficient) embodiment is very similar to existing vacuum tubes for x ray generation. The difference is that one does not need the anode 11 to have an angle relative to the incoming electrons in order to channel the generated x rays to the outside through a window. Our aim is not to generate x rays but a propulsive electromagnetic force (x rays however are a secondary effect of this system). A propulsion unit 16 is shown in figure 5.c) were the cathode 10 is connected to the ground, or to a negative high voltage polarity or to both, and has a strong geometric asymmetry at the center were the electric field will be highest favoring strong electron emission 12 from this point towards the anode 11. Since these electrodes are in a vacuum (or low pressure) 14 protected by an enclosure 13, the electrons will acquire a very high energy from the electric field and since they suffer no collisions (or few collisions) with surrounding gas molecules when going from one electrode to the other all the energy will be dissipated when colliding with the anode 11.

These electrons 12 will generate a current I in the opposite sense of their velocity (figure 5.d)). Using Equation (2) and considering that the charge q is the charge q_C on the capacitor plates (anode in our case), the total force on the electrode will be:

$$\mathbf{F} = -q_C \frac{d\mathbf{A}}{dt} = q_C \mathbf{E}_{Induced}. \qquad (7)$$

Where $\mathbf{E}_{induced}$ is the electric field produced by the time change of the vector potential created by the accelerating or decelerating electrons. According to Jefimenko (1989) the external magnetic vector potential $\mathbf{A}$ of a current carrying wire of total length L is given by:

$$\mathbf{A} = \frac{\mu_0 I}{2\pi} \ln \frac{L}{r} \mathbf{u_x}. \qquad (8)$$

In this equation, μ_0 is the magnetic permeability of the vacuum, I is the electric current, r is the radius of the current carrying wire (electron radius in our case) and $\mathbf{u_x}$ is the unit vector in the positive direction as shown in figure 5.d). Equation (8) shows that the vector potential always has the direction of the current. Using Equations (7) and (8) we have:

$$\mathbf{F} = -q_c \frac{d\mathbf{A}}{dt} = -q_c \frac{d}{dt}\left[\frac{\mu_0 I}{2\pi}\ln\left(\frac{L}{r}\right)\right]\mathbf{u_x} = -q_c \frac{\mu_0}{2\pi}\ln\left(\frac{L}{r}\right)\frac{dI}{dt}\mathbf{u_x}. \qquad (9)$$

We know that $I = nqvS$, where n is the number of charges, q is the charge of the involved electric charges, v is their velocity and S is the effective area of the conducting path. The force will be:

$$\mathbf{F} = -q_c \frac{nqS\mu_0}{2\pi}\ln\left(\frac{L}{r}\right)\frac{dv}{dt}\mathbf{u_x}. \qquad (10)$$

Therefore the magnitude and direction of the force will be dependent on the acceleration/deceleration of the moving charged particles dv/dt and on their charge q (although we are considering electrons, any other charged particle can be used). Considering that all the energy qV gained by the electrons (with mass m_e) when subject to a potential difference V is converted into the (relativistic) kinetic energy $(\gamma-1)m_ec^2$, (γ is the relativistic Lorentz gamma factor and c is the speed of light) then the electrons take on the velocity v:

$$v = c\sqrt{1 - \frac{1}{\left(1 + \frac{qV}{m_ec^2}\right)^2}}. \qquad (11)$$

Considering a charge of 1.25×10^{-11} C at the anode and after some calculations it is found that the force produced on element 11 during the acceleration phase of the electrons is extremely small (10^{-11} N considering an electron current of 5 mA). When the electrons decelerate they will generate the so called Bremsstrahlung radiation, decelerating from near the light velocity (or lower) to zero velocity in a very short time, generating x-rays in the process. The electron acquires an energy E of 44 eV or 7.05×10^{-18} J when subject to a 44 kV potential difference. Using the relation:

$$E = eV = h\nu = hc / \lambda_{min}, \qquad (12)$$

where h is the plank constant (6.6256×10^{-34} Js), ν is the frequency of the photon, and λ_{min} is the minimum wavelength, we can determine the approximate value of the frequency of the generated x-rays as 1.06×10^{16} s^{-1}. The inverse of this value is a measure of the time interval in which the electrons decelerate (when they collide with matter) and correspond to 9.40×10^{-17} s. Using this last value and the velocity attained by the electrons at the anode (Equation (11)) the deceleration will be 1.24×10^{24} (ms^{-2}). In bremsstrahlung, a continuous spectrum with a characteristic profile having an energy cutoff is produced were:

$$\lambda_{min} = \frac{hc}{eV}. \tag{13}$$

When the electrons collide frontally with the atom they lose all their kinetic energy and have the deceleration value calculated before, but not all electrons collide at this frontal angle and lose all their energy. Therefore a characteristic profile of x ray energy with a cutoff λ_{min} will be produced and the force will have to be integrated for all this energy distribution, which will depend on the atomic number Z of the collision material. Considering that element 11 is made of copper, a force of approximately 13 mN is found using this process for a spark with 5 mA of current. The use of dense collision materials for the anode 11 is advantageous since more electrons will lose more of their accumulated energy and generate higher induced electric fields when colliding.

Therefore the only relevant force will be generated when the electrons rapidly decelerate in the collision with the anode and generate very high induced electric fields $\mathbf{E}=-d\mathbf{A}/dt$, with the consequent release of x rays due to the very fast deceleration. Considering Equation (10), and that the charge q of electrons is negative, then the direction of the force on the anode 11 along the x axis direction will depend only on the signal of dv/dt.

Alternatively to the cathode 10, one can use element 17, that can be a laser, to generate a plasma in the low pressure environment 14 and accelerate the existing electrons to relativistic speeds towards the anode (figure 5.e)). In order to facilitate the presence of a plasma one can also use cathode 10 (in the position of figure 5.c)) in conjunction with the laser. Element 17 may also represent any electron source with (or without) accompanying charge accelerator. This element will emit the electrons near or at light velocity (or at any desired velocity) and improve the propulsion efficiency, by decoupling electron velocity from the potential difference between cathode and anode that occurred before (besides providing greater control on the generated electron beam current).

If element 10 is superconductive (and preferably also element 11) then instead of a localized spark from a sharp point one can have electron emission from the entire surface of the cathode (which is connected to a high voltage negative polarity and/or to ground) towards the anode. This has the advantage to greatly increase the generated force.

A different setup can have a dielectric (of any dielectric constant and with or without any immersed conductive or semi-conductive particles) 3 between elements 10 and 11 has represented in figure 5.g), which will favor charge accumulation on both electrodes. Electron emission occurs in a central evacuated space 14 for force production like before.

If wished (one or more coils) a coil 1 (figure 5.h)) or magnet(s) 4 (figure 5.i)), and/or magnet(s) 4 surrounded (or not) by coil(s) 1 (not represented; where the coil(s) of all embodiments can be excited by any constant, symmetrically or asymmetrically pulsed or oscillating, or modulated or any other current or voltage waveform or wave shape), can be used around the whole setup or just element(s) 3 and/or 10 and/or 11 (or in any other disposition) in order to generate a magnetic field in any desired direction for any desired purpose (for example: to diminish the heat load on the anode 11, or to control the accelerated electrons or charged particles in order to manipulate or change the zone of impact in order to alter or control the direction of the produced force, or to increase the heat load on the cathode 10 in order to increase electron emission).

A force is also produced if element 11 is outside the evacuated chamber 13 (figure 5.j)). As an example, in this case an appropriate filament from an incandescent lamp can be used as a cathode electron emitter towards the anode (any metal connected to a high positive voltage and touching the opposite side of the lamp). In order to augment the charge on the anode an extra dielectric 3 and cathode 10 may be used (figure 5.k)). If the charge on this extra cathode is negative it should be farther away from the anode in order to minimize counter electromagnetic forces in the opposite direction from the anode (but if the anode manages to reasonably shield the cathode from the induced electric fields, then they can be separated by shorter distances). Connecting the extra cathode to the ground should also minimize this counter effect.

A practical way to mount the components is shown in figures 5.l) and 5.m). As these last two figures show, in all the possible setups, one or more electrodes (cathodes 10 and/or anodes 11) can be completely or partially enclosed by a dielectric 3. These can be positioned outside (or inside) enclosure 13 (figure 5.k)), or the dielectric 3 and anode 11 can be used to close one (or more) side(s) of enclosure 13 (figure 5.l)), or eventually one can use only anode 11 to close one (or more) side(s) of enclosure 13 (figure 5.m)). It is assumed that in these variations space is made to use vacuum sealing o-rings and closing bolts, or only glue, or any other method to solidify together the different components and enable vacuum or low pressure sealing 14.

Alternatively this extra dielectric and cathode can also be contained inside the evacuated chamber 13 (figure 5.n)) and another extra dielectric 3 and anode 11 can also be added to the cathode electron source 10 in order to augment the accumulated charge on the same. If wished a series of consecutive anodes and cathodes can be used like shown in figure 5.o). If the operation between them is synchronized then when the discharge from the cathode towards the anode occurs, the cathode that is adjacent to the anode is discharged and therefore any counter force is minimized. Instead of just constant positive or negative voltages one can also use positive and negative pulses applied respectively to the anode and cathode (valid for all setups), which should also help in the synchronization process.

Alternatively the cathode 10 (figure 5.p)) or the anode 11 (figure 5.q)) can be placed outside the evacuated chamber 13. The advantage of the electrons not hitting the anode 11 directly like shown in figures 5.q) to 5.t) is that they will collide with a neutral electrode (cathode connected to ground) which can directly absorb the arriving electrons to ground and still allow the anode to feel the intense induced electric fields (although it may also be possible to absorb or collect the electrons at the anode 11). This can allow constant operation because the anode does not lose temporarily its charge when the electrons impact. In these figures the space between the extra cathode 10 and the anode 11 may be filled with a dielectric 3, any environmental material 9 or gas or be evacuated 14.

The emitting cathode 10 can be simply an electron filament (heated or not), and one can use any number of electron sources 10 (figure 5.u)). The anode can be a very long electrode 11 (figure 5.v)) or many independent electrodes. The anode 11 can also have any embedded cooling system in order to maintain proper working temperature for functioning, and may rotate or not. There exist hundreds if not thousands of x ray tube patents. All these common and known characteristics can be used together with the embodiments described here, including any extra electrodes like anti-cathodes, or pressure regulating systems, or lead added to the enclosure 13 in order to diminish the transmitted x rays, or any cooling system, etc. Sometimes concave cathodes 10 can also be used in order to focus the electron beam 12 on the anode (figure 5.w)), and the same cathode can have one or more asymmetries (or filaments) capable of electron emission (figure 5.w)). Another variation might include concave anodes 11 (figure 5.x)) and enclosures 13 of differing geometries. In all these embodiments we can have pulsed operation (spark) or continuous operation (continuous electron emission) depending on the kind of electron source 10 used (any known electron source can be used as element 10) since the charge on the anode 11 can be continuously maintained with the proper high voltage source.

A further variation may use an oval (ellipsoidal, circular, etc.) electrode 2 or anode 11 and use a cathode 10 or laser 17 inside elements 2/11 in an evacuated (or low pressure) environment 14 in order to accelerate electrons 12 towards elements 2/11 (figure 5.y)). Like before element 17 may also represent an electron source with accompanying charge accelerator. This element will emit the electrons near or at light velocity and improve the propulsion efficiency. Since in these conditions elements 2 and 11 act like a Faraday cage to elements 10 and 17 (which can be fixed or moving), the inside surface of elements 2/11 will be at a potential equivalent to ground. But the outside surface of elements 2/11 will be at a high voltage (positive or negative charge, constant, pulsed or alternating). This setup also allows for a constant force to be produced because the impacting charged particles (electrons, protons or other) transmit the induced electric fields to the exterior surface (and the exterior charge can be maintained by any means). In this form by the correct placing and activation of elements 10 and 17 one can perfectly control and vector propulsion in any direction. In order to minimize charge dissipation from elements 2 and 11 it is possible to cover them with any other material (dielectric or other). Elements represented in figure 5.y) may stand for a small propulsion unit 16 that can be placed were desired around a carrying mass or may stand for the general propulsion system used by a vehicle, but were some internal space inside elements 2/11 would have to be added to allow for storage and human occupancy (preferably at the center).

Alternatively the outside surface (of the propulsion unit or the vehicle) can be an enclosure 13 of any material, and the electrodes 2 or anodes 11 can be tilted in any angle in an evacuated (or low pressure) environment 14, with elements 10 or 17 bellow (figure 5.z)). Elements 2/11 and 10/17 can be in any number and at any angle and can be in a fixed or moving position relative to each other or in relation to chamber 13 (figure 5.aa)).

A system that allows for the flexible change of physical distance between elements 10 (or 17) and 11 is represented in figure 5.ab). In this case the dielectric 3 is separated into three different parts, two of the same size (or similar size or any other size) of elements 10 and/or 11 (and positioned near those elements) and a third horizontal part (cylinder, rectangle, or any other shape) that provides for the physical connection between all the elements (between the different dielectric parts 3 or between some dielectric parts 3 and elements 10 and/or 11 directly) and that can be displaced in the horizontal direction (bidirectional horizontal arrow in figure 5.ab)) and be fixed in any desired position. In this case the horizontal dielectric element 3 can eventually enter (or not) inside other elements 3 and/or 10, and/or 11.

One can eventually add a (one or more) sharp feature(s) to emitting (smooth) element 10 (or 17) in order to facilitate the electron emission or discharge towards element 11 as shown in figure 5.ac). The dielectric 3 may eventually not be present at the side of elements 10 and/or 11 as shown in figure 5.ad) (where element 11 doesn't have a dielectric by its side). Furthermore, one can add also a dielectric 3 and/or an additional element 10 (protected or enclosed by element 3) to the left of element 11 for the purpose to augment the electric charge on element 11 (figure 5.ad)).

The discharge from element 10 or 17 can also be towards convex (or any other shape) element(s) 11 (figure 5.ae)). As always, element 11 may also have an additional dielectric 3 and/or element 10 (connected to earth or negative) for the purpose of charge augmentation on element 11 (figure 5.af)).

A flexible system that allows rapid inversion of the generated force is represented in figure 5.ag). Here we have element 11 at the center (that is charged positive in this case) and there are elements 10 or 17 at the right and left that emit electrons or charged particles towards element 11 (that can also be any variation of the previous setups, for example: cathode 10 at the center connected to a negative potential and/or ground, surrounded to the right and left by a dielectric 3 followed by anodes 11 (figure 5.ah)); this would augment the positive charge on the exposed elements 11 to the incoming stream 12 of charged particles). By activating elements 10 or 17 at the right or left a force can be generated in both directions with extreme flexibility and fast response time. A system like this can also be used to generate high intensity opposed electric fields (figure 5.ag)) if elements 10 or 17 are activated at the same time. Now we have two or more elements 10 and/or 17 that emit electrons or charged particles towards anode 11 that is connected only to ground (or any other voltage polarity). When electrons collide from both the right and the left, high intensity induced electric fields in opposite directions will be generated. These opposed fields will generate a gravitational repulsion as explained in the World patent WO 2010/151161 A2 which can be used for propulsion due to its property for mass repulsion. Due to these gravitational effects it is possible to also observe a residual force in all the mentioned setups even without any electron (or any other charged particle) emission.

In all described embodiments we can use any type of (symmetric or asymmetric - with any dimension or relative dimension or shape) capacitor including (for example) any ultracapacitor that can be operated at any voltage level (low voltage or high voltage) in order to dramatically increase the generated force (due to the much higher accumulated charge on the electrodes). In all these cases the dielectric of the capacitor may have any embedded substance and/or have uniform or non-uniform properties (dielectric constant, material, conductivity, embedded substance distribution, etc.). Eventually, if desired, the configurations of figure 5 can also be used to produce or generate electric energy if they are attached (and excited in order to produce a unidirectional or rotational force) to any element that produces energy by rotation (for example: if they are attached to the blades of a wind turbine or equivalent).

Using electromagnetic principles related to Equation (3) a different propulsion system may be accomplished by the use of the interaction between the longitudinal electric field emitted by antennas and the electric charge accumulated in capacitors. The first experimental observation of longitudinal electrodynamic waves was made by Monstein and Wesley (2002). They observed experimentally that conductive spheres 18 have the ability to emit electric longitudinal waves in space. They emit oscillating electric fields that are perpendicular to the sphere's surface.

An embodiment using this concept uses a sphere 18 near a capacitor with cathode 10 connected to ground (or negative), a dielectric (one or more) 3 with any dielectric constant or with immersed conductive/semi-conductive particles or with volume charge 5, and with anode 11 connected to a high voltage polarity (positive or negative, constant, pulsed or oscillating). For example in figure 6.a) we have the anode 11 charged positive and an electric field from antenna 18 imparts a force on the whole capacitor to the left. If the charge on element 11 were negative the force would be in the opposite sense. When the emitted electric field from element 18 changes direction then the force on the capacitor will be opposite to the case just referred. If element 10 is charged with an opposite charge to element 11 then it will suffer a counter force in the opposite direction then felt by element 11, so it is preferable to connect element 10 to ground in order to diminish any counter force. Since the emitted electric field E is oscillating, then in order to maintain a constant force on element 11 this electric field has to be asymmetrical, that is, the electric field directed to the right as to have higher magnitude than the one directed to the left (or vice-versa) or the force will be zero. In this case the antenna 18 has to be feed with asymmetric voltage/current impulses or pulses in order to generate a resultant force on element 11 in a desired direction.

Taking a different perspective, figure 6.a) can be representing just an instant in time were the charge on element 11 is positive and the electric field emitted from the antenna 18 has the represented direction. If one wishes to generate a constant force on element 11 if the emitted electric fields from antenna 18 are symmetrically oscillating, then one can also connect element 11 to an oscillating voltage source at the same frequency and phase has the one feeding antenna 18. In this way the electric field E from antenna 18 produces a force to the left on the positive charges that element 11 has accumulated (figure 6.a)). When the approaching electric field E from antenna 18 changes direction, then the charge on element 11 can be reversed to negative so that it will continue to be subject to a force to the left like before. Or the force can be made to change direction just by introducing the proper phase change between the sources feeding the antenna 18 and element 11. In this way a constant force on the capacitor and element 11 can be produced (so element 11 is not limited to its role as an anode here but can assume any voltage as necessary, therefore an element 2 can be used in its place with or without the referred cathode and dielectric).

Now that the basic propulsion concept is explained, we will mention several possible variations on the same concept. For starters the geometry of antenna 18 is not limited to a circular or sphere shape but can assume absolutely any shape (oval, toroid, rectangle, concave, convex, etc.), and can be involved (or not) with any desired material (dielectric, semi-conductor, etc.). Secondly, the mentioned capacitor with charged electrode(s) were the force is applied can be only a dielectric 3 or electrode 2 charged to any polarity and with any shape.

If a conducting element 2 is placed behind antenna 18 it will reflect this radiation in the opposite direction. In particular, if element 2 has the shape of a parabolic reflector then the radiation from element 18 can be focused like a beam to the left (figure 6.b)), and element 2 will be acting like an electromagnetic lens 19 by focusing this radiation. Element 2 can be a simple conducting element or it can be connected to any voltage polarity (positive or negative, constant, pulsed or oscillating). Element 2 can even be made of several lamps with plasma inside in order to form a plasma reflector (Jenn, 2003). Elements 2 and 18 can be exposed to any environmental element 9 or they can be protected by an enclosure of any material and with any shape. Propulsion will occur as discussed before.

A different antenna can also be used, the well known zone plate 19 used in acoustics (Everest, 2001). The zone plate is made with several concentric circular metal rings 2 with different spaces between them in order to focus sound on a specific point at a distance (figure 6.d)). The slits in the zone plate 19 are arranged so that the several path lengths differ by multiples of a half wavelength of the longitudinal wave propagated, so that all diffracted rays arrive at the focal point in phase, combining constructively. This setup can also function as an acoustic lens for electrodynamic longitudinal waves (figure 6.c)). Element 19 can also be any type of acoustic lens that is known. Elements 2 that compose element 19 can be simple conducting elements or they can be connected to any voltage polarity (positive or negative, constant, pulsed or oscillating). Elements 2 can even be made with circular lamps with plasma inside in order to form a plasma reflector (Jenn, 2003). Elements 2, 18 and 19 can be exposed to any environmental element 9 or they can be protected by an enclosure of any material and with any shape. Propulsion will occur as discussed before.

As discussed before, elements 2, 18 or 19 can be protected or involved by an enclosure 13 of any material. This enclosure can have any shape and can allow or not for a space between the referred elements and enclosure 13 (figure 6.e)). As mentioned, elements 2 or 18 can have any shape (figure 6.f)), and if a space is allowed between enclosure 13 and element 2 which contains any gas at any pressure, then the setup can function as a plasma antenna 20 (Jenn, 2003) if a voltage polarity (positive or negative, constant, pulsed or oscillating) is applied to element 2 that ionizes and moves the surrounding particles in order to make them also emit electrodynamic longitudinal waves that can be used for propulsion like discussed before (figure 6.g)).

As discussed before, Brown (1960, 1965) designed asymmetric capacitors for propulsion in the atmosphere (figure 7.a)), where element 11 is a corona wire (charged positively) and element 10 is any grounded or negatively charged electrode. We will now present improvements to his original setups, which can not only work in the atmosphere but also outside of it. Despite being 50 years old, the propulsion physical mechanism for Brown's setups was only recently explained in simple scientific terms by Martins and Pinheiro (2011a, 2011b) as being due to an electrostatic force of interaction between the generated volume ions in the surrounding gas and the electric charges (or induced electric charges) on the surrounding electrodes (that occurred mainly on the ground electrode because of charge separation effects). Therefore the force that acts on these configurations will be given by the first term on the right side of Equation (2):

$$\frac{d}{dt}(m\mathbf{v}) = -q\nabla V. \qquad (14)$$

Since the propulsion force is of electrostatic nature, between the volume ions and the electrodes, the first improvement that we suggest is to use magnets (or coils with or without a magnetic or ferromagnetic core) 4 for the purpose to increase the temporal permanence or residence time of the volume ions near the electrodes. With this in mind a first application could use magnets 4 at the extremities of cathode 10 (of any shape and connected to negative polarity and/or earth) for the purpose of generating a magnetic field that is parallel to the surface of element 10 (figure 7.b)). The magnets 4 can be placed in the represented position or they may be turned into a perpendicular position (or in any other relative position). One can use two repelling magnets on each extremity (or any number along the length of element 10) in order to increase the magnetic effects (figure 7.c)). Although two magnets are represented, one can use any number of magnets along the length of element 10 (figure 7.d)) which can be placed inside or outside element 10.

Element 10 may also have any shape and may also have any number of elements 11 nearby (upwards or downwards) as represented in figure 7.e). The magnets 4 can be placed in any relative position (above or below element 10) as further exemplified in figure 7.f), and they can be placed in the represented position or they may be turned into a perpendicular position (or in any other relative position - the magnetic field can have any direction). Figure 7.g) represents a possible upward view of the setup in figure 7.f) (that instead of being circular as in figure 7.g) could also be linear instead). In the case of figure 7.g) the supporting structure of magnets 4 (not represented in full) can also conceal them completely (inside a solid structure) if necessary in order to be able to function more efficiently in aerodynamic terms.

One can also use only one of the electrodes (elements 10 or 11) with special ionizing features if desired. Figure 7.h) exemplifies the use of three (non-limiting) different metallic ionizing features (metallic arrow, three needles, one needle) on element 11 (charged positively in this case) that will generate positive volume ions (represented by the + sign) that will be electrostatically repelled by element’s 11 body and generate an upward force on it.

There are many options to generate volume ions near the electrodes (elements 10 or 11). Below element 11 one can use consecutive electrodes 10 (grounded or negatively charged) side by side with other electrodes 11 (corona wire or other) in order to generate the necessary volume ions to interact with the upward element’s 11 body in order to generate a vertical force (figure 7.i)).

In order to increase the electrostatic vertical interaction force one can increase the electric charge on element 11 by using a dielectric 3 (of any relative dielectric constant or mixture of constants/materials, and with any immersed particles or not) and another element 10 (charged negatively and/or connected to earth) above the mentioned element 11 (figure 7.j)). As a further possible variation on all these setups, one can immerse magnets 4 inside the dielectric 3 (or in any other relative exterior position to the dielectric 3 or elements 10 and/or 11) as represented in figure 7.k).

Instead of being generated locally, the volume ions can be generated elsewhere by any means and later being injected or placed (through conductive elements 2, that may be electrically connected or not to element 11, or that may also be nonconductive or of any material) below element 11 (that can be flat, concave, convex, cylindrical, discoid or have any other shape) for propulsion purposes (figure 7.l)). In order to increase (the vertical force and) the temporal permanence or residence time of the volume ions near element 11 (one can use magnets 4, not represented) one can use several elements 10 (connected to earth or charged negative) like represented in figure 7.m), or one can use only a single and longer element 10 like represented in figure 7.n).

Another improvement would be to add a third electrode to the basic asymmetric capacitor type geometry (figure 7.a)). By adding an element 11 (charged positively) above the corona wires 11 (charged positively) that are themselves above grounded (or charged negatively) element 10, one can greatly increase the generated total vertical force on the electrodes (figure 7.o)). These configurations can work in the atmosphere or in any surrounding gas. One can even use an enclosure 13 (of any material, dielectric or otherwise) in order to trap element 9 (that can be any liquid or gas) between elements 10 and 11 (figure 7.p)). This last configuration has the advantage of being a propulsion unit 16 that can be used anywhere (in a vacuum if wished) and still being able to generate a force (while element 9 is present as described). Like referred before in figure 7.j) one can use a dielectric 3 (of any relative dielectric constant or mixture of constants/materials, and with any immersed particles or not) and another element 10 (charged negatively or connected to earth) above the mentioned element 11 (figure 7.q)) in order to increase the propulsive force. The application of this extra dielectric and electrode can also occur below as represented in figure 7.r). Furthermore, the mentioned elements (10, 11, 13) can have any desired shape as represented by way of example in figures 7.s) and 7.t). Sometimes, depending on the shape of elements 10 and/or 11, the force may not be on the usually expected direction because of partial Faraday cage effects or electrostatic repulsion effects, but this would have to be analyzed on a case by case basis.

Note that, in figures 7.o) to 7.t), elements 10 or 11 (above or below corona wires 11), can be replaced by a dielectric 3 or by a protection provided by element 13. The dielectric 3 (with or without an external follow up element 10 or 11 connected to a high voltage source; that can be used to attract an electrostatic charge present in element 9 to the surface of dielectric 3) could also contribute with an electrostatic propulsion force if its surface (in contact with element 9) accumulates some electrostatic charge present in element 9. One other possible variation will be the containment by element 13 of an asymmetric capacitor (formed by elements 10/11 as described previously) surrounded by element 9. As the propulsion force is electrostatic, this system can work in vacuum if element 9 is also contained by element 13. The corona wires 11 could also be replaced by any source that ionizes element 9 (for example: any charge emission sources or piezoelectric charge emission or ionization).

In a way to significantly increase the developed force by all configurations of figure 7 and avoid a spark discharge between elements 10 or 11 (charged with high tension), we suggest that the current I (I=V/R) be limited by a resistance R at the same time that tension V is increased (the resistance can be fixed or change according to the applied tension to elements 10 or 11). In this way, the applied tension to the electrodes/elements 10/11 can increase significantly (until now the applied tension was limited by the generated electric field that gave rise to a disruptive current discharge that interrupted the electrostatic propulsion mechanism) without generating a disruptive current discharge (spark discharge) which as important applications in the generated force increase that can be generated.

Although the ion generating element 11 (corona wire for example) and body electrode 11, was represented connected to a positive high voltage source (generating positive corona discharges, or a force on a positive charged body 11) one can also use negative corona discharges (or any other discharge or ion generating means) and element 11 can instead be charged negative. Therefore all the represented elements 10 and 11 can switch places or roles in any desired way (example: the injected ions in figures 7.l) to 7.n) could also be of negative polarity, with elements 11 charged negative or positive, and element 10 being charged positive, negative or grounded).

In order to illustrate some preferable (non-limiting) applications of the propulsion units 16 discussed before (in figures 1 to 7) we illustrate some concepts in figure 8. There can be a uniform distribution of propulsion units 16 around the periphery of the craft (with mass 21) in order to vector propulsion as illustrated in figure 8.a). Figures 8.b) and 8.c) illustrate possible top or bottom views of figure 8.a). Figures 8.d) to 8.f) illustrate some different shapes. There can be used any shape whatsoever for the vessel or mass 21. The only important factor is the use of several propulsion units 16 to vector propulsion which can be in the mass periphery or immersed at any position inside mass or vessel 21.

Brown, T.T.: "A method of and an apparatus or machine for producing force or motion," G.B. Patent No. 300,311, November 15, 1928.

Brown, T.T.: "Electrokinetic Apparatus," U.S. Patent No. 2,949,550, August 16, 1960.

Brown, T.T.: "Electrokinetic Apparatus," U.S. Patent No. 3,187,206, June 1, 1965.

Bushman, B. B., "Apparatus and method for amplifying a magnetic beam," US005929732A, 1999.

Canning, F. X., Melcher, C., and Winet, E., "Asymmetrical Capacitors for Propulsion," NASA/CR—2004-213312, 2004.

Campbell, J.W.: "Apparatus and Method for Generating Thrust Using a Two Dimensional, Asymmetrical Capacitor Module," U.S. Patent No. 6,317,310 B1, November 13, 2001.

Campbell, J.W.: "Apparatus for Generating Thrust Using a Two Dimensional, Asymmetrical Capacitor Module," U.S. Patent No. 6,411,493 B2, June 25, 2002.

Campbell, J.W.: "Cylindrical Asymmetrical Capacitor Devices for Space Applications," U.S. Patent No. 6,775,123 B1, August 10, 2004a.

Campbell, J.W. *et al*, "Barrel-Shaped Asymmetrical Capacitor," NASA/CR—2004-213283, 2004b.

Everest, F. A., *The Master Handbook of Acoustics*, 4th edition, McGraw-Hill, 2001.

Ford, R. A., *Homemade lightning: creative experiments in electricity*, (McGraw-Hill, 1996).

Jefimenko, O. D., *Electricity and magnetism*, 2nd ed. (Electret Scientific Co., Star City, 1989).

Jenn, D. C., "Plasma antennas: Survey of techniques and the current state of the art," NPS-CRC-03-001, Naval Postgraduate School, California, 2003.

Martins, A. A., and Pinheiro, M. J., "On the influence that the ground electrode diameter has in the propulsion efficiency of an asymmetric capacitor in nitrogen gas," *Physics Of Plasmas*, **18**, 033512 (2011a).

Martins, A. A., and Pinheiro, M. J., "Modeling of an EHD corona flow in nitrogen gas using an asymmetric capacitor for propulsion," *Journal of Electrostatics* (2011b), doi:10.1016/j.elstat.2011.02.002.

Monstein, C., and Wesley, J. P., "Observation of scalar longitudinal electrodynamic waves," *Europhysics Letters*, **59** (4), pp. 514-520, 2002.

Talley, R. L., "Twenty first century propulsion concept," Veritay Technology report for the Phillips Laboratory of the Air Force Systems Command Propulsion Directorate, 1991.

Lisbon, 22 October 2010

Claims

1. Electromagnetic propulsion system, characterized by the use of a coil (1) (with any shape, cylindrical, toroidal, etc.), with or without a ferromagnetic or magnetic core (4), at the center (or near the center, or in any position) of a dielectric disk (3) with several metallic conductive elements (2) (that may have any shape: spheres, oval, etc.) at the periphery (or at any other position) that are connected (or not) to a high voltage source (positive or negative, constant, symmetrically or asymmetrically pulsed or oscillating).

2. The apparatus according to claim 1, further characterized by the possibility of connecting elements (2) to different voltage polarities, such that the elements that are contained in half the dielectric perimeter can be connected to one polarity and the remaining to the opposite polarity, in order to generate a unidirectional force due to the interaction between the charge in elements (2) and the induced electric field E generated by the time change of the coil's current magnetic vector potential.

3. The apparatus according to claims 1 and 2, further characterized by the possibility of involving (one or more) coil(s) (1) (with any shape, cylindrical, toroidal, etc, and with or without a ferromagnetic or magnetic core (4)) with conductive element(s) (2) (of any shape, sphere, oval, ellipsoidal, parabolic, etc) that are connected (or not) to a high voltage source (positive or negative, constant, symmetrically or asymmetrically pulsed or oscillating) and that may (or not) form a Faraday cage around coil(s) (1) in order to shield this coil(s) (that are distributed around the inner periphery of element(s) (2) or in any fashion) from any outside electric fields; or by the possibility of the excitation to coil(s) (1) and/or element(s) (2) being synchronized to achieve directional propulsion.

4. The apparatus according to claims 1 to 3, further characterized by the possibility of using only magnet(s) (4) (with any shape) without surrounding coil (1), were propulsion is achieved by the asymmetric charge variation on surrounding conductive element(s) (2); or by the possibility of coil(s) (1) and/or magnet(s) (4) and/or element(s) (2) being one big unit or may represent several independent units that work separately and that may form

(or not) a global bigger unit); or by the possibility of element(s) (2) being disposed around coil(s) (1) and/or magnet(s) (4) in any number or fashion and in any geometry (for example inside, above, below or on the side of a toroidal or cylindrical coil or both coils in the same setup) and connected to any voltage polarity in any independent or global fashion; or by the possibility of element(s) (2) being protected or covered by a dielectric element (3) (or any other material).

5. The apparatus according to claims 1 to 4, further characterized by the possibility of using coil(s) (1) around a capacitor formed by two or more elements (2), separated by a dielectric (3), were at least one element (2) is electrically connected to ground and the other(s) to any voltage polarity (positive or negative, constant, symmetrically or asymmetrically pulsed or oscillating), in such a way that propulsion will be achieved by interaction with between the charge on element(s) (2) and the induced electric field E generated by the time change of the coil's (1) (with or without a ferromagnetic or magnetic core (4)) current magnetic vector potential; or by the possibility of dielectric element (3) promoting the existence of volume charge (5) in its interior and/or having conductive or semi-conductive element(s) (5) or any other embedded element (5).

6. The apparatus according to claims 1 to 5, further characterized by the possibility of using coil(s) (1) attached to element(s) (2) in such a way that coil(s) (1) (with any shape, cylindrical, circular toroidal, rectangular toroidal, etc, and with or without a ferromagnetic or magnetic core (4)) are not at the center (near the center or can even be in the center) of element(s) (2) (which can have any geometry, square, rectangular, circular, semi-circular, circular with a triangular gap or asymmetry, oval with several gaps or asymmetries, etc), where the induced electric field E generated by the time change of the coil's (1) current magnetic vector potential promotes charge separation on element(s) (2) (any number of elements which can even be stacked one above the other) and at the same time induces a directional force on the separated charges; or by the possibility of artificially augment the charge in the points of charge accumulation by any means (each

electrode(s) (2) can be one big unit or may be separated into independent sections); or by the possibility of using in all the setups discussed before any type of (symmetric or asymmetric - with any dimension or relative dimension or shape) capacitor including (for example) any ultracapacitor that can be operated at any voltage level (low voltage or high voltage) in order to dramatically increase the generated force (due to the much higher accumulated charge on the electrodes), were one possible configuration can be the use of one or more coils (1) (with or without a magnetic or ferromagnetic core (4)) immersed in a (one or more equal or different) dielectric(s) (3) (that may have any embedded substance and/or have uniform or non-uniform properties - dielectric constant, material, conductivity, embedded substance distribution, etc.) and with the electrodes (with any geometry or shape) (2) nearby (embedded in element (3) or not, and parallel or not) forming a capacitor and charged to opposing polarities (or the same polarity or any polarity or ground); or by the possibility of coil(s) (1) also being replaced by any other source of changing electric fields like radiofrequency tubes, microwave tubes or cavities, or any other equivalent electromagnetic tube (or cavity) or source that can function at any frequency.

7. The apparatus according to claims 1 to 6, further characterized by the possibility of coil(s) (1) being metal conducting coils, or fiber optic coils, or radiofrequency cable coils, or microwave cable coils, or a coil material that can produce a (conducting) plasma inside, or an electron conducting path inside, or any suitable conductor of electromagnetic energy, were the coil(s) can have any geometry (cylindrical, toroidal, etc.), or can have one or more conducting layers (from the same coil or other different coils) in any disposition or direction.

8. The apparatus according to claims 1 to 7, further characterized by the use of one or more power sources of direct current or voltage (high or low, positive or negative, constant, symmetrically or asymmetrically pulsed or oscillating), or by one or more power sources of (symmetric or asymmetric) alternating or pulsed current and/or voltage, that operates at any frequency (high or low, including radiofrequency, microwave, ultraviolet or higher), with or without any type of modulation (frequency

or amplitude modulation, for example); or a power source according to Avramenko's patent (US6104107); or a power source that produces electric or magnetic (symmetric or asymmetric) rotating fields; or a power source that produces one or more frequencies; or by the connection of one or more power sources to the same coil(s) (1) or element(s) (2); or a power source that changes continuously the frequency of the exciting wave (current or voltage) in a sequential, caotic or repetitive manner (chirped excitation), linearly or non-linearly, with or without any type of modulation, or using or not white noise, pink noise, or any type of noise or caotic electromagnetic excitation, or by the use of a power source with a delicate control of the phase; or by the use of any number of these power sources in an isolated or conjugated way; or by the use of any other power source; or by the use of any of these power sources connected to one or more coils (1) and/or elements (2).

9. Electromagnetic propulsion system, characterized by the use of a dielectric (3) (circular or with any shape, and with or without embedded conductive or semi-conductive particles in its interior or exterior), surrounded by any number of electrode(s) (2) (with any geometry, pointed, circular, etc, and positioned above, below or side of dielectric (3)) for the purpose of charging and/or rotating dielectric (3) through the known principle of electrostatic motors (Ruhmkorff's electrostatic motor principle or any other electrostatic motor configuration), and the use of magnet(s) (4) (with any shape) outside the dielectric (3) for the purpose of generating a force on the current I (rotating electric charges on element (3) or on the periphery of element (3)) transported by the dielectric (3), when element(s) (2) are connected to a high voltage source (positive or negative, constant, symmetrically or asymmetrically pulsed or oscillating) as needed; or by the possibility of magnets (4) being isolated magnets or being two or more magnets arranged in any form that projects the magnetic field lines to the current I transported by dielectric (3) (including the magnet arrangement disclosed in patent US005929732A) in order to generate a force as discussed before; or by the possibility of one or more magnets (4) having one or more coils (1) around them and connected to a power source; or by the possibility of element (3) being rotated mechanically (not dependent of

electrostatic acceleration) with appropriate magnets (4) placed at the periphery of element (3) (physically connected to the disc and rotated by it or the magnets (4) are at the element (3) periphery but disconnected from it and stationary) for force generation, where one can use any number of ion source(s) to charge (at the periphery, and/or on the top and/or on the bottom surface) element (3) (before or) while it rotates; or by the possibility of disc (3) also being replaced by a conducting material (2) (with any shape - wire, disc, ring or other (interrupted or not in order to allow the passage of current) - or cross section) that transports a current (using an appropriate power source) in order to also generate in this way a useful force for propulsion.

10. The apparatus according to claim 9, further characterized by the possibility of using coil(s) (1) (with any shape, cylindrical, toroidal, etc), with or without a ferromagnetic or magnetic core (4), at the center (or near the center, or in any position) of a conductive element (2) (of any shape, circular, elliptic, oval, etc) with several elements (4) (with any shape) at the periphery (connected or outside or inside element (2), or at any other position) of element (2), where element(s) (4) will generate a force on the currents I induced on element (2) by coil(s) (1) due to the transient electric fields E; or by the possibility of magnets (4) being isolated magnets or being two or more magnets arranged in any form that projects the magnetic field lines to the current I transported by element(s) (2) (including the magnet arrangement disclosed in patent US005929732A) in order to generate a force as discussed before; or by the possibility of one or more magnets (or ferromagnetic or other materials) (4) having one or more coils (1) around them and connected to a power source; or by the possibility of adjusting and generating the proper magnetic polarity (electromagnet) in element(s) (4) (using other coil(s) (1)) in time synchrony with the changing current I induced by coil(s) (1), in order to obtain a unidirectional force on the system.

11. The apparatus according to claims 9 and 10, further characterized by the possibility of replacing coil(s) (1) (that had the purpose to induce currents on element(s) (2)) with the mentioned magnet arrangements of two or more magnets as discussed in claim 10 (including mentioned

coil(s) (1)), that can be placed above or below element(s) (2) in order to also generate induced currents I and transient electric fields E like before, to generate a propulsion force as discussed in claim 10.

12. The apparatus according to claims 9 to 11, further characterized by the possibility of using the mentioned magnet arrangements (with coil(s) (1)) (including claim 11) above and below element(s) (2) such that both magnet arrangements oppose (or attract) the same magnetic pole (north or south) towards element(s) (2) in order to spread (almost) horizontal magnetic field lines in a plane and in element(s) (2), where propulsion will be accomplished by the interaction between the induced currents on element(s) (2) and the magnetic field lines from the mentioned magnet arrangements (in this case one can use or not additional magnets (4) as in claim 10), that will depend on the vertical position of element(s) (2) relative to the mentioned magnet arrangements.

13. The apparatus according to claims 9 to 12, further characterized by the possibility of replacing element(s) (2) with element(s) (3) with several metallic conductive elements (2) (of any shape, spheres, oval, etc) at the periphery (or at any other position) that are connected (or not) to a high voltage source (positive or negative, constant, symmetrically or asymmetrically pulsed or oscillating), which can possess all the characteristics mentioned in claims 1 to 8, where now propulsion will depend on the vertical position of element(s) (2) and (3) relative to the mentioned magnet arrangements, and the asymmetric electric fields generated by the changing currents of coil(s) (1) in these magnet arrangements.

14. The apparatus according to claims 9 to 13, further characterized by the possibility that coil(s) (1) have the properties described in claim 7 and that the power source(s) have the characteristics described in claim 8 connected to one or more coil(s) (1) and/or element(s) (2); or by the possibility of element(s) (2) being any type of conducting (including superconducting) or magnetic material (diamagnetic, ferromagnetic, paramagnetic, etc); or by the possibility of element(s) (2) being a metal (or material or several different metals or materials connected side by side) with the atoms deliberately aligned magnetically (in a permanent way) in any (one or more directions) desired

direction (that may contribute substantially for the propulsion force if the interaction of the magnetic field of these atoms with the current I present (or induced) in element (2) is in a useful direction for force production or for developing a vertical (horizontal or other) force for propulsion); or by the possibility of also passing deliberately a current (using an appropriate power source or also a homopolar generator) through one or more conducting materials (2) (with any shape - wire, disc, ring or other (interrupted or not in order to allow the passage of current) - or cross section) that can have its atoms magnetically aligned in order to also generate in this way a useful force for propulsion.

15. Electromagnetic propulsion system, characterized by the use of magnets (4) (with any shape) at the periphery (or at any other position in element (2)) of conductive element (2) (with any shape, circular disc, ring, or otherwise), and also by the presence of exterior magnet(s) (4) (with any shape) that may be supported by a conducting (or non-conducting, or any other material) element (2) (with any shape, circular ring, annulus, or otherwise), where the central element (2) (or the external element (2)) is rotated and the magnets (4) on the central element (2) induce currents on the external supporting element (2) (if it is used or if is a conductor) and the external magnets (4) also induce currents on central element (2); or by the possibility of all magnets being in any relative position or preferably where the magnets on the center element (2) have a perpendicular magnetic orientation relative to the external magnets (4) and vice versa, where any orientation can be used and magnets in the central or exterior element (2) can have alternately perpendicular different polarities, but always maintaining the perpendicular relation between the magnets in the central end exterior element (2)(example, if a magnet (4) emits a north pole towards the exterior periphery of central element (2) in the horizontal direction, then the exterior magnet will emit a north or south magnetic pole in the upward or vertical direction); or by the possibility of rotating the center (and/or exterior) element (2) with constant velocity, and/or with an acceleration and/or with a changing acceleration in either sense, and/or with a central axis, and/or with the addition of a second axis of rotation (that introduces an asymmetry in the rotation),

and/or with an eccentric axis of rotation which will constantly change the physical distance between the periphery of central (or exterior) element (2) and the external (or inner) magnets (4) (in a non-linear manner) all along the 360° axis of rotation, in order to generate an electromagnetic propulsion force in a desired direction; or by the possibility of connecting one or more elements (2) to one (or more) high (or low) voltage power source(s) with the characteristics described in claim 8; or by the possibility of one or more magnet(s) (or electromagnets, or ferromagnetic or other materials) (4) having one or more coil(s) (1), with the properties described in claim 7, around them and connected to power source(s) with the characteristics described in claim 8 connected to one or more coil(s) (1).

16. Electromagnetic propulsion system, characterized by the use of isolated magnets (4) or two or more magnets (4) arranged in any form (including the magnet arrangement disclosed in patent US005929732A) that generates a magnetic beam (or not) in order to subject a conducting element (2) (of circular, square, rectangular, conic, U shape, symmetric or asymmetric shapes or any other shape) to a strong magnetic field, where one or more magnets (or ferromagnetic or other materials) (4) have one or more coils (1) around them and connected to a power source, in such a way that when a changing current flows though coil(s) (1) a very high alternating magnetic (and electric) field is produced in volume and involves also element(s) (2) which will generate in response currents and fields in opposition to the external fields, that will induce a force of repulsion between the external and induced fields (on element(s) (2)) that can be used for propulsion purposes.

17. The apparatus according to claim 16, further characterized by the possibility of placing the referred magnet arrangement in any position relative to element (2), but preferably in the same plane (at the side or through an opening in element (2) at the center or other relative position) where some of the magnets (4) can protrude (or not) to one of the sides of element (2) (preferably below) and assume any vertical or horizontal orientation (or any other orientation); or by the possibility of adding more magnet(s) (4) to the opposite side of the magnet assembly in order to generate (or not) a second (or more) magnetic

beam in the same magnetic assembly in the opposite direction from the first (or any number of magnetic beam sources in the same assembly) and dispose the new assembly also as before in any position (preferably with the generated magnetic beams parallel to the surface of element(s) (2)) in order to generate a propulsive force as discussed before.

18. The apparatus according to claims 16 and 17, further characterized by the possibility of using any number (in order to vector propulsion and increase efficiency) of the mentioned magnet assemblies (in any pattern or geometry, and in any attractive or repelling configuration between assemblies) attached to one or more conducting elements (2) (of any shape, disc, circular, tubular, sphere, etc); or by the possibility of using any magnetic shielding material (6) (or a conducting or ferromagnetic or any other material, that will absorb or deflect the magnetic field lines into its interior) around the magnet assembly (in order to protect interior occupants near or inside element (2)); or by the possibility of using any non-magnetic material (7) to protect the magnet assembly from outside or exterior elements (9); or by the possibility of the mentioned magnet assemblies generate additional propulsive forces by the interaction with any external element(s) (9) (water, air, soil or any other) using the same mechanism referred before (in order to diminish environmental resistances to motion or to move in any environment, from water, air, land or space)); or by the possibility of element(s) (2) being any type of conducting (including superconducting) or magnetic material (diamagnetic, ferromagnetic, paramagnetic, etc); or by the possibility of element(s) (2) being a metal (or material or several different metals or materials connected side by side) with the atoms deliberately aligned magnetically (in a permanent way) in any (one or more directions) desired direction (that may contribute substantially for the propulsion force if the interaction of the magnetic field of these atoms with the current I present (or induced) in element (2) is in a useful direction for force production or for developing a vertical (horizontal or other) force for propulsion); or by the possibility of connecting one or more elements (2) to one (or more) high (or low) voltage power source(s) with the characteristics described in claim 8; or by the possibility of one or more magnet(s) (or

electromagnets, or ferromagnetic or other materials) (4) having one or more coil(s) (1), with the properties described in claim 7, around them and connected to power source(s) with the characteristics described in claim 8 connected to one or more coil(s) (1).

19. Electromagnetic propulsion system, characterized by the use of coil(s) (1) (with shape similar to elements (2) and/or (6), or of cylindrical, toroidal, or any other shape) around element(s) (2) and/or (6) (of circular, square, rectangular, conic, U shape, symmetric or asymmetric shapes or any other shape; where element(s) (6) or (4) can function as a core to coil(s) (1) or not), and protected (or not) by element (7) (with shape similar to elements (2) and/or (6), or any other shape), in such a way that when the coil(s) (1) are connected to a power source they will generate surrounding intense changing electromagnetic fields that will interact with any external environment material(s) (9) (water, air, soil or any other) which if conductive will generate opposed currents in response and as a consequence will be repelled from coil(s) (1) making possible the generation of directional propulsive forces or the appreciable diminution of resistant forces to the motion of the setup; or by the possibility that coil(s) (1) involve total or partially elements (2) and/or (6); or by the possibility that element(s) (6) can also be one or more magnetic element(s) (4) (or any other material) with any shape (with shape similar to elements (1), and/or (2), and/or (6), or hollow, tube, circular, cylindrical, toroidal, etc); or by the possibility that coil(s) (1) are any number of coils parallel or perpendicular (or at any other angle) to each other which can generate fields in phase, or out of phase (or at any phase), or even electromagnetic rotating fields; or by the possibility of any of the mentioned elements being separated in smaller sections that can function independently connected or not to the same power source; or by the possibility to use this setup to diminish environmental resistances to motion in water, air or land or to move in those elements (for example, diminish motion resistance to boats or submarines moving in water, or even protecting submarines from high pressures that exist at very high oceanic depths without having to worry about the mechanical structural integrity of the vessel); or by the possibility to create secured places under water (without

the presence of water) for the application of any purpose using appropriate structures for the desired effects (for example, use of an inverted U geometry to create a secured archaeological underwater research site without water).

20. The apparatus according to claim 19, further characterized by the possibility of instead of using a coil (1) to generate the intense electromagnetic fields, these are generated without coil (1) by directly exciting element(s) (2) and/or (6) with a changing high voltage power source; or by the possibility of these elements being protected from the external environment (9) by element(s) (3) and/or (7), and additional protection can be used (for any person inside) inside element(s) (2) and/or (6) by using element(s) (3), (6), or (7); or by the possibility of any of the mentioned elements being separated in smaller sections that can function independently connected or not to the same power source; or by the possibility of all the geometries and application characteristics mentioned in claim 19 being valid for this variation; or by the possibility of having one or more coil(s) (1) (with the properties described in claim 7) and/or element(s) (2) and/or (6) connected to power source(s) with the characteristics described in claim 8.

21. Electromagnetic propulsion system, characterized by the use of an enclosure (13) (dielectric, semi-conductor, or of any other material which may contain any embedded particles - for example led - or not; and that may have any shape, cylindrical, rectangular, oval, etc; and that may be transparent or opaque), where a vacuum or low pressure (of any gas) (14) is maintained, containing a capacitor with cathode (10) (connected to the negative terminal of a high voltage source, constant, symmetrically or asymmetrically pulsed or oscillating, that can also (or not) be connected to the ground, or only connected to the ground) separated from anode (11) (connected to the positive terminal of a high voltage source, constant, symmetrically or asymmetrically pulsed or oscillating (that can also be connected to the ground or not)) using (or not using) a dielectric (3) (that can have any relative dielectric constant or variable shape or cross section, can have only one dielectric constant or have several different dielectric materials with different dielectric constants side by side (and with any immersed particles or not); with

or without complete or partial gaps (the dielectric is only at the cathode or the anode, or both - at the right or left of each electrode - and may accommodate or not for a third dielectric piece that may connect both dielectrics or allow for the distance or space between them to be changed as desired), and with or without volume charge or embedded conductive or semi-conductive particles (5)), that may be supported (or not) by (any number of) supporting elements (15), whereby a force is developed by the capacitor and transmitted to the whole structure (in order to form a propulsion unit (16)) whenever electrons (12) emitted by element (10) are accelerated towards element (11) and collide with it, in a continuous manner (continuous force) or in transient events like sparks (pulsed force).

22. The apparatus according to claim 21, further characterized by the possibility of element(s) (3) and/or (10) and/or (11) and/or (13) and/or (15) having any shape (flat, disks, cylinders, hollow or not, spheres, oval, toroidal, smooth, pointed or sharp, wires, squares, rectangles, convex, concave, circular, parabolic, symmetric or asymmetric by themselves or in relation to other elements and with similar or different dimensions in relation to other elements, or with any other shape, width or length, or composite of shapes); or by the possibility of element(s) (3) connecting (or not) element(s) (10) and (11) (leaving a hollow space or spaces at its geometrical center or elsewhere with element (14) or not) or may be only on one or both of those elements separately (or may have an element (14) gap or a gap with an element (3) of different dimension than the adjacent element (3) and/or (10) and/or (11)); or by the possibility of using any combination of one or more element(s) (3) and/or (10) and/or (11) and/or (13) and/or (15) together (for example, using a sharp pointed element (10) together with a smooth element (10) for the purpose of facilitating electron emission or discharge through the sharp electrode).

23. The apparatus according to claims 21 and 22, further characterized by the possibility of placing element(s) (10) at (or near) one of the walls of enclosure (13) and/or placing element(s) (11) near (or at) the opposite (or any other) wall of enclosure (13); or by the possibility that element(s) (11) (and/or (10) and/or (3)) are near (or at) one of the walls of enclosure (13) but outside of enclosure

(13), and adjacent to these element(s) (11) (and/or (10) and/or (3)) there can be (or not) a dielectric (3), which can also (or not) be in contact with another element (10) (or (11)) forming a capacitor for the purpose to increase the charge on element (11) (or (10)); or by the possibility that this last capacitor can be placed inside enclosure (13) (or that element(s) (3) and/or (10) can be left outside enclosure (13) and the rest inside) on the opposing wall to existing element(s) (10) which emit electrons (12); or by the possibility that this last element (10) also has a dielectric (3) with or without an adjacent element (11) for the purpose to increase the charge on element (10) and augment the emission of electrons (12) (or that element(s) (3) and/or (11) can be left outside enclosure (13) and the rest inside); or by the possibility that one or more electrodes (cathodes (10) and/or anodes (11)) can be completely or partially enclosed by a dielectric (3), that can be positioned outside (or inside) enclosure (13); or by the possibility that the dielectric (3) and/or anode (11) and/or elements (10) and/or (17) can be used to close one (or more) side(s) of enclosure (13), or eventually one can use only anode (11) or one of the mentioned elements to close one (or more) side(s) of enclosure (13) (assuming that in these variations space is made to use vacuum sealing o-rings and closing bolts, or only glue, or any other method to solidify together the different components and enable vacuum or low pressure sealing (14)); or by the possibility that several series of the mentioned capacitors (in the emitting side and/or collision side) can be placed one after the other inside the same enclosure (13) or with successive enclosures (13); or by the possibility that electron emission (12) by element(s) (10) can be synchronized by any means (using voltage pulses on element(s) (10) and/or (11) for example), or can be continuous (with a fixed or variable controlled intensity).

24. The apparatus according to claims 21 to 23, further characterized by the possibility of emitting cathode (10) being simply an electron filament (heated or not); or by the possibility of element (10) being a laser (17) or any electron source with (or without) accompanying charge accelerator (17) (with any known system of charge or electron acceleration) in order to make electron (or any other charged particle) acceleration independent of the electric fields due to the (magnitude of) voltage polarity

on element(s) (10) and/or (11); or by the possibility of using superconducting electrodes on elements (10) and/or (11) in order to improve the effect or broaden the discharge to the whole elements surface; or by the possibility of using any known (large surface or otherwise) discharge used to generate and/or accelerate electrons (or any other charged particles with any polarity) towards element (11) (or (10)); or by the possibility of using any number of elements (10) and/or (17) emitting along (the vertical and/or horizontal directions) and towards the surface of element(s) (11); or by the possibility of element(s) (3) and/or (10) and/or (11) and/or (17) being fixed or being able to be directed, rotated or placed anywhere inside element(s) (13).

25. The apparatus according to claims 21 to 24, further characterized by the possibility of using a dielectric (3) between element(s) (10) and (11) that allows for a passage or channel with element (14) in the geometric center (or periphery or at any position) of element(s) (10) and/or (11); or by the possibility of using one or more coil(s) (1) (with or without magnetic or ferromagnetic core (4), and where the coil(s) of all embodiments can be excited by any constant, symmetrically or asymmetrically pulsed or oscillating, or modulated or any other current or voltage waveform or wave shape), and/or magnet(s) (4), around the whole enclosure (13) and/or element(s) (3) and/or (10) and/or (11) and/or (17) (or in any other disposition) in order to generate a magnetic field in any desired direction for any desired purpose (for example: to diminish the heat load on the anode (11), or to control the accelerated electrons or charged particles in order to manipulate or change the zone of impact in order to alter or control the direction of the produced force, or to increase the heat load on the cathode (10) in order to increase electron emission); or by the possibility of emitted electrons (12) hitting element (10) (instead of element (11) that remains near element(10) and separated or not by element(s) (3) and/or (9) and/or (14)) in the capacitor (on the collision side) mentioned in claim 23 (where element(s) (11) and/or (3) can be inside or outside enclosure (13)) and where element(s) (10) (that are connected to ground in this case) can involve element(s) (11) partially or completely.

26. The apparatus according to claims 21 to 25, further characterized by the possibility of element(s) (10) and/or (17) being involved by element(s) (2) and/or (11) (forming a Faraday cage) and immersed in a vacuum (or low pressure) (14), in such a way that electrons (12) are emitted from element(s) (10) and/or (17) towards element(s) (2) and/or (11) (that are charged with any voltage polarity, positive or negative, constant, symmetrically or asymmetrically pulsed or oscillating) in order to generate a directional force as desired; or by the possibility of element(s) (10) and/or (17) being fixed or being able to be directed, rotated or placed anywhere inside element(s) (2) and/or (11); or by the possibility of using element(s) (2) and/or (11) tilted in any angle in an evacuated environment (14) inside an enclosure (13), with element(s) (10) and/or (17) emitting electrons (12) (towards element(s) (2) and/or (11)) above or below or to the side of element(s) (2) and/or (11); or by the possibility of using any number of element(s) (2)/(11), and/or element(s) (10)/(17), and/or element(s) (3) at any angle or relative position, that can be in a fixed or moving (rotating or translacional) position relative to itself or each other or in relation to chamber (13); or by the possibility of using a system that allows for the flexible change of physical distance between elements (10) (or (17)) and (11) were the dielectric (3) can be separated into three different parts (or any number of parts), two of the same size (or similar size or any other size) of elements (10) and/or (11) (and positioned near those elements) and a third horizontal part (cylinder, rectangle, or any other shape) that provides for the physical connection between all the elements (between the different dielectric parts (3) or between some dielectric parts (3) and elements (10) and/or (11) directly) and that can be displaced in the horizontal direction and also be fixed in any desired position, were the horizontal dielectric element (3) can eventually enter (or not) inside other elements (3) and/or (10), and/or (11); or by the possibility of the dielectric (3) may eventually not be present at the side of elements (10) and/or (11); or by the possibility that elements (10) and/or (11) are of any material with any atomic number; or by the possibility of adding also a dielectric (3) and/or an additional element (10) (protected or enclosed by element (3)) to the left (or

at any other position) of element (11) for the purpose to augment the electric charge on element (11).

27. The apparatus according to claims 21 to 26, further characterized by the possibility of using element (11) (that is charged positive - constant, pulsed, alternated, or other - in this case) at the center of enclosure (13) (that is evacuated or at low pressure (14)) and using elements (10) and/or (17) at the right and/or left that emit electrons (12) or charged particles towards element (11) (instead of element (11) at the center, one can use any variation of the previous setups, for example: cathode (10) at the center connected to a negative potential and/or ground, surrounded to the right and left by a dielectric (3) followed by anodes (11); this would augment the positive charge on the exposed elements (11) to the incoming stream (12) of charged particles), in order to alternately and rapidly generate propulsive forces in two opposite directions as desired; or by the possibility of using the last setup by activating both elements (10) and/or (17) (at the right and left) at the same time (were element (11) can be connected only to ground or to any other voltage polarity) in order to generate high intensity induced electric fields in opposite directions that will generate a gravitational repulsion as explained in World patent WO 2010/151161 A2 which can also be used for propulsion due to its property for mass repulsion; or by the possibility of using all known and common characteristics of any x ray tube together with the embodiments described here, including any extra electrodes like anti-cathodes, or pressure regulating systems, or lead added to the enclosure (13) in order to diminish the transmitted x rays, or any cooling system (etc), or concave cathodes (10) to focus the electron beam (12) on the anode, or using any type of electron (or any other charged particle with any polarity) source, or the anode (11) can also have any embedded cooling system in order to maintain proper working temperature for functioning, and may rotate or not, and the anode's surface (or part of the surface) can be in any direction relative to elements (10) and/or (17); or by the possibility that elements (10) and/or (11) are superconductive or not; or by the possibility of using in any of the described setups any type of (symmetric or asymmetric - with any dimension or relative dimension or shape) capacitor including (for example) any ultracapacitor

that can be operated at any voltage level (low voltage or high voltage) in order to dramatically increase the generated force (due to the much higher accumulated charge on the electrodes); or by the possibility that in all the setups the dielectric (3) may have any embedded substance and/or have uniform or non-uniform properties (dielectric constant, material, conductivity, embedded substance distribution, etc.); or by the possibility of all the mentioned configurations being also used to produce or generate electric energy if they are attached (and excited in order to produce a unidirectional or rotational force) to any element that produces energy by rotation (for example: if they are attached to the blades of a wind turbine or equivalent); or by the possibility of all the mentioned setups also having a residual force even without any electron (or any other charged particle) emission; or by the possibility of having one or more coil(s) (1) (with the properties described in claim 7) and/or element(s) (2) and/or (10) and/or (11) and/or (17) connected to (one or more equal or different voltage and/or current - any type of constant, pulsed or oscillating excitation) power source(s) with the characteristics described in claim 8.

28. Electromagnetic propulsion system, characterized by the use of an element 18 (with the shape of a sphere, oval, toroid, rectangle, disc, concave, convex, or any other shape), that can be involved (or not) with any desired material (dielectric, semi-conductor, or any other), near a capacitor with cathode (10) (with any shape) connected to ground (or negative, constant, pulsed or oscillating), a dielectric (one or more) (3) (with any shape or with any dielectric constant and with or without any immersed particles (5) - including conductive/semi-conductive - and with or without volume charge (5)) and anode (11) (with any shape) connected to a high voltage polarity (positive or negative, constant, pulsed or oscillating), in such a way that a propulsive force will be generated when the electric fields emitted by element (18) interact with the charge accumulated in element (11) or with any other charged element (dielectric or any other); or by the possibility that if the applied voltage to element (11) is constant then the electric field from element (18) has to be asymmetrical, that is, the electric field directed to the right as to have higher magnitude than the one directed to the left (or vice-versa) in order to generate a directional

force (feeding element (18) with asymmetric voltage/current impulses or pulses in order to generate a resultant force on element (11) in a desired direction); or by the possibility of using only elements (2) and/or (3) and/or (11) (with any shape) electrostatically charged or connected to a high voltage polarity (positive or negative, constant, pulsed or oscillating) and subject to the electric field of element (18) to generate propulsion forces; or by the possibility of connecting elements (2) and/or (11) to an oscillating voltage source at the same frequency and phase has the one feeding element (18), or at the opposite phase or with any other phase (or frequency) relationship between the two signals.

29. The apparatus according to claim 28, further characterized by the possibility of placing a conducting element (2) behind element(s) (18) in order to reflect the radiation from element (18) (and form an electromagnetic lens (19)) in a given direction, where element (2) can have the shape of a parabolic reflector (or any other shape) in order to focus the radiation from element (18) like a beam in any desired direction; or by the possibility of element (2) being a simple conducting element or connected to any voltage polarity (positive or negative, constant, pulsed or oscillating); or by the possibility of element (2) being made of several lamps (one or more and with any geometry) with plasma inside in order to form a plasma reflector; or by the possibility of element (2) and/or (18) being exposed to any environmental element (9) or being protected by an enclosure (13) of any material and with any shape; or by the possibility of using a zone plate ((2) or (19)) or any other type of acoustic lens as an acoustic lens for electrodynamic longitudinal waves; or by the possibility of elements (2) that compose element (19) being simple conducting elements or connected to any voltage polarity (positive or negative, constant, pulsed or oscillating); or by the possibility of elements (2) being made with circular lamps with plasma inside; or by the possibility of elements (2), (18) and (19) being exposed to any environmental element (9) or being protected by an enclosure (13) of any material and with any shape; or by the possibility of enclosure (13) allowing or not for a space between the referred elements and enclosure (13); or by the possibility that if a space is allowed between enclosure (13) and element (2) which contains any gas at any pressure, then

the setup can also function as a plasma (20) antenna emitting longitudinal electric fields like element (18), if a voltage polarity (positive or negative, constant, pulsed or oscillating) is applied to element (2) that ionizes and moves the surrounding gas particles in order to make them also emit electrodynamic longitudinal waves.

30. The apparatus according to claim 28 and 29, further characterized by the possibility of using all setups referred in claim 29 as electric longitudinal wave emitters, which can be used for propulsion purposes like mentioned in claim 28; or by the possibility that elements (2) and/or (10) and/or (11) and/or (18) and/or (19) are superconductive or not; or by the possibility of using in any of the described setups any type of (symmetric or asymmetric - with any dimension or relative dimension or shape) capacitor including (for example) any ultracapacitor that can be operated at any voltage level (low voltage or high voltage) in order to dramatically increase the generated force (due to the much higher accumulated charge on the electrodes); or by the possibility that in all the setups the dielectric (3) may have any embedded substance and/or have uniform or non-uniform properties (dielectric constant, material, conductivity, embedded substance distribution, etc.); or by the possibility of having one or more element(s) (2) and/or (10) and/or (11) and/or (18) and/or (19) connected to power source(s) with the characteristics described in claim 8.

31. Electromagnetic propulsion system, characterized by the use of a capacitor with cathode (10) (connected to the negative terminal of a high voltage source, constant, symmetrically or asymmetrically pulsed or oscillating, that can also (or not) be connected to the ground, or only connected to the ground) separated from anode (11) (connected to the positive terminal of a high voltage source, constant, symmetrically or asymmetrically pulsed or oscillating (that can also be connected to the ground or not)) that makes use of (any number of) magnets (4) at the extremities of cathode (10) for the purpose of generating a magnetic field that is parallel to the surface of element (10) (magnets (4) can be placed in any given position or orientation - in attraction or repulsion with any nearby magnets - while generating magnetic field components that are parallel (and eventually perpendicular or in any other

direction) to the surface of element (10) and/or (11)); or by the possibility of using any number of magnets (4) along the length (or width) of element (10) (and/or (11), and/or element (3) or any other element of any shape) which can be placed inside or outside element (10) (and/or (11), and/or element (3) or any other element of any shape) in any configuration, geometry or pattern (linear, circular, concave, convex, etc.); or by the possibility of using any number of elements (10) and/or (11) and/or (3) (dielectric) and/or (4) (magnets or coils (1) with or without magnetic or ferromagnetic cores) in close proximity and in any relative position (upwards or downwards) or orientation; or by the possibility of elements (10) and/or (11) having special ionizing features if desired (for example: metallic arrow, three needles, one needle, etc.); or by the possibility of using below element(s) (11) (and/or (10)) consecutive electrodes (10) (grounded or negatively charged or otherwise) side by side with other electrodes (11) (corona wire or any other) in order to generate the necessary volume ions to interact with the upward element's (11) body in order to generate a vertical electrostatic force; or by the possibility of using a dielectric (3) (of any relative dielectric constant or mixture of constants/materials, and with any immersed particles or not) and another element (10) (charged negatively or connected to earth or otherwise) above the mentioned element(s) (11) with the purpose to increase the electrostatic charge (and the electrostatic force) on element(s) (11); or by the possibility of immersing (or containing) elements (4) inside the dielectric (3) (or in any other relative exterior position to the dielectric (3) and/or elements (10) and/or (11)) or inside any other material.

32. The apparatus according to claim 31, further characterized by the possibility of the volume ions being generated elsewhere by any means and later being injected or placed (through conductive elements (2), that may be electrically connected or not to element (11), or that may also be nonconductive or be of any other material) below element (11) and/or (10) for propulsion purposes; or by the possibility of using elements (4) and/or several elements (10) or eventually only a single and longer element (10) nearby element (11) (upwards, downwards or other relative position); or by the possibility of adding a third

electrode to the basic asymmetric capacitor type geometry (of claim 31) by adding an element (11) (charged positively) above the corona wires (11) (charged positively) that are themselves above grounded (or charged negatively) element (10) (that can work in the atmosphere or in any surrounding gas); or by the possibility of using an enclosure (13) (of any material, dielectric or otherwise) in order to trap element (9) (that can be any liquid or gas) between main elements (10) and (11) (advantage of being a propulsion unit (16) that can be used anywhere (in a vacuum if wished) and still being able to generate a force while element (9) is present as described); or by the possibility of again using a dielectric (3) (of any relative dielectric constant or mixture of constants/materials, and with any immersed particles or not) and another element (10) (charged negatively or connected to earth or otherwise) above (or below) the mentioned element (11); or by the possibility of element(s) (3) and/or (10) and/or (11) and/or (13) having any shape (flat, disks, cylinders, hollow or not, spheres, oval, toroidal, smooth, pointed or sharp, wires, squares, rectangles, convex, concave, circular, parabolic, symmetric or asymmetric by themselves or in relation to other elements and with similar or different dimensions in relation to other elements, or with any other shape, width or length, or composite of shapes); or by the possibility of the ion generating element (11) (corona wire for example) and body electrode (11) (that was represented connected to a positive high voltage source, generating positive corona discharges, or a force on a positive charged body (11)) switching places or roles in any desired way (example: the injected ions mentioned at the beginning of claim 32 could also be of negative polarity, with elements (11) charged negative or positive, and element (10) being charged positive, negative or grounded; or one can also use negative corona discharges (or any other discharge or ion generating means) and element (11) can instead be charged negative); or by the possibility that sometimes, depending on the shape of elements (10) and/or (11), the force may not be on the usually expected direction because of partial Faraday cage effects or electrostatic repulsion effects (that would have to be analyzed on a case by case basis); or by the possibility that elements (10) and/or (11) are superconductive or not;

or by the possibility of elements (10) or (11) (above or below corona wires (11)), can be replaced by a dielectric (3) (with or without an external follow up element (10) or (11) connected to a high voltage source; that can be used to attract an electrostatic charge present in element (9) to the surface of dielectric (3)) that could also contribute with an electrostatic propulsion force if its surface (in contact with element (9)) accumulates some electrostatic charge present in element (9); or by the possibility of containment by element (13) of an (any number of) asymmetric capacitor (formed by elements (10)/(11) as described previously) surrounded by element (9); or by the possibility of the corona wires (11) being replaced by any source that ionizes element (9) (for example: any charge emission sources or piezoelectric charge emission or ionization); or by the possibility that current I (I=V/R), applied to elements (10) or (11), being limited by a resistance R at the same time that tension V is increased (the resistance can be fixed or change according to the applied tension to elements (10) or (11)); or by the possibility of using in any of the described setups any type of (symmetric or asymmetric - with any dimension or relative dimension or shape) capacitor including (for example) any ultracapacitor that can be operated at any voltage level (low voltage or high voltage) in order to dramatically increase the generated force (due to the much higher accumulated charge on the electrodes); or by the possibility that in all the setups the dielectric (3) may have any embedded substance and/or have uniform or non-uniform properties (dielectric constant, material, conductivity, embedded substance distribution, etc.); or by the possibility of having one or more coil(s) (1) (with the properties described in claim 7) and/or element(s) (2) and/or (10) and/or (11) connected to (one or more equal or different voltage and/or current - any type of constant, pulsed or oscillating excitation) power source(s) with the characteristics described in claim 8.

33. Electromagnetic propulsion system, characterized by the possibility of using the apparatus according to claims 1 to 8, or 9 to 14, or 15, or 16 to 18, or 19 to 20, or 21 to 27, or 28 to 30, or 31 to 32; or by the possibility of using, in any independent or conjugated way, any of the setups mentioned in this claim (propulsion units (16)), mechanically attached to a mass (21) (or part of that mass

(21), which has any shape), and disposed around its periphery (or at any other desired position, in the interior or exterior of mass (21)) in any number and/or disposition for propulsion purposes; or by the possibility that any of the conducting elements referred in these claims being superconductive or not.

Lisbon, 22 October 2010

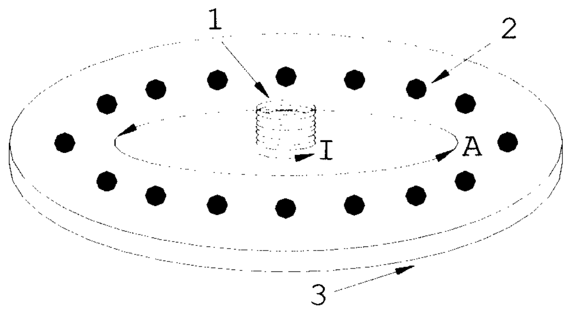

Figure 1.a)

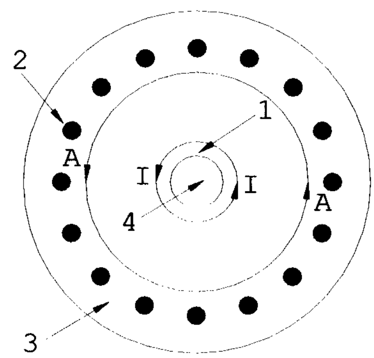

Figure 1.b)

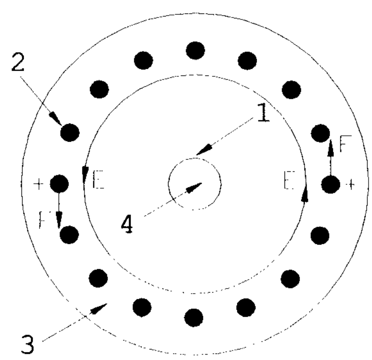

Figure 1.c)

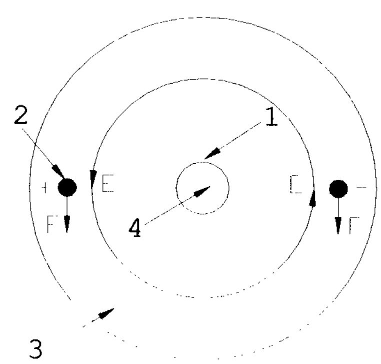

Figure 1.d)

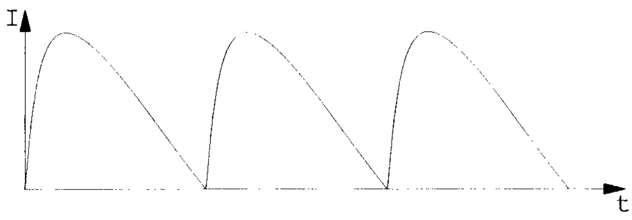

Figure 1.e)

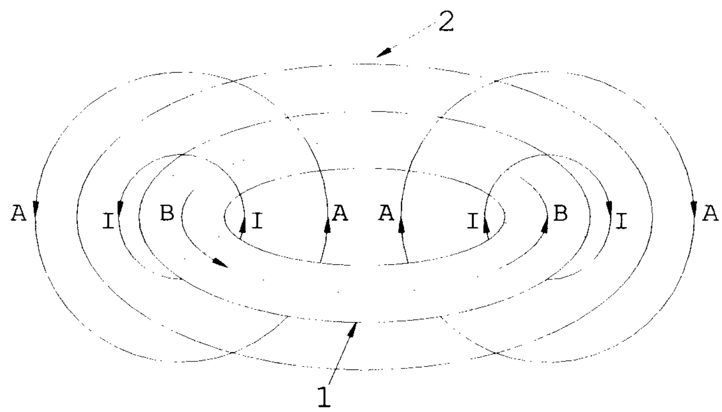

Figure 1.f)

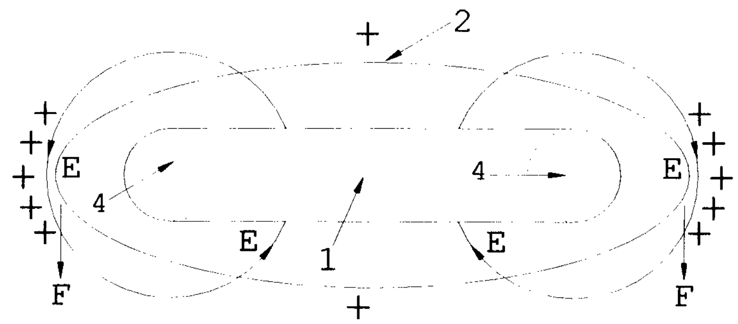

Figure 1.g)

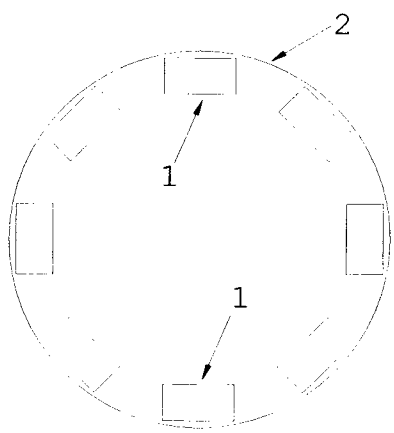

Figure 1.h)

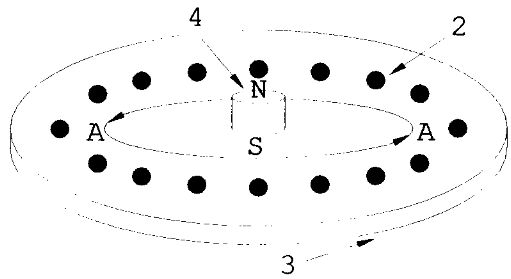

Figure 1.i)

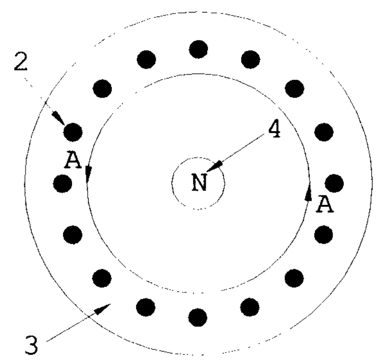

Figure 1.j)

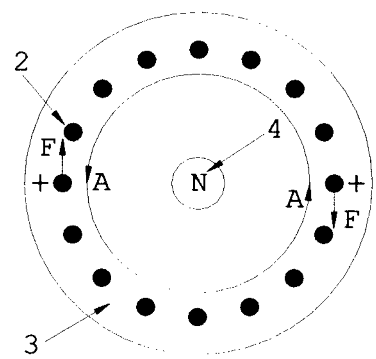

Figure 1.k)

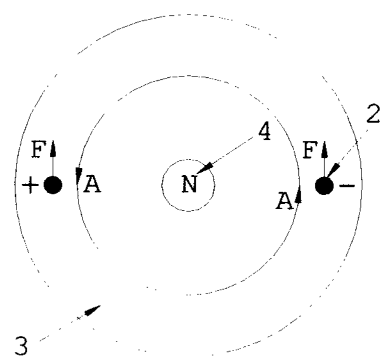

Figure 1.l)

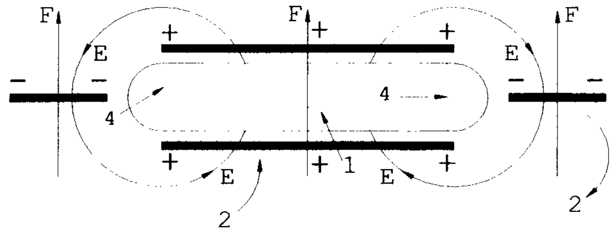

Figure 1.m)

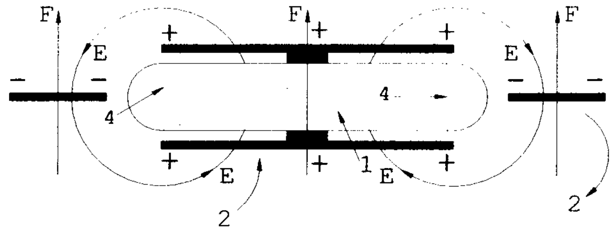

Figure 1.n)

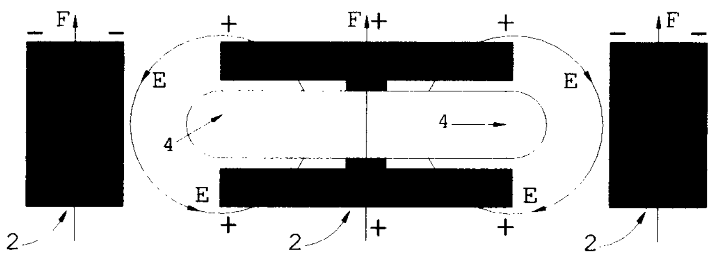

Figure 1.o)

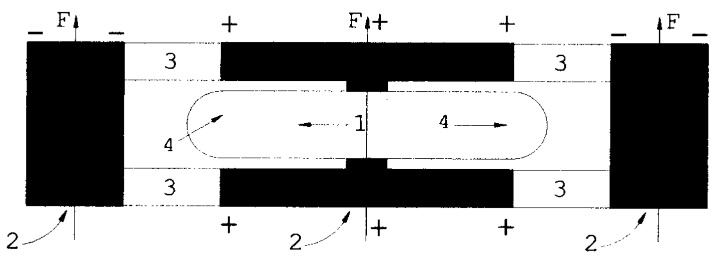

Figure 1.p)

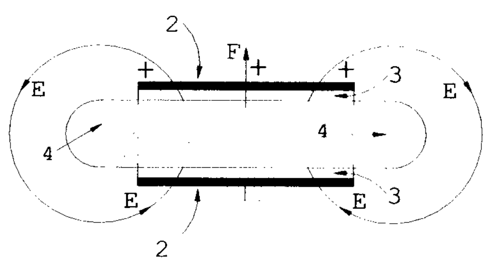

Figure 1.q)

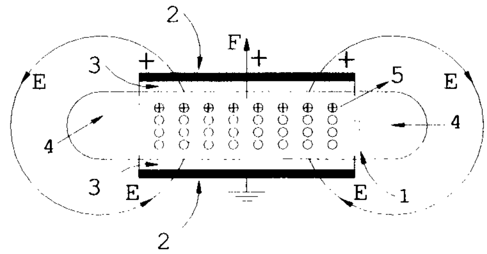

Figure 1.r)

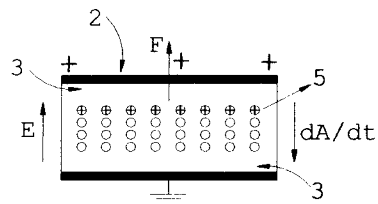

Figure 1.s)

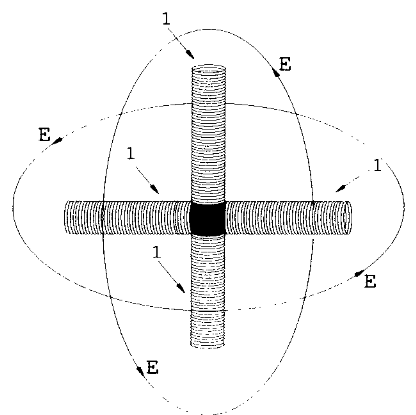

Figure 1.t)

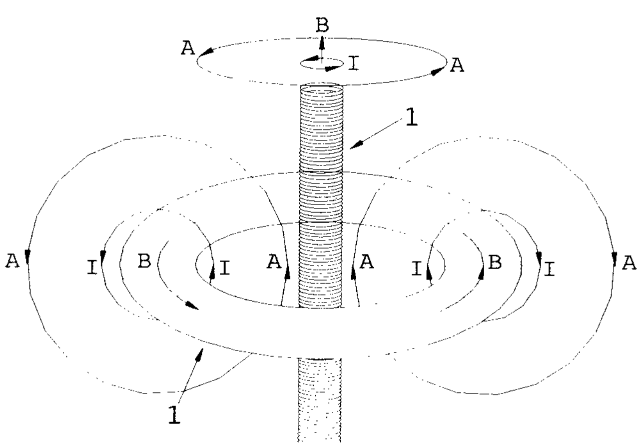

Figure 1.u)

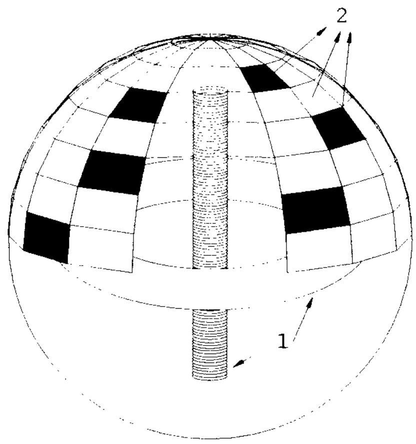

Figure 1.v)

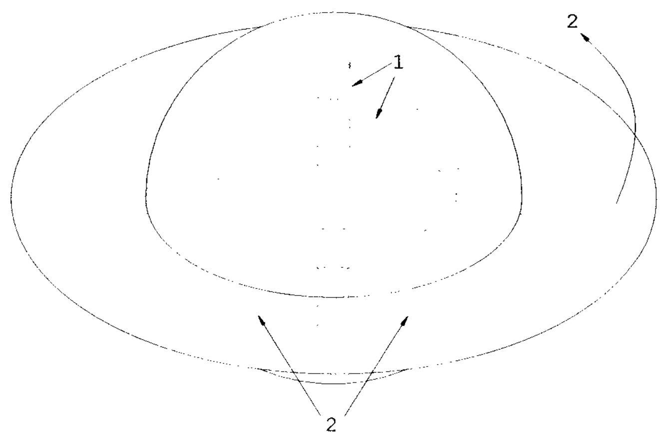

Figure 1.w)

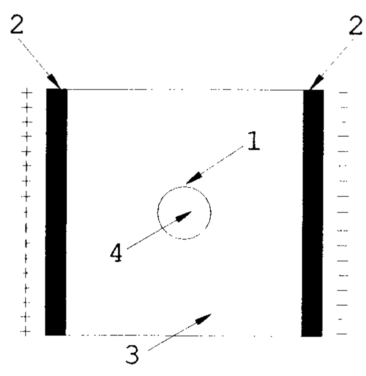

Figure 1.x)

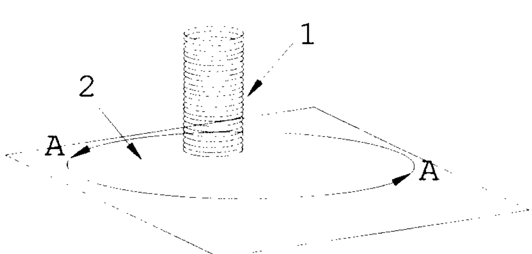

Figure 2.a)

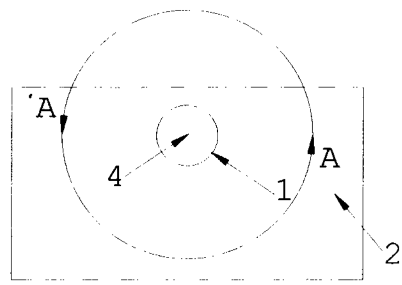

Figure 2.b)

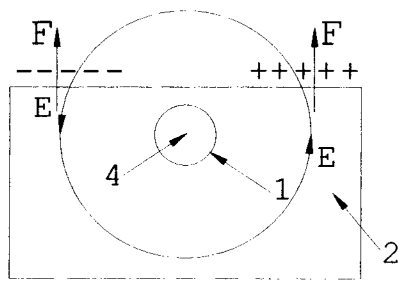

Figure 2.c)

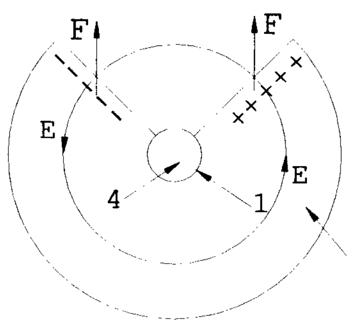

Figure 2.d)

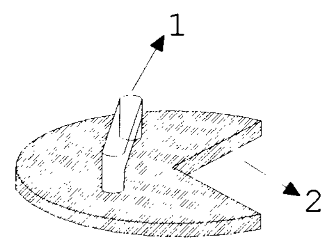

Figure 2.e)

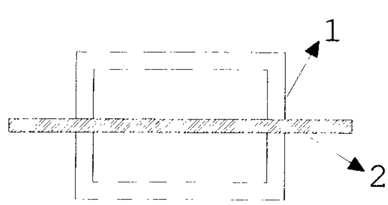

Figure 2.f)

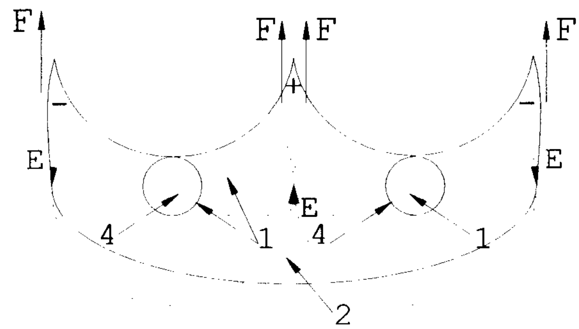

Figure 2.g)

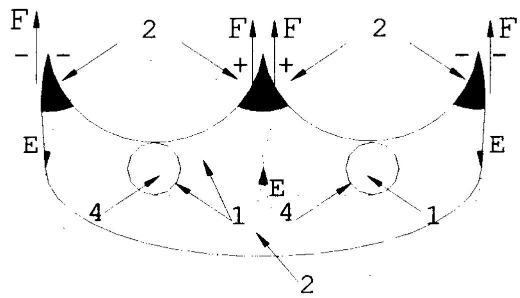

Figure 2.h)

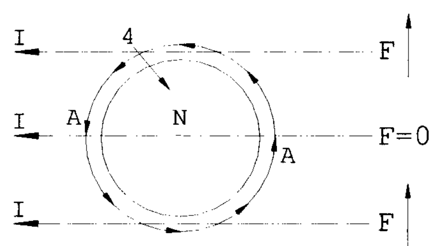

Figure 3.a)

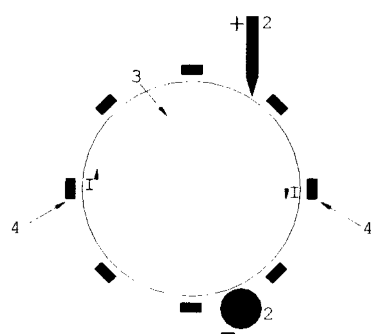

Figure 3.b)

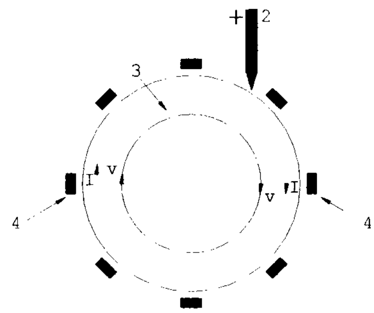

Figure 3.c)

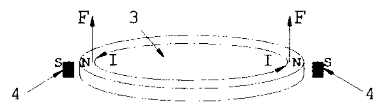

Figure 3.d)

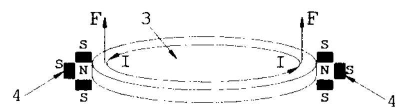

Figure 3.e)

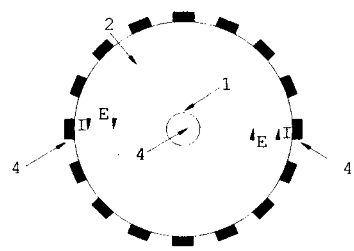

Figure 3.f)

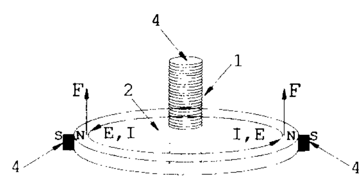

Figure 3.g)

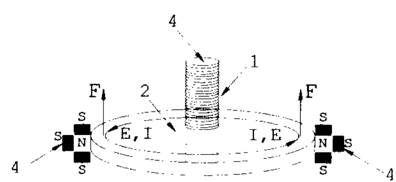

Figure 3.h)

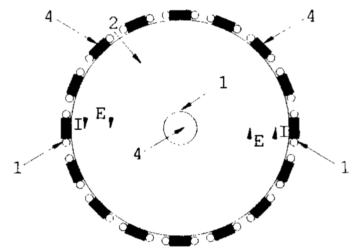

Figure 3.i)

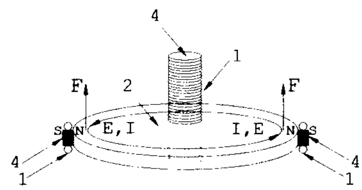

Figure 3.j)

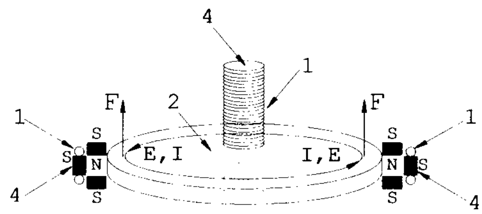

Figure 3.k)

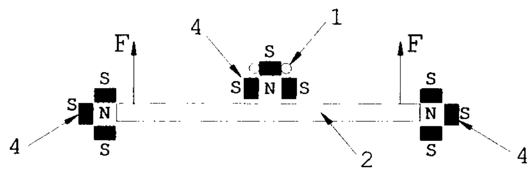

Figure 3.l)

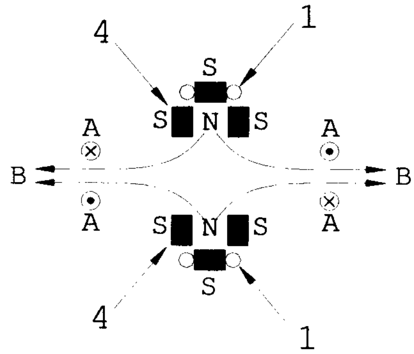

Figure 3.m)

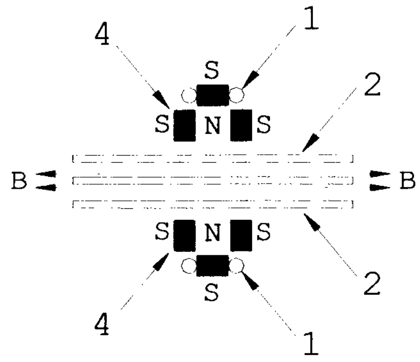

Figure 3.n)

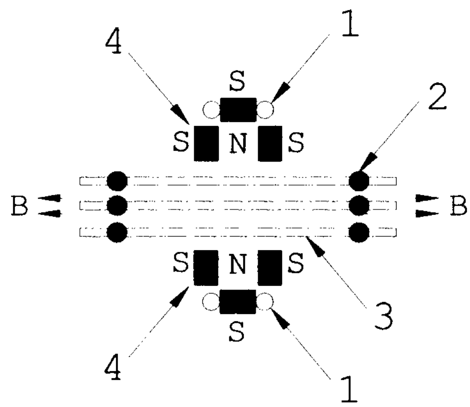

Figure 3.o)

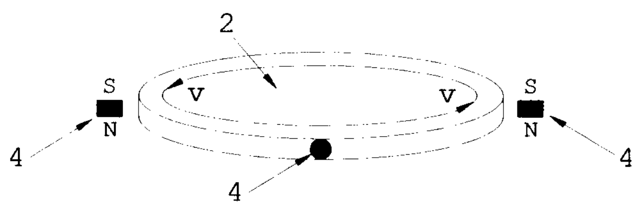

Figure 3.p)

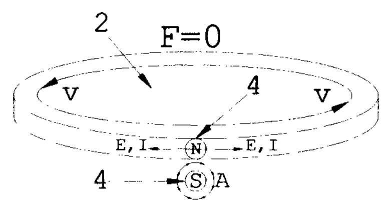

Figure 3.q)

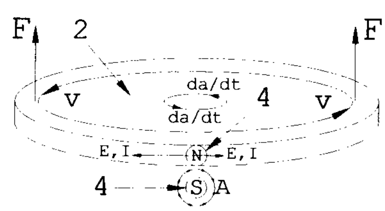

Figure 3.r)

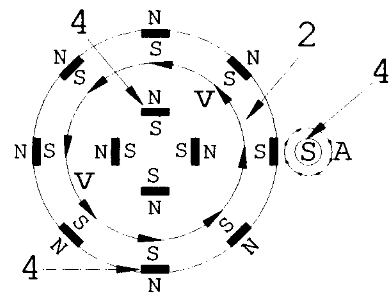

Figure 3.s)

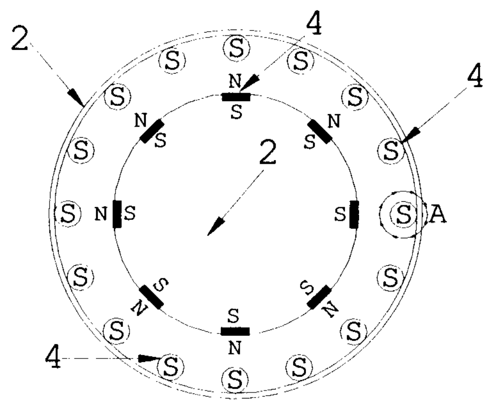

Figure 3.t)

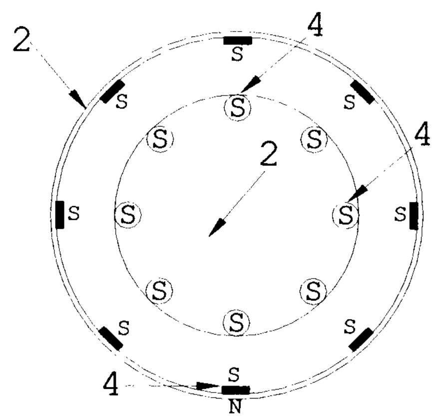

Figure 3.u)

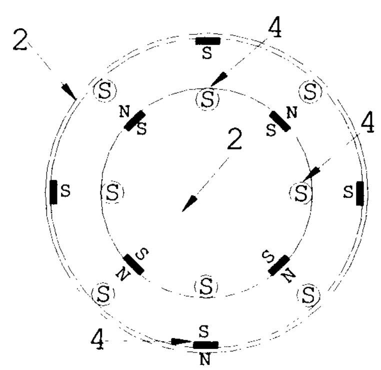

Figure 3.v)

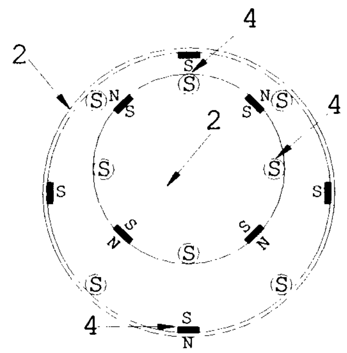

Figure 3.w)

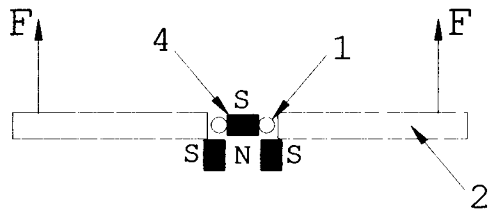

Figure 4.a)

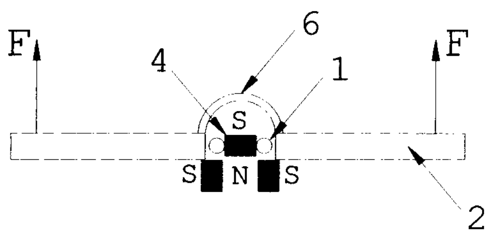

Figure 4.b)

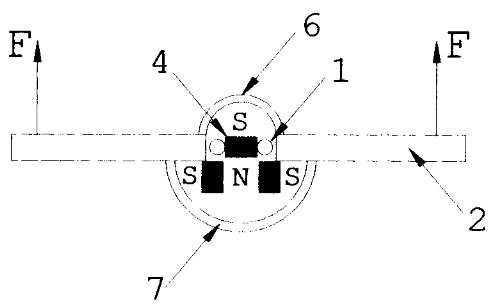

Figure 4.c)

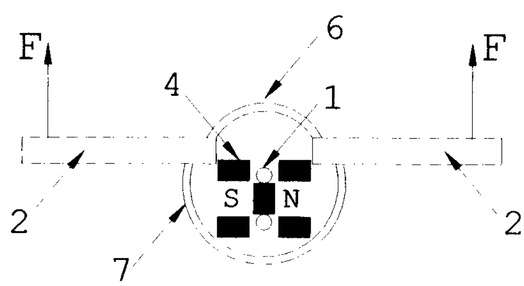

Figure 4.d)

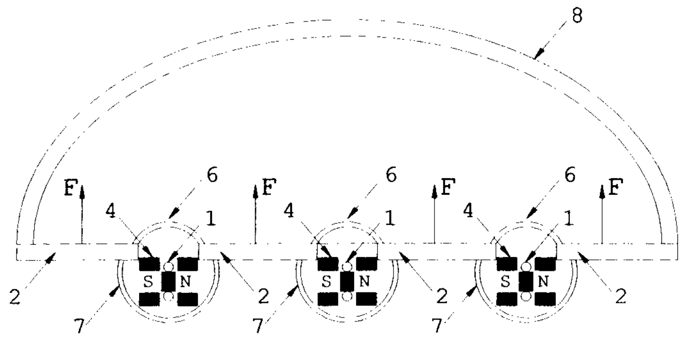

Figure 4.e)

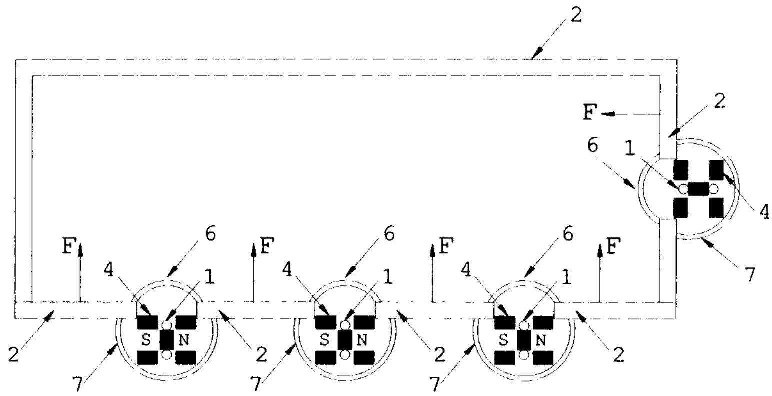

Figure 4.f)

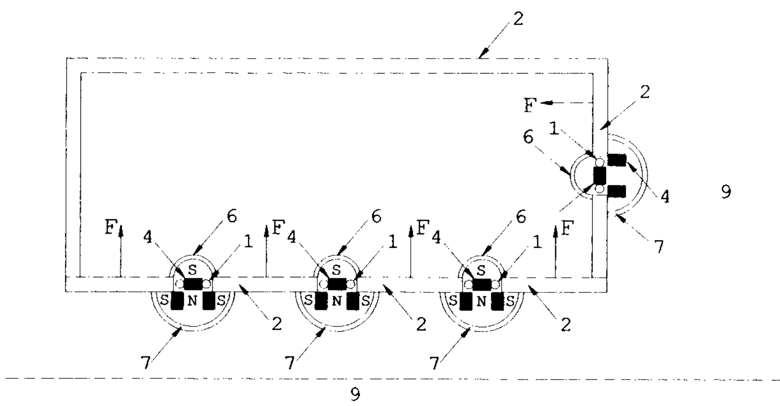

Figure 4.g)

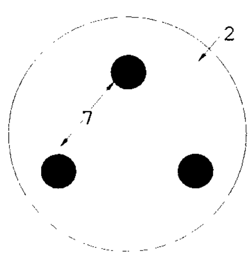

Figure 4.h)

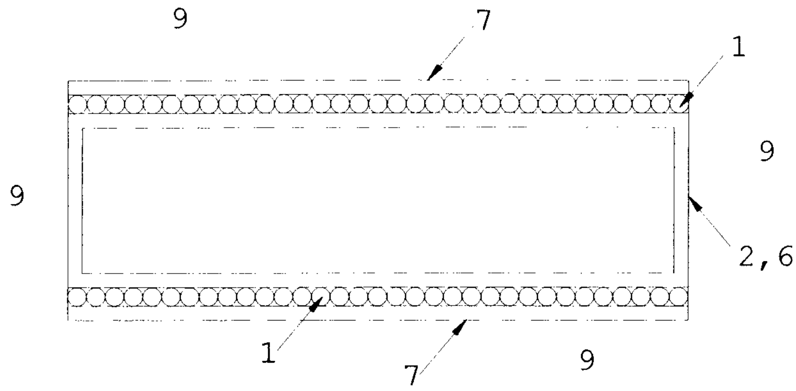

Figure 4.i)

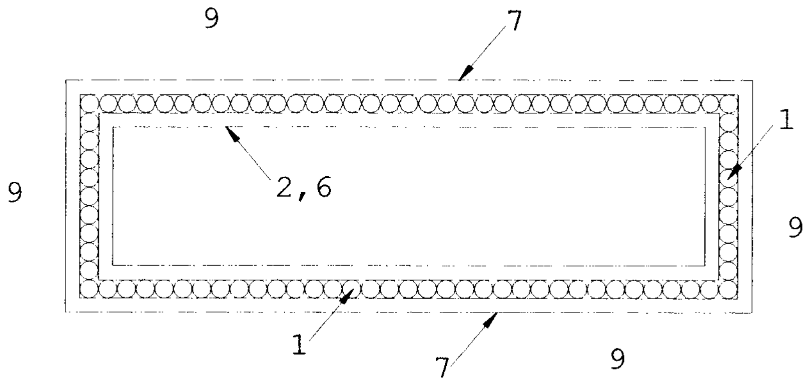

Figure 4.j)

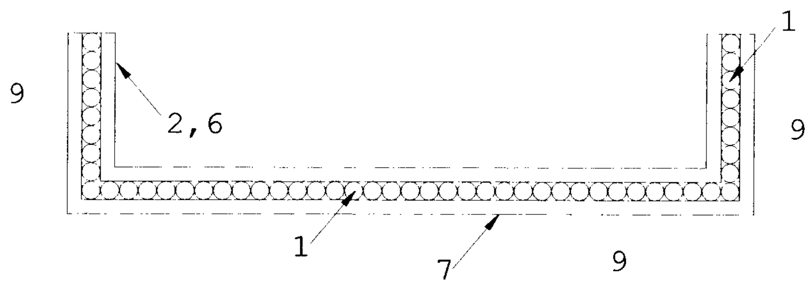

Figure 4.k)

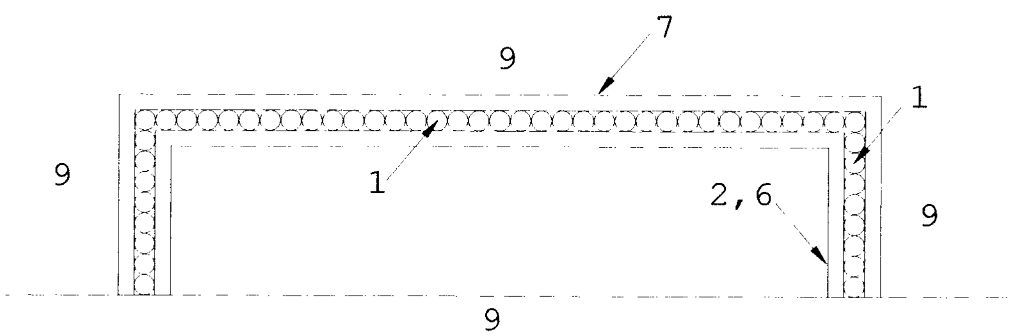

Figure 4.l)

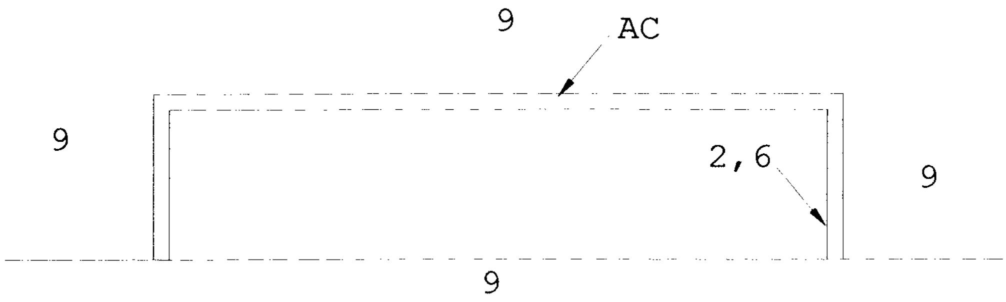

Figure 4.m)

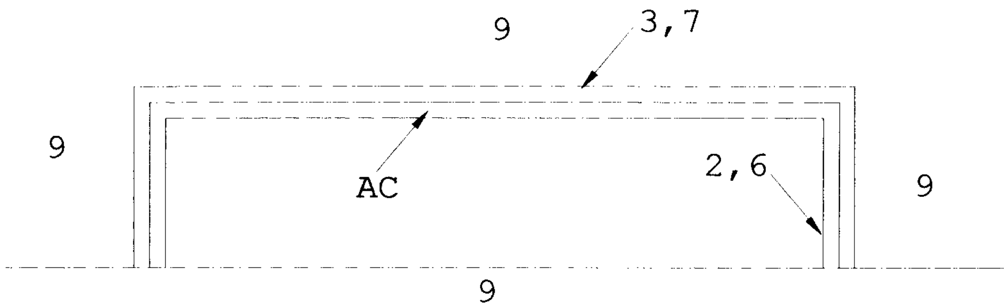

Figure 4.n)

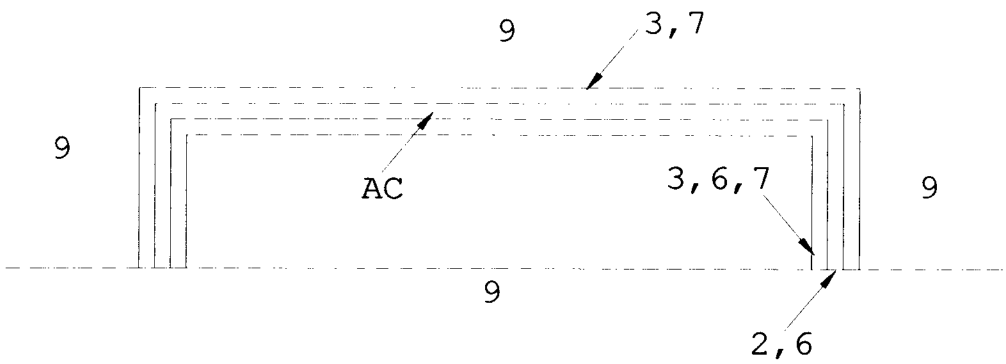

Figure 4.o)

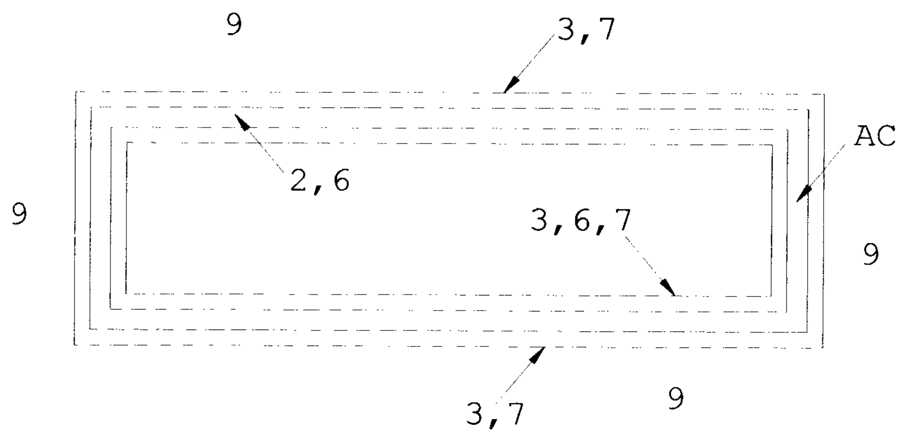

Figure 4.p)

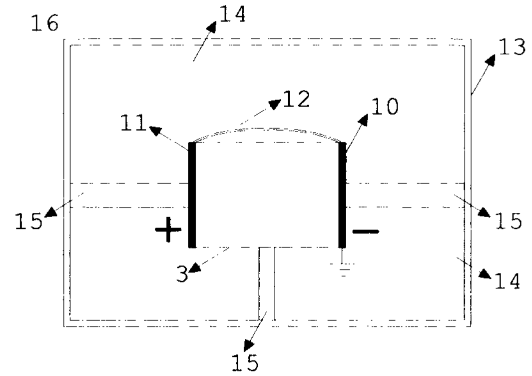

Figure 5.a)

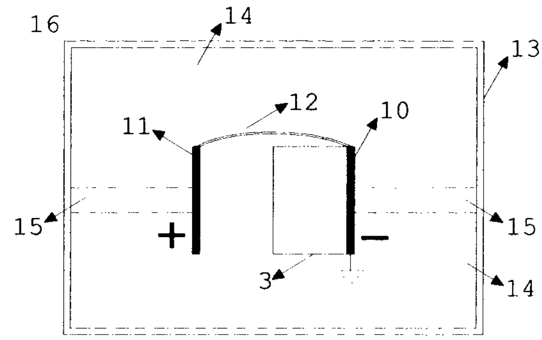

Figure 5.b)

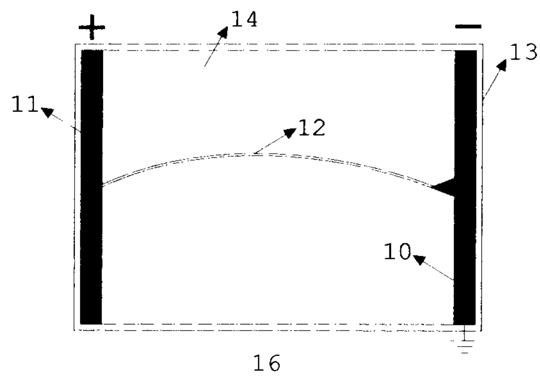

Figure 5.c)

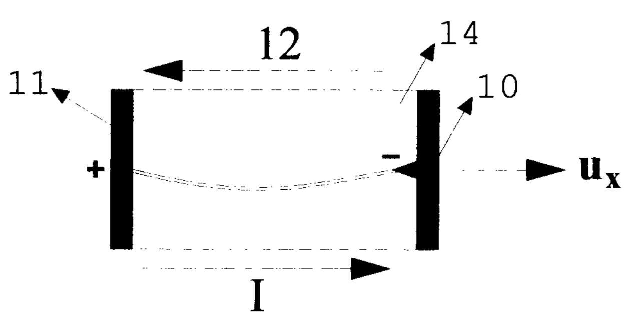

Figure 5.d)

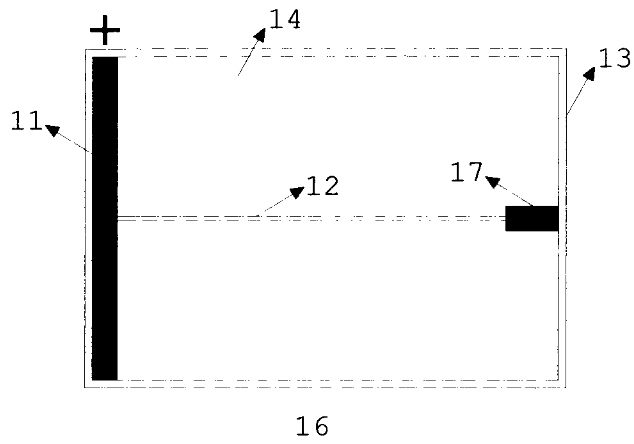

Figure 5.e)

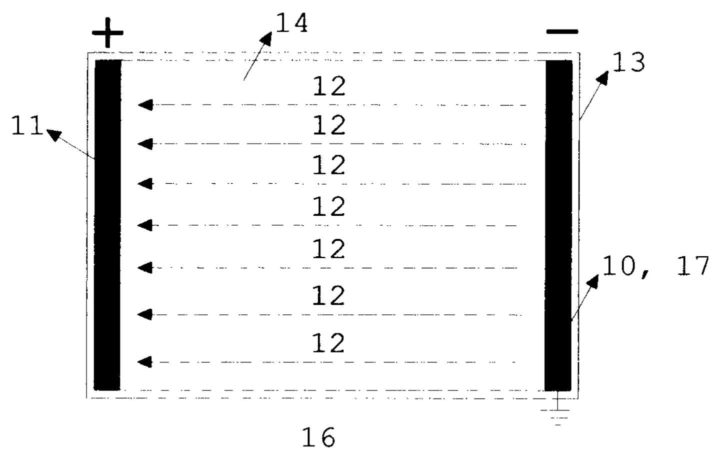

Figure 5.f)

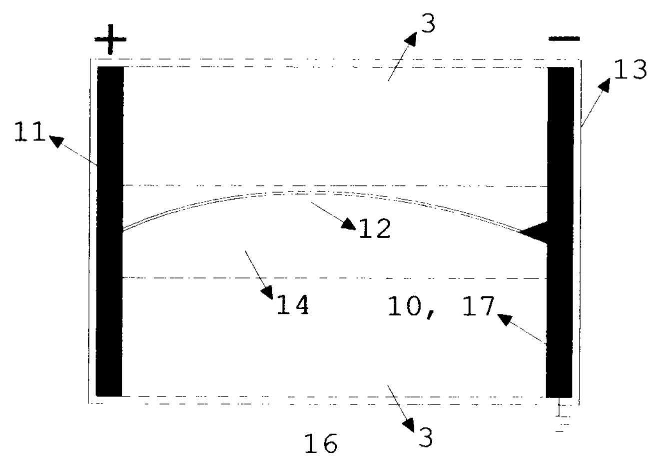

Figure 5.g)

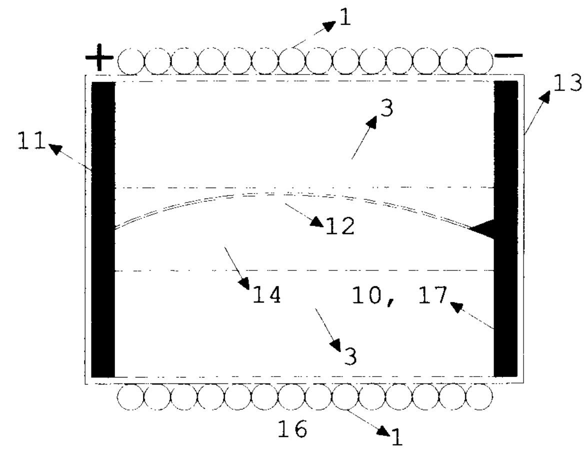

Figure 5.h)

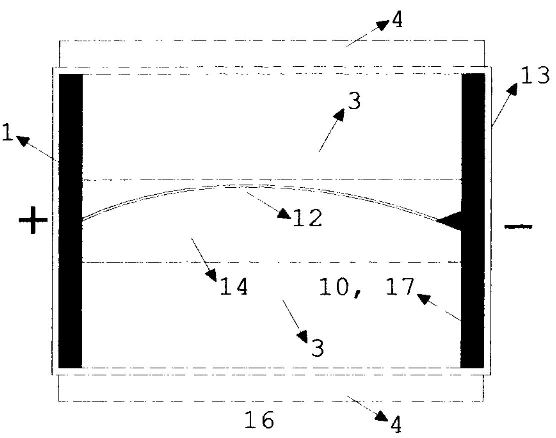

Figure 5.i)

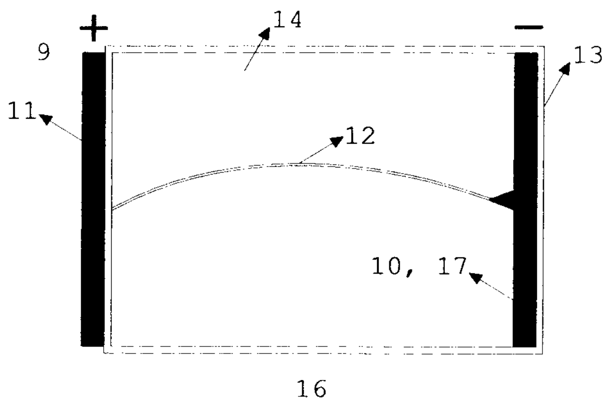

Figure 5.j)

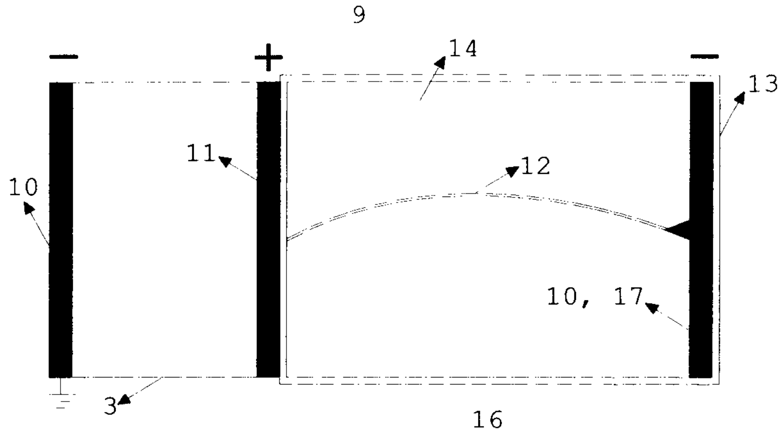

Figure 5.k)

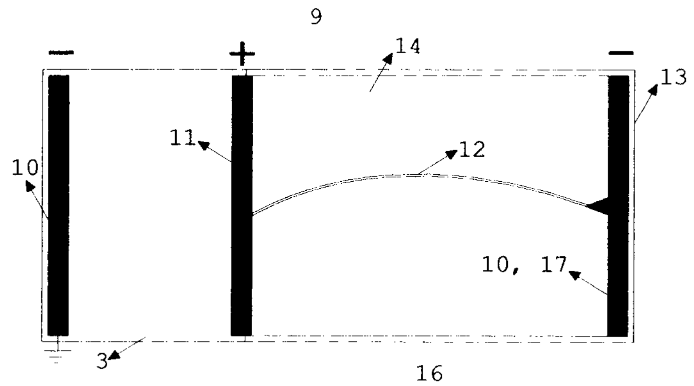

Figure 5.l)

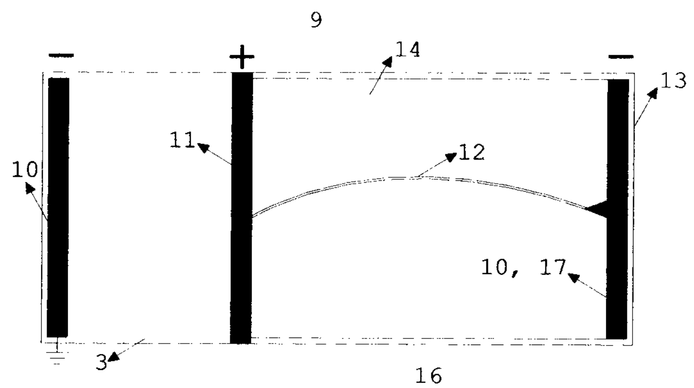

Figure 5.m)

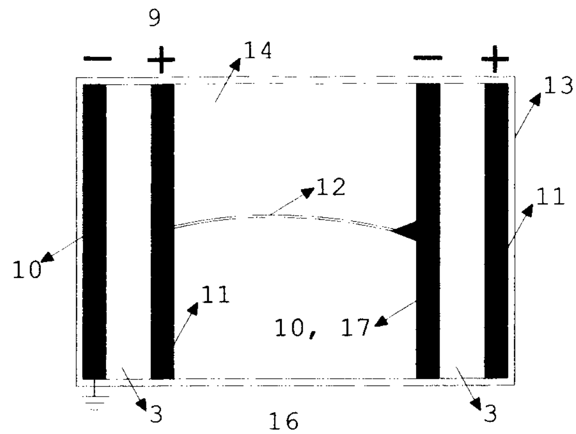

Figure 5.n)

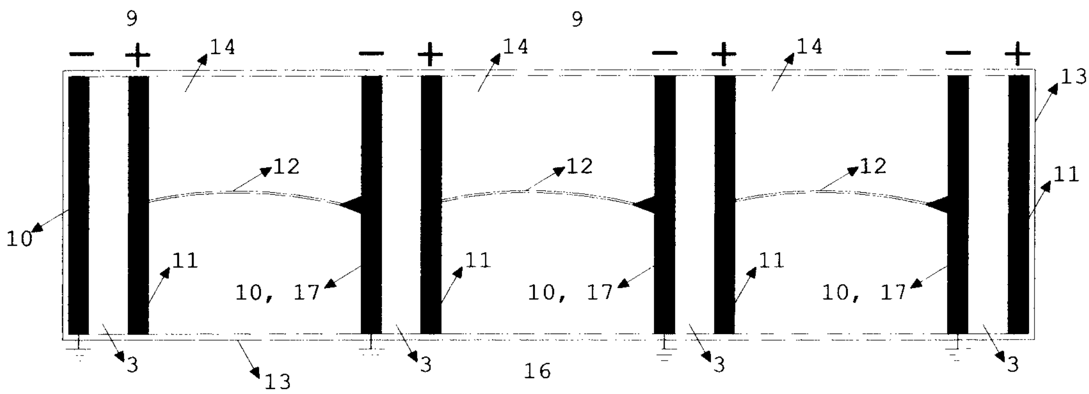

Figure 5.o)

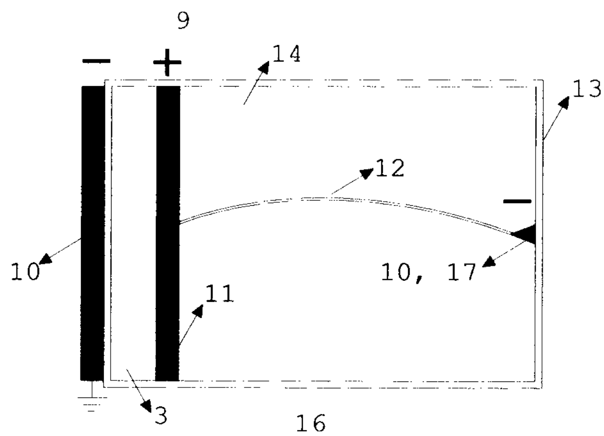

Figure 5.p)

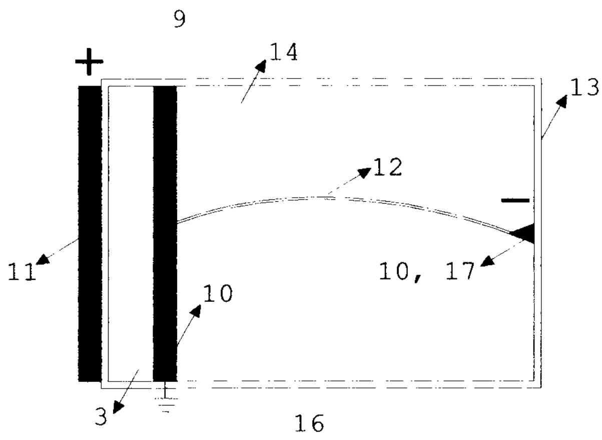

Figure 5.q)

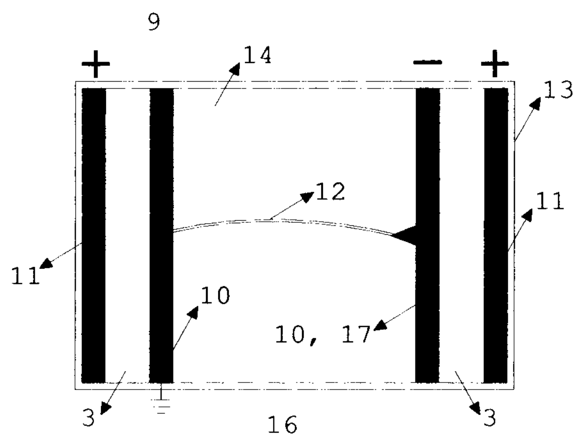

Figure 5.r)

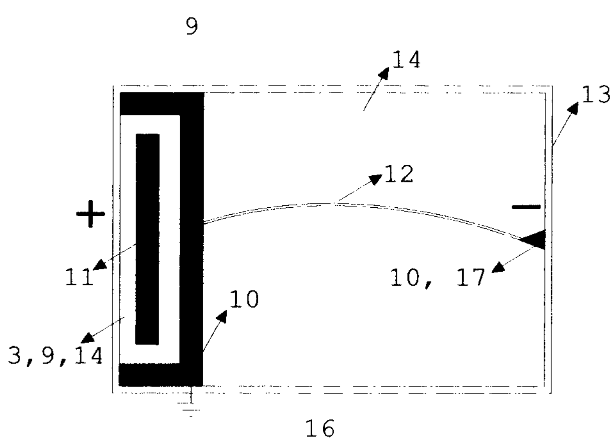

Figure 5.s)

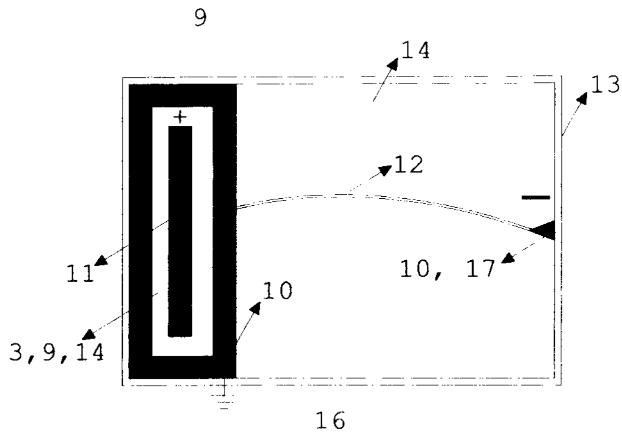

Figure 5.t)

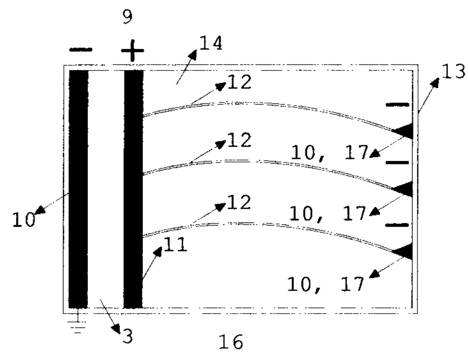

Figure 5.u)

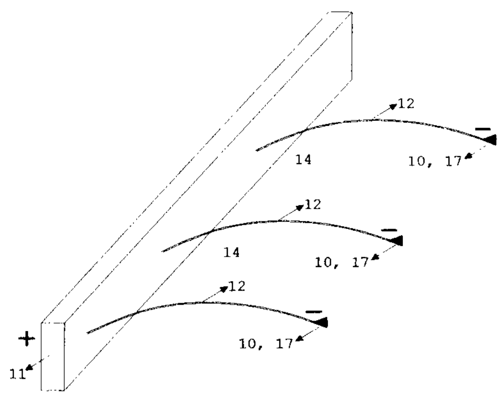

Figure 5.v)

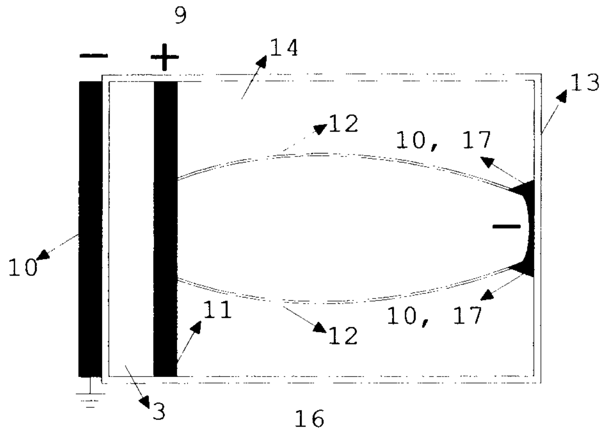

Figure 5.w)

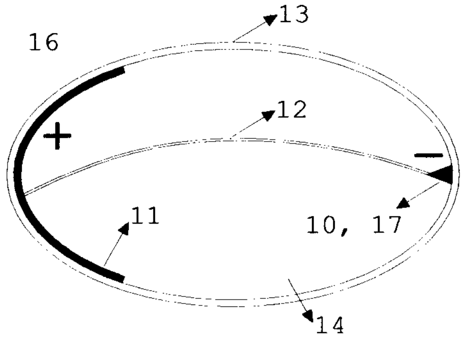

Figure 5.x)

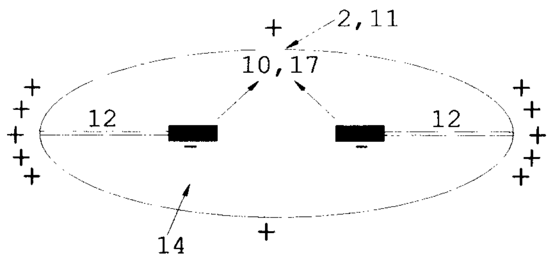

Figure 5.y)

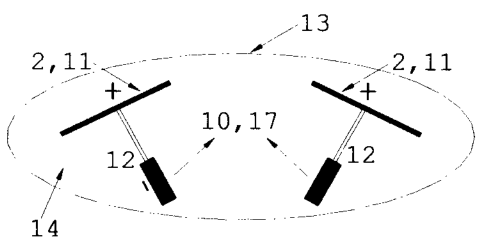

Figure 5.z)

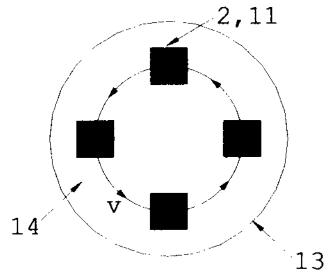

Figure 5.aa)

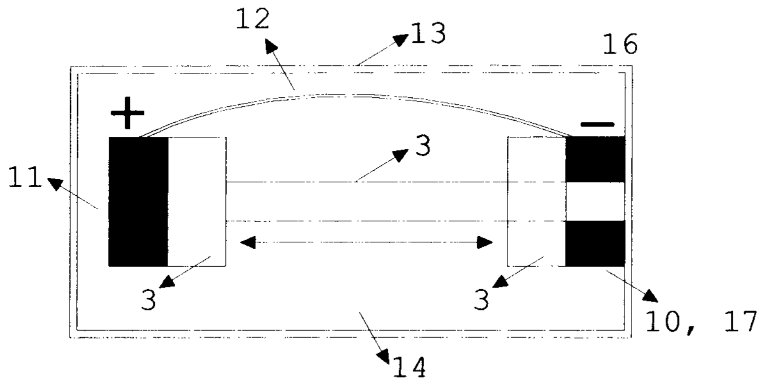

Figure 5.ab)

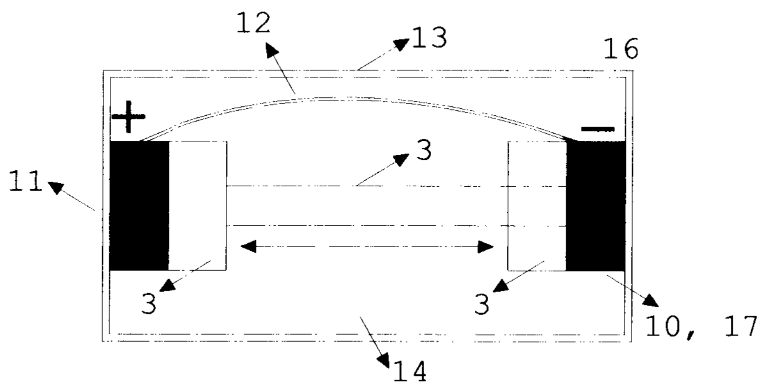

Figure 5.ac)

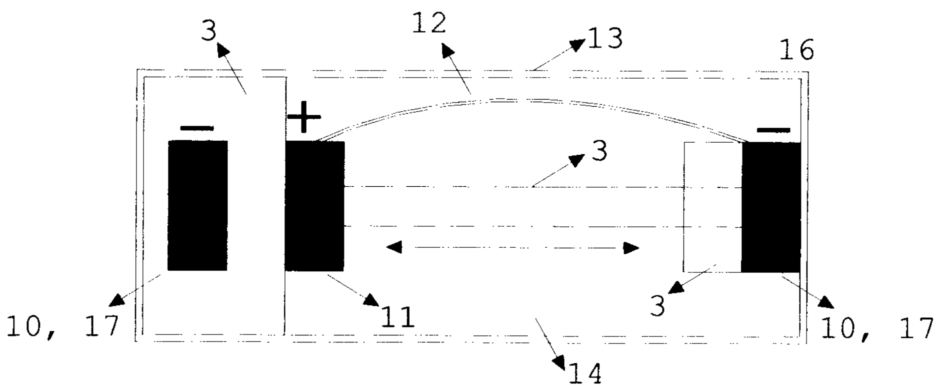

Figure 5.ad)

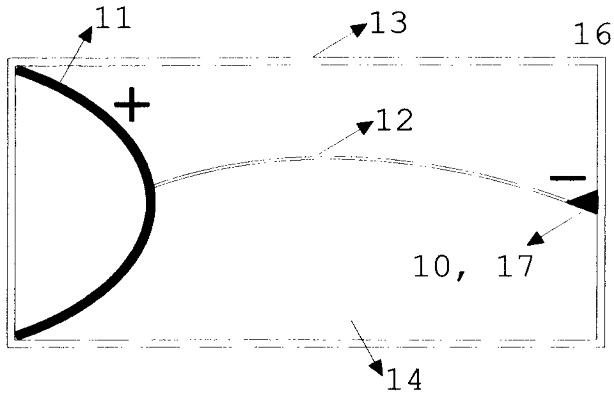

Figure 5.ae)

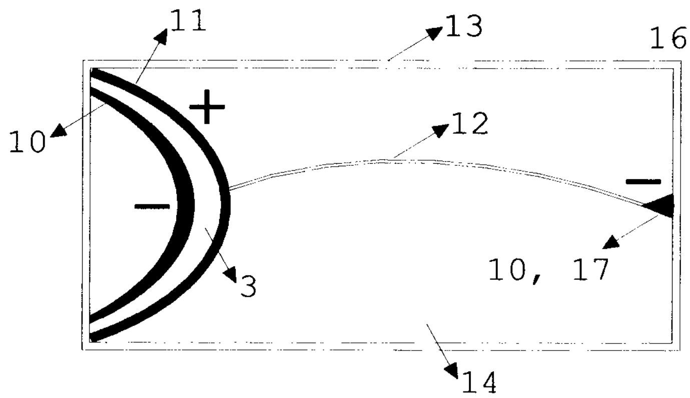

Figure 5.af)

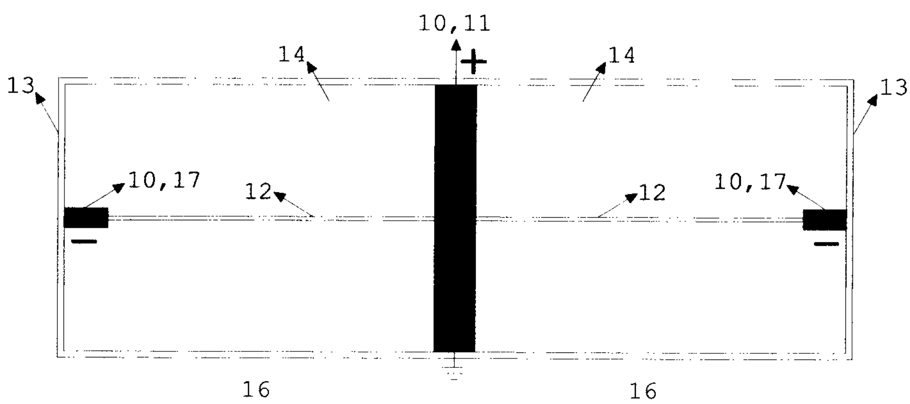

Figure 5.ag)

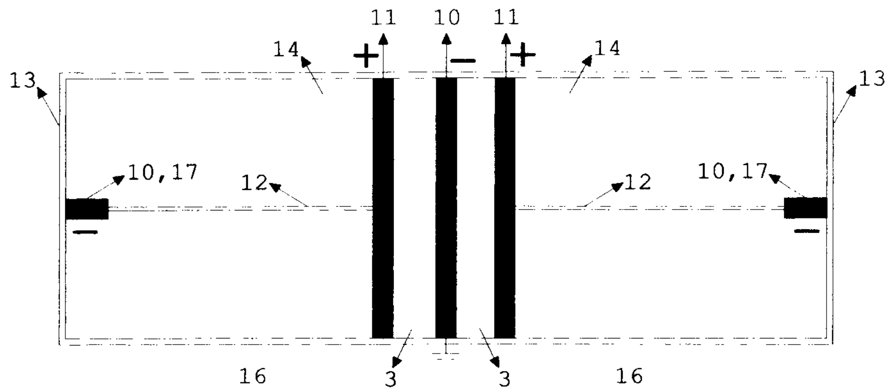

Figure 5.ah)

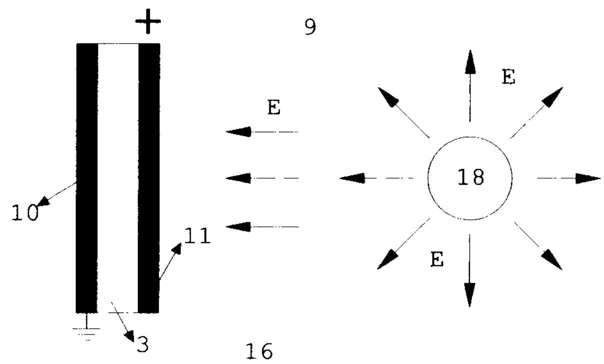

Figure 6.a)

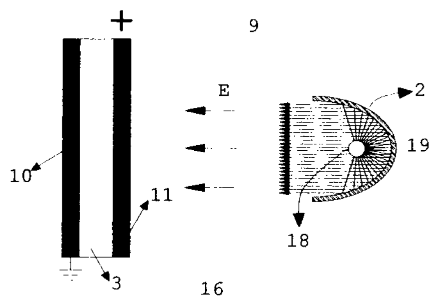

Figure 6.b)

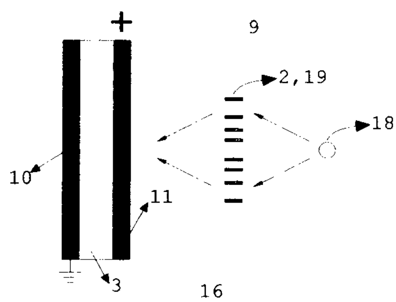

Figure 6.c)

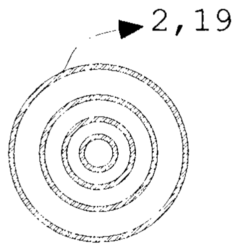

Figure 6.d)

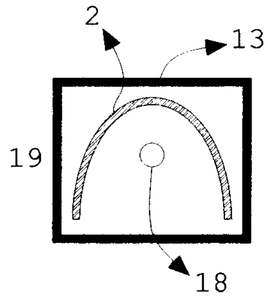

Figure 6.e)

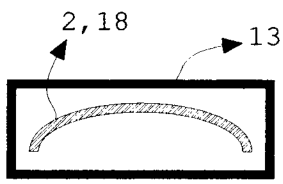

Figure 6.f)

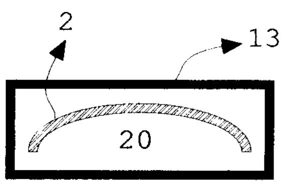

Figure 6.g)

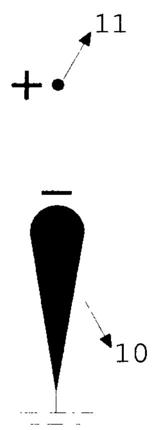

Figure 7.a)

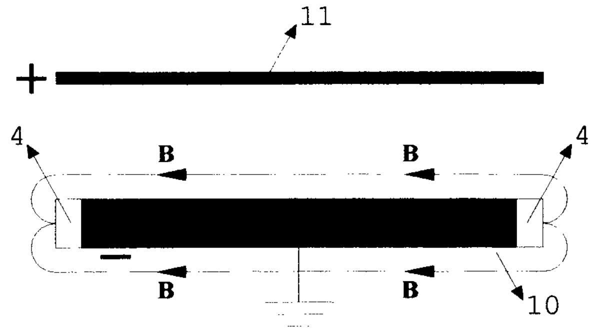

Figure 7.b)

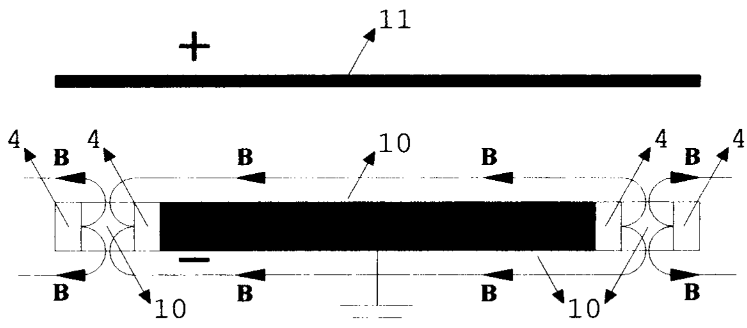

Figure 7.c)

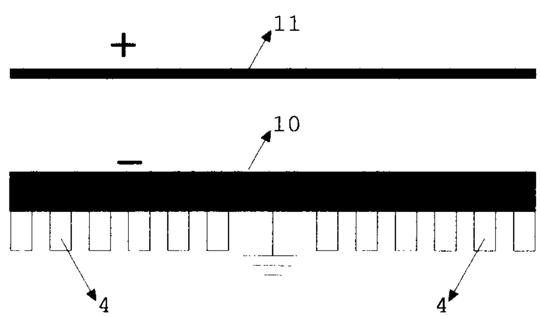

Figure 7.d)

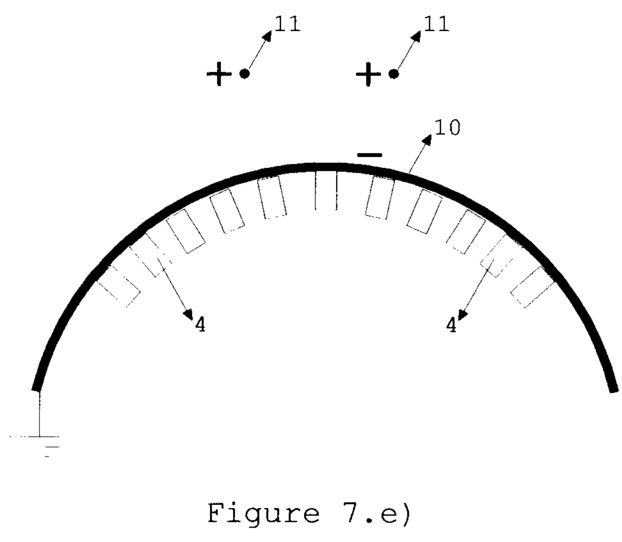

Figure 7.e)

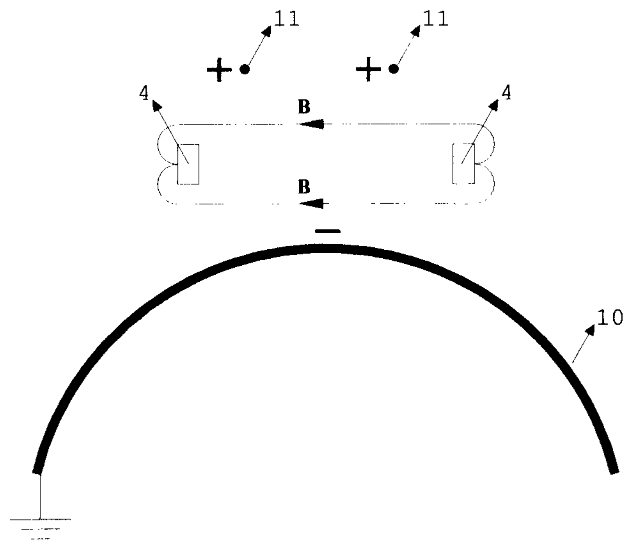

Figure 7.f)

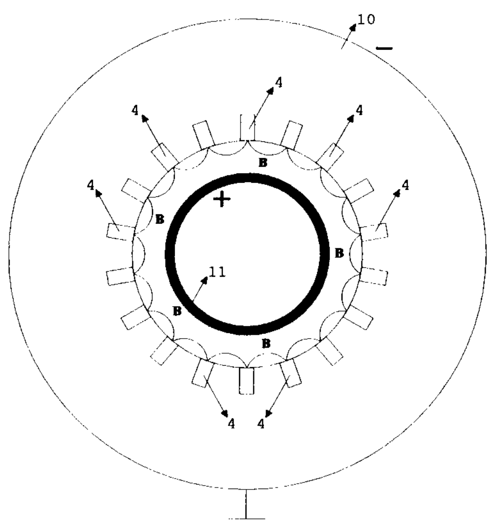

Figure 7.g)

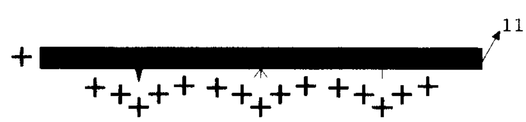

Figure 7.h)

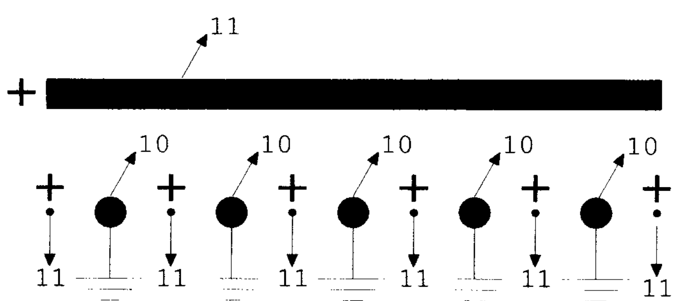

Figure 7.i)

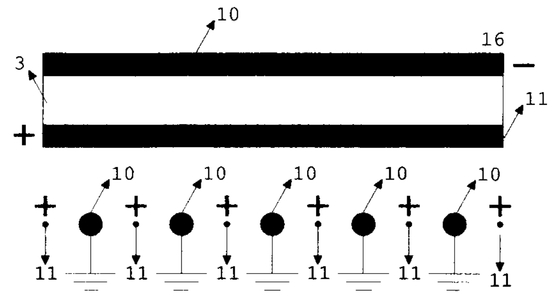

Figure 7.j)

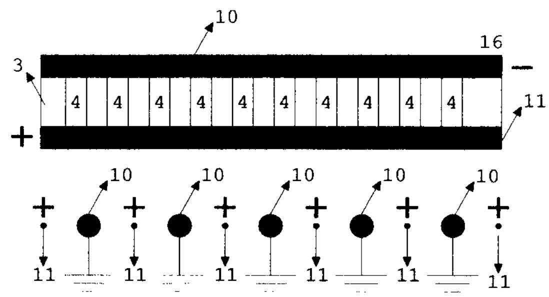

Figure 7.k)

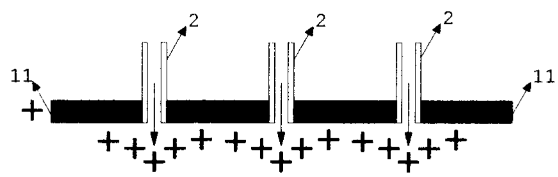

Figure 7.l)

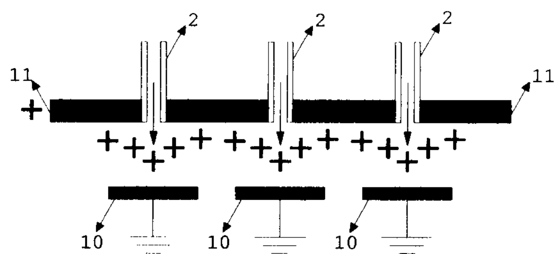

Figure 7.m)

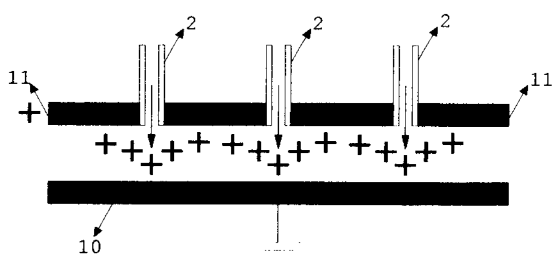

Figure 7.n)

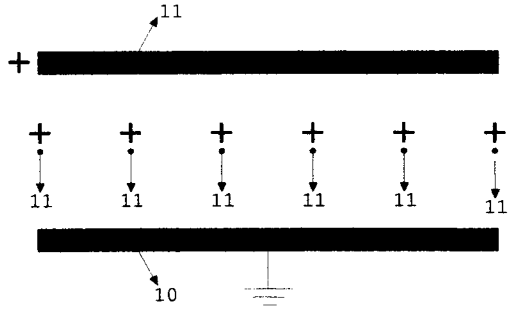

Figure 7.o)

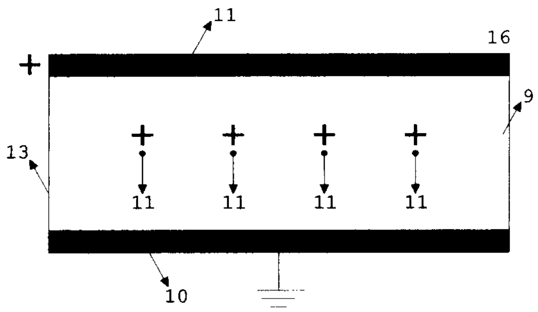

Figure 7.p)

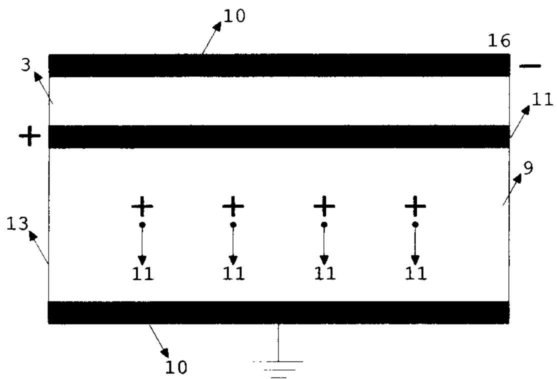

Figure 7.q)

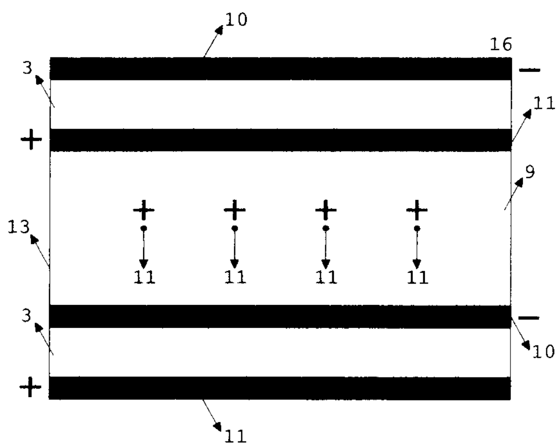

Figure 7.r)

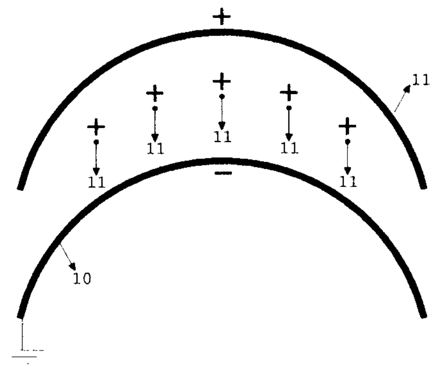

Figure 7.s)

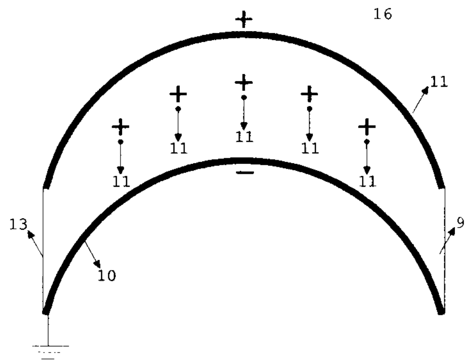

Figure 7.t)

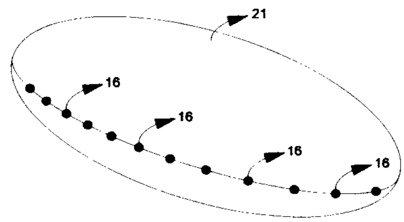

Figure 8.a)

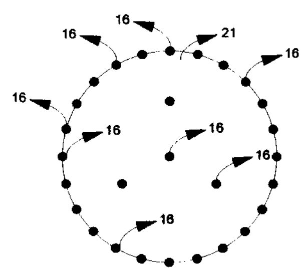

Figure 8.b)

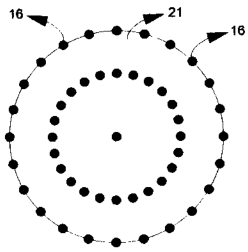

Figure 8.c)

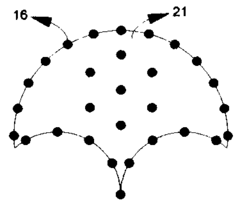

Figure 8.d)

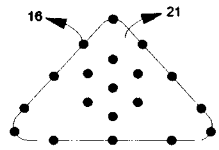

Figure 8.e)

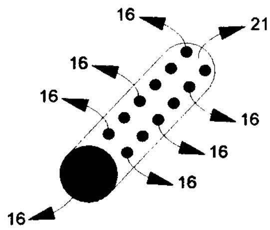

Figure 8.f)