Casimir Generator

Horace Heffner June 21, 2008

OBJECTIVE

The purpose here is to provide a means of extracting energy upon demand from the zero point field (ZPF), by utilization of the Casimir force.

FUNDAMENTAL METHOD

The following method is intended to provide a means to build a nano-scale zero point field powered generator, a true free energy generator:

(1) let two parallel conductive thin plates attract in the axis normal to them, the y axis, gaining energy from the attraction of the plates due to the Casimir force. Use that movement, say mechanically or by heat generation or by conversion to electrical energy, to do useful work.

(2) Slide the plates apart sideways, say in the x axis. This will cost some of the energy gained by the attraction, but should cost far less than just separating the plates while they move only on the x axis, because the opposition to movement in the x direction from the ZPF is based on the size of the Casimir force generated on the edges of the plates, which is much smaller, because the Casimir force is a $1/y^4$ force and the distances between any two points on the edge related surfaces are typically much further apart than the plate separation y.

(3) Move the now separated but still parallel plates back to the original position by a route that avoids a separation distance smaller than the original separation in the y axis. This should take nominal energy. Alternatively, simply reverse the x direction relative motion, which then repeats the energy producing y axis motion of the plates.

(4) Repeat the cycle as fast as practical.

EXAMPLE OF IMPLEMENTATION

One means to implement this scheme at nano-scale is to make one plate, call it the oscillating plate, a plate free to move in the y axis, though with small angular (tilting) motion due to bending of a supporting arm that permits this motion, be a long flexible plate located above a rotating plate. Near the oscillating plate, and parallel to it, provide a rotating wheel which brings into proximity to the oscillating plate a segment of the wheel which acts as the second plate for a Casimir attraction. A line normal to the plane of the oscillating plate is approximately parallel to the axis of motion of the wheel, i.e. normal to the plane of the rotating plate. The rotating plate could be in the form of a wheel with major portions of opposed quarters removed. By removing opposed quarters, or at least a symmetrical group of segments, the wheel remains balanced. The oscillating plate requires a blocking mechanism to prevent contact between the oscillating plate and the rotating plate due to a runaway attraction of the Casimir force. Energy from the motion of the oscillating plate can be extracted as electrical energy by various means. Since far less energy is required for the x axis separation of the oscillating plate and the rotating plate than the energy produced by their y axis attraction, some of the energy from the motion of the oscillating plate can be used to drive the generator. The oscillating plate returns to its starting position by spring action, and is at the point of maximum spring displacement when closest to the rotating plate. Multiple oscillating plates can be used with a single wheel, and if convenient, they can be located on opposed sides of the wheel. Either the flat side of the wheel or the cylindrical side of the wheel can be used for the rotating plate active surface. If the cylindrical side is used then the oscillating plate should be curved to fit its contour.

Fig. 1 through Fig. 5 portray steps in the relative motion of the plates of the suggested device. The oscillating plate is represented by ooo's, the rotating plate by xxx's. For drawing convenience the y axis is vertical in all the figures, the x axis is horizontal. The direction of motion of the plates is shown by arrows. The proportions chosen were merely for ease and clarity of communicating the motions.

Fig. 1 shows a starting configuration of the repeated steps. The y displacement between the plates is at maximum. The deflection of the oscillating pendulum is thus maximum. As the rotating plate moves into opposed parallel position, and plate overlap begins, the y axis Casimir force develops between the two plates.

The Casimir force begins to move the oscillating plate toward the rotating plate, as shown in Fig. 2, and increases as both the exposed area increases and the y axis separation distance decreases.

The point of maximum approach is shown in Fig. 3. A motion blocking structure (not shown) stops the y axis motion of the oscillating plate. The wheel must be rigid in comparison to the oscillating plate, so as to maintain motion of the rotating plate only in the x axis. The motion blocking structure requires contact between dielectric surfaces in order to prevent a Casimir force at the point of contact. The middle vertical line of Fig. 3 is assumed to be the y=0 line.

When the rotating plate moves laterally away from the oscillating plate, as shown in Fig. 4, the area exposed to the Casimir force is reduced and thus the Casimir force is reduced and the oscillating plate begins to return to its original position due to the spring action associated with that plate. The increase in the y axis separation further decreases the Casimir force.

Finally the configuration reaches that shown in Fig. 5, which is symmetrical to Fig. 1, and thus the cycle is closed. The oscillating plate is again at maximum displacement.

TWO PENDULUM IMPLEMENTATION

A possibly much easier design to implement consists of two pendulums. The rotating plate is replaced by a plate on the side of a pendulum that can vibrate only in the x direction. This x direction moving plate is the driver plate, oriented in the x direction like the oscillating plate, but moving only in the x direction, and mounted on what can be called the driver pendulum because its motion is driven by a capacitive coupling. The oscillating plate, which moves only in the y direction, is then called the drone plate on the drone pendulum, and its motion is driven entirely by changes in the Casimir force as before.

Energy from the drone plate's range of motion can be tapped capacitively, i.e. by changes in the plate separation of a capacitor plate mounted on the drone pendulum and a static plate. Alternatively, the energy of the drone pendulum might be extracted in the form of heat generation due to impact of the drone upon a motion restriction barrier, as well as heat generated by motion of, and thus distortion of, the drone pendulum, or in the form of sound due to the coordinated motion of all the pendulums. However, conversion of the drone pendulum motion to electrical energy is greatly enhanced by the two pendulum design because all the pendulums of such a generation system can be organized in a series plus parallel array such that any desired voltage or current can be generated.

Significant advantages of the two pendulum system are small size, simplicity, the ability to rapidly turn the power generated on or off, and the ability to place the output in series to increase the voltage generated, due to the fact all the pendulums can be driven in synchronization by control of a single input signal used to drive all the driver pendulums.

WHERE THE ENERGY COMES FROM

The energy for the generator comes from the zero point field, a flux of virtual photons known to have a cubic frequency distribution. The presence of a cavity surrounded by conductors creates the Casimir force. The cavity excludes zero point field wavelengths larger than the cavity dimensions. The force results from zero point radiation having less flux through a plate coming from the direction of the cavity. An analogy is a suction cup stuck to a piece of glass, but not a passive cup, one with an active vacuum pump connected to it. Once the vacuum is created between the cup and the glass the air pressure on the outside holds the cup and glass together fiercely, even though there is some air leakage on the sides, which has no net force due to symmetry around the cup. However, if the cup is free to slide sideways, say due to a lubricant, then the vacuum is easily broken. It is well known that the energy in the Casimir case is provided by the vacuum. The zero point field is analogous to the vacuum pump in this case.

The incremental work dE performed by attracting the plates a small increment dy is of the form of work times displacement:

$$dE = F(y)\ dy$$

where F(y) is the y axis casimir force between the two plates given by:

$$F(y) = A\ [h * c * \pi^2 / (240\ y^4)\ ]$$

where A is the overlapped area of the plates, h is Planck’s constant, and c is the speed of light. The incremental work is thus:

$$dE = A\ [h * c * \pi^2 / (240\ y^4)\ ]\ dy$$

Except at the plate edges, there is no such work performed by plates sliding past each other laterally in a vacuum, say in the x direction, unless they are close enough that friction occurs.

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This is not a typical perpetual motion scheme. All the energy in perpetual motion schemes can typically be described in a fully closed system in which energy can be proven to be conserved. When the Casimir force is involved the system is not closed. The Casimir force is due to momentum transfer from a flux of virtual photons, and that flux flows throughout the universe. Any system utilizing that flux can not be described as a closed system and is thus free to obtain energy from that flux provided a means is found to break the force symmetry. The suggested motion of parallel plates breaks this symmetry.

SOME SIMPLIFYING DEFINITIONS

Let y be the separation between the drone and driver plater surfaces. Let w be the x axis width of the drone plate and drive plate. When the motion of the drive plate is in the +x direction, then when x = -w the overlap between the two plates begins and when x = +w the overlap between the two plates ends. When the motion of the diver plate is in the -x direction, then when x = +w the overlap between the two plates begins and when x = -w the overlap between the two plates ends. The z axis size of the plates is k, and the total area of each plate is k*w.

The area A(x) of the overlap is given by:

$$A(x) = k * \max((w-|x|),0)$$

where |x| is the absolute value of x.

For the sake of simplicity, assume that the drone pendulum is designed such that the force G(y) opposing the y direction Casimir force F(y) is such that the displacement is a function of the area A(x) between the plates and is such that the displacement y of the drone, given an overlapped area A(x) is maintained as:

$$y = c * A(x) = c * k * \max((w-|x|),0)$$

for some small constant c. This then alleviates the need for stop mechanisms for the drone plate through avoiding contact between the two by an appropriate choice of c and k.

This assumption can be carried out by making the resisting force

$$G(y) \sim= k_2 * 1/y^r$$

for y slightly larger than 4. The assumed force management can be carried out if momentum effects are controlled, possibly through forces imposed by the energy extraction mechanism.

SYMMETRY OF THE EDGE EFFECT FORCE

Note that Fig. 1 is laterally symmetric to Fig. 5. Fig. 2 is laterally symmetric to Fig. 4. The line of this x axis lateral symmetry lies in the center of Fig. 3, and is designated as x=0. The y displacement of the drone plate is symmetric about the x axis, i.e.

$$y = c * k * \max((w-|x|),0)$$

Now, the geometry of the plates is symmetric about the x axis as well. The means C(x), the x axis component of the Casimir force between the plates, is symmetric as well, i.e.:

$$C(x) = -C(-x)$$

Since the geometry of the edges of the two plates for any two laterally symmetric positions are symmetrical about the x = 0 line, any Casimir force for one of those positions is equal and opposite to that of the other. Therefore, when the energy required to overcome any x axis Casimir effect is integrated over all x positions, i.e. C(x) dx is integrated, it is zero for slow pendulum motions, and should still be practically near zero even for faster pendulum actions. The only net energy required to move the driver plate is that which is required to bend the driver plate torsion pendulum, which can be nominal, because it is driven primarily by spring action of the driver torsion pendulum.

POSSIBLE DIFFICULTIES

The primary difficulty is maintaining the symmetry $y = c * k * \max((w-|x|),0)$ while energy is being drained from the y axis motion of the drone plate. It is necessary to avoid hysteresis, a loss of this symmetry, due to extracting more work out of the attraction of the plate vs the pendulum restoration swing. The energy extraction mechanism needs to extract energy symmetrically, equally on both parts of the swing, and this could require active management circuits.

It is also diffcult to prevent runaway attraction. For this reason, a practial generator would be likely be built using a repulsive rather than an attractive Casimir force. This avoids the need to construct motion stops, but adds the complication that the generating capacitor plates, both being conductors, must be separate entities driven by the generator's moving parts.

PROOF OF CONCEPTS (an update of 7/2009)

The Casimir effect is said to be due to the fact a virtual photon can not be emitted in a given direction if a reflecting atom is in its path at a distance less than its wavelength. In other words, a cavity with a conducting metal surface prevents any wavelength virtual photon from crossing the cavity in a particular direction if its wavelength is longer than the path length for the virtual photon through the cavity in that direction. If you draw a line segment spanning the cavity, of length r, then virtual photons of wavelength r or larger are prevented from taking that path, in either direction. This results in an inward pressure vector along that line segment. For convenience here, call such a line segment a "ZPF free line". That line segment is free of any ZPF virtual photons moving in the direction of the line segment and of greater wavelength than the length of the ZPF free line. This is not conventional terminology, but it will save a lot of typing.

Because the prevention of emission is symmetric along any ZPF free line, it is immediately clear that no net inertial force can result from the shaping of static matter of a given kind for this purpose. Any net force on one end of any ZPF free line line is balanced by an equal but opposed force at the other end, due to the isotropic property of the ZPF. Note that inertial drives are still feasible provided the ZPF can can be used to effect inertial mass change, and the involved changing mass is accelerated appropriately, which is the basis of the inertial drive proposed here:

http://mtaonline.net/~hheffner/ZPE-CasimirThrust.pdf

However, ZPF balanced forces can result within matter shaped for the purpose, resulting in pressures, and energy can feasibly be extracted from movement under this pressure, as will be shown.

Interestingly, the formulas for computing pressure along ZPF free lines between atoms match the formulas for computing the van der Waals retarding interaction between two atoms. Using ZPF free line concept thus works for analyzing devices designed to work on van der Waals forces as well as Casimir forces.

Note that by dealing only with ZPF free lines we have changed perspective completely, from an external virtual photon flux point of view to an internal force line point of view, and simplified the nature of the force computation procedure. We no longer have to deal with the external nature of the ZPF, or the overall shape of the matter, when addressing forces between conducting surfaces. We only have to deal with nooks and crannies and cavities that include ZPF free lines. This of course includes the edges of overlapping parallel plates. We do not have to be concerned with rays impinging from all angles. We only need to deal with the enclosed ZPF free lines and their lengths.

Mostepanenenko and Sokolov (Dokl. Akad. Nauk SSSR, 298. 1380-1383) provides two principles (assumptions) for simplified but accurate practical computing using these concepts: 1. The additivity principle, and 2. the renormalization principle.

1. The Additivity Principle:

"The dependence of the interaction potential of macrobodies on the distance can be determined by summing the potentials of the van der Waals retarding interaction beteen single atoms belonging to different bodies."

2. The Renormalization Principle

“The value found for the constant of the interaction potential of the macrobodies should be reduced by the same factor as that by which the true constant of the interaction between flat plates of the same materials differ from the constant obtained for them by the additivity principle.”

Beyond that, the van der Waals retarding interaction U(r) at distance r between two individual atoms with electric and magnetic polarizabilites a1E, a2E, a1M, and a2M, is:

U(r) = C/r^7

where:

C = (-23/Pi) ((a1E a2E)(a1M a2M) + a1M a2M)
+ (7/(4 PI)) ((a1E a2M) + (a2E a1M))

We can differentiate the interaction potential sum to obtain a force. The interaction potentials can be summed independently in each axis, thus providing the ability to compute a force vector for each surface element if desired, and broken down according to any axis basis.

Note that the larger a ZPF free line, the less wavelengths excluded, and thus the less force evolved along that line. The smaller r is the greater the force.

The fringe force at the edges of overlapping capacitor plates is used to produce the torque in electrostatic motors. Electrostatic motors conserve energy, so it just happens that when an edge with a small fringe force is dragged across a wide capacitor, a lot of energy is expended (or obtained depending on polarity) and that energy is exactly equal to the energy stored between the plates when together at potential. This involves the Coulomb force, which is a 1/r^2 force. The Casimir force involves large negative exponents on r, and thus the fringe force Casimir effect can not be conservative with regard to plate edges. Further, and most importantly, the casimir force involves only straight lines. There are no bending E field lines to deal with.

The energy involved in plate motion due to the Casimir force between plate edges and an opposing plate, at least for conductive surfaces, is highly dependent on the plate edge geometry. It is purely an effect between surfaces.

While Mostepanenenko's principles involve fudging C, he says the powers of r always come out right using his method. Therefore the method serves well for a comparative analysis, because, in designs using the a single conductive surface material, we can ignore the material related (fudged) constant C. It will now be proven, by comparative analysis, that the lateral force between a square plate edge and an adjecent parallel plate is not the same as for a beveled plate edge and opposing plate, and thus a net energy gain is feasible from a Casimir effect motor provided the edges of the plates are appropriately shaped.

The following comments refer to various aspects of Figure 6. In Fig. 6 we are comparing the side edge of two top slabs, a rectangular one vs one with a beveled edge. Now we pick any point S1 on the edge of the beveled slab. We need to sum the potentials (or forces) from every ZPF free line between S1 and every point S2 on the bottom slab surface. All such ZPF free lines (S1,S2) lie within the angle S4,S1,S5. The line (S1,S4) is parallel to the bottom slab surface, (P6,S2).

Now, for every such ZPF free line (S1,S2) there exists a unique corresponding ZPF free line on the rectangular slab edge (P1,P2), which shares an intersecting point S3 on the rectangular slab edge. In every case, (S1,S2) is larger than the corresponding (S3,S2). Because this is true for every possible point S1, the sum of the potentials for the beveled edge are smaller than the sum of the potentials for the rectangular slab edge. There are many ZPF free lines from the rectangular slab edge to the bottom slab which have not been evaluated, and for which there are no corresponding ZPF free lines from the beveled edge, but this only makes the inequality larger. In every case of corresponding ZPF free lines, the lines make the same angles with respect to the bottom slab, so the force vectors can be broken into axis oriented vectors and summed independently without changing the direction of the inequalities.

There are analogous arguments if the bevel goes the other way, making an even better, larger force, cavity than the rectangular slab edge.

For the above reasons, a free energy rotor can be made of blades of parallelogram shape, with a back bevel on one side and a forward bevel on the opposed edge, or even a squared off edge substituting for one of the beveled edges. Since the forces on the two edges are not balanced, a net torque results without application of external energy. This results in a free energy motor.

This also provides proof that the earlier proposed Casimir generator principles work, provided the slab edges are beveled.

Figures follow.

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xxxxxxxxxxxxxxx -> x axis motion
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Fig. 1

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                 ooooooooooooooo  | y axis motion
                                  v
      xxxxxxxxxxxxxxx -> x axis motion
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Fig. 2

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                 ooooooooooooooo
                 xxxxxxxxxxxxxxx -> x axis motion
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Fig. 3

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                                 ^
                 ooooooooooooooo |  y axis motion

                            xxxxxxxxxxxxxxx -> x axis motion
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Fig. 4

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                 ooooooooooooooo


                                  xxxxxxxxxxxxxxx -> x axis motion
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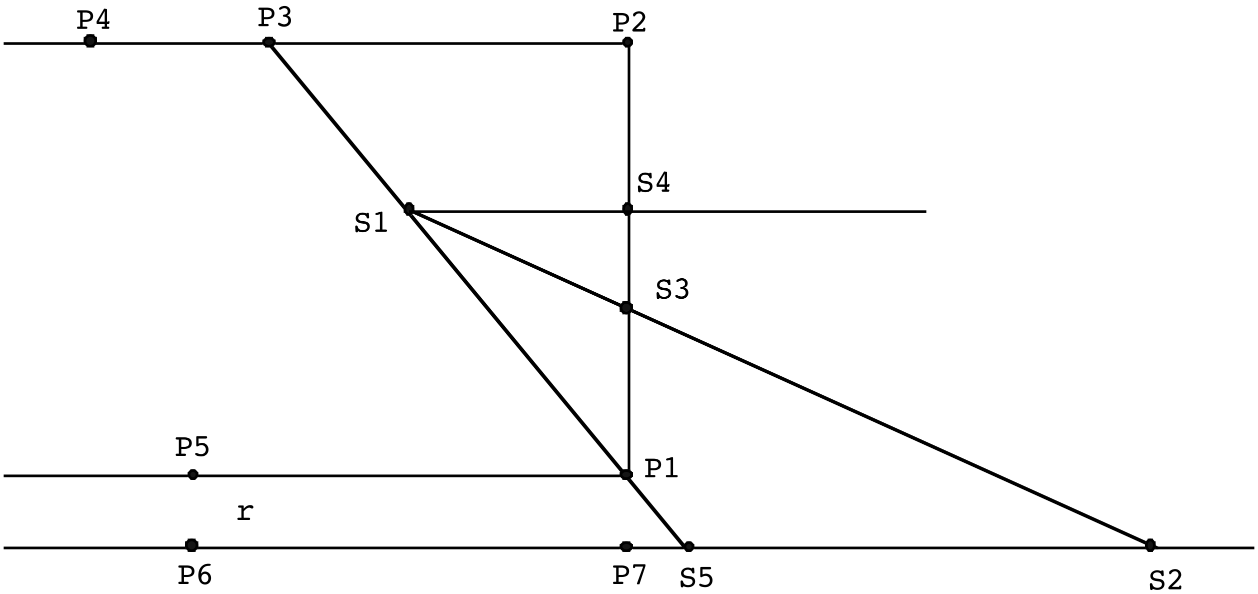
Fig. 5



(P6,S2) - top of bottom slab

(P5,P1) - bottom of top slabs

(P5,P1,P2,P4) - sides of rectangular top plate

(P5,P1,P3,P4) - sides of beveled top plate

S1 S2 and S3 - points for van der Waals retardation calculation

(S1,S2)- ZPF free line for S1 on beveled slab to some point S2

(S3,S2) - ZPF free line corresponding to (S1,S2) for comaparison

S4,S1,S5 - angle of feasible ZPF free lines to second plate from S1

Fig. 6 - Diagram for Casimir Force Comparison