Casimir Boiler

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OBJECTIVE

The purpose here is to provide a means of extracting energy upon demand from the zero point field (ZPF), by utilization liquid flow of van der Waals force bound liquids through cavities sufficiently small to reduce the Casimir force component and thus the boiling point.

METHOD

The Casimir force is hypothesized here to be at least part of the van der Waals force that can bind noble gas atoms like Argon, or molecules, especially symmetric molecules, like carbon tetrachloride, CCl4. This suggests that moving van der Waals bound molecules through a Casimir cavity of sufficiently small size will reduce the van der Waals binding energy, and in the case of liquids, reduce the boiling point and enthalpy of evaporation. Energy from achieving the boiling can be achieved via Carnot cycle engine and generator, and the liquid thereby condensed and recycled.

SOME CANDIDATE LIQUIDS

The binding energy is reflected in the enthalpy of vaporization for candidate liquids. The problem with noble gases is they have very low boiling points and low enthalpies of vaporization.[1]

Table 1 shows some candidate liquids for Casimir cavity boiling.

Element/ Compound	Enthalpy of Vaporization (kJ/mol)	(eV/molecule)
Helium	0.08	0.000829
Neon	1.74	0.01803
Argon	6.52	0.0676
Krypton	9.05	0.0938
Xenon	12.7	0.1363
Radon	18.1	0.1876
CCl4	32.54	0.3373
CF4	135.7	1.406

Table 1 - Casimir cavity boiling candidates

Carbon tetrachloride, CCL4 and carbon tetraflouride (tetrafluoromethane), CF4, may be good candidates for a Casimir boiler because they are highly symmetric and relatively inert in the expected operating conditions. CF4, with a boiling point of -127.8 C has the same problem as the noble gases, the energy producing device would have to be encapsulated in a cryogenic envelope. However, CF4 has a stellar 1.4 eV per molecule enthalpy of vaporization. The problem in all cases is knowing just how much of the liquid state binding energy is due to the Casimir force. This is best determined experimentally.

Of the prospects examined, CCl4 is the most readily available, has the best boiling point, 76.72 °C (350 K), and has a good enthalpy of vaporization, 32.54 kJ/mol, or 0.3373 eV/molecule. It has a density of 1.5867 g/cm^3, and a molar mass of 153.82 grams. Except for availability, and toxicity[2] , it is good for amateur experiments. CCl4 is a probable carcinogen. It was used by dry cleaners at one time for spot cleaning.

A PROPOSED EXPERIMENT

An experiment to evaluate CCl4 prospects for a Casimir force boiler would consist of measuring any boiling point depression from imposing a fine mesh barrier between the liquid and gas phases of CCl4. A closed circuit with condenser would be used to recycle the CCl4. A controlled heater and stirrer would be used to maintain the temperature of the liquid phase.

The interesting part is deciding what to use for barriers, i.e. flow-through Casimir cavities. One possibility is sintered fine metal powders. Another is stacked fine foils, like gold leaf, with a dielectric powder or micro-beads used as a plate separator. Plate separation has to be under 10^{-7} m to obtain any effect.

Preparing flow-through Casimir cavities might be as simple as the following steps:

1. Anodize a clean aluminum surface to a sufficient depth, creating an alumina nano-pore array surface.

2. Remove the aluminum substrate by etching.

3. Aluminize the alumina pores to create flow-through Casimir nano-cavities.

Such porous surfaces, nanopore arrays, might be used in gas flow-through mode, or as evaporation surface gas-liquid interfaces. There is a variety of means to make nanopore arrays.[3 4 5 6]

Another approach is to use self-assembling nanotechnological structures as a starting point for building aluminized flow through Casimir cavities.[7]

United States Patent, 4,190,321, Dorer , et al., February 26, 1980, "Microstructured transmission and reflectance modifying coating" may be of interest in regards to making flow-by nano-structures, especially for use in a gas or vapor medium, vs flow through nano-structures. A similar flow-by approach using carpets of carbon nanotubes is feasible. [8]

POTENTIAL PERFORMANCE

Suppose 10 percent of the heat of vaporization is due to shieldable Casimir force for CCl_4. That is 3.25 kJ/mol, or (1.5867 g/cm^3)(3.25 kJ)/(153.8 g) = 0.0335 kJ/cm^3 = 33.5 kJ/liter boiled, or 33.5 MJ per 1000 liters boiled.

Looking at this from a practical standpoint, at 1 liter per second boiling rate, that is 33.5 kW output, and at a 1000 liter per second boiling rate 33.5 MW output. It would take a pretty large device to produce 10 kW, enough to run a home, as that would require boiling about 300 ml per second for that output alone. It would make an improved efficiency home heater, but all of the electricity generated would have to be fed back into the boiler just to achieve a COP of 1.14. provided the electrical generation were 30 percent efficient. It would only produce 1.14 times the heat over the energy supplied.

If it turned out that 100 percent of the heat of vaporization is due to shieldable Casimir force, and Cavities small enough to release all that energy were used (an unlikely possibility), then a home heater could run by boiling a mere 100 cc per second, or 6 liters a minute. Using a 30 percent efficient electricity generating system, a COP of $1 + 0.3 + 0.3^2 + 0.3^3 + 0.3^4 + 0.3^5 = 1.42$ can be achieved if all the electrical energy is fed back to the boiler. If 51 percent of the produced enthalpy, in the form of heat plus electrical energy, could be recovered and fed back into the boiler for heating, then the boiler would be able to sustain self operation plus produce electricity. The Casimir supplied enthalpy is recovered as it heats the gas as it condenses, by drawing molecules together via the Casimir force, so this energy can be directed immediately toward heating the liquid by heat exchanger.

INITIAL GAS CONCEPT

The initial concept for this wa gas mode, using molecules that have no possibility of hydrogen, ionic, or covalent bonding, i.e. for which a large portion of their bonding energy is the Casimir force. The initial vision was gas molecules at the low end of the Boltzmann tail coming together, gaining thermal energy from the attraction (this is classical Puthoff etc., and evokes the long standing riddle of how to separate the attracted entities) and then quickly flowing through a Casimir cavity to break the Casimir bond so that recycling could occur. I saw the process as occurring very fast, as via a flow through a series Casimir thin passageway baffles, or even through a device as envisioned for extracting momentum from the Casimir force described here, and diagrammed in Fig. 1 here:

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

This might work in a "flow-by" basis using Raney nickel, carbon nanotubes, grooved metal surfaces, or any number of catalysts contained in a series of baffle like filters though which the candidate gas might flow.

Part of the problem with this concept was obtaining a fast recycling rate, providing adequate time for the condensation, and yet avoiding complete condensation. Further, it is the bound molecules that are in the high end Boltzmann tail that are likely to have the extra kinetic energy to break the Casimir bond within a Casimir cavity. Sufficient time for heat exchange and heating must occur between cycles. It still may be gas mode is the way to go, but it looks complex to check out and possibly very expensive.

So, this leads to the conclusion - why not just let things condense. You still get to extract the energy when you let it condense. The Casimir force for these molecules *is* the force that primarily causes the condensation. The enthalpy of vaporization then provides an upper bound on the energy to be derived from each cycle, and a convenient means to compute feasibility. In this context then the Casimir energy is essentially obtained by reducing the boiling point. And there you have it: a "Casimir Boiler" concept for solving the old riddle of how to get the Casimir bound entities apart.

Obtaining self operation depends heavily on the proportion of energy of the bond that comes from the Casimir force (or van der Waals force if preferred.) Selection of the best candidate for practical application depends heavily on this. Candidates like CF_4, NF_3, or UF_6 can not be discounted for use in actual practical devices. CCl_4 is merely singled out as a possible practical chemical for inexpensive checking of principle. It is entirely possible that a machine operating within a cryogenic envelope or high temperature envelope can be developed to produce electrical energy using these principles. Any system using the ZPF is not a closed system.

It could be that, via heat exchanger, boiling a chemical with a boiling point near that of the gas chosen for its Casimir properties would be of great use. A a closed boiling cycle may extract energy much more efficiently than using a Sterling engine, especially under very controlled circumstances, like use in a power plant. A hybrid is also clearly feasible.

[1] Wikipediea article on noble gasses:
http://en.wikipedia.org/wiki/Noble_gas

[2] MSDS for CCl4:
http://msds.chem.ox.ac.uk/CA/carbon_tetrachloride.html

[3] "Polycrystalline nanopore arrays with hexagonal ordering on aluminum", A. P. Li,a) F. Muller, A. Birner, K. Nielsch, and U. Gosele.
http://www.mpi-halle.mpg.de/~porous_m/Publications/jvsta1999.pdf

[4] Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V., München
http://www.mpi-halle.mpg.de/~porous_m/Publications/jvsta1999.pdf

[5] "Two-dimensional lateral superlattices of nanostructures: Nonlithographic formation by anodic membrane template",Jianyu Liang, at al, Journal of Applied Physics, VOl 91, No. 4, 15 Feb, 2002,http://optonano.engin.brown.edu/publications/pdf/JAP02544.pdf

[6] http://www.esco.co.kr/pdf/download/JPK/app0403-2.pdf

[7] http://www.physorg.com/news9639.html

[8] google (nanotube carpet).