The Production of Electricity out of a Heat Bath

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Abstract. In order to clarify the dispute between Loschmidt and Boltzmann/Maxwell concerning the existence of a temperature gradient in insulated vertical columns of gas, liquid or solids, macroscopic measurements of the temperature distribution in air, water and solids were performed. A negative temperature gradient, cold at the top and warm at the bottom, is found in insulated vertical tubes, while the outside environment has a reverse gradient. This is explainable by the influence of gravity. It allows the production of electricity out of a heat bath.

Keywords: Second Law, temperature, temperature gradient, isolated system, heat bath, energy production

INTRODUCTION

Late in the 19th century J. Loschmidt believed that a vertical column of solids in an isolated system would show a temperature gradient under the influence of gravity, being cold at the top and warm at the bottom. L. Boltzmann and J. C. Maxwell disagreed. Their theories and understanding of the Second Law supported an equal temperature over height. This historical discussion between J. Loschmidt, L. Boltzmann and J. C. Maxwell is covered in [1], [2], and [3]. A. Trupp gives a good summary in [4]. Only actual measurements can resolve this dispute. Prior measurements could not be found in the literature. Own first results were reported for air in [8] and for water in [5,7]. It became clear that finding a vertical temperature gradient would be meaningful only if measured values would be higher than the adiabatic lapse rate, as lower ones might be created by internal convection currents.
1. BASIC TEST SETUPS

It is known that temperature gradients in gases and liquids are stable only up to the adiabatic lapse rate [6]. Higher negative values are not possible, because the column of a gas or a liquid becomes unstable. Lower temperature at the top than at the bottom create higher densities at the top resulting in convection currents which would diminish the temperature gradient to values below the adiabatic lapse rate. In order to make greater values possible, the author tried various convection-suppressing designs. It was found that the use of fine powders, like glass powder, largely eliminated convection currents. It had the added advantage that it prevented any heat exchange by radiation within the test setup.

The basic setup consisted of an elongated container in a vertical position with a volume of ½ up to 2 liter with heights of 15 cm up to 100 cm. They were highly insulated to the environment by a sequence of Dewar glasses, vacuum panels, Pet fibers, aluminum tubes and polystyrene foam boxes, as described under 3. The temperature gradient T(Gr) in the inner axis was measured with thermocouples, arranged as a thermopile.

2. MEASURED VALUES OF THE TEMPERATURE GRADIENT T(Gr) FOR AIR.

The experiment B 76 published in [8] and [5] shows for air, filled with glass powder, a negative gradient of T(Gr) = - 0.07 K/m, averaged over time, over a period of nine months within an environment with a positive gradient. The use of a convection depressant medium, like glass powder, is necessary because the measured value of T(Gr) is 5 times greater than the adiabatic lapse rate of -0.014 K/m, the limit for a stable vertical column. Without a convection depressant, air currents would develop and negate such a large gradient.

Fig.1 demonstrates the basic setup of the experiment B 76. The temperature gradient T(Gr) is measured in position 5 at the middle axis within the inner Dewar 1. Further to the outside Dewar Glasses 2 and 3 provide additional insulation as do the insulation panels 8, 9, and 10.
FIGURE 1. Basic setup for experiment B 76 measuring the temperature gradient in air.

The middle axis within the inner Dewar shows a negative gradient of $T(Gr) = -0.07 \text{ K/m}$, averaged over time - lowest curve - , over a period of 7 months within an environment with a positive gradient of $+0.17 \text{ K/m}$ - highest curve-.

FIGURE 2. Measured values of the temperature gradient for four months calculated
The complete paper can be downloaded from [5] or [8]. The experimental data shows clearly that the inner axis of the vertical column of air with glass powder shows a negative average temperature gradient of -.07 K/m within a positive gradient in the environment.

4. MEASURED VALUES OF THE TEMPERATURE GRADIENT $T(Gr)$ FOR WATER EXPERIMENT B 372.

The experiment B 372 published and on my web page www.firstgravitymachine.com shows for a water column filled with glass powder a negative gradient of $T(Gr) = -.05$ K/m, as an average value over time, measured over a 3 month period within an environment with a positive gradient. The use of a convection depressant medium, like glass powder, is necessary as the measured value of $T(Gr)$ is much greater than the adiabatic lapse rate for water of about -.0001 K/m, the limit for a stable vertical column.

**FIGURE 3.** Test setup for measuring the temperature gradient for water.
Test B 372 measures the vertical temperature gradient in two identical glass tubes of 40 mm diameter and 850 mm length. Each glass tube is individually surrounded by a PVC tube of diameter 50 mm and length 910 mm. Tube 1 (1) and its surrounding PVC tube (2) are filled with water and fine glass powder, while tube 2 (3) and its PVC tube (4) only with clear water. These are arranged in a PVC tube of diameter 125 mm and 1000 mm length (5). The remaining space is filled with small balls of glass foam of 1mm diameter (10). The bottom part is filled with small brass shavings (11) in order to try to equalize the bottom temperatures of the two 50 mm PVC tubes.

The assembly is inside a 150 mm diameter and 1100 mm long aluminum tube of wall thickness 5 mm (6). This in turn is placed into another aluminum tube of 220 mm diameter, 1200 mm length and a wall thickness of 5 mm (7). Each of these are closed at the top with round aluminum plates of the same thickness.

The aluminum tubes containing the test assembly are standing in the center of a double-walled aluminum housing of height 1500 mm and an inner diameter of 500 mm with 50 mm between the two walls (8). This space is filled with water. The whole assembly is insulated on the outside with 100 mm of glass wool (9). The space between the larger aluminum tube and the inner aluminum housing, i.e. between (7) and (8), is filled with fine PET fibres (12).

The temperatures inside the test setup are measured by thermocouples and by thermistors. These are mounted at the tops and at the bottoms of the inner axes of the two glass tubes. Additional sensors are mounted on the outside of these glass tubes and on the outside of the two PVC tubes. The temperatures of the double-walled aluminum housing are measured 3 cm below the top and above the bottom’
FIGURE 4. Temperature gradients curve 1 – 4 and thermistor temperatures 5 and 6

Fig. 4 shows four temperature gradients of the eight values measured by thermocouples as temperature differences from December 14 through March 15. Each point of the curve represents a 10 value average (of a ten times repeated reading of the same sensor) measured every hour, using the scale on the left side of the graph. The smooth lines represent the two temperatures measured by thermistors of the six values measured hourly in centigrade, using the scale on the right side.

The complete paper can be downloaded from [5] and [7]. The experimental data taken over a period of winter and spring for a vertical column of water filled with glass powder shows continuously throughout the total time span a negative of -.05 K/m within a positive gradient in the environment.

5. SOLIDS

Long-term experiments with copper, copper powder, aluminum silicon mono crystal and especially lead indicate that a negative temperature gradient develops in isolated rods arranged in a vertical position.
Average values for various metals are found to be lower than -.001 K/m which means they are still negative but lower than those found for gases and liquids.

6. T(Gr) MEASURED AT TIMES OF THERMAL EQUILIBRIUM.

A long term equilibrium, meaning constant temperatures over time, cannot be reached as the temperatures in the environment always fluctuate to some degree and the best insulation of the experiment cannot avoid some temperature fluctuations within the innermost part of the test setup. Therefore the measured values of T(Gr) fluctuate around a long-term average. But if there exists a vertical gradient, it should show up with its correct value at those times, when there is no influx or outflow of heat into or out of the innermost experimental space.

This will be demonstrated by graphing all measured values of Experiment B372 for water, Fig.3 and 4, of the gradient as a function of the temperature changes over time of the innermost vertical axis. Trend lines are calculated as least squares regression lines for the scattered values. The trend
line for the lower scattered values for inner tube 1 (water with glass powder) intersect the vertical zero line, where the rate of temperature change is 0, at -0.05 K/m. The upper markers give a T(Gr) value of -0.12 K/m for inner tube 2 (only water). Both of these values agree well with the long term average values, seen on curves 1 and 2 in Fig. 4. The error bars correspond to +/- 1 SDs for all measured values.

B372: Temperature gradient as function of the speed of temperature change December 2006 - March 2007

Under equilibrium conditions at periods when there is no heat influx or outflow at x=0, measurements show a negative gradient, confirming the long term measured averages of a negative gradient.

7. T(Gr) CONFIRMED THROUGH TURNING EXPERIMENTS

This especially built turning drum allows to install an experiment in the inner drum which keeps standing still while the outer drum is rotating once every minute. This creates a very steady temperature gradient in the inner non-rotating aluminum drum. (The insulation around the outer drum is not shown). This setup allows turning the experiments installed in the inner drum by 180°, on their head, without disturbing the outer insulation.
FIGURE 7. This turning drum built out of aluminum sheet allows to turn experiments by 180° on their heads without disturbing the heavy insulation attached on the outside (not shown in picture)

The following graph of turning experiment V76 as described under [8] shows the average gradient after being turned on its head 9 times by 180°, first from the normal position onto its head and after 40 hours back into its normal position.

FIGURE 8. Repeated turning experiments each over 30 hours indicate the change of the temperature gradient after being turned by 180° from its normal position onto its head and back
The graph shows that it takes about 30 hours after the turning for the gradient to re-establish itself, cold at the top and warm at the bottom. These turning experiments are a strong indication for confirming that a negative temperature gradient develops in vertical columns of air under the influence of gravity.

8. HOW DOES HEAT TRAVEL FROM COLD TO WARM?

In describing how heat can travel from cold to warm, that is, from one location with a low temperature to another with a higher one, one runs right away into a problem: What is the definition of temperature? Looking at textbooks and related references and even websites for a definition of temperature many different ones can be found.

I will use the following:

"Temperature: A convenient operational definition of temperature is that it is a measure of the average translational kinetic energy associated with the disordered microscopic motion of atoms and molecules. The flow of heat is from a high temperature region toward a lower temperature”

And what is now my trouble with this definition? It does not fit to my experimental results! My results show that because the earth has a gravitational field, heat can flow here from a low temperature region towards a higher temperature region. Furthermore, an “equilibrium” condition can exist simultaneously with a temperature gradient over height.

As a consequence of this, I can define two kinds of temperatures:

1. The “conventional” temperature which is measurable by a thermometer that shows this conventional temperature, when all internal energy is equipartitioned, that is the energy is distributed equally between all degrees of freedom. It is correct for an assembly of molecules which are in constant contact and interchange with each other.

2. The second one, which I call “gravitational” temperature, or temperature
based on the effect of gravity $T(Gr)$, is valid for molecules between collisions. This gravitational temperature is in effect, when the internal energy is not equally distributed between all degrees of freedom. It can be higher than the “conventional” temperature, when a molecule is falling in a gravitational field and the vertical speed component collects more energy, than the rest of the degrees of freedom, or it can be lower, when a molecule moves against a gravitational field and the opposite happens.

In a container filled with a gas, we can find both types of temperatures existing at different locations. How does this understanding of temperature affect the temperature gradient existing between the top and the bottom of this container?

Let us assume that our vertical container is isolated very well against the environment and has three sections.

![Figure 9](image.png)

**FIGURE 9.** Indicating the increase of the speed of a molecule in a Knudsen gas being accelerated on its vertical path through the influence of gravity

The middle section has a height of $H_2$ and is filled with a Knudsen gas, meaning that the free length of the molecules in it is large in comparison to the height $H_2$. The molecules are hardly hitting each other bouncing between the walls of the container.
The top section 1 and the bottom section 3 of the container are filled with a dense gas, whose molecules have a Maxwellian speed distribution. The heights $H_1$ and $H_3$ are small compared to $H_2$. There is a good heat transfer between the gas in section 1 and the dividing wall $W_1$ and between the gas in section 3 and dividing wall $W_3$. Therefore, these walls have the same temperatures as the gases in section 1 and section 3.

Presently in physics textbooks it is being taught that under equilibrium conditions, the temperatures in all sections, including all walls, would be the same, based on the theoretical calculations by Boltzmann and on the argument by Maxwell, who declared that these have to be identical based on the understanding of the Second Law. Contrary to this, my measurements show that, even starting out with a condition of equal temperatures, a temperature difference will develop between the top and the bottom. The temperature on the top will decrease and the temperature on the bottom will increase, arriving to a new equilibrium condition after a while, with a temperature gradient, which I call $T(\text{Gr})$. This means that energy, in the form of heat, had to travel from cold to warm, from the top section to the bottom section. How can this happen?

Let us assume that the top and the bottom walls, $W_1$ and $W_3$, have rough surfaces. Let us further assume that a molecule hits the top wall and, because of the rough surface, gets thermalized, meaning that its energy becomes distributed equally between all degrees of freedom. We assume that our molecule gets reflected from the upper wall $W_1$ and flies vertically down to the lower wall $W_3$. On its way gravity will accelerate this molecule and its potential energy, $M \cdot g \cdot H$, will be changed into kinetic energy. Because the gravitational field creates a force only in the vertical direction, this increase of kinetic energy will show up only in the vertical speed component. Our molecule will impact the lower wall $W_3$ not in an equipartitioned condition, that is, energy will not be distributed equally into all degrees of freedom, as it was, when it started out from the upper wall. There, the temperature was defined as above under 1 and called “conventional” temperature. The molecule arrives at the bottom wall $W_3$ with a temperature defined under 2 as “gravitational” temperature.

For a better understanding, let us compare this “heating up” of a molecule through the acceleration in a gravity field to a heating up of the same molecule through an electrical heating element. In this second case the energy entering the gas would be quickly thermalized by the collisions with other molecules.
Through this process the energy introduced would be distributed over all degrees of freedom. In a diatomic gas, like nitrogen or oxygen, having 5 degrees of freedom at room temperature, 2/5 would go to the rotational degrees of freedom and 3/5 to the translational ones. Only these 3/5 influence the “conventional” temperature of the gas, which can be calculated using the specific heat of the gas in question.

When our “vertically accelerated molecule” arrives at the lower wall, it will be caught up in the roughness of the surface and becomes thermalized. It will leave the wall with the temperature of the wall. This means that its vertical speed component will be smaller, when it leaves than what it was, when it had arrived at the wall. So it delivered energy to the wall, heating it slightly, thus energy was transferred from the upper to the lower wall. This means: Heat was transferred from a colder to a warmer space, i.e. from a wall with a lower to a wall with a higher temperature.

On the way up the opposite takes place. Our molecule, leaving with a speed corresponding to the temperature of the lower wall and being thermalized, will arrive at the upper wall decelerated by the effect of gravity. Gravity again will have affected the vertical speed component by reducing its magnitude. It arrives at the upper wall W1 with a “gravitational temperature” lower than the “conventional temperature” of the wall. After impinging and getting thermalized in the rough surface of the wall, it will bounce back from it having received some energy from the upper wall in this thermalizing process. Thus, the molecule has cooled the upper wall.

In the walls W1 and W2 the molecules follow a Maxwell-Boltzmann distribution which also means, that their energy is distributed equally over all degrees of freedom. An equilibrium condition will have been reached, when the “conventional” temperatures in the upper and lower walls will be equal to the “gravitational” temperatures of the arriving molecules. At this equilibrium, the temperature of W1 is lower than that of W3.

Boltzmann’s argument for equal temperatures over height is based on looking at an ideal gas, while my experiments take place with real gases. This might explain the difference in the final results.

We can calculate the temperature gradient based on this energy transfer as follows:
The potential energy is

\[ E_p = -M \cdot g \cdot H \]  

(1)

with \( M \) = mass; \( g \) = constant of gravitation; \( H \) = height difference

(Negative, because \( g \) and \( H \) are measured in opposite directions)

We equate this potential energy \( E_p \) to the amount of energy available for a temperature increase of this mass

\[ E_{avail} = M \cdot c_{Gr} \cdot T \]  

(2)

with \( c_{Gr} \) = effective specific heat; \( T \) = Temperature increase

We now can equate \( E_p \) with \( E_{avail} \) or

\[ E_p = E_{avail} = M \cdot g \cdot H = M \cdot c_{Gr} \cdot T \]  

(3)

or

\[ T = \frac{g \cdot H}{c_{Gr}} = T_{Gr} \]  

(4)

\( c_{Gr} \) is not the normal specific heat of the gas or liquid in question, because the acceleration through \( g \) affects only the vertical speed component of the molecule. The potential energy of a molecule is converted only into an increase of its speed in its downward direction. No energy is added to the other degrees of freedom, like the remaining two translational directions (left to right and front to back) or to the rotational energy in molecules that consist of several atoms. Therefore,

\[ c_{Gr} = \frac{c}{n} \]  

(5)

with \( c \) = specific heat; \( n \) = number of degrees of freedom

We therefore get

\[ T_{Gr} = \frac{-g \cdot H}{c_{Gr}} = \frac{-g \cdot H \cdot n}{c} \]  

(6)
With this formula for a height of 1 meter and taking the number of degrees of freedom for water as 18, we obtain

\[ T_{Gr} = -0.04 \text{ K/m for water} \]  
(7)

and taking the number of degrees of freedom for air as 5, we obtain

\[ T_{Gr} = -0.07 \text{ K/m for air.} \]  
(8)

A different way for this calculation starts with the thought that a molecule will accelerate on its downward path in accordance with the law for free fall, first formulated by Newton:

From the equation \( M \cdot \frac{v^2}{2} = M \cdot g \cdot H \) we obtain for the velocity:

\[ v = \sqrt{2 \cdot g \cdot H} \text{ or } v = \sqrt{2 \cdot 9.81 \cdot 1} = v = \sqrt{19.62} = 4.43 \text{ m/sec} \]  
(9)

The gravitational temperature would then be for air with Boltzmann constant \( k = 1.38 \times 10^{-23} \text{ J/K} \)
Molecular weight \( M = 29 \text{ kg/Mol} \)
Avogadro's Number for (Mol) Kilomol \( N = 6.02 \cdot 10^{26} \)

\[ T_{Gr} = \frac{M \cdot v^2}{2/(k/2)} = \frac{29/(6.02 \cdot 10^{26}) \cdot 4.43^2/(1.38 \cdot 10^{-23})}{.07 \text{ K/m}} \]  
(10)

And for water with Molecular weight \( M = 18 \text{ kg/Mol} \)

\[ T_{Gr} = \frac{M \cdot v^2}{2/(k/2)} = \frac{18/(6.02 \cdot 10^{26}) \cdot 4.43^2/(1.38 \cdot 10^{-23})}{.04 \text{ K/m}} \]  
(11)

These are the same results as calculated above.

The significance lies in the fact that I found experimentally throughout the years practically identical results as published in [8] and [9] in 2002 and 2003, for two such different molecules, for air and for water. The experimentally found values are practically identical with the calculated values according to the formulas developed above.
9. PERPETUUM MOBILES OF THE SECOND KIND ARE POSSIBLE, CONSEQUENCES FOR THE SECOND LAW

Sheehan quotes Trusdell in [10]:

“Every physicist knows exactly what the First and Second Laws mean, but it is my experience that no two physicists agree on them.”

Sheehan then continues to describe 21 formulations, two of the first ones being [32] and [33]:

**Kelvin-Planck:** No device, operating in a cycle, can produce the sole effect of extraction a quantity of heat from a heat reservoir and the performance of an equal quantity of work.

In this, its most primordial form, the Second Law is an injunction against perpetuum mobile of the second type (PM2). Such a device would transform heat from a heat bath into useful work, in principle, indefinitely. Other common (and equivalent) statement includes:

**Perpetual Motion** Perpetuum mobile of the second type are impossible.

My experimental results contradict all of these statements. My experiments have shown:

…a device is possible which extracts heat from a heat reservoir and produces work in the form of electricity……,

...heat can flow from cold to warm… and

...Perpetuum Mobiles of the Second Kind are possible…..

Therefore my findings are contradicting the Second Law, they are not in agreement with practically all established statements of it. But the Second Law is valid only for isolated systems. The above statements by Kelvin-Planck and others about the impossibility of a perpetuum mobile of the second kind are correct only for isolated systems. “Isolated” means here, that no transfer of energy or mass across the boundary around the system takes place. But on
earth we cannot exclude the effect of the gravitational force! This gravitational force inserts and exerts energy in and out of my experimental setups. So in discussing the influence of my results onto the Second Law we have to view it as part of an isolated system. We have to visualize our boundary to include the mass of the earth which is the source of the gravitational force affecting my experiments!

The combination of a heat bath with a vertical column of gas, liquid or solid material with the effect of gravity, makes possible the movement of heat from cold to warm, the extraction of work out of a heat bath. This contradicts commonly used and taught statements of the Second Law. So I believe, we need a new statement of the Second Law, but we have to make sure that any such new statement makes clear, that it is concerned only with isolated systems.

I feel that this could be a new general statement of the Second Law:

**In isolated systems – with no exchange of matter and energy across their boundaries AND WITH NO EXPOSURE TO FORCE FIELDS - initial differences of temperature, densities, and concentrations in assemblies of molecules will disappear over time, resulting in an increase of entropy.**

Conversely:

**In isolated systems - with no exchange of matter and energy across its boundaries - FORCE FIELDS LIKE GRAVITY can generate in macroscopic assemblies of molecules temperature, density, and concentration gradients. The temperature differences may be used to generate work, resulting in a decrease of entropy.**

10. FROM THE MAXWELL DEMON TO A T(GR) FAIRY: THE PRODUCTION OF ENERGY OUT OF A HEAT BATH, GRAVITY MACHINES

In the middle of the 19th century thermodynamics was an important topic for the physicists and chemists of the time. More and more they became convinced that the atmosphere was filled with billions of gas molecules, moving around in a Brownian (random) motion, their speed being an indication of their internal energy and of the temperature of the gas. So the total of their internal energy represented a huge amount of energy.
Transferring this idea to the water in an ocean, the question arose, whether we could use this energy, for instance, to drive an ocean liner across the seas?

The answer was “No, we couldn’t”! The Second Law of Thermodynamics, which was formulated during those years, forbade it. In order to produce work out of a heat bath, one always needed a temperature difference. And thinking about it, Maxwell and others invented the idea of a “Maxwell Demon”. This “Demon” was somehow able to measure the speed of individual molecules in a heat bath and to separate the fast moving ones from the slow ones, shown here in a figure from Wikipedia:

![FIGURE 10. Maxwell Demon separating slow and fast molecules from each other](image)

The fast molecules on the right side would represent a higher temperature than on the left. This difference could be used to create work.

The fact is that up to now nobody has found such a “demon”. The results of my experiments during the last 13 years change this. I didn’t find a Demon, but I realized that gravity has the effect of a Demon. In a vertical column of gas or liquid, gravity makes sure that on the top the average speed of the molecules is lower than at the bottom.

This is demonstrated in the following two pictures. On the left, we have a large heat bath with a narrow height, where in all parts the average speed of the molecules is identical. On the right side, the container is a vertical
column of gas or liquid, where the effect of gravity had created a vertical temperature gradient. This gradient can be used to produce electricity through a thermocouple, or more effectively through a Peltier element, arranged between the top and the bottom.

When we generate electricity out of this container, then the temperature in it will decline. By making a heat-transmitting connection between the heat bath and this vertical column, we can raise the temperature of the gas or the liquid in the column again up to the temperature of the heat bath. This arrangement represents the model for a continuing production of electricity out of a heat bath.

FIGURE 11. A heat bath, left, is thermally connected to a vertical column of molecules creating a temperature difference, cold at the top and warm at the bottom.

If we want the Gravity Machine to work in cyclical way, we just would connect and disconnect the heat bath with the Gravity Machine from time to time.
FIGURE 12. Typical design of a Gravity Machine delivering an electric current to a resistor mounted on the outside

The above Fig. 12 shows a typical setup which I call a “Gravity Machine”. In the inner one of two nested Dewar flasks, filled with glass powder and air, a thermopile (1) is mounted along the vertical axis. This arrangement is heavily insulated on the outside, in order to reduce the influence of temperature fluctuations from the environment. Under the influence of gravity a negative vertical temperature gradient of about -.07 K/m develops in the air within the inner Dewar flask, very similar to experiment B76, described under 3.

The thermopile is connected to a 100 Ohm resistor. As shown in the following graph we measured the current through the resistor and the voltage of the thermopile continuously for 2 days in November of 2007, the values being shown on the left side of the graph.
FIGURE 13. Electrical output of a Gravity Machine as shown in Fig. 12

The wattage, obtained as Ampere times Volt, is shown on the right hand scale. As can be seen, the output of this machine, around 6 times $10^{-13}$ W, is extremely small. Nevertheless, it is still very meaningful, because this power has been produced without the addition of outside energy, based only on a negative temperature gradient generated by the influence of gravity. Furthermore, all of this took place surrounded by an outside environment having a positive temperature gradient.

This gravity machine has only a working volume of .3 liter and is therefore too small to generate enough power to drive a machine or an electric light. But it demonstrates the principle that heat can flow under the influence of gravity from a cold reservoir to one with a higher temperature and so produce the temperature difference needed to create work.
Gravity machines are covered by

EUROPEAN PATENT APPLICATION Number 03 002 000.2-2315. and
US Patent Application 61/493,053

11. OPTIMAL DESIGN FOR A TRANSPORTABLE GRAVITY MACHINE

In order to show an optimal temperature gradient a Gravity Machine needs a lot of insulation to protect it from the long term temperature changes and short term fluctuations in the environment. This results in large dimensions, too big to be easily transported. An optimal design which allows not only an easy transport but also the turning of the whole machine by 180 degrees on its head is shown in Fig. 15:
Here is of special importance the copper/foam spiral. It consists of a thin copper sheet with a thickness of .7mm wound up together with a polyethylene foam sheet with a thickness of 2 mm into a spiral with about 10 windings. The spiral is well insulated towards the environment and shows on its inner side a temperature gradient very close to zero. This is optimal for the creation of an innermost negative temperature gradient, unaffected by the positive gradient in the environment. The spiral design has a much more efficient effect than one thick aluminum tube combined with one thick polystyrene foam tube with the same overall dimensions.

12. DESIGNS FOR LARGE SCALE APPLICATIONS.

In order to create greater amounts of work, i.e. in the form of electricity, one needs a great height of the innermost container and a large volume. The total temperature difference between the top and the bottom is determined by the temperature gradient $T(Gr)$ in K/meter of the material in the innermost container, the total height and the amount of work producible by the volume. The following Fig.16 shows the $T(Gr)$ values calculated for some gases and liquids:
## T(Gr) Calculation

**Gases**  
19-Jun-08  
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<th></th>
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<th>Radon</th>
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<td>sp. Heat cv (J/kg,K)</td>
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<td>92</td>
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<tr>
<td>sp. Heat cp (J/kg,K)</td>
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<tr>
<td>speed of sound (m/sec)</td>
<td>1493</td>
<td>1000</td>
<td>500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>heat conductivity (W/m,K)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>degree of freedom</td>
<td>18</td>
<td>100</td>
<td>104</td>
<td>13182</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T(Gr) (k/m)</td>
<td>-0.042</td>
<td>-0.533</td>
<td>-0.466</td>
<td>-59</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TABLE 1.** calculation of T(Gr) values for gases and liquids

To fill the inner container with radon seems to be a good choice, creating theoretically a T(Gr) of .5 K/meter, except that Radon is scarce, expensive, and radioactive. Xenon, with a theoretical T(Gr) value of .3 K/m, might be a more economical choice. In a tube installed as temperature difference element – a Gravity Machine – at the side of a mountain or in a mine shaft similar to Fig.9 with a height difference of 500 meter one would get a total temperature difference of about 250 K which is high enough for an economical production of steam or to drive a Stirling Engine.
FIGURE 16. Gravity Machine installed on a mountain side or in a mine shaft

The work taken out has to be replenished from a heat bath, like a river, connected to the upper or lower part of the tube though an heat exchanger.

Further testing has to show if liquids with long organic molecules would create higher values of $T(Gr)$. This would be necessary for an application in accordance with Fig. 17:

FIGURE 17. Possible design for installing a Gravity Machine in a family home or commercial installation, cooling on the left and heating on the right
This installation of a refrigerator, a Gravity Machine and a warm water heater in a family home would have an available height of only 10 meters. A gradient of -5 K/m would be necessary to create a temperature difference of about 50 C. This would be enough to provide the cooling needs through a heat exchanger at the top of the house and all heating needs through one in the cellar. Further experiments have to show if a material with such a large gradient can be found. In a 20 floor hotel tower with a height of 100 meters a gradient of .5 K/m might be already sufficient to satisfy all heating and cooling needs.

13. CONCLUSION

The results of hundreds of measurements of the temperature gradient in insulated columns of gases, liquids, and solids show a negative gradient within a positive gradient in the environment. This principle result can be demonstrated graphically by a metal rod mounted within a block of plastic foam for optimal insulation:

FIGURE 18. A metal rod mounted in an insulating polystyrene foam block shows a negative gradient, cold at the top and warm at the bottom, surrounded by an opposite temperature gradient, warm at the top and cold at the bottom
Measurements of the vertical temperature gradient in insulated columns of gases, liquids and solids have shown a negative gradient, cold at the top and warm at the bottom. This result negates the opinions of Maxwell and Boltzmann and strengthens the opinion of Loschmidt. It demonstrates that heat can travel from cold to warm under the influence of gravity.

The generated temperature gradients can be used to provide work, i.e. in the form of electricity. This represents a Perpetuum Mobile of the Second Kind. Statements of the meaning of the Second Law have to be reworded.

Additional tests have to show if materials and designs can be found which allow the production of usable energy in today’s economical environment.
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