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Searl Technology

Julio C. Gobbi[1]
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ABSTRACT: This article aims to demonstrate that John Searl developed a magnetic system that can be used for electrical energy generation and discoid craft propulsion. His experiments on rotating magnets gave him the understanding about how to gather electrostatic charges from the atmosphere as an electric current source. The base of his discoveries is a device called SEG, an apparatus done with a magnetic ring and several magnetic rollers turning around it. It will be developed a first mathematical approach to quantify his SEG generator and IGV propulsion systems.

KEYWORDS: magnetic plate, magnetic roller, SEG generator, IGV propulsion, gyro cell.

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1 Introduction

John Robert Roy Searl, from England, developed several self-powered devices between the years 1946 and 1956. Searl's original idea was that free electrons from rotating metallic bodies tend to move in the radial direction, due to inertial forces. Thus, an electric potential developed between the center and the periphery of a rotating disk and between the inner and outer edges of a rotating ring. He also maintained the view that the electromotive force induced in rotating bodies due to the Earth's magnetic field could be used to generate electrical energy. His early experiments showed tiny voltages in the radial direction of high-speed steel discs and rings. [1]

Initially, Searl suggested that the devices could be composed of segmented rings of permanent magnets, interleaved with insulating spaces in the same plane, and the whole set would be put in rotation. The energy of the magnets would be transformed into electrical energy by placing electromagnetic coils on the periphery of the rotating device.

1 E-mail: solismagnus@gmail.com

In an experiment carried out in open air with a generator of 90 cm in diameter with three rings composed of magnetic segments in the same plane, with a number of induction coils on the periphery, the armature was set in motion by a small motor. The device produced an electrostatic potential of the order of 1 MVolts in the radial direction at relatively low speed, indicated by static effects on nearby objects, crackling and the smell of ozone. The generator levitated while increasing the speed of rotation and acquired a bluish glow, broke the connection between itself and the machine, and rose to a height of 15 meters. There it stopped for a short time, still increasing the rotation speed and it was surrounded by a pink halo, which indicates ionization of the air at very reduced pressure. Local radio receivers turned on by themselves. Finally, the entire generator accelerated to fantastic speed and disappeared into the stratosphere.

After some time, Searl started experiments with permanent magnets in rotation, which resulted in a considerable improvement in the results. Observing the inertial and gyroscopic effects of balls in high rotation, Searl developed a device where a stationary ring (called plate) was surrounded by a number of rollers made of magnetic material, forcing them to rotate on their own axis and simultaneously revolving around the ring, rotating them with a motor and thus producing voltages of the order of 30 kVolts.

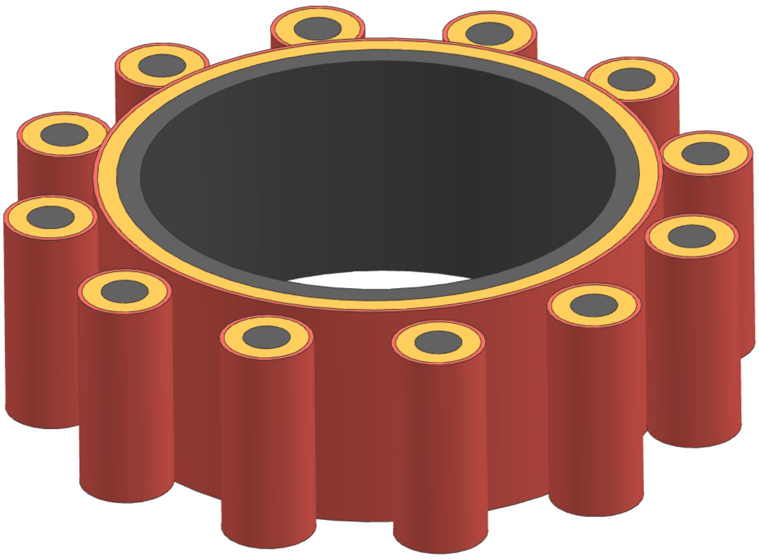

Figure 1: Magnetic central ring (plate) and rollers.

At a certain critical speed, some of the generators suddenly entered a positive feedback operating mode that spontaneously ran without any mechanical connection to the engine. With the progress of the tests, this critical speed was reduced almost to zero by careful design and increasing the number of rollers and, eventually, it was possible to produce self-starting generators.

Searl found that when the generators were operating, the air pressure decreased in and around the generator. With voltages greater than 30 kVolts, the air movement was directed out of the periphery of the generators and a candle light placed in the center of the generator ring went out due to lack of oxygen. This decrease in air pressure would explain the absence of electrical discharges between the central plate and the rollers. It also observed a decrease in temperature near and inside the generators. Objects placed inside the generator ring have lost their weight.

2 Description of the SEG

The basic unit of the Searl Effect Generator – SEG consists of a magnetic stationary ring, called plate, and a number of magnetic cylindrical wheels called rollers. The rollers are arranged around the plate and held in position by magnetic attraction. During operation, each roller spins around its axis and simultaneously orbits the plate. Experience has shown that the output power increases when the number of rollers increases and, to achieve smooth operation, the ratio between the outer diameter of the plate and the diameter of the rollers must be a positive integer greater than or equal to 12. The choice of this proportion allows to achieve a resonant mode of magnetic spinning wave (magnetic vortex) between the mobile elements of the device. It was also observed that the space between adjacent rollers must be greater than the diameter of a roller.

The plate and rollers are magnetized with a process that superimposes AC (100 mA, 10MHz) and DC (180 A * loop) for each magnet to acquire a specific pattern of magnetic poles recorded on two tracks, which consists of an individual number of poles north and south, corresponding to the AC frequency used in the magnetization process. The magnetic materials used are combined with other elements of the Periodic Table not involved in the magnetization process through a sintering process, putting them all together under pressure.

One of these rollers used in the original experiments was analyzed qualitatively and the presence of the following elements was demonstrated: aluminum, silicon, sulfur, titanium, neodymium, iron. Basically, each roller consists of a core of magnetized ferromagnetic material, one or two layers of dielectric material capable of storing electric charges (being electrified) and, on the outer layer, a material that is a good electricity conductor. In one of the projects, the sequence of materials used on the plate and on the rollers was from the inside to the outside: Neodymium, Nylon, Iron, Titanium.

Figure 2: Basic unit called gyro cell.

When the SEG is used in an electrical plant, induction coils with a core of mild steel, silicon steel or high permeability ferrite with a “C” shape must be placed on the periphery of the plate, so that the rollers pass through their air gap. The magnetic field of the rollers, when passing through the air gap of the coil cores, induces an electric potential in the coils. The coils are connected in series or parallel; its number of turns and diameter are calculated for the maximum load of the system. The SEG generator therefore behaves like a primary impeller, where the generation of energy is done in the same way as any generator that depends on a primary force.

The rollers are attracted magnetically by the plate and are positioned vertically with the polarity reversed. While the rollers are with the South pole up, the plate will be with the North pole up. When in operation, the rollers do not touch the plate, so there is no friction. Due to the magnetic repulsion between the rollers, they remain positioned equidistant from each other and all move together in the same direction.

The system has a radial flow of electrons that depart from the center to the periphery of the generator, which lowers its temperature, reducing its electrical resistance. The greater the load connected on the induction coils, the greater the acceleration of the rollers and the lower the temperature. The system self-adjusts until a critical point is found. At a temperature of 4 Kelvin, the SEG becomes superconducting and completely loses its electrical resistance. At this point it levitates, enveloped in a perfect vacuum caused by the movement of electrons that collide with the air and dissociate and ionize it. Without control, it accelerates until it disappears into space. To control it, a powerful radio frequency transmitter is required, which is of the same frequency used to magnetize the rollers.

More complex units can be made by mounting additional plates and rollers to the basic unit. Each section consists of a plate with its corresponding rollers placed concentrically on the same plane as the first section, so the subsequent plates will be larger, the rollers will have the same diameter but will be in greater quantity.

3 How the SEG Works

The magnetization method used for the rollers, superimposing AC on the DC field, aims to auto-start and maintain the speed of the rollers, as well as the speed control of the rollers. It is a complex system that will not be discussed. Instead, we will simplify the study by considering only the interaction between electric and magnetic continuous fields, using Lorentz force. It is the basic principle behind the Faraday disk (also called homopolar disc), where a magnetized material in rotation produces an electric field between its center of rotation and the periphery.

This approach allows the rollers to be assembled with just three layers:

1. Magnetizable material in the core
   The recommended ones are hard ferromagnetic compounds based on iron oxide (Fe_2O_3) like ferrite, or rare-earth elements like neodymium (NdFeB).
2. Electrizable material in the inner layer
   The ferroelectric ones are based on synthetic polymers like electret and certain waxes that can be electrically polarized.
3. Electrical conductive material in the outer layer
   The good conductors like copper (Cu), bronze (Cu + Sn) or brass (Cu + Zn).

In this case, the magnetized rollers are rotated and, at the same time, translated around the plate. Thus, we have the creation of two radial electric fields: one is produced between the center and the periphery of the rollers due to their rotation, the other is produced between the plate and the periphery of the device due to the translation movement of the rollers. These electric fields are created by the deflection of electrostatic charges from the atmosphere, which can be collected at the periphery of the device.

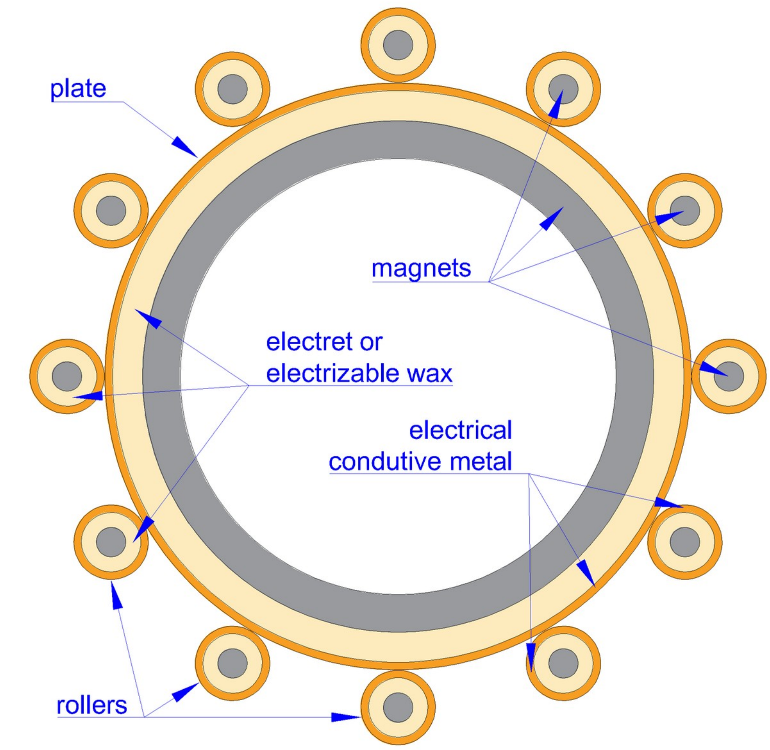

Figure 3: Basic SEG unit.

The radial electric field produced by the initial impulse of the rollers polarizes the electrizable material contained in the inner layer of the rollers and thus maintains the movement of the rollers themselves by the Lorentz force principle, that is, with a magnetic field perpendicular to an electric field there will be movement. The greater the rotation of the rollers, the greater the electric field developed in the dielectric of the roller and, thus, the greater the speed. The electrons accumulated in the outer conductive layer of the rollers, being in rotation, behave like a circular electric current and, therefore, reinforce the magnetic field of the rollers, if they are properly polarized, otherwise the tendency is to depolarize the field of the rollers. The device will find a balance point between its velocity, electric field and magnetic field vectors, according to the Hall effect formula $\vec{E}=\vec{v}\times\vec{B}$.

The translation movement of the rollers causes positive electric charges to be projected towards the center and negative electrical charges towards the periphery of the device, as shown in the article Power from Electrostatic Charges [2]. Due to the system being composed of 12 magnetized rollers, a magnetic vortex is created that constantly attracts more electrical charges from the environment and the system is self-supporting, always attracting more charges from the environment and projecting them towards the center or the periphery of the device. The addition of more roller plates amplifies the system's energy production.

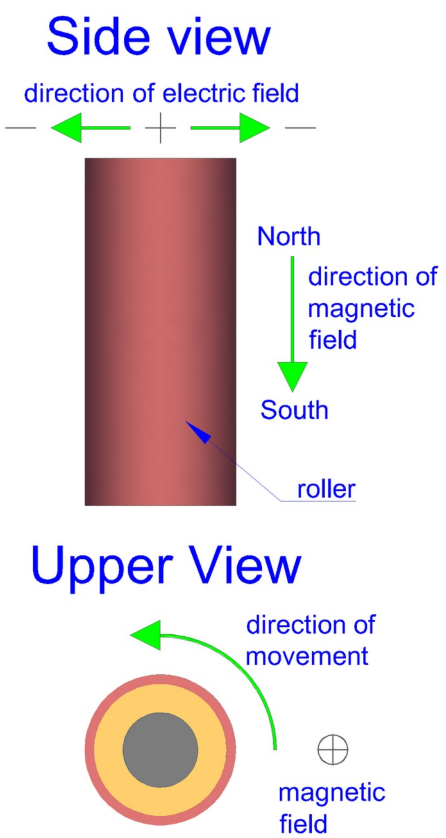

Figure 4: Field vectors direction.

The magnetic field vector in the magnetized material of the rollers has the same direction inside as outside of it, which reaches the dielectric layer of the electrizable material. This is because the magnetic poles are created by the surface distribution of magnetic charges of the magnets. In this situation, the electric potential difference developed in the magnetic material and in the outer layer of the rollers, as they are of electrical conductive material, is extremely small, which is why in the calculations only the electric potential difference present in the dielectric material is considered.

The calculation of the radial electric potential difference on the dielectric material is done through the integral:

$$V_E=\int E\,dr=\int_{r_1}^{r_2} v\,B\,dr=\int_{r_1}^{r_2} B\,\omega\,r\,dr=B\,\omega\left[\frac{r^2}{2}\right]_{r_1}^{r_2}=\frac{1}{2}B\,\omega\left(r_2^2-r_1^2\right) \quad .$$

With:

V_E = Electric potential [V];
E = Electric field [V m^{-1}];
B = Surface density of magnetic charge [Wb m^{-2}] [T];
ω = 2πf = Angular speed of roller [rad s^{-1}];
v = ωr = Translation speed of roller [m s^{-1}];
r = Dielectric radius [m];
r_1 = External dielectric radius [m];
r_2 = Internal dielectric radius [m].

To have an idea of the value of the radial electric field developed in the electrizable material of the SEG rollers, we can consider that the magnets used were neodymium based with B = 1.38 T and the translation speed of the rollers around the plate was 250 km/h (69.44 m/s). As the rollers that were tested had different diameters, we can estimate that with rollers 42 mm in diameter, 20 mm corresponded to the magnets, leaving 10 mm thick for the dielectric material and 1 mm thick for the external metallic cover. Thus, the electric potential developed radially in the dielectric material of the rollers was:

$$V_E=\frac{1}{2}B\,\omega\left(R^2-r^2\right)=\frac{1}{2}B\frac{v}{R_e}\left(R^2-r^2\right)=\frac{1}{2}1.38\frac{69.44}{2.1*10^{-2}}\left(\left(2*10^{-2}\right)^2-\left(10^{-2}\right)^2\right)=0.6845\,V \quad .$$

With:

V_E = Electric potential [V];
B = Surface density of magnetic charge = 1.38 T;
$\omega = v/R_e$ = Angular speed [rad s^{-1}];
$v = \omega r$ = Linear speed = 250 km/h = 69,44 m s^{-1};
R = Radius of dielectric's external circumference = $2*10^{-2}$ m;
r = Radius of dielectric's internal circumference = 10^{-2} m;
R_e = Radius of roller's external circumference = $2.1*10^{-2}$ m.

The electric field corresponding to this potential is:

$$E=\frac{V_E}{(R-r)}=\frac{0.6845}{(2*10^{-2}-10^{-2})}=68.45\,V\,m^{-1} \quad .$$

4 The SEG Energy Generator

We will study two different systems that have been developed to extract electrical energy from the SEG:

1. The high-voltage system – source of electric current
   This system was originally developed to measure the electric potential generated between the stationary plate and the movable rollers. The positive terminal of the generator is extracted from the plate's internal face and the negative terminal consisted of a number of electrodes in the shape of a comb, connected in parallel, mounted along the entire periphery of the generator, close to the rollers;
2. The low-voltage system – electric potential induction
   This system consisted of a number of coils wound on C-shaped ferrosilicon cores, fixed around the generator so that the magnetized rollers, when rotating around the plate, passed through the air gap of the cores inducing AC voltage in the coils. These were connected in series or parallel, or a combination of both.

When Searl developed this generator system, he connected one of the poles of the coils on the plate, which is the positive pole of the high-voltage system, so that the negative electric charges (electrons) projected to the periphery of the gyro cell, when they collide with the coils positioned on the periphery, provided additional electrostatic current to the output circuit. The amount of charges added was sufficient for the SEG generator be used as a self-sufficient home generator system. But both high and low voltage systems are independent, so the generator can provide two separate and independent voltages.

4.1 High Voltage System

The high voltage system collects the negatively charged particles (electrons) projected to the periphery of the device through electrodes distributed throughout its external perimeter. The electrodes are connected in parallel and conduct the collected electrons to the negative pole of a storage system. The positive pole of the storage system is connected to the stationary ring (plate), where the positive charges are deflected.

If no storage system is connected to the set, there will be a tendency to indefinitely increase the electric potential in this circuit because the electrons accumulate in the electrodes. Between the electrodes on the periphery and the center of the plate, a capacitor is formed that charges as long as electrons collide with the electrodes. This system works as a source of DC electric current, so it is not enough to connect capacitors – it is necessary to control the maximum voltage achieved. For laboratory tests, it is sufficient to connect a battery bank, measure and control the electric charge current. The mathematical development for the calculations of this system is demonstrated in the chapter Electric Charges Gathering by Magnetic Vortex in the article Power from Electrostatic Charges [2], which deals with the gathering of ions from the atmosphere.

The translation speed of the rollers around the plate, which is its tangential speed, is calculated by knowing its rotation speed, which is a function of the magnetic and electric fields applied to the rollers:

$$V_E = \frac{1}{2} B \omega \left(R^2 - r^2\right) \quad \Rightarrow \quad \omega = \frac{2 V_E}{B\left(R^2 - r^2\right)} \quad \Rightarrow \quad v = \omega R_e = \frac{2 V_E R_e}{B\left(R^2 - r^2\right)} \quad .$$

With:

V_E = Electric potential [V];
B = Surface density of magnetic charge [Wb m^{-2}] [T];
ω = 2πf = Angular speed of rotation [rad s^{-1}];
v = ωr = Translation or tangential speed of roller [m s^{-1}];
R = Radius of dielectric’s external circumference [m];
r = Radius of dielectric’s internal circumference [m];
R_e = Radius of roller’s external circumference [m].

The rotation speed of the rollers in RPM (revolutions per minute) is determined considering that:

$$f = \frac{v_{RPM}}{60} \quad , \quad \omega = 2\pi f = 2\pi \frac{v_{RPM}}{60} = \frac{2 V_E}{B\left(R^2 - r^2\right)} \quad \Rightarrow \quad v_{RPM} = \frac{60 V_E}{\pi B\left(R^2 - r^2\right)} \quad .$$

With:

v_{RPM} = Rotation speed of roller [RPM];
f = Frequency of rotation [cycles s^{-1}].

After calculating the electric current equivalent to the gathering of charges that collide in the collecting belt, we can calculate the potential and the electric field produced by the device, considering the capacitor formed between the plate and the collecting belt, to confirm the reports that the system produced high voltage.

$$V_E = Q_E \frac{R_{cp}}{\varepsilon S_c} = I_E t \frac{R_c}{\varepsilon S_c} \quad .$$

With:

V_E = Electric potential [V];
Q_E = Electric charge [C];
I_E = Electric current [A];
t = Time [s];
R_{cp} = Distance between collecting belt and plate [m];
ε = Electric permittivity of medium [C V^{-1} m^{-1})] [F m^{-1}];
S_c = Collecting belt surface [m^2].

The mathematical development for the calculations of the example below is demonstrated in the chapter Electric Charges Gathering by Magnetic Vortex in the article Power from Electrostatic Charges [2].

Example:

Rollers composed of a cylindrical neodymium magnet of 1.38 T and 20 mm in diameter, surrounded externally by a layer of electrically polarizable material (electret) 10 mm thick with a stored electrostatic potential of 0.2 V and, on the outside, a metallic layer of copper, brass or bronze with 1 mm thickness to give structure and to avoid the wear of the roller when rolling. The external diameter of the rollers is 42 mm.

There are 12 rollers that revolve around a 35 cm outer diameter plate. The plate has a 10 mm thick magnet layer on the inside, a 5 mm layer of electrical insulating material and a 1 mm metallic layer of copper, brass or bronze on the outside. The thickness of the plate is 16 mm.

In the outer perimeter of the SEG device, a metal strap (collecting belt) with a diameter of 50 cm and a width of 10 cm is placed, where the electrons projected to the periphery will be collected.

Calculation of rotation speed of the roller:

$$v_{RPM} = \frac{60\,V_E}{\pi\,B\left(R^2 - r^2\right)} = \frac{60*0.2}{\pi*1.38\left(\left(2*10^{-2}\right)^2 - \left(10^{-2}\right)^2\right)} = 9.23*10^3\,RPM \quad .$$

With:

v_{RPM} = Rotation speed of roller [RPM];
V_E = 0.2 V;
B = 1.38 T;
R = $2*10^{-2}$ m;
r = 10^{-2} m.

Calculation of the translation speed of the rollers when rolling on the plate surface:

$$v = \omega R_e = \frac{2\,V_E\,R_e}{B\left(R^2 - r^2\right)} = \frac{2*0.2*2.1*10^{-2}}{1.38\left(\left(2*10^{-2}\right)^2 - \left(10^{-2}\right)^2\right)} = 20.3\,m s^{-1} = 73.0\,km/h \quad .$$

With:

v = ωr = Translation or tangential speed of roller [m s^{-1}];
R_e = $2.1*10^{-2}$ m.

Calculation of the amount of electric charges in the air under the influence of the magnetic field:

$$q_E = N\,n_e\,e\,S_i\,2\,d_i = 12*4*10^{25}*1.602*10^{-19}*3.14*10^{-4}*2*5*10^{-2} = 2.42*10^3\,C \quad .$$

With:

q_E = Electric charges [C];
N = Number of magnets = 12;
n_e = Ion density of the atmosphere = $4*10^{25}$ electron m^{-3};
e = Electric charge of electron= $1.602*10^{-19}$ C;
S_i = Magnet surface area = $\pi*r^2 = \pi*(10^{-2})^2 = 3.14*10^{-4}$ m^2;
d_i = Penetration distance of magnets magnetic field = 5 cm = $5*10^{-2}$ m.

Calculation of force on charges:

$$F = B\,e\,v = 1.38*1.602*10^{-19}*20.3 = 4.49*10^{-18}\,N \quad .$$

With:

F = Force on charge [N];
B = 1.38 T;
e = $1.602*10^{-19}$ C;
v = 20.3 m s^{-1}.

Calculation of charge acceleration:

$$a=\frac{B e v}{m_e}=\frac{1.38*1.602*10^{-19}*20.3}{9.109*10^{-31}}=4.93*10^{12} m s^{-2} \quad .$$

With:

a = Charge acceleration [m s^{-2}];
B = 1.38 T;
e = 1.602*10^{-19} C;
v = 20.3 m s^{-1};
m_e = Gravitational charge (mass) of electron = 9.109*10^{-31} kg.

$$t_1=\sqrt{\frac{2 l_i}{a}}=\sqrt{\frac{2*2*10^{-2}}{4.93*10^{12}}}=9.00*10^{-8} s \quad .$$

With:

t_1 = Acceleration time [s];
l_i = Diameter of magnets = 2*10^{-2} m;
a = 4.93*10^{12} m s^{-2}.

Calculation of charge speed after acceleration:

$$v_o=a t_1=\sqrt{2 a l_i}=\sqrt{2\frac{B e v}{m_e} l_i}=\sqrt{2\left(\frac{1.38*1.602*10^{-19}*20.3}{9.109*10^{-31}}\right)2*10^{-2}}=4.44*10^5 m s^{-1} \quad .$$

With:

v_o = Charge speed [m s^{-1}];
B = 1.38 T;
e = 1.602*10^{-19} C;
v = 20.3 m s^{-1};
m_e = 9.109*10^{-31} kg;
l_i = 2*10^{-2} m.

$$t_2=\frac{d_2}{v_o}=\frac{R_c-R_i-0.5 l_i}{v_o}=\frac{0.4-0.345-0.5*2*10^{-2}}{4.44*10^5}=1.01*10^{-7} s \quad .$$

With:

t_2 = Speed time [s];
d_2 = Distance between magnets and collecting strip [m];
v_o = 4.44*10^5 m s^{-1};
R_c = Distance between plate axis and collecting strap = 0.4 m;
R_i = Distance between plate axis and magnets axis = 0.345 m;
l_i = 2*10^{-2} m.

The trajectory duration of the charges to the collection strap is:

$$t=t_1+t_2=9.00*10^{-8}+1.01*10^{-7}=1.91*10^{-7} s \quad .$$

Calculation of the electric current produced by the system in the collecting strap:

$$I_E=\frac{q_E}{t}=\frac{N n_e e S_i 2 d_i}{t}=\frac{12*4*10^{25}*1.602*10^{-19}*3.14*10^{-4}*2*5*10^{-2}}{1.91*10^{-7}}=1.26*10^{10} A \quad .$$

With:

I_E = Electric current [A];
t = $1.91*10^{-7}$ s;
N = 12;
$n_e = 4*10^{25}$ electron m^{-3};
e = $1.602*10^{-19}$ C;
$S_i = \pi*r^2 = \pi*(10^{-2})^2 = 3.14*10^{-4}$ m^2;
d_i = 5 cm = $5*10^{-2}$ m.

After 1 second, the approximate electric potential produced by the device between the plate and the collecting strap will be:

$$V_E = q_E \frac{R_{cp}}{\varepsilon_0 S_c} = I\,t \frac{R_{cp}}{\varepsilon_0 S_c} = 1.26*10^{10}*1 \frac{0.091}{8.8543*10^{-28}*2.513*10^{-1}} = 5.15*10^{36}\,V \quad .$$

With:
V_E = Electric potential [V];
$I_E = 1.26*10^{10}$ A;
t = 1 s;
R_{cp} = 0.091 m;
ε_0 = Electric permittivity of medium = $8.8543*10^{-28}$ C V^{-1} m^{-1} [F m^{-1}];
S_c = Collecting strap surface = 2π r*l = $2\pi*0.4*10^{-1} = 2.513*10^{-1}$ m^2.

This value of electrostatic potential confirms the results obtained in Searl's experiments, which report ozone production, rarefaction of the air by ionization and interference on close electronic devices.

4.2 Low Voltage System

For the SEG low voltage system, electric induction coils with ferromagnetic core are placed on the periphery of the plate. For optimal use of the available energy, the number of these coils must be the same as the rollers, and must be arranged in such a way that the rollers pass through the air gap of the coil cores, which have a “C” shape.

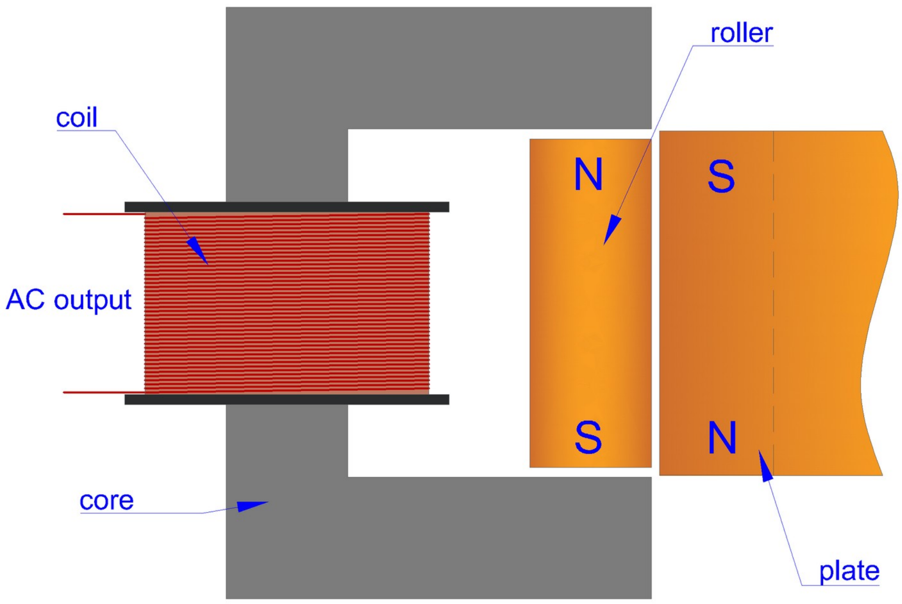

Figure 5: Roller inside ferromagnetic core gap.

The calculation procedure for these coils is based on the electric induction equation:

$$V_E = -N \frac{dq_M}{dt} = -N S \frac{dB}{dt} \quad .$$

With:

V_E = Electric potential [V];
N = Number of coil turns;
q_M = Magnetic charge [Wb];
B = Surface density of magnetic charge [Wb m^{-2}] [T];
S = Magnetic surface of roller [m^2];
t = Time [s].

When the rollers pass in the air gap of the core, there is a sinusoidal variation in the surface density of the magnetic charge of the core (magnetic induction) that induces an electric potential inversely proportional to the time duration of this variation. The electric potential induced in each coil will be proportional to the number of coil turns:

$$f = 1/t \quad , \quad q_M = BS \quad \Rightarrow \quad V_E = -\frac{dq_M}{dt} = -N\,BSf \quad .$$

With:

V_E = Electric potential [V];
N = Number of coil turns;
B = Surface density of magnetic charge of roller [Wb m^{-2}] [T];
S = Magnetic surface of roller [m^2];
f = Translation frequency of the rollers around plate [Hz].

Each roller that passes through the air gap of the ferromagnetic core induces an electric potential in the coil, so the frequency of the sine wave will be multiplied by the number of rollers that translates into the plate:

$$f = N_r \frac{v_{RPM}}{60} \quad .$$

With:

f = Frequency of induced sinusoidal electrical potential [Hz];
N_r = Number of rollers;
v_{RPM} = Translation speed of rollers around the plate [RPM].

In each coil, with 12 rollers surrounding the plate, it will be induced a sine wave of frequency equivalent to:

$$f = 12 * \frac{v_{RPM}}{60} = \frac{v_{RPM}}{5}\,Hz \quad .$$

The energy that can be extracted from the low voltage system depends on the magnetic energy density of each roller and their magnetic volume, and corresponds to the energy of the magnetostatic field:

$$U = \frac{1}{2} B H S l = \frac{1}{2} \frac{B^2}{\mu} S l \quad .$$

With:

U = Energy [J];

B = Surface density of magnetic charge of the rollers [Wb m^{-2}] [T];
H = Magnetic field intensity of the rollers [A m^{-1}];
μ = Magnetic permeability of the magnets [Wb A^{-1} m^{-1}] [H m^{-1}];
S = Magnetic surface of roller [m^2];
l = Length of the rollers [m].

The passage of each roller through the peripheral coils determines a frequency that defines the electrical power that can be extracted from the set of rollers in one coil:

$$P = U f = \frac{1}{2}\frac{B^2}{\mu} S d f \quad .$$

With:
P = Power [W];
U = Energy [J];
f = Frequency of induced sinusoidal electrical potential [Hz].

If the device has 12 coils, we will have 12 times this power. The calculation of each coil follows the conventional procedure for calculating transformers. The classic formula for calculating transformers is:

$$N = \frac{V_E}{4.44\, B_{MAX}\, A f} \quad .$$

With:
N = Number of coil turns;
V_E = Electric potential (RMS) applied to coil [V];
B_{MAX} = Maximum surface density of magnetic charge of ferromagnetic core [Wb m^{-2}] [T];
A = Core section area [m^2];
f = Operating frequency [Hz].

To apply this formula to the low voltage system of the SEG generator, the magnetic induction B_{MAX} is the surface density of magnetic charge of the rollers, which must be lower than the maximum allowed by the ferromagnetic material used in the cores. The area of the cores A must be equal to or greater than the magnetic surface S of the rollers.

Example:

SEG generator with 30 cm diameter plate and 12 rollers rotating on its perimeter with a translation speed of 300 RPM. Each roller consists of 4 neodymium magnets (NdFeB), 20 mm in diameter and 10 mm high, mounted on top of each other, totaling 40 mm in height, with magnetic induction remaining Br = 13,800 G (1.38 T) (1 Gauss = 10^{-4} Tesla), intrinsic coercive magnetic field iHc = 13 kOe (1.0 MA/m) (1 kOe = 79.67 kA/m) and energy product BHmax of 48 MGOe (energy density u = 382 kJ/m^3) (1 MGOe = 7.957 kJ/m^3). The outer diameter of each roller is 40 mm, adding the dielectric material and the outer metallic layer. Along the perimeter of the plate there are 12 coils with oriented grain silicon steel sheet core with B_{MAX} = 1.5 T, section area A = 4×4 = 16 cm^2, in C format, with 50 mm air gap, where the rollers pass. The output voltage of each coil is 120 Volts AC @ 60 Hz.

$$f = 12\frac{v_{RPM}}{60} = 12\frac{300}{60} = 60\, Hz \quad .$$

With:
f = Frequency of induced sinusoidal electrical potential [Hz];

v_{RPM} = 300 RPM.

The tangential speed of the rollers around the perimeter of the plate is:

$$v=\omega r=2\pi f r=2\pi\left(\frac{v_{RPM}}{60}\right)r=2\pi\frac{300}{60}1.7*10^{-1}=5.34\,m\,s^{-1}=19.2\,km/h \quad .$$

With:

v = Tangential speed of rollers [m s^{-1}];
r = Distance between the roller and plate centers = 17 cm = $1.7*10^{-1}$ m;
f = Translation frequency of rollers = v_{RPM}/60 Hz [cycles s^{-1}].

Calculation of the coils, considering that they will be connected in parallel:

$$N=\frac{V_{RMS}}{4.44\,B_{MAX}\,A\,f}=\frac{120}{4.44*1.38*1.6*10^{-3}*60}=204\,turns \quad .$$

With:

N = Number of coil turns;
V_{RMS} = 120 V;
B_{MAX} = 1.38 T;
A = 16 cm^2 = $1.6*10^{-3}$ m^2;
f = 60 Hz.

The magnetic volume of each roller is:

$$V_m=\pi r^2 l=\pi\left(10^{-2}\right)^2*4*10^{-2}=1.26*10^{-5}\,m^3 \quad .$$

With:

V_m = Magnetic volume of the rollers [m^3];
r = Radius of magnets = 10 mm = 10^{-2} m;
l = Length of magnets = 40 mm = $4*10^{-2}$ m.

The magnetic energy of each roller is:

$$u=382\,kJ/m^3=3.82*10^5\,J\,m^{-3} \quad \Rightarrow \quad U=u\,V_m=3.82*10^5*1.26*10^{-5}=4.81\,J \quad .$$

The power that can be extracted from each coil in the passage of the 12 rollers, considering that the final frequency is 60 Hz, is:

$$P=U\,f=4.81*60=289\,W \quad .$$

Therefore, the enameled wire used for winding the coils must support the electric current that can be extracted from each coil:

$$I=\frac{P}{V_{RMS}}=\frac{289}{120}=2.41\,A \quad .$$

The set of 12 coils can provide a total power of:

$$P_T=12*P=12*289=3.47*10^3\,W \quad .$$

In this condition, with the coils connected in parallel, the electric current that can be extracted from the set is:

$$I_E = \frac{P}{V_{RMS}} = \frac{3.47 * 10^3}{120} = 28.9\,A \quad .$$

As we can see, the electrical power available through the magnetic energy of the rollers is enough to power various equipment in a home and we can easily design a SEG generator with greater power by increasing the diameter of the plate and the number of rollers. As the rollers rotate without the need for any external energy, the system is self-supporting and the energy calculated above is freely available.

5 The IGV Propulsion System

John Searl's IGV (Inverse Gravity Vehicle) propulsion system is based on the SEG gyro cell, being composed of several concentric SEG units mounted on the same plane. The outer plates are larger than the inner plates and the rollers, being of the same diameter, are in greater quantity. This assembly provides an increase in the system power and also a larger area for the magnetic vortex creation.

The figure below shows an assembly with three concentric SEG units that allow propulsion. The diameter of the inner plate, in the case of a discoid craft, must be such that the rollers circulate on the periphery of the craft's hull.

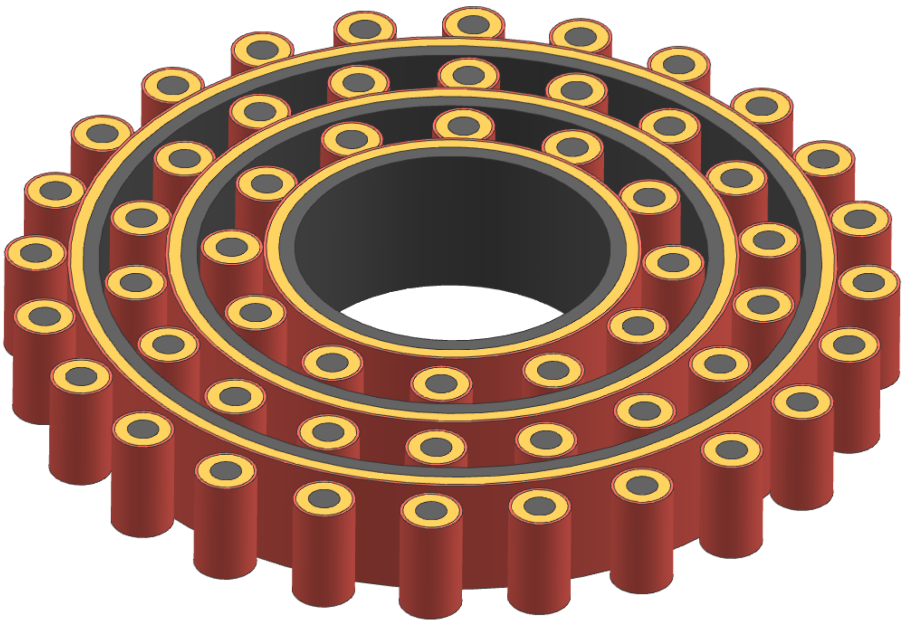

Figure 6: IGV propulsion unit.

An IGV unit produces three types of propulsion:

1. Magnetic propulsion system
   Provides magnetic repulsion between the magnetic field created in the center of the plates and the vertical component of the terrestrial magnetic field.
2. Mechanical propulsion system 1
   Provides mechanical thrust by coupling the rollers that translate around the plate to a disk attached to a shaft that rotates at the roller translation speed.
3. Mechanical propulsion system 2

It is based on the atmospheric pressure gradient caused by the air ionization around the device as a result of the high-voltage electrostatic field developed between the plates and the periphery of the device. The movement and separation of atmospheric electrostatic charges caused by the translation and rotation of the rollers provides a low pressure envelope that can be used for thrust.

5.1 Magnetic Propulsion System

The magnetic propulsion system works by the principle of controlling the force of the terrestrial gravitational field through the repulsion between the magnetic field created in the center of the equipment and the vertical component of the terrestrial magnetic field. There may be attraction or repulsion between these two fields:

1. When the magnetic field generated in the center of the equipment has the same direction as the vertical component of the terrestrial magnetic field, there will be repulsion between these two fields and the disk will weigh less;
2. When the magnetic field generated in the center of the equipment has a contrary direction to the vertical component of the terrestrial magnetic field, there will be attraction between these two fields and the equipment will weigh more.

We saw in the chapter Magnetic Propulsion Through Vortexes of the article EM-GI Propulsion Systems [3] how we can calculate magnetic fields capable of canceling the gravitational force of the planet Earth through the circulation of electric charges. In the IGV system, the circulation of electric charges is achieved by creating a magnetic vortex that attracts the electrostatically charged particles from the environment to the magnetic center and projects them into circulation at the periphery of the plate, according to the calculations developed in the chapter Electric Charge Gathering by Magnetic Vortex of the article Power from Electrostatic Charges [2].

These circulating electric charges are equivalent to a high electric current that produces an intense magnetic field, required to the necessary repulsion/attraction for propulsion. The calculating method for the magnetic repulsion with the vertical component of the terrestrial magnetic field and the amount of gravitational charge (mass) that can be levitated is exactly the same already developed in the articles quoted above, which is why we will only use the ready-made equations.

Example:

Rollers composed of a cylindrical neodymium magnet with a remaining magnetization of 1.38 Tesla and 40 mm in diameter, externally surrounded by a layer of electrically polarizable material (electret) 20 mm thick with a stored electrostatic voltage of 0.4 Volt, and on the outside a metallic layer of 2 mm thick to give structure and to avoid the wear of the roller when rolling. The rollers are 84 mm in diameter.

In the first section there are 235 rollers that rotate around a 12 m outer diameter plate. In the second section, there are 245 rollers that revolve around a 12.50 m outer diameter plate. In the third section there are 255 rollers that revolve around a 13 m outer diameter plate. The plates are positioned concentrically and have a 20 mm thick magnet layer on the inside, a 20 mm layer of dielectric material and a 2 mm metal layer on the outside. The plates are 42 mm thick.

In the outer perimeter, a metallic belt with 14 m in diameter is placed where the electrons projected to the periphery can be collected.

Calculation of rotation speed of the roller:

$$v_{RPM}=\frac{60\,V_E}{\pi\,B\left(R^2-r^2\right)}=\frac{60*0.4}{\pi*1.38\left(\left(4*10^{-2}\right)^2-\left(2*10^{-2}\right)^2\right)}=4.61*10^3\,RPM\quad.$$

With:

v_{RPM} = Rotation speed of roller [RPM];
V_E = 0.4 V;
B = 1.38 T;
R = $4*10^{-2}$ m;
r = $2*10^{-2}$ m.

Calculation of the translation speed of the rollers when rolling on the surface of the plate:

$$v=\omega R_e=\frac{2V_E R_e}{B\left(R^2-r^2\right)}=\frac{2*0.4*4.2*10^{-2}}{1.38\left(\left(4*10^{-2}\right)^2-\left(2*10^{-2}\right)^2\right)}=20.3\,m\,s^{-1}=73.0\,km/h\quad .$$

With:

v = ωr = Translation or tangential speed of roller [m s^{-1}];
R_e = $4.2*10^{-2}$ m.

Calculation of the amount of electrical charges in the air under the influence of the magnetic field:

$$q_E=N\,n_e\,e\,S_i 2\,d_i=735*4*10^{25}*1.602*10^{-19}*1.257*10^{-3}*2*5*10^{-2}=5.92*10^5\,C\quad .$$

With:

q_E = Electric charges [C];
N = Number of magnets = 235+245+255 = 735;
n_e = Ion density of the atmosphere = $4*10^{25}$ electron m^{-3};
e = Electric charge of electron= $1.602*10^{-19}$ C;
S_i = Magnet surface area = $\pi*r^2 = \pi*(2*10^{-2})^2 = 1.257*10^{-3}\ m^2$;
d_i = Penetration distance of magnets magnetic field ≈ 5 cm = $5*10^{-2}$ m.

Calculation of force on charges:

$$F=B\,e\,v=1.38*1.602*10^{-19}*20.3=4.49*10^{-18}\,N\quad .$$

With:

F = Force on charge [N];
B = 1.38 T;
e = $1.602*10^{-19}$ C;
v = 20.3 m s^{-1}.

Calculation of charge acceleration:

$$a=\frac{B\,e\,v}{m_e}=\frac{1.38*1.602*10^{-19}*20.3}{9.109*10^{-31}}=4.93*10^{12}\,m\,s^{-2}\quad .$$

With:

a = Charge acceleration [m s^{-2}];
B = 1.38 T;
e = $1.602*10^{-19}$ C;
v = 20.3 m s^{-1};
m_e = Gravitational charge (mass) of electron = $9.109*10^{-31}$ kg.

$$t_1=\sqrt{\frac{2l_i}{a}}=\sqrt{\frac{2*4*10^{-2}}{4.93*10^{12}}}=1.27*10^{-7}\,s\quad .$$

With:

t_1 = Acceleration time [s];
l_i = Diameter of magnets = 4*10^-2 m;
a = 4.93*10^12 m s^-2.

Calculation of charge speed after acceleration:

$$v_o = a t_1 = \sqrt{2 a l_i} = \sqrt{2 \frac{B e v}{m} l_i} = \sqrt{2 \left(\frac{1.38*1.602*10^{-19}*20.3}{9.109*10^{-31}} \right) 4*10^{-2}} = 6.28*10^5 m s^{-1} \quad .$$

With:

v_o = Charge speed [m s^-1];
B = 1.38 T;
e = 1.602*10^-19 C;
v = 20.3 m s^-1;
m_e = 9.109*10^-31 kg;
l_i = 4*10^-2 m.

$$t_2 = \frac{d_2}{v_o} = \frac{R_c - R_i - 0.5 l_i}{v_o} = \frac{7 - 6.042 - 0.5*4*10^{-2}}{6.28*10^5} = 1.49*10^{-6} s \quad .$$

With:

t_2 = Speed time [s];
d_2 = Distance between magnets and collecting strip [m];
v_o = 6.28*10^5 m s^-1;
R_c = Distance between plate axis and collecting strap = 7 m;
R_i = Distance between plate axis and magnets axis = 6.042 m;
l_i = 4*10^-2 m.

The trajectory duration of the charges to the collection strap is:

$$t = t_1 + t_2 = 1.27*10^{-7} + 1.49*10^{-6} = 1.62*10^{-6} s \quad .$$

Calculation of the electric current produced by the system in the collecting strap:

$$I_E = \frac{q_E}{t} = \frac{N n_e e S_i 2 d_i}{t} = \frac{735*4*10^{25}*1.602*10^{-19}*1.257*10^{-3}*2*5*10^{-2}}{1.62*10^{-6}} = 3.65*10^{11} A \quad .$$

With:

I_E = Electric current [A];
t = 1.62*10^-6 s;
N = 735;
n_e = 4*10^25 electron m^-3;
e = 1.602*10^-19 C;
S_i = π*r^2 = π*(2*10^-2)^2 = 1.257*10^-3 m^2;
d_i ≈ 5 cm = 5*10^-2 m.

Applying the magnetic field formula, without introducing magnetic material inside the ring, we have:

$$H = \frac{I_E}{2 r} = \frac{3.65*10^{11}}{2*7} = 2.61*10^{10} A m^{-1} \quad .$$

With:

H = Magnetic field [A m^{-1}];
$I_E = 3.65*10^{11}$ A;
r = 7 m.

$$B = \mu_0 H = 1.256637*10^{-6}*2.61*10^{10} = 3.28*10^4\, T \quad .$$

With:

B = Surface density of magnetic charge [Wb m^{-2}] [T];
$\mu_0 = 1.256637*10^{-6}$ Wb A^{-1} m^{-1};
$H = 2.61*10^{10}$ A m^{-1}.

With these information we can calculate the repulsion force between the magnetic fields and the amount of gravitational charge (mass) that can be levitated.

$$F = q_M H = B S H = 10^{-9}*1.539*10^2*2.61*10^{10} = 4.01*10^3\, N \quad .$$

With:

F = Attraction/repulsion force [N];
$B = 10^{-9}$ T;
$S = \pi r^2 = \pi(7)^2 = 1.539*10^2$ m^2;
$H = 2.61*10^{10}$ A m^{-1}.

$$q_G = \frac{F}{G} = \frac{4.01*10^3}{9.80665} = 4.09*10^2\, kg \quad .$$

With:

q_G = Gravitational charge (mass) [kg];
$F = 4.01*10^3$ N;
G = 9.80665 m s^{-2}.

5.2 Mechanical Propulsion System 1

With the eletrization of the dielectric material in the rollers, they will be self-propelled by the principle of Lorentz force and can do mechanical work like a unipolar motor. The difference between the unipolar motor and the rollers is that the electric field is applied to a material capable of electrically polarizing and, being submitted to a magnetic field, it provides a velocity vector even if there is no radial electric current. Considering that the area of the magnets is conductive and there is no electric current (it is an electrostatic field), it has all its surface equipotential and does not collaborate in the rotation of the rollers. So, the speed calculations consider only the dielectric area that is subjected to the applied electric field.

$$V_E = \frac{1}{2} B \omega (R^2 - r^2) \quad \Rightarrow \quad \omega = \frac{2 V_E}{B(R^2 - r^2)} \quad \Rightarrow \quad v = \omega R_e = \frac{2 V_E R_e}{B(R^2 - r^2)} \quad .$$

With:

V_E = Electric potential [V];
B = Surface density of magnetic charge [Wb m^{-2}] [T];
$\omega = 2\pi f$ = Angular speed of rotation [rad s^{-1}];
$v = \omega R_e$ = Translation or tangential speed of roller [m s^{-1}];
R = Radius of dielectric’s external circumference [m];
r = Radius of dielectric’s internal circumference [m];
R_e = Radius of roller’s external circumference [m].

To use the mechanical energy of the rollers, it is necessary to mechanically couple them to a disc that contains pins distributed in its perimeter, which are the spin shaft of the rollers. Thus, on a plate that contains 12 rollers it is necessary to attach a disc that contains 12 pins. The center of this disc is rigidly fixed to a mechanical shaft which will rotate at the translation speed of the rollers. The calculation of the shaft rotation depends on this speed and the distance from the center of the rollers to the center of the disc:

$$v_{RPM}=\frac{60}{2\pi}\omega=\frac{60\,v}{2\pi\,d} \quad .$$

With:

v_{RPM} = Rotating speed of shaft [RPM];
$\omega = 2\pi f$ = Angular speed of the rollers translation [rad s^{-1}];
v = Translation speed of rollers [m s^{-1}];
d = Distance from roller axis to plate axis [m].

Example:

Roller composed of a cylindrical magnet of magnetic induction remaining B = 1 T, intrinsic coercive magnetic field H = 1 MA/m, with 5 cm in diameter and 10 cm in length with a central hole of 1 cm in diameter, externally surrounded by a layer of electrically polarizable material 2 cm thick with a stored electrostatic voltage of 0.5 V and, on the outside, a metallic layer of stainless steel of 1 mm of thickness to give structure and to avoid the wear of the roller when rolling. The diameter of the rollers is 92 mm. There are 12 rollers that revolve around a 1 m diameter plate. The central holes of the 12 rollers are coupled to 12 pins on a disc rigidly attached to a mechanical axis.

Calculation of the translation speed of the rollers when rolling on the external surface of the plate:

$$v=\omega R_e=\frac{2V_E R_e}{B\left(R^2-r^2\right)}=\frac{2*0.5*4.6*10^{-2}}{1\left(\left(4.5*10^{-2}\right)^2-\left(2.5*10^{-2}\right)^2\right)}=32.857\,m\,s^{-1}=118.29\,km/h \quad .$$

With:

v = Translation or tangential speed of roller [m s^{-1}];
$R_e = 4.6*10^{-2}$ m.

The rotation of the mechanical shaft is determined by:

$$v_{RPM}=\frac{60\,\omega}{2\pi}=\frac{60\,v}{2\pi\,d}=\frac{60*32.857}{2\pi*0.546}=5.75*10^2\,RPM \quad .$$

With:

v_{RPM} = Rotating speed of shaft [RPM];
v = 32.857 m s^{-1};
d = 50 cm + 4.6 cm = 0.546 m.

5.3 Mechanical Propulsion System 2

The second mechanical propulsion system works as described in the chapter Inexhaustible Energy of the article Power from Electrostatic Charges [2] and calculated as a propulsion system in the chapter Magnetic Propulsion Through Vortexes of the article EM-GI Propulsion Systems [3], and provides, through the dissociation and ionization of the air molecules, a low pressure wrap around the device.

The magnetic vortex created by the rotation and translation of the rollers around the plates causes the electrostatic charges of the atmosphere to be attracted to the magnetic center of the system and, afterwards, to be projected towards the periphery of the plate where they circulate in orbital positions, as a consequence of the Lorentz force. This kinetic movement of charged particles, outside and inside the plate and rotating roller assembly, causes the dissociation and ionization of the surrounding air molecules by colliding with them, resulting in a pressure lowering.

This low pressure envelope eliminates the device's friction with air when it moves, allowing the device to reach high speeds without being subjected to excessive pressure, a necessary condition in discoid crafts. It should be noted that if the dissociation and ionization of the surrounding air is greater at the top of the disc, this side will be subjected to less atmospheric pressure than the bottom side and this atmospheric pressure gradient will cause it to move vertically. The acceleration, in this case, will be proportional to this pressure difference. The calculation methodology is detailed in the chapter Mechanical Propulsion Through Magnetic Vortexes of the article EM-GI Propulsion Systems [3], including application examples, but basically is reduced to:

$$F=\Delta P*S=q_G a \quad \Rightarrow \quad a=\frac{F}{q_G}=\frac{\Delta P*S}{q_G} \quad .$$

With:

F = Force [N];
ΔP = Pressure difference [N m^{-2}];
S = Area with pressure difference [m^2];
a = Acceleration [m s^{-2}];
q_G = Gravitational charge (mass) of device [kg].

Through the use of mechanical deflectors and/or magnetic fields, it is possible to use the high kinetic energy charges projected to the periphery so that they dissociate a greater amount of atmospheric air in the upper, lower or lateral sections of the device. The intensity control of the magnetic field generated by electromagnets, positioned along the perimeter of the device, allows controlling the atmospheric pressure gradient. Depending on the direction and intensity of the pressure gradient, it is possible to cause the craft to levitate and/or propulsion it in any direction, what allows a complete steering and navigation system, as shown in the figure below.

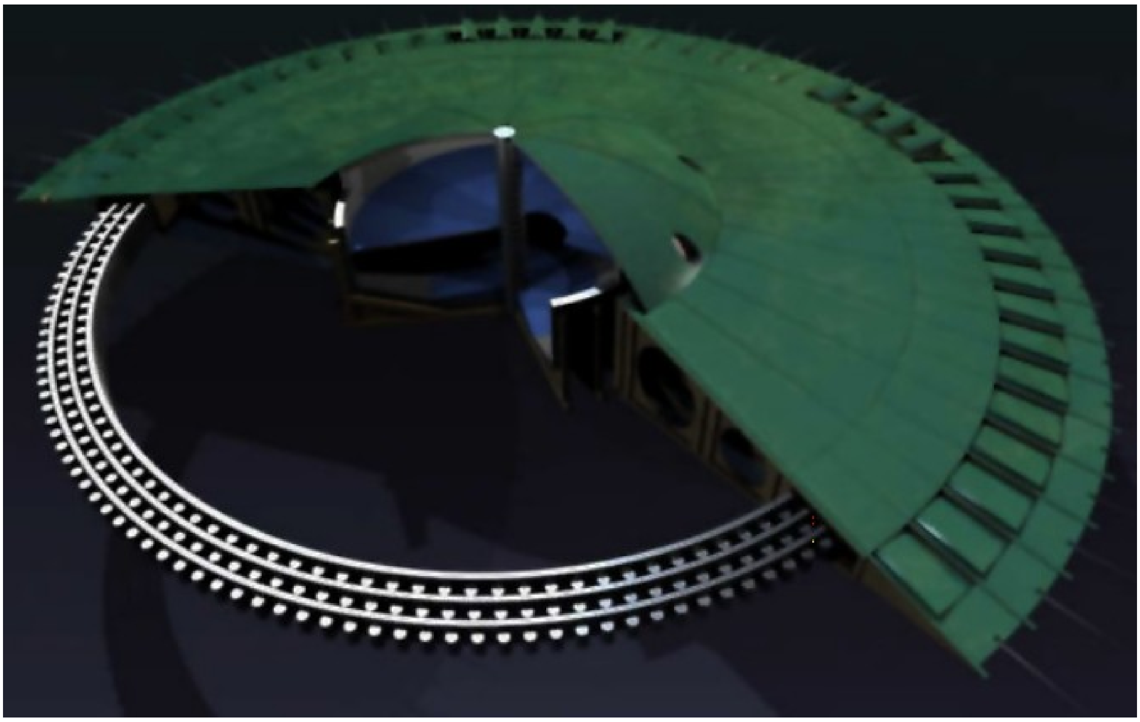

Figure 7: Flying saucer concept with IGV technology.

6 Conclusion

John Searl has developed a complete and self-powered equipment for electrical generation and propulsion based on magnetic vortex technology. Its implementation is done with the use of magnetic, dielectric and electroconductive materials.

The Searl Effect Generator – SEG generator is composed of a stationary ring, called plate, and several rollers that spins around it. It produces electrical energy by two processes:

1. High voltage with attraction and projection of electrostatic charges from the atmosphere from the center to the periphery of the device.
2. Low voltage with electric potential induction, passing magnets inside transformer gaps, composed of ferromagnetic core and coil, positioned around the device perimeter.

Carefully projecting this device, it is possible to extract free energy from it. For the high voltage system, the electric current source calculated in the example gives approximately 10^{10} Amperes for a device with 50 cm in diameter. For the low voltage system, the electric power calculated in the example gives approximately 3.5 kW for a device with 50 cm in diameter.

The Inverse Gravity Vehicle – IGV is composed of several concentric SEG gyro cell mounted in the same plane. It gives three type of propulsion systems:

1. Magnetic levitation through repulsion/attraction of the magnetic field generated in the center of the device and the vertical component of the terrestrial magnetic field.
2. Mechanical propulsion coupling the traction force of the rollers, in its translating movement around the plate, with a mechanical shaft.
3. Mechanical propulsion with the pressure gradient caused by the atmospheric air ionization with the charged particles projected to the periphery of the device.

For the magnetic levitation, the mass that can be levitated is 400 kg with a 13 m in diameter device. The mechanical system with air ionization was already demonstrated in the article Power from Air Ionization [4]. The difference is that the charges projected to the periphery are not created with RF electric fields but extracted from the atmosphere, so the energy spent in the RF generator is not necessary.

All these energies are almost freely produced by the SEG and IGV devices, so with these first mathematical approach we are invited to experiment with them.

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