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## ABSTRACT

*Today, the sun is a very useful energy source because it continuously radiates energy. An electron is radiating energy continuously too. A new electrostatic generating method using this electron's electric field energy as a driving force of charge carriers was invented, and its success was presented on ESA 2017 and ESA 2019 by a bench model. This new electrostatic generator was realized by asymmetric electrostatic force, which is a new phenomenon. The electric output of the bench model was only a few ten micro-watt. However, it is expected to be kilo-watt when parts size are reduced to 1/100. This expect was confirmed with a simulation.*

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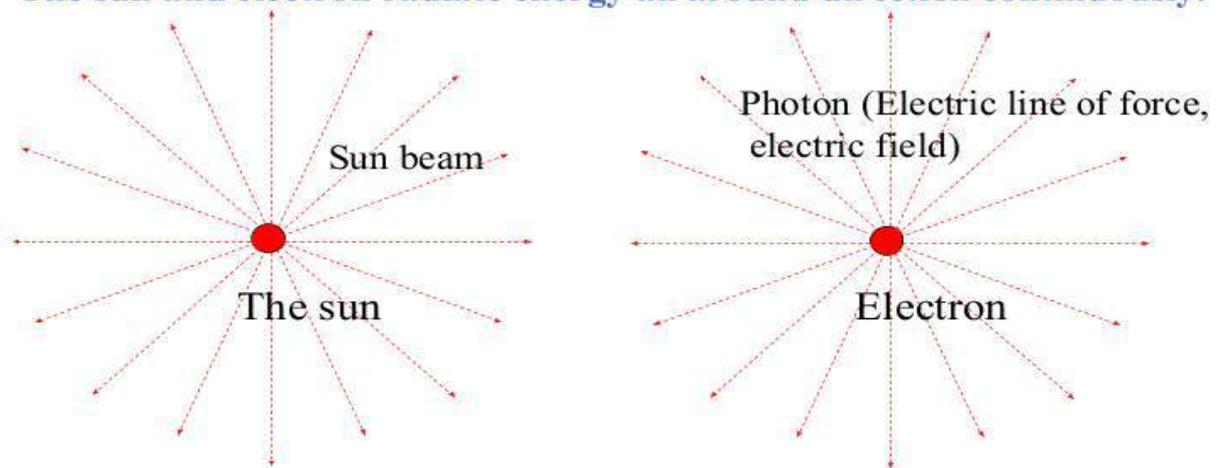
radiating a huge energy around it continuously as shown in figure 1. Like as the sun, an electron too is radiating an energy around it continuously. Of course, the radiated energy from an electron is very little. However, the number of an electron in our world is huge. An electret keeps electron on its surface very long time (100 years). Therefore, if a new electrostatic generator is driven by an electret only, this one will solve the environment problem perfectly. Because it does not produce CO<sub>2</sub>, it is safety, it produces electric energy all time every where, it has long life time and its cost is low.

## I. INTRODUCTION

### 1.1 Two very useful energy sources: Sun and Electron

Today the most useful energy source to solve the environment problem is the Sun, because it is

**The sun and electron radiate energy all around direction continuously.**



*Fig. 1:* There are two big renewable energy: the sun (used) and an electron (not used)

1.2 Asymmetric electrostatic force

$$f=qE \tag{1}$$

For a long time, the electrostatic force has been calculated by the well-known Coulomb's Formula (1).

where f: Electrostatic force that acts on a point charge.

q: Quantity of a point charge.

E: Intensity of the electric field in which a point charge is placed.

It is apparent from this formula that the magnitude of this electrostatic force does not change when the direction of the electric field turns over as shown in Figure 2.

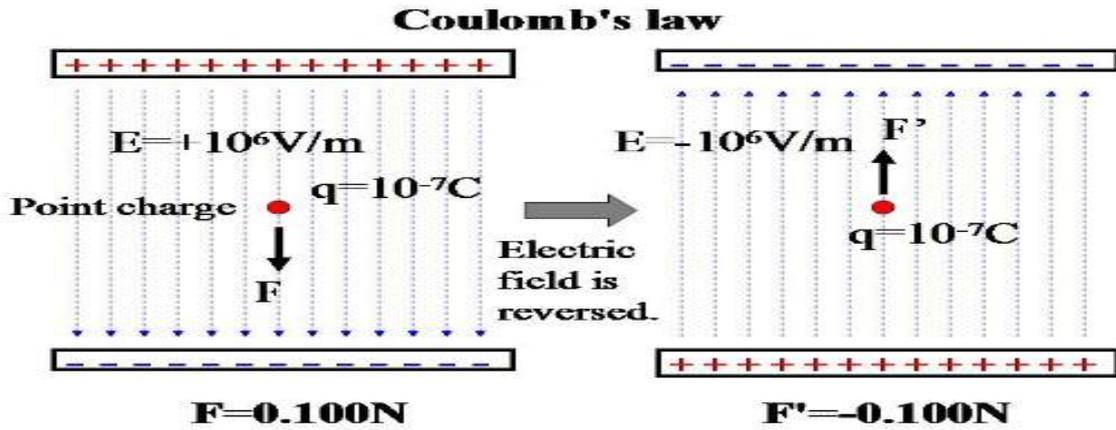


Fig. 2: the well-known Coulomb's Form

The application of this formula is limited to point charges and sphere-shaped charge carriers [1].

A new electrostatic generator driven by this new phenomenon was invented.

A new electrostatic generator driven by only an electric field using Coulomb's law was tried for several years. Many different ideas were tested by a simulation and simple experiment. However, a solution was not found, but a very useful phenomenon was found in those simulations by chance.

The electrostatic force that acts on an asymmetric charged conductor changes largely when the direction of the electric field reverses, as shown in Figure 3.

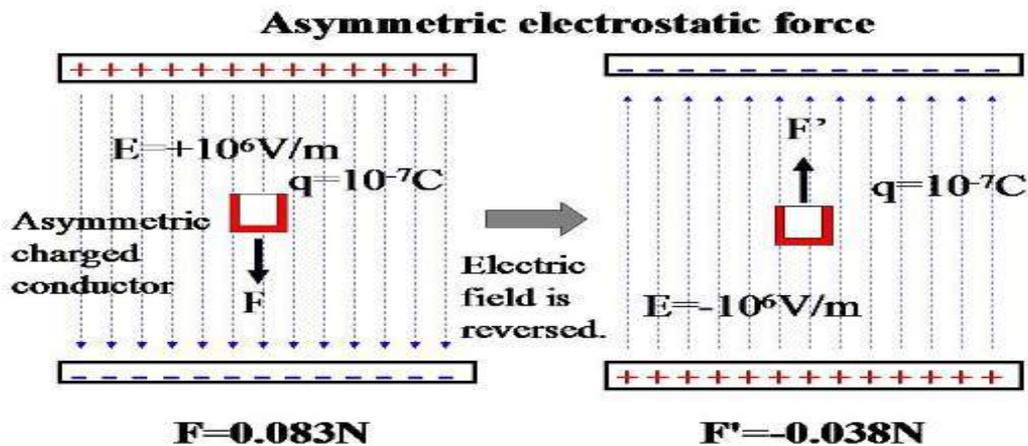


Fig. 3: Electrostatic force that acts on charged box conductor (Asymmetric electrostatic force)

This new phenomenon was named asymmetric electrostatic force [2],[3],[4],[5],[6],[7],[8]. The left side electric field of Figure 3 was named a forward electric field, and the right side electric field was named a backward electric field.

### 1.3 Basic theory of the new electrostatic generator

The basic theory of an electrostatic generator is defined by lifting the charge to a high potential by mechanical force against the electric force that acts on this charge.

It is impossible for the mechanical force to carry the charge directly. Therefore, the charge is packed into a suitable body. We call this body the charge carrier.

A basic unit of the new electrostatic generator that is driven by asymmetric electrostatic force is concretely shown in Figure 4.

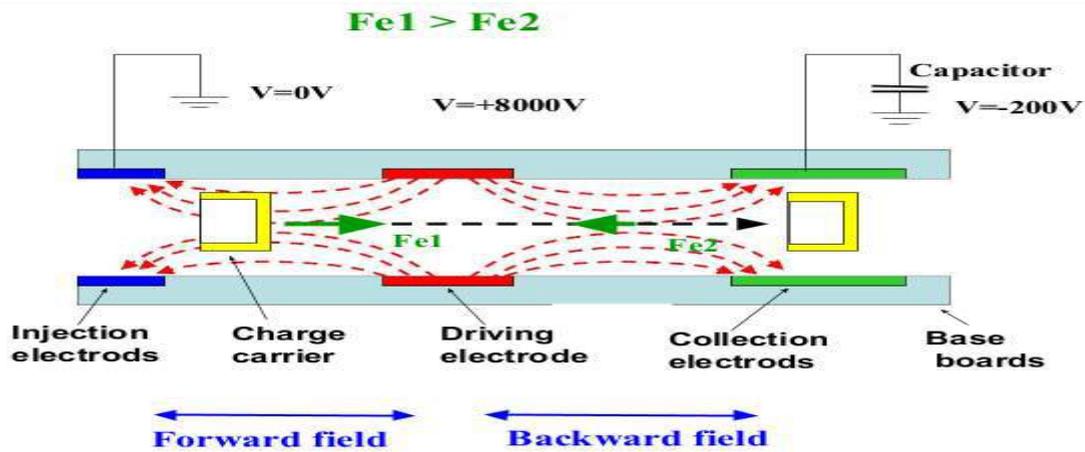


Fig. 4: Schematic layout of one unit of the new electrostatic generator

This generator mainly consists of a charge injection electrode, driving electrode, charge collection electrode, and charge carrier.

A positive high voltage was applied to the driving electrode. The injection electrode was grounded. The collection electrodes were kept at a negative low voltage.

As a result, the driving electrode and the injection electrode produced a forward electric field for a negative charge between them.

The driving electrode and the collection electrode produced a backward electric field for a negative charge between them.

A gutter-shaped conductor was used as a charge carrier that carries a negative charge (electron) from the injection electrode to the collection electrode through the driving electrode.

The asymmetric electrostatic phenomenon produces a large electrostatic force  $F_{e1}$  in the

forward electric field and a weak electrostatic force  $F_{e2}$  in the backward electric field.

Therefore, the charge carrier gains large kinetic energy in the forward electric field. Then, it loses some of its kinetic energy in the backward electric field.

As a result, the charge carrier maintains extra kinetic energy when it arrives at the collection electrode.

The carried charge can be lifted to a higher potential by this extra energy.

This is the principle of the electric field-driven generator.

### 1.4 Experimental equipment of the electric field driven generator

Figure 5 shows the front view, Figure 6 shows a plane view and Figure 7 shows a photograph of the experimental equipment.

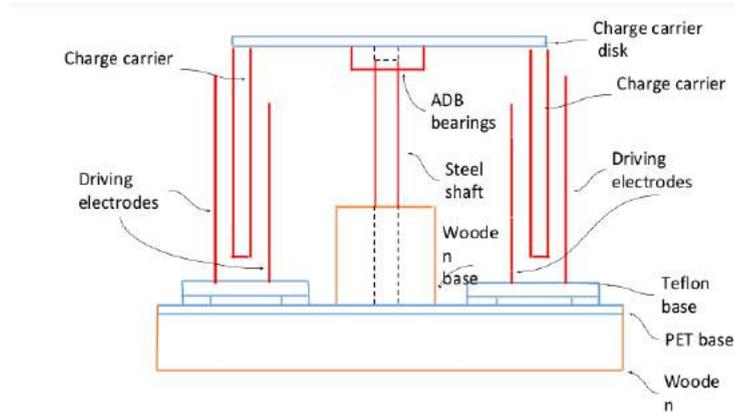


Fig. 5: Front view of the experimental equipment of the electric field driven generator

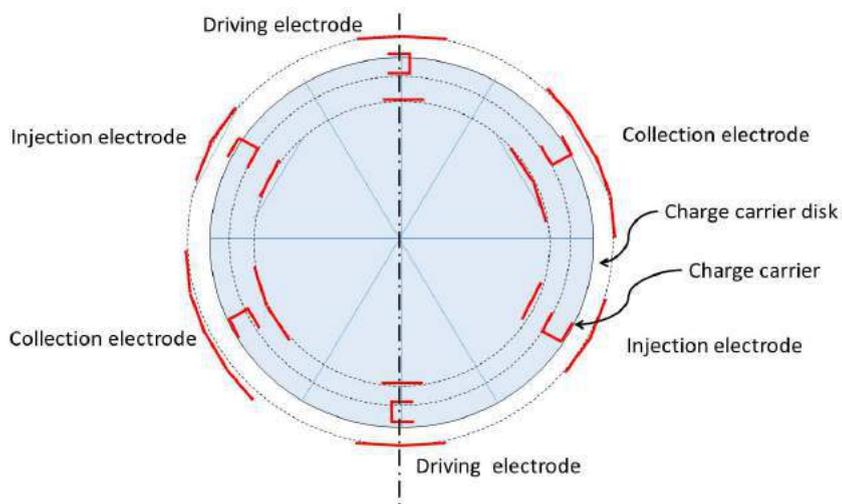


Fig. 6: Plane view of the experimental equipment of the electric field driven generator

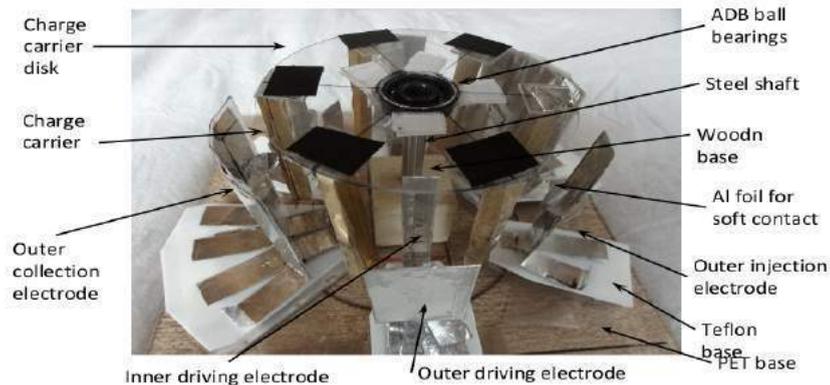


Fig. 7: Photograph of the main part of the electric field driven generator

This equipment mainly consists of a charge injection electrode, a driving electrode, a charge collection electrode, and a charge carrier disk that has six charge carriers.

(autonomous decentralized bearing) bearings were fixed on the center of the disk.

The six charge carriers were placed at 60 degrees intervals, as shown in Figure 6.

The charge carrier disk is a 0.5-mm thick PET plate with a diameter of 95 mm. ADB

The two charge injection electrodes, the two driving electrodes, and the two charge collection electrodes were placed on the main PET base plate at 60 degrees intervals, as shown in Figure 6.

The injection electrode was always grounded, the driving electrode was connected to a high voltage power supply, and the surface potential of the collection capacitor was measured by a surface potential meter.

The collection electrodes could perform semi-Faraday gauges. When the charge carrier was connected to the collection electrode by the aluminum foil, more than 90% charge on the charge carrier was transferred to the collection electrode (simulation result).

A surface potential meter (SHISHIDO ELECTROSTATIC: STATIRON-DZ 3) was used to measure the surface potential of the collection capacitor.

#### 1.4 Experimental result of the electric field-driven generator

When -7kV was applied to the driving electrode, the charge carrier disk start to rotate

automatically slowly. Then the rotation speed increase gradually, and it becomes constant finally. <https://youtu.be/yNwOOTq3N-o> You can see this movie, when you click here.

This result indicates that the charge carrier disk can rotate endlessly by the electrostatic force against the air resistance force and kinetic friction force.

When the charge carrier continues to rotate, the surface potential of the collection electrode capacitor becomes higher in the negative direction. These results mean that this experimental equipment continued to endlessly generate electric power.

Figure 8 shows the surface potential change of the collection electrode capacitor when the driving voltage was 7.0 kV.

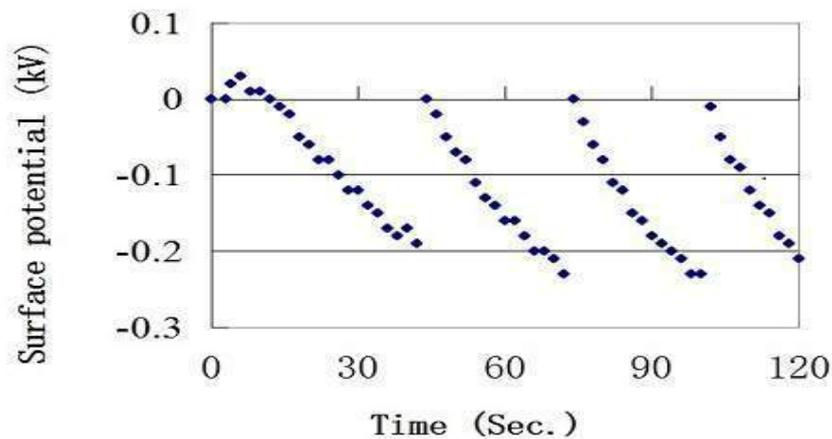


Fig. 8: The surface potential change of the capacitor of the collection electrode for the rotation time of the charge carrier disk

This result was presented in ESA 2017 [9],[10], and an improved result was presented in ESA 2019 [11] using the new charging method shown in Figure 9.

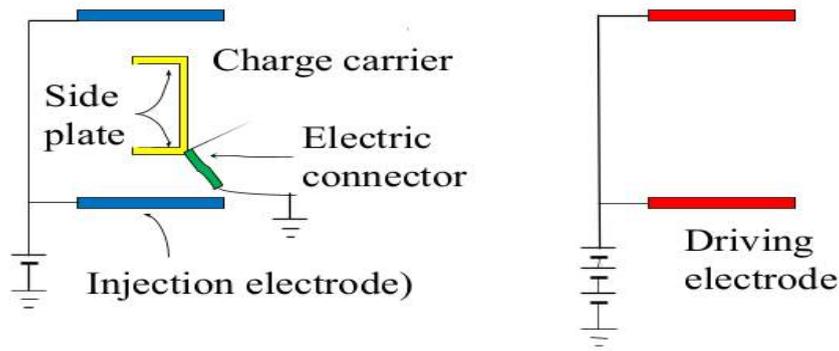


Fig. 9: The improved charge injection method

In Figure 9, the upper and lower back plates of the charge carrier and the injection electrode temporarily produce two capacitors.

Therefore, many injection charges (electrons) are injected into the side plates of the charge carrier from the ground through the electric connector.

The experiment of the new electrostatic generator succeeded. However, its electric output was only a few tens micro watt.

Therefore, the target of this paper is increasing the output to kW order from  $\mu W$  order.

## II. INCREASING METHOD OF THE ELECTRIC OUTPUT

### 2.1 Structure of the commercial machine

The experimental machine explained former has a big useless space under the charge carrier disk. Therefore, a commercial machine must lay the charge carrier down as shown in Fig.10.

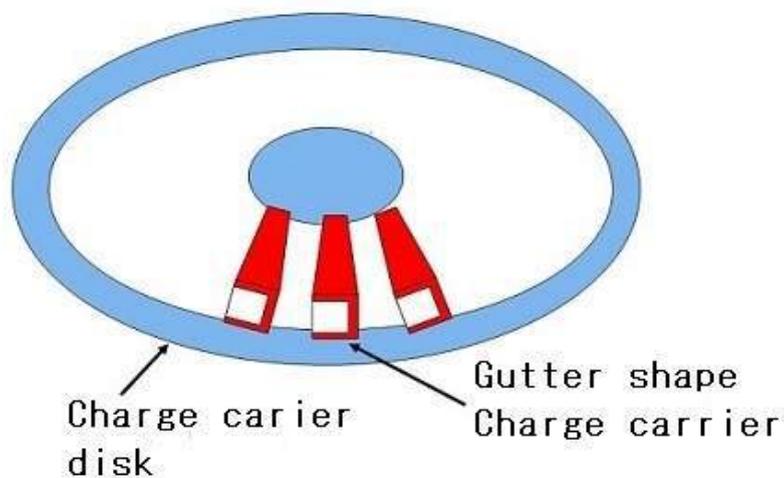


Fig. 10: Horizontally placed gutter shape charge carrier on the charge carrier disk

The injection (charging) electrode and the high voltage (driving) electrode on the experimental machine are changed to the injection (charging) electret and the high voltage (driving) electret on the commercial machine.

And also the injection (charging) electret, the high voltage (driving) electret and the collection electrode must be laid down too. They are placed

face to face on back side of the upper electrodes disk and on surface side of the lower electrodes disk as shown in Fig.11.

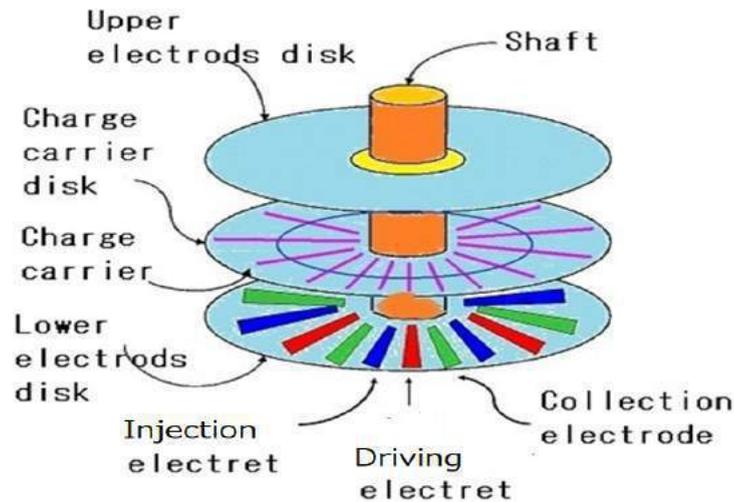


Fig. 11: One set of the new electrostatic generator consists of three disks and a center shaft

If the size of the charge carrier is 5\*5\*50mm like as the experimental machine, the radius of the disks become 90mm, and distance between the upper electrodes disk and the lower electrodes disk becomes 15mm.

This consist is named as 1 set. The size of 1 set become about same as CD cassette.

For high electric power, this set must be piled up as shown as Fig.12.

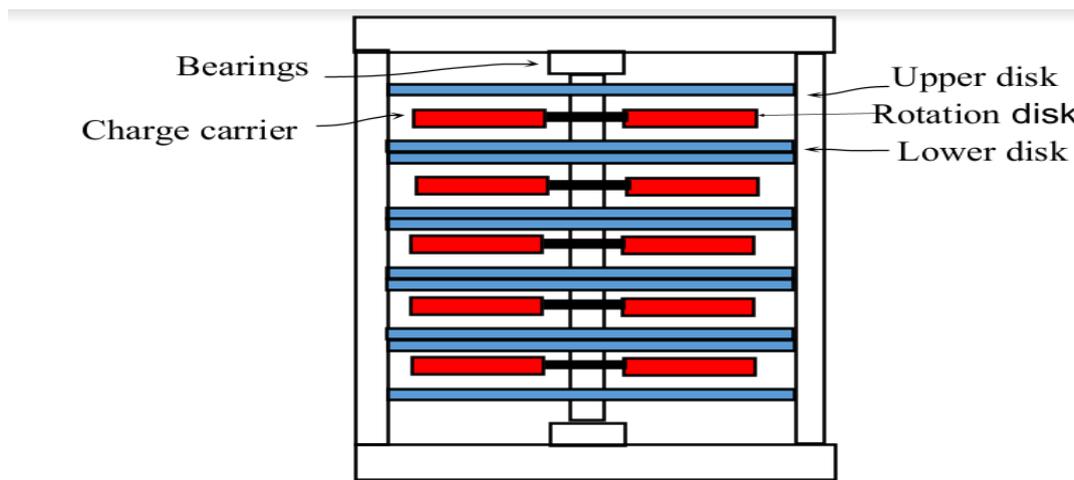


Fig. 12: An example of a commercial machine structure consists of five sets

The upper electrodes disk and the lower electrodes disk are fixed to main body.

The charge carrier disk is fixed to center pole shaft and rotates with it. Fig.12 shows five sets piling structure. However, many sets can be piled on one ball bearings, because the weight of the charge carrier is very light (10g).

The rotation speed of the charge carrier disk of the experimental machine is about 100 rpm.

However if air resistance that acts on the rotate charge carrier becomes zero by vacuum condition of the commercial machine, it will become several thousand rpm.

And if the ball bearings rotation is replaced of magnetic floating rotation, the rotation speed will become several ten thousand rpm. As a result, very big electric power will be realized.

*2-2 The methods that can increase the electrical output to one million times*

*2-2-1 High speed rotation of the charge carrier disk*

The rotation speed of the charge carrier disk is about 100 rpm. The main resistance component is the air resistance. Therefore if the air in the equipment is drawn to the outside, the rotation speed become high.

The maximum rotation speed of the ADB ball bearings is 30,000 rpm. Therefore, when the rotation speed of the charge carrier disk become 10,000 rpm, the collected charge volume per seconds, namely a current becomes 100 times.

*2-2-2 Increasing the charge density of the charge carrier*

When the charge carrier enters between the upper and lower charge injection electret, two air

capacitors are produced temporally between the injection electret and the side plane plate of the gutter shape charge carrier.

At this time, the charge carrier is earthed. As a result, some charge is injected into the charge carrier. The polarity of this charge is reversal to the polarity of the charge on the injection electret.

The injected charge density is in direct proportion to the charge density of the injection electret and inverse proportion to the distance between the injection electret and the side plane plate of the charge carrier.

Now this distance is 7.5mm, namely 7500  $\mu\text{m}$ . Therefore, when this distance is reduced to 75  $\mu\text{m}$  as shown in Fig.13 (2), the injected charge density increases to 100 times.

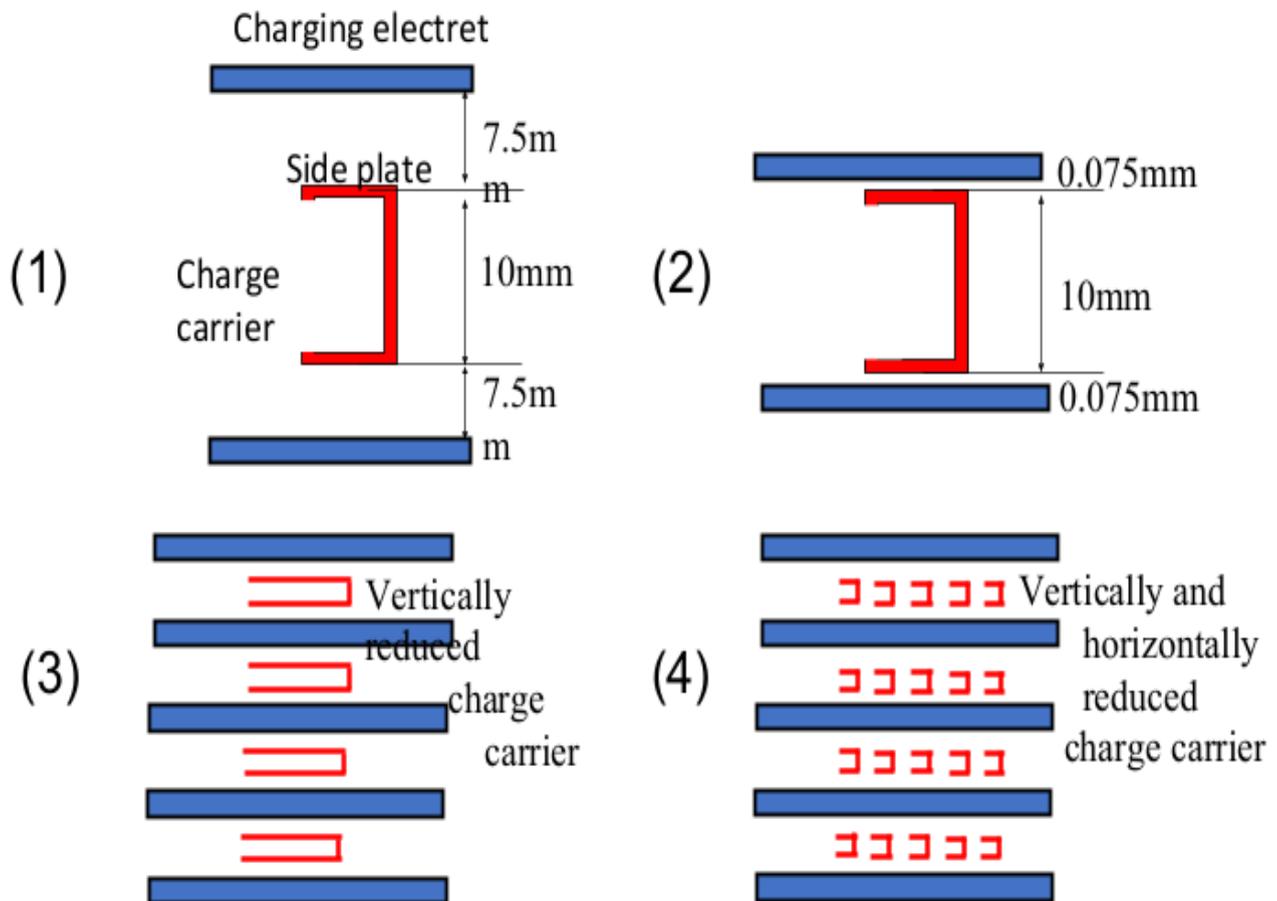


Fig.13: Charge carrier downsizing steps

As a result, the collected charge volume per second, namely a current becomes 100 times.

### 2-2-3 Method of increasing volume charge density

The height of the charge carrier was not related with the injection charge density. Therefore, the total volume charge of the all charge carriers become 100 times when the height is reduced from 10mm to 0.1mm as shown Fig.13 (3). However, width of the vertical reduced charge carrier becomes too long. Asymmetric electrostatic force can not pull this charge carrier. Therefore, the width must be reduced to 1/100 as

shown in Fig.13 (4). As a result, total charge volume of the all charge carrier in the equipment becomes 100 times. Namely, the volume charge density becomes 100 times.

If multiply by those three methods, the electric output becomes  $100 \times 100 \times 100 = 1,000,000$  times.

### 2-3 Simulation of the output increasing methods

Then the electric output of the field driven generator was simulated by finite difference method when the part size is reduced to 1/100. On the electrode disk, the size reduced injection electrets, the driving electrets and the collection electrodes are placed as shown in Fig.14.

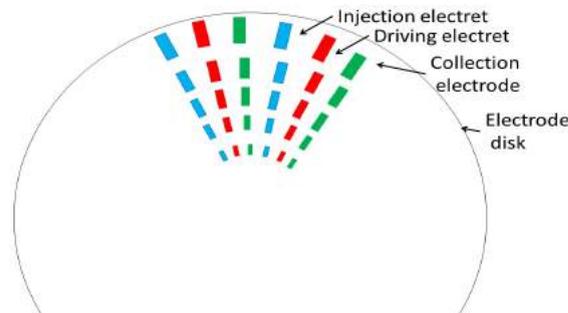


Fig.14: Plane view of the electrode disk in that the three parts is reduced to 1/100

The radial direction is called as line and the circle direction is called as row in Fig.14. The width of the three parts are 0.160mm, 0.064mm and 0.192mm respectively. The distance between the injection electret and the driving electret is 0.330mm, and the distance between the driving electret and the collection electrode is 0.320mm. The distance between the collection electrode and the next injection electret is 0.140mm. As a result, the width of the one set become 1.200mm. The thickness of the two electret layer are 0.008mm,

and the surface charge density of the two electret are  $0.2 \text{ mC/m}^2$  And  $1.0 \text{ mC/m}^2$  respectively. The radius of the electrode disk is 50mm and thickness is 0.040mm. Therefore, 250 set are placed on the first row. The distance between the upper electrode disk and the lower electrode disk is 0.180mm.

On the charge carrier disk, the charge carriers are placed radially as shown in Fig.18.

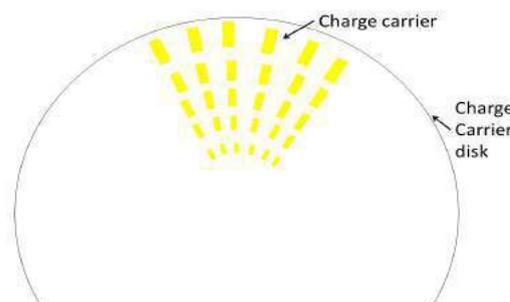


Fig. 15: Plane view of the charge carrier disk in that the charge carriers is reduced to 1/100

The width, the height and the length of the charge carrier are 0.102mm 0.104mm and 0.600mm respectively.

The distance between the horizontal plates of the charge carrier and the injection electrets is 0.010mm.

The distance between the charge carriers is 1.100mm. As a result, 250 charge carrier are placed on the first row. The length of the charge carrier is 0.600mm and the distance between charge carriers is 0.100mm on radial direction. As a result, 33 charge carrier are placed from 50mm to 25mm radial length.

The width of all parts and distance between parts on the 33 row becomes 50% of that of the first row. However, the heights and the length are the same as the first row.

At first, the electrostatic force that acts on the charge carrier on the first row was simulated. When the charge carrier placed just under the injection electret and earthed, the injected charge was simulated as  $-1.53 \times 10^{-11}$  [C]. Then the electrostatic force that acts on this charged carrier was simulated while the charge carrier left from the injection electret and arrive at the collection electrode. The result is shown on Fig.16.

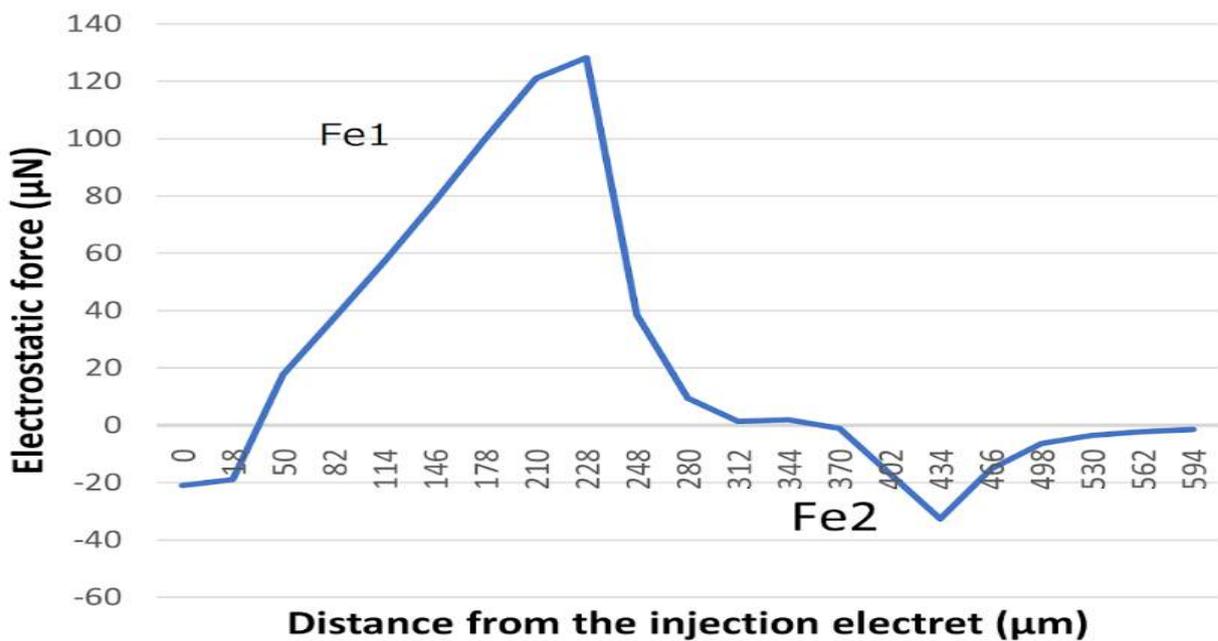


Fig. 16: Distance from the injection electret and electrostatic force that acts on the charge carrier on first row

It is apparent from this graph that the forward force is very strong and the backward force is very weak. As a result, the large extra energy remains when the charge carrier arrives at the collection electrode. It was  $1.21 \times 10^{-8}$  [J]. The carried charge quantity was  $-1.53 \times 10^{-11}$ [C], therefore, this charge can be lift up to  $-794$ [V] by this extra energy.

One charge carrier transports  $-1.53 \times 10^{-11}$ [C] when it traverse in the one unit. There are 250 unit on the first row. Therefore, when the charge carrier disk rotates one time,  $-3.79 \times 10^{-9}$ [C] is transported to the

collection electrode. There are 250 charge carrier on the first row, therefore, when the charge carrier disk rotates one time,  $-9.49 \times 10^{-7}$ [C] is transported to the collection electrode. The rotation speed of the charge carrier is expected 10 000 r m in the vacuum. Therefore it rotate 167 times in one second. As a result,  $-1.58 \times 10^{-4}$ [C] is transported to the collection electrode in one second. Namely the current is  $-1.58 \times 10^{-4}$ [A]. And the lifted voltage is  $-794$ [V]. Then the electric output of the first row becomes  $1.26 \times 10^{-1}$ [W].

The electrostatic force that acts on the charged charge carrier on the 33 row was simulated. It is shown in Fig.17.

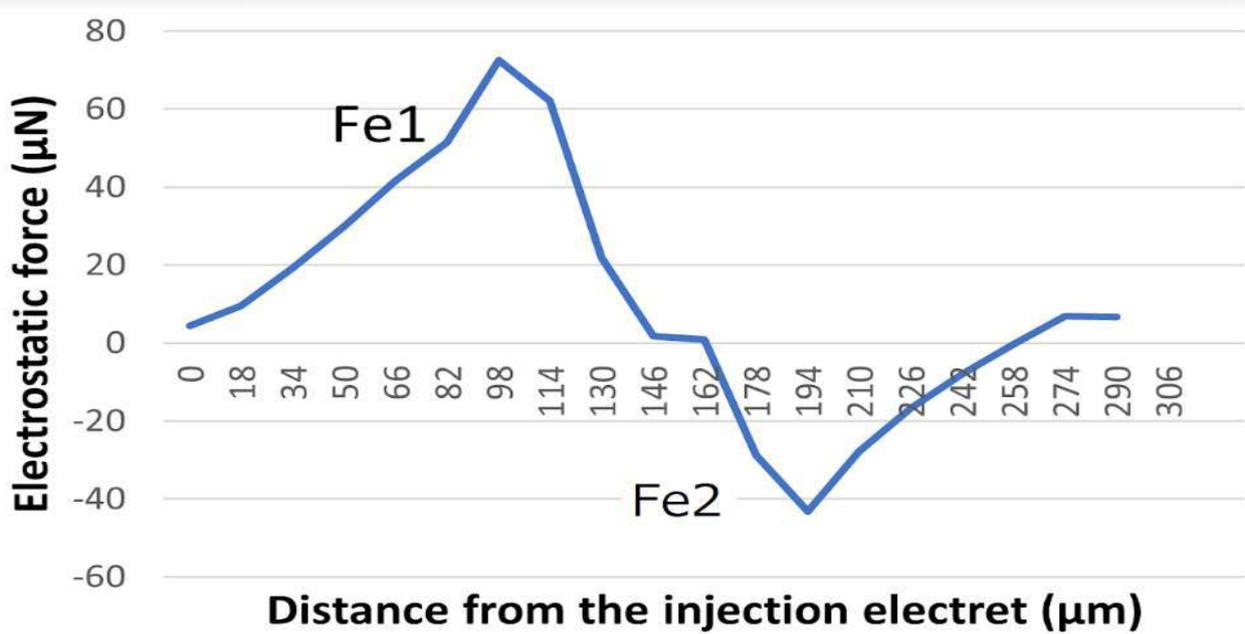


Fig. 17: Distance from the injection electret and electrostatic force that acts on the charge carrier on 33 row

The forward electrostatic force is not so strong and the backward electrostatic force is not so weak. As a result, the electric output of the 33 row was calculated as  $3.40 \times 10^{-2}$  [W]. The electric output of the second row to 32 row was estimated from that of first and 33 row. And the total electric output of the first row to 33 row became 2.63 [W].

The thickness of the three disk is 0.180mm. Therefore 555 sets can be piled in 100mm cubic box. As a result, the electric output of the 10cm cubic generator became 1.46 [kW].

### III. CONSIDERATION

The horizontal distance between charge carriers was took 1.1mm in the simulation. However, it can be reduced to 0.3mm when the three charge carrier disks can be electrically separated. As a result, the electric output become three times. And the rotation speed of the charge carrier disk may be increased from 10,000rpm to 20,000rpm or 30,000rpm. As a result, the electric output become two or three times. And the surface charge density of the electret may be increased

more two times. As a result, the electric output become more two times.

The thickness of the charge carrier was 0.002mm in the simulation. However, this may be very difficult. Therefore, the thickness was increased from 0.002mm to 0.020mm. And The electrostatic force that acts on this charge carrier was simulated. Its result is shown in Fig.18.

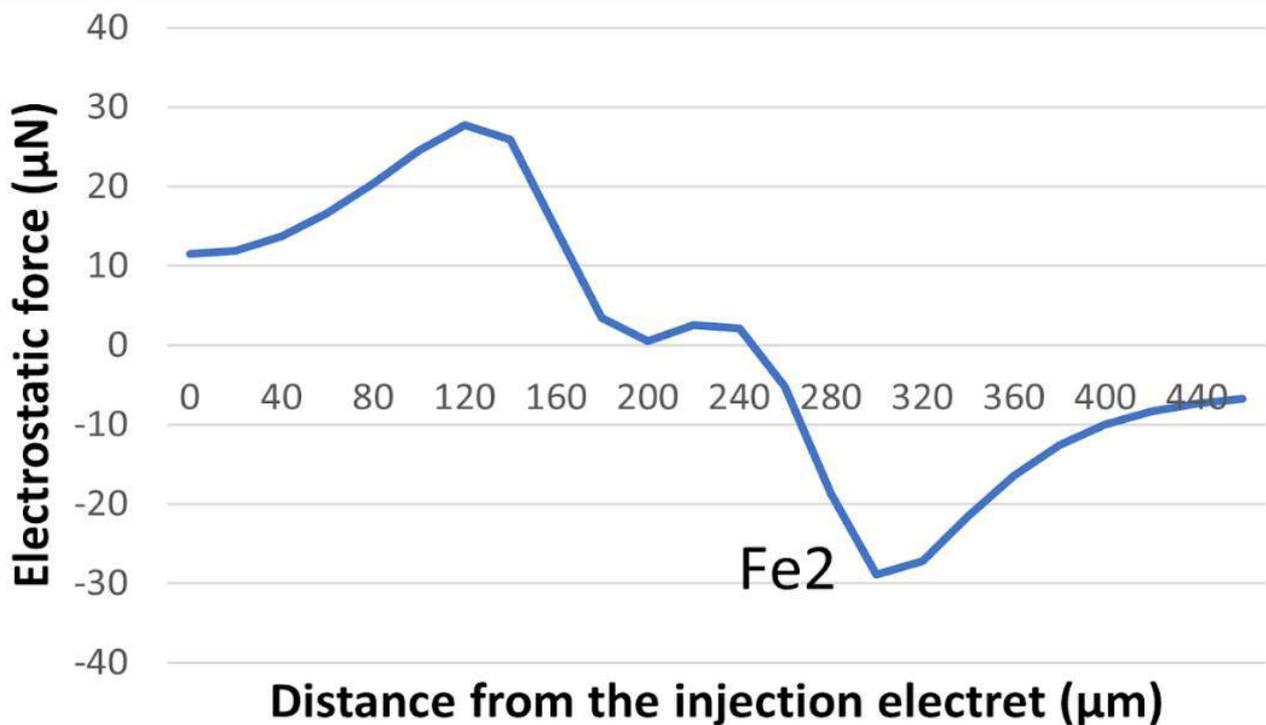


Fig. 18: Distance from the injection electret and electrostatic force that acts on the charge carrier that is consisted of 0.020mm thickness plate

It is apparent from this graph that the forward electrostatic force is about same as the backward electrostatic force. As a result, the extra energy became only  $2.45 \times 10^{-10}$  [J]. This means the electric output is almost zero. Therefore, the height of the charge carrier must be increased from 0.1mm to 1.0mm. However, the electric output becomes 1/10.

#### IV. CONCLUSION

The electric output of the 10cm cubic generator was estimated to be 1.46[kW] by the simulation when the parts size was reduced to 1/100. And there are another ideas that can increase the output more. However, the thickness of the charge carrier is 0.002mm. This may be difficult to produce with low cost. Therefore, mechanic engineer and physics researcher together must thought out the best solution.

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- Power supply for radiotelephone relay stations. It can be installed on telephone poles without the need for solar cells or storage batteries.
  - Power supply for equipment (traffic signals, emergency guidance) required even during a power outage.
  - Power supply for meteorological observation equipment that is difficult to replace batteries in the sea, in tunnels, on mountain peaks, etc. And so on.

Note, the new electrostatic generator has the following features.

1. No maintenance or energy supply required (in the case of magnetic levitation rotation, lubrication is required for bearings).
2. Does not generate CO<sub>2</sub>.
3. Miniaturization is possible.
4. The parts required for manufacturing are common and the product cost is low.
5. Long life (the life of the electret is 100 years).
6. The output is stable.
7. No danger (during manufacturing, use, disposal)
8. Lightweight.
9. Directly connected power supply for each electric product, eliminating the need for power transmission lines and capacitors.

As its application, for example

- Elimination of non-electric areas, temporary power supply in disaster areas, power supply in nuclear shelters.
- Use in space where sunlight does not reach (beyond Jupiter).
- Use inside the body where energy cannot be supplied from the outside, such as an artificial heart.
- Electronic devices that need to be charged frequently, such as smartphones and PCs.