Discharging Experiments Using Hamilton Flywheel

NaRiKa Corporation

1. Learning Outcome

We will learn about the difference between Corona Discharge and Spark Discharge, as well as, the principle of Corona Discharge that is continuous discharge from accurate point of metal into the surrounding air. In case of using Hamilton Flywheel, it is rotated by the repulsive force occurred between the electric charge at the metallic point of flywheel and the electric charge in the surrounding air charged by the metallic point discharge.

2. Introduction of various types of Discharges

Spark Discharge:

Spark Discharge is the phenomenon of electrons transferred between two electrodes in a discontinuous manner when insulation breakdown occurs after high voltage is kept impressed to two electrodes and the voltage reaches a tipping point. Electrostatic discharging phenomenon that occurs when human fingers touch doorknob is seen as Spark Discharge.

Corona Discharge:

Also, known as "Point Discharge" that is the continuous discharge from accurate electrode. The name of "Corona Discharge" is derived from the emission at the discharging point that resembles solar corona.

3. Electrostatic Generator: "Static Genecon"

We already know that if we rub piece of plastic with felt or different kind of cloth then static electricity will be generated. And we have in various ways confirmed properties of above mentioned way of generating static electricity. As a result, we have learned among other things as well, that electrostatic charge has two kinds. Furthermore, we can store static electricity because of the invention of Leyden jar and Electrophorus. By using them we can store greater amount of static electricity, thus conducting experiments with large amount of static electricity. Because of that invention research about static electricity accelerated in the past.

In 1929, Robert J. Van de Graaff (1901-1967, USA), with purpose to invent particle accelerator, invented high voltage electrostatic generator, so called:" Van de Graaff generator". Van de Graaff generator can generate low electric current, but it can accumulate high amount of voltage. It is often used for demonstration experiments in schools.

In this unit, we will use "Static Genecon" that generates static electricity continuously in the same way as Van de Graaff generator to perform various experiments. For example: Charge & Discharge, or Repulsion and Attraction experiments, by analysis of the behavior during experiments, let's deepen our understanding of static electricity.

Static Genecon
(Narika B10-1324)

"Static Genecon", developed by NARIKA Corporation, is a smaller version of Van de Graaff generator. Below you can find a simple explanation of the operating principle. The basic principle is: by rubbing two things against each other, static electricity is generated.

In drawings below, we can see simplified internal structure of Static Genecon. Felt reinforced with metallic copper is in contact with drum made of PVC. Also, to collect electricity charge generated on the surface of the PVC drum, there is a collector made of metal (Figure 1).

If you rotate slowly the handle of Static Genecon, PVC drum will rotate, and rub felt. As a result of the friction, on the surface of PVC drum negative charge, and on the felt positive charge will be generated. On the surface of nonconductor static electricity will not move, therefore when PVC drum is rotated, negatively charged static electricity formed on the surface of PVC drum is transferred to the collecting plate.

Because collecting plate and PVC drum are not in contact, due to negative charge on the surface of PVC drum, collecting plate will be induced and negative electric charge on the surface of PVC drum will be neutralized. Because of the electrostatic induction of collecting plate, negative charge will easily move inside the conductor. On the other hand, positive charge generated on the surface of felt will be supplied by negative charge from metallic copper plate inside of the felt, therefore it will be electrically neutralized (seemingly it looks like transference of positive charge. See Figure 2 and Figure 3.).

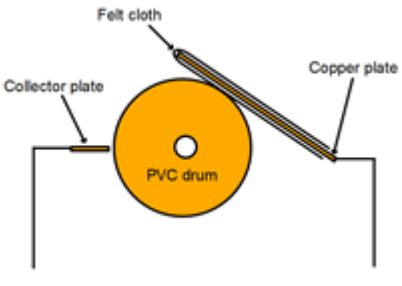


Figure1

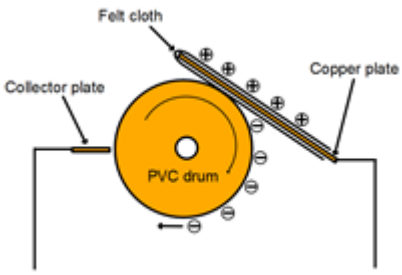


Figure2

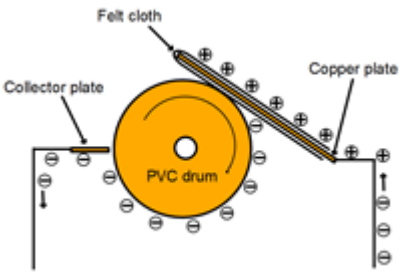


Figure3

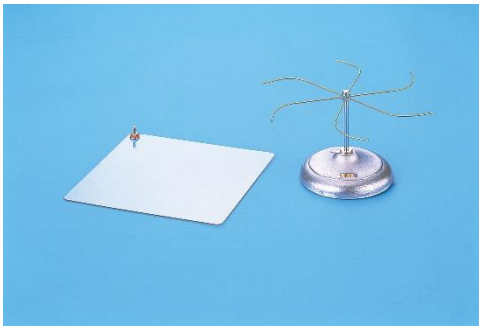
4. Discharging Experiments Using Hamilton Flywheel

1. What to prepare

●Static Genecon: 1 pc (Narika B10-1324)

●Hamilton Flywheel: 1 pc (Narika B10-1324-02)

Static Genecon
(Narika B10-1324-W0)

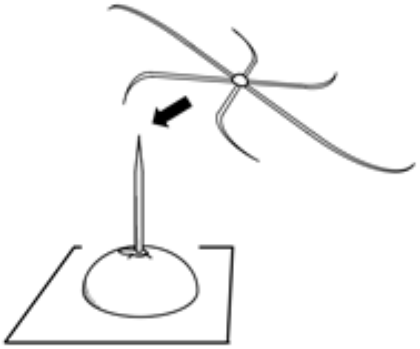


Hamilton Flywheel
(Narika B10-1324-02)

2. Experiment procedure

1) Hamilton Flywheel is lightweight. As well, the pointed ends are sharp, therefore please be careful when manipulating with them.

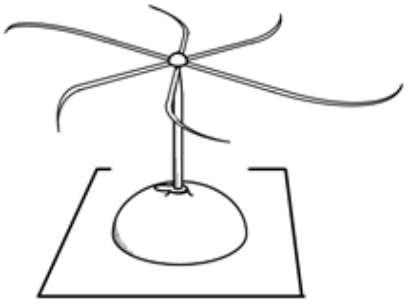
2) On the base is sharp pointed end pin. Please avoid injury when manipulating with it.



3) Paying attention to above mentioned, attach Hamilton Flywheel as shown on the drawing on the right.
***CAUTION: Sharp pointed end like a needle.**

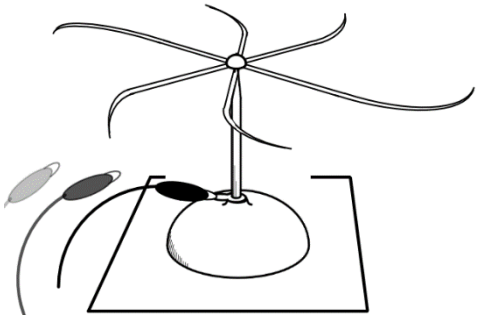
4) Flywheel is made of thin and fragile material. Therefore, it may happen that some of the pointed ends of flywheel are not on the imaginary circumference (created by the pointed ends). In that case, please make adjustment to the pointed ends.

5) Place the flywheel on the table and adjust the shape by your fingers. Direction of each pointed end should be on the imaginary circumference.



6) Use negative (–) terminal (red) of Static Genecon and connect it by cable with terminal on the base of Hamilton Flywheel.

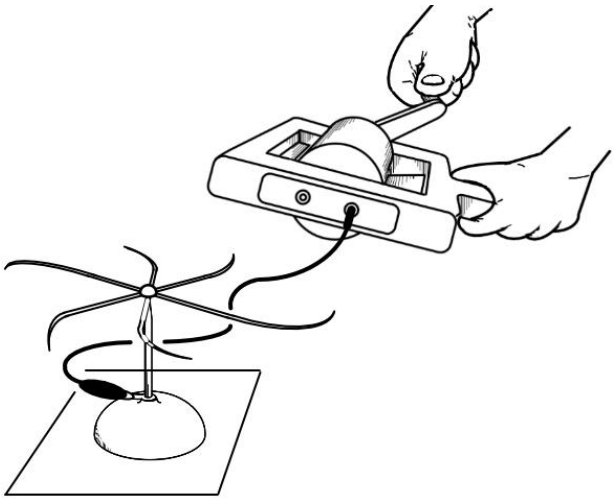
7) Do not connect anything to the Positive (+) terminal (black) of Static Genecon.



8) Start slowly rotating the handle of Static Genecon. Keep slowly rotating for a while.

9) Hamilton Flywheel will soon start to rotate slowly.

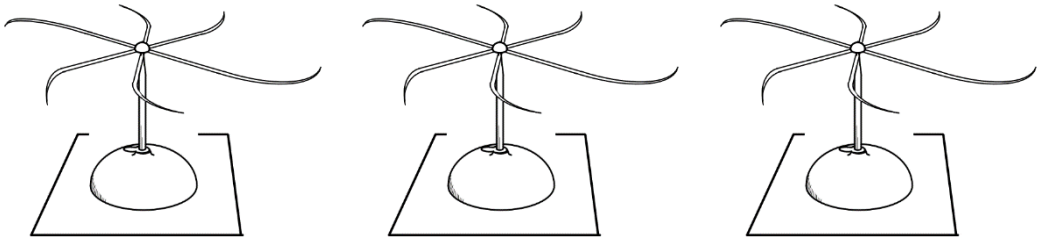
10) If the Hamilton Flywheel does not start to rotate, adjust the direction of pointed ends of flywheel.



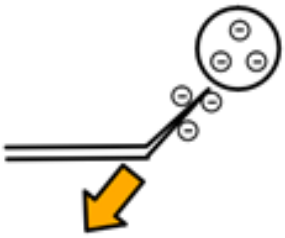
***If the flywheel does not rotate, there is a chance that Static Genecon gets some dust. In such case, clean the Static Genecon.**

5. Questions

1. Explain the rotation mechanism of the Hamilton Flywheel by using (+) positive and (-) negative charge signs. Please use the drawings bellow.



Rotation mechanism of the Hamilton Flywheel by Corona Discharge:
By concentration of electrical charge at the pointed end connected to the base of Hamilton Flywheel, air around the pointed end becomes also charged. Since the pointed end and the air around it has like charge, repulsive force occurs, as shown on the right figure, which rotates the Flywheel.



2. Summarize below the differences between discharge of two Aluminum Collecting Spheres and the discharge of Hamilton Flywheel.

Spark Discharge seen between two Collecting Spheres is phenomenon of electrons transferred between two spheres in a discontinuous manner when insulation breakdown occurs after electrical charge is stored on the two surfaces of the spheres and reaches a tipping point of spheres' accumulation capacity of electrical charge per superficial area.

On the contrary, Corona Discharge is continuous discharge of weak emission, unlike emission in a discontinuous manner made by Spark Discharge, based on the charged air around the concentrated electrical charge at the pointed end.