Mixing Bowl Van de Graaff Generator

By Spencer Coonrod,

Zane Sturm,

And Chris Wendel

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Section H1

Introduction:

An electrostatic generator is a machine that produced static electricity. The Van de Graaff generator is one type of electrostatic generator that utilizes a moving belt to generate the static electricity while transferring it. The Van de Graaff generator was invented by the American physicist Robert J. Van de Graaff in 1929. This honors project is the construction of a Van de Graaff generator from attainable supplies.

Structure and Supplies:

Van de Graaff Generator:

Supplies

- 1 four-inch PVC pipe
- 1 2'x2' wooden board
- 4 two-inch PBC pipe endings
- 2 six-inch threaded rods
- 2 metal bowls
- Teflon tape, foil tape, electrical tape
- Hot glue, Rubber Cement
- Palates exercise band
- Copper wire
-5.2 Watt Drill urgh urgh urgh (Tim Allen grunt)

We drilled two pairs of holes in the four-inch PVC pipe; two at the bottom, and two at the top. With the end caps and the threaded rods we formed two axels that would turn the rubber exercise band used to move charge. On the end cap part of the axels we put Teflon tape on the bottom axel and foil tape on the top axel. Once our axels were in place we ran the band through the pipe and connected it

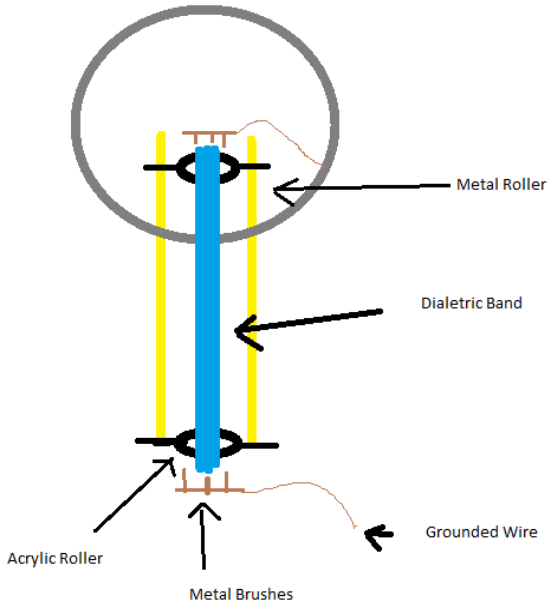
around the axels with rubber cement. At this point we cut the extra rod off our axels except for one of the bottom sides used to turn the axels with a drill. Next we cut a four-inch diameter hole in the bottom of one of our bowls and used hot glue to attach it to the top of the pipe. Adjacent to the band at both the upper and lower axels we attached combs made of copper wire and foil tape. The upper comb is connected to the collecting sphere. The other bowl we placed on top and secured with electrical tape. To provide stability and insure insulation we attached to entire device to the wooden board and used hot glue to secure it.

The Physics Behind It:

Dielectric or insulating (does not conduct charge) materials can leave surfaces electrically charged with opposite signs of charge and with high potential difference all while the surfaces are separated. There have been many different examples of Van de Graaff's concept produced all of which work off the idea of creating charge with a machine. One of the most commonly used devices is a basic spherical structure, which uses some sort of dielectric belt to produce a charge on a conducting ball.

The rollers should be covered with two different materials, usually acrylic and metal. The dielectric belt, which in our case is made of rubber, moves the charge from one axel to the other. Combs are placed adjacent to the band at the top and bottom of the system. The lower comb is close to the earths potential and drains negative charge, which in turn produces a positive charge on the belt. Once a charge is built up on the belt, the positive charge draws the negative charge from the

upper comb that is connected to the conducting sphere. The system is grounded so as the negative electric charge moves from the system to the earth a positive charge is produced and collected in the conducting sphere. As long as the band is turning, more charge is being built up in the collecting sphere.



Conclusion:

The generator was constructed to the specifications originally planned and with minor adjustments worked adequately, generating multiple inch long arcs and one as long as an inch and one half. The project group became concerned when the Van de Graaff quit producing these arcs. The group realized the entirety of the testing had been conducted during a thunderstorm and therefore the humidity levels in the air were very high. High humidity levels in the air prevent statics charge from build

causing the problems in the generator. The change in results was caused by a door being left ajar. Testing in other conditions proved humidity was the cause of the problem and that a working Van de Graaff generator was constructed. The group also learned a lesson in static electricity.

Side Projects:

Franklin Bells:

Supplies:

- 1 three-foot long piece of 1”x1” square dowel rod
- Four-foot piece of copper wire
- 2 Metal food cans
- 1 Coke tab
- One-foot piece of twine

The dowel rod was cut into three equal sections and attached with screws at 90° from each section. The copper wire is hung from the structure and attached with a small nail to the cans. With the twine we hung the Coke tab between the cans. When current is run through the wires the tab bounces back and forth between the cans. The physics behind this is in the physics section of the report.

Capacitor:

Supplies:

- 1 Metal conducting can
- 1 plastic cup
- Water
- Copper Wire

The plastic cup was placed into the metal conducting can. Water is then placed into the plastic cup and the copper wire is placed inside the water. The plastic cup is a dielectric and reduces the amount of current going through. This allows a small build-up up charge on one side of the dielectric and the charge slowly travels through the cup to the conducting metal. This allows a steady flow of charge over time as opposed to a quick burst of charge that ends once the power source is disconnected.

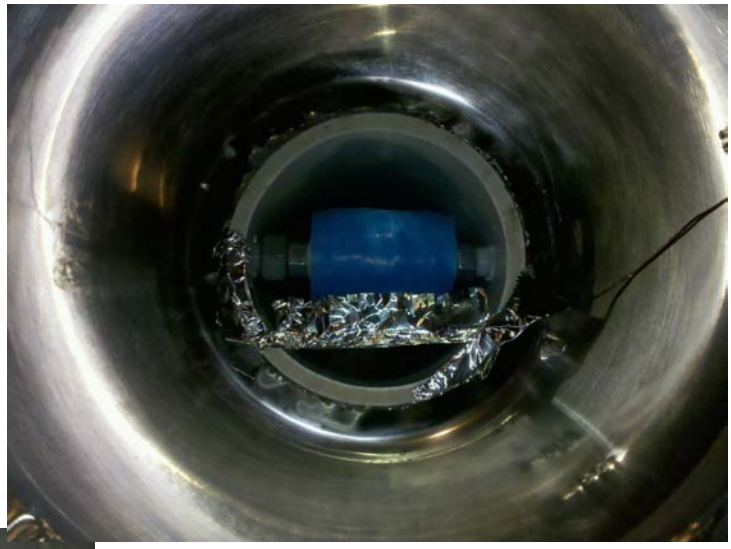
Electrostatic Motor:

Supplies:

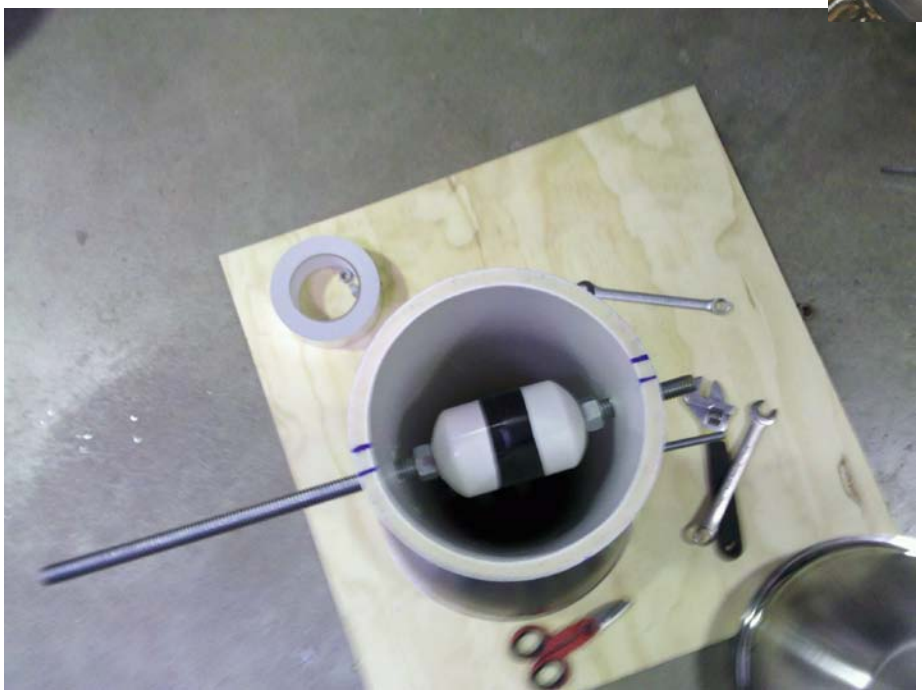
- 4 Coke Cans
- Cardboard pizza box
- Copper Wire
- Masking tape
- 20oz Soda bottle
- Steel wire
- Aluminum Tape

The plastic soda bottle is suspended by the steel wire so it can rotate freely. Strips of aluminum tape are placed on the outside of the bottle. The bottle is positioned between two copper wires, one connected to a generator (in our case the Van de Graaff) and the other wire is grounded. The wire connected to the generator will gain a net charge. Some of this net charge gained by the wire will be deposited on the aluminum tape. Since both the tape and the wire have the same positive or negative charge they will repel each other creating a torque, which rotates the bottle. Then the tape will rotate near the grounded wire were it will deposit its charge. The tape will continue a cycle of gaining and depositing charge until the generator quits supplying net charge.

These are the photos of the construction.



Here is a inside view of the top of our generator. It shows the Pilates band on rollers used to move the electrostatic charge to the top and the metal foil brush used gather the charge and move it to the sphere.



Works Cited

Bread, Denis. "Van De Graaff Generator - the Basics." Practical Physics. 28 May 2009. Web. <http://www.practicalphysics.org/go/Guidance_30.html;jsessionid=abCXOhT1zOh4?topic_id=$parameters.topic_id&collection_id=%24parameters.collection_id>.

Rehorst, Mark. "Van De Graaff Generator." Van De Graaff Generator. 21 Mar. 2009. Web. <http://mark.rehorst.com/Van_de_Graaff/>.

"Van De Graaff Generator." Wikipedia. Web. <http://en.wikipedia.org/wiki/Van_de_Graaff_generator>.

Zavisa, John. "How Van de Graaff Generators Work" 01 April 2000. HowStuffWorks.com. <http://science.howstuffworks.com/transport/engines-equipment/vdg.htm> 26 September 2010.