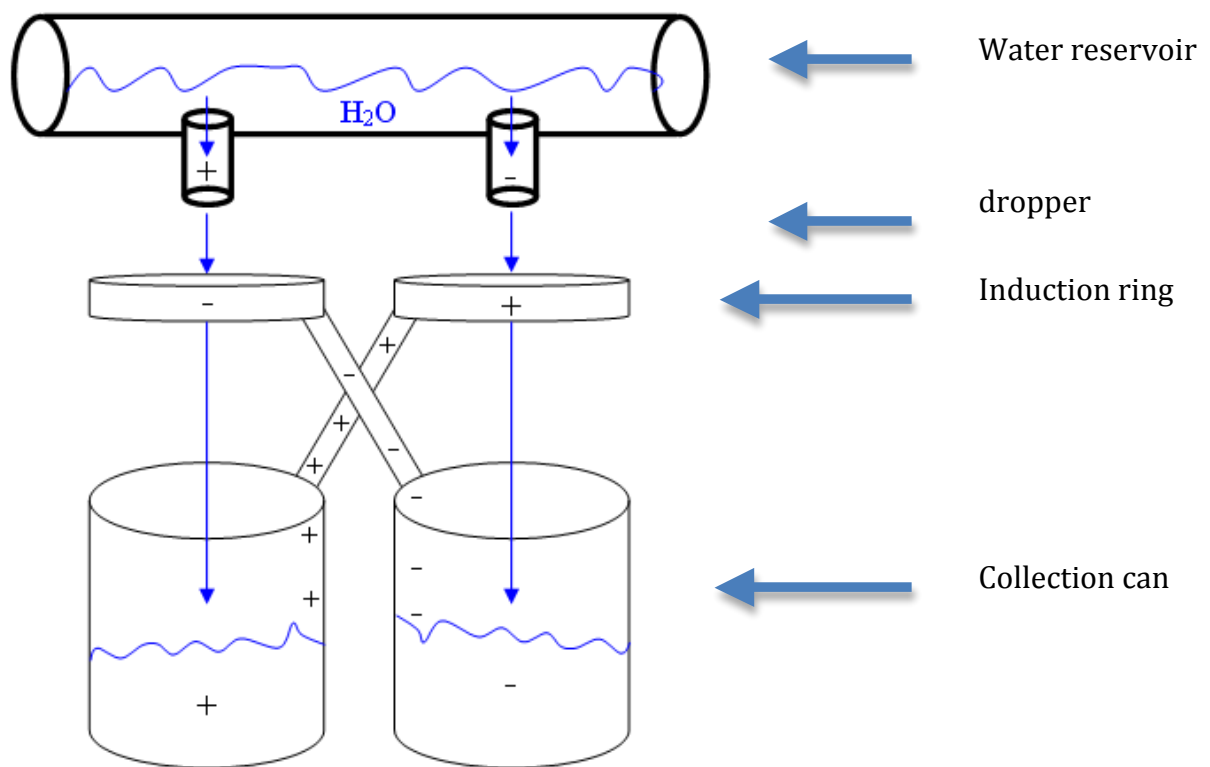


Kelvin Water Dropper  
UP II Honors Project  
John Hodges  
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William Thompson, also known as Lord Kelvin, was a 19<sup>th</sup> century engineer and physicist. He worked mainly with electricity and thermodynamics. He came up with the idea of absolute zero, and the Kelvin temperature scale bears his name. He also worked with the principle of electrostatic induction on which his generator works.

The following is a basic diagram of the generator that will aid in the description of its operation. It should be noted that the shown charges have been added to simplify the description. The charges may be reversed in practice (Wikipedia).



The Kelvin water dropper relies on two principles to operate. The first is electrostatic induction. This is defined as the distribution of electric charge on one material under the influence of a near by object with an electric charge (Britannica). The second principle is that of positive feedback. This is simply any effect that causes more of itself.

It is important to completely isolate all parts of the generator from the ground. Styrofoam makes a great insulator and was used to isolate the collection cans and induction rings from the wooden frame. Also, any sharp edges should be avoided as they allow points for static charge to “bleed off” into the surrounding air.

Before the water is turned on, the generator is electrically neutral. However, there is usually a very small imbalance of charge between the cans that starts the process in motion. If the generator does not initially appear to work, a small charge may be introduced to one of the cans to start the process. Simply rubbing a balloon against your head and touching it to the can will accomplish this.

It will be assumed that the left can, and therefore the right ring starts with a positive charge. As water flows down the dropper, the positively charged ring induces a negative charge on the water. As this water leaves the dropper, it

retains this negative charge. When the drop is collected in the can, this charge is distributed over it and the left ring.

This process is repeated on the other side, except with opposite charges. The negatively charged ring induces a positive charge on water drops which fall into the collection can and positively charge the right ring. This is the positive feedback that was discussed earlier. As the generator continues to run, the charge will get larger. As the charge gets larger, the rings will be able to induce a larger charge on the water droplets. Thus, the charge of the generator increases exponentially with time (Beaty). The energy that is converted into electrical energy by this generator comes from gravity. It is gravity that pulls the water drops away from the oppositely charged induction rings and towards the like charged collection cans.

Eventually, this charge will become so large that it needs to discharge. This discharge will occur wherever the positive and negative sides are closest together. This is usually between the wires that connect the rings to the cans. A spark gap can be attached to better see this discharge.

A Kelvin water dropper makes a great demonstration of the principle of electrostatic induction. When properly constructed, a spark in excess of one centimeter can be observed, letting you know that your generator is a success.

## Bibliography

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