Charging Bicycle Station Second Gen

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Engineering Analysis

Document

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2 OVERVIEW

To have an understanding of how the generator will work, a generator analysis is needed. Within the generator, we have a few generator equations that are essential to understand how the generators will work. Electromotive force, magnetic field, and magnetic flux will be discussed below and the finalized idea of how the generator will work.

3 PROBLEM STATEMENT

The bicycle charging station on the second floor is not fulfilling its intended function so we have been tasked with creating a new station to replace or supplement it. The new charging station should be a highly portable system able to charge many common personal devices while tracking and displaying power generation statistics for educational and conservation purposes.

4 BACKGROUND

The details of how the generator will work begin with the magnetic field. According to the Biot–Savart law, Ampère's circuital law, and Gauss's law for magnetism; a generator works with the idea of electromagnetism. Within any magnetic field in a wire, it's calculated with the permeability of free space (4*pi*10^-7) multiplied with the current and divided by the coils wire length, which is 2*pi* ***r***, with ***r*** standing for the radius. The strength of the magnetic field depends on the current ***I*** in the wire and ***r***, the distance from the wire. The other calculation is finding the magnetic field of the axis contained within the generator. As the coil is wrapped around the axis (armature) the number of loops will determine the strength of the magnetic field, which in turn will create a higher output voltage. Since magnetic fields are a

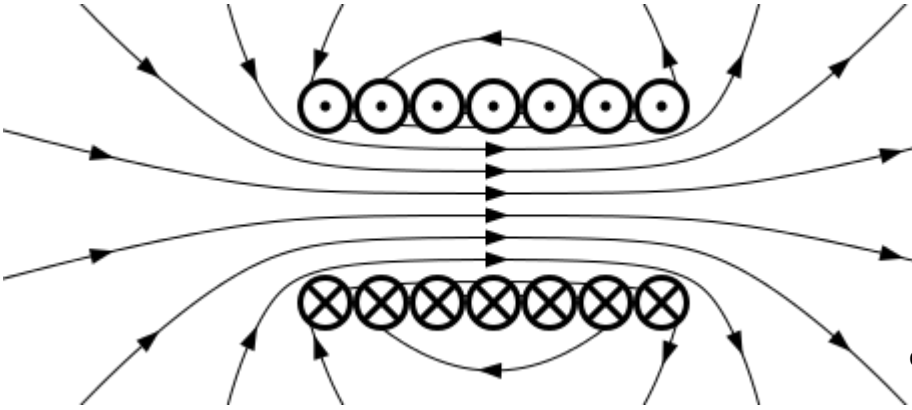

Figure 1: Faraday's Law

major part of the generator, a solenoid can be a potential component within the generator. The solenoid is simply an iron core with an enameled coil around it. This creates a very strong magnetic field as it acts an electromagnet. Since a strong magnetic field is essential for a generator, the magnetic flux becomes equally as important. The magnetic flux is the magnetic field multiplied by the surface area of the magnetic field

5 PURCHASED GENERATOR

Figure 2: Purchased Generator

A purchased generator is built to maximize efficiency and minimize cost. Purchased Generators are designed to use machined parts that fit together with minimal wasted space. By minimizing gap space, the generator achieves a higher flux density and a higher number of turns with the same materials. According to Faraday's Law, higher flux density increases the induced electro-motive force on the wire causing a larger current. The more turns of wire used in a generator multiplies the current generated due to Ampere's Law. From these two aspects we can see that a machined generator is very efficient. Unfortunately, generators in our price range do not have the best efficiency but the machined production leaves them more efficient than most handmade generators.

6 CUSTOM GENERATOR

A custom built generator has the obvious benefit of having a lower cost but has a higher risk associated with it. It takes longer to build, can be very fragile, and may be inefficient depending on the skill and commitment of the people making it. Because the parts are not machined, the gaps and errors in the construction can make the generator less efficient or unreliable. However, if constructed well, a custom made generator can be optimized for a particular purpose and can exceed the efficiency of a generic purchased generator. This can be done by selecting the proper materials and building the generator to have coefficients optimized to the speed at which it will be run.

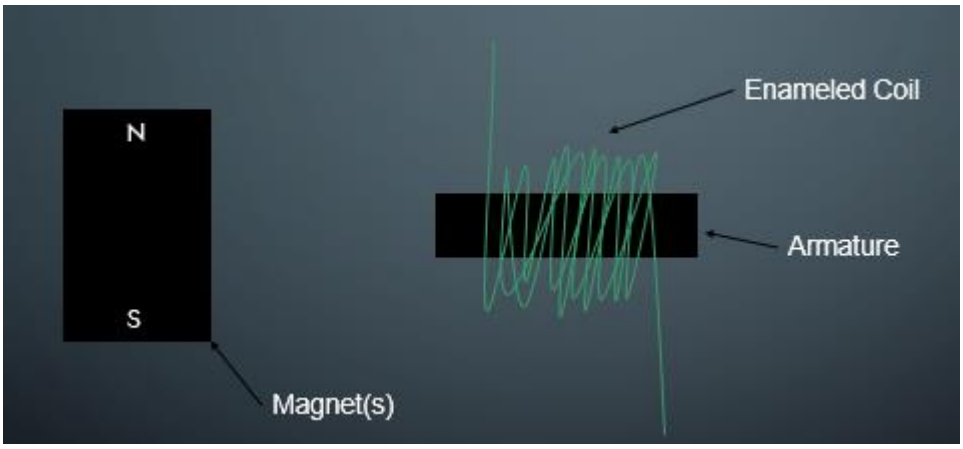

Figure 3: Custom Generator

7 CONCLUSIONS

Due to the advantages possible from a custom generator, the team has decided to build a generator by hand at first. Because our project is separated into discrete components, we can change the generator later if we find that the one we made has faults or is less efficient than expected.

8 REFERENCES

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