Small Scale Hydroelectric DC Generator

One (or many) Revolutions in Renewable Energy

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Motivation

The goal was to design and construct a barebones small-scale generator which can be built at home from easily obtained parts. The generator must be portable and use the energy of a stream to charge USB devices.

Focus was to be placed on constructing everything ourselves, including winding our own coils.

Applications

- ❑ Useful as a renewable energy source for camping, developing nations, and other locations where power infrastructure does not reach

Goals

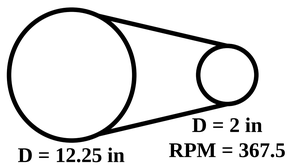
- ❑ Build a device that can use a small stream to produce a steady 5V 1A output that can be used to power small devices
- ❑ Make the device portable and low-cost

Methodology

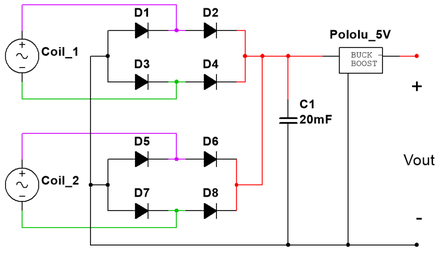
Faraday's law: $\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$, $\Phi = B \cdot A$

ε: induced voltage — N: number of loops

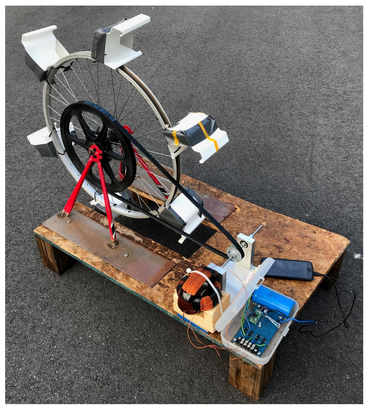
ΔΦ: change in magnetic flux — Δt: change in time

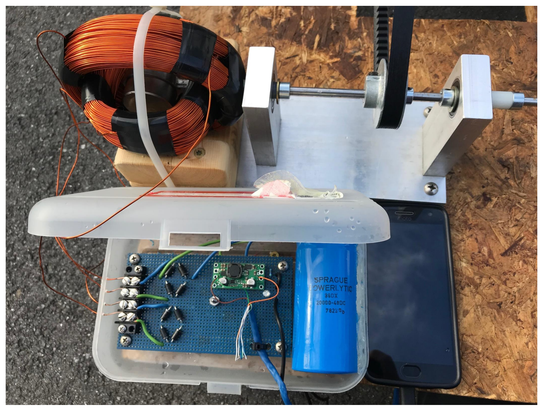


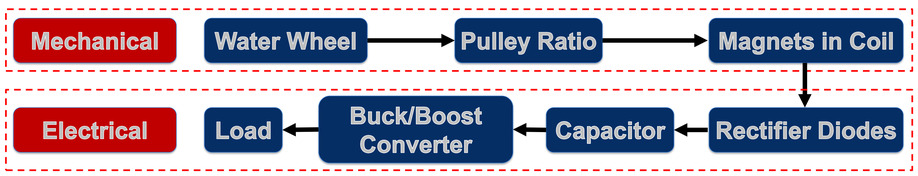
Pulley Ratio = $\frac{12.25}{2}$ = **6.125**



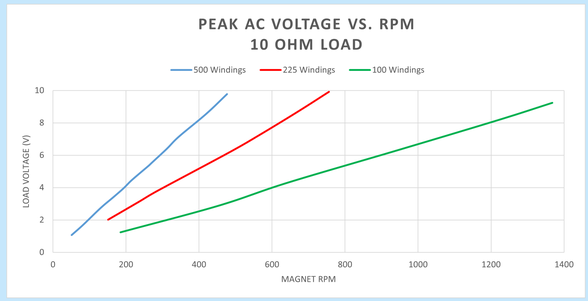
Alternating current must be rectified into a ripple before being regulated to a smooth 5 volts

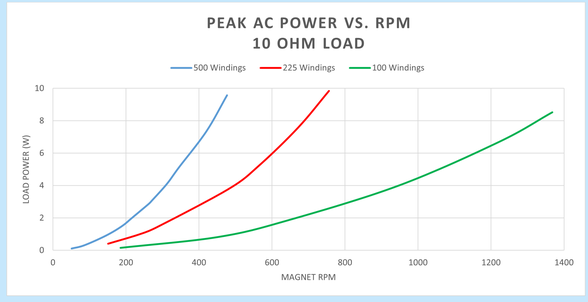






Results





- ❑ Charge testing was performed on a Moto G5+ measured with an ammeter.
- ❑ For load analysis a Saleae Logic Pro was used to view and record all waveforms.

Discussion

- ❑ The original design had one coil, but two coils were utilized to smooth the ripple voltage
- ❑ A buck/boost converter was chosen as a more efficient alternative to a 7805 linear regulator
- ❑ Reducing belt tension lowers frictional losses but causes it to slip under heavy load

Conclusion

- ❑ The generator performed as expected, supplying an output of 5 volts and 830 milliamps with a 6 ohm load
- ❑ In further revisions of the project, efficiency can be improved by reducing frictional losses in the mechanical connections
- ❑ All parts other than the buck/boost converter and large neodymium magnets are easily obtained

Future Improvements

- ❑ Integrate charge controller for faster charging rates
- ❑ Use a bike chain for less friction
- ❑ Impedance matching for maximum power
- ❑ Implement a more efficient alternator