SPARC
Student Project Research Committee

Spark Gap Tesla Coil

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Project Initiation Date: 9/24/15

Project Overview:

As a demonstration for Auburn's E-Day, built a full size tesla coil. A tesla coil acts as a giant voltage transformer that can generate arcs of electricity into the air. Nicola Tesla invented and built the first tesla coils. His intentions were to create wireless energy. While tesla coils do in fact create a strong electromagnetic field, they are not ideal for practical applications. The intent of this project is to learn concepts about electricity and magnetism and demonstrate them to the community.

How it Works:

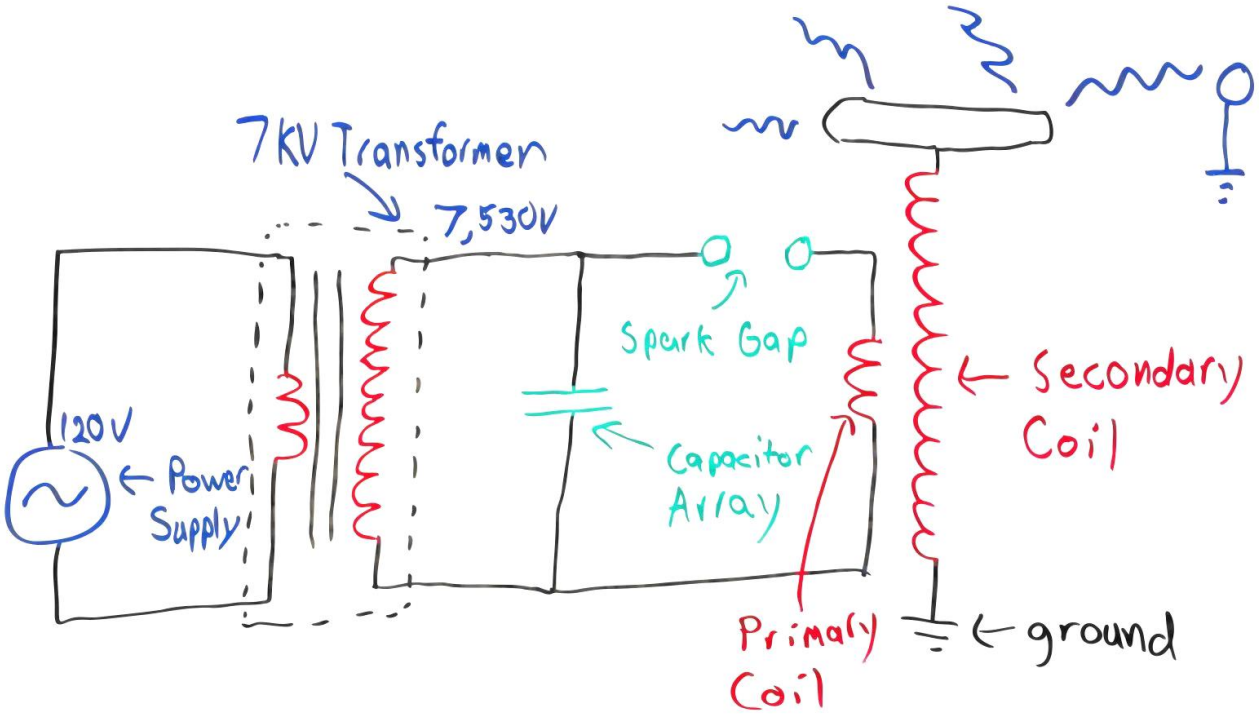
There are two different types of tesla coils: spark gap and solid state. Nicola Tesla built spark gap tesla coils. A spark gap tesla coil works by using a high voltage transformer that then charges a capacitor. The capacitor then discharges across a small gap of air hence the spark gap. This creates a resonating square wave of high voltage that then is conducted through a primary coil. The primary coil inducts through electromagnetism into the secondary coil. Charge builds up in the air around the toroid and creates an arc of electricity.

Our Progress:

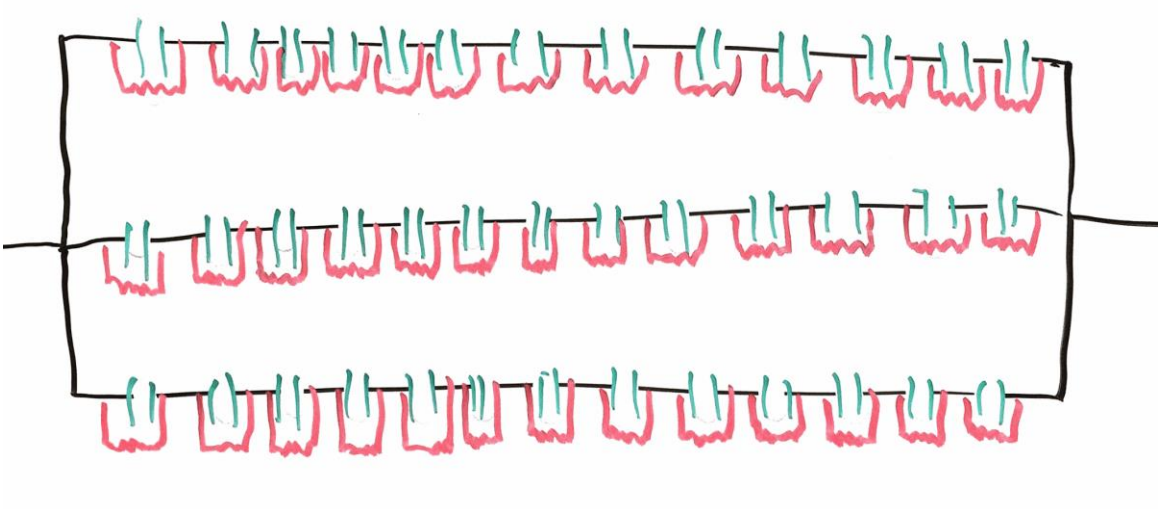
The goal is to develop a tesla coil that can shoot out arcs of lengths up to 3 feet. Our long term goal is to create a musical tesla coil. Basically it produce arcs in the resonance and rhythm as preprogrammed music. We decided to divide the project into three sections: miniature spark gap tesla coil, large spark gap tesla coil, and large musical solid state tesla coil. We completed the miniature tesla coil and it works as designed and generates an arc length of about 2 cm. From there we have constructed a full scale tesla coil using a 7530 volt transformer. The Tesla Coil creates arcs up to 6" thus creating approximately 400,000 volts of electricity. Some future work on the spark gap Tesla Coil would be increasing the size of capacitors by using fabricating capacitors out of raw material.

Schematics:

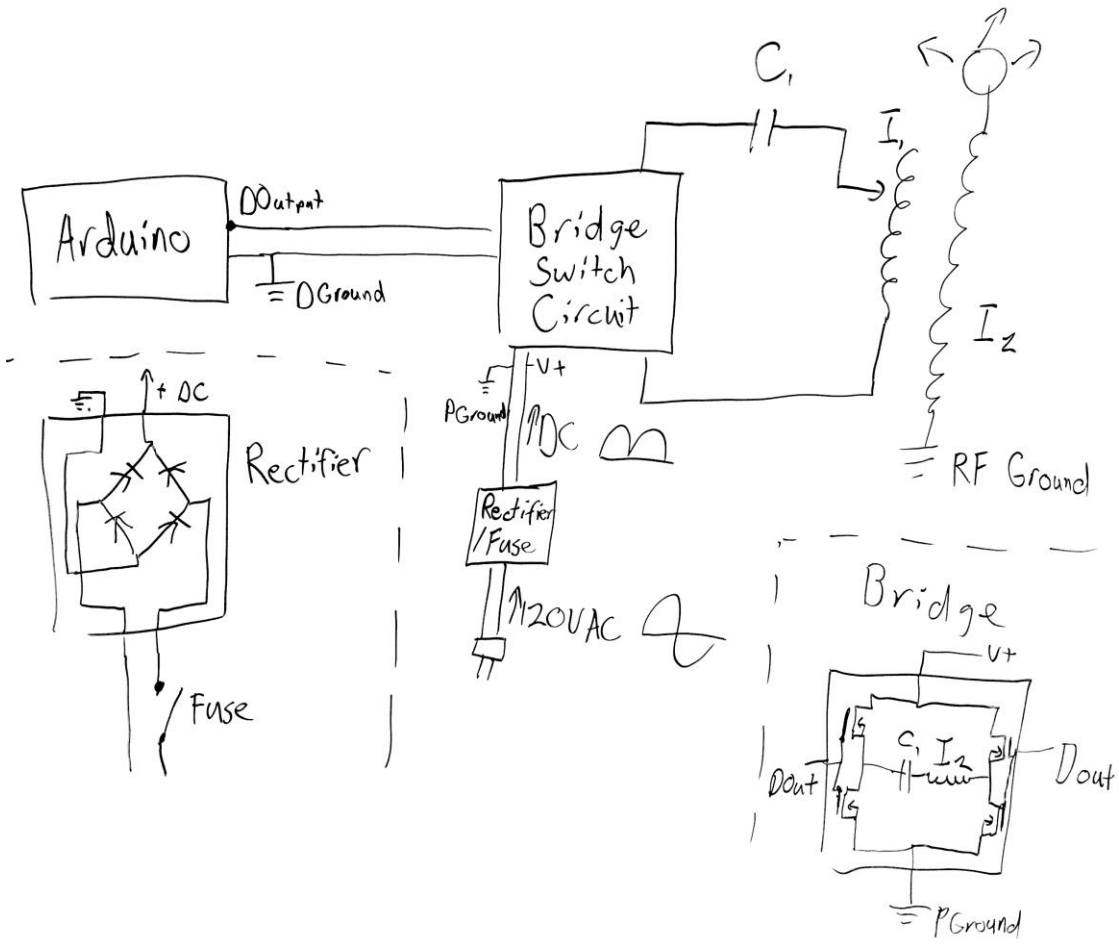
- Spark Gap Circuit



- Capacitor Array



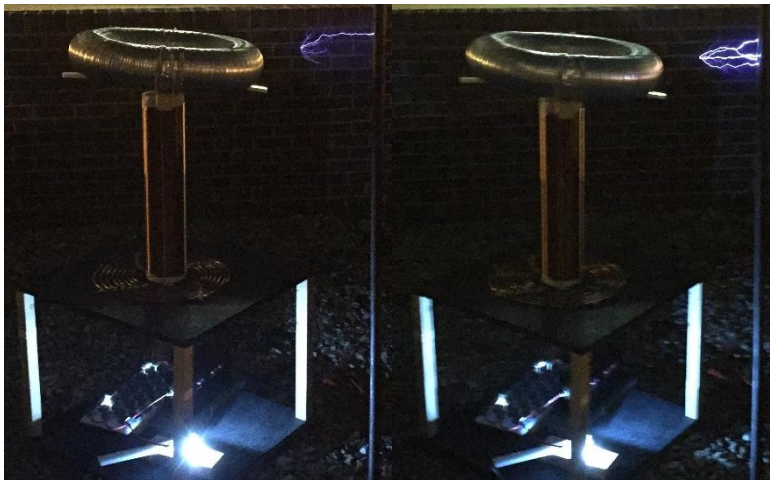
- Solid State Musical Tesla Coil


C1
I1
I2
Arduino
DOutput
DGround
Bridge
Switch
Circuit
+DC
Rectifier
Fuse
V+
PGround
DC
Rectifier
/Fuse
120VAC
RF Ground
Bridge
V+
C1
I2
DOut
DOut
PGround

Specifications:

Sub Assembly	*Specification*	*Number*	*Unit*
Power	Output Voltage	7,530	Volts
	Output Current	35	mA
	Output Power	263.55	Watts
Capacitor	Net Capacitance	0.0157	micro F
	Individual Cap	0.068	micro F
	Array	3 x 13	
Spark Gap	radius of electrode	0.5	inches
	distance between	0.25	inches
Primary Coil	Turns	15	
	radius inner	3.75	inches
	radius outer	11.25	inches
	length	58.88	feet
	Radius between	0.296	inches
	Inductance	87.684	micro H
	Diameter of wire	0.2	inches
Secondary Coil	Turns	1508	
	radius	2.27	inches
	Height	21.81	inches
	Diameter	28	AWG
	Frequency	135	Hz
Toroid	radius inner	3.25	inches
	radius outer	10.5	inches

Photos of Operation:



Useful Links:

Inspiration: https://www.youtube.com/watch?v=fdIYwIWfYyo

Miniature Tesla Coil: https://www.youtube.com/watch?v=qUKYCRhXFgo

Small Scale Example: https://onetesla.com/

How Tesla Coils

Work: http://www.realclearscience.com/articles/2014/01/29/how_tesla_coils_work_108474.html

List of Tesla Coil Formulas: http://teslacoils4christ.org/TCFormulas/TCFormulas.htm

How to make a Musical Tesla Coil: http://www.instructables.com/id/Build-a-Musical-Tesla-Coil-like-a-Pro/

MMC Capacitor: http://deepfriedneon.com/tesla_f_mmc.html