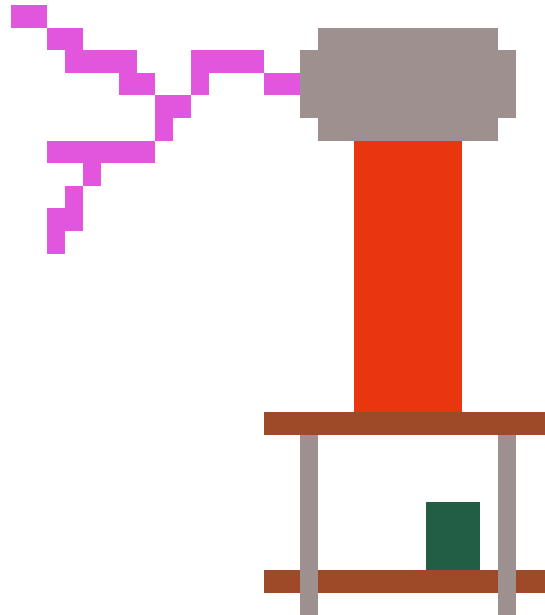


Tesla Coils

Pat Masterson KE2LJ



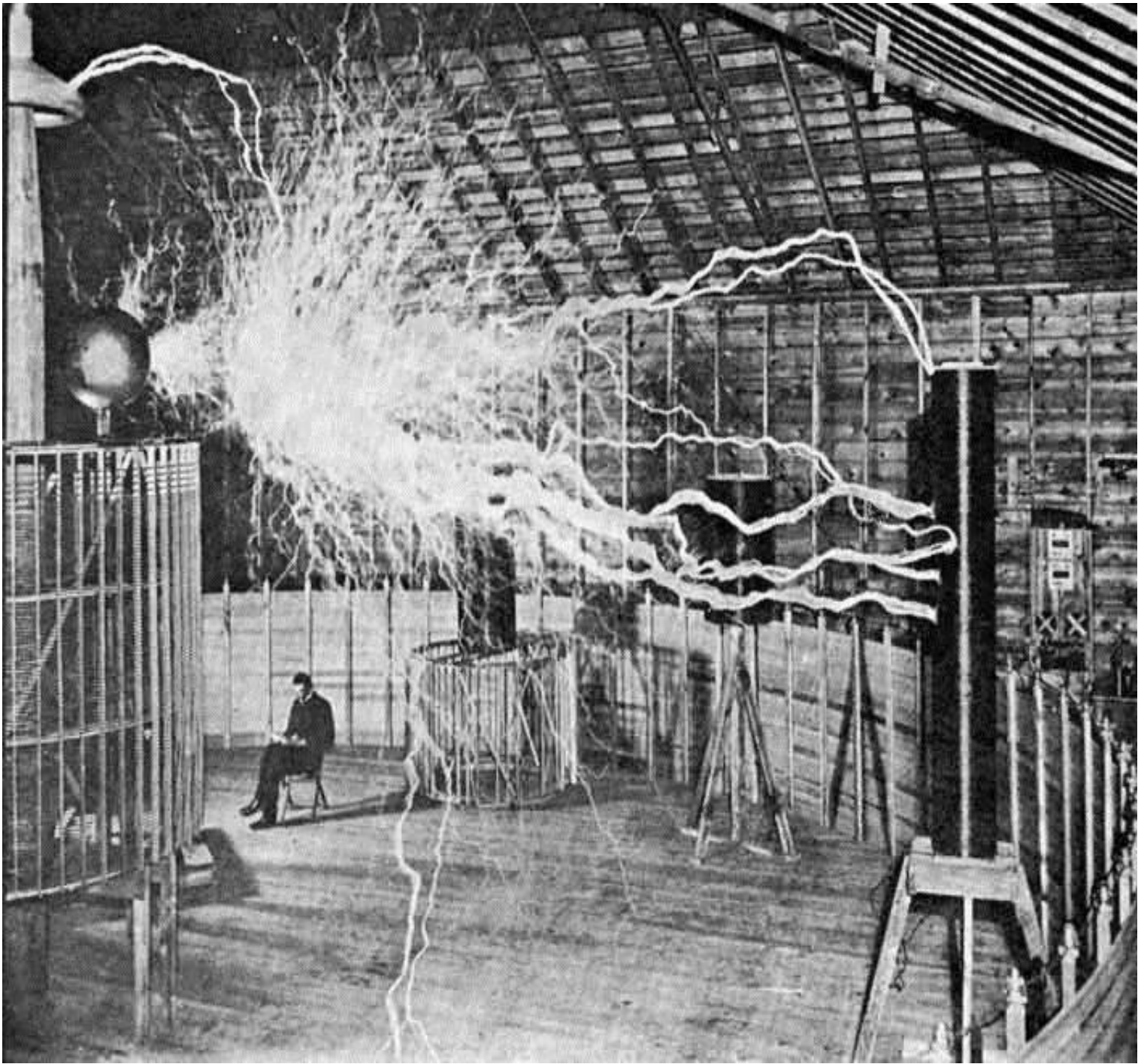
Tesla history

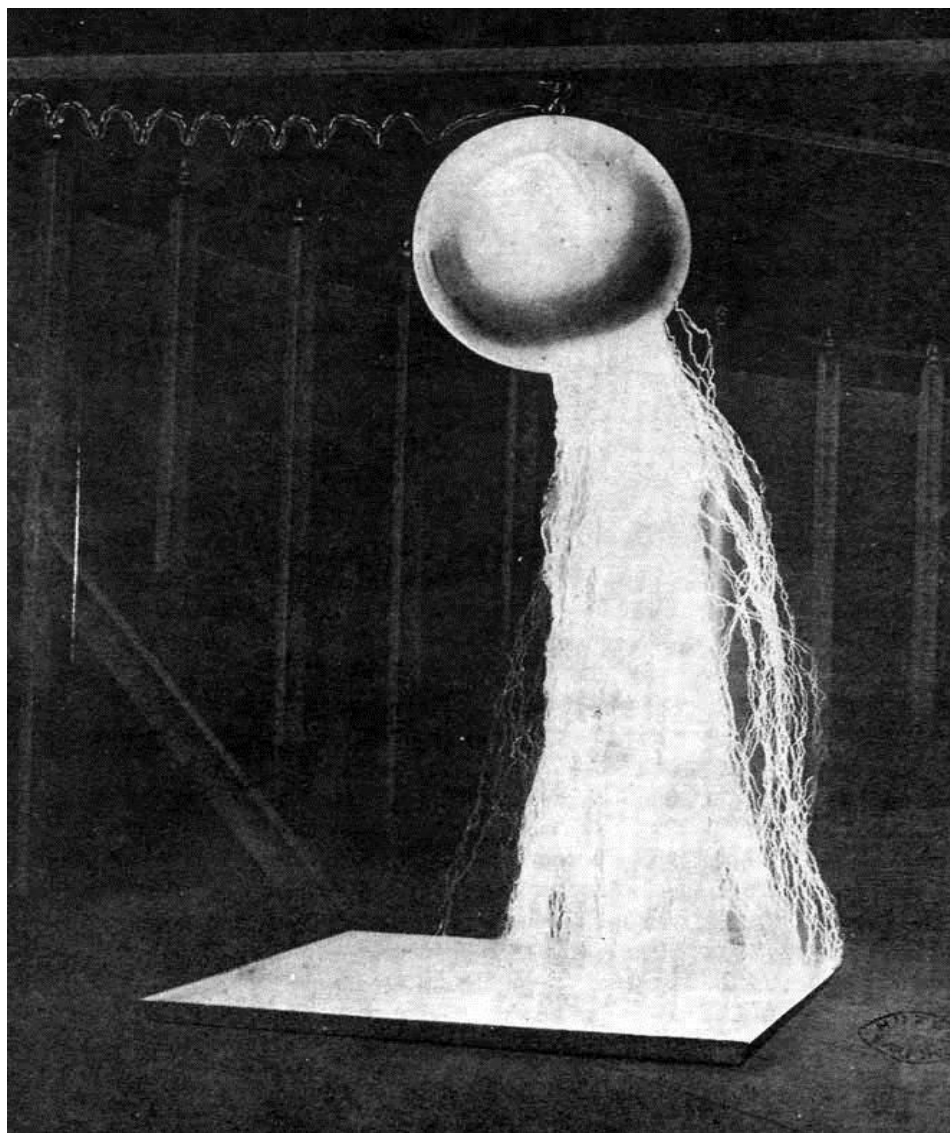
Nicolai Tesla

(b. July 9/10, 1856, Smiljan, Croatia--d. Jan. 7, 1943, New York City), Serbian-American inventor and researcher who discovered the rotating magnetic field, the basis of most alternating-current machinery. He emigrated to the United States in 1884 and sold the patent rights to his system of alternating-current dynamos, transformers, and motors to George Westinghouse the following year. In 1891 he invented the Tesla coil, an induction coil widely used in radio technology.

Tesla in Colorado Springs

A photograph taken in Colorado Springs during an experiment on December 31, 1899. Tesla reads a book in the background, while several million volts lightnings cascade around the laboratory. The roar that accompanied such discharges could be heard ten miles away. The photograph was obtained using trick photography. Experiment was repeated several times to capture the lightnings and then the inventor would sit on a chair to complete the picture.





Tesla's purpose was to transmit electrical energy through the atmosphere, and not have to use wires to everyone's house.

Is this possible? It's very inefficient. Some modern experimenters have tried.

"Dr. Resonance" <[resonance@jvl.net.com](mailto:resonance@jvl.net)> says:

We also conducted this experiment with a large 18 inch dia. coil (8 ft. spark at 7.5 kVA). Using an identical coil with a 30 x 7.5 inch toroid as a receiver, with a good ground, we were able to light an 18 mm neon tube at a distance of 4,250 ft. from the transmitting coil. Freq was 170 KHZ. The lamp was steady brightness all along the tube.

I was quite surprised. I only expected perhaps 100-200 feet. Then we loaded the coil on the back of an open pickup and drove away stopping to drive a short 12 inch ground spike as we tested.

Wardenclyffe

For his new construction project, Tesla acquired land on the cliffs of Long Island Sound. The site was called Wardenclyffe. By 1901 the Wardenclyffe project was under construction, the most challenging task being the erection of an enormous tower, rising 187 feet in the air and supporting on its top a fifty-five-ton sphere made of steel.

Beneath the tower, a well-like shaft plunged 120 feet into the ground. Sixteen iron pipes were driven three hundred feet deeper so that currents could pass through them and seize hold of the earth. "In this system that I have invented," Tesla explained, "it is necessary for the machine to get a grip of the earth, otherwise it cannot shake the earth. It has to have a grip... so that the whole of this globe can quiver."

As the tower construction slowly increased, it became evident that more funds were sorely needed. But Morgan was not quick to respond. Then on December 12, 1901, the world awoke to the news that Marconi had signaled the letter "S" across the Atlantic from Cornwall, England to Newfoundland. Tesla, unruffled by the accomplishment, explained that the Italian used 17 Tesla patents to accomplish the transmission. But Morgan began to doubt Tesla. Marconi's system not only worked, it was also inexpensive.....



You probably know where the Tesla Lab is located already, but in case you don't...

It is right next to the Shoreham Post Office and Shoreham Fire House on Route 25A. It is enclosed in the Agfa (GAF) cyclone fenced compound, and you can still recognize the old Tesla building from the front, looking through the fence. There is a Tesla Club in this area. They were in the process of negotiations to purchase or receive the property for their use.

Tesla Web Sites

<http://www.teslasociety.com>

<http://www.teslascience.org/>

<http://j.webring.com/hub?ring=teslaring>

<http://www.pupman.com>

tesla coil builders assoc.

Founded
Glen's Falls



1982
New York

Let it be known that MIKE MASTERSON (1357)
has been inducted into the T.C.B.A. and is
authorized to operate electrical devices with
Tesla currents of high voltage & high frequency.

Ann'd 1982-1990

Witnessed by Harry Goldman

what is a tesla coil

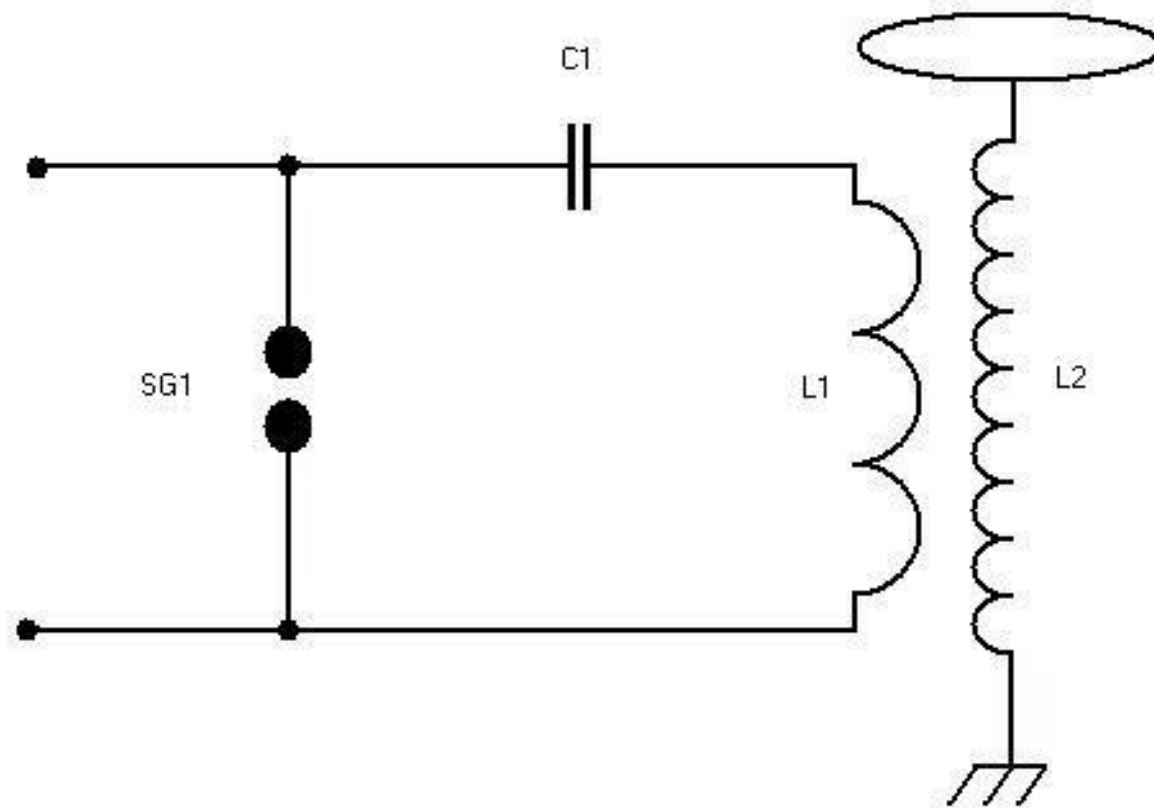
- . A two stage transformer which creates high voltage at high frequencies.***
- . Power levels 1 to 6 KW (or more!)***
- . Frequencies 100 to 500 KHz***

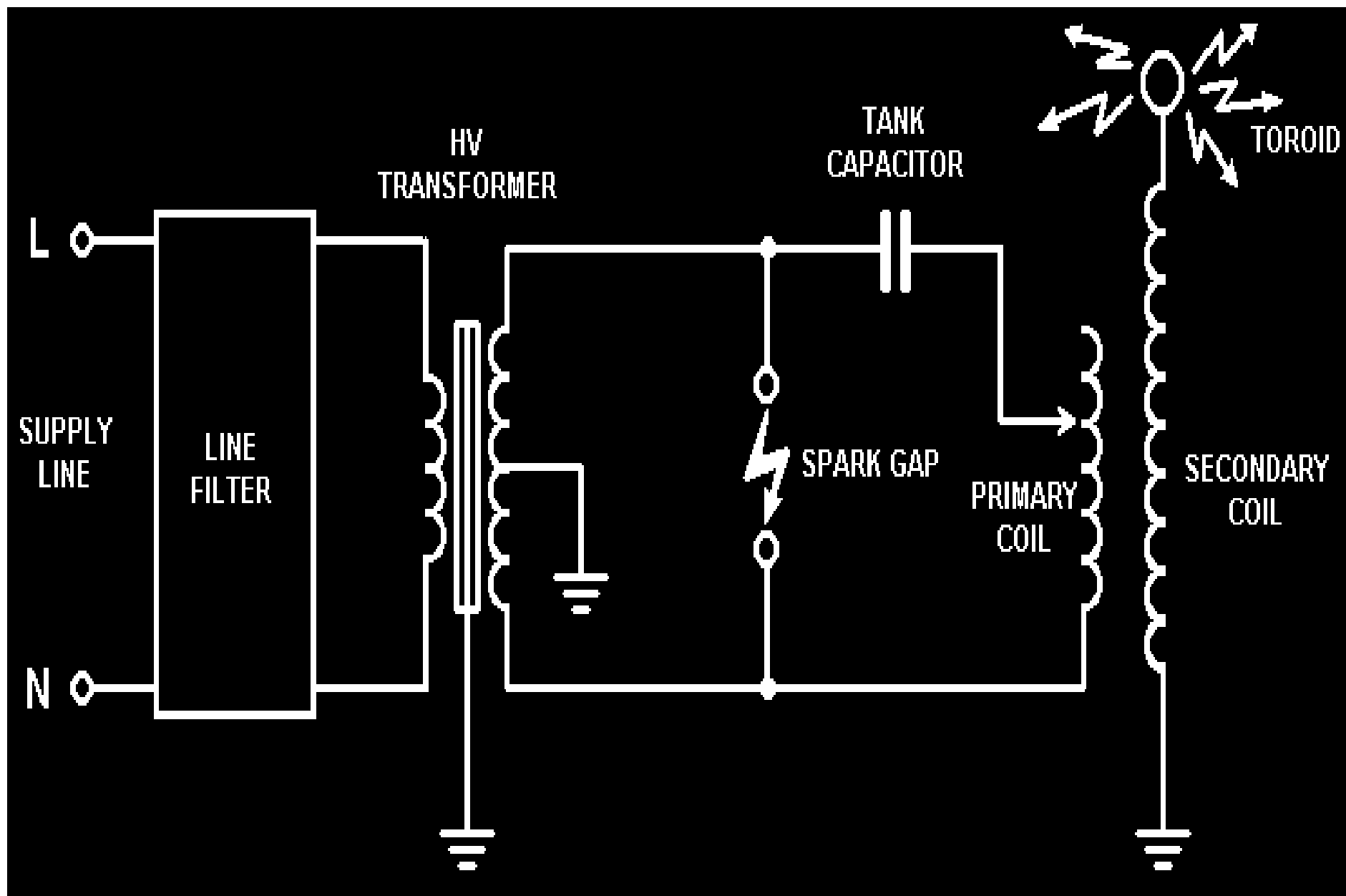
The 'Tesla Coil' is a device invented by the brilliant scientist Nikola Tesla (born 1856, died 1943). It is a high voltage, high frequency, power generator, primarily built for conducting experiments and to observe phenomenon associated with alternating electricity. With this coil, Tesla was able to generate voltages of such magnitude, they would shoot out of the apparatus as bolts of lightning!

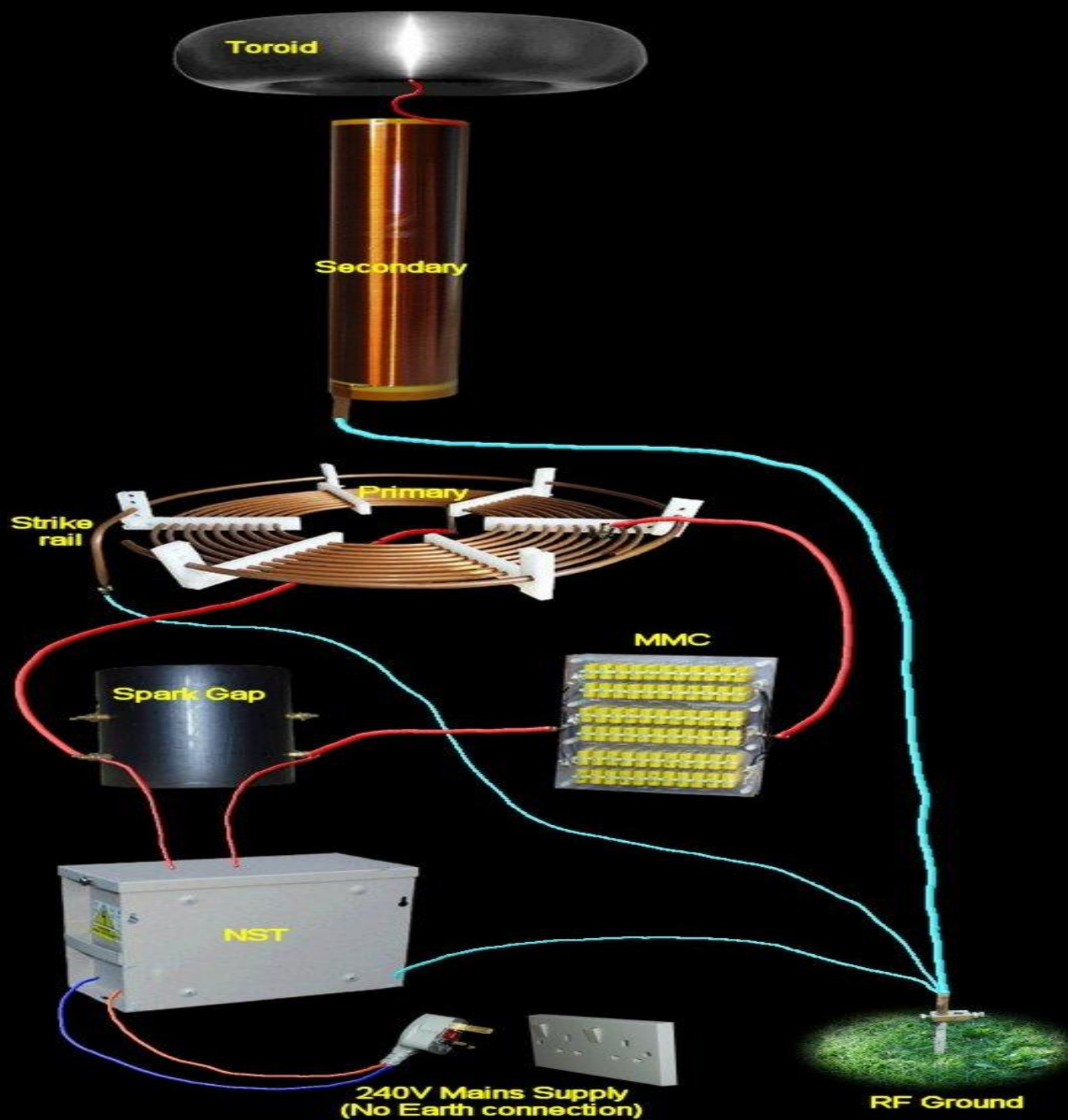
Although the sight of writhing streamers of electricity jumping though the air is certainly spectacular, to Tesla it represented energy loss. On occasion, Tesla deliberately adjusted his equipment to produce these visible outputs as a means of gauging the state of tune of the system, and to provide some feedback for his experimentations

Today, Tesla Coils are built by amateurs all over the world for one reason only, the thrill of making your very own Lightning!

basic schematic - classic spark gap coil

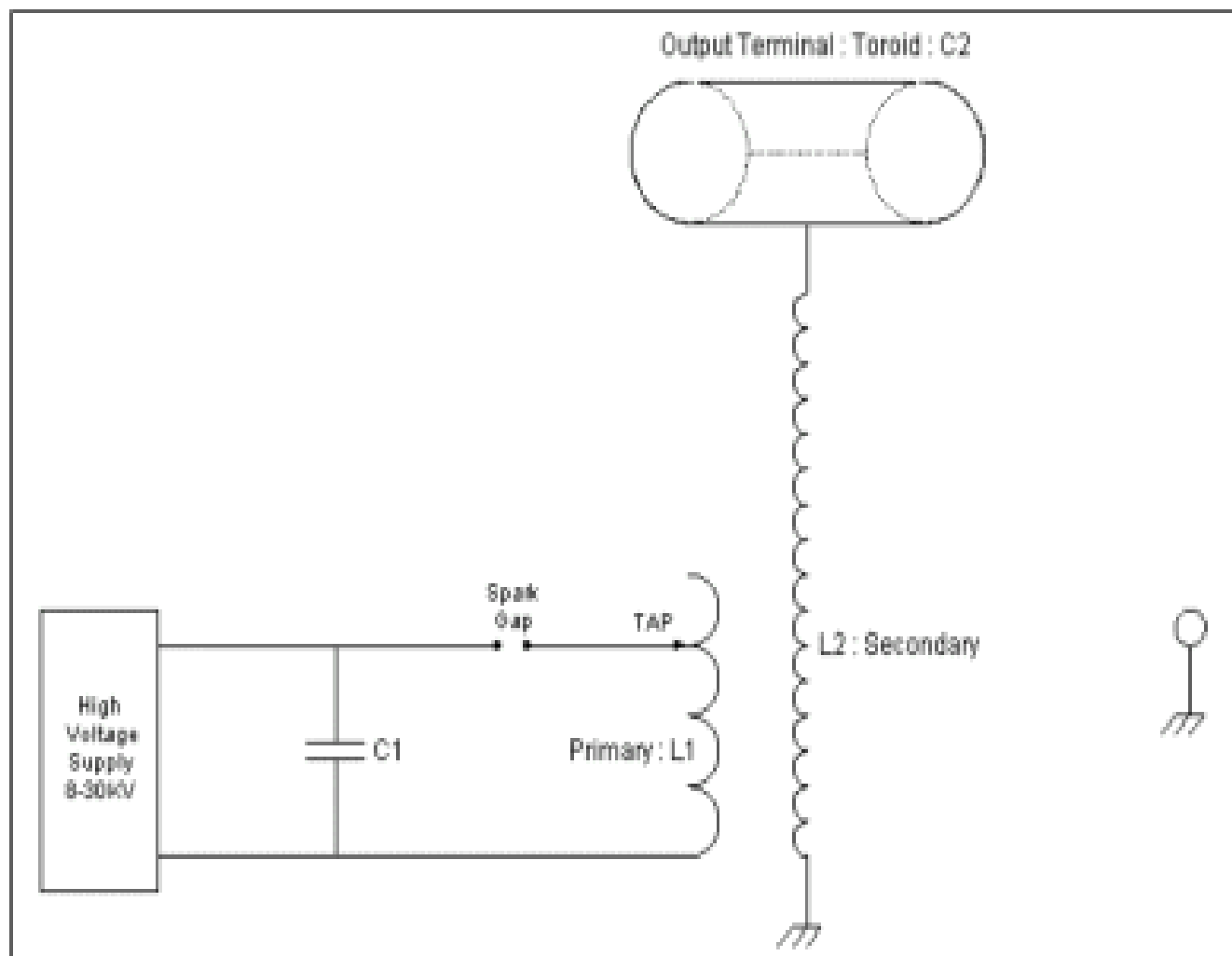




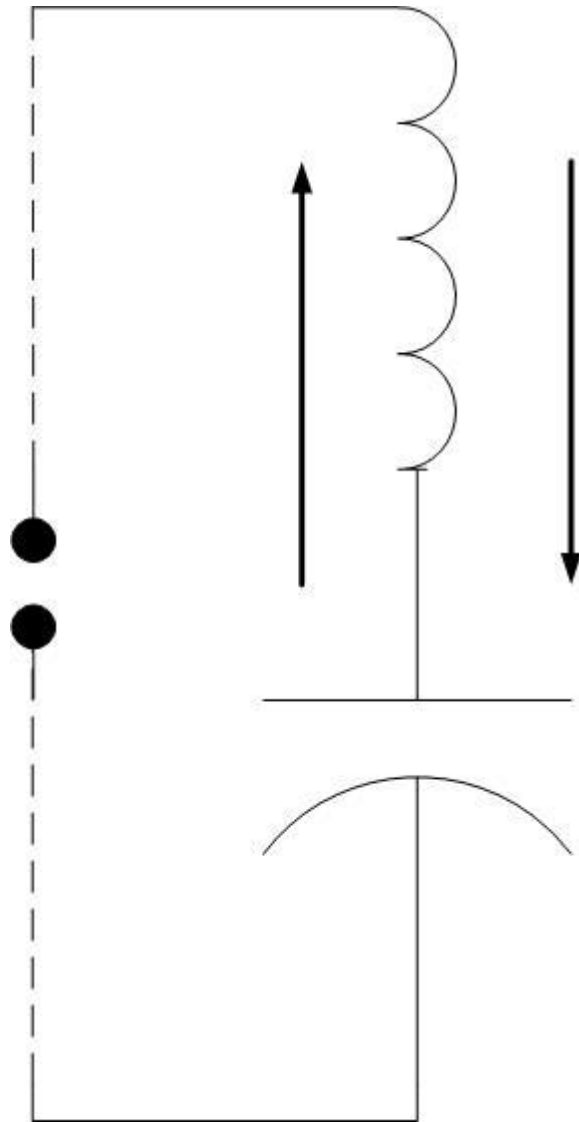


theory of operation

- . HV Transformer on AC Line produces 6KV to 15 KV at 30 to 120 milliamps.**
- . Spark gap rich in harmonics 100 to 400 Khz**
- . Primary Cap and Coil make resonant circuit.**
- . Energy coupled into secondary**
- . Series resonant circuit is long coil and top hat toroid.**
- . Toroid stores energy on large surface area.**



Series Resonant Circuit



HV transformer

- . NST 6KV/30; 12/30; 15/60; 15/120**
- . MOT. Can stack in Parallel**
- . Oil Burner**
- . Pole Pig. Needs current ballast.**

Four MOT Stack





Six MOTs





12/30, 15/30, 15/60, 7.5/60

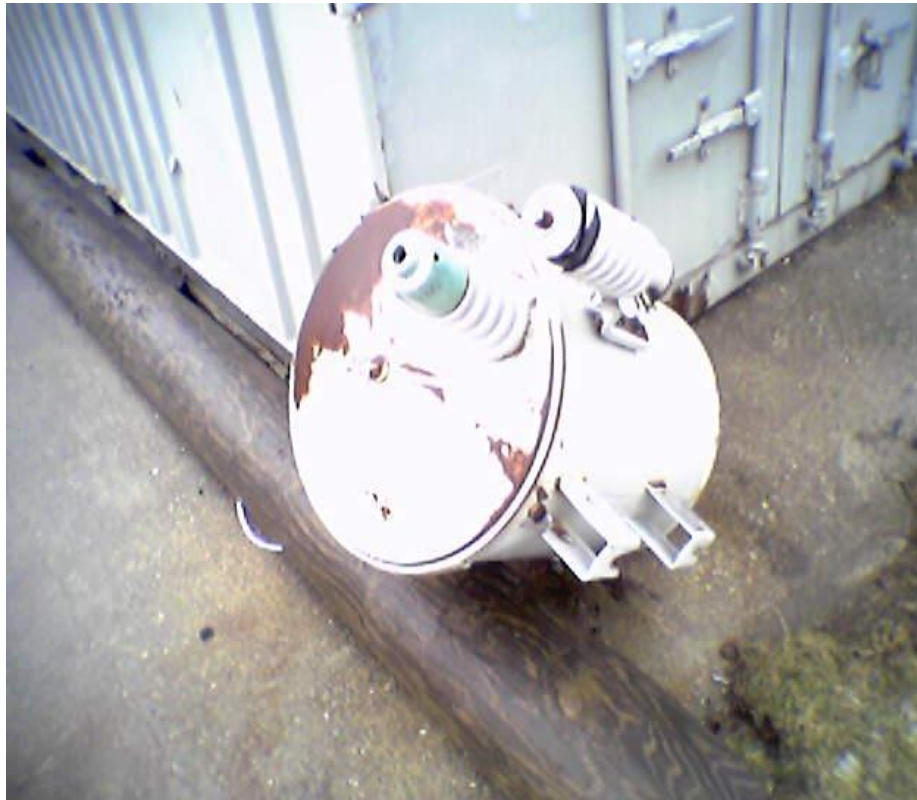


Neon Xfmr



Pole Pig

Discarded Pole Pig!



Primary Capacitor

- . 20 – 60 KV required. (~ 3.5 applied V)**
- . withstand high current pulses**
- . Heating. Immerse in oil.**
- . Rapid polarity reversals.**
- . glass plate caps**
- . rolled poly with foil**
- . stacks of commercial caps: MMC (multi miniature capacitor)**
- . Beer bottles with salt water.**
- . At 14.4 kV a good value would be 14 x .15 MFD 2 kV MMC ??**

Glass Plate Caps

- $C = .224 \frac{eA}{d}$ pico farads
- $e = 3.5$ to 8 for glass
- $A = 9'' \times 8'' = 72$
- $d = .25$ inch

- $C = 245 \text{ pf} = 0.245 \text{ nf}$
- Not much capacitance

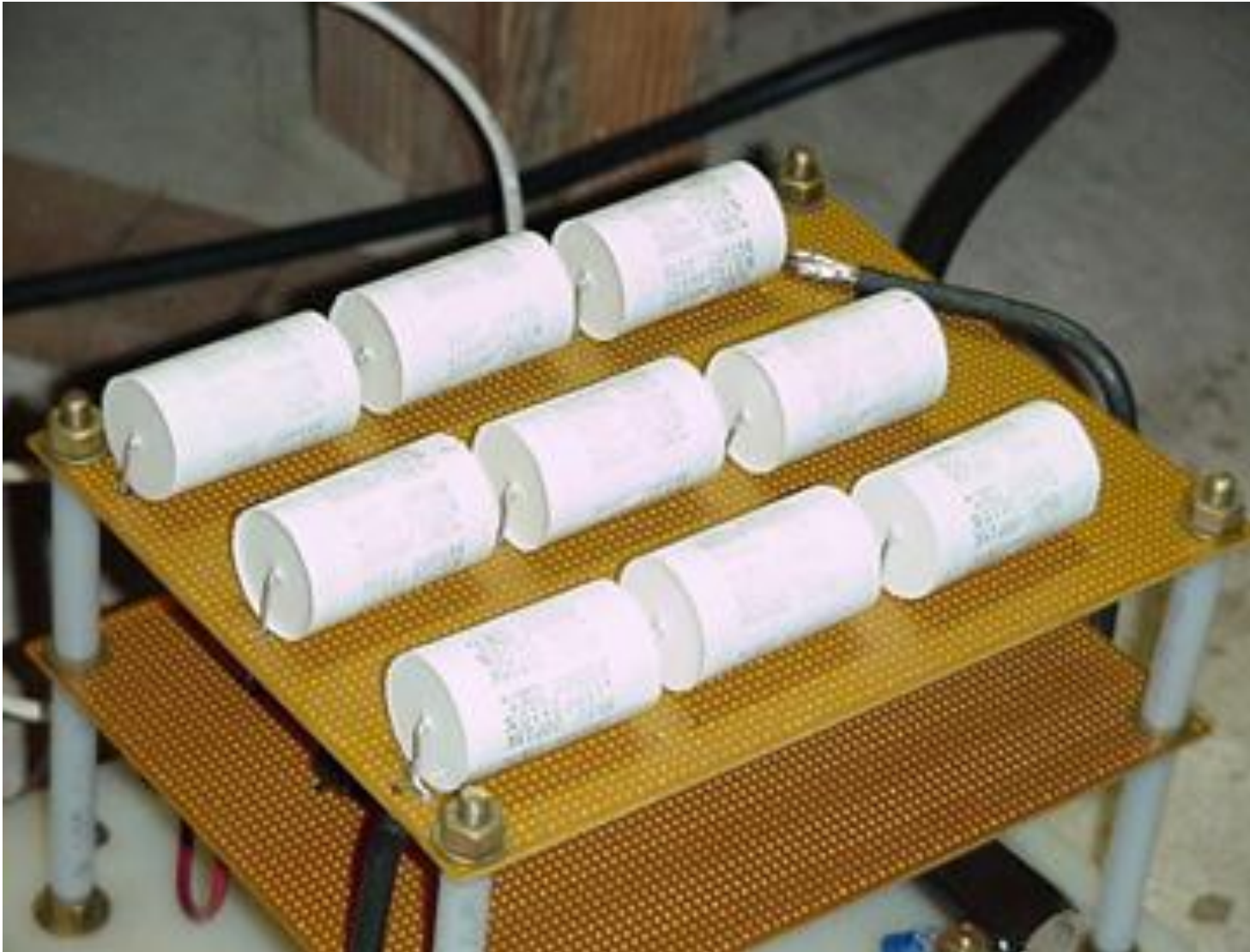
Beer Bottle Capacitor





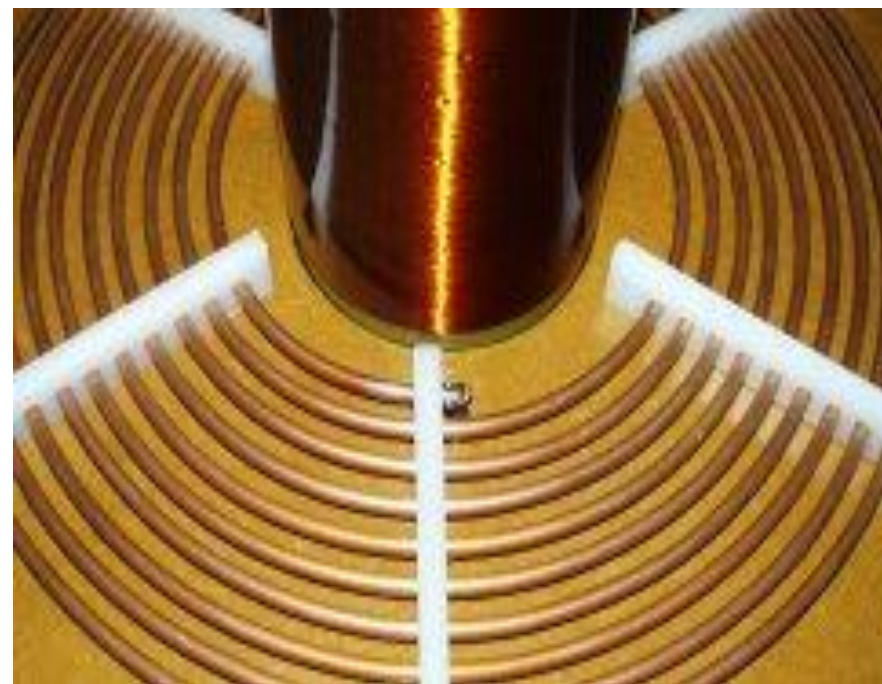
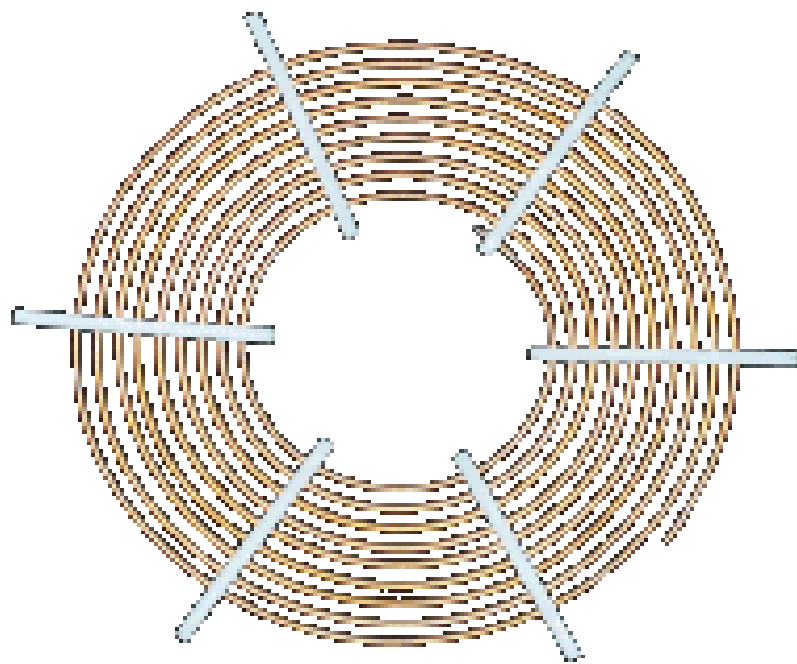
MMC Capacitor Bank

MMC Capacitors



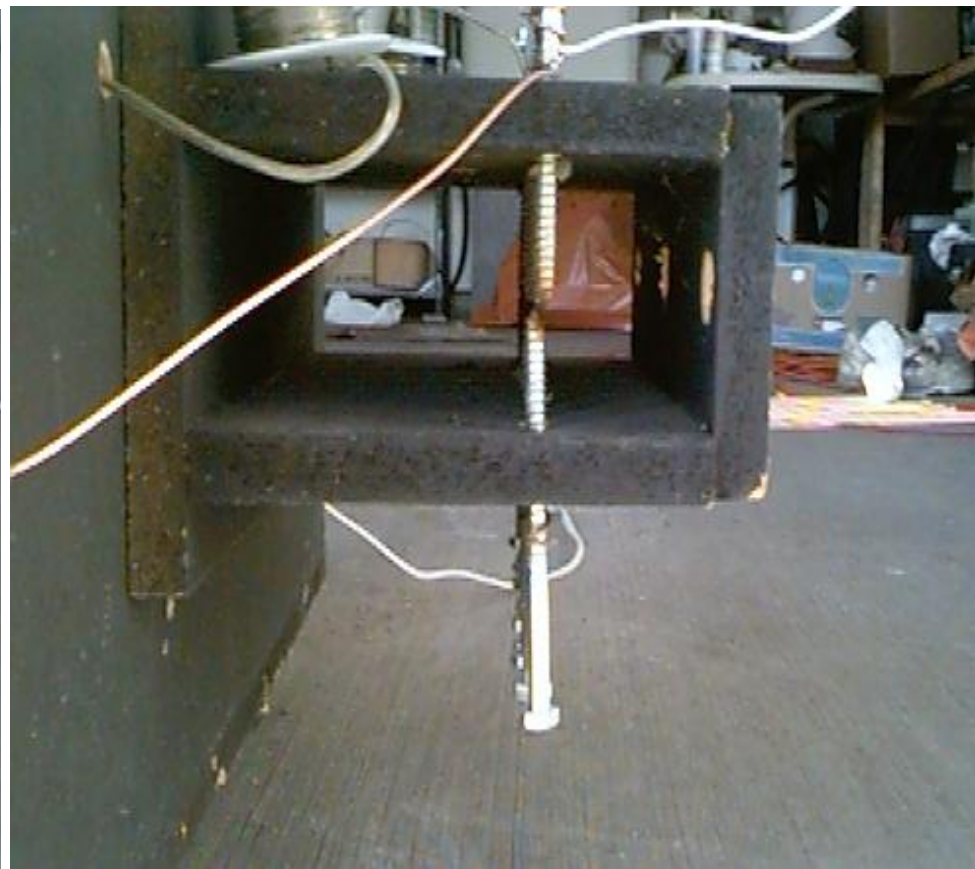
Primary coil

- . High circulating current. 100 Amps or more.***
- . flat coil, not cylinder***
- . 1/4 inch refrigerator tubing***
- . 10 Ga wire.***
- . various tap positions.***

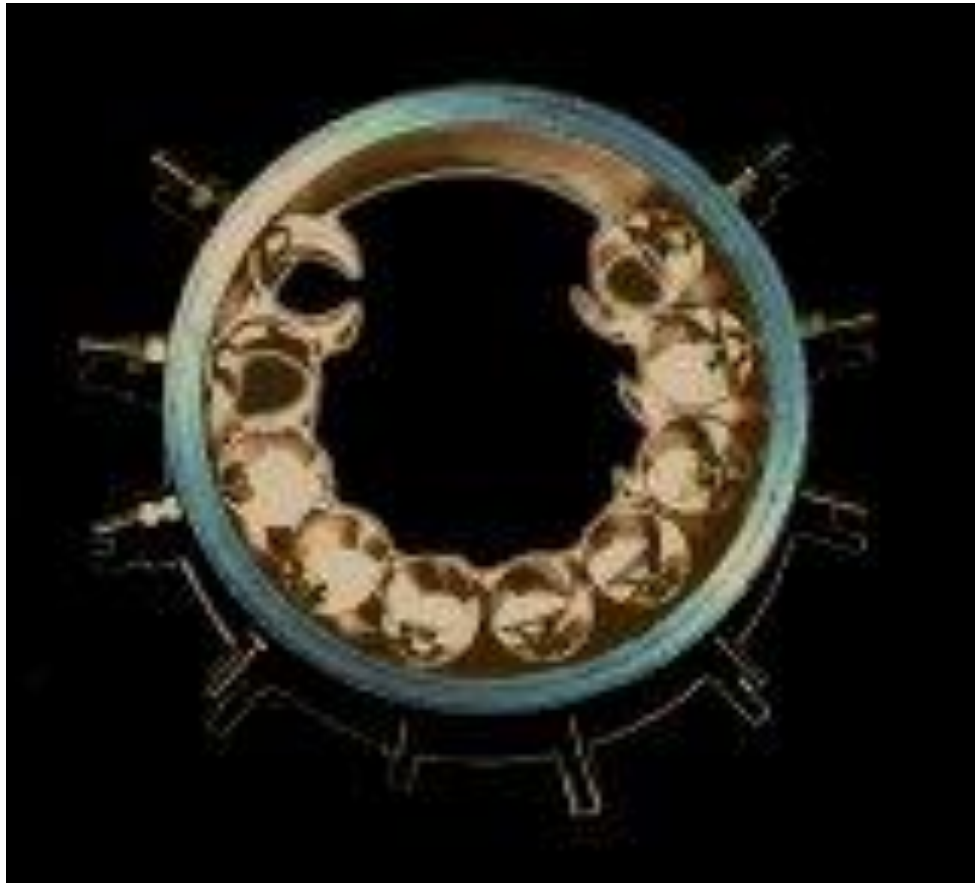


Spark gap

- . *high current***
- . *not too wide: .25 inch.***
- . *needs quenching***
- . *static:***
- . *2 carriage bolts***
- . *multiple copper tube gaps with blower***
- . *Rotary: sync or async***
- . *triggered gap***



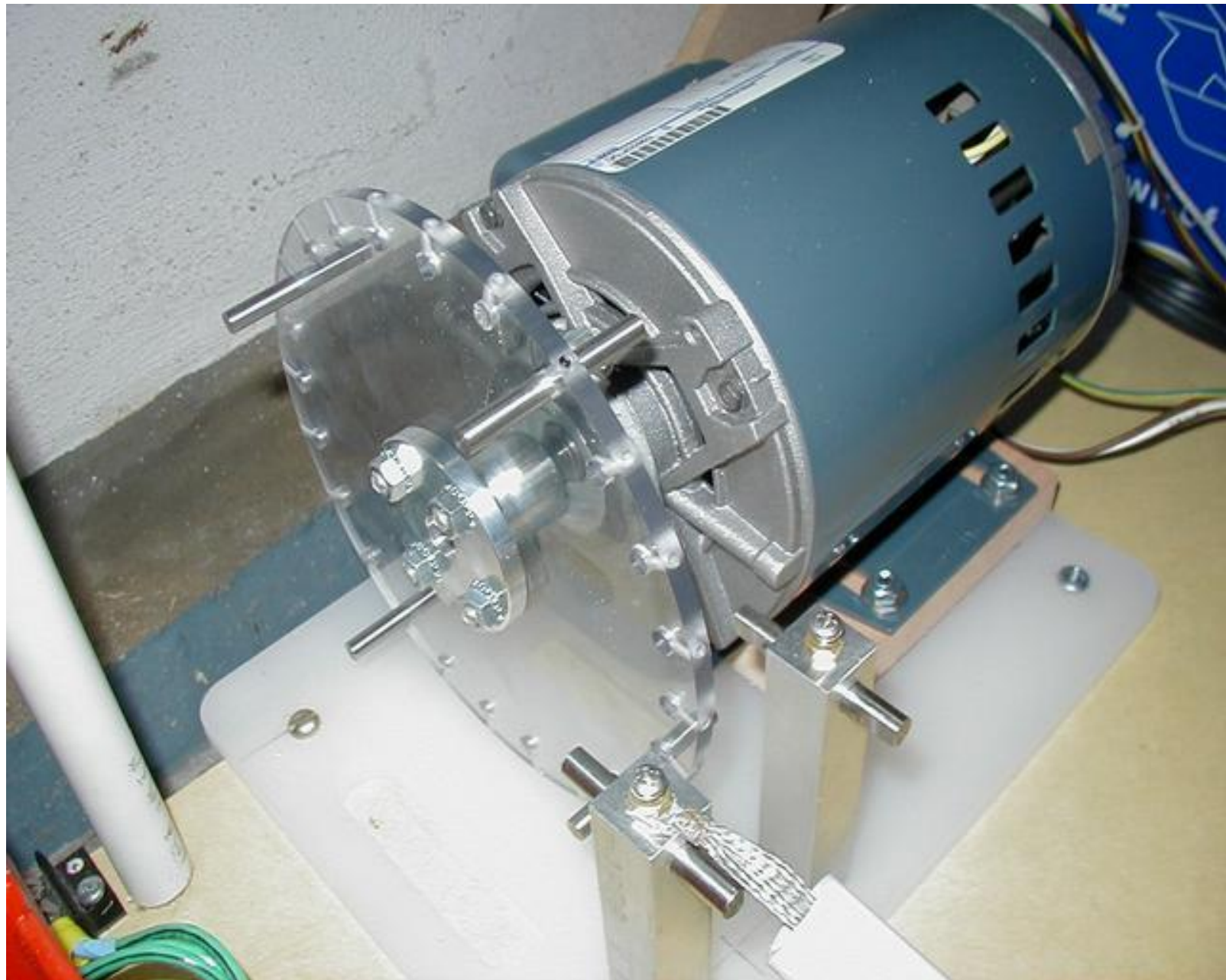




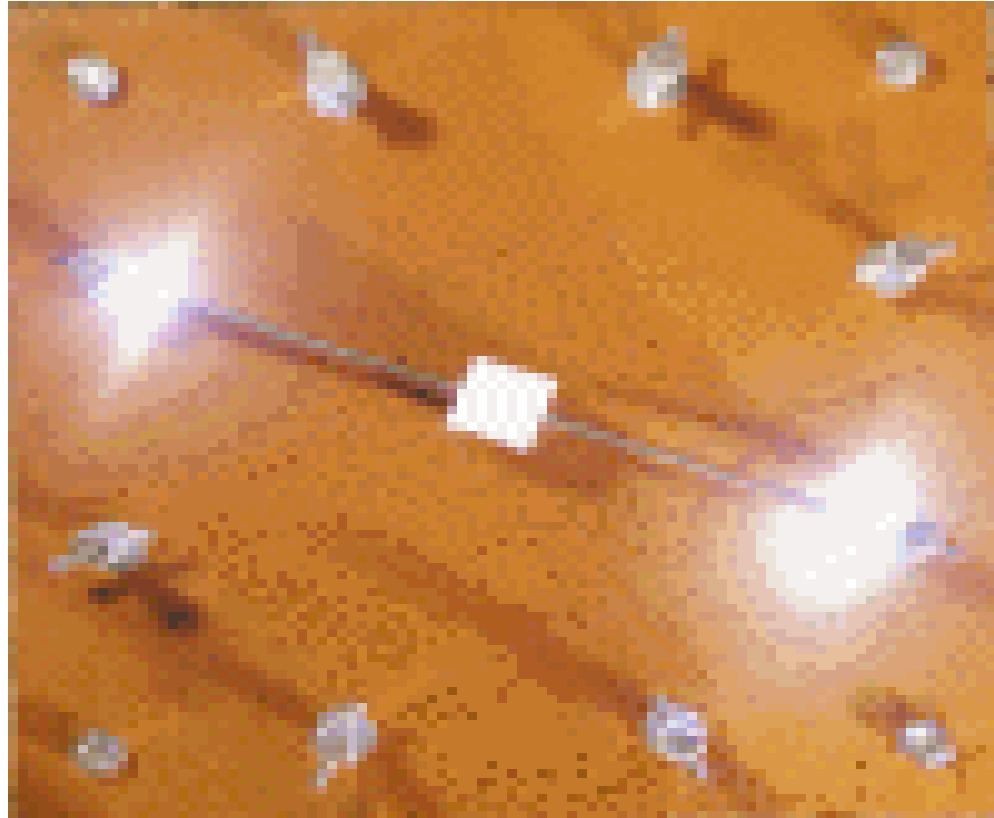
Multiple tap points



Synchronous Rotary Sparc Gap



Rotary Sparc Gap

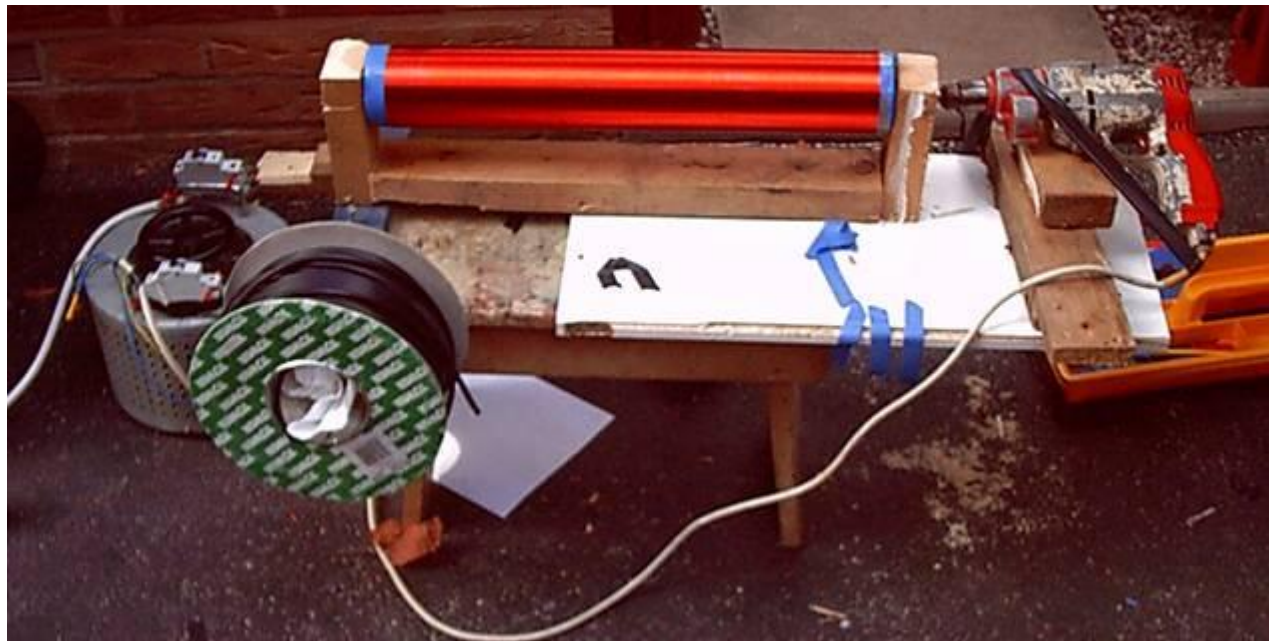


Magnetic Quenching



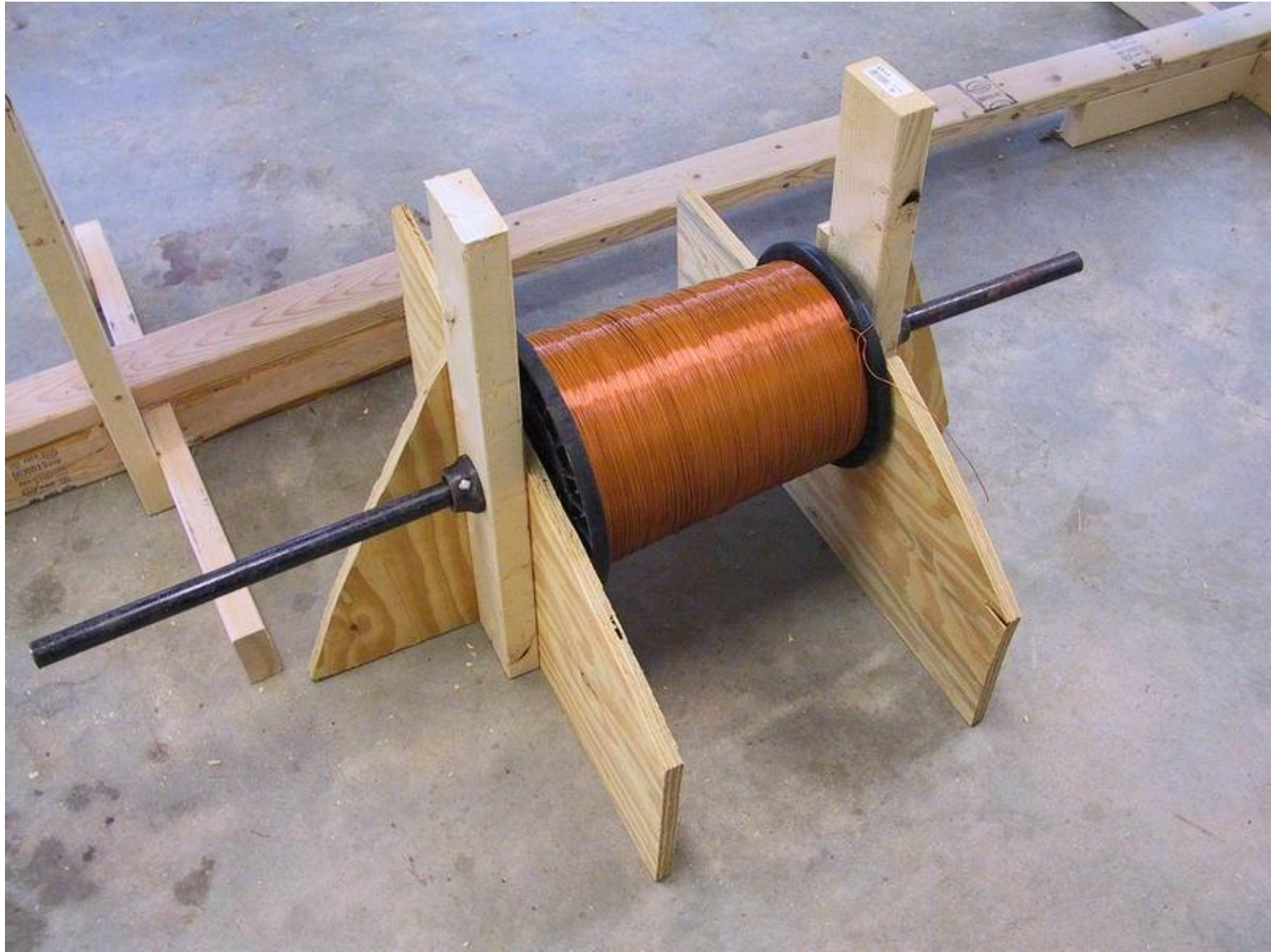
Secondary Coil

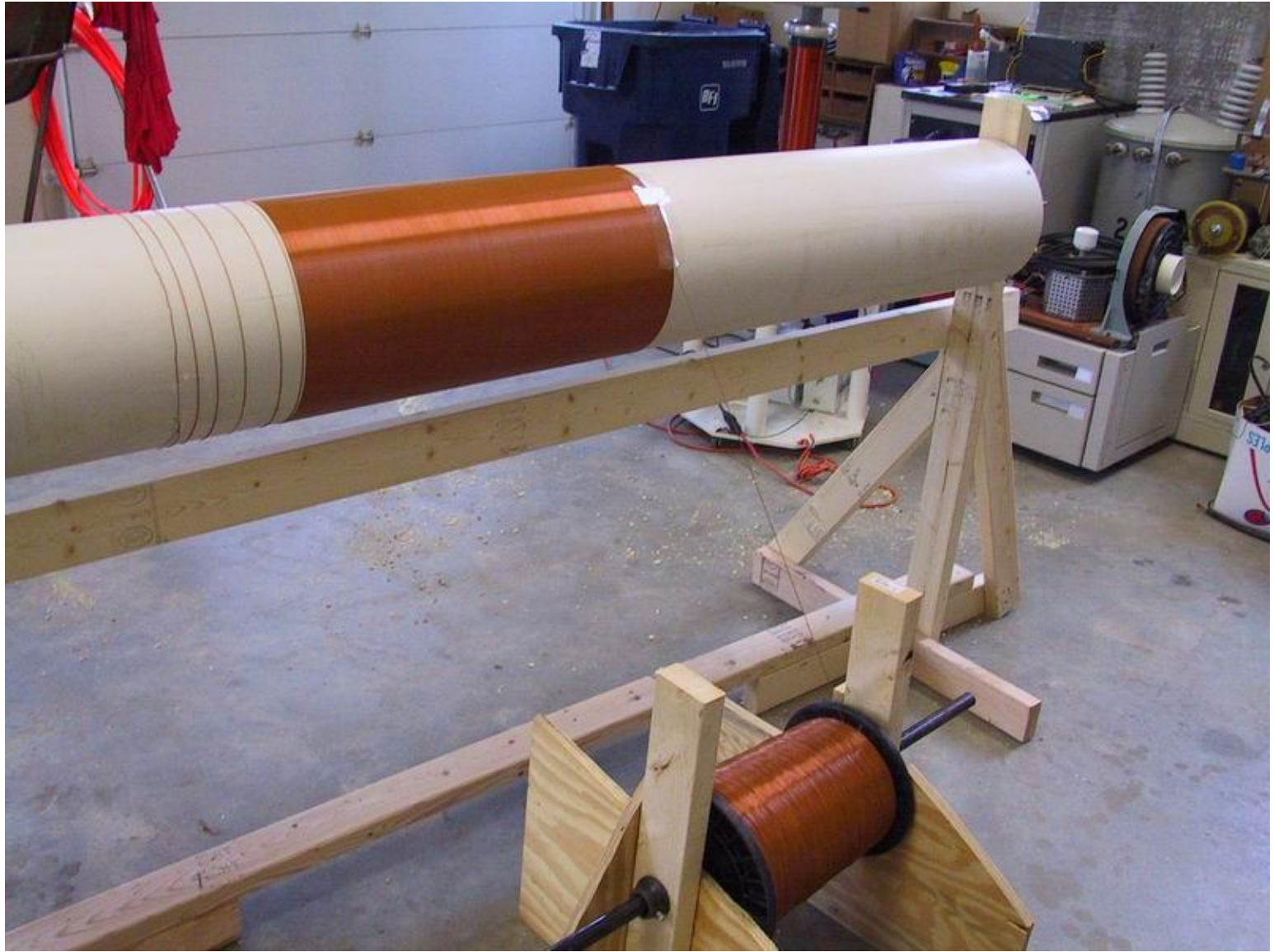
- . 1000 to 1300 turns of magnet wire (24g to 32g)***
- . PVC coil form . 3 to 8 inch diameter.***
- . 6:1 width to height***
- . Polyurethane first.***
- . Use a winding jig. very tedious.***
- . 3 finishing coats of poly. inside and out.***



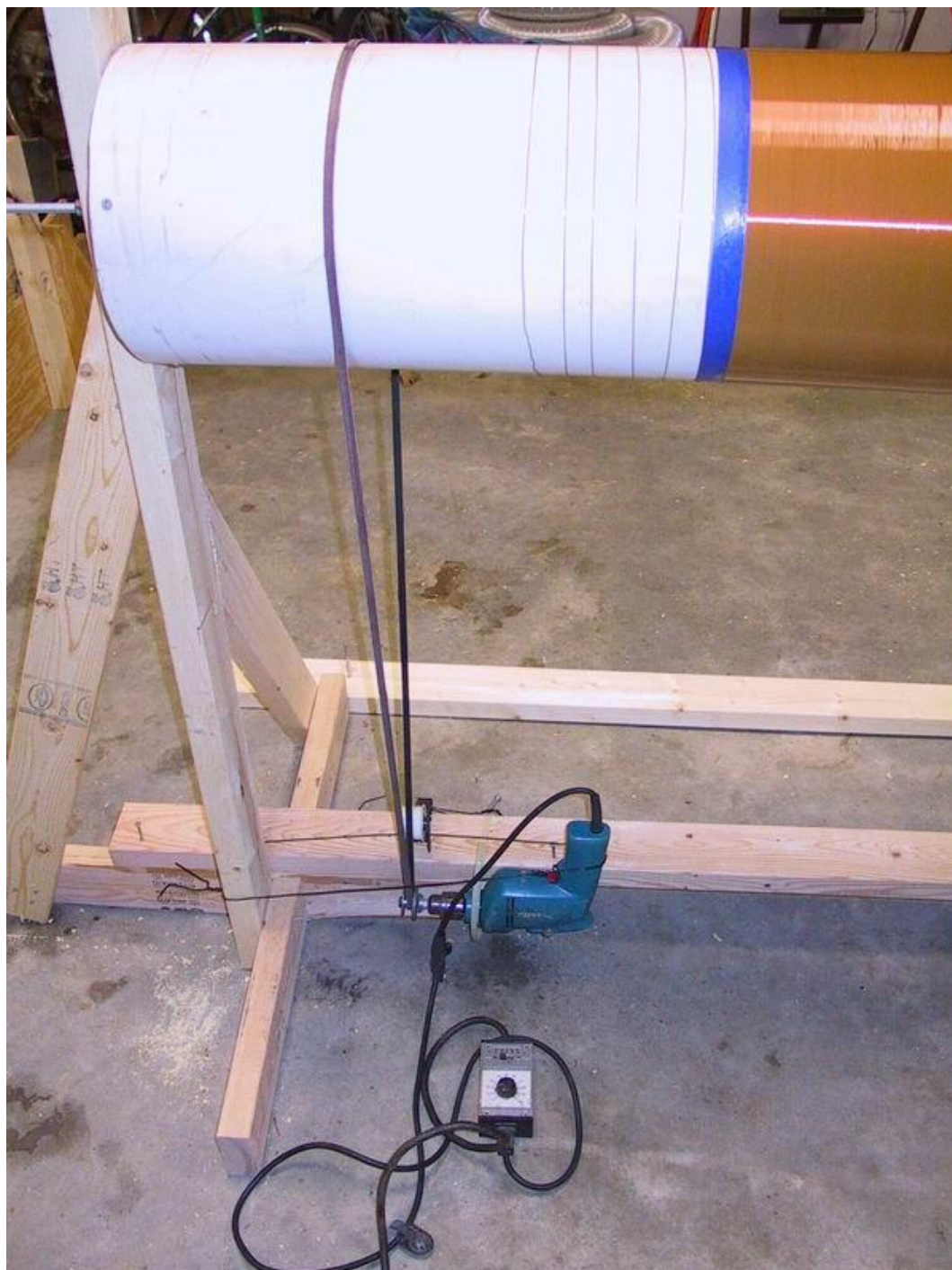












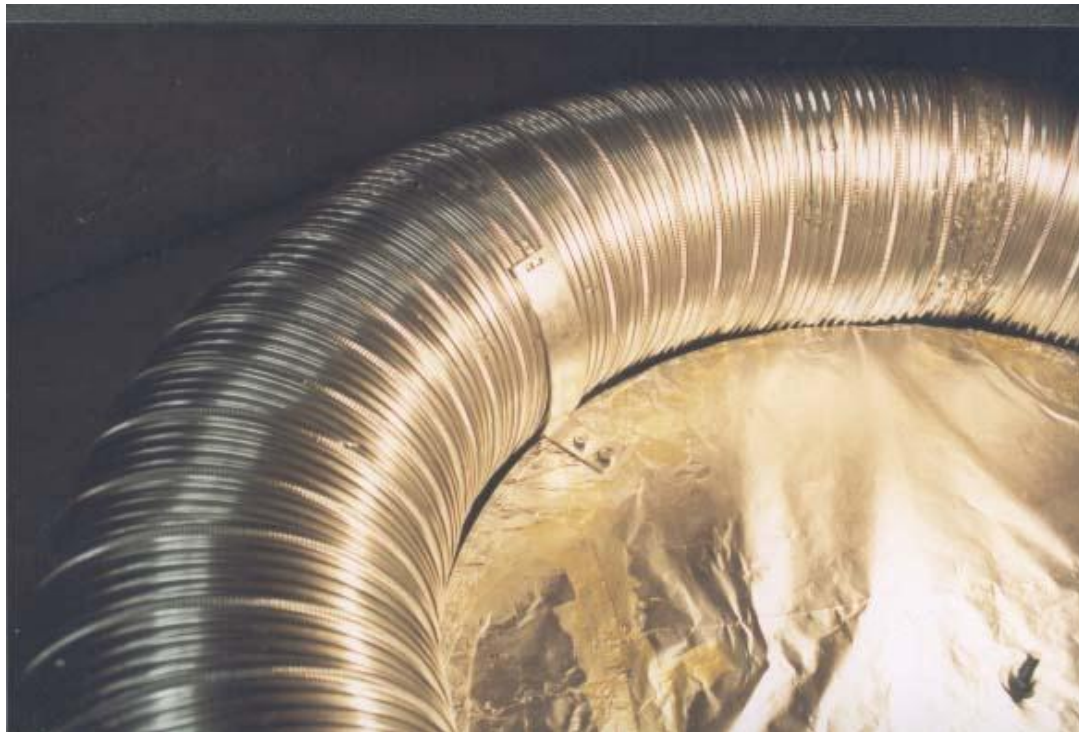
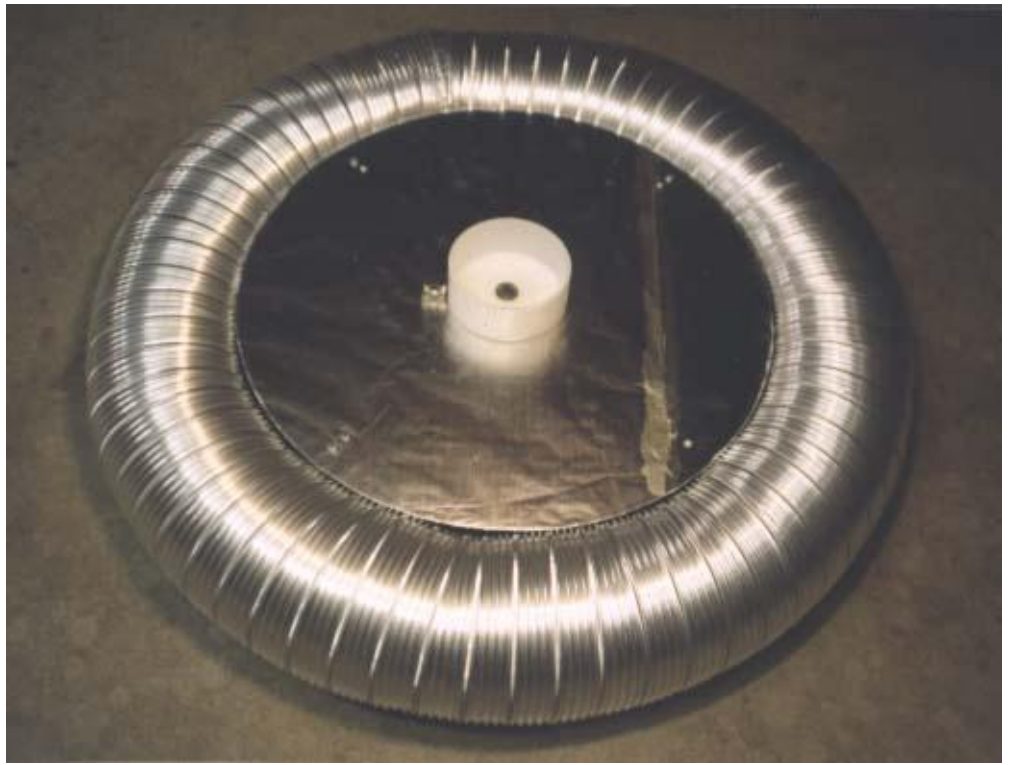


Capacitance Hat.

- . *A necessity***
- . *Toroid best***
- . *Sphere second best***
- . *stores energy on successive cycles.***
- . *can be too large or too small***
- . *made from dryer duct and aluminum tape***
- . *can buy spun aluminum toroids.***

Spun Aluminum Toroid



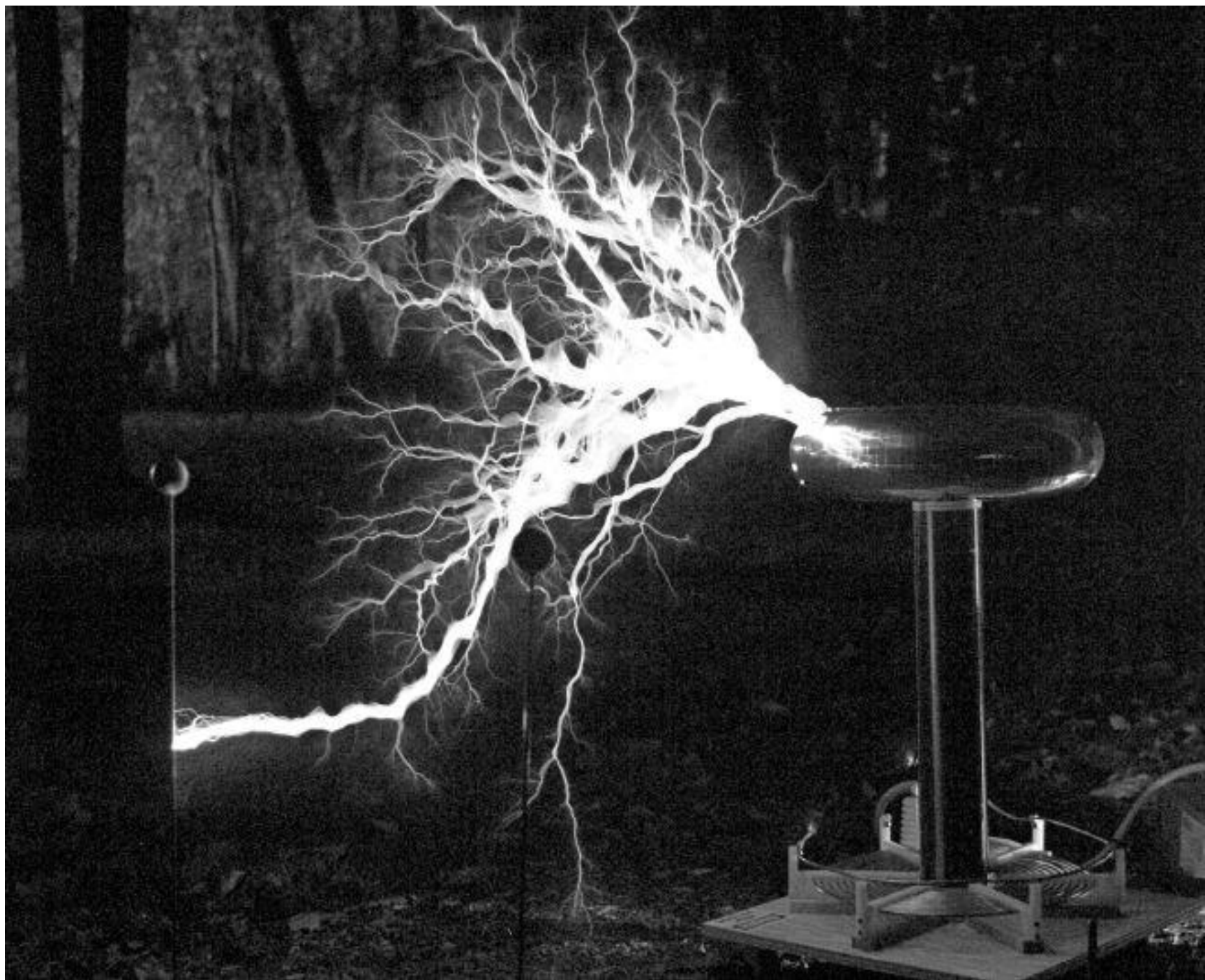


Pitfalls. Watch out for:

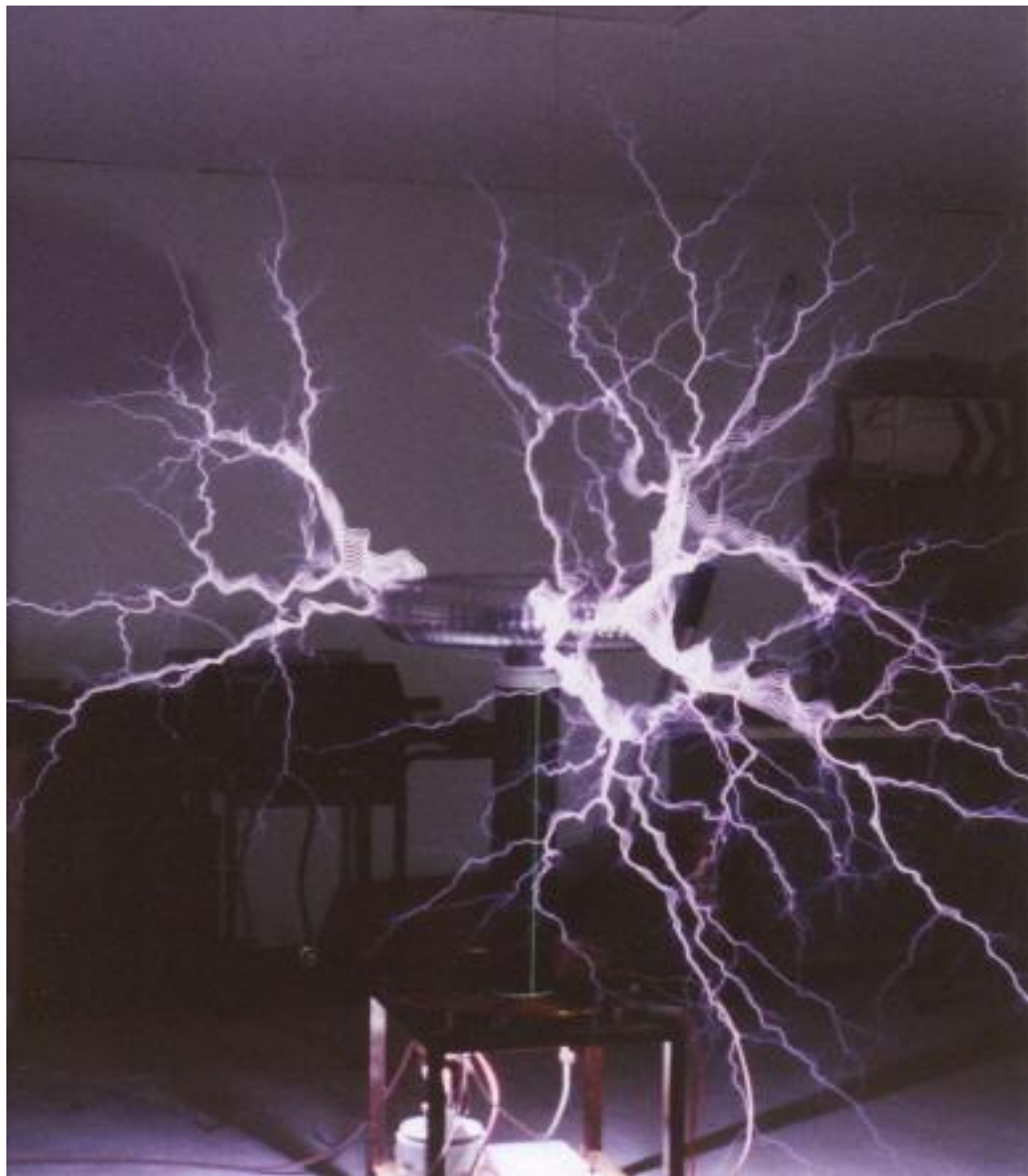
- *Series resonance with NST Secondary. Cap choice.*
- *GFI's in newer NSTs*
- *RF into NST Secondary. RC filters on both sides.*
- *RF hash into power lines. Use power line filter.*
- *power factor. correct with "run caps" on AC line.*
- *grounding:*
 - *110V AC ground*
 - *HV center tap*
 - *Secondary coil RF*
- *errant sparks. use strike rail, spacers on secondary.*
- *higher toroid.*

Pictures!

















Faraday Cage



KB2IRH in the Cage



Electrum Project

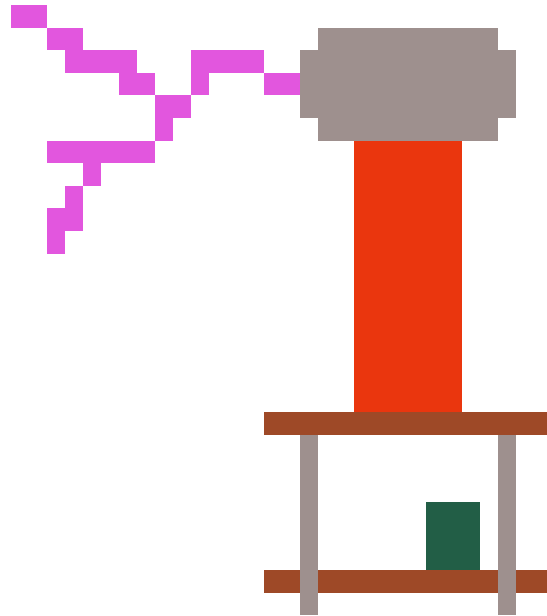


**Electrum at the Lightning On Demand test site in 1998.
G. Leyh is taking waveform measurements inside the sphere.
(Photo by A.R. Donaldson)**



The End

Pat Masterson KE2LJ



Now to the Demo..