Trashy Tesla Coil

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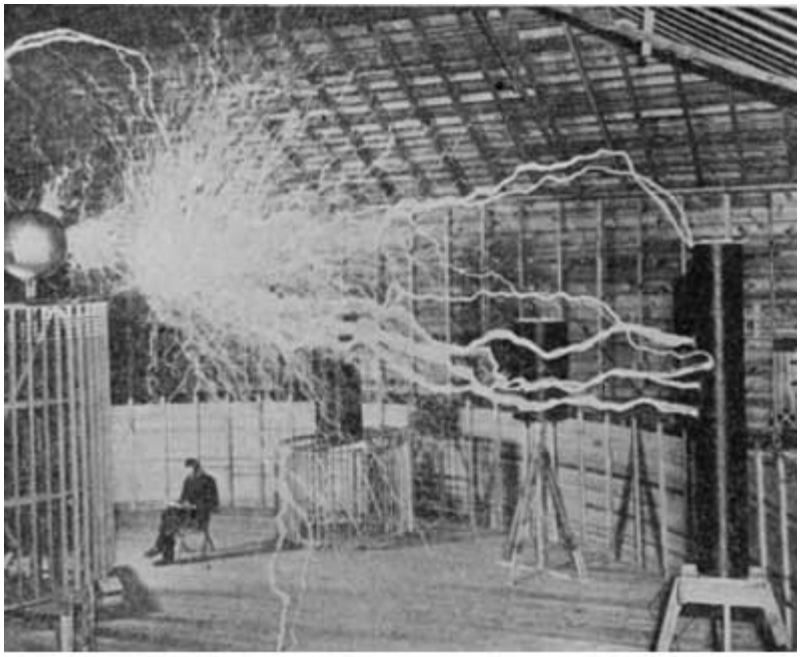


Tesla's Colorado Springs Laboratory in 1899.

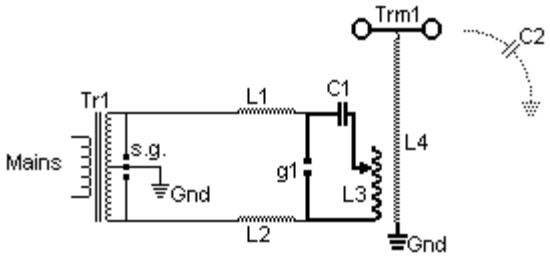
Link to Homepage and index

A Trashy Introduction

So you still don't believe that people throw away tons of good stuff you can use to have some fun. To prove it to you, I've decided to make a Tesla Coil from only stuff I've found in the garbage. I will include a detailed list of all components used and where/what they came from.

Tesla Coil Basics

I'm not going to go into great detail of how these things work, because at least at this time I don't consider myself much of an expert on the subject. From what I have read, the tesla coil uses resonant conditions to boost say 10,000 volts to a million volts or so. The weird thing is that the output voltage is not really dependent on the coil turn ratio like conventional transformers are. This resonant condition is kinda like pushing a kid on a swing. If you give the kid a little kick at the right moment, e'll go a little higher. The tank circuit of the primary inductor and capacitor resonates at a fixed frequency depending on the inductance and capacitance values. This frequency of oscillation is inversely proportional to the product of the inductance and capacitance. To make things work, our primary side has a large capacitance and a small inductance. To match the same frequency, our secondary has a small capacitance (torroid) and a large inductance (coil). To further complicate the idea, power is fed to the primary coil at the same resonant frequency. The high frequency power is supplied by charging the capacitor until it reaches a voltage sufficient to breakdown air across a spark gap and the spark gap distance is adjusted so that the correct frequency is attained. Here



is a diagram of the circuitry. The mains are typically 120 VAC and Tr1 boots it up to about 10,000 V at several mA. S.G. is some safety gap thing (pirated this figure from some other website), L1 and L2 are high frequency chokes, g1 is the spark gap, C1 is the primary capacitor bank and L3 is the primary inductor. L4 is the secondary coil and Trm1 is the torriod or secondary capacitor. Since all of the parts involved operate at such high voltage, it is almost necessary to build them (unless you want to spend big dollars). Luckily, the components involved in the Tesla Coil are all pretty simple and can be made from everyday junk as I hope to show.

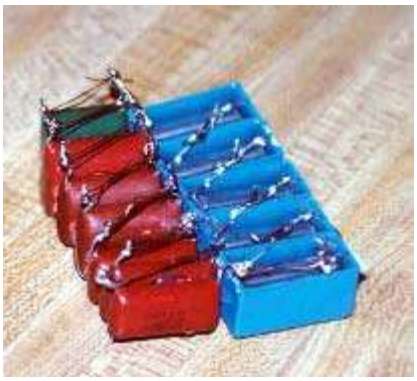
Primary Power Source

Dumpster List: Small Neon Sign Transformer

From what I've read in the library (I'm starting to read on my own now) the typical primary power supply is anywhere from 5,000-10,000 V at 30-100 mA. If I were going to go buy a power source, I would check ebay or a University surplus store or just steal one (just kidding Gillian) from a university. Universities use this kind of stuff to power lasers and all kinds of equipment. Of course the higher the voltage and the higher the current the better, a general rule of philosophy. But, with a budget of zero dollars, my choices are a bit restricted. The best I can do, at least for now, is to use a neon sign transformer I found in a Frat house dumpster back in Iowa. This little guy produces 7,500 V at 30 mA. A bit weak for a tesla coil, so I'll keep looking around. But, since it takes less than 30 milliamps ta kill ya, you should be real careful like me when you're messing around with this stuff.

Discharge Capacitor

Dumpster list: High Voltage Television Capacitors



There seem to be two main options for the capacitor bank. Due to the extremely high voltages involved, it's either going to take some serious scrounging to find suitable capacitors, or I could make my own. I have read several websites and such on how to make HV capacitors from polyethylene sheets and aluminum foil. Aluminum foil is commonly found (in the trash) but the PE sheets may prove to be a bit difficult. So I've opted to find several relatively high voltage capacitors and link them together in series so that the voltage across each capacitor is the total voltage divided by the number of capacitors (that is if the capacitance of each capacitor is the same). This means that I'm going to have to find a good source of high voltage caps. First I tried HV microwave capacitors but ran into trouble. These guys were too big for the 30 mA neon sign power supply and wouldn't charge fast enough to work with the 60 Hz cycle of the wall outlet. So then I used a bunch of television capacitors (the ceramic ones that have leads that are really far apart) which, seemed to work pretty well. Sometimes one of the capacitors will blow up or just smoke a lot, but if everything worked well it wouldn't be as fun to make.

Spark Gap

Dumpster list: Pair of 1/4" Boltz and Nutz

In order for a Tesla Coil to operate effectively, some thought must be put into the spark gap. The simplest spark gap would be to have two finely threaded screws as electrodes, with the spark gap distance being adjustable. The problem with simple spark gaps is this: once the air between the gap has been ionized with the arc, the resistance of the gap is reduced partially due to the increase in air temperature, allowing the frequency of the system to fluctuate. This is not good. To reduce this effect, it is desired to "quench" or cool the spark gap. There are several ways to accomplish this task. One way is to have multiple spark gaps, say a half dozen or so in series. This helps keep the temperature of each gap at a minimum. You could also blow compressed air or have a fan directed at the gap to quench the spark. Another method is to use a rotary spark gap. The frequency of the spark is then controlled by rotating electrodes mounted on a variable speed motor. This is the method that I chose to start with. After I'd invested some serious time into this method and built a variable speed motor control, I scrapped this idea because I could never get the motor to spin fast enough that the system would not arc and burn in places I didn't want it to. So now I'm going with a simple design consisting of two quarter inch bolts with nuts glued to a plastic box from a gyroscope (spinning toy). Although it's not going to dissipate much heat, it shouldn't get real hot cause the neon sign power supply is kinda wimpy.

Primary Coil

Dumpster list: Lamp Shade and Humidifier Cord

The day I got my new bike from the store (my last bike came from a dumpster and the brakes didn't work) I wanted something to do so I could drive my new bike around, so I went scrounging around at Stanford in EV. What a wonderful day that was! I had spent a lot of time thinking (yes, thinking) on something I could use for a primary form or base. On this cool California day I ran across a small lampshade that someone didn't love anymore :(so I grabbed it for myself. A few minutes later I came across a fan with a nice long cord beside the dumpster but I left it for the less enthusiastic dumpster diver, it's kinda like stealing candy from babies. I wanted something I had to dig for! So I dug, and dug, and found me a nice humidifier with a pretty good cord on it. So my primary coil was ready to be constructed, just a lampshade, some outlet cord and some hot glue and I was in business. It has cuts through the insulation about every half turn so that I can adjust the inductance of the circuit by not using part of the coil.

Secondary Coil

Dumpster list: Plastic Wrap Tube and Microwave fan motor Wire

The first thing I picked up for the secondary form was an empty (dang it!) can of pringles. I hauled this around in my

bag until I ran across a nice heavy duty cardboard tube that came from one of those industrial sized plastic wrap dispensers. Next to be found is the enamel-coated wire for the secondary. With previous experience in finding hundreds of feet of high quality wire, I headed back for the dumpsters. An excellent source of such wire are microwave cooling fans. They are easily removable but the wire is a bit tricky to get at. On such fans, the wire is wound on a coil around a squarish coupling made of iron sheets. You can remove a few of the laminated iron sheets with a small flat screw driver and a hammer. After several of these sheets are removed, the entire coil of wire can be dislodged leaving you with a hundred feet or so of nice wire. Winding the coil can be a bit time consuming but if you're good you can think of a way to make it easier. I couldn't so I wound it by hand and it took a real long time. One microwave fan motor spool made about 7 inches of coil on the plastic wrap tube.

Secondary Grounding

Properly grounding the secondary is VERY VERY important. Do NOT use the regular ground for your house outlets. The ground must be separate to prevent a high voltage/low current streamer from allowing a low resistance path to house ground for the high current primary. You should consult other web-sites about this (not sure if many talk about it) because it is very important. You need to pound a long metal spike into the ground somewhere and use that for your secondary ground potential. Improperly grounding could lead to health hazards (none of you care or you wouldn't even read this site of course) but also very importantly, anything plugged into your house outlets will be at risk for overvoltage/failure. So kiss your nice fancy CD player and Wagner's mom's 25,000 Watt dildoe charging station goodbye!

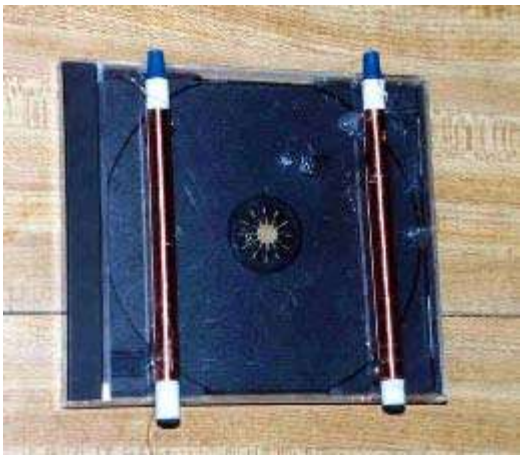
Torroid

Dumpster list: Stovetop Grease Catcher Thingys

The torroid increases the capacitance on the secondary side of the coil. The way this capacitor works: The secondary voltage is so high that you only need one conductive surface, the torroid itself! The insulation is the air and the other "plate" is ground. It's ok if you don't get it Kurtz. I'll explain it to you sometime in simple terms that even you can understand. Oh boy do I love Saturday! A great day for sleeping in, not showering and digging through the trash in EV. Almost to the end of my dumpster route, came across a stove range-top. I immediately set my eyes on the shiny stove grease catchers. A quick flip and an instant torriod! So now I have two sizes of torroids cause this range-top has small burners and large burners. These particular grease catchers weren't too grimy but since you flip them over, you only see the bottom of them anyways.

Chokes

Dumpster list: Bic Pens and Motor Wire



In order to keep the high frequency pulses created by the spark gap from really messing up or ruining the power supply, chokes are installed to "filter out" this high frequency noise. Chokes are simple inductors and I chose to make mine out of blue bic pens that I found on the ground. I do recommend blue bic pens because blue is better than other colors of bic pens. The wire I used came from an electromagnet that I got from the steering system of an RC car I found in a dumpster at a poorly guarded construction site. Don't have any idea why the heck it was in there. You could also use wire from a microwave fan. The wire was wound by putting the end of the bic pen in a cordless drill and spinning it down. It worked quite well. And that's a nice CD case, huh? Well that didn't come from a dumpster, it's Gillian's.

Tuning: Considerations of Design

In order to properly design a tuned tesla coil, you need to do all kinds of math and hard things with numbers, nuff said.

The Final Cabob, This is One Trashy Tesla

And here is a photo after the torroid was put on. That hunk of dumpster aluminum foil the spark is flying to is connected to ground. What? you don't think I'm anal enough to get aluminum foil from the trash? Well give me your address and I'll let you smell the fish stick chunks that were left on it! An interesting event happened while testing out the trashy tesla after installing the torroid. For some funky reason every time I switched on the power, the sprinkler system in the yard turned on. I'm not kidding here. The yard gets watered every time I fire it up. This thing puts out such a large electric field that anything electronic in the area goes wacko.

Ere are some more cool photos after a bit more tuning!





This last one is me holding up a small fluorescent light bulb, not attached to ground or anything! Now the sparks are flying over four inches. According to this chart I have relating the voltage to spark gap distance (It's off the scale now), the voltage of this trashy telsa exceeds 250,000 Volts!

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