TeslaStuff

Complete Plans for a Quality 4 inch diameter Tesla Coil

TeslaStuff is a division of Rainy Lake Electronics

Safety First!

The high voltages and currents associated with Tesla Coils can cause injury and death. Do not touch any part of the unit while it is plugged in. Keep a ABC type fire extinguisher accessible

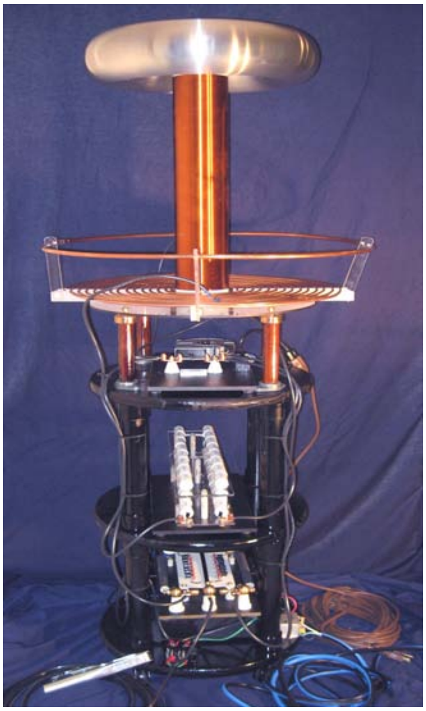
Tesla Coils and Pacemakers do not mix! Please inform all people in the area where the unit will be operated.
In addition, try and operate the unit as far away as possible from sensitive electronics ie, computers, TV's etc.

Do not look directly at the spark gap when it is firing without eye protection (welding goggles). The spark gap generates intense UV light.

Tesla Coils generate a significant amount of ozone. Use in a well ventilated area and keep the run times short.

Congratulations and Welcome to Coiling!

The following is an excellent design for medium size Tesla Coil, capable of 30 inch to 52 inch streamers (sparks), depending on the neon transformer and tank capacitor bank used. I have built and sold the component parts for this coil for several years and made adjustments along the way to increase performance and simplify the construction process.



Be sure and study the attached safety sheet. The combination of high voltage and current stored in the capacitor bank can be a lethal one. While there is a lot of great coil building information on the internet, the step by step plans available are mostly outdated and (or) underperforming.

This Tesla Coil is based on my "Fast Start Package" available on my website, www.TeslaStuff.com . While of course I would be grateful for any and all parts you purchase from me, I provide all the information necessary to "roll your own secondary coil" and I give you the exact specifications of all components so you can source them from wherever you wish. As you go through the construction process and have a question or a problem, I am happy to help. My email address is Alan@TeslaStuff.com . So, let's get started!

Tools, Skills, Study and Parts Needed

Tools

For the most part, tools that most folks have around the house, are all that is needed, basic hand tools, tubing cutter, hot glue gun, drill, saber saw etc. If you happen to be a wood or metal worker, so much the better. A drill press, band saw, table saw, chop saw, lathe, router and the like, can make your project go more quickly and look more professional. As for the electrical end of things, must haves are a soldering iron (for fine pc board work), terminal crimpers, a VOM (volt ohm meter) and basic electrical tools (side cutters, needle nose pliers etc.). Optional are an Oscilloscope, “L” meter, signal generator and frequency counter.

Skills

Proficiency with basic hand tools and a power drill. Any other expertise is a plus. You will need to be proficient with soldering iron for the pc board work with the MMC and “Terry Filter”. If you have not soldered before, I recommend and hour or two of practice before attempting the actual filter construction.

Study

The understanding of Tesla Coil operation is an integral part of the construction process. While you don’t need to become an Electrical Engineer, a basic understanding of Tesla Coil operation will improve your overall experience and enjoyment of the process and is a major step in insuring your safety. A good place to start is the three coil building links on my website, www.TeslaStuff.com .

Component Parts

The Base

While technically not part of the operating Tesla Coil, in practical terms you need something to support the Primary and Secondary Coils, Spark Gap, Terry Filter and the very heavy transformer. Of course, you are welcome to use what ever base you wish. Having tried many different approaches, listed in the following pages is a base that is very easy to construct, allows ample room for the needed components (and later upgrades), is very strong, uses ball bearing rollers for easy movement, positions the coil at a nice height for a good display and is relatively inexpensive (about $75 from the local home center, see picture). I also recommend using an 18 inch Lexan circle supported by four 7 inch ceramic standoffs to mount the actual primary and secondary coils on (the standoffs and Lexan are included in my fast package).

Components Needed to Build the Actual Tesla Coil

-50 feet of ¼ inch od copper water or refrigeration tubing
-Plastic material to make the support combs for the primary coil (Lexan, polypropylene (cutting board material), phenolic, fiberglass, acrylic (hard to work with), etc.
-A 4 inch x 22 inch piece of PVC pipe. I like schedule 35 for a nice combination of not being to thick, but yet sturdy. It also adapts well to the end caps I am going to suggest.
-One flat top end cap for 4 inch PCV pipe and one 3 inch flat top end cap for PVC (it will be sanded down to fit inside the 4 inch PVC for the bottom end cap.
-24, 25 or 26 awg HAPT 2 (heavy coated) magnet wire to wind the secondary, get approximately 1500 feet or about 2 pounds. For our purposes, we will be using 26 awg wire.
-Dolph's AC-43 to coat the secondary. While it does not have as good electrical properties, clear spray oil based enamel can also be used. I don't like poly based coatings as they tend to yellow over time..
-Three ¼ -20 x 1 ½ inch long nylon pan head bolts.
-Two ¼- 20 x 1 ½ inch long brass pan head bolts with matching nuts and washers.
-One 3 inch x 12 inch spun aluminum toroid.
-One 12kV 30ma neon sign transformer, old style with no GFCI protection. (at the end of these plans are options and specifications for using transformers with different voltage and current ratings)
-One 20 amp, 250 volt (minimum) RFI/EMI line filter
-Components for making a "Terry Filter" (exact list is on the attached Terry Filter construction diagram)
-One approx 5 inch x 7 inch pc board to use for the construction of the Terry Filter (note, this needs to be perf board with no copper cladding)

-Sixteen of the Cornell Dubillier 942C20P15K or 942C20P15K-F capacitors.
-Sixteen ½ watt 10 Meg ohm bleed resistors for the above.
-One pc board to mount the above 942 capacitors to. No copper cladding can be present and it should be a heavy well made board as these capacitors are heavy.
-Spark gap components. I recommend a basic gap with two tungsten rods with copper holders quenched with a fan to get the Tesla Coil "dialed in". Optional spark gap upgrades will be discussed later.
-Heat resistant base to mount the spark gap on and/or the use of ceramic standoffs.
-Twenty five feet of High Voltage GTO 14awg wire
-Twenty five feet of 4 awg to 8 awg stranded wire for the RF ground connection.
-A 4 to 6 foot piece of copper pipe or copper plated steel for a RF ground rod.
-One 10 amp rated (minimum) Variac (autotransformer)
Assorted electrical connectors, fuse holders, 12awg power cord wire, 12 awg hook up wire as well as other optional items may be needed, depending on how (and where) you want to control your coil from.

Construction

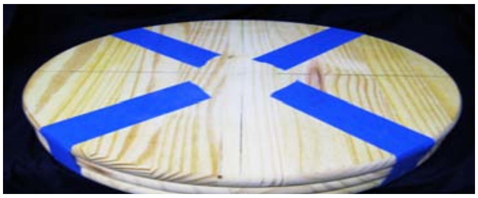
The Base

Every quality project needs a good foundation, so let's start with the base. A quick trip to the home center and I picked up the following (see picture), three 18 inch unfinished pine table top blanks, four 2 foot lengths of 1 ½ inch schedule 40 PVC pipe, sixteen 1 ½ PVC pipe end caps (get the ones that are flat on top, rather than rounded, you make have to check a couple stores). A box of ¼ x ¾ sheet metal screws with a flat or pan type head and four ¼-20 x 2 inch bolts with nuts and washers.

First, find the center of one of the 18 inch pine circles (you need a carpenters square and a straight edge to do this, "Google it" if your not sure how, its really quite easy). Use a straight edge to bisect the circle and draw a line. Next, use a carpenters square to center another line at 90 degrees to the first .

Next, stack all three pine circles on top of each other, align them, and secure them with painters tape so they don't move. Use the lines as a guide to drill a 1/8 inch hole through all three blanks at once to get and exact alignment for screws and bolts for the PVC supports (don't drill all the way through the bottom blank, this will be the top, just drill enough to mark it) . The lines will also be your guides for mounting the wheels (see picture). Before you remove the tape, mark the sides of the circles so you can re align them in the exact same position as when you drilled them, otherwise the alignment will be off.

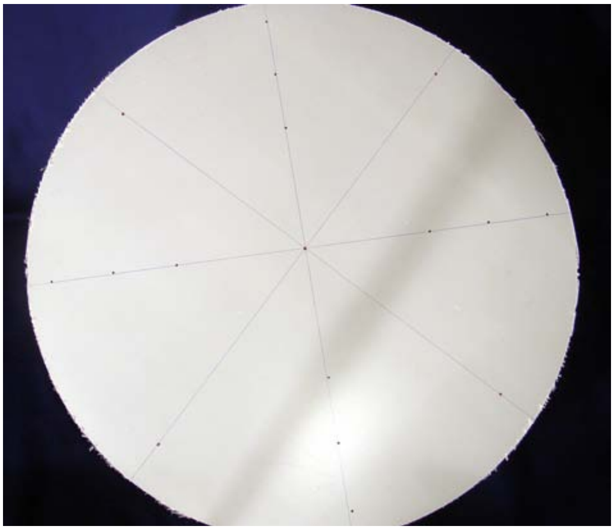
The center pine circle end caps will be secured with the four ¼-20 x 2 inch bolts, so you will need to enlarge the four holes to ¼ inch on the center blank only. Drill a ¼ inch hole in the center of every end cap (a tip, measure the top of the end cap in both direction to find the center, most caps have manufacture markings on top that you can use to remember the center point when you find it). Secure all the end caps and wheels as shown in the photos. To make the supports you will need to cut each one of the two foot lengths of PVC in half. All that's left it to put it together and paint if so desired. No glue is needed to hold the PVC supports in place.

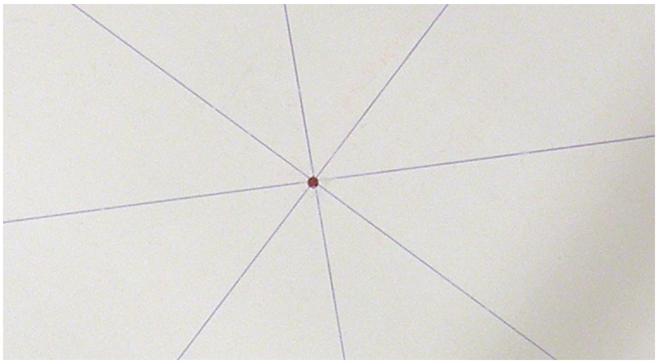


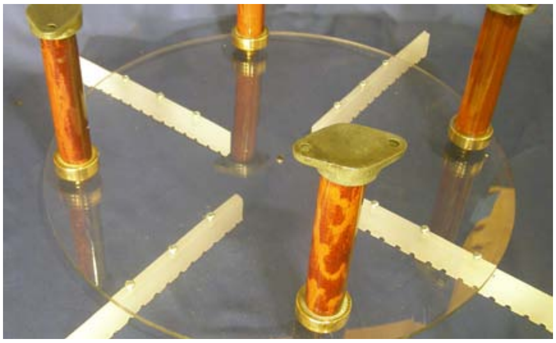
The Primary Coil

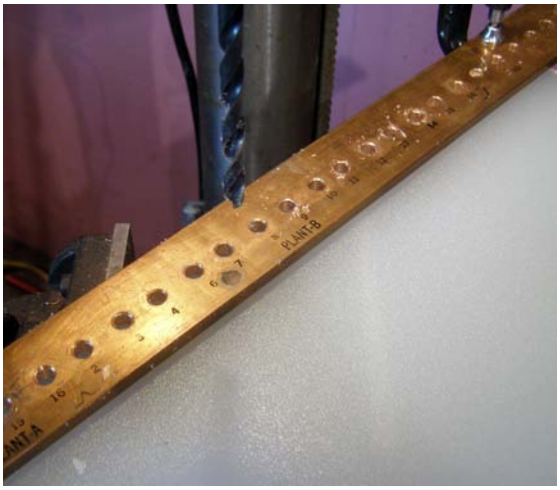
Lexan Base

Place the four 7 inch standoffs at even points on the top pine circle of the base to support the Lexan circle. Find the center of the Lexan circle and use the same procedure we used on the bottom pine circle of the base to mark two lines that bisect the Lexan at 90 degree angles. Use these lines to align the standoffs along the outer edge of the Lexan (see picture). Once aligned, mark the points and drill a ¼ inch hole on each one to attach the standoffs. Also drill a ¼ inch hole in the exact center of the circle.





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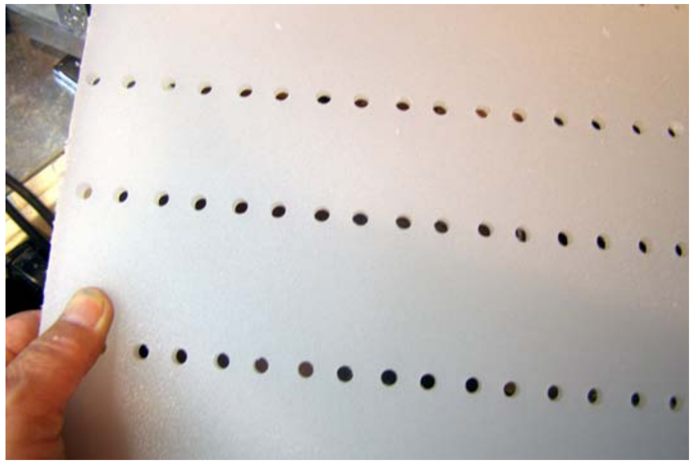
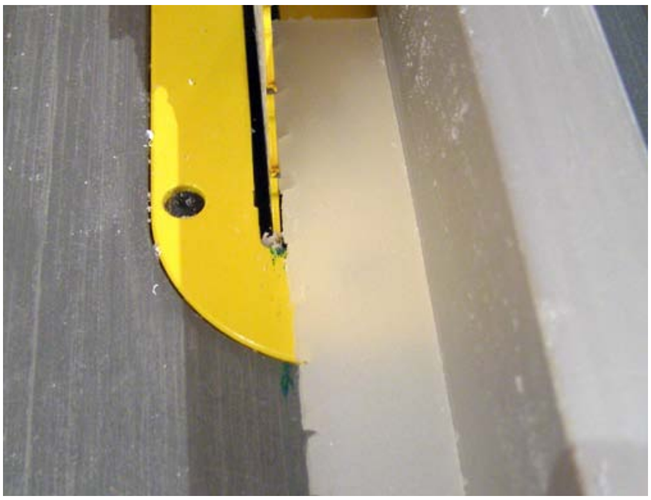
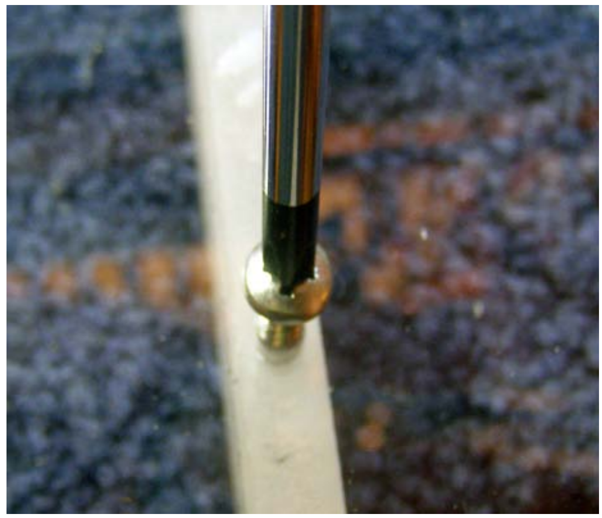
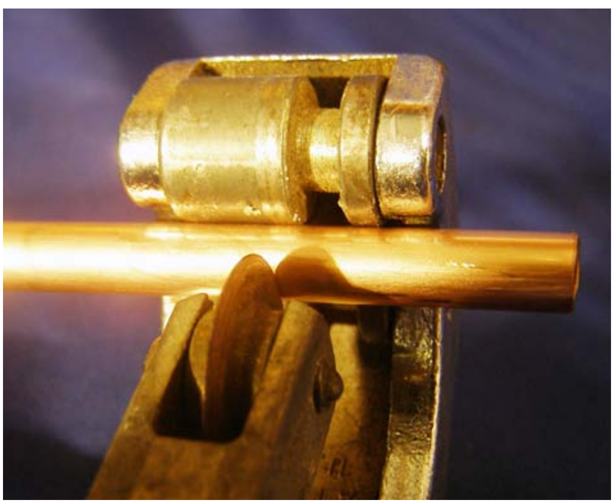
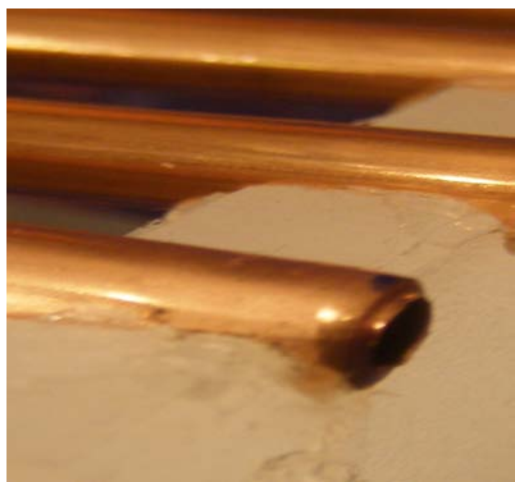






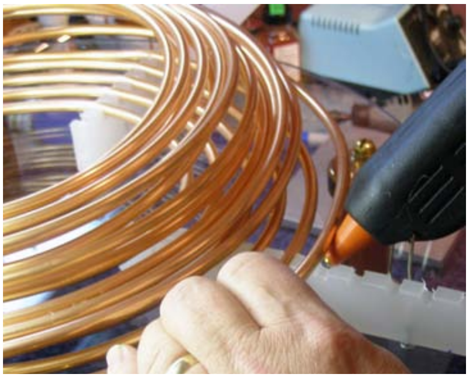
Winding the primary

Before we wind the primary, we have to make the support combs(see pictures previous page). You have many different options here. If you Google “Tesla Primary Coil Supports” and hit the images tab, you will see many different versions of ways to support your primary. For our

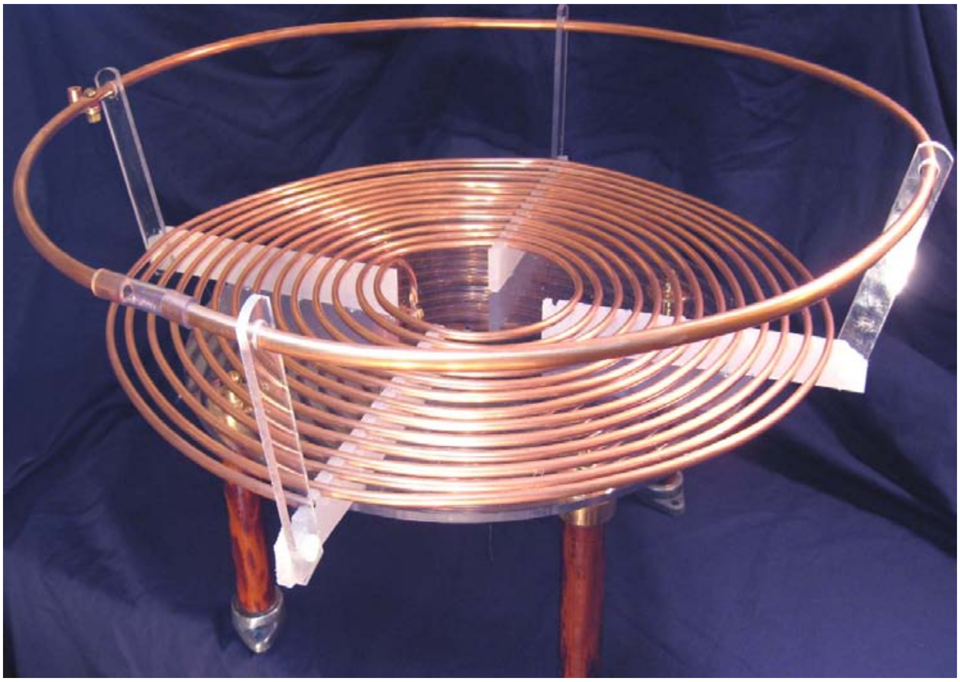
example, I am going to make the combs out of Polypropylene (soft plastic cutting board material). The photos are very detailed and should answer most of your questions on the construction of the combs. Basically, you drill fourteen, ¼ quarter inch holes in a straight line evenly spaced at ¼ inch to 3/8 of an inch apart. The dimensions in our example combs when finished are 1 inch x 9 ½ inches. To allow the copper tubing to be placed in the comb, the top 15% of the ¼ inch holes are cut off using a table, saber or band saw. Try and leave as much of the hole as possible, while still allowing room for the tubing to be pressed in.

Some things to keep in mind as you wind the primary. First, don’t unroll the copper tubing. Try and use its original shape to your advantage. You want to keep the amount you bend the tubing to a minimum. The copper tubing tends to become “work hardened” and tough to work with if you bend it to much.

With our four inch secondary, we want the center hole of the primary to be about 5 ½ inches in diameter. Drill a ¼ inch hole in the Lexan about 1 inch from the side of the secondary. This is where the copper tubing will go through the Lexan base so you can make the electrical

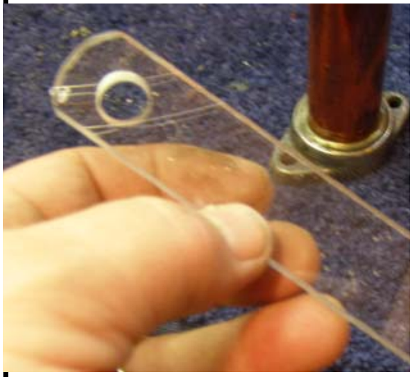


connection underneath the primary coil. Press the tubing into the combs working your way around until you complete the secondary. I find, adding just a small drop of hot glue works well to hold things in place. Don't over do it with the glue or you will have a mess on your hands. Take your time. This is a slow process. At the outside edge of the primary coil, when you finish the last turn, you will trim the excess with a tubing cutter and glue the final end in place. Plan on spending about 1 hour after you are done "tweaking" the copper tubing positioning to get a great professional finished look.

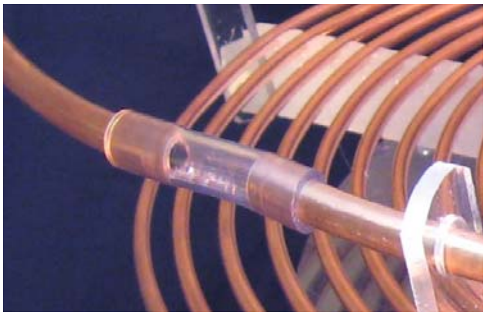


To Strike Rail, or not to Strike Rail, it's up to you.

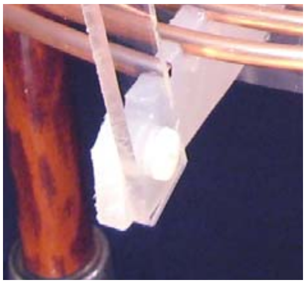
Knowledgeable Tesla Coil builders are about evenly divided on whether to use a strike rail or not. I have included one in our example coil so you can see how to make one. The basic theory is to provide a more attractive target for a stray streamer strike, rather than the pri-

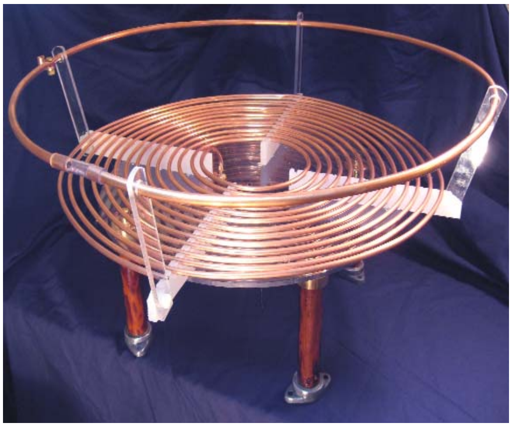


mary and the capacitor tank circuit that, if hit, can cause serious damage your Tesla Coil. The strike rail can be made from the same ¼ inch copper



tubing you made your primary from. I happened to have a piece of 3/8 copper tubing lying around, so that's what I used that in our example coil. A couple key points, the strike rail is connected with the high voltage GTO wire directly to the RF ground. Also, make sure the strike rail coil does not make a complete circle (see picture) or it will "de-tune" your primary coil. I like to complete the gap in the copper circle with a piece of clear plastic tubing as shown in the photo.





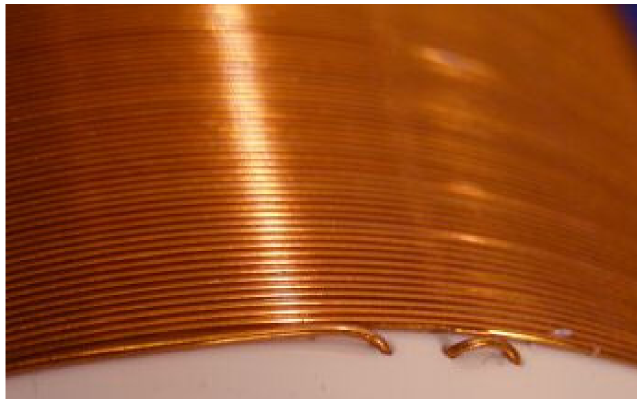
The Secondary Coil

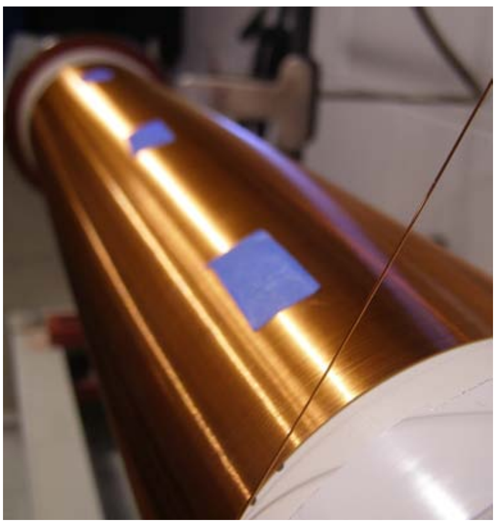
The first choice you have to make is if you are going to buy a secondary from me, or "roll your own". A few tips if you are going to attempt winding the secondary yourself. Start with a 22 inch piece of schedule 35 PVC. I like schedule 35 because its about 1/8 of an inch thick,

which is ideal for our purpose It's imperative that the ends are cut square. A carpenter's chop saw works well. Make sure the blade is sharp so the PVC does note crack or chip. Drill three 1/32 inch holes in each end as shown in the photo. To prepare the PVC for winding, I first remove all markings, grease etc with lacquer thinner. Clean it very well inside and out. Next, I clean it again with denatured alcohol both inside and out. When dry, I spray it with a thin coat of Dolph's AC-43 clear insulating enamel and let dry for 24 hours. The length of the actual windings will be 19 ½ inches centered on the 22 inch PVC form. The wire used should be "HAPT 2" magnet wire, 24, 25 or 26 awg. All will work well.

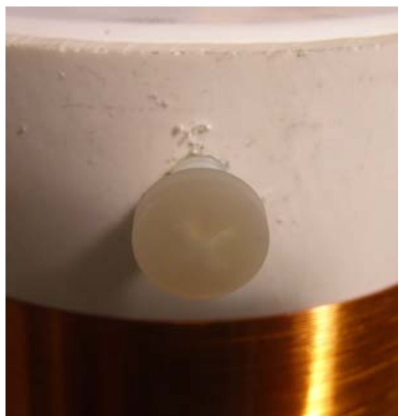
Even if this is the only secondary coil you ever wind, I suggest you build a coil winder (preferably with a motor, Google “Tesla Coil Winder” for some ideas on how to build one). To begin, thread the wire through the holes as show in the photo. Leave about 12 inches of wire inside the coil form.

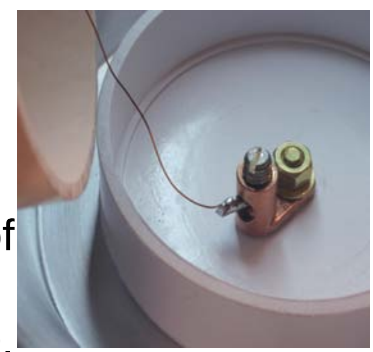
Constant tension must be applied at all times when winding. Blue painters tape is your best friend when winding your first coil. Apply about a one inch piece often to the completed windings to keep from “losing your work” if you slip and lose tension. When completed, secure the windings through the other set of holes, then, coat again with Dolph’s AC-43 (clear spray enamel, while it does not have the same electrical properties, will also work well to secure the windings). I personally don’t like poly as it tends to yellow after time. After several thin coats (you want to avoid runs), let it dry completely. Try and avoid touching the windings as the salts from your hands can sometimes cause problems with arcing or “racing sparks”.





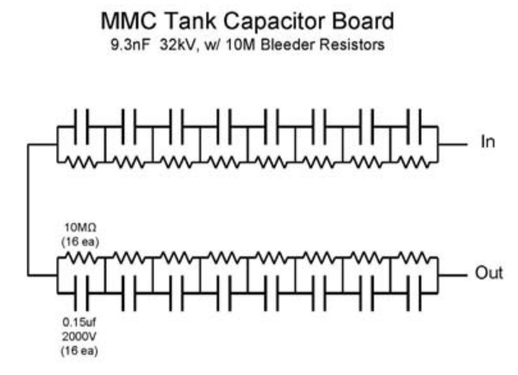
Now for the end caps. You may need to shop several stores, but you will need a 4 inch end cap and a 3 inch end cap, both with flat tops. To make your secondary look professional and not like a piece of plumbing, you will need to cut the end caps down to a height of about 1 ½ inches. I use a table saw for this. The caps are tapered, so if you set the cap sideways on the saw table, your cuts will not be square. You will need to hold the top of the cap tightly to a flat table saw side guard. Visegrip's work well for this. After trimming, drill a ¼ inch hole in the exact center of each end cap. Sand the bottoms smooth, making sure to keep them square. The 3 inch end cap goes inside the bottom of the secondary. You will need to spin the 3 inch secondary cap using a lathe, drill press or hand drill and sand the exterior to reduce the diameter, little by little, until it just fits inside the bottom of the secondary form. Of course, you can eliminate all of the above steps and buy a finished secondary from me, complete with both end caps for $125.00.

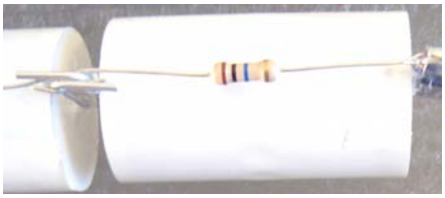


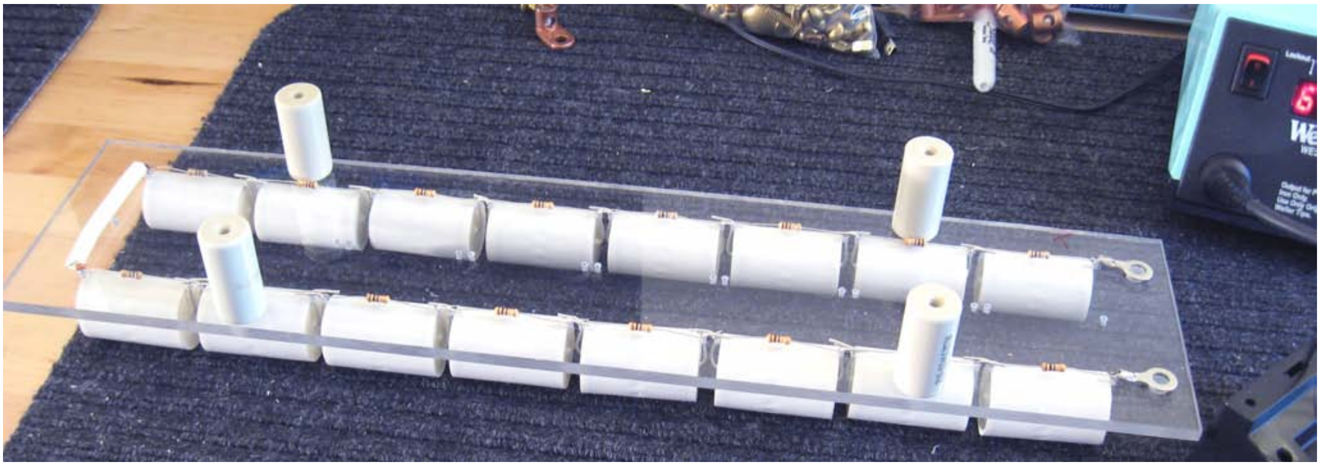


The MMC Tank Capacitor

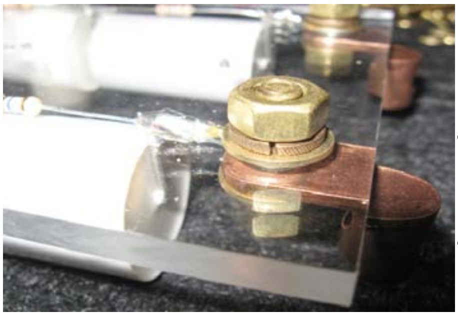
The following MMC (Multi Mini Capacitors) capacitor bank uses sixteen of the Cornell Dubillier C942C20P15K-F snubber capacitors with a rating of 0.15 uf at 2000 vdc They will all be run in series for a final value of 9.3 nf at 32,0000 volts. Even though our transformer is rated at only 12,000 volts, the higher voltage rating is necessary because the caps are rated at DC, we need to have a voltage rating of at least double to safely use them in this AC circuit. This additional "headroom" will allow many years of use without the fear of destroying the capacitors. After obtaining the capacitors, the next step it to choose a pc board to mount them on. The capacitors are heavy, so pick a sturdy one. A fiberglass pc perf board with no copper cladding works well, any copper solder points on the pc board will lead to arcing. I also sell Lexan circuit boards that work well for these MMC's (see the pictures for some examples).

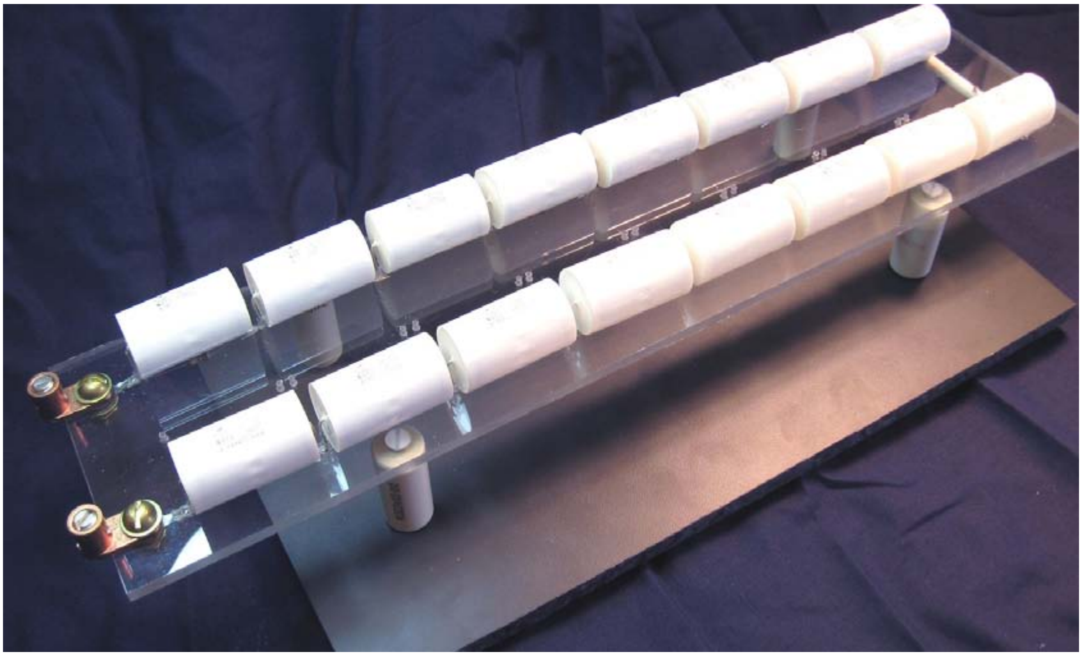






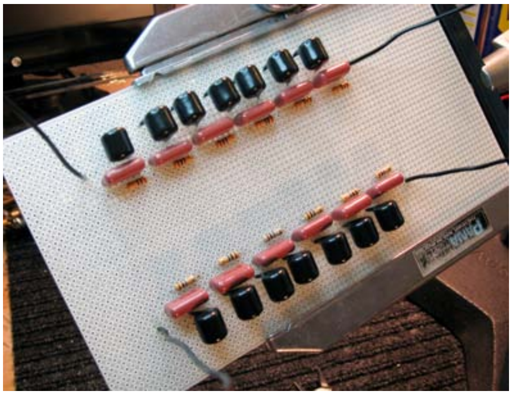
When laying out your MMC, leave a minimum of one inch space between multiple rows to prevent arching. Always try and think to the future (a large pc board with the room for expansion is a good idea). If you upgrade later by adding additional power, everything becomes even more susceptible to unwanted arcing. You will notice in the schematic and the pictures there is a 10 Meg ohm, ½ watt resistor soldered in parallel with each capacitor. These are known as bleed resistors. Their purpose is to render the capacitor bank safe in less than 30 seconds after the power is removed. Cheap insurance and one additional step toward our goal of the safe operation of your coil. Once you have your capacitors and resistors soldered in place, you need to attach a terminal connection to each end of the capacitors that you have just run in series. This will be so you can make a connection to the other components with high voltage GTO wire. You have a few options here. A brass bolt run through the pc board for a ring terminal works well, as does copper lug type terminals (see pictures).

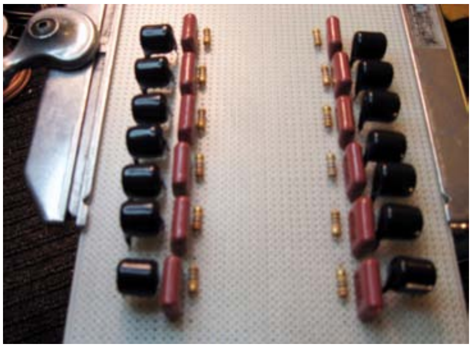


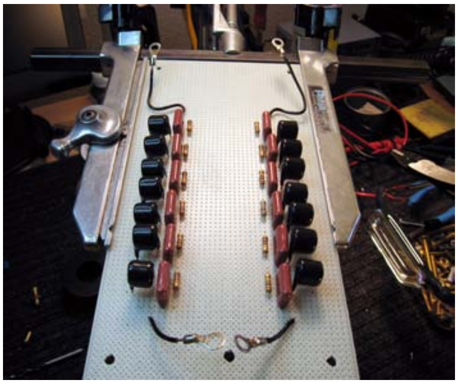


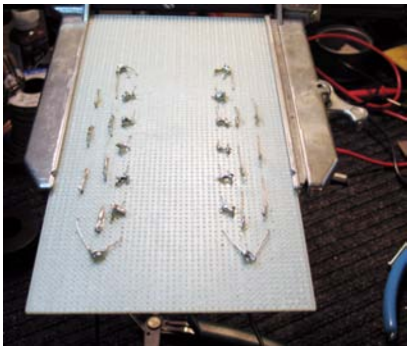
Transformer Protection Filter (Terry Filter)

Neon transformers were not designed for the abuse that a Tesla Coil puts them through. High frequency, high voltage spikes being fed back into the neon transformer will destroy it, unless, some type of protective circuit is used. While many designs are available, the "Gold Standard" is one designed by electrical engineer and "Tesla Guru" Terry Fritz. This is the one I suggest you use. With over 100 of these coils in use, I have not heard of a single case in which a neon transformer was destroyed while this protective circuit was in place. A copy of Terry's original schematic is shown on the next page. Note that the number of MOV's used changes with the output voltage of the neon transformer. For a 12kV transformer you will use a total of 14 MOV's. Notice I left plenty of room for the addition of two more MOV's should you ever decide to use the filter with a 15kV neon transformer. Also note the spacing of the components leaving a two inch empty strip (see picture) in the middle of the pc board to prevent the possibility of arcing.

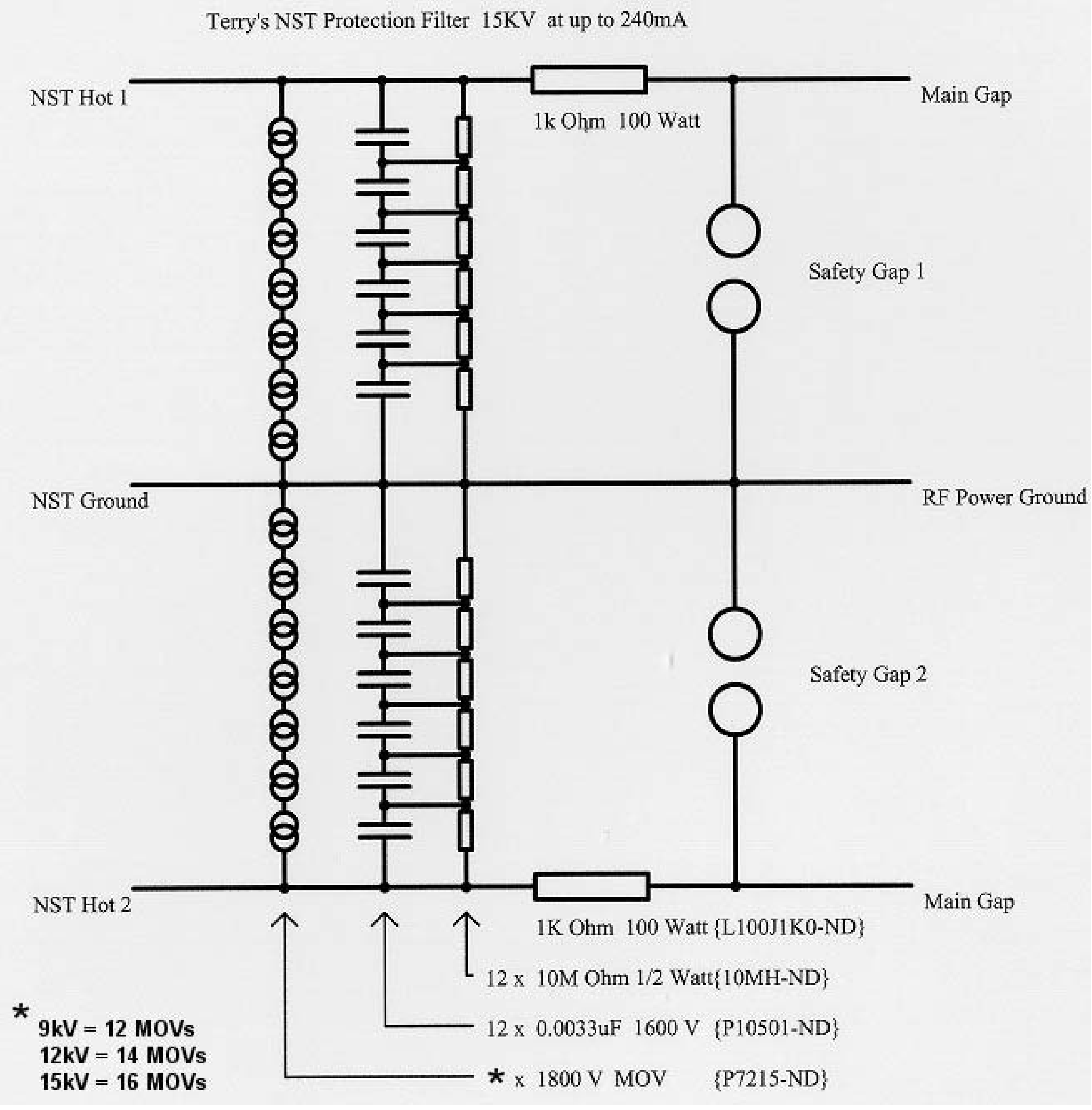




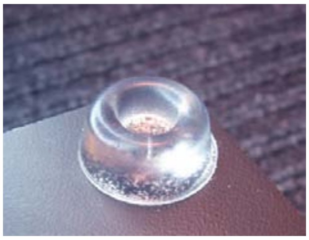


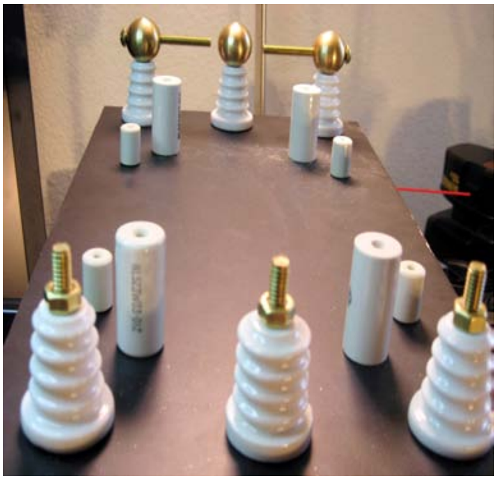


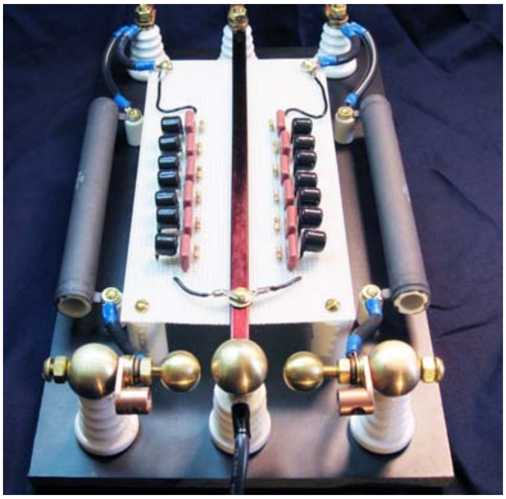
Terry Fritz's Original Schematic



As in our MMC, a quality pc perf board, 5 x 7 inch or larger, with no copper cladding anywhere is our choice to mount the components on. Take a close look at the pictures of the finished Terry Filter's. Note the spacing of all the other component parts as well. This is the layout you need to use to prevent unwanted arcing. All of the component parts mounted on the pc board for the filter are "non-polarized" and can be wired in either direction. Because of the number of parts and terminal connections involved, most folks mount the pc board on another piece of base material (like Polypropylene or Phenolic) to be able to mount all the needed additional terminals, safety spark gap etc. If, at this point, you are not familiar with the safety gap and its function, time to go back to my website and "study up" using the three coil building links provided.







The Main Spark Gap

In my “Fast Start Package”, the main gap I provide consists of two copper holders, two pure tungsten rods and a small “squirrel cage” fan to “quench” the gap. These items need to be mounted on a piece of heat resistant material such as phenolic and/or mounted on ceramic standoffs (see picture). The gap size is easy to adjust with just a screw driver. The starting point for your gap width will be ¼ of an inch. I like a simple spark gap such as this one for initial coil assembly and to get your Tesla Coil “dialed in”. You can squeeze some extra performance out of your coil by using a different, while more complicated, spark gap design. Some of these include: a multi rod tungsten gap, a “sucker” gap and rotary gap. Some pictures are shown below.

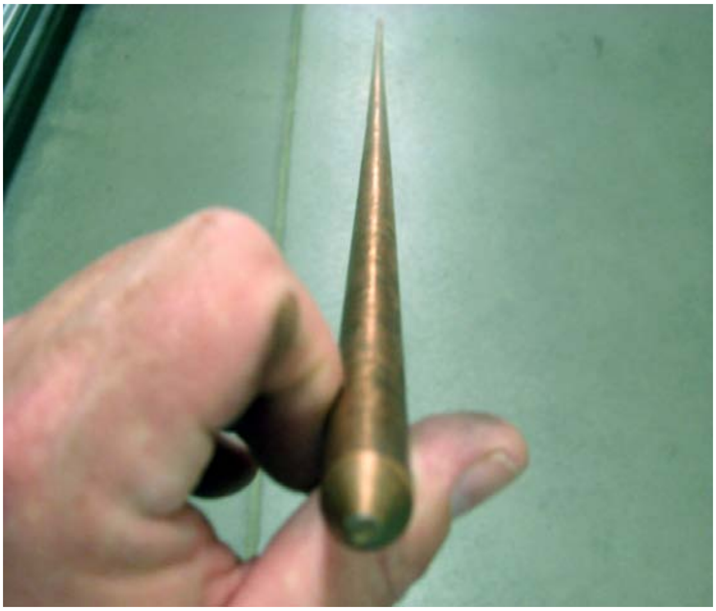
Counter Sunk Screw head coated with “Corona Dope”

Synchronous Rotary Spark Gap

“Sucker Gap” (vacuum in the base for quenching)

The RF Ground

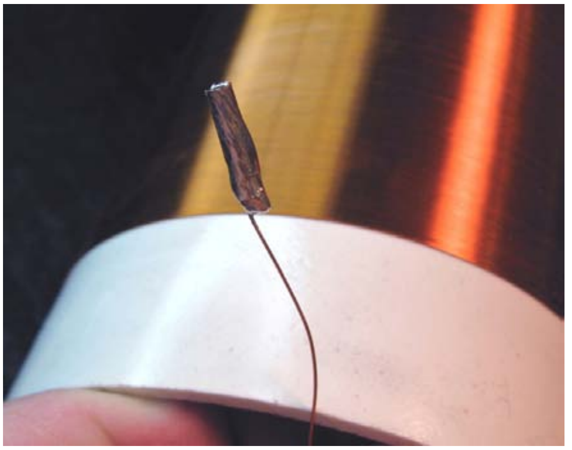
A medium size Tesla Coil like the one we are building requires two grounds. One, the “mains” ground in home or business electrical wiring. Two, a RF ground which is a copper pipe or copper plated steel rod (available at the home centers for about $20, see picture) of 4 to 8 feet in length driven into the earth. If your really in a pinch, and can’t access a true RF ground, you can substitute a counterpoise ground. This is a 6 foot circle or square of chicken wire or hardware cloth place under the coil base on the floor.



A six foot copper plated steel grounding rod

A welding clamp is a handy device for connecting the RF Ground

Putting it all together

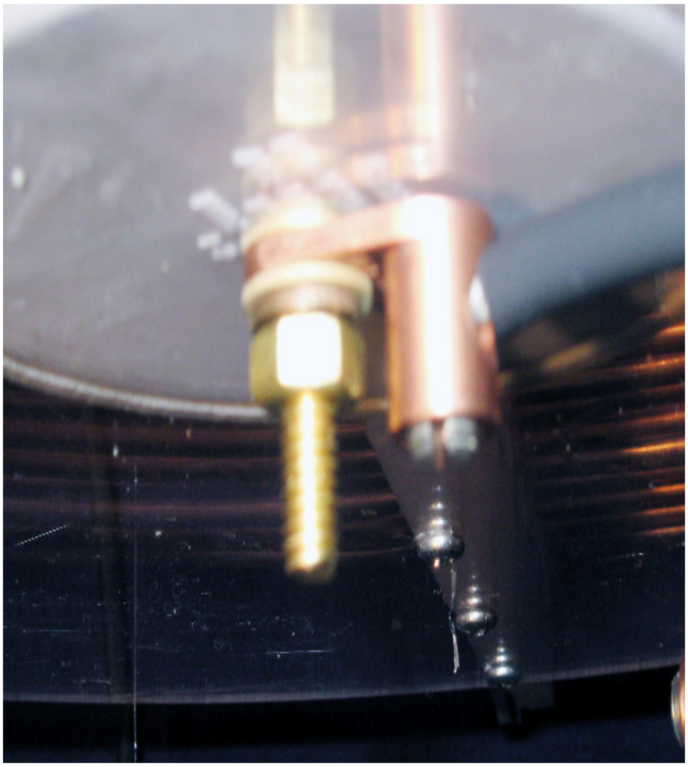


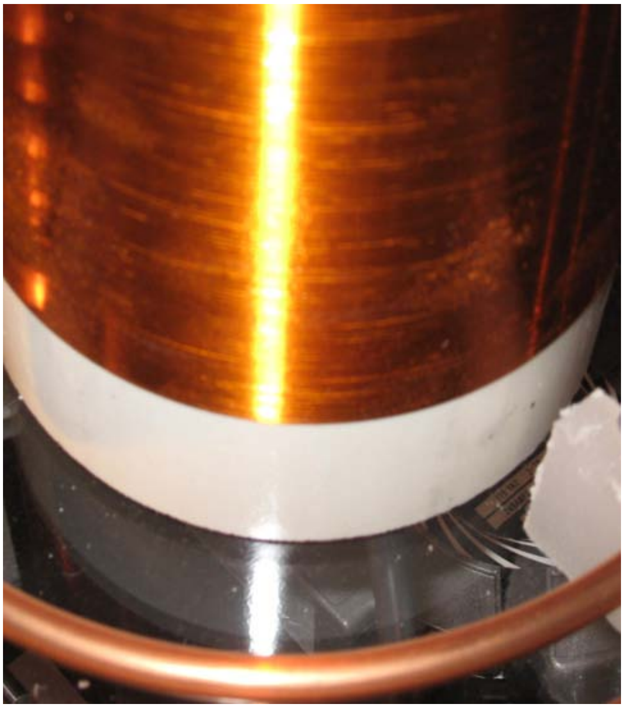
Ok, let's get started! First we need to trim the ends of the magnet wire in the secondary coil. The goal is to leave

just enough wire to allow for the removal of the end caps with as little excess wire inside the secondary coil form as possible. A lot of coils designs call for the wire to be run on the outside of the secondary coil form to prevent arching. As long as the leads are kept

short, you can have the clean look of having the wires inside the coil form without any arching. On the wire for the top end cap, solder a small piece of heavy copper wire about 3/8 of an inch long to the thin magnet wire (see picture). I like to use a copper terminal lug on the bottom side of the end cap. This way, with just the twist of a screw driver, you can remove the top cap with the toroid attached. If you did not add the piece of heavy wire, the thin magnet wire would quickly become weak and soon break. With the addition of the small piece of heavy wire, you can get many years of service, without fear of breaking the magnet wire.

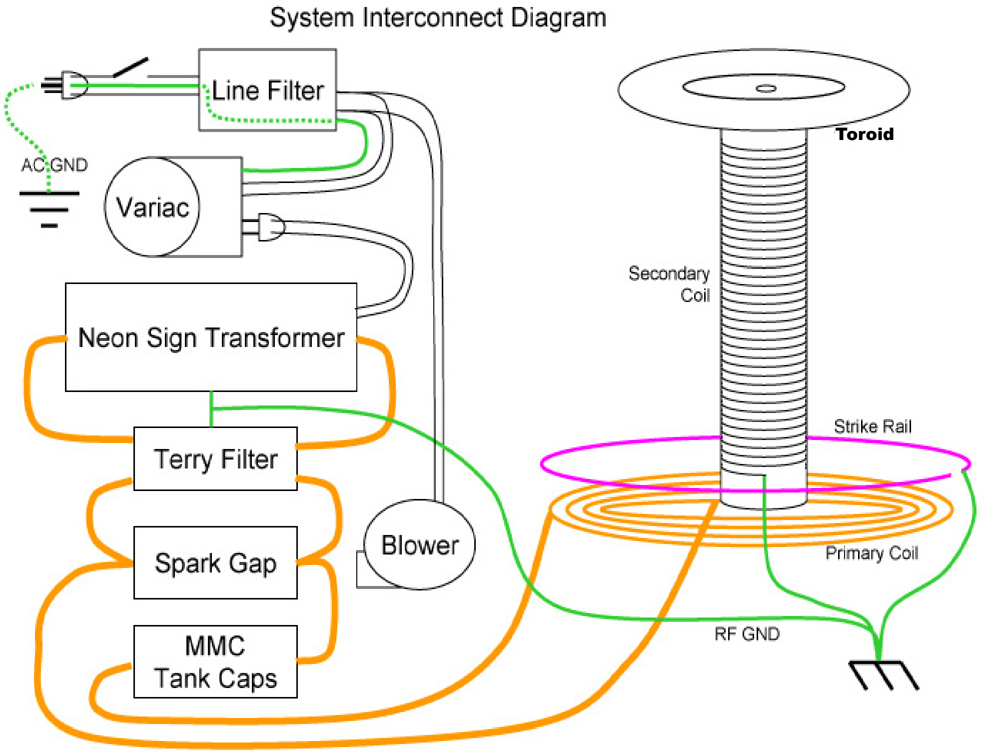
Now for the bottom connection. Crimp and solder a ring terminal with a ¼ inch diameter hole leaving enough wire to reach the center hole you drilled in the Lexan. Use a brass bolt to secure the bottom of the secondary (going though the ring terminal). Again, I like to use a copper terminal lug on the bolt after you run it through the Lexan and a additional terminal lug on the copper tubing we ran through the Lexan (see picture).
A ring terminal with a ¼ inch hole also works well.





Wiring

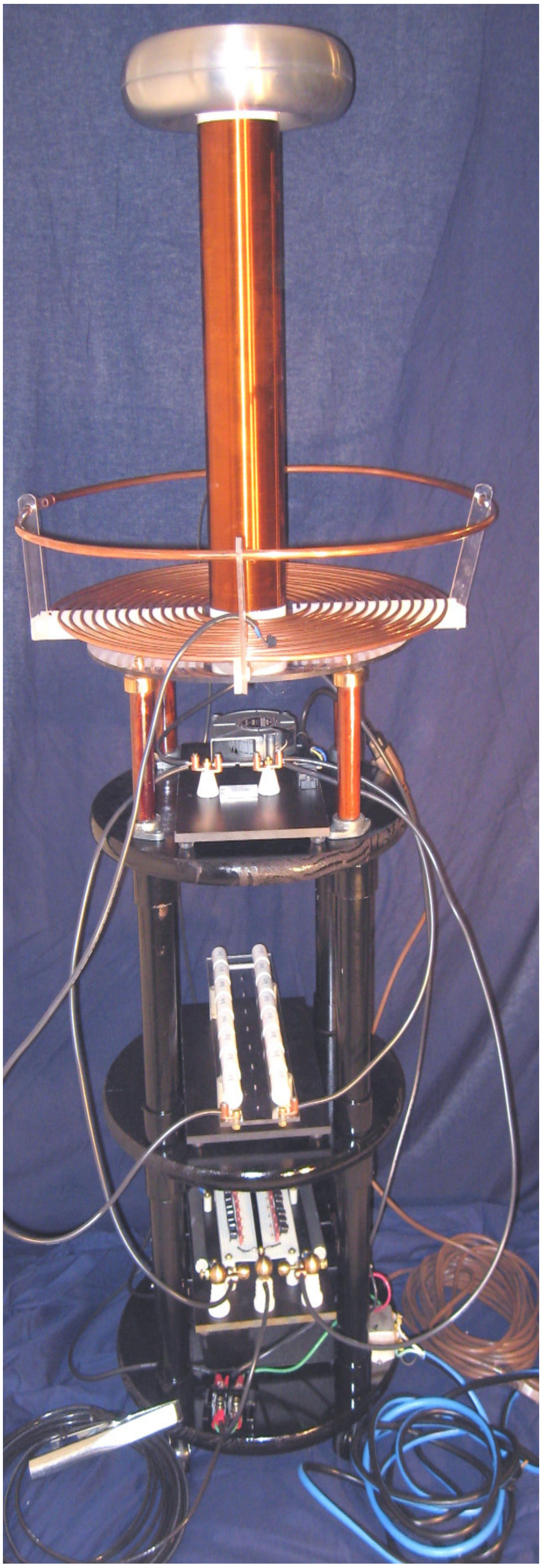
I have tried to make the wiring diagram as simple as possible. Key points to keep in mind are all high voltage connections need to be made with the high voltage GTO wire. A 25 ft, 14awg extension cord with the female end removed makes a good main power cable for your coil. You will also need a second power supply cord (18 awg is fine) to supply power to the quenching fan (as the main power cord to the coil will be running through the Variac and you want the fan running at full speed all the time). All other wiring can be made with 12 or 14 awg house wiring. The RF ground cable should be heavy, 4 to 8 gauge. I like welding cable for its flexibility and in fact, I use a welding clamp to terminate the cable and attach the cable to the RF grounding rod. Copper ribbon is also excellent, although it can be tough to work with. I recommend using crimp type connectors for all the terminal connections. If you wish, you can go the "extra mile" and crimp and solder them.



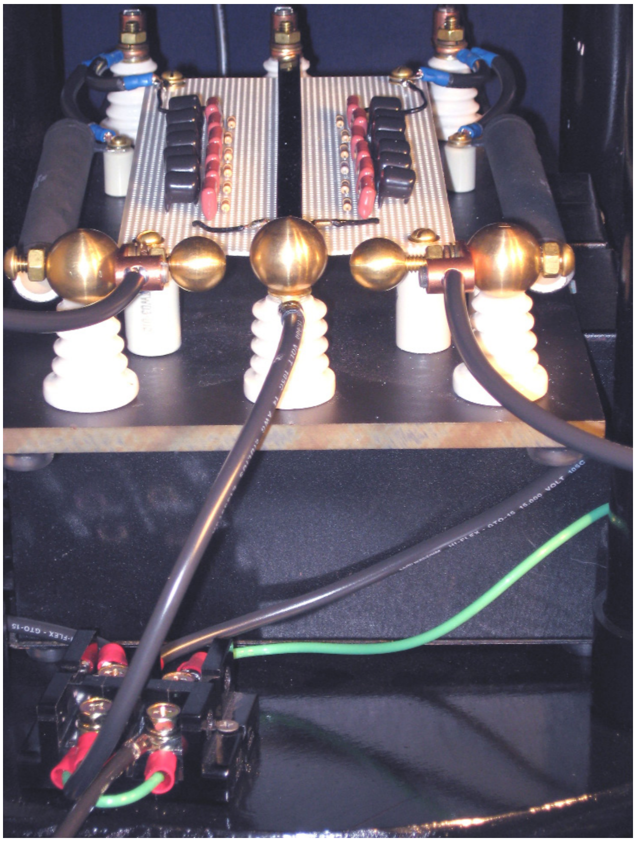
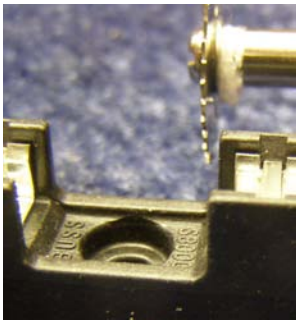
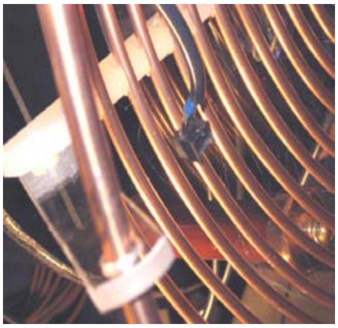
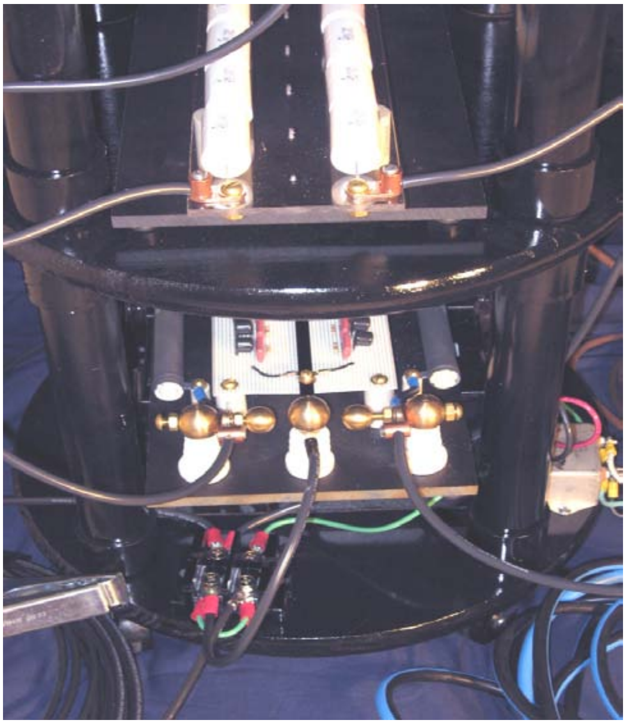
Note- The Line Filter can go before <u>or</u> after the Variac. In our example coil, the line filter is wired after the Variac for mounting and ease of use

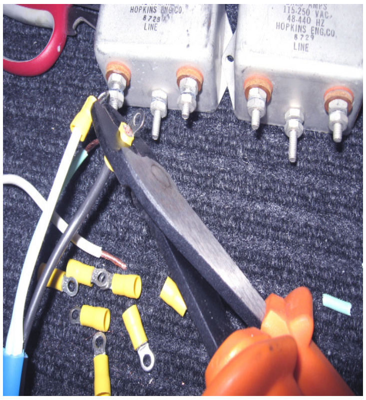
First Light Wiring Check

Before your “fire her up” for the first time, double check all connections. Set the tungsten spark gap at a width of ¼ inch and turn on the quenching fan. Next, tap the primary at turn number 10 with your modified fuse holder clip. Plug the power cord from the coil into the Variac and position yourself about 12 feet back from the coil. This first power up should be done in total darkness so you can diagnose any problem arcing issues right away. Turn on the Variac and slowly increase the power to about 50 %. The spark gap should start to fire. (one note, if you have not seen a Tesla Coil in operation, “up close and personal”, the spark gap is LOUD). Check for any arcing on all of the connections, paying special attention to the Terry Filter and the windings of the secondary coil. You also may start to see some “corona” or steamers coming from the Toroid (a good thing!). If all is well, continue to increase the power up to %100, again watching for any unwanted arcing. You want to keep these first runs short, less than one minute, until you make sure everything is working properly. See the next page for more pictures.



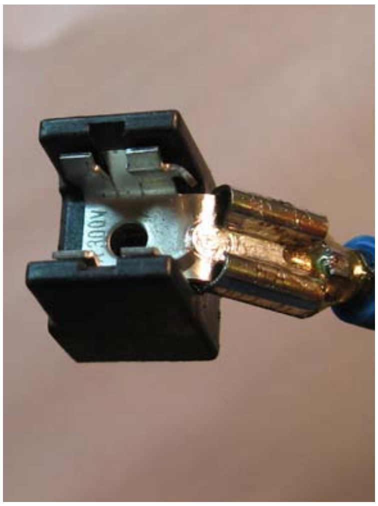
All wired up before “cleaning up” with tie wraps

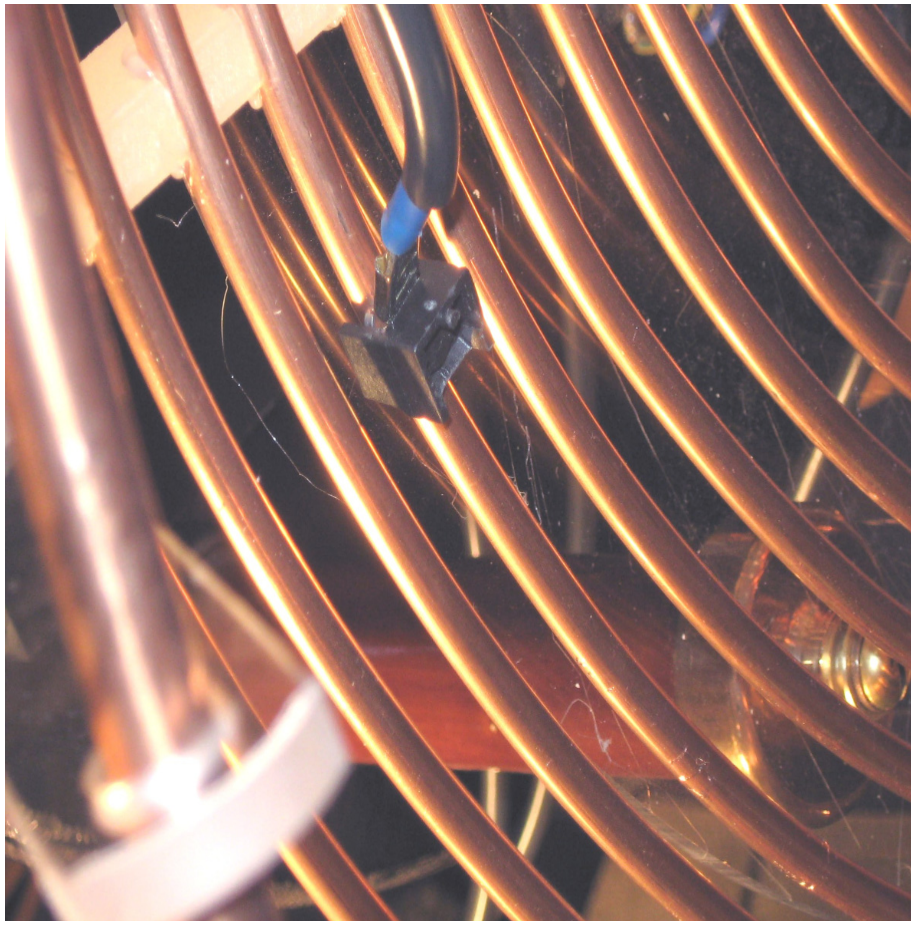








Tuning

If your coil performed as in the above paragraph, that's great news. Now its time for some fine tuning to achieve the maximum spark length. Adjust the tap point, 3 inches at a time, clockwise and counter-clockwise running the coil at each new point and noting the streamer length coming off the toroid. It should not take very long to figure out where the "sweet spot" is.





Operating Tips

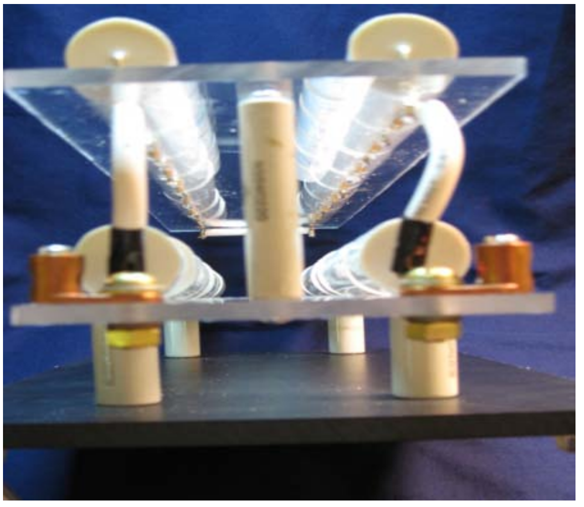
Its good practice to keep your runs short to minimize the possibility of damage to the components and allow the ozone generated to dissipate, 1 to 3 minutes is a good run time to shoot for. If you are in the USA, feel free to use the 140 volt setting on the Variac (for our international folks, limit the voltage to 140 vac as well with these American transformers). With the Terry Filter in place, I have never damaged a transformer and you can squeak out a little extra performance.

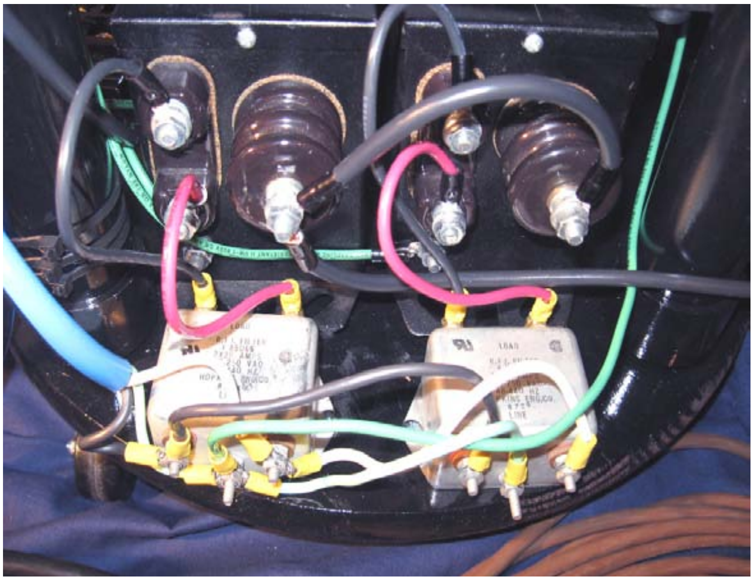
Upgrading for Better Performance

One of the nice features of this Tesla Coil design is the ease of which it can be upgraded. You can increase the performance of your coil as your time and budget allows, without changing the primary or secondary coil!

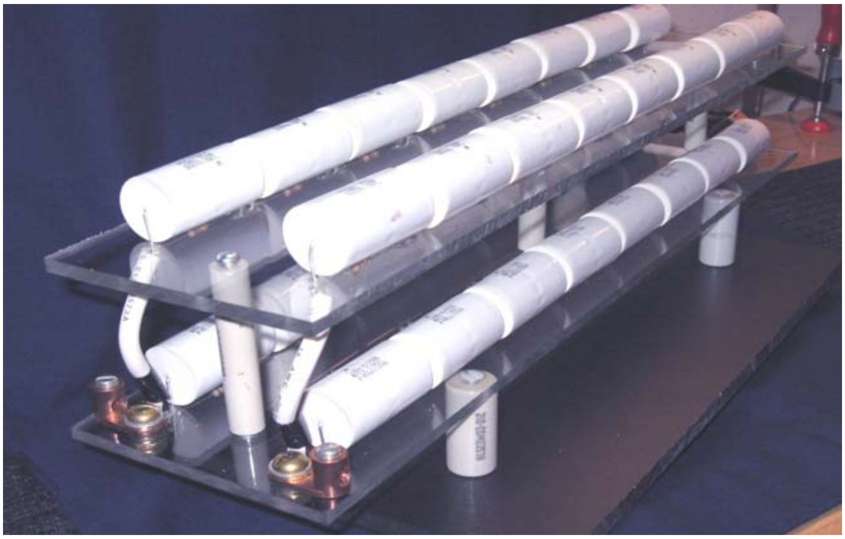
Upgrade #1

This involves simply adding a second identical neon transformer run in parallel with your first one. Tesla Coils LOVE current, adding a second transformer will take you from 30ma to 60ma and will almost double your streamer size (spark length). The Terry filter will handle over 240ma so no adjustment is needed. You will however need to





increase the size of the MMC. You will need to go from one series string of 16 of the 942 capacitors to two series strings run in parallel for a total of 32 capacitors. This will give you the needed value of 18.7nF at 32kV. At this current level you should also upgrade the spark gap as well to get the maximum performance. You will also need to retune the tap point on your primary and then you will be ready to go!



Upgrade #2

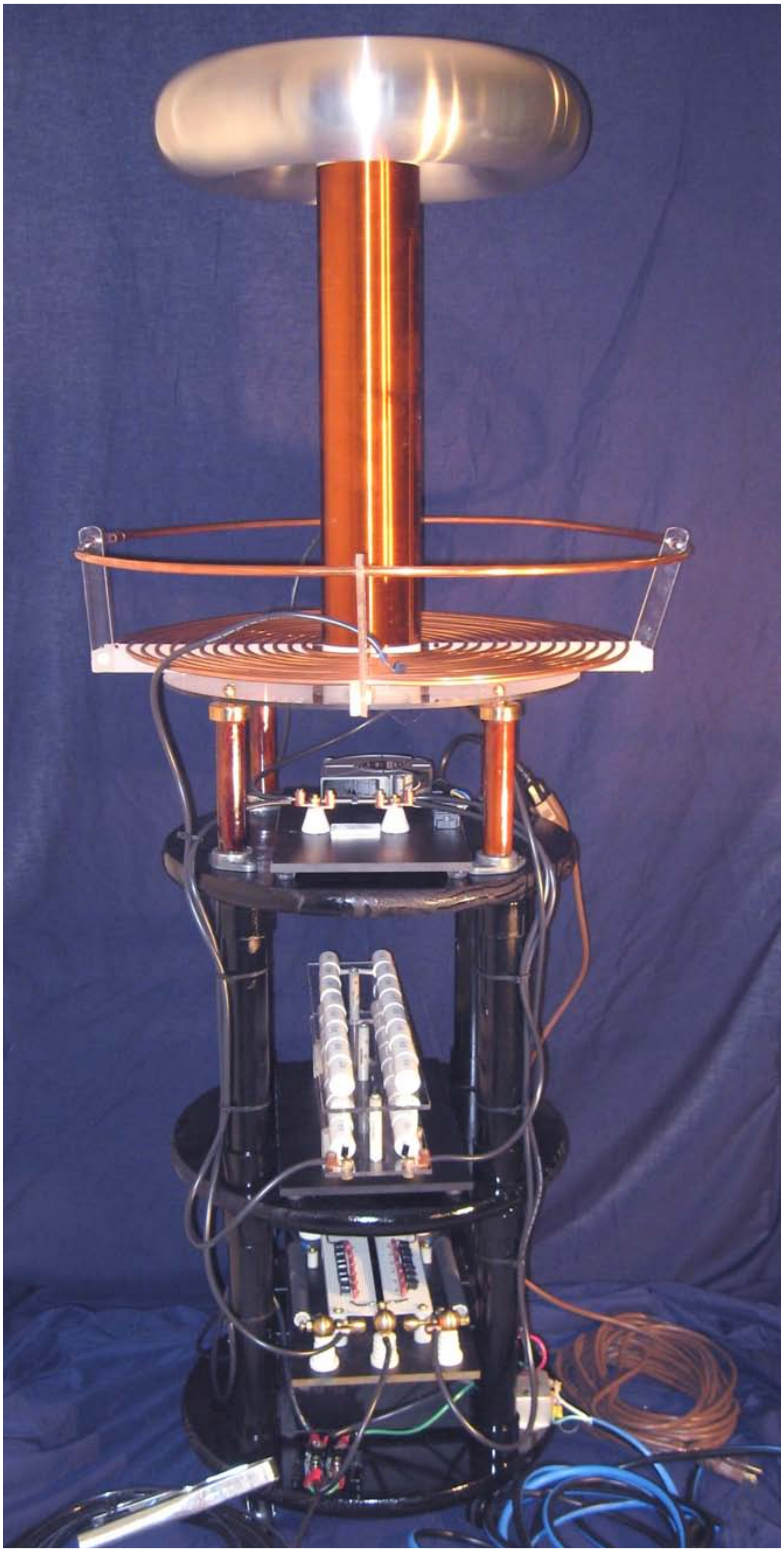
If you change you neon transformer from a 12kV 30 ma, to a 15kV 30 ma, you will see a small increase in performance. No changes are needed to the MMC capacitor bank. You will have to add two additional MOV's to your Terry Filter however. After that's done, just retune and you're ready to go!

Upgrade #3

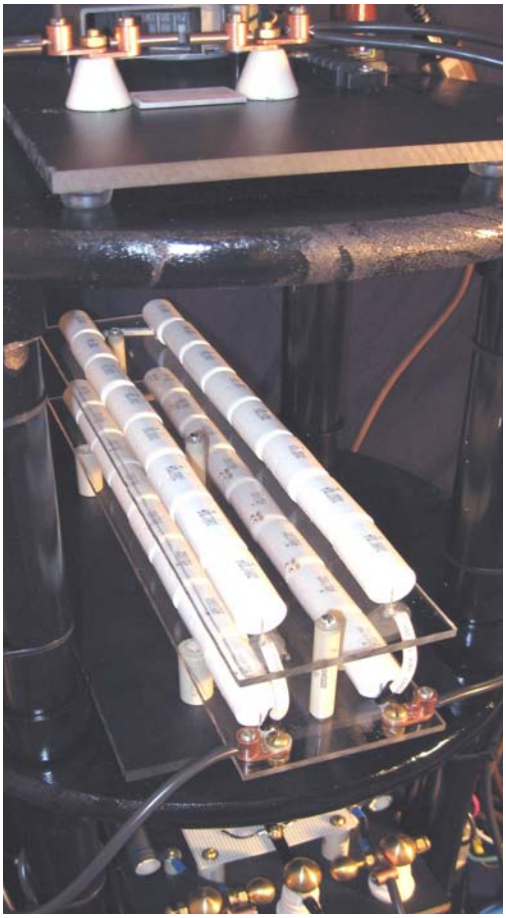
If you upgrade a single 15kV 60ma transformer (or two 15kV 30ma transformers in parallel), here is what you need to do. First, add the two extra MOV's to the Terry filter. Next, you will have to upgrade the MMC capacitor bank to two series strings of (20) each for a total of 40 capacitors. This will give you the needed value of 15nF at 40kV. With this upgrade I would also suggest upgrading the spark gap as well.

Other Upgrade Considerations

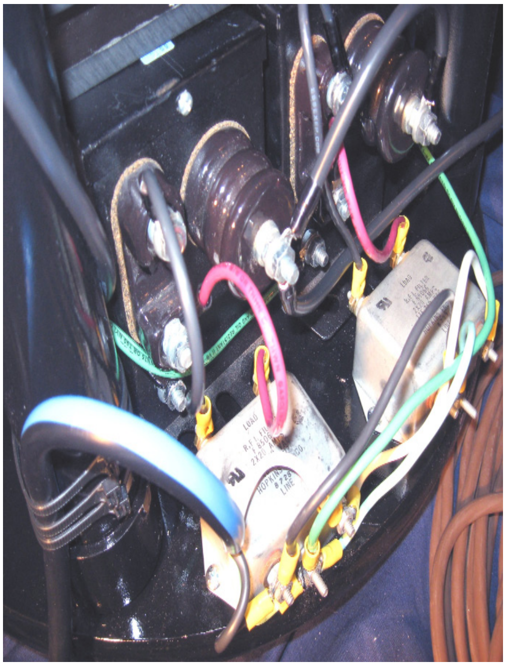
If you upgrade to a 60ma power source, while not absolutely necessary, you could upgrade the toroid to a 4.5 x 18 inch as well. The nice thing is, you can do this at any time as your budget allows.



Tesla Coil with 4.5 x 18 Toroid & Dual 12 30's



Double Stack MMC



Two 12 30's in Parallel