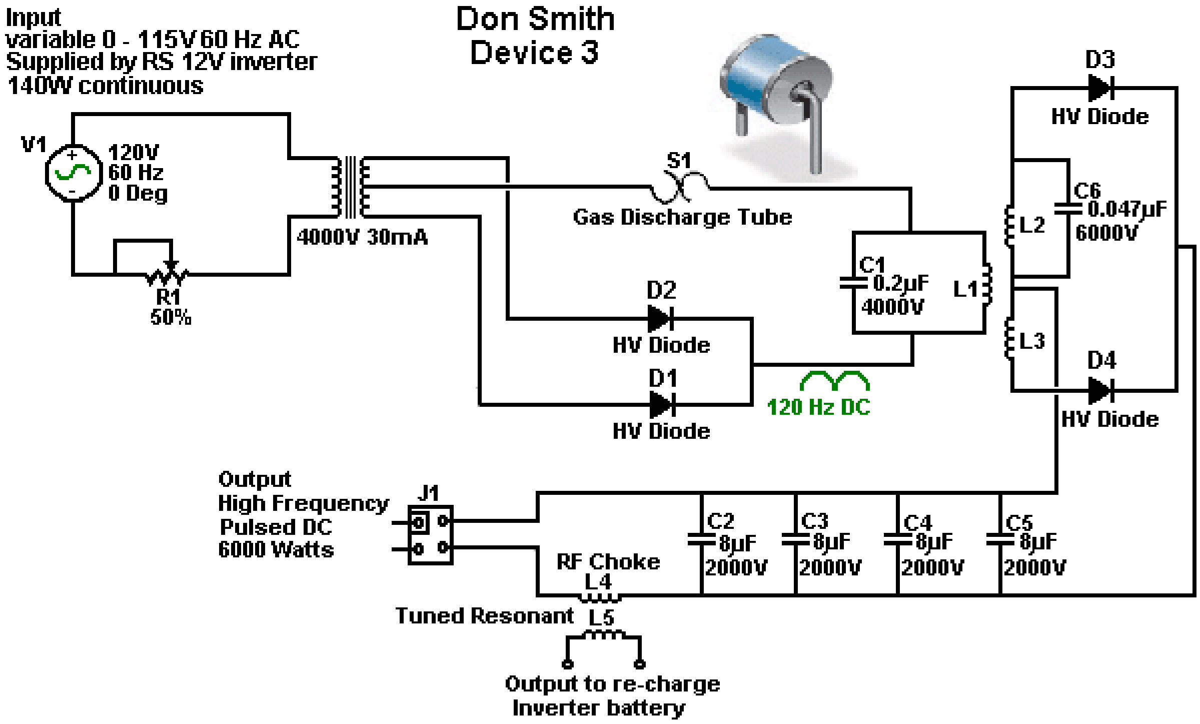
I have recently been passed a copy of Don's circuit diagram for this device, and it is shown here:



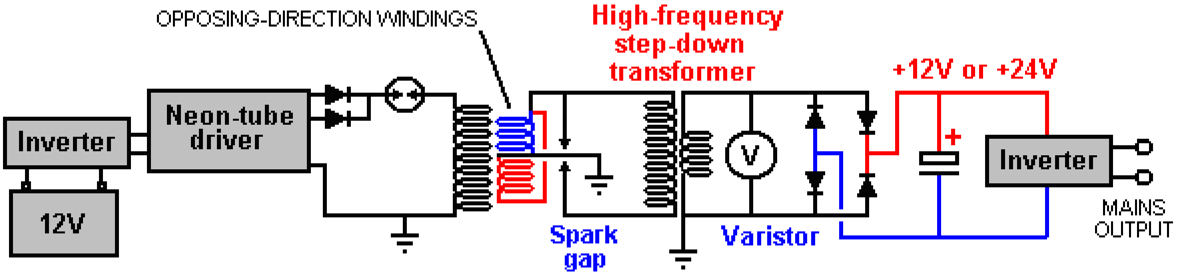
The 4000V 30mA transformer shown in this circuit diagram, may use a ferrite-cored transformer from a neon-tube driver module which steps up the voltage but it does not raise the frequency as that is clearly marked at 120 Hz pulsed DC. You will notice that this circuit diagram is drawn with Plus shown below Minus (which is most unusual).

Please note that when an earth connection is mentioned in connection with Don Smith's devices, we are talking about an actual wire connection to a metal object physically buried in the ground, whether it is a long copper rod driven into the ground, or an old car radiator buried in a hole like Tariel Kapanadze used, or a buried metal plate. When Thomas Henry Moray performed his requested demonstration deep in the countryside at a location chosen by the sceptics, the light bulbs which formed his demonstration electrical load, glowed more brightly with each hammer stroke as a length of gas pipe was hammered into the ground to form his earth connection.

Don also explains an even more simple version of his main device. This version does not need a Variac (variable voltage transformer) or high voltage capacitors. Here, a DC output is accepted which means that high-frequency step-down transformer operation can be used. This calls on the output side, for an air-core (or ferrite rod core) transformer which you would wind yourself from heavy duty wire. Mains loads would then be powered by using a standard off-the-shelf inverter. In this version, it is of course, very helpful to make the "L1" turns wire length exactly one quarter of the "L2" turns wire length in order to make the two coils automatically resonate together. The operating frequency of each of these coils is imposed on them by the output frequency of the neon-tube driver circuit. That frequency is maintained throughout the entire circuit until it is rectified by the four diodes feeding the low-voltage storage capacitor. The target output voltage will be either just over 12 volts or just over 24 volts, depending on the voltage rating of the inverter which is to be driven by the system.

As the circuit is capable of picking up additional magnetic pulses, such as those generated by other equipment, nearby lightning strikes, etc. an electronic component called a "varistor" marked "V" in the diagram, is connected across the load. This device acts as a voltage spike suppressor as it short-circuits any voltage above its design voltage, protecting the load from power surges. A Gas-Discharge Tube is an effective alternative to a varistor.

This circuit is effectively two Tesla Coils back-to-back and the circuit diagram might be:



It is by no means certain that in this circuit, the red and blue windings are wound in opposing directions. The spark gap (or gas-discharge tube) in series with the primary of the first transformer alters the operation in a somewhat unpredictable way as it causes the primary to oscillate at a frequency determined by it's inductance and it's self-capacitance, and that may result in megahertz frequencies. The secondary winding(s) of that transformer **must** resonate with the primary and in this circuit which has no frequency-compensating capacitors, that resonance is being produced by the exact wire length in the turns of the secondary. This looks like a simple circuit, but it is anything but that. The excess energy is produced by the raised frequency, the raised voltage, and the very sharp pulsing produced by the spark. That part is straightforward. The remainder of the circuit is likely to be very difficult to get resonating as it needs to be, in order to deliver that excess energy to the output inverter.

One very significant thing which Don pointed out is that the mains electricity available through the wall socket in my home, does **not** come along the wires from the generating station. Instead, the power station influences a local 'sub-station' and the electrons which flow through my equipment actually come from my local environment because of the influence of my local sub-station. Therefore, if I can create a similar influence in my home, then I no longer need that sub-station and can have as much electrical energy as I want, without having to pay somebody else to provide that influence for me.

## A Practical Implementation of one of Don Smith's Designs

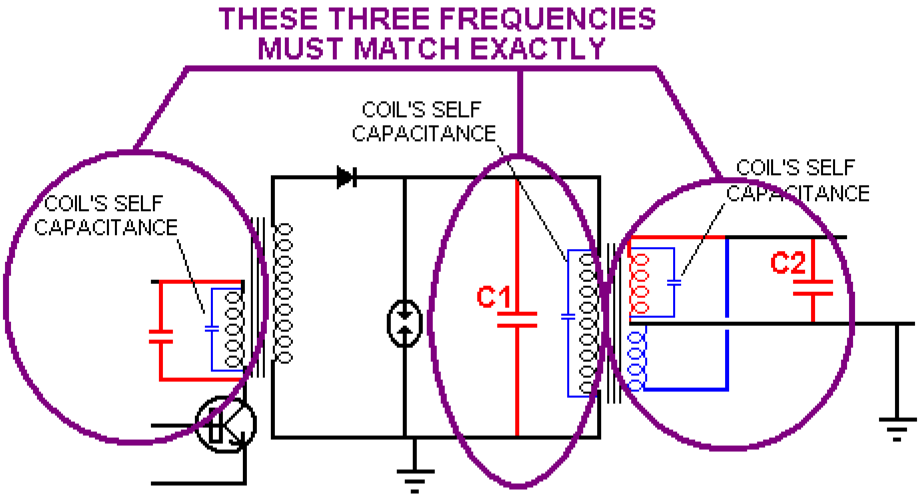
The objective here, is to determine how to construct a self-powered, free-energy electrical generator which has no moving parts, is not too expensive to build, uses readily available parts and which has an output of some kilowatts. However, under no circumstances should this document be considered to be an encouragement for you, or anyone else to actually build one of these devices. This document is presented solely for information and educational purposes, and as high voltages are involved, it should be considered to be a dangerous device unsuited to being built by inexperienced amateurs.

This design is based on the work of Don Smith of America and some of the details have been clarified by "Zilano" of the energetic forum, who claims to have already constructed five successful implementations of Don's designs and been disconnected from the grid for some months now in spite of having a continuous power requirement of 4.25 kilowatts. Thanks is due to both Zilano and the energetic forum members for sharing their expertise and providing a platform for presenting and discussing this development.

In broad outline, this particular implementation of Don's device consists of a power supply which provides the operational power to an active transformer section which produces excess, usable power, useful to a household. The gain in power is provided by boosting the voltage to around four thousand volts, raising the frequency to around thirty-five thousand cycles per second, producing very sharp voltage pulses with a spark gap and then stepping that power down to the equivalent of the local electricity supply voltage through a resonant, high-frequency transformer. That process gains a massive amount of excess power provided that resonance is maintained throughout the circuit.

However, that process is not without it's difficulties. If the frequency is stepped up to vastly more than the frequency provided by the local mains supply, then there is the difficulty of getting that frequency back down again so that it can be used to drive motors and mains power supplies which are designed to use that lower frequency. One solution is to convert the output to DC, use a filter to block the high-frequency ripple and then use a standard off-the-shelf inverter to provide the required frequency and voltage.

The other difficulty is the high voltage. Apart from the serious danger of using potentially lethal voltages, the arrangement needs very accurately tuned sections, which in turn requires accurate capacitor values, but high-voltage capacitors are not readily available in a wide range of values, and worse still, they are very expensive compared to capacitors of lower voltages.  The general layout is:



Although the circuit is basically a simple one, the three separate sections ringed around have to run at exactly the same frequency.  Each coil winding has it's own internal capacitance.  Normally, we don't generally bother about that capacitance as the value is usually quite small, but in this circuit which is running at high speed, a small capacitance can have a significant effect.

The first of these three matching frequencies is no great problem as it is the oscillator circuit which is running at low voltage, and so any capacitors used to adjust it's frequency are readily available and very cheap.  The capacitors **C1** and **C2** are a different matter as they are operating at high voltage, and high voltage capacitors are not readily available at low cost or in many different values, however, these three frequencies **can** be matched exactly and the circuit made to work, producing excess power.

On the energetic forum, many very relevant and helpful comments have been made, some of which are reproduced here:

Frequency changes when a capacitor is attached across a coil.  The capacitance of the coil needs to be measured and added to the capacitor used.  With a capacitor connected across the coil, the frequency will remain the same and not shoot to up to MHz values!

We force the required frequency (35 kHz) with the input oscillator and then pad L1 to resonate at that frequency. Because the coils are resonating, the resistance between the coils is zero, and so power is there which used to be eaten up by resistance.  When we step the voltage down, the power remains the same but it is now in the form of high amps and low voltage.

We use bi-directional windings so we can control voltage and amps or reduce voltage and amps by increasing the number of clockwise or counter-clockwise turns.  The coil with 80 turns is wound clockwise.  The other coil has 5 turns clockwise and 5 turns counter- clockwise.  Coil primary 2" and secondary 3" with the coil winding spaced out so that there are 4 turns per inch on the secondary.

Make the L1 primary 4 times the wire length of the secondary L2.  This means that if L2 is 1 foot then L1 should be 4 feet, and if using bi-directional winds for L2, then 1 foot + 1 foot and 4 feet in L1.

The position of the spark gap in the circuit is important.  Don't use a spark gap in series.  Capacitors must be in parallel across the primary coil and a spark gap in parallel before that L/C combination.  If you change the spark gap position, all you will be getting is induction power which is always under unity and we don't want that.  The power gain comes from the spark and resonance.  A spark gap is a voltage-operated device, whereas a transistor is a current-operated device, and a spark is an important part of OU otherwise Kapanadze and Don Smith would have used a transistor.

Sparks keep pumping excess energy, so a spark gap is a vital part of the circuit.  As long as the spark gap is running, you will get a whopping amount of energy.  A spark gap is a current amplifier.  A spark can also be generated at 350 volts which is a manageable voltage.  An earth ground improves the performance and is always a must for tapping power.  It is advisable to separate the high-voltage and low-voltage sections of the circuit. They must not have a single earth, because if the voltage-controller fails, then you get high-voltage AC as a free bonus along  with the mains frequency and voltage, and if that happens, then you may have the pleasure of meeting Don

Smith, Tesla and Moray without a flight!

We overcame the mutual-inductance factor of the L1/L2 transformer by using copper-coated welding rods, as we can alter the coil's "Q" factor by increasing or reducing the number of rods inserted. It doesn't matter what way you wind the counter-clockwise and clockwise coils, what matters is how we join the ends and take the output between the joined ends and the centre-tapped (grounded) point of the coil. These coils are wound with four turns per inch as spreading the turns out reduces the self-capacitance of the winding.

Make sure that resonance is reached. **If you add copper-coated welding rods, then the coil inductance will change and you will need to get resonance again by adding capacitors across both the primary and the secondary coils**. At resonance, the results will be best. If you don't have resonance, the results will be low as they are just based on induction and that's what we don't want. We want resonance in order to give us the results.

A Neon Sign Transformer will work fine provided that it does not have a ground-fault interrupter built into it. If it does have one, then whenever you earth it in one of Don's circuits, it trips the cut-out and so is useless. That is why I made my own oscillator without a Ground-Fault Interrupter circuit.

You can use any wire but don't use hollow copper pipe. Consider how many amps you want in the output, and choose the copper wire diameter accordingly. It is better to use solid copper rather than stranded wire, but stranded wire can be used. When you have resonance, thicker output coil wire generates more amps and if you want to keep the input power low, then make the primary coil wire thinner. We don't have to worry about insulation provided that we keep the voltage per turn below 300 volts.

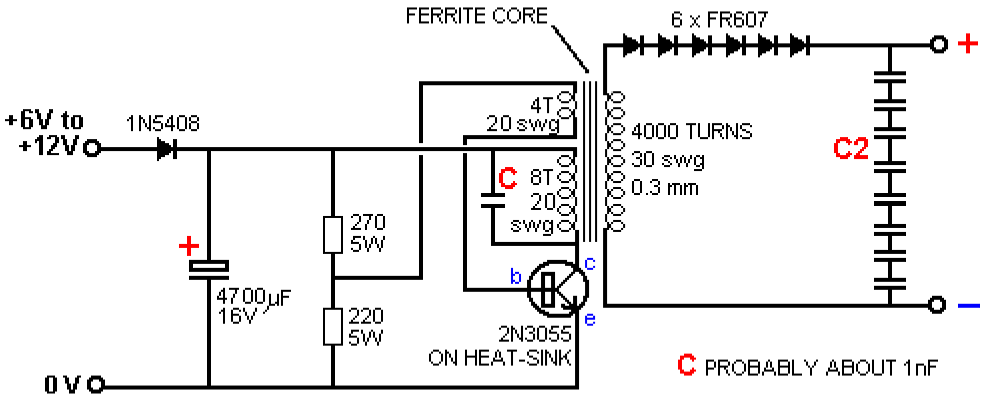
We can override the coil wire lengths ratio and just keep turns ratio of the primary and secondary in 1:4 ratio, so if the primary has 5 turns then the secondary can have 20 turns and if using bi-directional winds on the secondary, then 20 turns in each limb of the secondary winding bifilar or alternatively, 10 turns in each limb of the secondary winding. Capacitors on both windings will be needed to get resonance.

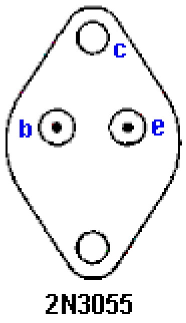
Filament bulbs powered with high frequency will not burn brightly because of the high frequency and high voltage. Lower the frequency and lower the voltage and see the difference: then excess power is yours.

In this circuit of Don Smith's which we are examining, the oscillator frequency does not need to be any particular value, provided that it is over twenty thousand cycles per second. The generated voltage is not at all critical and four thousand volts has just been selected as a good compromise voltage intended to give an excellent power gain without being particularly expensive. There are lots of alternatives which can be used as a spark gap, so there is no need to be concerned if some particular item is not readily available. In other words, there are many different ways to construct a working device.

The first step is to implement the power input section. It is possible to buy a ready-made power supply of this type as they are made to power neon-tube displays, but it is both cheaper and better to construct one from scratch. That way, if the manufacturing of the type of power supply used is discontinued, then it does not matter. Also, if one is built from scratch, then the understanding gained from building it, places the constructor in a position to repair or replace it should it become damaged or destroyed.

The following method of construction is just one of the various ways in which a power supply of this kind can be constructed, and if you are not familiar with circuit diagrams, then I suggest that you read through the electronics tutorial available free at [http://www.free-energy-info.com/Chapter12.pdf](http://www.free-energy-info.com/Chapter12.pdf) as it will explain everything you need to know to be able to read and understand circuits and how they work. This is a possible circuit:





As with almost all circuits, this diagram is read from left to right. So, the first thing which we encounter is an input of any voltage between six and twelve volts. The current draw from this battery is just under one amp, so we are talking about a reasonably powerful battery.

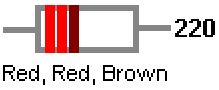
We then encounter a diode and a large-value capacitor which is connected directly across the battery. While it might be imagined that these components are there to iron out any voltage fluctuations caused by sudden demands for current, that is not the case. Although it is not shown in the diagram above, when the construction of the device is completed and it is running satisfactorily, then it is possible to take a small amount of the output power and feed it into this capacitor, which allows the battery to be removed and the device then powers itself without the need for a battery. So for the moment, we can ignore this capacitor except for including it in the circuit when it is being built.

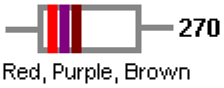
The diode is a device which allows current flow in one direction only, or at least, that is the theory. In practice, things are seldom perfect and so your average diode does not switch on and off instantly. For most applications, this does not matter very much as the diode only switches on and off about a hundred times per second, and so a normal diode such as the 1N4007 could be used in this position as it will never be required to switch faster than that. The 1N4007 diode can handle a thousand volts and up to one amp of current. However, some people may prefer to use a 1N5408 diode which is cheap and can handle up to 3 amps, as the current flowing in this section of the circuit is not far from the one amp which is the maximum current that a 1N4007 diode can switch. The 1N5408 diode can work at up to one thousand volts but it is not considered to be particularly fast switching. Possibly a better choice might be the FR607 which can handle a thousand volts, six amps and can switch on and off very quickly, which is useful when we reach the section of the circuit which switches seventy thousand times per second.

The active part of the circuit is the 2N3055 transistor along with its two resistors and one capacitor. The 3055 transistor looks like this:

The case type is called TO-3 and the 2N3055 is able to handle currents of up to fifteen amps continuously. In spite of that current handling capacity, it gets hot when working with even just one amp and so it needs to be mounted on a heat sink to dissipate the heat produced.

In this circuit, the transistor is wired as an oscillator or signal-generator, getting feedback from a coil of just four turns of wire. The frequency of the signal can be adjusted by the capacitor marked "**C**" in the circuit diagram. The two resistors feed current to the transistor to keep it running. They each need to have a power rating of 5-watts and unless they are ceramic with the value printed on them, they will have colour bands like this:





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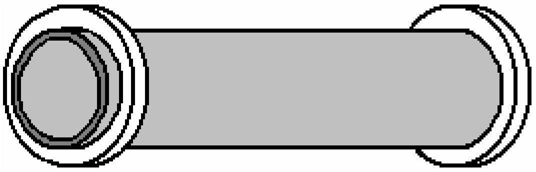
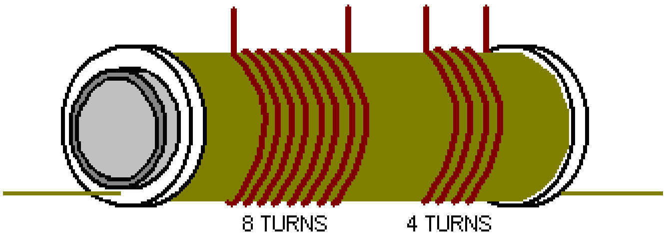
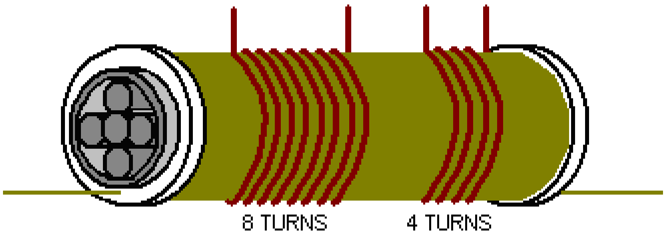
The next component in the circuit diagram looks very complicated, but in fact, it is a very simple item, namely, a coil of wire. This coil is wound on a short piece of plastic pipe of 2-inch (50 mm) diameter. The pipe diameter is not particularly critical, so any plastic pipe within five or six millimetres of that diameter should work well. A length of pipe of about four inches (100 mm) is cut off and fitted with discs in order to convert it into a shallow spool:



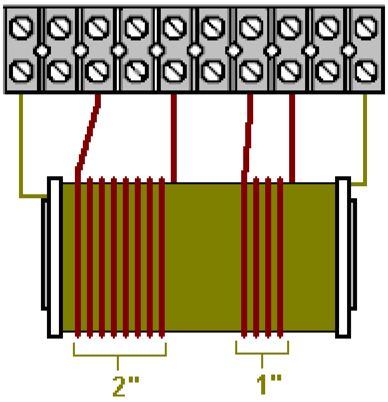
This is then wound with an entire 500 gram reel of 30 SWG (#28 AWG) enamelled copper wire, and while this 0.3 mm diameter wire is expensive, making this coil is considerably cheaper than buying a ready-made neon-tube driver module. Wire with diameters down to 38 SWG (#34 AWG) could be used but due to the greater length, the turns would need to be counted unless you compensate by increasing the number of turns in the 8-turn coil. When the winding is completed and the end of the wire secured, two other small windings are made using 20 SWG (#19 AWG) enamelled copper wire which has a diameter of 0.9 mm. Only a 50 gram reel of this wire will be needed as one winding has just eight turns and the other, only four turns, although these numbers can be increased. Increasing the number of turns in the 8-turn coil reduces the output voltage, while increasing the turns in the 4-turn coil gives an increased drive to the transistor.



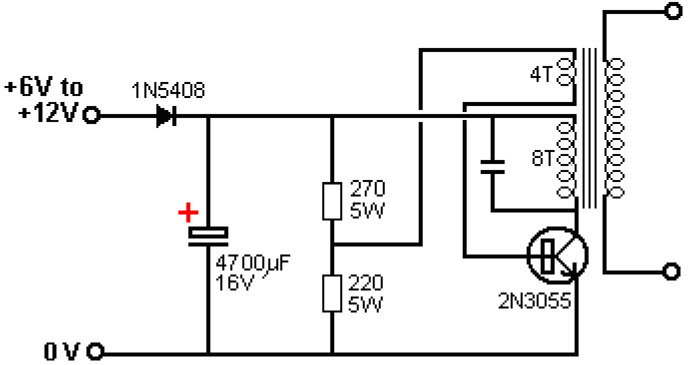
Finally, ferrite rods four inches (100 mm) long are placed inside the plastic pipe in order to improve the magnetic coupling between the three windings, although the coil appears to work perfectly well without these ferrite rods. Placing the primary winding inside the secondary winding would give better magnetic coupling but having the short primary winding accessible on the outside is an enormous advantage.



The coil can then be taped over using electrical tape, and if you have a neat disposition, attached to a base board and fitted with screw connections:



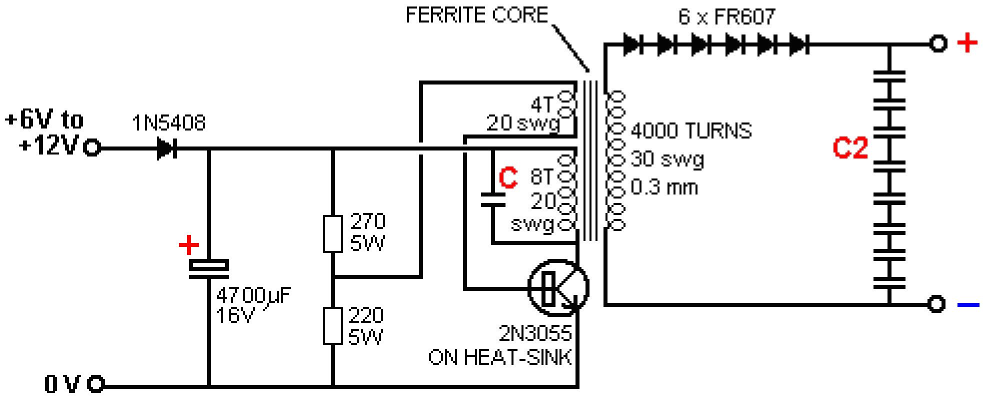
These are the physical items needed in order to build the circuit up to here:



The output voltage is controlled by the input voltage and the ratio of the 8-turn primary winding to the about 4000-turn secondary, which is a ratio of 1:500, which means that if the 8-turn winding has twelve volts pulsed across it, then there will be six thousand volts developed across the secondary winding. In our case, the voltage will not be quite as high as that because the 500-gram reel of wire has 700 metres (2,300 feet) of wire on it and that is not quite long enough to give a full 4000 turns on our coil.

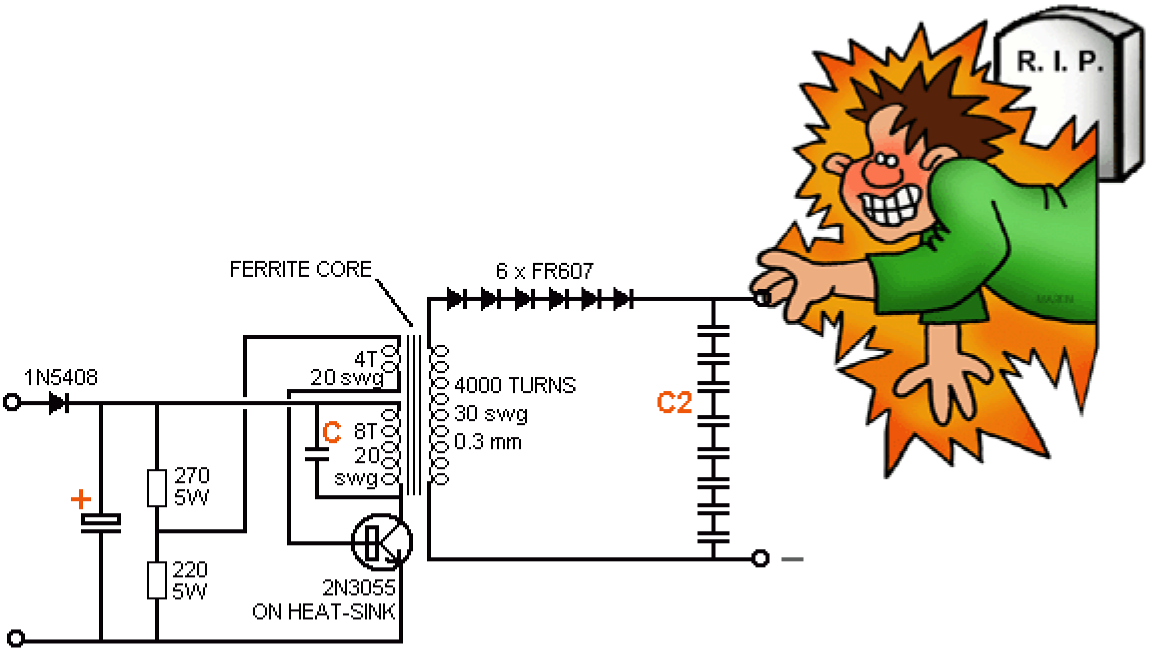
It may surprise you to know that this part of the circuit achieves a major increase in power when it is running. The power is proportional to the square of the voltage multiplied by the square of the frequency. Driven by a battery, the circuit draws less than twelve watts, but let's compare the output to the mains instead, in which case the voltage has increased from 240 volts to 4000 volts (16 times higher) and the frequency has increased from 50 cycles per second to 35,000 cycles per second (700 times higher) and that gives a power increase of more than 136 million times. The difficulty is to extract that excess power without losing it and that is what this design is all about.

The first step in keeping hold of this excess power is to convert it to pulsing DC and that is done with a diode. It could be done with just one diode if you happen to have a powerful diode which can operate at high speed and which can handle at least six thousand volts. A diode like that is expensive, so a more practical option is to use several cheap diodes connected in a chain. Each of the FR607 diodes mentioned above can handle a thousand volts, and so using six of them allows the high voltage to be dealt with. However, please don't think that you **have** to use FR607 diodes, as they are just my personal choice. You can use any diode which can operate rapidly and which has a reasonably high voltage rating ("Peak Inverse Voltage" is the fancy technical term).



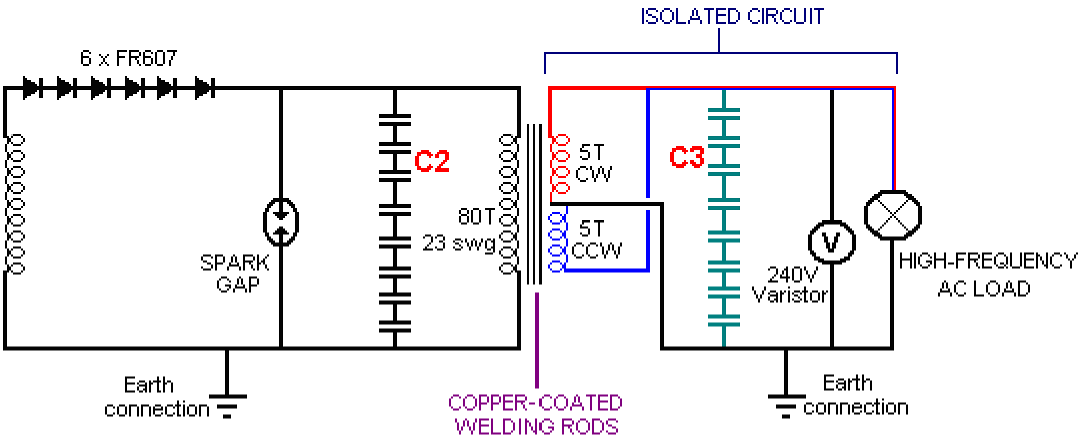
In this particular version of the circuit, we want to feed the pulsing DC output from the diodes into a capacitor "**C2**" with a coil connected across it. If we have the same problem with finding a cheap, high voltage capacitor, it can be cheaper to use several capacitors in a chain. However, unlike diodes, each extra capacitor added to the chain, while it does increase the voltage which can be handled, reduces the overall capacitance of the 'composite' capacitor chain. Polypropylene capacitors are the best type for this kind of circuit, but they are rather expensive for their capacity.

However, please understand that adding the diodes and the "**C2**" capacitor has raised the danger level of the circuit very substantially:



This is not a toy and a high-voltage capacitor is a very dangerous thing when charged up, so great care needs to be taken when dealing with any such device. Let me stress again that this document is **NOT** a recommendation that you should actually construct one of these devices, but is merely presented as an educational item for information purposes only. If you decide to ignore this fact and construct any such device, then the responsibility for any injury or damage caused by it is solely and entirely yours, as you have been told not to do it.

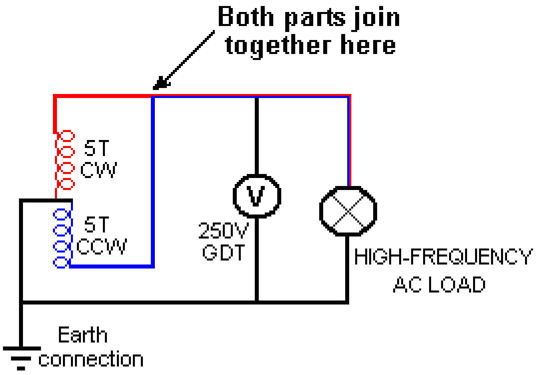
An effective method for extracting the increased energy from this circuit is to reverse the process and use a transformer to step down the high voltage, increasing the available current in the process. We need to keep this secondary process isolated from the power supply, and so the next transformer is actually an isolation transformer and the two sides of the circuit must not be connected together. You will notice that there is a genuine earth connection used for each side of the circuit. These **have** to be two completely separate ground wire connections. If a single earth connection were used, or two separate wires run to a common earthing point, then that would bypass the isolation transformer and connect the two sections of the circuit together through the earth wiring. So, please understand that when the circuit shows two separate earth connections this is **not** just a convenient way of drawing the circuit but instead it shows two essential, separate wires running to two different earthing rods (or metal objects buried in the ground).



As can be seen here, the remainder of the circuit looks simple and innocent. That impression is slightly misleading as the circuit operation is subtle. The capacitor "**C2**", if used, does not need to have a large capacitance as the circuit operates at high frequency. Consequently, capacitor "**C2**" must fill up rapidly. Although capacitor "**C2**" has a small value, it needs to be selected with great care. First, the output frequency of the actual physical oscillator section needs to be measured exactly with a frequency meter. Then, both the inductance and the capacitance of the 80-turn coil must be measured with an LCR meter. Either a nomograph or an on-line calculator will specify the exact value of capacitance which is needed across the coil inductance in order to make the combination resonate at exactly the frequency being generated by the oscillator section. Part of that required capacitance is already there due to the coil's own self-capacitance, and so that needs to be subtracted from the calculated capacitance in order to determine what physical capacitor needs to be connected across the coil. Getting that exact capacitance using the few high-voltage capacitors available on the market is then the challenge.

When the voltage on capacitor "**C2**" reaches a high value, the spark gap connected to it conducts and it's spark discharge of the capacitor energy passes a very sharp, high-voltage pulse to the primary winding of the isolation transformer. In spite of it's impressive name, the isolation transformer primary is just a coil of enamelled copper wire of 23 SWG (#22 AWG) size (0.6 mm diameter) wound on a two-inch (50 mm) plastic pipe. To improve it's magnetic coupling, the pipe can be filled, either partially or completely, with copper-coated welding rods (or ferrite rods). If the plastic tube can slide, then it is said that the high-voltage capacitor "**C3**" can be omitted and the output stage can be fine-tuned by adjusting the position of this 80-turn coil inside the 5+5-turn coil. I think that Zilano disagrees with this.

The final coil is a really major item in this design and Zilano's arrangement is somewhat different from Don Smith's method. The key feature is that this coil is wound with two sections and those sections are wound **in opposing directions**. The design shows just five turns of thick wire in each of the two parts. One part produces current and the other part produces voltage. These two are out of phase and will short-circuit each other at all frequencies other than their common, resonant frequency. It is possible to vary the turns in one part to enhance either voltage or current but that is a procedure for later experimentation in the unlikely event that it should be needed. The two sections are connected directly together as shown here:



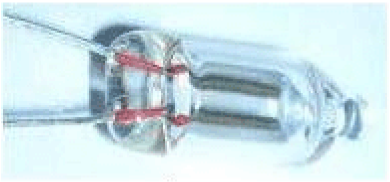
Due to the turns ratio between the primary and secondary winding in this transformer, this arrangement steps the voltage back down to around 240 volts while keeping the frequency high and boosting the output current to a very high level (providing that resonance is maintained). To protect against voltage spikes a Varistor or Gas-Discharge Tube is connected across the output. A varistor has considerable capacitance while a GDT has a capacitance, typically, of less than 1 pF, so apart from being a more robust component, a Gas-Discharge Tube is probably the better choice and GDTs with spark voltages from 90V to 350V are readily available. Don Smith may show a spark gap in that position but he is actually intending it to be a Gas-Discharge Tube as they are commercially available and intended for just that purpose.

A really key factor in the 80:5+5 transformer is that the length of wire in the two windings should have a direct ratio in order to force resonance. To get the exact resonance between these two coils, the inner coil can be moved slightly off-centre inside the larger coil. While it may be possible to tune the 5+5 turn coil by positioning it, if the wire length in those turns is exactly one quarter of the wire length in the 80-turn coil, Don Smith generally shows a fine-tuning capacitor connected across the coil. Again, the method for determining the correct value for that capacitor is to measure the (combined and wired across each other) inductance of the coil and it's self-capacitance (which will be reduced by having the turns spread out – four turns per inch if the wire is small diameter and one wire thickness if the wire is say, 6 mm in diameter). If a 4:1 ratio is not used, then it is still possible to overcome that situation by careful selection of larger capacitors to connect across the windings.

At this point many people get stuck, wondering how they can get back down to the mains frequency as it does not occur to them that many important applications do not need that frequency. The low frequency of the mains is mainly to allow cheap motors to run on the mains supply, and that low frequency makes mains electricity much more dangerous to humans, than a high frequency supply of the same voltage. Equipment which does not have a mains-powered electric motor is likely to operate on a high-frequency supply. For example, I am told that halogen lamps are much more efficient when driven by a high frequency supply, and so they give their rated output on a much lower level of input power. I can see no reason why a halogen heater should not work perfectly well on the output from this circuit, and heating is a major cost for most people who live in cold countries. However, those halogen heaters which have a tiny mains-powered motor built in for making the heater swing from side to side, probably should not have that option switched on.

The immediate impression is that fan heaters are a non-starter due to their mains-powered fan. But these heaters generally have a switch setting which allows the heater to be used as a fan on its own. If then, the heater wiring were changed so that the heating elements are powered by the high frequency supply and the fan remains mains-powered, then the operational cost of the heater would drop to that of just running a fan on the mains supply. So, the simple circuit shown so far has very serious potential for a household.

When making an earth connection, it is sometimes suggested that connecting to water pipes or radiators is a good idea as they have long lengths of metal piping running under the ground and making excellent contact with it. However, it has become very common for metal piping to be replaced with cheaper plastic piping and so any proposed pipe connection needs a check to ensure that that there is metal piping which runs all the way into the ground.



**Neon**

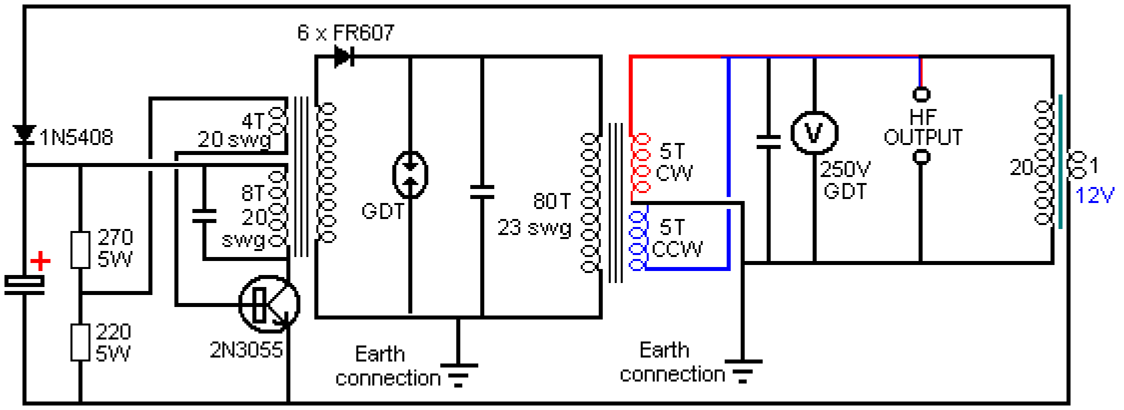
**Gas-Discharge Tube**

The spark gaps shown can be commercial high-voltage gas discharge tubes, adjustable home-made spark gaps with stainless steel tips about 1 mm apart, car spark plugs, or standard neon bulbs, although these run rather hot in this application. A 15 mm x 6 mm size neon bulb operates with only 90 or 100 volts across it, it would take a considerable number of them connected in series to create a high voltage spark gap. However, it is a distinct possibility for people, such as myself, with limited constructional skills as the wires of successive neons only need to be twisted together and then clamped in a screw connector block.

It should be clearly understood that I, personally, am a complete beginner as far as this device design is concerned. I certainly don't have all the answers by any means and the purpose of this information is to draw together sufficient basic information in order to allow a newcomer to understand the overall design concept. At this point in time, this is a development project for the more advanced and experienced experimenters.

To make this design self-powered, it has been suggested that a simple resistor divider pair placed across the 240-volt high frequency output can be used to feed the input of the power supply circuit which has already been set up with a diode and capacitor to receive just such an input. This is not a solution which appeals to me as a current of up to one amp may be required, which means that 250 watts will be drawn from the output in order to supply a mere 12 watts of power. I know that the 250 watts of output is free, but I still don't think much of having to dissipate 238 watts in order to supply 12 watts, besides which, doing that would be nearly impossible with resistors. The high frequency prevents a standard transformer being used, but winding a 1-amp step-down transformer on a an insulated ferrite rod is hardly a major undertaking. The current in the primary wire would be only 50 mA, so in theory, wire as fine as 38 SWG (#34 AWG) with a diameter of just 0.15 mm could be used for it. The first page of the Appendix shows the details of these wires. I would also suggest putting a 12V zener diode across the input of the power supply to ensure that no more than 12 volts gets fed back from the output to the input, although a 250V Gas-Discharge Tube connected across the output would effectively prevent a voltage runaway from this positive feedback.

The ratio of the primary turns to the secondary turns on such a transformer would be 240:12 or 20:1 and the smallest wire for the secondary would be 22 SWG (#21 AWG). However, if you are going to wind a step-down transformer for this job, then you might as well make the windings much larger and rectify the output so that you can run a standard inverter from it, to power things which really do need mains frequency, as well as providing the twelve volt input needed to run the circuit. With just the basic feedback the circuit might be like this:



So far, this construction has opted for the most simple arrangement, one which can be constructed with minimal equipment.  That does not mean that it is not possible to have a full-blown, mains frequency, mains voltage, self-powered device without the need for an inverter, by modifying this implementation one step further and pulsing the output at the local mains frequency.  However, for the moment, I will direct you to the forum where there are various options shown and where discussions can be held with experienced people who are working to advance this design further.  The forum link is:

http://www.energeticforum.com/renewable-energy/4864-donald-smith-devices-too-good-true-60.html.

The construction suggested so far is that transformers are wound on PVC plastic pipe.  Most people believe that PVC is a good electrical insulator and that is reasonably true for DC and low frequency work, it is not true at higher frequencies where PVC is actually a poor choice.  One way around this is to coat the PVC pipe with a high voltage insulating varnish, such as shellac (used by ladies to enhance the appearance of their nails).  Three coats should be used.  Nowadays, shellac is expensive, and so an alternative would be useful.  Using acrylic tube rather than PVC overcomes the problem.  I understand that dissolving table tennis balls in 30 cc of 100% acetone per ball gives a lacquer which is likely to be suitable for insulating for high frequency work – a search will find instruction videos on YouTube if that option appeals to you.

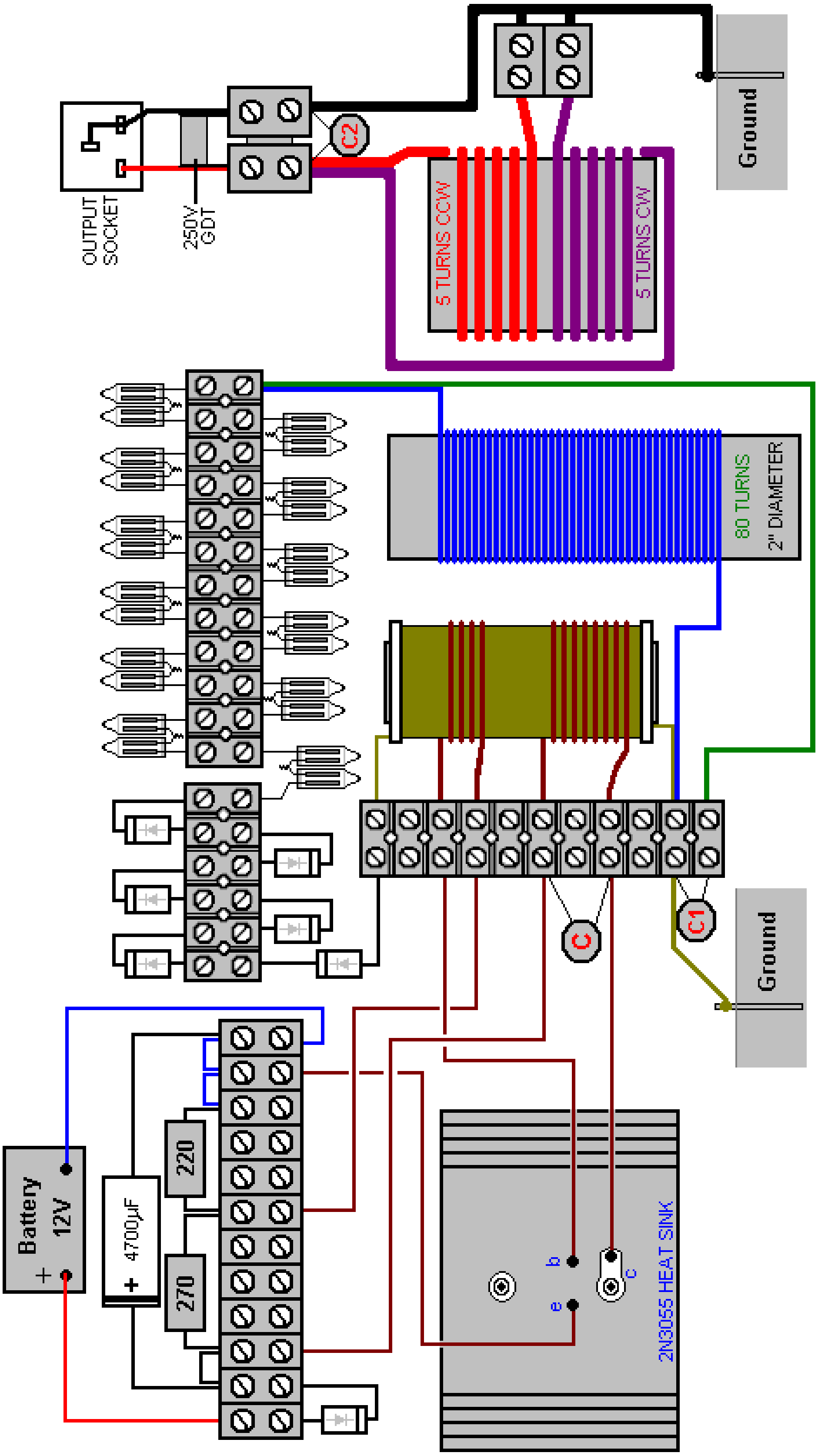
Let me stress once again, that this description must not be considered a recommendation or encouragement by me to persuade you to actually physically build one of these high-voltage devices.  Should you decide to do so, then it is against my specific recommendation and you do so entirely at your own risk.

I have never built one of these devices, so the following physical layout is purely speculative and not guaranteed to work.  Although a single Gas-Discharge Tube may well give a better result, for a spark gap, simple 15 mm x 6 mm diameter neon lamps are shown here, as much to show the technique as anything else.  These neon lamps fire at around one hundred volts and so the ones shown in this layout will trigger at around 2,400 volts.   Lower voltages can be selected, going down in jumps of around 200 volts by connecting to the terminal block at an earlier position which excludes the end neons.  Higher spark trigger voltages can be obtained by adding a second terminal block of neons.  These devices are silent in operation, no mechanical construction is required and the spark voltage setting can be altered quite easily.  They appear to light continuously but the current flow through them is a series of spark discharges occurring in very rapid succession.  One person who has constructed this exact configuration reports that the neons get very hot in his implementation.

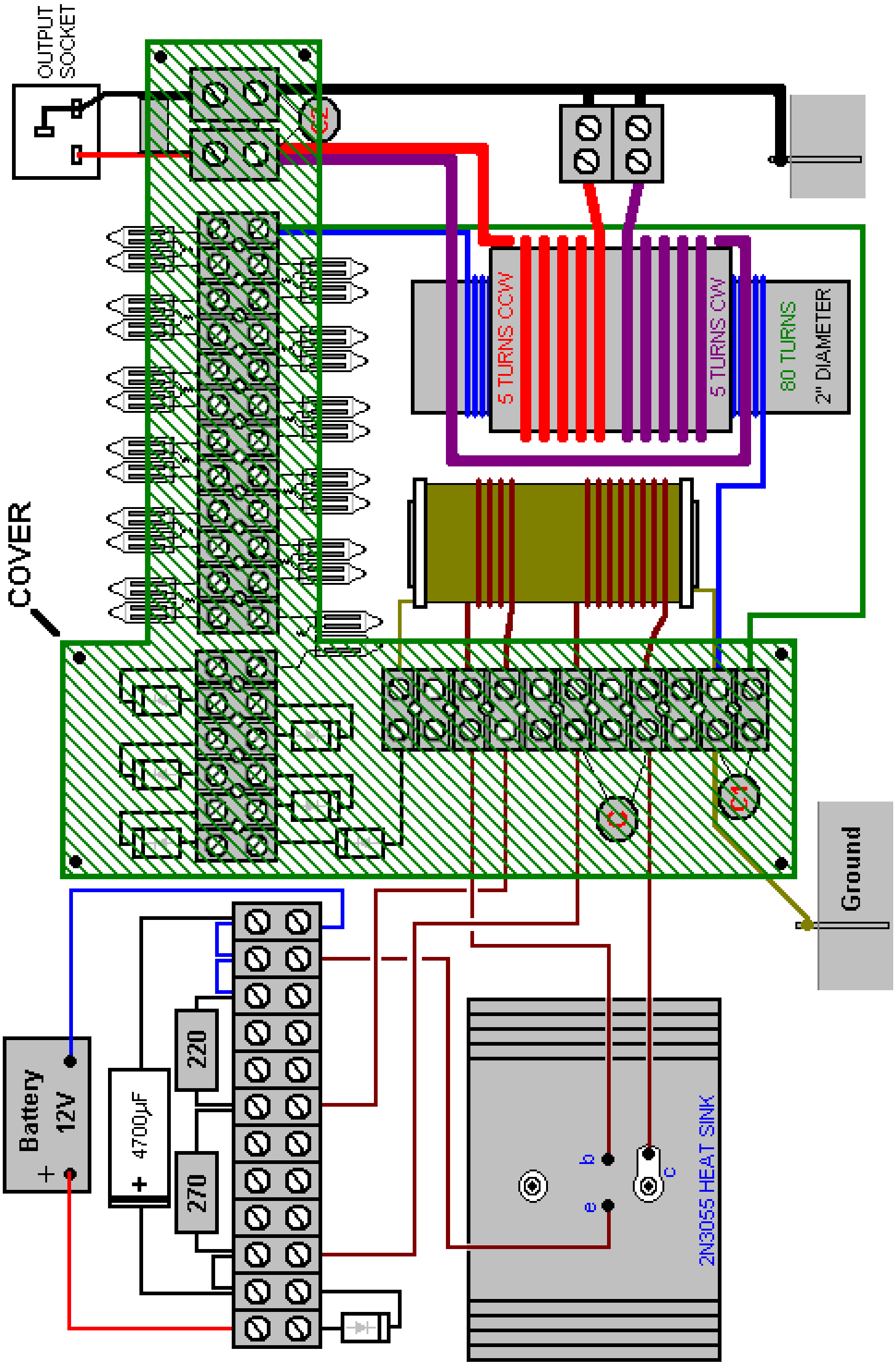
The underneath view of the heat sink for the 2N3055 transistor is shown in order to indicate clearly, where the connecting wires go.  The collector of the 2N3055 transistor is it’s case, and so a solder tag or other similar method is used to connect a wire to it.  It is normal to solder wires to the base and emitter pins of the transistor, but if soldering is not an option, then a single screw pair cut off a terminal block can be used instead.

A circuit breaker has not been shown although that would be normal practice.  This is because it appears that if the output of this device is short-circuited, it does not cause any problems for the device.  One could be placed just before the output socket(s) if it is felt to be an essential item for other reasons.

A notional physical layout might be as shown below:



Parts of this circuit are highly dangerous to touch, so apart from wearing thick rubber gloves when working on it, and possibly connecting a ten megohm resistor across each high-voltage capacitor (which does not have a coil connected across it), a non-conducting cover should be fitted over those parts of the circuit which have high voltage on them when operating, perhaps something like shown here:



The circuit is **not** powered up unless the cover is already fastened in place. It is probably not necessary to cover over the screw connectors of the output section as their screws are fairly well shielded by the tall plastic surround for each individual screw. As the circuit creates high-power, high-frequency currents, it will act as a radio-frequency transmitter, and so, when it is working correctly, it should be enclosed in a ferrous metal box which is connected to one (and only one) of the two earth wires.

This section may be expanded at a later date to show an effective way to lower the output to high-power AC at the local mains voltage and frequency.

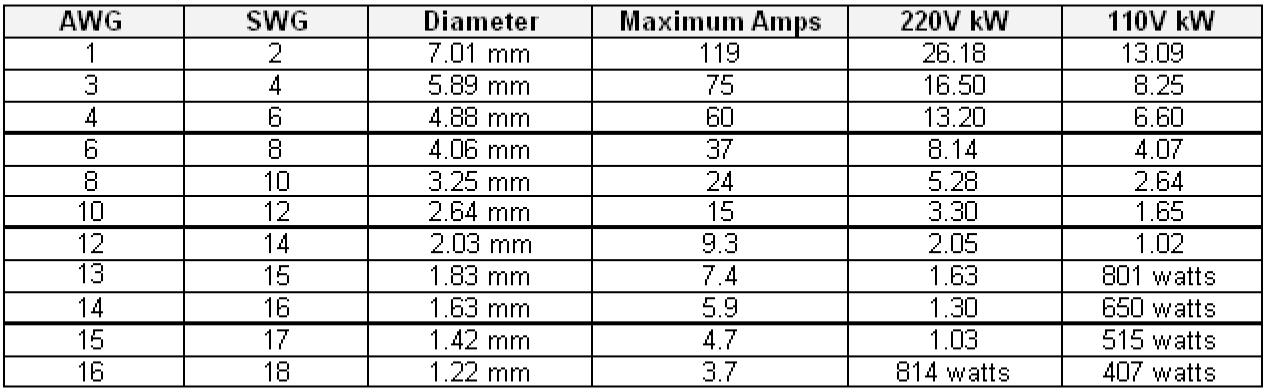
Here is a possible inventory of the main components used so far:

| Item | Quantity | Code |
|---|---|---|
| Capacitor, 4700uF 16V (or higher voltage rating) | 1 | - |
| Diodes, high frequency, high voltage, 1A or higher | 7 | 1N5084 |
| Resistor, 5 watt (Red, Purple, Brown) | 1 | 270 ohm |
| Resistor, 5 watt (Red, Red, Brown) | 1 | 220 ohm |
| Ceramic capacitor (measured values, probably composite) | 3 | measured |
| Solid enamelled copper wire | 50g reel | 20 SWG |
| Solid enamelled copper wire | 500g reel | 30 SWG |
| Solid enamelled copper wire | 100g reel | 23 SWG |
| Heavy gauge wire, sufficient for 10 turns of 2” diameter | - | - |
| High-power bipolar transistor | 1 | 2N3055 |
| TO-3 transistor heat sink plus nuts, bolts and one solder tag | 1 | - |
| Earth connecting rods or similar plus connecting wire | 2 | - |
| Spark gap (home-made) or car spark plug | 1 | - |
| Alternative to spark gap: 15 x 6 mm 100V wire-ended neon lamps | 50 | - |
| Electrical terminal strips (12-way) | 5 | - |
| Mains voltage Varistor | 1 | - |
| PVC pipe, 2-inch (50 mm) diameter, 4.5 inches (110 mm) long | 1 | - |
| Ferrite rods, 10 mm diameter, 4-inches (100 mm) long | 5 | - |
| PVC pipe, 2-inch (50 mm) diameter, 30 inches (700 mm) long | 1 | - |
| PVC pipe, 3-inch (75 mm) diameter, 12 inches (300 mm) long | 1 | - |
| Electrical insulating tape | 1 reel | - |
| Baseboard on which to secure the components | 1 | - |
| 12V battery or 12-watt 12V power supply | 1 | - |
| Battery connectors to suit battery type | 2 | - |
| Optional: insulating varnish for the PVC pipes, shellac or similar | 1 bottle | - |

There is nothing magical about the three-inch and two-inch diameters used by Don Smith when building this device. The three-inch diameter is the largest size which he could buy from Barker & Williamson who make high efficiency coils, and the two-inch diameter is as large as could slide inside that coil when wrapped around with the thick “jumbo speaker wire” cable which he used for the inner coil. In passing, you might note that while 50 mm metric PVC pipe is exactly 50 mm outer diameter (2-inches), the 2-inch PVC pipe is a good deal larger than two inches outer diameter, the ones which I have measured were around 2.188 inches (55 mm).

In our case, we have to wind these two coils on two different cylinders of some description. As mentioned before, PVC pipe is not a great material when using high-frequency high-voltage signals. The much more expensive acrylic pipe is excellent, but if using PVC, then performance will be better if the PVC pipe is coated with an insulating lacquer as mentioned earlier.

The length of wire in the turns of the 5+5 turn coil should be exactly one quarter of the length of the wire in the turns of the (hopefully) 80-turn coil. The length per turn in the 3-inch coil depends on how thick the wire plus it’s insulation is. To determine that, the desired output power of the device is chosen, for example, that might be two kilowatts. A suitable wire is then selected from the specification for commercially available wires:



| AWG | SWG | Diameter | Maximum Amps | 220V kW | 110V kW |
|---|---|---|---|---|---|
| 1 | 2 | 7.01 mm | 119 | 26.18 | 13.09 |
| 3 | 4 | 5.89 mm | 75 | 16.50 | 8.25 |
| 4 | 6 | 4.88 mm | 60 | 13.20 | 6.60 |
| 6 | 8 | 4.06 mm | 37 | 8.14 | 4.07 |
| 8 | 10 | 3.25 mm | 24 | 5.28 | 2.64 |
| 10 | 12 | 2.64 mm | 15 | 3.30 | 1.65 |
| 12 | 14 | 2.03 mm | 9.3 | 2.05 | 1.02 |
| 13 | 15 | 1.83 mm | 7.4 | 1.63 | 801 watts |
| 14 | 16 | 1.63 mm | 5.9 | 1.30 | 650 watts |
| 15 | 17 | 1.42 mm | 4.7 | 1.03 | 515 watts |
| 16 | 18 | 1.22 mm | 3.7 | 814 watts | 407 watts |

It is recommended that the wire have a current carrying capacity of 20% more than the expected actual load, so that it does not get very hot when in use. The wire diameters do not include the insulation, although for solid enamelled copper wire, that can be ignored. To get the accurate wire length, the actual wire to be used is wound around the 3-inch former and a mark made across the five turns. The turns are then gently unwound and straightened out and the distance taken for those turns measured accurately. The thicker the wire, the greater the length needed as the effective coil diameter increases with the thickness of the wire.

If, for example, the wire selected is 8 SWG with a diameter of 4.06 mm. then the diameter including the insulation might be 6 mm and the length of ten turns on a 3-inch former 2,582 mm. Four times that is 10.33 metres which is the length of wire in the turns of the coil on the 2-inch former.

The wire for the 2-inch former coil can be half the diameter, and so 14 SWG would be chosen and that is available as solid enamelled copper wire. Most of the nominally 2-inch PVC pipes in my area have an actual outer diameter of about 55.5 mm which suggests that 10.33 metres would give only 57 turns on it. With a 50 mm PVC pipe, that would be 63 turns which is a long way from the 80 turns which would suit the voltage step-down requirements.

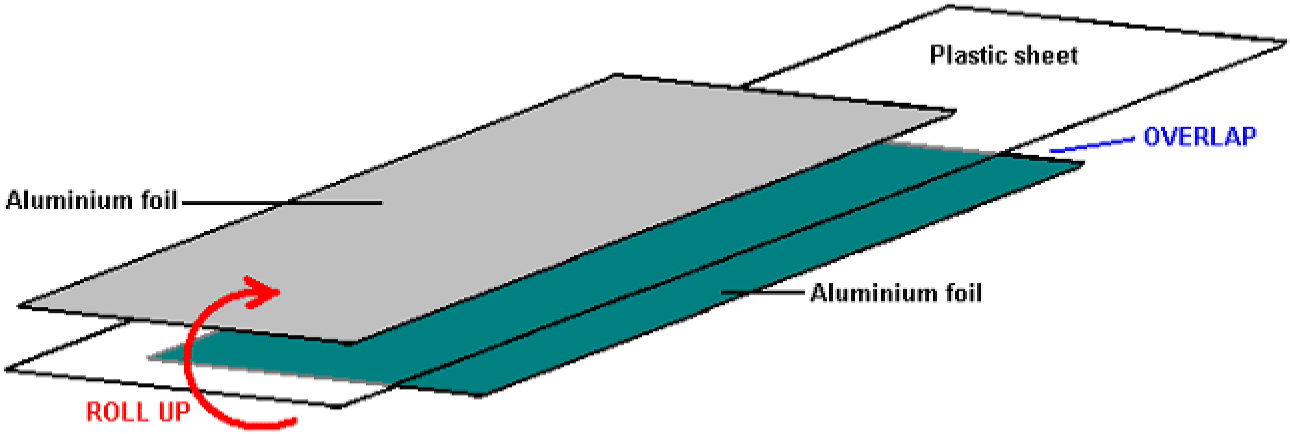
To overcome this, we can either drop the generated voltage to about 2735 volts by increasing the number of turns in the 8-turn generator coil primary, pad both coils with expensive high-voltage capacitors (if we have the technical know-how to do that), or select a smaller diameter wire for the 80-turn coil, use a pipe with a slightly smaller diameter or use a former larger than 3-inches for the larger coil. The next wire size down is 15 SWG with a diameter of 1.83 mm which would give about 63 turns so that is clearly not an option.

Using 14 SWG wire and 80-turns on a 50 mm pipe would give a wire length of about 13076.5 mm for the 5+5 turn coil which, using 8 SWG wire would need a former with a diameter of 4-inches, which actually might not be a bad thing.

Just to clarify matters. The length of wire in the transformer winds is important, but not critical. If the wire length is wrong but you want the coil's resonant frequency to exactly match the power supply frequency, you can't, but what you can do is connect the right value of capacitor across the coil, making the resonant frequency of the resulting coil/capacitor combination an exact match for the power supply frequency. The really important thing is to make the 5+5 turn secondary coil resonate with the 80-turn primary and that will always happen if the wire length in the turns of the 5+5 turn coil is exactly one quarter of the wire length of the 80-turn coil. If the resonance between the 80 and 5+5 turn coils is not quite perfect, then moving the 80-turn coil slightly relative to the 5+5 turn coil can correct that. Don preferred to use a small capacitor across the 5+5 coil to match the tuning exactly. What is essential is to have resonance between those two coils, otherwise, there will not be any excess power output.

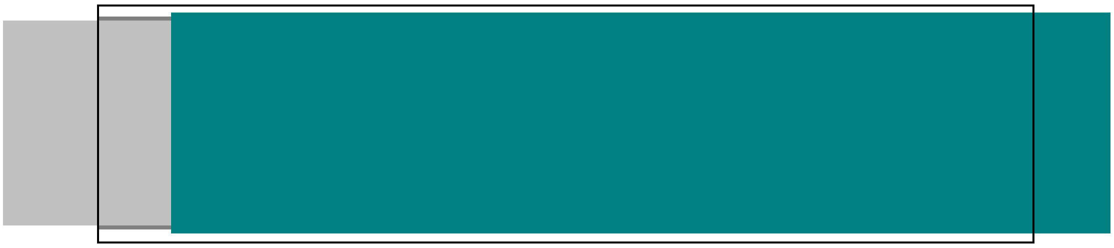
In one of Zilano's posts it is stated: Very important: the position of the spark gap is important. Don't use a spark gap in series. Capacitors must be in parallel across the primary coil and a spark gap in parallel before the L/C combination. If you change the spark gap position, all you will be getting is induction power which is always under unity and we don't want that.

The Geek Group of America, has a very instructive video explaining capacitor types and how they are made, at http://www.youtube.com/user/thegeekgroup#p/search/0/pdYJgnWe40s although they use higher voltages than a Don Smith design needs. The Geek Group video says that they sell high-voltage polypropylene capacitors at $1 over their bulk-purchase costs. If they do, then I have been unable to locate where they have them on offer. They also demonstrate how high-voltage capacitors can be constructed:



The materials are just aluminium (“baking”) foil and plastic sheet, which while it is shown as transparent here, can of course, be opaque. Two long strips of foil are separated by a long strip of plastic (longer than the foil strips so that it forms an outer cover when rolled up). These are then rolled up:

Note the overlap where there is a considerable width of the plastic sheet between the ends of the two strips of foil. When rolled up, the ends of the foil stick out:



A wire is then attached to the foil ends, and ideally, the capacitor placed inside a plastic container:

The longer the foil strips, the higher the capacitance. The wider the foil strips, the higher the capacitance. The thinner the plastic, the higher the capacitance. The thicker the plastic, the higher the working voltage, but the lower the capacitance. As with any purchased capacitor, an LRC meter has to be used to determine the exact capacitance since, for resonance, we need an exact value (although a high-voltage trimmer capacitor might be used to produce an exact match). This description is **NOT** an encouragement or recommendation that you should make one of these, but is presented here solely as an educational description of how a capacitor can be made. High-voltage capacitors are very, very dangerous and when charged, can kill you. Alternative home-build capacitor types include the Leyden jar where a glass jar has foil inside and out, and the ‘seawater’ capacitor where a strong salt solution inside and outside a glass bottle forms the capacitor.

There are not that many high-voltage capacitors available at low cost. For example, at the present time on eBay, a 100nF 10 kV polypropylene capacitor costs £16.22 and there is a month’s delay while it ships from China:

A paper in oil 100nF 4 kV capacitor is £14.87:

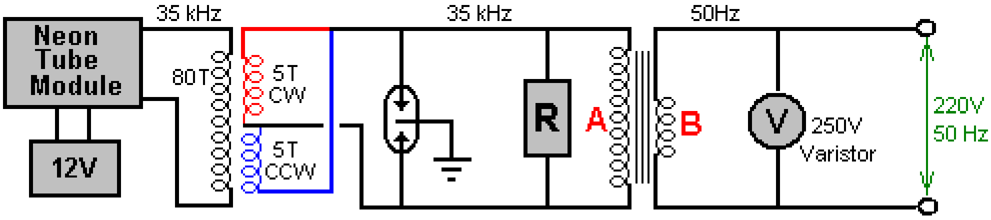
and an RFT 100nF 4 kV capacitor costs £18.81:

and more than one high-voltage capacitor will probably be needed.  If this device interests you, then you should watch these two videos:

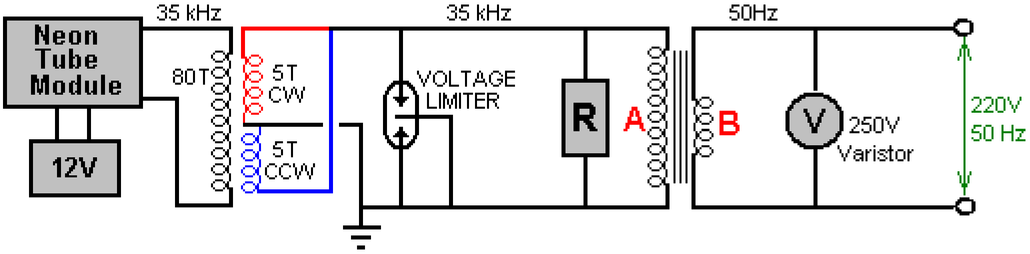
http://www.youtube.com/watch?v=Qp1fxvNjGmQ

http://www.youtube.com/watch?feature=endscreen&NR=1&v=gW265RlFEeQ

What Don Smith says in these two videos is particularly interesting.  He uses a 12V neon tube driver module to provide a 35 kHz frequency, high voltage output and feeds that directly into an air-core transformer where the only requirement is that the length of wire in the coils must be an even division or even multiple of each other.  My understanding is that these wire lengths are the lengths of wire used in the actual winds and the lengths do not include the straight connecting wires which are not part of the turns.  Other people disagree, so tests need to be conducted to establish which view is correct, although, making the connecting leads have a 4:1 ratio also, seems like a simple arrangement.  In this simplified circuit of Don's, he does not mention a working spark gap, but instead, if I understand him correctly, he shows it this way:



This is **VERY** interesting.  Firstly, there is no working spark gap in this circuit.  The spark gap shown is a Gas-Discharge Tube - a commercially manufactured voltage-limiter which only fires if there is an unwanted voltage surge, pinning the voltage on the two rails to the design maximum, of perhaps 500 volts, dictated by the output voltage of the neon tube module and the ratio of the turns in the 80:5+5 transformer (which could be 160:5+5 if a greater voltage drop is required).  When things are running normally, it doesn't fire at all and you will notice that the only earth connection which Don mentions is for this spark gap.  However, it is my opinion that it is important to earth the middle point of the 5+5 turn coil which would make the circuit look like this:



Another very encouraging feature is that no high-voltage capacitors are needed. The voltage is now stepped down to the wanted output level, say, 230 volts, by the ratio of the number of turns in coil ”A” to the number of turns in coil “B”, and to make sure that there are no spikes passed along with the output AC, a varistor or Gas-Discharge Tube is connected across the output, say one of 250 volts so that it will not act unless a serious voltage surge happens. Please remember that varistors have a very low power rating and so should only be conducting occasionally, while Gas-Discharge Tubes are more robust.

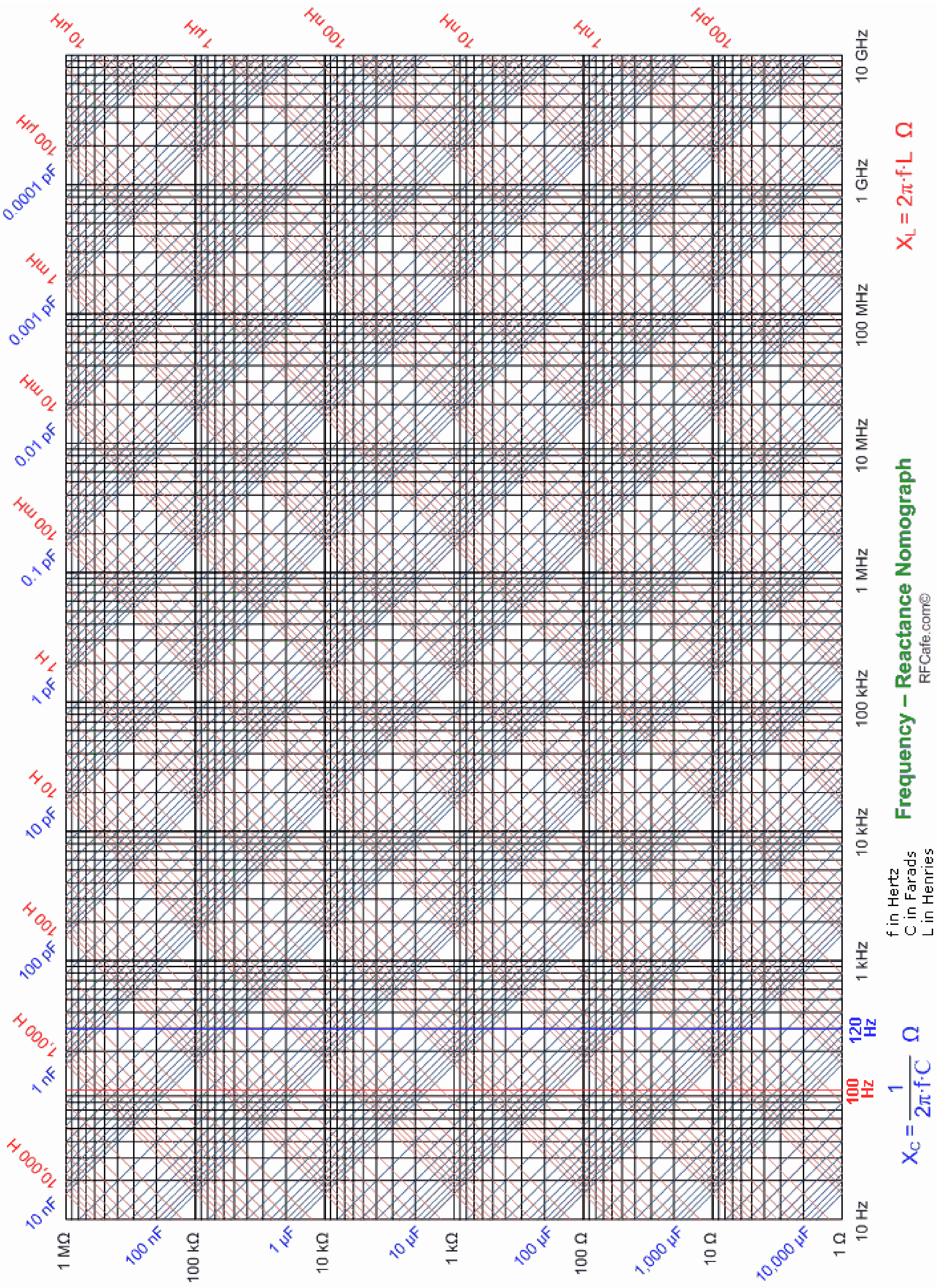
We want the output frequency to be 50 Hz or in America 60 Hz. Don says that the way to do this is to connect a resistor “R” across coil “A”. Don remarks that “R” could be a coil/resistor combination, or a coil/capacitor combination, or a resistor/capacitor combination. But, considering the practical problems involved with this method appears to rule it out, but let’s follow the process through to see what results.

There is nothing to stop you picking the turns ratio of the 80:5+5 turn transformer to give you the desired output voltage at coil “A” but even doing this, there is likely to be a serious problem. No matter what the voltage is, it would be nice to be able to predict the value of the resistor or capacitor needed for “R”.

To do this, Don recommends the use of a Nomograph which has a frequency range down to 50 Hz. To set up this circuit, you need a multimeter which can measure frequency and an “LCR” meter which can measure the inductance of a coil. So the procedure is to use the LCR meter to measure the inductance of coil “A”. You then follow the sloping inductance line for that inductance to where it cuts the (red) 100 Hz line and that lets you read off the capacitance which could be used, or the resistor which could be used to lower the frequency to 50 Hz. However, the power dissipation in any such resistor or capacitor would be enormous and you are probably looking at an electric fire being the “resistor”. Ohms Law tells you the current which will flow through that resistor is 220 volts is connected across it and the power dissipation will be 220 times that current. A 100 mH primary would need around a 33 ohm resistor which would have a power dissipation of nearly 1500 watts (commonly known as an electric fire). So a different method of altering the frequency is needed.

You will notice that this circuit of Don’s appears to be in direct conflict with what Zilano says about a working spark gap and an earth both being essential for high energy gains. It is also interesting to note that Zilano says that everything that Don says is 100% correct. It would appear that experimentation is needed to establish the best working methods for gaining energy with a circuit of this nature.

Here is a nomograph:



The wire for the “A” and “B” coils of the output step-down/isolation transformer should be chosen from the table five pages above, ensuring that the wire can carry 120% of the required output current. At the present time, a suitable multimeter can be bought through eBay for £13 and a suitable LCR meter for £10 (delivered):

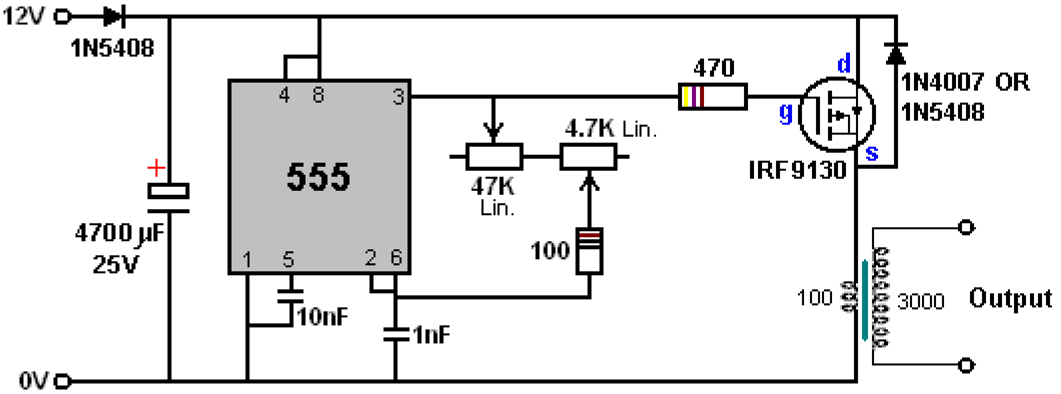
Hz ∿

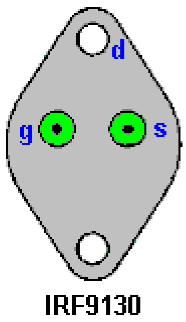
L / C / R

We need to give this final output transformer an extra winding and use that winding to modulate the high frequency with a 50 Hz or 60 Hz signal.

However, our initial problem is getting some hands-on experience with this circuitry. As an initial step, we might choose to do some experimenting with lower voltages. Capacitors are readily available at low cost with voltage ratings up to 400 volts, so perhaps we should consider initial tests within that range

As the resonance of the 80-turn / 5+5 turn transformer is the most critical factor, we could start by getting that resonance established. The resonance is related to frequency and not voltage, so getting it to resonate at a lower voltage is a perfectly workable idea. Also, instead of matching the 80-turn coil resonance to the oscillator frequency, we could adjust the oscillator frequency to match a chosen coil/capacitor combination. For this, we can set up a variable frequency oscillator perhaps like this:





One advantage of this circuit is that the output transformer is driven at the frequency set by the 555 timer and that frequency is not affected by the number of turns in the primary winding, nor it's inductance, wire diameter, or anything else to do with the coil. While this circuit shows the rather expensive IRF9130 transistor, I expect that other P-channel FETs would work satisfactorily in this circuit.

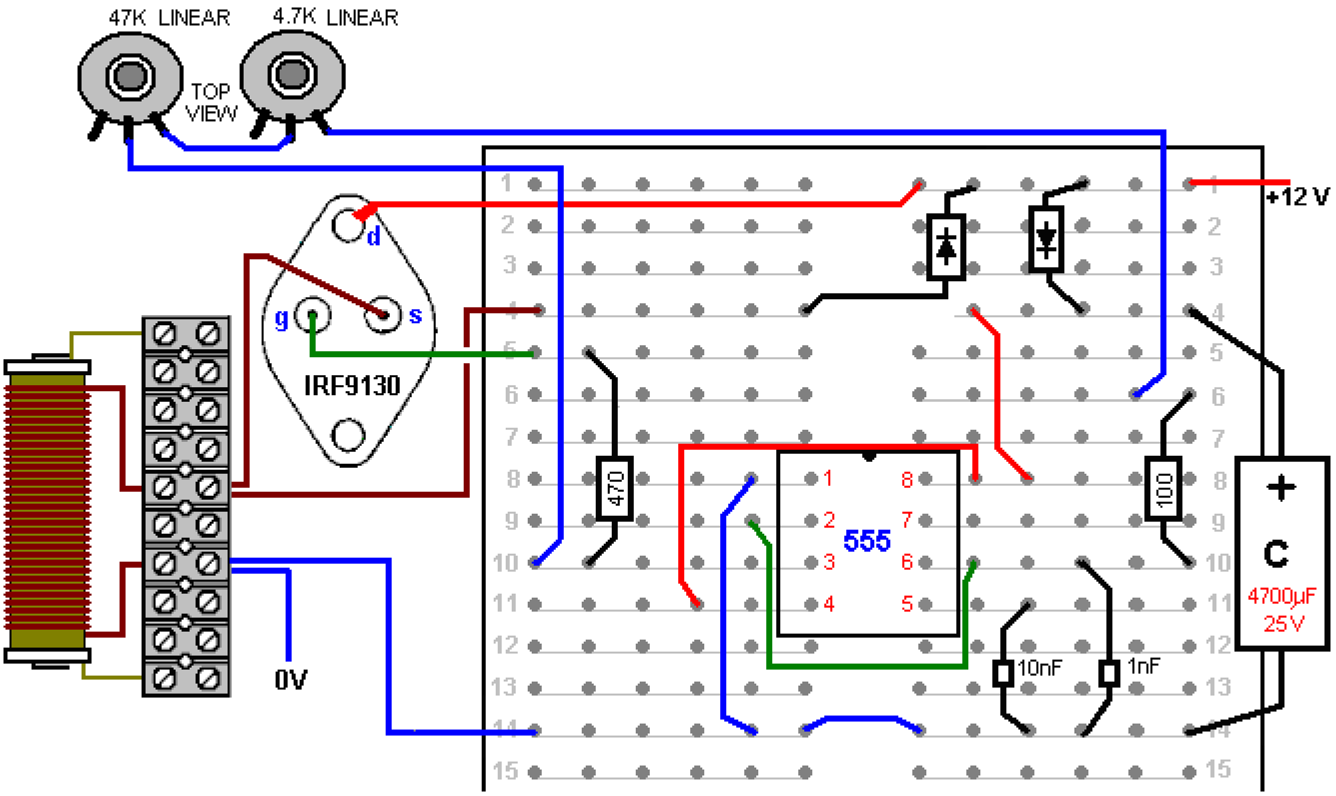
The circuit has the power supply diode and capacitor as before, ready to receive energy from the output at some later date if that is possible and desired. The 555 circuit is standard, giving a 50% Mark/Space ratio. The 10 nF capacitor is there to maintain the stability of the 555 and the timing section consists of two variable resistors, one fixed resistor and the 1 nF capacitor. This resistor arrangement gives a variable resistance of anything from 100 ohms to 51.8K and that allows a substantial frequency range. The 47K (Linear) variable resistor controls the main tuning and the 4.7K (Linear) variable resistor gives a more easily adjustable frequency for exact tuning. The 100 ohm resistor is there in case both of the variable resistors are set to zero resistance. The output is fed through a

470 ohm resistor to the gate of a very powerful P-channel FET transistor which drives the primary winding of the output transformer.

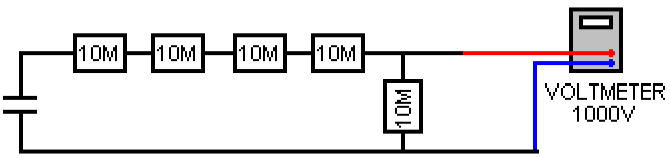
The output transformer can be wound on an insulating spool covering a ferrite rod, giving both good coupling between the windings, and high-frequency operation as well. The turns ratio is set to just 30:1 due to the high number of primary winding turns. With a 12-volt supply, this will give a 360-volt output waveform, allowing 400V-volt rated, low-cost capacitors to be used for tuning the resonant transformer.

Looking at the wire specification table, indicates that quite a small wire diameter could be used for the oscillator output transformer's secondary winding. While this is perfectly true, it is not the whole story. Neon Tube Drivers are very small and the wire in their output windings is very small diameter indeed. Those driver modules are very prone to failure. If the insulation on any one turn of the winding fails and one turn becomes a short-circuit, then that stops the winding from oscillating, and a replacement is needed. As there are no particular size constraints for this project, it might be a good idea to use enamelled copper wire of 0.45 mm or larger in an attempt to avoid this insulation failure hazard.

If the primary winding is placed outside the secondary winding (a practice probably frowned upon by electronics experts), then when we have determined the exact capacitors needed for resonance and replaced them with their more expensive high-voltage counterparts, we have the option of reducing the number of primary winding turns to produce a higher output voltage. Reducing the turns to 10 will give 3,600 volts, 9 turns 4,000 volts and reducing to 8 turns will give an output voltage of around 4,500 volts. A plug-in board layout might be:

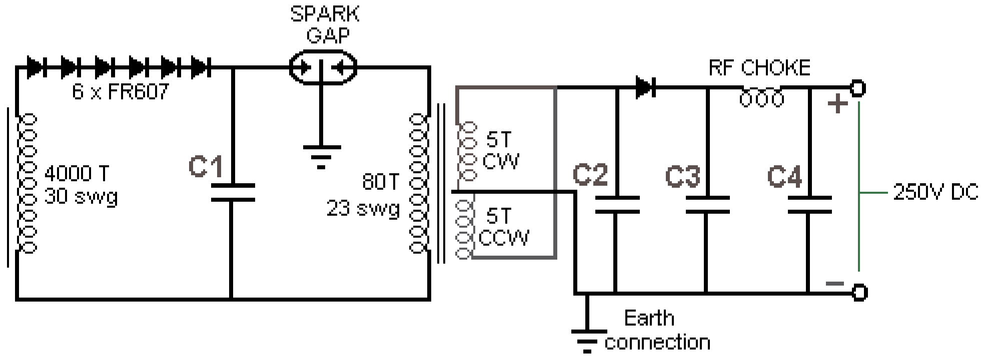


Please remember that you can't just stick your average voltmeter across a 4 kV capacitor (unless you really do want to buy another meter) as they only measure up to about a thousand volts DC. So, if you are using high voltage, then you need to use a resistor-divider pair and measure the voltage on the lower resistor. But what resistor values should you use? If you put a 10 Megohm resistor across your 4 kV charged capacitor, the current flowing through the resistor would be 0.4 milliamps. Sounds tiny, doesn't it? But that 0.4 mA is 1.6 watts which is a good deal more than the wattage which your resistor can handle. Even using this arrangement:



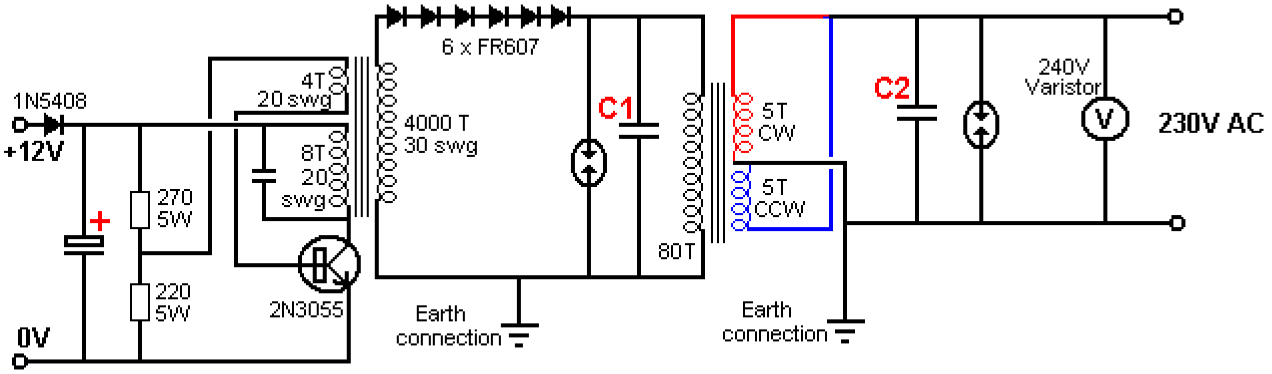
the current will be 0.08 mA and the wattage per resistor will be 64 mW. The meter reading will be about 20% of the capacitor voltage which will give a voltmeter reading of 800 volts. The input resistance of the meter needs to be checked and possibly, allowed for as the resistance in this circuit is so high. When making a measurement of this type, the capacitor is discharged, the resistor chain and meter attached, and then, and only then, is the circuit powered up, the reading taken, the input power disconnected, the capacitor discharged, and the resistors disconnected. High-voltage circuits are highly dangerous, especially so, where a capacitor is involved. The recommendation to wear thick rubber gloves for this kind of work, is not intended to be humorous.

A DC output circuit has been shown by Zilano:



This circuit uses four high-voltage capacitors and C2 needs to be the exact value to get the vital resonance between the primary and secondary windings of the transformer. The output has to be pulsed by an additional circuit in order to provide an AC output.

Another Zilano circuit arrangement is:



If you measure the frequency of the driving oscillator using a frequency meter, and measure the inductance of the 80-turn coil using an ("LCR") inductance meter, then the http://www.deephaven.co.uk/lc.html website calculator will tell you what size of capacitor ("C1") needs to be connected across the coil to make it resonate at that frequency. The same applies to the 5+5 turn coil. The frequency will be the same and the inductance and self-capacitance of the coils connected across each other can also be measured, giving the size of "C2". It needs to be clearly understood that every coil has inductance, capacitance and resistance. These vary with the number of turns, the spacing of the turns, the size of the wire, the material of the wire and the overall length of the wire in the coil. While the capacitance is normally quite low, it still forms part of the parallel-connected capacitor which controls the resonant frequency of the coil/capacitor combination. At the resonant frequency, the coil resistance doesn't matter, but the coil's own capacitance is always a factor which must be allowed for.

The output from this circuit will be AC at the frequency generated by 2N3055 circuit, due to the frequency controlling effects of the two capacitors **C1** and **C2**. There are various ways of converting that AC output to the local mains frequency.