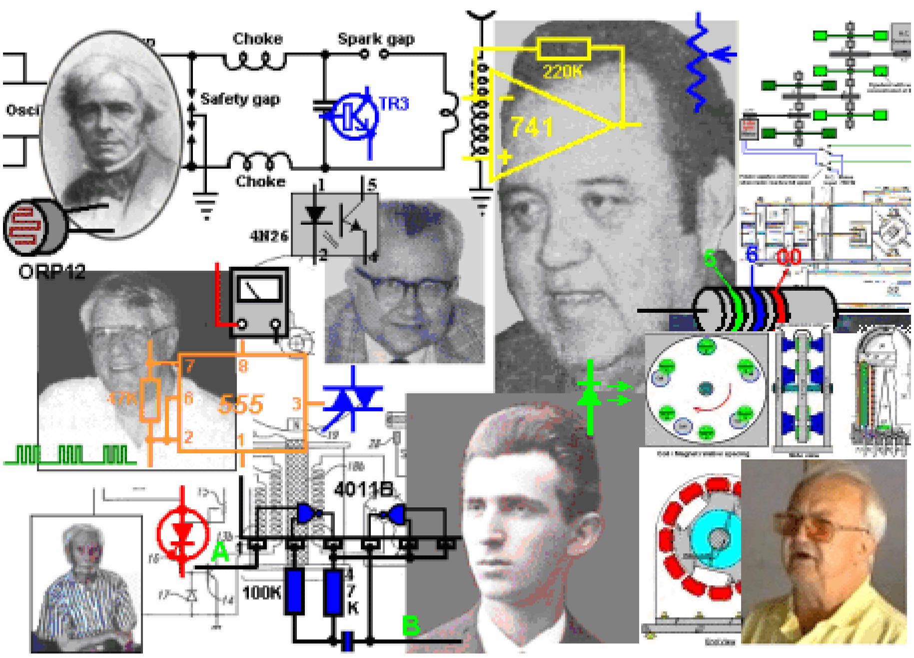
Would you Like to have Free Electricity?



By Patrick J. Kelly

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Introduction

I am Irish, born during World War 2, graduated from Trinity College Dublin in the 1960s as a Civil Engineer. This document contains most of what I have learned about free-energy after researching it for a number of years. When I started looking into this subject, there was very little useful information and any that was around was buried deep in incomprehensible patents and highly technical documents. My purpose here is to make it easier for you to locate and understand some of the relevant material now available.

What you believe is up to yourself and is none of my business. Let me stress that almost all of the devices discussed in the following pages, are devices which I have not personally built and tested. It would take several lifetimes to do that and it would not be in any way a practical option. Consequently, although I believe everything said is fully accurate and correct, you should treat everything as being “hearsay” or opinion.

Some time ago, it was commonly believed that the world was flat and rested on the backs of four elephants and that when earthquakes shook the ground, it was the elephants getting restless. If you want to believe that, you are fully at liberty to do so, however, you can count me out as I don’t believe that.

The Wright brothers were told that it was impossible for aeroplanes to fly because they were heavier than air. That was a commonly believed view. The Wright brothers watched birds flying and since, without question, birds are considerably heavier than air, it was clear that the commonly held view was plain wrong. Working from that realisation, they developed aeroplanes which flew perfectly well. The years passed, and the technology started by the Wright brothers and their careful scientific measurements and well-reasoned theory, advanced to become the “science” of aeronautics. This science was used extensively to design and build very successful aircraft and “aeronautics” gained the aura of being a “Law”. Unfortunately, somebody applied aeronautic calculations to the flight of bumblebees and discovered that according to aeronautics, bumblebees couldn’t possibly fly as their wings could not generate enough lift to get them off the ground. This was a problem, as it was perfectly possible to watch bees flying in a very competent manner. So, the “Laws” of aeronautics said that bees can’t fly, but bees actually **do** fly. Does that mean that the laws of aeronautics were no use? Certainly not - those “laws” had been used for years and proved their worth by producing excellent aircraft. What it did show was that the “Laws” of aeronautics did not yet cover every case and needed to be extended to cover the way that bees fly, which is through lift generated by turbulent airflow.

It is **very** important to realise that what are described as scientific “Laws” are just the best working theories at the present time and it is virtually certain that those “Laws” will have to be upgraded and extended as further scientific observations are made and further facts discovered. Let’s hope those four elephants don’t get restless before we have a chance to learn a bit more!

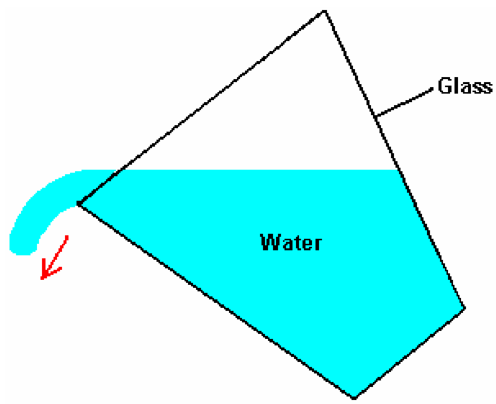
It should be stressed at this point, that this material is intended to provide you with information and only that. If you should decide, on the basis of what you read here, to build some device or other, you do so solely and entirely at your own risk and on your own responsibility. For example, if you build something in a heavy box and then drop it on your toe, then that is completely your own responsibility (you should learn to be more careful) and nobody other than yourself is in any way liable for your injury, or any loss of income caused while your toe is recovering. Let me amplify that by stating that I do not warrant that any device or system described in this document works as described, or in any other way, nor do I claim that any of the following information is useful in any way or that any device described is useful in any way or for any purpose whatsoever. Also, let me stress that I am not encouraging you to actually construct any device described here, and the fact that very detailed construction details are provided, must not be interpreted as my encouraging you to physically construct any device described in this document. You are welcome to consider this a work of fiction if you choose to do so.

I apologise if this presentation seems very elementary, but the intention is to make each description as simple as possible so that everybody can understand it, including people whose native language is not English. If you are not familiar with the basic principles of electronics, then please read the simple step-by-step electronics tutorial in the Appendix which is intended to help complete beginners in the subject.

At this point in time - the early years of the twenty-first century - we have reached the point where we need to realise that some of the "laws" of science do not cover every case, and while they have been very useful in the past, they do need to be extended to cover some cases which have been left out until now.

For example, suppose a bank robber broke into a bank and stole all of the cash there. How much could he take? Answer: "every coin and every note". The limit is the sum total of all cash in the building. This is what the "Law" of Conservation of Energy is all about. What it says is very simple – you can't take out any more than there is there in the beginning. That seems pretty straightforward, doesn't it?

As another example, consider a glass tumbler filled completely with water. Using common sense, tell me, how much water can be poured out of the glass? For the purposes of this illustration, please take it that temperature, pressure, gravity, etc. all remain constant for the duration of the experiment.

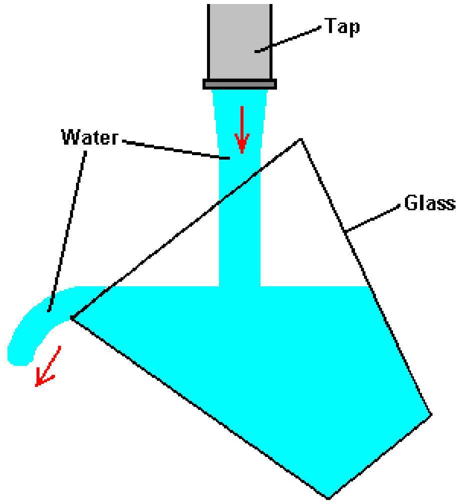


The answer is: "the exact volume contained inside the tumbler". Agreed. This is what present day science says. To be strictly accurate, you will never be able to pour all of the water out as a small amount will remain, wetting the inside of the glass. Another way of putting this is to say that the "efficiency" of the pouring operation is not 100%. This is typical of life in general, where very few, if any, actions are 100% efficient.

So, are we agreed with current scientific thinking then – the maximum amount of water which can pour out of the tumbler is the total volume inside the tumbler? This seems simple and straightforward, doesn't it? Science thinks so, and insists that this is the end of the story, and nothing else is possible. This arrangement is called a "closed system" as the only things being considered are the glass, the water and gravity.

Well, unfortunately for current scientific thinking, this is not the only possible situation and "closed systems" are almost unknown in the real world. Mostly, assumptions are made that the effects of anything else around will cancel out and add up to a net zero effect. This is a very convenient theory, but unfortunately it has no basis in reality.

Let's fill our glass with water again and begin to pour it out again, but this time we position it underneath a source of flowing water:



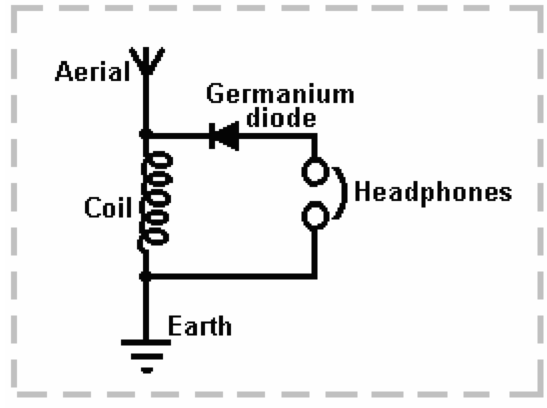
So, now, how much water can be poured out of the tumbler? Answer: “millions of times the volume of the tumbler”. But hang on a moment, haven’t we just said that the absolute limit of water poured from the tumbler has to be the volume inside the tumbler? Yes, that’s exactly what we said, and that is what current science teaching says. The bottom line here is that what current science says does in fact hold true for most of the time, but there are cases where the basic assumption of it being a “closed system” is just not true.

One popular misconception is that you can’t get more energy out of a system than you put into it. That is wrong, because the sentence was worded carefully. Let me say it again and this time, emphasise the key words: “**you** can’t get more energy out of a system than **you** put into it”. If that were true, then it would be impossible to sail a yacht all the way around the world without burning any fuel, and that has been done many times and none of the driving energy came from the crews. If it were true, then a grain mill driven by a waterwheel would not be able to produce flour as the miller certainly does not push the millstones around himself. If that were true, then nobody would build windmills, or construct solar panels, or tidal power stations.

What the statement should say is “more energy can’t be taken out of a system than is put into it or is already in it” and that is a very different statement. When sailing a yacht, the wind provides the driving force which makes the trip possible. Notice that, it is the environment providing the power and not the sailors. The wind arrived without them having to do anything about it, and a lot less than 100% of the wind energy reaching the yacht actually becomes forward thrust, contributing to the voyage. A good deal of the energy arriving at the yacht ends up stretching the rigging, creating a wake, producing noise, pushing the helmsman, etc. etc. This idea of no more energy coming out of a system than goes into it, is called “The Law of Conservation of Energy” and it is perfectly right, in spite of the fact that it gets people confused.

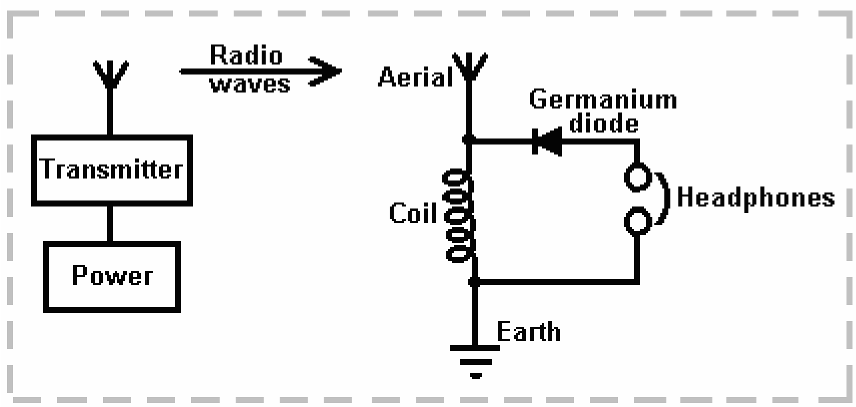
“Free-Energy Devices” or “Zero-Point Energy Devices” are the names applied to systems which appear to produce a higher output power than their input power. There is a strong tendency for people to state that such a system is not possible since it contravenes the Law of Conservation of Energy. It doesn’t. If it did, and any such system was shown to work, then the “Law” would have to be modified to include the newly observed fact. No such change is necessary, it merely depends on your point of view.

For example, consider a crystal set radio receiver:



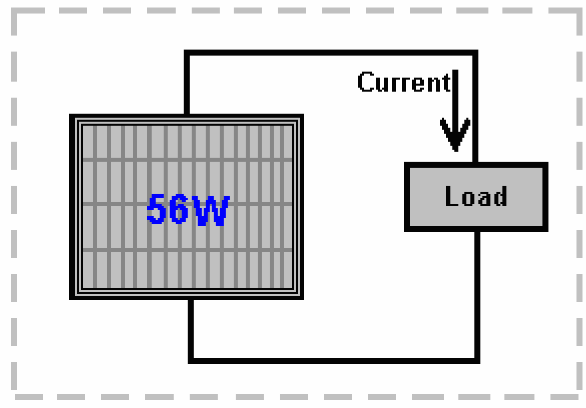
Looking at this in isolation, we appear to have a free-energy system which contradicts the Law of Conservation of Energy. It doesn't, of course, but if you do not view the whole picture, you see a device which has only passive components and yet which (when the coil is of the correct size) causes the headphones to generate vibrations which reproduce recognisable speech and music. This looks like a system which has no energy input and yet which produces an energy output. Considered in isolation, this would be a serious problem for the Law of Conservation of Energy, but when examined from a common sense point of view, it is no problem at all.

The whole picture is:

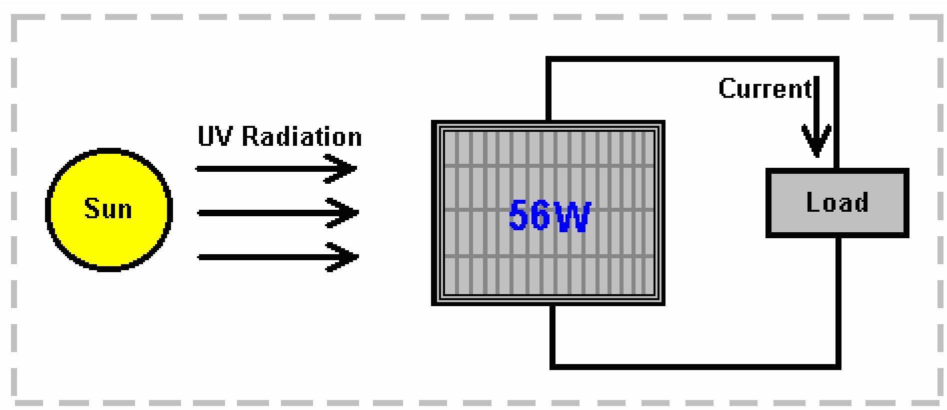


Power is supplied to a nearby transmitter which generates radio waves which in turn, induce a small voltage in the aerial of the crystal set, which in turn, powers the headphones. The power in the headphones is far, far less than the power taken to drive the transmitter. There is most definitely, no conflict with the Law of Conservation of Energy. However, there is a quantity called the "**C**oefficient **O**f **P**erformance" or "**COP**" for short. This is defined as the amount of power coming out of a system, divided by the amount of power that **the operator** has to put into that system to make it work. In the example above, while the **efficiency** of the crystal set radio is well below 100%, the **COP** is greater than 1. This is because the owner of the crystal radio set does not have to supply any power at all to make it work, and yet it outputs power in the form of sound. As the input power from the user, needed to make it work is zero, and the COP value is calculated by dividing the output power by this zero input power, the COP is actually infinity. **Efficiency** and **COP** are two different things. Efficiency can never exceed 100% and almost never gets anywhere near 100% due to the losses suffered by any practical system.

As another example, consider an electrical solar panel:



Again, viewed in isolation, this looks like (and actually **is**) a Free-Energy device if it is set up out of doors in daylight, as current is supplied to the load (radio, battery, fan, pump, or whatever) without the user providing any input power. Again, Power Out with no Power In. Try it in darkness and you find a different result because the whole picture is:



The energy which powers the solar panel comes from the sun.. Only some 17% of the energy reaching the solar panel is converted to electrical current. This is most definitely not a contravention of the Law of Conservation of Energy. This needs to be explained in greater detail. The Law of Conservation of Energy applies to closed systems, and only to closed systems. If there is energy coming in from the environment, then the Law of Conservation of Energy just does not apply, unless you take into account the energy entering the system from outside.

People sometimes speak of "over-unity" when talking about the efficiency of a system. From the point of efficiency, there is no such thing as "over-unity" as that would mean that more power was coming out of the system than the amount of power entering the system. Our trusty bank robber mentioned above would have to take out of the bank vault, more money than was actually in it, and that is a physical impossibility. There are always some losses in all practical systems, so the efficiency is always less than 100% of the power entering the system. In other words, the efficiency of any practical system is always under unity.

However, it is perfectly possible to have a system which has a greater power output than the power input which **we** have to put into it to make it work. Take the solar panel mentioned above. It has a terribly low efficiency of about 17%, **but**, we don't have to supply it with any power to make it work. Consequently, when it is in sunlight, it's Coefficient Of Performance ("COP") is it's output power (say, 50 watts) divided by the input power needed to make it work (zero watts) which is infinity. So, our humble, well-known solar panel has terrible efficiency of 17% but at the same time it has a COP of infinity.

It is now generally accepted that "Dark Matter" and "Dark Energy" form more than 80% of our universe. There is nothing sinister about the adjective "Dark" as in this context, it merely means that we cannot see it. There are many useful things which we utilise, which we can't see, for example, radio waves, TV signals, magnetism, gravity, x-rays, etc. etc.

The actual situation is, that we are sitting in a vast field of energy which we can't see. This is the equivalent of the situation for the crystal set shown above, except that the energy field we are in is very, very much more powerful than the radio waves from a radio transmitter. The problem is, how to tap the energy which is freely available all around us, and get it to do useful work for us. It can definitely be done, but it is not easy to do.

Some people think that we will never be able to access this energy. Not very long ago, it was widely believed that nobody could ride a bicycle faster than 15 miles per hour because the wind pressure on the face of the rider would suffocate him. Today, many people cycle much faster than this without suffocating - why? - because the original negative opinion was wrong.

Not very long ago, it was thought that metal aircraft would never be able to fly because metal is so much heavier than air. Today, aircraft weighing hundreds of tons fly on a daily basis. Why? - because the original negative opinion was not correct.

It is probably worth while, at this point, to explain the basics of Zero-Point Energy. The experts in Quantum Mechanics refer to how the universe operates as "Quantum Foam". Every cubic centimetre of "empty" space is seething with energy, so much in fact, that if it were converted using Oliver Heaviside's equation (made famous by Albert Einstein) $E = mC^2$ (that is Energy = Mass multiplied by a very big number), then it would produce as much matter as can be seen by the most powerful telescope. There is actually nothing "empty" about space. So why can't we see anything there? Well, you can't actually see energy. All right then, why can't you measure the energy there? Well, two reasons actually, firstly, we have never managed to design an instrument which can measure this energy, and secondly, the energy is changing direction incredibly rapidly, billions and billions and billions of times each second.

There is so much energy there, that particles of matter just pop into existence and then pop back out again. Half of these particles have a positive charge and half of them have a negative charge, and as they are evenly spread out in three-dimensional space, the overall average voltage is zero. So, if the voltage is zero, what use is that as a source of energy? The answer to that is "none" if you leave it in it's natural state. However, it is possible to change the random nature of this energy and convert it into a source of unlimited, everlasting power which can be used for all of the things we use mains electricity for today - powering motors, lights, heaters, fans, pumps, ... you name it, the power is there for the taking.

So, how do you alter the natural state of the energy in our environment? Actually, quite easily. All that is needed is a positive charge and a negative charge, reasonably near each other. A battery will do the trick, as will a generator, as will an aerial and earth, as will an electrostatic device like a Wimshurst machine. When you generate a **Plus** and a **Minus**, the quantum foam is affected. Now, instead of entirely random plus and minus charged particles appearing everywhere, the **Plus** which you created gets surrounded by a sphere of minus charge particles popping into existence all around it. Also, the **Minus** which you created, gets surrounded by a spherical-shaped cloud of plus-charge particles popping into existence all around it. The technical term for this situation is "**broken symmetry**" which is just a fancy way of saying that the charge distribution of the quantum foam is no longer evenly distributed or "symmetrical". In passing, the fancy technical name for your **Plus** and **Minus** near each other, is a "**dipole**" which is just a techno-babble way of saying "two poles: a plus and a minus" - isn't jargon wonderful?

So, just to get it straight in your mind, when you make a battery, the chemical action inside the battery creates a Plus terminal and a Minus terminal. Those poles actually distort the universe around your battery, and causes vast streams of energy to radiate out in every direction from each pole of the battery. Why doesn't the battery run down? Because the energy is flowing from the environment and not from the battery. If you were taught basic physics or electrical theory, you will probably have been told that the battery used to power any circuit, supplies a stream of electrons which flows around the circuit. Sorry Chief - it just ain't like that at all. What really happens is that the battery forms a "dipole" which nudges the local environment into an unbalanced state which pours out energy in every direction, and some of that energy from the environment flows around the circuit attached to the battery. The energy does **not** come from the battery.

Well then, why does the battery run down, if no energy is being drawn from it to power the circuit? Ah, that is the really silly thing that we do. We create a closed-loop circuit (because that's what we have always done) where the current flows around the circuit, reaches the other battery terminal and immediately destroys the battery's "dipole". Everything stops dead in it's tracks. The environment becomes symmetrical again, the massive amount of readily available free-energy just disappears and you are back to where you started from. **But**, do not despair, our trusty battery immediately creates the Plus and Minus terminals again and the process starts all over again. This happens so rapidly that we don't see the breaks in the operation of the circuit and it is the continual recreation of the dipole which causes the battery to run down and lose it's power. Let me say it again, the battery does **not** supply the current that powers the circuit, it never has and it never will - the current flows into the circuit from the surrounding environment.

What we really need, is a method of pulling off the power flowing in from the environment, without continually destroying the dipole which pushes the environment into supplying the power. That is the tricky bit, but it has been done. If you can do that, then you tap into an unlimited stream of inexhaustible energy, with no need to provide any input energy to keep the flow of energy going. In passing, if you want to check out the details of all of this, Lee and Yang were awarded the Nobel Prize for Physics in 1957 for this theory which was proved by experiment in that same year. This book includes circuits and devices which manage to tap this energy successfully.

The purpose of this book is to present the facts about some of these devices and more importantly, where possible, explain the background details of why and how systems of that type function. As has been said before, it is not the aim of this book to convince you of anything, just to present you with some of the facts which are not that easy to find, so that you can make up your own mind on the subject.

The science taught in schools, colleges and universities at this time, is well out of date and in serious need of being brought up to date. This has not happened for some time now as people who make massive financial profits have made it their business to prevent any significant advance for many years now. However, the internet and free sharing of information through it, is making things very difficult for them. What is it that they don't want you to know? Well, how about the fact that you don't have to burn a fuel to get power? Shocking, isn't it !! Does it sound a bit mad to you? Well, stick around and start doing some thinking.

Suppose you were to cover a boat with lots of solar panels which were used to charge a large bank of batteries inside the boat. And if those batteries were used to operate electric motors turning propellers which drive the boat along. If it is sunny weather, how far could you go? As far as the boat can travel while the sun is up and if the battery bank is large, probably most of the night as well. At sun-up on the next day, you can continue your journey. Oceans have been crossed doing this. How much fuel is burned to power the boat? None !! Absolutely none at all. And yet, it is a fixed idea that you have to burn a fuel to get power.

Yes, certainly, you can get power from the chemical reaction of burning a fuel - after all, we pour fuel into the tanks of vehicles "to make them go" and we burn oil in the central heating systems of buildings. But the big question is: "Do we have to?" and the answer is "No". So why do we do it? Because there is no alternative at present. Why is there no alternative at present? Because the people making incredibly large financial profits from selling this fuel, have seen to it that no alternative is available. We have been the suckers in this con trick for decades now, and it is time for us to snap out of it. Let's have a look at some of the basic facts:

We tend to have the impression that people who lived a long time ago were not as clever as we are - after all, we have television, computers, mobile phones, games consoles, aeroplanes, …. But, and it is a big "but", the reason why they did not have those things is because science had not advanced far enough for those things to become possible. That did **not** mean that the people who lived before us were any less clever than we are.

For example, could you, personally, come up with an accurate calculation of the circumference of the Earth? This has to be without prior knowledge, no satellites, no astronomical information, no calculators, no computers and no experts to guide you. Eratosthenes did by observing the shadows in two wells some 800 kilometres apart. When was that? More than two thousand years ago.

You have probably heard of the geometry of Pythagoras who lived hundreds of years before Eratosthenes, and that geometry is still used in remote areas to lay out the foundations for new buildings. You have probably heard of Archimedes who worked out why things float. He lived more than two thousand years ago. So, how do those people stack up against you and me? Were they stupid people?

This is quite an important point because it demonstrates that the body of scientific information enables many things which were not thought possible in earlier times. This effect is not restricted to centuries ago. Take the year 1900. My father was a youngster then, so it is not all that long ago. It would be another three years before Orville and Wilbur Wright made their first 'heavier-than-air' flight, so there were no aircraft around in 1900. There were no radio stations and most definitely, no television stations, nor would you have found a telephone inside a house. The only serious forms of information were books and periodicals or teaching establishments which relied on the knowledge of the teachers. There were no cars and the fastest form of transport for the average person was on a galloping horse.

Today, it is difficult to grasp what things were like not all that long ago, but come closer in time and look back just fifty years. Then, people researching in scientific fields had to design and build their own instruments before they ever got to experimenting in their chosen fields of knowledge. They were instrument makers, glass-blowers, metal workers, etc. as well as being scientific researchers. Nowadays there are measuring instruments of all kinds for sale ready-made. We have silicon semiconductors which they didn't have, integrated circuits, computers, etc. etc.

The important point here is the fact that advances in scientific theory have made possible many things which would have been considered quite ridiculous notions in my father's time. However, we need to stop thinking as if we already know everything there is to know and that nothing which we think of as "impossible !!" could ever happen. Let me try to illustrate this by remarking on just a few things which as recently as the year 1900 would have marked you out as a "lunatic crank", things which we take for granted today because, and only because, we are now familiar with the science behind each of these things.

Certainties in the year 1900

A metal aeroplane weighing 350 tons couldn't possibly fly - everyone knows that !!

You couldn't possibly watch someone who is a thousand miles away - talk sense !!

No ! Of course you can't speak to somebody who lives in a different country unless you visit them !

The fastest way to travel is on a galloping horse.

A machine could never beat a man at chess - be realistic !

Today, we know that these things are not just possible, but we take them for granted. We have a mobile phone in our pocket and could easily use it to talk to friends in other countries almost anywhere in the world. It would seem very strange if we could not do that any more.

We each have a television and can watch, say, a golf tournament taking place at the other side of the world. We watch in real time, seeing the result of each stroke almost as soon as the golfer does himself. Even suggesting that such a thing was possible might have got you burnt at the stake for witchcraft not all that long ago, but not having television would seem a very strange situation for us today.

If we see a 350 ton metal Boeing 747 aircraft flying past, we would not think it to be strange in any way, let alone think it was "impossible". It is routine, casual travel at 500 mph, a speed which would have been considered to be a fantasy when my father was young. The fact that the aircraft is so heavy, is of no concern to us as we know that it will fly, and does so, routinely, every day of the year.

We take for granted, a computer which can do a million things in one second. Today, we have lost the understanding of how big "a million" is, and we know that most people are likely to lose a game of chess if they play against a computer, even a cheap chess computer.

What we need to understand is that our present scientific knowledge is far from being comprehensive and there is still a very large amount to be learned, and that things which the average person today would consider "impossible" are quite liable to be casually routine day-to-day devices in just a few years time. This is **not** because we are stupid but instead it is because our current science still has a long way to go.

The objective of this website (http://www.free-energy-info.tuks.nl) is to explain some of the things which current science is not teaching at the present time. Ideally, we want a device which will power our homes and cars without the need to burn a fuel of any kind. Before you get the idea that this is some new and wild idea, please remember that windmills have been pumping water, milling grain, lifting heavy loads and generating electricity for a very long time now. Water wheels have been doing similar work for a very long time and both of these devices are fuel-less.

The energy which powers windmills and water wheels comes to us via our Sun which heats air and water, causing wind and rain, feeding power to our devices. The energy flows in from our local environment, costs us nothing and will keep on coming whether we make use of it or not.

Some years ago Cal-Tech in the USA spent a million dollars proving that on board fuel reformers for vehicles would give us all better fuel economy and cleaner air. They did long-term testing on buses and cars to provide proof. They teamed up with the very large auto-parts supplier Arvin Meritor to put these new devices in production vehicles. Then "One Equity Partners" bought out Arvin Meritor's division that did all the final work to get fuel reformers put into all new vehicles. They created a new company, EMCON Technologies, and that company dropped the fuel reformer from their product line, not because it did not work, but because it **did** work. This is not "conspiracy theory" but a matter of public record.

Some years ago, Stanley Meyer, a very talented man living in America, found a very energy-efficient way of breaking water into a mixture of hydrogen gas and oxygen gas. He pushed on further and found that a vehicle engine could be run on quite a small amount of this "HHO" gas if it was mixed with air, water droplets and some of the exhaust gas coming from the engine. He got funding to allow him to start manufacturing retro-fit kits which would allow any car to run on water alone and not use any fossil fuel at all. You can imagine how popular that would have been with the oil companies and the government. Just after getting his funding, Stan was eating a meal at a restaurant when he jumped up, said "I've been poisoned !", rushed out into the car park and died on the spot. If Stan was mistaken, and he died of 'natural causes', then it was remarkably convenient timing for the oil companies and the government, and his retro-fit kits were never manufactured.

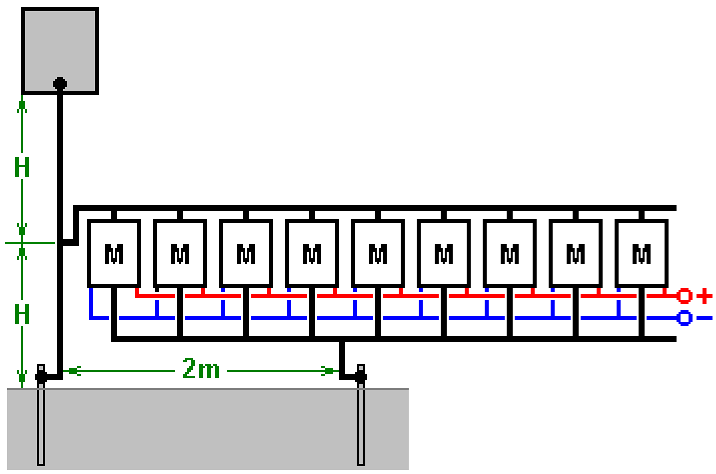
Even though Stan left behind many patents on the subject, until recently nobody managed to replicate his very low-power electrolyser, then Dave Lawton in Wales achieved the feat and many people have since replicated it by following Dave's instructions. More difficult still is getting an engine to run on no fossil fuel as Stan did, but recently, three men in the UK achieved just that by getting a standard petrol-engined electrical generator to run with water as the only fuel. Interestingly, this is not something which they want to pursue as they have other areas which appeal more to them, but more about these systems later on.

Chapter 1 - Aerials

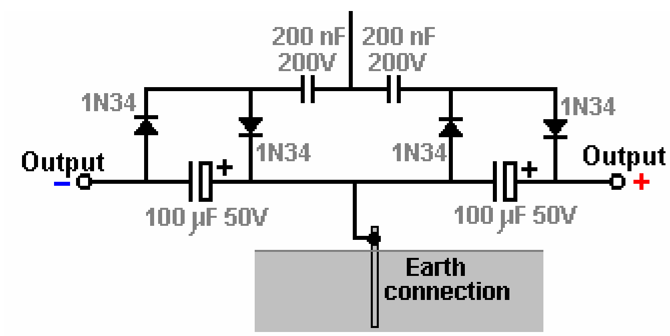
The universe is seething with energy, energy which is a combination of electricity and magnetism. When that radiation passes through our Sun it causes the effects which we call "sunlight". Heading towards the Earth, sunlight encounters our ionosphere and some of that energy is absorbed there. The result is that the ionosphere has a very high electrical charge compared to the surface of the Earth. That causes a voltage gradient between the ionosphere and the Earth. That is why your head is at a much higher voltage than your feet when you are standing up.

With two pieces of wire, we can utilise that fact and access continuous free power. One piece of wire we mount so that it sticks straight up in the air. The other piece of wire is attached electrically to the Earth. Electricity then flows down the vertical wire, through any circuit we choose to put between the wires and on to the earth. This is not a difficult concept to understand and any aerial system can gather energy from low power sources: local radio signals, the 100 to 200 lightning strikes per second, radio signals from space, or from the high-power charged ionosphere. Let me give you three different examples:

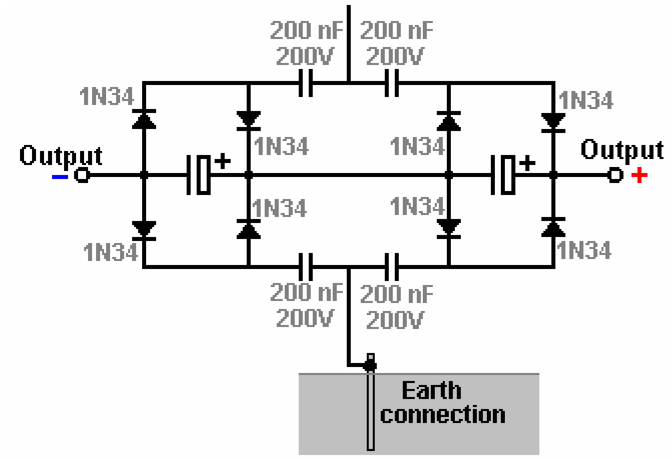
1. Dragan Kljajic draws 96 watts from his aerial:



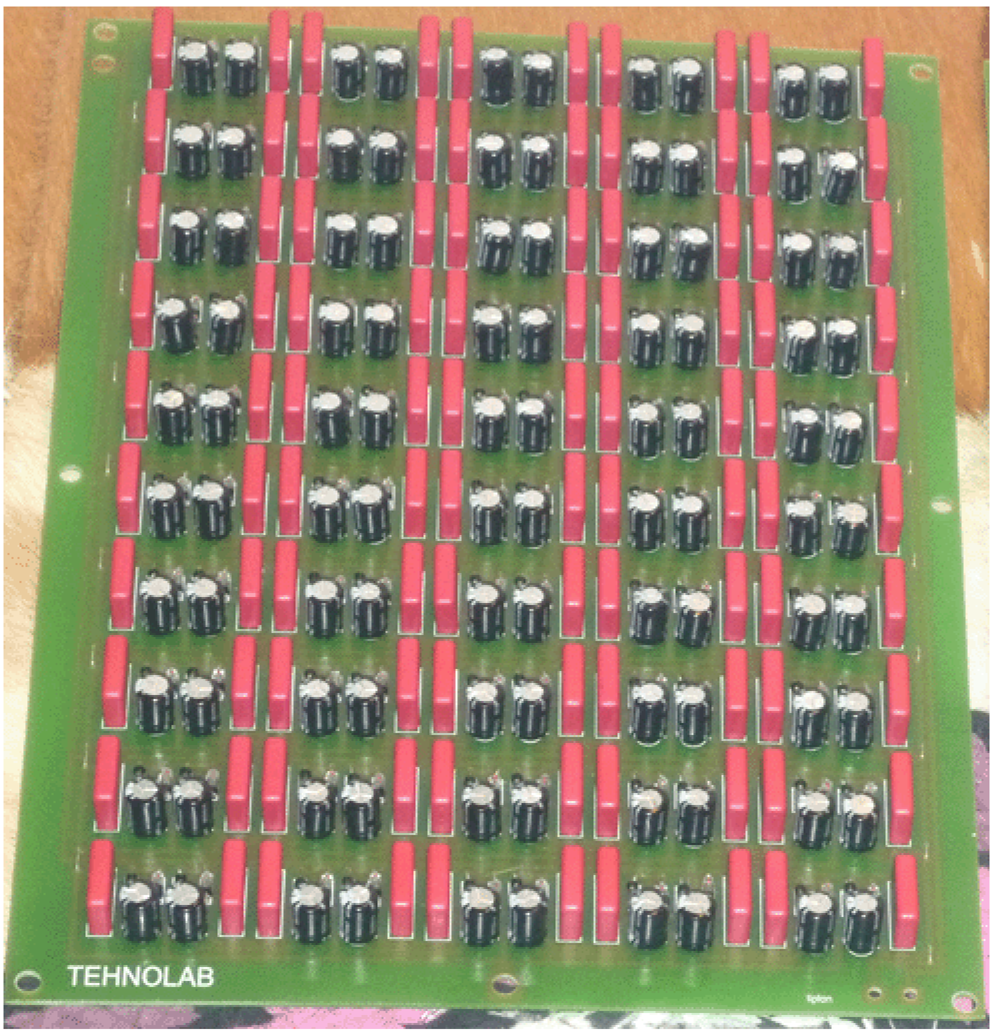
In this aerial design, the top of the wire is connected to a large shiny plate and two separate earth wires are used. The boxes marked "M" (for "Module") each represent a circuit like this:



Although, a better circuit would be:

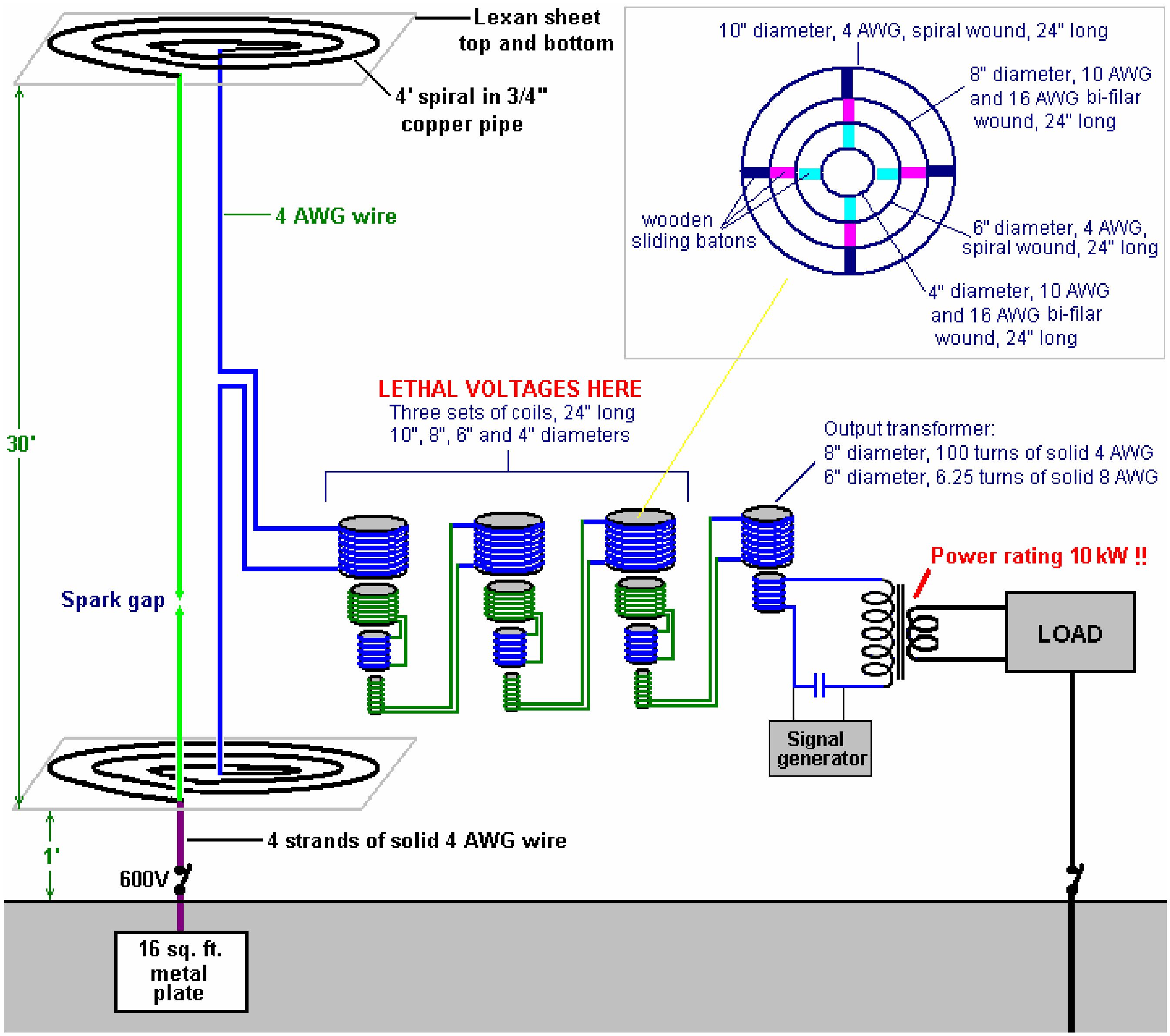


Dragan has mounted 100 of these modules on two printed circuit boards like this one:



While 96 watts does not sound like much, it is actually very useful indeed. For example, nowadays a 13-watt LED bulb gives out about 1060 lumens of light and that is the same as a 100-watt incandescent light bulb. I use three of those 13-watt bulbs to light my living area very brightly indeed, and that is less than 40 watts which is only half of the output from Dragan's aerial system.

Moving on, we come to Lawrence Rayburn of Canada who has produced an advanced aerial like this:

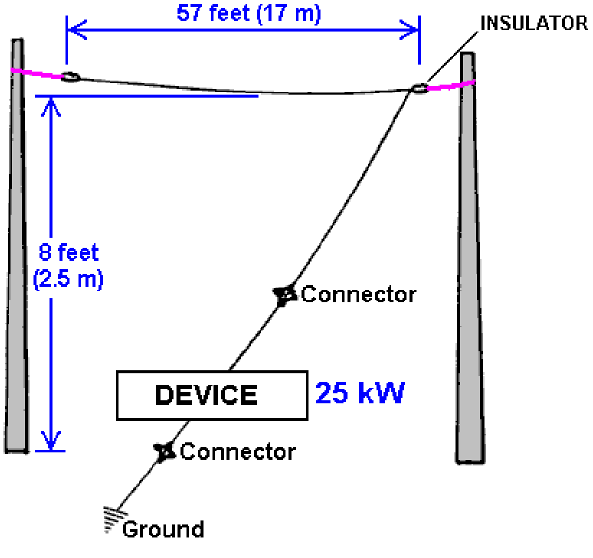


This complicated-looking arrangement is two 4-foot diameter spirals of copper pipe each sandwiched between two sheets of Lexan plastic. These are mounted thirty feet apart with one above the other and connected with a wire with a spark gap. Coils of wire are used to tune the system and drop the voltage down to 220 volts. This is a powerful system which outputs 10 kilowatts of electrical power because it is tuned to the ionosphere.

While that is a good deal of power, it is small when compared to the output of the 1936 system made by Thomas Henry Moray as it put out 50 kilowatts.

Moray's equipment is said to have contained a germanium diode which he built himself in the days before solid-state devices became readily available. The equipment was examined and tested many times. On dozens of occasions, he demonstrated the equipment driving a bank of twenty 150W bulbs, plus a 600W heater, plus a 575W iron (a total of 4.175 kW). The power picked up by this device needed only small diameter wires and had characteristics different from conventional electricity. One demonstration which was repeated many times, was to show that the output power circuit could be broken and a sheet of ordinary glass placed between the severed ends of the wire, without disrupting the supply. This type of power is called "Cold electricity" because thin wires carrying major power loads, do not overheat. This form of energy is said to flow in waves which surround the wires of a circuit and not actually through the wires at all. Unlike conventional electricity, it does not use electrons for transmission and that is why it can continue through a sheet of glass which would stop conventional electricity dead in its tracks.

On one occasion, Moray took his equipment away from all urban areas to a place chosen at random by a critic. He then set up the equipment and demonstrated the power output, well away from any man-generated electrical induction. He disconnected the aerial and showed that the power output stopped immediately. He connected the aerial again to generate the output as before. He then disconnected the earth connection which stopped the output again. When the earth wire was connected again, the output power returned. He found that the power output level fell somewhat at night. The aerial used in his demonstrations was reported to be like this:



From which it can be seen that even a relatively short aerial wire suspended not far from the ground, is capable of collecting substantial amounts of usable electrical power. The earth used in the remote demonstrations was a length of gas pipe which was hammered into the ground. It was noted that as each hammer blow drove the pipe deeper into the earth, the light bulbs (which formed the electrical load) shone more brightly, indicating that the quality of the earth connection is very important when serious power is being drawn from an aerial.

To put this in context, a washing machine is one of the highest loads in many households and one of those requires about 2.2 kilowatts. If you cannot read the circuit diagrams shown above, then perhaps you should take a look at the Electronics tutorial which forms the Appendix of this book.

The problem with the design of Thomas Henry Moray is that he never shared the details as he was intimidated into silence after having been shot at many times. However, one big advantage of his design is that it shows that even a short aerial can gather major amounts of usable power.

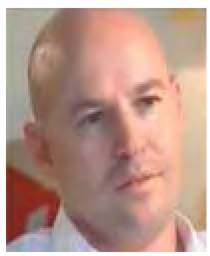
Chapter 2 - Electrolysis

If you place two metal electrodes in water and pass a current between them, two separate gasses are released: Hydrogen and Oxygen. If the Hydrogen is collected and compressed in a cylinder, then it can be used as fuel to run a car. Hydrogen has a very small atom and so, to prevent the hydrogen from leaking out through the walls of the cylinder, special material has to be used when making the cylinder.

Hydrogen gas has a low energy content and that causes “scientific experts” to discount it as a fuel. That attitude is reinforced by their lack of knowledge on how to produce the gas efficiently. They assume that the method used by Michael Faraday is the only method and that Faraday’s energy results are the final answer. However, technology has moved on and efficiencies some 1200% more effective than Faraday’s methods have been built and used.

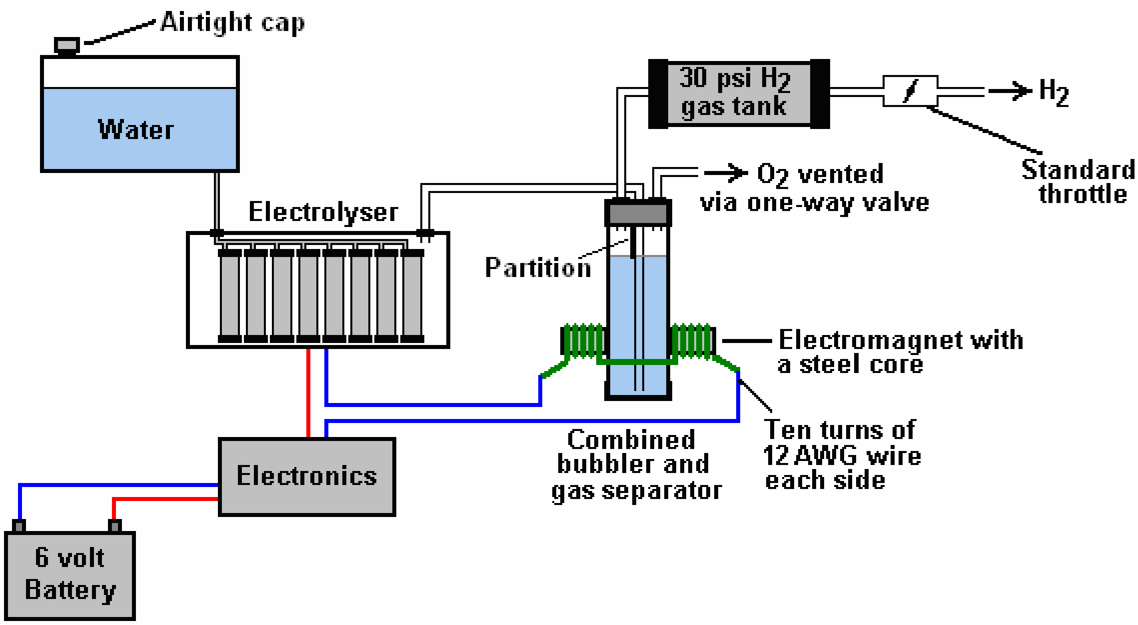
Another major factor is that the mixed gas from electrolysis, called “HHO”, typically has at least four times the energy content that hydrogen has on its own. These “experts” also “know” that hydrogen is so ineffective that they state that you can’t run an engine on it, without ever trying to run an actual engine. Their calculations are low by a factor of anything from four to forty-eight and engines can be run very well on hydrogen if you know the technology.

First, please understand that there are many different grades of HHO gas mix. The lower grades are contaminated with hot water vapour. The higher grades are so active that they will spontaneously ignite if compressed to fifteen pounds per square inch. Further, if the correct technique is used, what is produced by electrolysis forms between the electrodes rather than actually on the electrodes. That “gas” is known as “charged water clusters” and it has the highest energy rating of all.



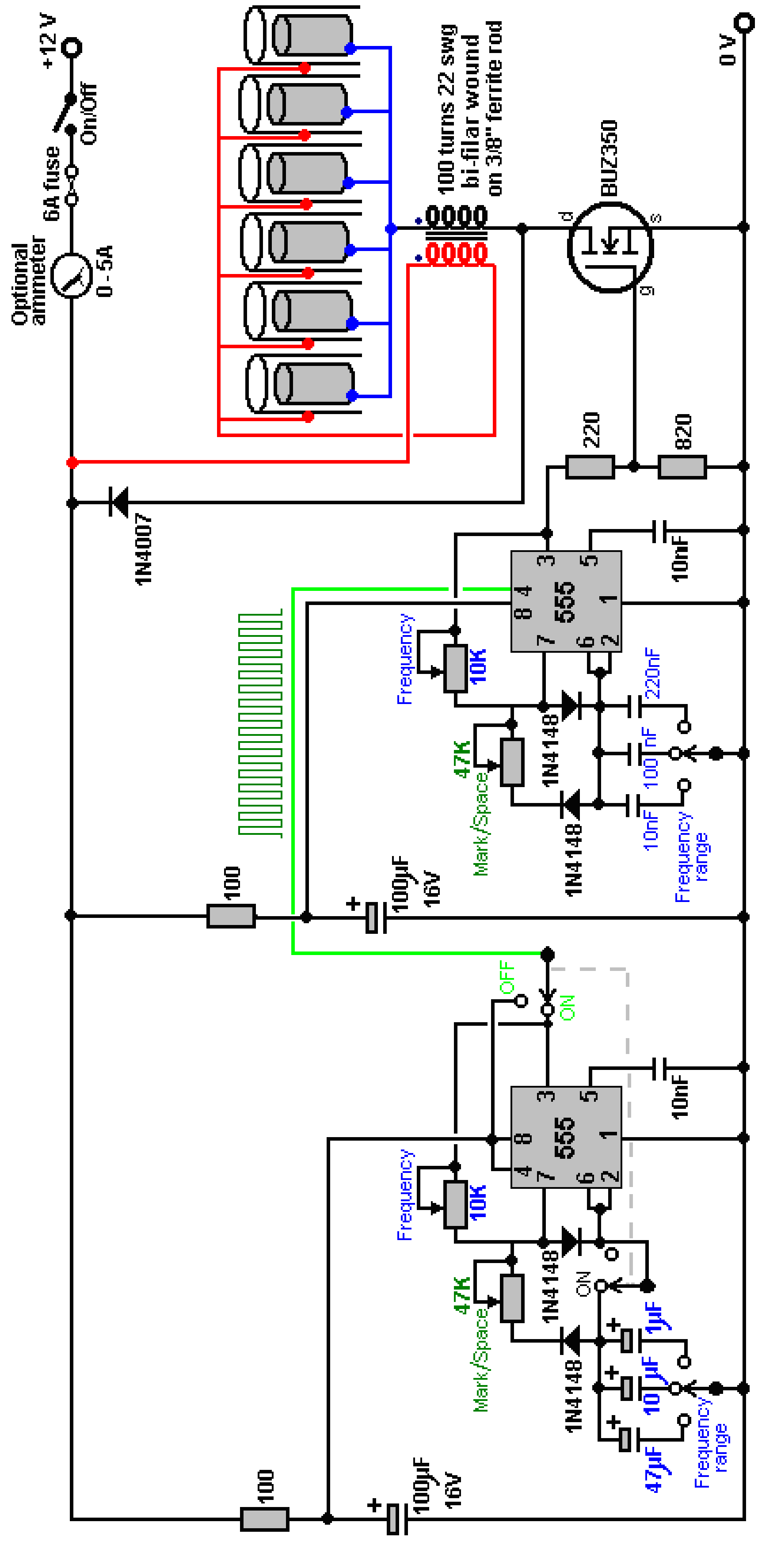
In New Zealand, Steve Ryan demonstrated that a motorcycle could be run using just water as fuel. The water was prepared by Steve and in my opinion, it looked like water saturated with charged water clusters. Either way, his motorcycle ran perfectly well.

In America, Zach West of the US Army, developed and tested a system to run a motorcycle on water alone. He built an electrolyser with spiral plates and then tried to reject most of the oxygen from the mix using a tall bubbler with a magnetic field across it:

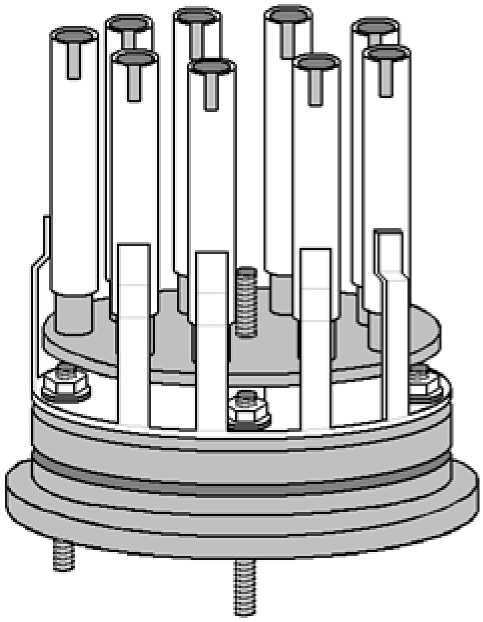


That allowed him to compress the remaining gas mix to thirty pounds per square inch into a tank which supplied extra gas to the engine for the odd times when extra was needed – typically, when starting off from traffic lights.

Stan Meyer is easily the best known developer of HHO systems. He demonstrated water-splitting at low power on a UK TV programme called “It Runs On Water” broadcast by the Channel 4 service. The programme was very vague about how exactly Stan’s circuit operated, but after much effort, Dave Lawton of Wales achieved the same result using a very simple circuit:

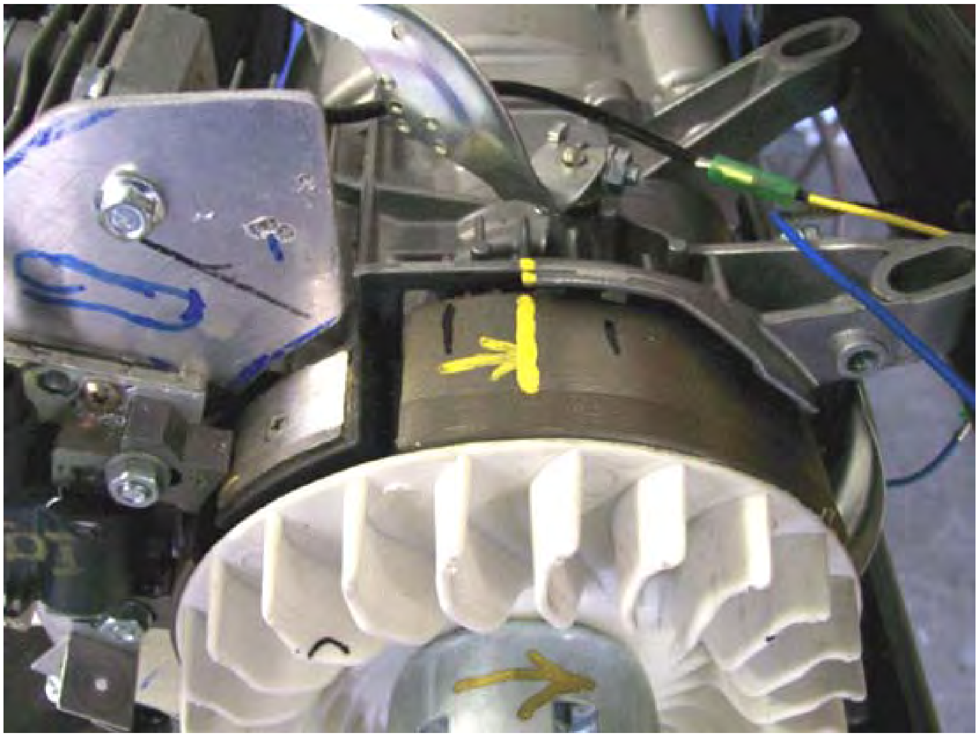

+12 V
On/Off
6A fuse
Optional ammeter
0 - 5A
100 turns 22 swg bi-filar wound on 3/8" ferrite rod
BUZ350
d
g
s
0 V
220
820
1N4007
10nF
555
Frequency
10K
47K
Mark/Space
1N4148
220nF
100nF
10nF
Frequency range
100
100µF 16V
OFF
ON
1µF
10µF
47µF

Both Stan Meyer and Dave Lawton used a complicated-looking arrangement of electrodes made from pairs of stainless steel pipes:



Even having plenty of HHO easily and cheaply made, the question is "what do you do with it?" Well, there a number of very useful things which can be done with HHO. For example, high quality heating without the use of a flame can be achieved by passing HHO into an ordinary catalytic converter:

Another very desirable option is to make a petrol generator run on HHO. There are two main ways to do this. The first is shown by Selwyn Harris of Australia and it involves altering the timing of the spark. This is needed because HHO gas has a flame-front speed about a thousand times faster than the flame-front speed of petrol droplets in air. If the spark is not delayed, then the spark will ignite the HHO before the inlet valve closes and that is definitely **not** something desirable:

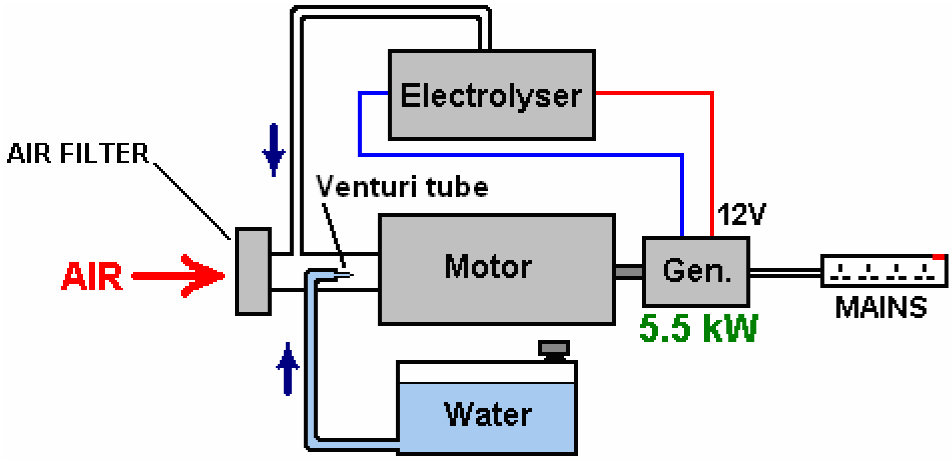


The second method uses an unmodified generator like this:

And instead of feeding it straight HHO, the HHO is bubbled through a container of acetone (or turpentine, or any similar liquid) to slow down it's flame-front speed. Not having to adapt the generator is a really major advantage.

The technique of treating HHO comes from an 1884 patent by Henry M. Paine although it was independently discovered and shared by David Quirey of New Zealand.

However, when water is converted to HHO gas, the volume of gas from one litre of water is about 1,450 litres of HHO. It follows then that when you reverse the process and convert it back into water again, the volume will **decrease** about 1,450 times.   Having that happen inside the cylinder of an engine is not what we want. So we add cold water mist to the air being drawn into the engine. That cold water absorbs a great deal of the heat of ignition and turns instantly into flash-steam. As the flash-steam has a very much greater volume, we get raised pressure inside the cylinder, which is what we want. The overall system is like this:



These systems have worked steadily every day for years now. They are popular with small remote communities where there is no mains grid and never will be due to the cost of running the mains all that way for so few people. The Venturi Tube generates the cold water mist without needing any moving parts. The HHO is generated using some of the electrical output from the generator and that arrangement provides kilowatts of excess electricity for the user to run other things.

A much more simple and cheap method of gaining a benefit from HHO gas is to use a booster. This is a small device which is mounted in the engine compartment of your car and which feeds HHO into the air entering your car engine. The HHO breaks down the petrol droplets ahead of the spark ignition and causes a much better burn of your main fuel. Please understand that this is a combustion enhancement and the HHO is not being burned as a fuel in its own right.

There are many designs of boosters and they can give mpg gains of anything from 20% to 100% although 50% is a common maximum. A very simple design is the “Smack’s Booster” which produces around 1.3 litres per minute (“lpm”) and while that sounds not very much, the best gains are often produced with just 0.5 lpm flow rate.

It is built using electric wall plates and is powered directly from the vehicle electrics. The gas production rate can be slowed down either by reducing the available current or by using a weaker electrolyte. The construction details are as follows:

The Smack’s Booster is a piece of equipment which increases the mpg performance of a car or motorcycle, and reduces the harmful emissions dramatically. It does this by using some current from the vehicle’s battery to break water into a mixture of hydrogen and oxygen gasses called “HHO” gas which is then added to the air which is being drawn into the engine. The HHO gas improves the quality of the fuel burn inside the engine, increases the engine power, cleans old carbon deposits off the inside of an old engine, reduces the unwanted exhaust emissions and improves the mpg figures under all driving conditions, provided that the fuel computer does not try to pump excess fuel into the engine when it detects the much improved quality of the exhaust.

This HHO gas booster is easy to make and the components don’t cost much. The technical performance of the unit is very good as it produces 1.3 litres of HHO gas per minute at a very reasonable current draw. This is how to make and use it.

Caution: This is not a toy. If you make and use one of these, you do so entirely at your own risk. Neither the designer of the booster, the author of this document or the provider of the internet display are in any way liable should you suffer any loss or damage through your own actions. While it is believed to be entirely safe to make and use a booster of this design, provided that the safety instructions shown below are followed, it is stressed that the responsibility is yours and yours alone.

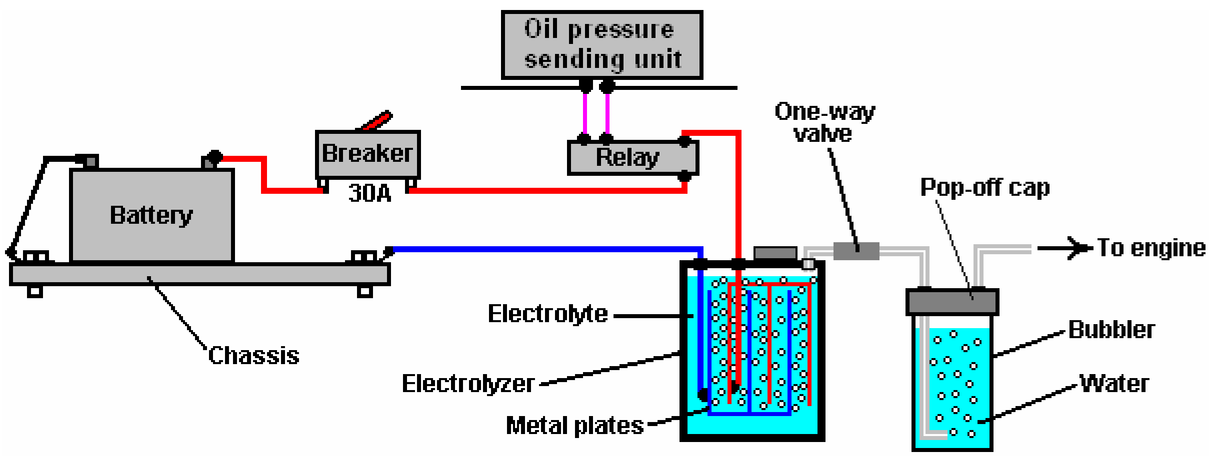
The Safety Gear

Before getting into the details of how to construct the booster, you must be aware of what needs to be done when using any booster of any design. Firstly, HHO gas is highly explosive. If it wasn't, it would not be able to do it's job of improving the explosions inside your engine. HHO gas needs to be treated with respect and caution. It is important to make sure that it goes into the engine and nowhere else. It is also important that it gets ignited inside the engine and nowhere else.

To make these things happen, a number of common-sense steps need to be taken. Firstly, the booster must not make HHO gas when the engine is not running. The best way to arrange this is to switch off the current going to the booster. It is **not** sufficient to just have a manually-operated dashboard On/Off switch as it is almost certain that switching off will be forgotten one day. Instead, the electrical supply to the booster is routed through the ignition switch of the vehicle. That way, when the engine is turned off and the ignition key removed, it is certain that the booster is turned off as well.

So as not to put too much current through the ignition switch, and to allow for the possibility of the ignition switch being on when the engine is not running, instead of wiring the booster directly to the switch, it is better to wire a standard automotive relay across the oil pressure sending unit and let the relay carry the booster current. If the engine stops running, the oil pressure drops and if the booster is connected as shown, then this will also power down the booster.

An extra safety feature is to allow for the (very unlikely) possibility of an electrical short-circuit occurring in the booster or its wiring. This is done by putting a fuse or contact-breaker between the battery and the new circuitry as shown in this sketch:



If you choose to use a contact-breaker, then a light-emitting diode ("LED") with a current limiting resistor of say, 680 ohms in series with it, can be wired directly across the contacts of the circuit breaker. The LED can be mounted on the dashboard. As the contacts are normally closed, they short-circuit the LED and so no light shows. If the circuit-breaker is tripped, then the LED will light up to show that the circuit-breaker has operated. The current through the LED is so low that the electrolyser is effectively switched off when the contact breaker opens. This is not a necessary feature, merely an optional extra:

In the first sketch, you will notice that the booster contains a number of metal plates and the current passing through the liquid inside the booster (the "electrolyte") between these plates, causes the water to break up into the required HHO gas mix. A very important safety item is the "bubbler" which is just a simple container with some water in it. The bubbler has the gas coming in at the bottom and bubbling up through the water. The gas collects above the water surface and is then drawn into the engine through an outlet pipe above the water surface. To prevent water being drawn into the booster when the booster is off and cools down, a one-way valve is placed in the pipe between the booster and the bubbler.

If the engine happens to produce a backfire, then the bubbler blocks the flame from passing back through the pipe and igniting the gas being produced in the booster. If the booster is made with a tightly-fitting lid rather than a screw-on lid, then if the gas in the bubbler is ignited, it will just blow the lid off the bubbler and rob the explosion of any real force. A bubbler is a very simple, very cheap and very sensible thing to install. It also removes any traces of electrolyte fumes from the gas before it is drawn into the engine.

You will notice that the wires going to the plates inside the electrolyser are both connected well below the surface of the liquid. This is to avoid the possibility of a connection working loose with the vibration of the vehicle and causing a spark in the gas-filled region above the surface of the liquid, and this volume is kept as low as possible as another safety feature.

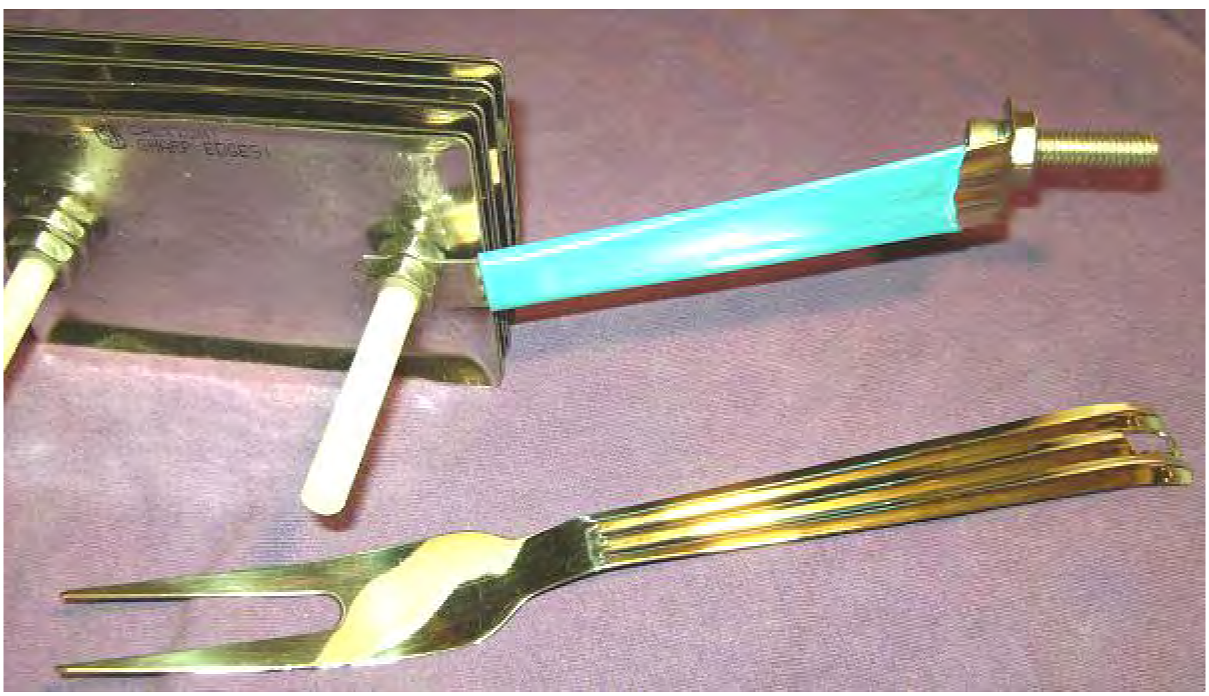
The Design

The booster is made from a length of 4-inch diameter PVC pipe, two caps, several metal plates, a couple of metal straps and some other minor bits and pieces.

This is not rocket science, and this booster can be built by anybody. A clever extra feature is the transparent plastic tube added to the side of the booster, to show the level of the liquid inside the booster without having to unscrew the cap. Another neat feature is the very compact transparent bubbler which is actually attached to the booster and which shows the gas flow coming from the booster. The main PVC booster pipe length can be adjusted to suit the available space beside the engine.

Bubbler connections close up:

This booster uses cheap, standard electrical stainless steel wall switch covers from the local hardware store and stainless steel straps cut from the handles of a wide range of stainless steel food-preparation ladles:

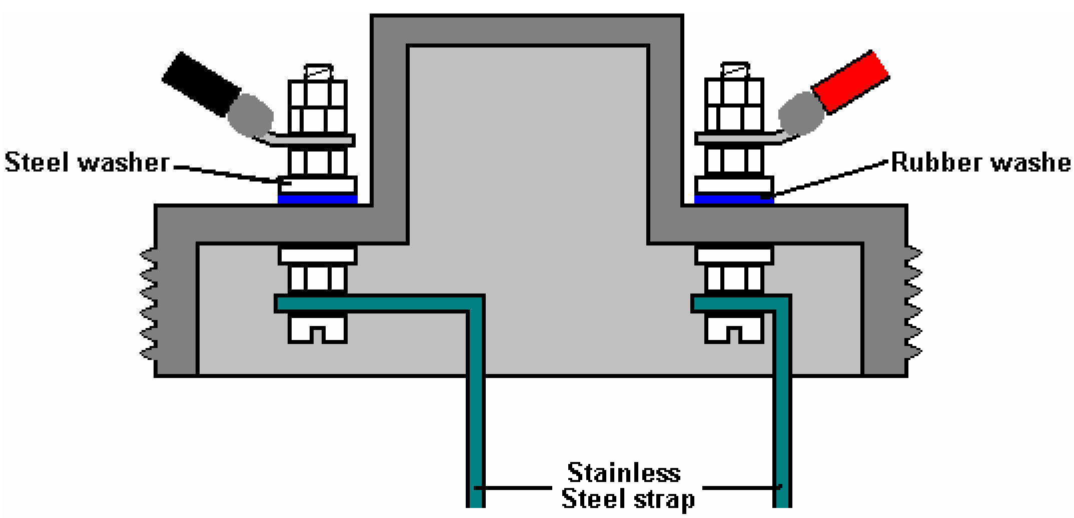


The electrical cover plates are clamped together in an array of eight closely-spaced pairs of covers. The plates are held in a vise and the holes drilled out to the larger size needed. The covers are further treated by being clamped to a workbench and dented using a centre-punch and hammer. These indentations raise the gas output from 1.5 lpm to 1.7 lpm as the both increase the surface area of the cover and provide points from which the gas bubbles can drop off the cover more easily. The more indentations the better.

The active surfaces of the plates - that is, the surfaces which are 1.6 mm apart from each other, need to be prepared carefully. To do this, these surfaces are scored in an X-pattern using 36-grade coarse sandpaper. Doing this creates miniature sharp-crested bumps covering the entire surface of each of these plates. This type of surface helps the HHO bubbles break away from the surface as soon as they are formed. It also increases the effective surface area of the plate by about 40%. I know that it may seem a little fussy, but it has been found that fingerprints on the plates of any electrolyser seriously hinder the gas production because they reduce the working area of the plate quite substantially. It is important then, to either avoid all fingerprints (by wearing clean rubber gloves) or finish the plates by cleaning all grease and dirt off the working surfaces with a good solvent, which is washed off afterwards with distilled water. Wearing clean rubber gloves is by far the better option as cleaning chemicals are not a good thing to be applying to these important surfaces.

Shown above are typical hand tools used to create the indentations on the plates. The active plate surfaces – that is, the surfaces which are 1.6 mm apart – are indented as well as being sanded.

An array of these prepared plates is suspended inside a container made from 4-inch (100 mm) diameter PVC pipe. The pipe is converted to a container by using PVC glue to attach an end-cap on one end and a screw-cap fitting on the other. The container then has the gas-supply pipe fitting attached to the cap, which is drilled with two holes to allow the connecting straps for the plate array to be bolted to the cap, as shown here:



CROSS-SECTION THROUGH CAP

In order to ensure that the stainless steel straps are tightly connected to the electric wiring, the cap bolts are both located on the robust, horizontal surface of the cap, and clamped securely both inside and out. A rubber washer or rubber gasket is used to enhance the seal on the outside of the cap. If available, a steel washer with integral rubber facing can be used.

As the stainless steel strap which connects the booster plates to the negative side of the electrical supply connects to the central section of the plate array, it is necessary to kink it inwards. The angle used for this is in no way important, but the strap should be perfectly vertical when it reaches the plates.

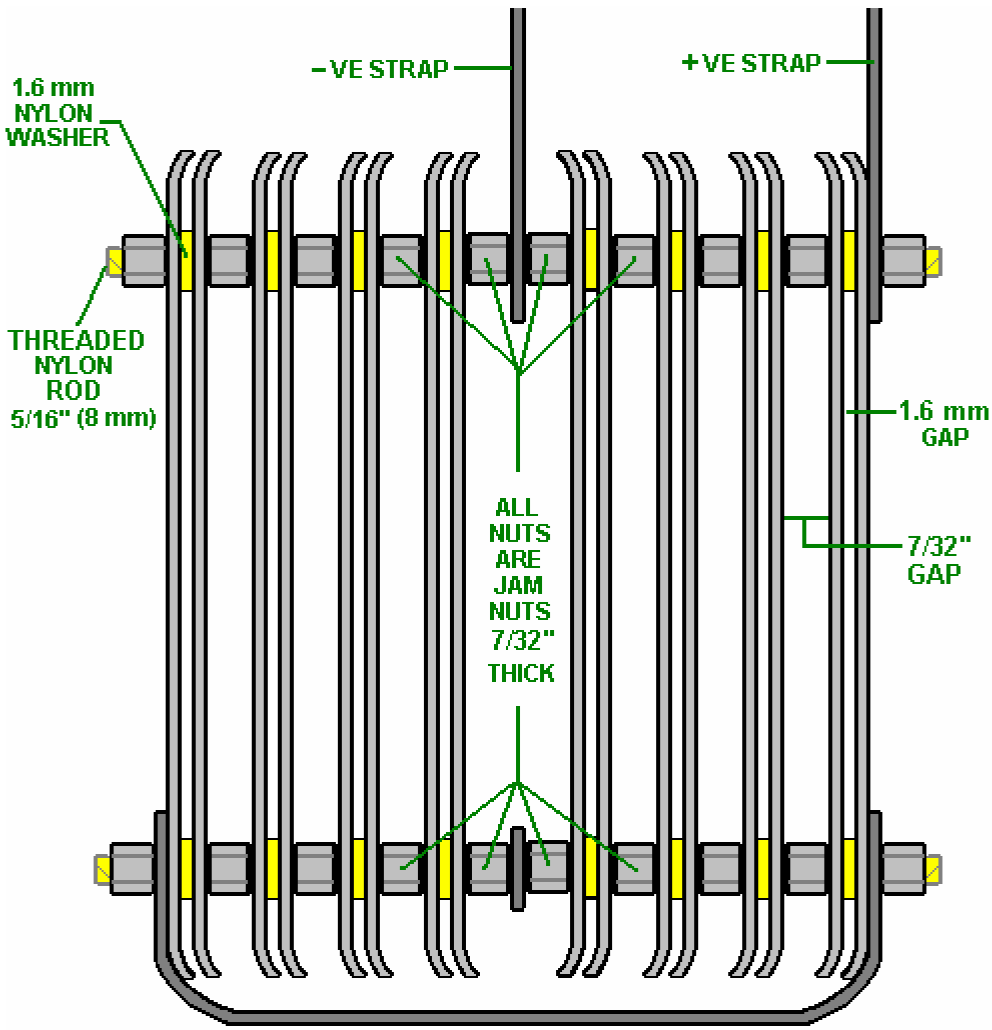
The picture above shows clearly the wall plates being used and how the bubbler is attached to the body of the booster with super-glue. It also shows the various pipe connections. The stainless steel switch-cover plates are 2.75 inch x 4.5 inch (70 mm x 115 mm) in size and their existing mounting holes are drilled out to 5/16 inch (8 mm) diameter in order to take the plastic bolts used to hold the plates together to make an array. After a year of continuous use, these plates are still shiny and not corroded in any way.

Three stainless steel straps are used to connect the plate array together and connect it to the screw cap of the booster. These straps are taken from the handles of cooking utensils and they connect to the outer two plates at the top and the third strap runs across the bottom of the plate array, clear of the plates, and connects to both outside plates as can be seen in the diagrams.

The plates are held in position by two plastic bolts which run through the original mounting holes in the plates. The arrangement is to have a small 1.6 mm gap between each of eight pairs of plates. These gaps are produced by putting plastic washers on the plastic bolts between each pair of plates.

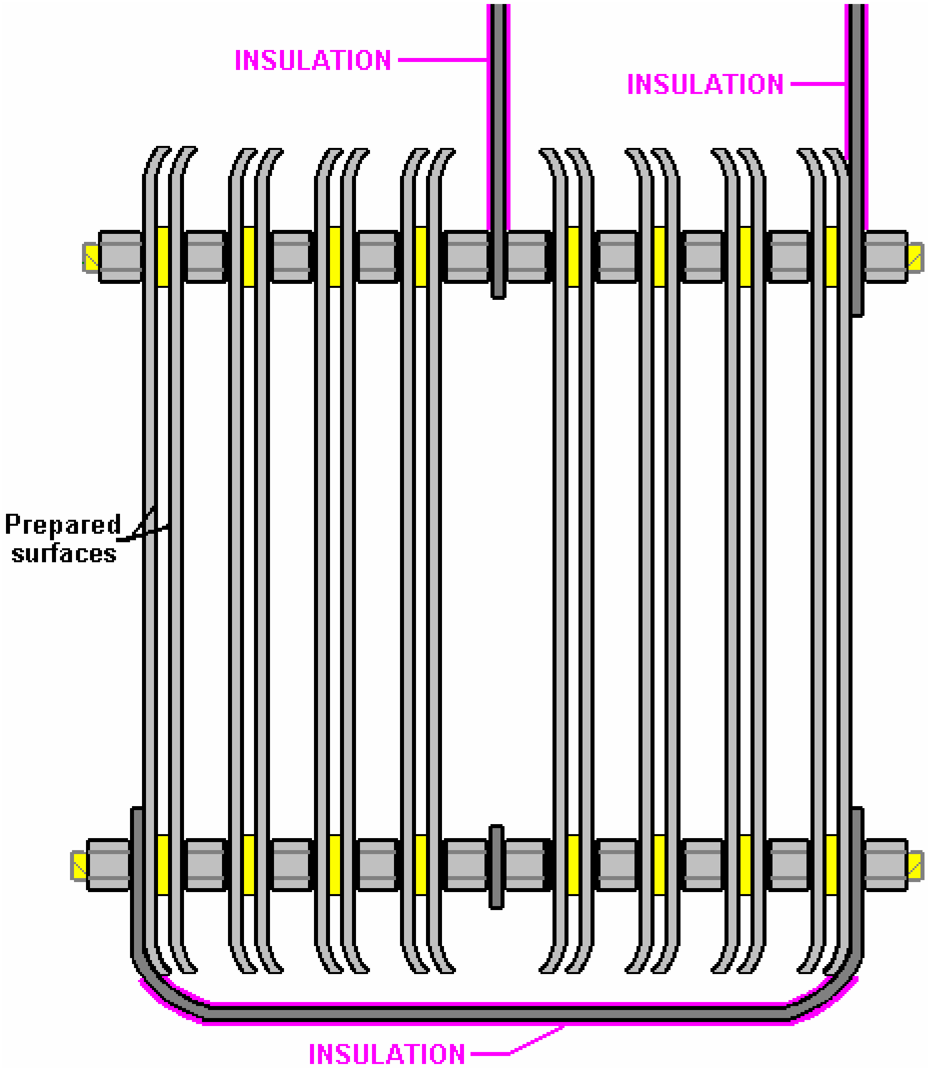
The most important spacing here is the 1.6 mm gap between the plates as this spacing has been found to be very effective in the electrolysis process. The way that the battery is connected is unusual in that it leaves most of the plates apparently unconnected. These plate pairs are called “floaters” and they do produce gas in spite of looking as if they are not electrically connected (they are connected through the electrolyte).

Stainless steel nuts are used between each pair of plates and these form an electrical connection between adjacent plates. The plate array made in this way is cheap, easy to construct and both compact and robust. The electrical straps are bolted to the screw cap at the top of the unit and this both positions the plate array securely and provides electrical connection bolts on the outside of the cap while maintaining an airtight seal for the holes in the cap.

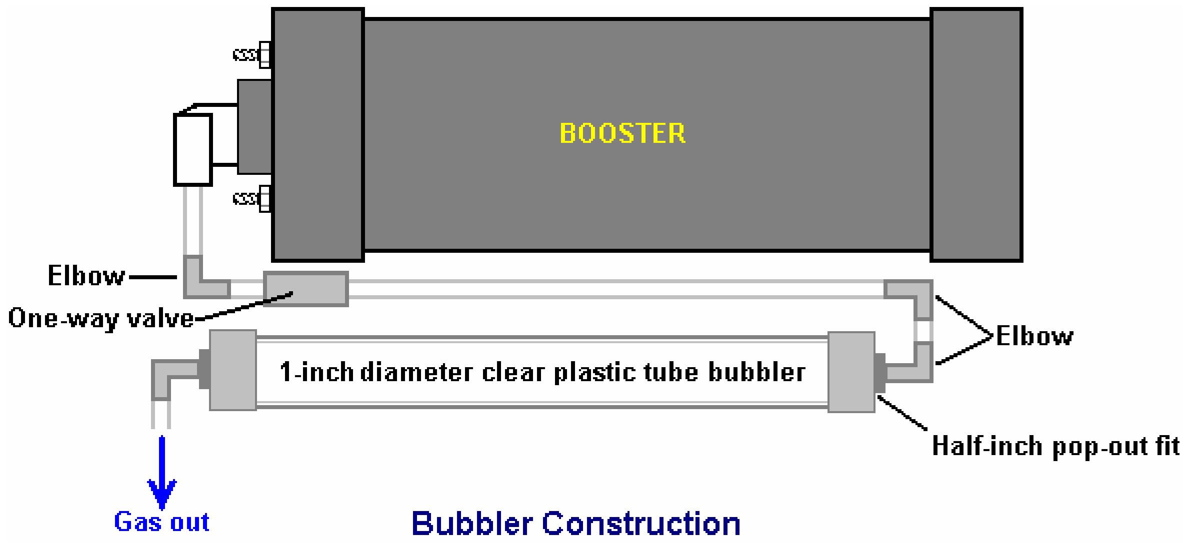


SIDE VIEW OF PLATE ARRAY

Another very practical point is that the stainless steel straps running from the screw cap to the plate array, need to be insulated so that current does not leak directly between them through the electrolyte. The same applies to the strap which runs underneath the plates. This insulating is best done with shrink-wrap. Alternatively, good quality tool dip (McMaster Carr part number 9560t71) is an effective method, but if neither of these methods can be used, then the insulating can be done by wrapping the straps in electrical insulating tape. Using that method, the tape is wrapped tightly around the straps, being stretched slightly as it is wrapped. The section running underneath the covers is insulated before the array is assembled.



The PVC housing for the booster has two small-diameter angle pipe fittings attached to it and a piece of clear plastic tubing placed between them so that the level of the electrolyte can be checked without removing the screw cap. The white tube on the other side of the booster is a compact bubbler which is glued directly to the body of the booster using super-glue in order to produce a single combined booster/bubbler unit. The bubbler arrangement is shown here, spread out before gluing in place as this makes the method of connection easier to see.



The half-inch diameter elbows at the ends of the one-inch diameter bubbler tube have their threads coated with silicone before being pushed into place. This allows both of them to act as pressure-relief pop-out fittings in the unlikely event of the gas being ignited. This is an added safety feature of the design.

This booster is operated with a solution of Potassium Hydroxide also called KOH or Caustic Potash which can be bought from various suppliers such as:
http://www.essentialdepot.com/servlet/the-13/2-lbs-Potassium-Hydroxide/Detail
http://www.organic-creations.com/servlet/the-653/caustic-potassium-hydroxide-KOH/Detail
http://www.aaa-chemicals.com/pohy2posa.html or
http://www.nuscentscandle.com/PHFLAKES.html To get the right amount in the booster, I fill the booster to its normal liquid level with distilled water and add the Hydroxide a little at a time, until the current through the booster is about 4 amps below my chosen working current of 20 amps. This allows for the unit heating up when it is working and drawing more current because the electrolyte is hot. The amount of KOH is typically 2 teaspoonfuls. It is very important to use distilled water as tap water has impurities in it which make a mess which will clog up the booster. Also, be very careful handling potassium hydroxide as it is highly caustic. If any gets on you, wash it off immediately with large amounts of water, and if necessary, use some vinegar which is acidic and will offset the caustic splashes.

The completed booster usually looks like this:


WWW.SMACKSBOOSTERS

But, it can be built using different materials to give it a cool look:

And attached to a cool bike:

The final important thing is how the booster gets connected to the engine. The normal mounting for the booster is close to the carb or throttle body so that a short length of piping can be used to connect the booster to the intake of the engine. The connection can be to the air box which houses the filter, or into the intake tube. The closer to the butterfly valve the better, because for safety reasons, we want to reduce the volume of HHO gas hanging around in the intake system. You can drill and tap a 1/4" (6 mm) NPT fitting into the plastic inlet tubing with a barbed end for connecting the 1/4" (6 mm) hose.

The shorter the run of tubing to the air ductwork of the engine, the better. Again, for safety reasons, we want to limit the amount of unprotected HHO gas. If a long run of 3 feet (1 metre) or more must be used due to space constraints, then it would be a good idea to add another bubbler at the end of the tube, for additional protection. If you do this, then it is better to use a larger diameter outlet hose, say 3/8" or 5/16" (10 mm or 8 mm). The parts needed to build this booster with it's bubbler can be found locally or ordered from web sites.

Powering your Booster

Use wire and electrical hardware capable of handling 20 amps DC, no less. Overkill is OK in this situation, so I recommend using components that can handle 30 amps. Run your power through your ignition circuit, so that it only runs when the vehicle is on. A 30 amp relay should be used to prevent damaging the ignition circuit which may not be designed for an extra 20 amp draw. Make sure to use a properly rated fuse, 30 amps is ideal. You can use a toggle switch if you like for further control. As an added safety feature, some like to run an oil pressure switch to the relay as well, so the unit operates only when the engine is actually running. It is very important that all electrical connections be solid and secure. Soldering is better than crimping. Any loose connections will cause heat and possibly a fire, so it is up to you to make sure those connections are of high quality. They must be clean and tight, and should be checked from time to time as you operate the unit just to be sure the system is secure.

Adjusting the Electrolyte

Fill your booster with distilled water and NaOH (sodium hydroxide) or KOH (potassium hydroxide) **only**. No tap water, salt water or rainwater! **No table salt or baking soda!** These materials will permanently damage the booster!

First, fill the booster with distilled water about 2" from the top. Add a teaspoon of KOH or NaOH to the water and then slide the top into place. Do not tighten it for now, but leave the top loose and resting in place. Connect your 12V power supply to the leads and monitor the current draw of the unit. You want 16 amps flowing when the booster is cold. As the water heats up over time, the current draw will increase by around 4 amps until it reaches about 20 amps, and this is why you are aiming for only 16 amps with a cold system.

If the current is too high, dump out some electrolyte and add just distilled water. If the current is too low, add a pinch or two at a time of your catalyst until the 16 amps is reached. Overfilling your booster will cause some of the electrolyte to be forced up the output tube, so a liquid level tube was added to monitor electrolyte level.

The booster generally needs to be topped off once a week, depending on how long it is in operation. Add distilled water, then check your current draw again. You may observe a drop in current over the course of a few refills, and this is normal. Some of the catalyst escapes the cell suspended in water vapor droplets, so from time to time you may need to add a pinch or two. The water in the bubbler acts to scrub this contaminant out of the gas as well. I highly recommend installing an ammeter to monitor current draw as you operate your booster.

Mounting the Booster

Choose a well ventilated area in the engine compartment to mount your booster. Since every vehicle design is different, I leave it up to you to figure out the best method to mount it. It must be mounted with the top orientated upwards. Large 5" diameter hose clamps work well, but do not over tighten them or the PVC may deform. I recommend mounting the booster behind the front bumper in the area usually present between it and the radiator. Support the weight of the unit from the bottom with a bracket of your design, then use two hose clamps to secure the unit, one near the top and one near the bottom. Never install the unit in the passenger compartment for safety reasons.

Output hose and Bubbler

The bubbler on the side of the unit should be filled about 1/3 to 1/2 full of water - tap water is fine for the bubbler. The check valve before the bubbler is there to prevent the bubbler water from being sucked back into the booster when it cools and the gases inside contract. **Make sure the bubbler level is maintained at all times**. **Failure to do so could result in an unwanted backfire explosion**. That water inside the bubbler is your physical shield between the stored HHO volume in the generator and the intake of your engine. Install the output hose as close to the carburetor/throttle body as close as possible by making a connection into the intake tube/air cleaner. Try to make the hose as short as possible to reduce the amount of gas volume it contains. I recommend using the same type of 1/4" poly hose that is used on the unit.

Here is a list of the parts needed to construct the booster and bubbler if you decide to build it yourself rather than buying a ready-made unit:

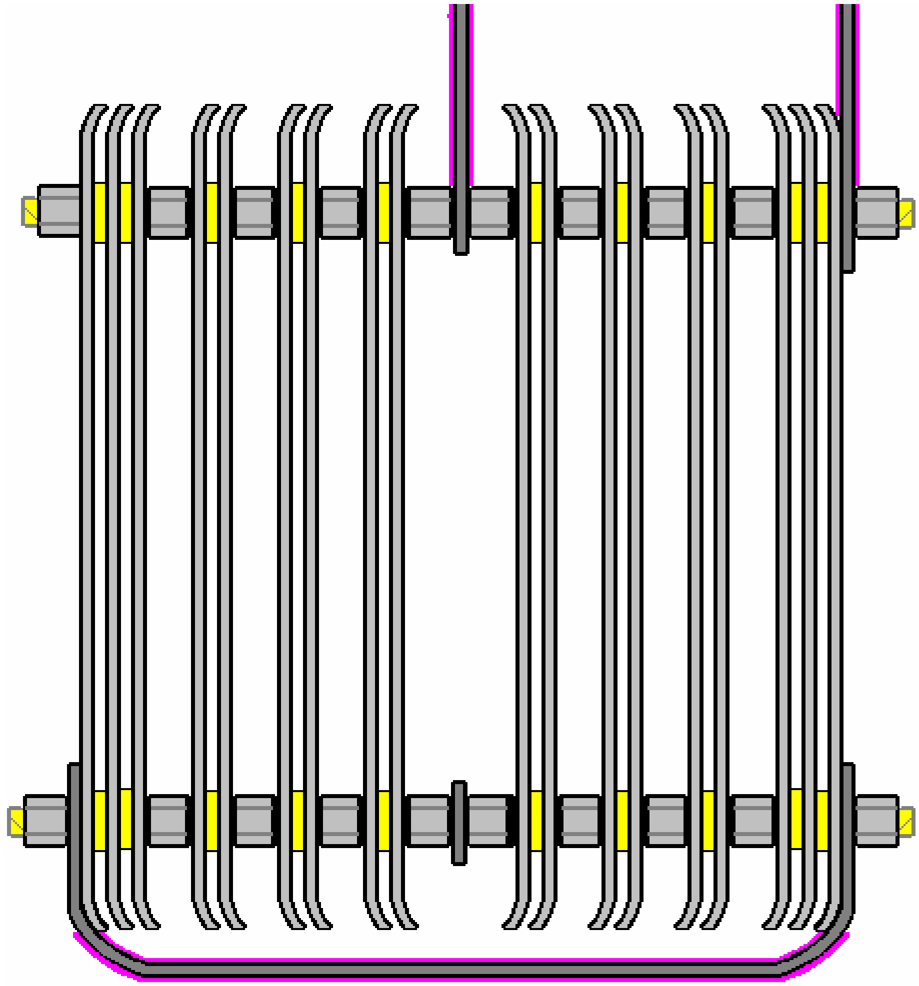
The Main Parts Needed

Part	Quantity	Comment
4-inch diameter PVC pipe 12-inches long	1	Forms the body of the booster
4-inch diameter PVC pipe end-cap	1	Closes the bottom of the booster
4-inch diameter PVC pipe screw cap	1	The top of the booster
90-degree Quick Connect Outlet fitting	1	3/8" O.D. Tube x 1/4" NPT from Hardware store
Level indicator Nylon barbed tube fitting	2	1/4" Tube x 1/8" NPT Part Number 2974K153 or from your local hardware store
Quarter-inch I.D. Poly sight tube	8”	Water-level indicator tubing - Hardware store
Stainless steel switch covers	16	The plate array components
Stainless steel straps 12-inches long	2	The electrical connections to the plates
3/4" Inside Diameter Clear poly tube	12-inch	From your local hardware store
5/16” stainless steel bolts 1.25” long	2	Electrical strap connection to the top cap
5/16” stainless steel nuts & washers	6 each	To fit the steel bolts in the cap
5/16” diameter nylon threaded rod	8” min.	Nylon Threaded Rod 5/16"-18 Thread. McMaster Carr Part No 98831a030
5/16” inch nylon washers 1.6 mm thick	1-pack	Nylon 6/6 Flat Washer 5/16", Pack of 100 McMaster Carr Part No 90295a160
5/16”-18 s/s jam nuts (7/32" thick)	20	McMaster Carr Part No 91841A030
90 degree Bubbler Fittings	2	1/4" Barbed Tube 1/2" NPT. McMaster Carr Part No 2974K156
Check valve	1	1/4" tube, McMaster Carr Part No 47245K27 or from your local Hardware store
PVC glue	1 tube	Same color as the PVC pipe if possible
5/16" Neoprene sealing washer	2	McMaster Carr Part No 94709A318 or from your local Hardware store
Tool dip – 14.5 oz	1	McMaster Carr Part No 9560t71
Optional: Light Emitting Diode	1	10 mm diameter, red, with panel-mounting clip
Quarter-watt resistor	1	470 ohm (code bands: Yellow, Purple, Brown)

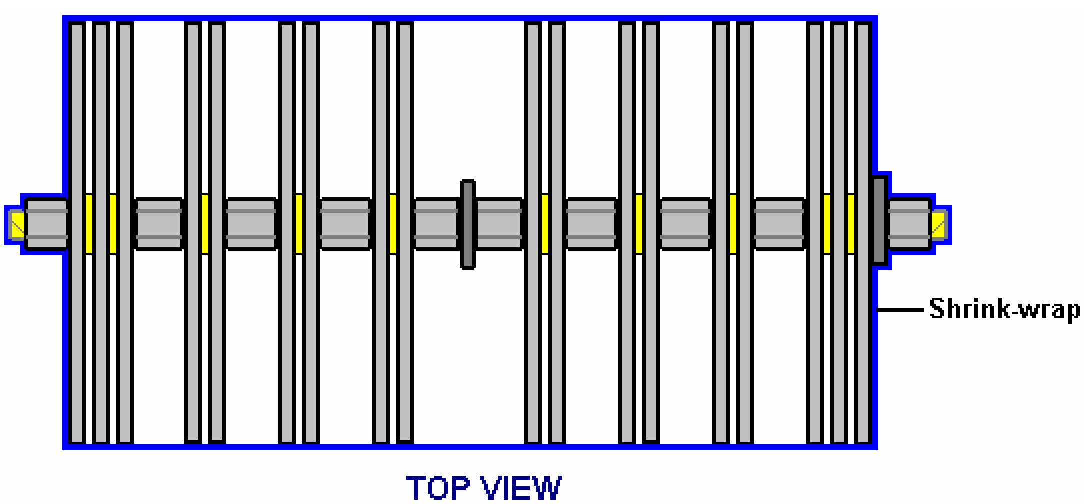
Now, having shown how this very effective booster and bubbler are constructed, it should be pointed out that if you use it with a vehicle fitted with an Electronic Control Unit which monitors fuel injection into the engine, then the fuel-computer section will offset the gains and benefits of using this, or any other, booster. The solution is not difficult, as the fuel-computer can be controlled by adding in a little circuit board to adjust the sensor signal fed to the computer from the oxygen sensor built into the exhaust of the vehicle. Ready-built units are available for this or you can make your own. If you want to make your own, then the web site document http://www.free-energy-info.com/D17.pdf shows you how and as well, points to Eagle-Research, the suppliers of alternative, ready-made units, also stocked by The Hydrogen Garage in America.

Quite an amount of testing and experimenting has been carried out by many of the people who have made copies of this booster and two variations which have been found to be helpful are shown here:

Firstly, in spite of the very restricted space inside the housing, it is possible to introduce two extra wall plates, one at each end of the plate stack. These plates are spaced 1.6 mm apart using plastic washers and this triple-plate group causes an extra voltage drop across the sub-set of three plates. The construction is then as shown here:



The second modification is wrapping the plate array in 4-inch shrink-wrap. This wrapping extends around the sides of the plates and helps by cutting out some of the unwanted electrical leakage paths through the electrolyte. This arrangement is shown here:



Enjoy using this booster and do your part in cutting greenhouse gas emissions.

Eletrik

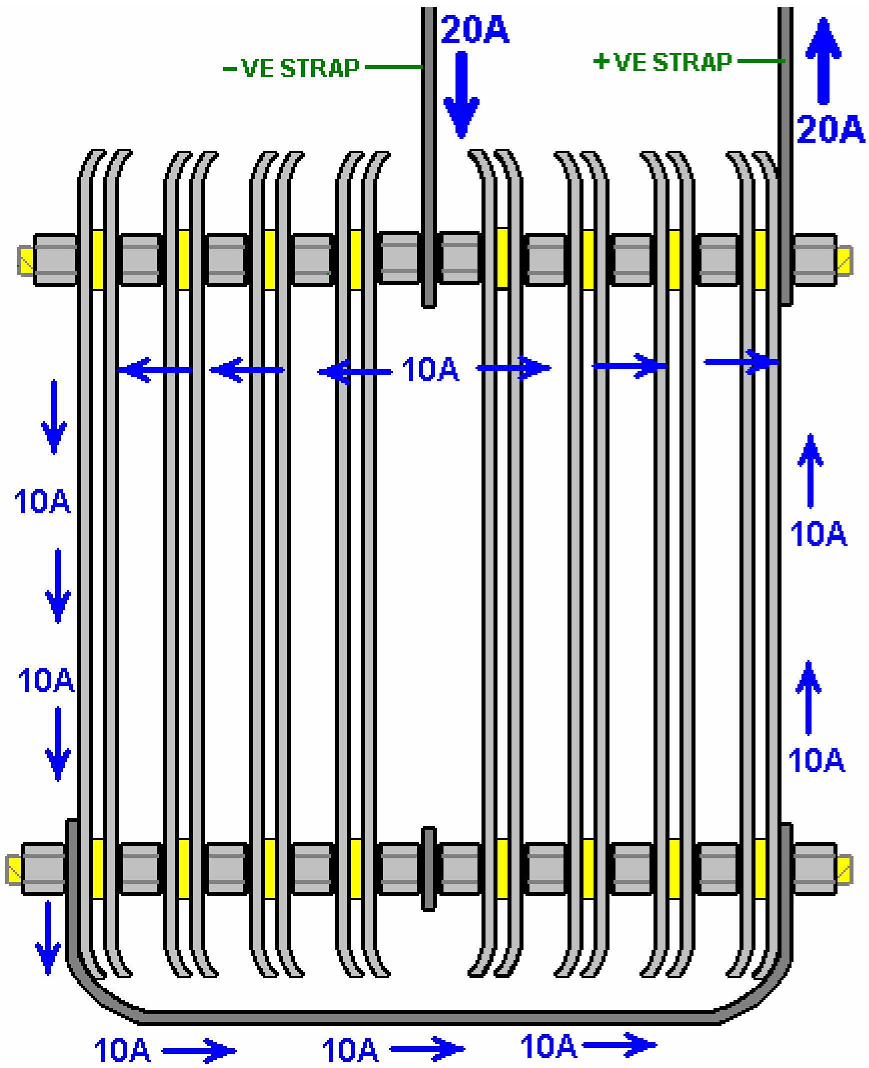
Smack's Booster is a trademarked name, and the design is patent-pending but remains fully disclosed for public use.

Date of release of this copy of the document: 3rd July 2008

Background Information

Many people find the plate arrangement of the Smack's Booster, rather difficult to understand, so this additional section is just to try to explain the operation of the cell. This has nothing to do with actually building or using a Smack's Booster, so you can just skip this section without missing anything.

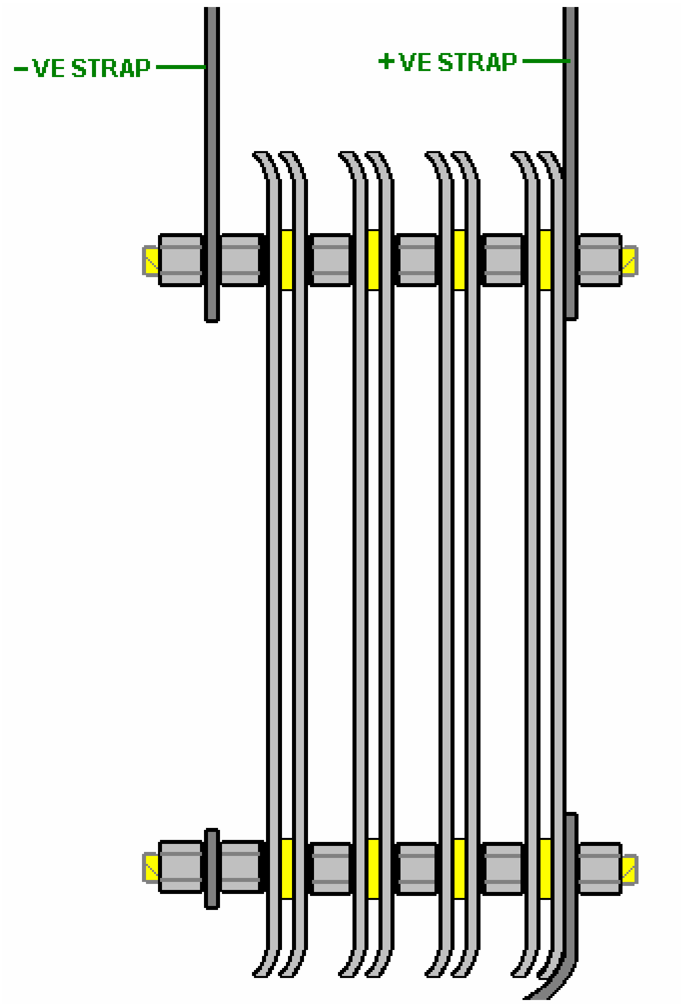
The Smack's Booster plate arrangement does look confusing. This is mainly because Eletrik has squeezed two identical sets of plates into one container as shown here:



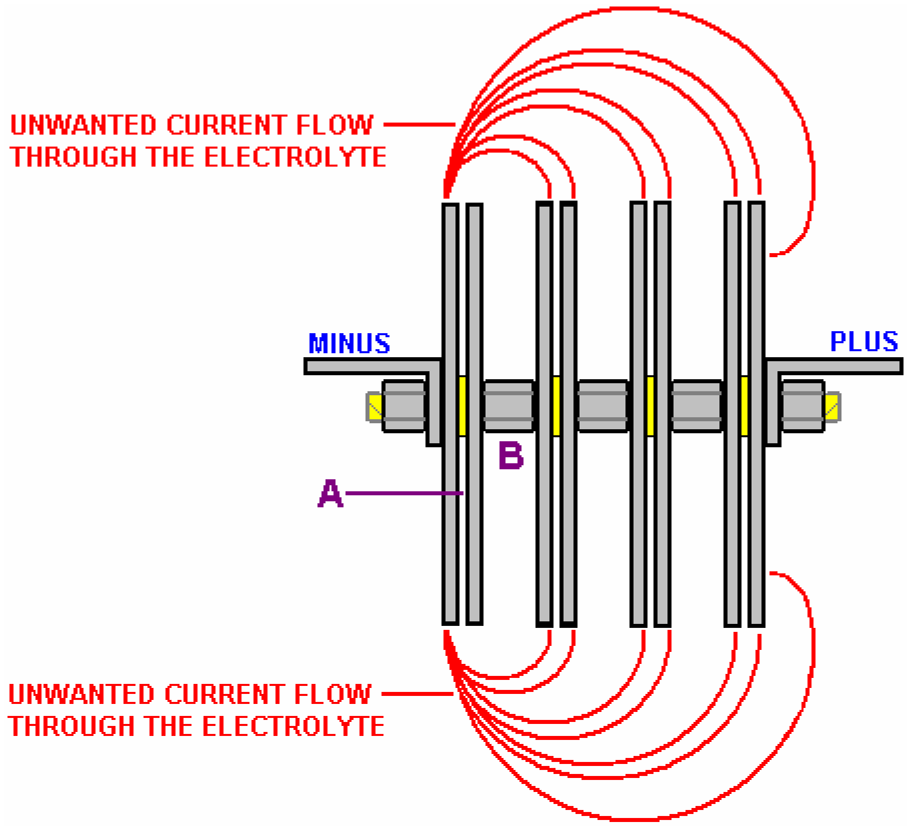
This arrangement is two identical sets of plates positioned back-to-back. To make it easier to understand the operation, let's just consider just one of the two sets of plates.

Here, you have just the electrical Plus linked to the electrical Minus by a set of four pairs of plates in a daisy chain (the technical term is: connected "in series" or "series-connected"). Easily the most electrically efficient way for doing this is to exclude all possible current flow paths through the electrolyte by closing off around the edges of all the plates and forcing the current to flow through the plates and only through the plates.

Unfortunately, this is very difficult to do in a cylindrical container and it has the disadvantage that it is difficult to keep the unit topped up with water and difficult to maintain the electrolyte level just below the top of the plates.



So, a compromise is reached where the current flow around and past the plates is combatted by strategic spacing of the plates:



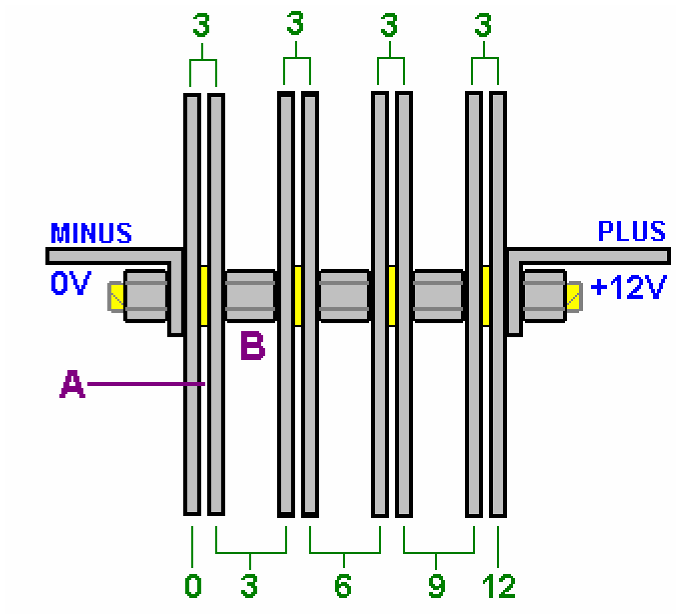
This diagram shows the way that the plates are connected. The red lines show paths of unwanted current flow which produce almost no gas. This wasted current flow is opposed by the useful current flow across gap "**A**" in the diagram.

To favour the flow across the 1.6 mm gap "**A**", an attempt is made to make the waste flows as long as possible by comparison. This is done by the gap "**B**" being made as large as possible, limited only by the size of the booster housing.

The voltage applied to the cell (13.8 volts when the engine is running) divides equally across the four plate pairs, so there will be one quarter of that voltage (3.45 volts) across each plate pair.

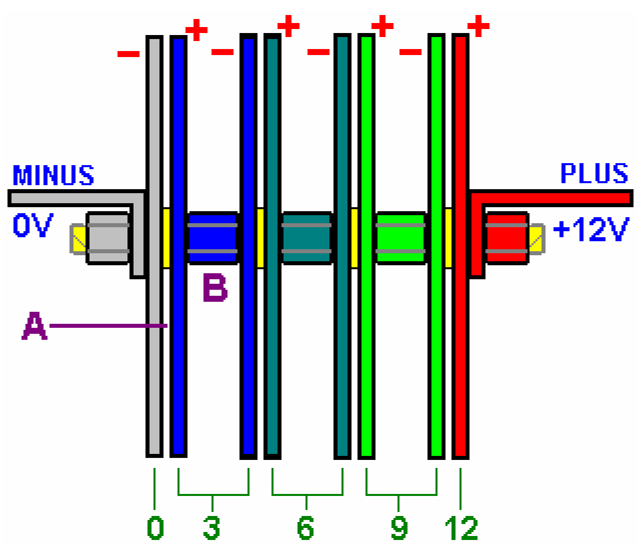
If you look again at the original diagram, you will see that there are two of these sets of four plate pairs, positioned back-to-back in the container. Each of these acts separately, except for the fact that there are additional current leakage paths through the electrolyte between the plates of one set and the plates of the second set.

There is a steady voltage drop progressively across the array of plates. Remember that they are connected in pairs in the middle due to the metal-to-metal connection created by the steel nuts between the plates:



VOLTAGE DROPS FOR A 12-VOLT SUPPLY

It is often difficult for people to get the hang of how the voltage drops across a chain of resistors (or matrix of plates). The voltages are relative to each other, so each plate pair thinks that it has a negative electrical connection on one plate and a positive connection on the other plate.



For example, if I am standing at the bottom of a hill and my friend is standing ten feet up the hill, then he is ten feet above me.

If we both climb a hundred feet up the mountain and he is at a height of 110 feet and I am at a height of 100 feet, he is still ten feet above me.

If we both climb another hundred feet up the mountain and he is at a height of 210 feet and I am at a height of 200 feet, he is still ten feet above me. From his point of view, I am always ten feet below him.

The same thing applies to these plate voltages. If you one plate is at a voltage of +3 volts and the plate 1.6 mm away from it is at a voltage of +6 volts, then the 6 volt plate is 3 volts more positive than the 3 volt plate, and there is a 3 volt difference across the gap between the two plates. The first plate looks to be 3 volts negative to the 6 volt plate when it "looks" back at it.

You can also say that the +3 volt plate is 3 volts lower than the +6 volt plate, so from the point of view of the +6 volt plate, the +3 volt plate is 3 volts lower down than it, and it therefore “sees” the other plate as being at -3 volts relative to it.

In the same way, my friend sees me as being at -10 feet relative to him, no matter what height we are on the mountain. It is all a matter of being "higher up" whether in terms of height above sea level on a mountain or in terms of higher up in voltage inside a booster.

Now, having shown how this booster and bubbler are constructed, it should be pointed out that if you use it with a vehicle fitted with an Electronic Control Unit which monitors fuel injection into the engine, then the fuel-computer section will offset the mpg gains and benefits of using this, or any other, booster. The solution is not difficult, as the fuel-computer can be controlled by adding in a little circuit board to adjust the sensor signal fed to the computer from the oxygen sensor built into the exhaust of the vehicle, to allow for the improved quality of the fuel being burnt in the engine. This is necessary because the exhaust will be so much cleaner than it used to be, that the computer will think that the engine is being starved of fuel (which it most definitely isn’t. With a booster, the engine runs cleaner, cooler and more smoothly and it has enhanced pulling power called “torque”. Ready-built units are available for correcting the oxygen sensor signal for the improved situation, or alternatively, you can make your own.

Chapter 3 - Gravity

In 1939, **William F. Skinner** of Miami in Florida, demonstrated his fifth generation generator powered by spinning weights. His demonstration can still be seen at http://www.britishpathe.com/video/gravity-power where he shows his design powering a twelve-foot lathe, a drill press and a power hacksaw, all simultaneously. The newsreel commentator states that the output power was "1200% of the input power" which is COP=12 but it is highly likely that he should have said "1200 times" rather than "1200%" because he continues to state that using the design would allow a one-horsepower (746 watts) input power to power 3,500 homes. If it were COP=12 then each of those 3,500 homes would receive less than 2.6 watts, which is clearly wrong. At the much more likely COP=1200, each household would receive on average, 255 watts, which might be just possible in 1939 when few appliances were electric. Anyway, Skinner's impressive equipment could be driven by drive band made of a single cotton thread, while powering his whole workshop. It looked like this:

This design has four nearly vertical shafts, each braced to give additional rigidity. These rotating shafts pass their rotating power to the mechanical output drive belt seen on the left. Each of these rotating shafts has a heavy weight in the form of a thick, short cylinder mounted high up near the top of the shaft and what is probably an even heavier weight in the form of a long narrower cylinder attached near the bottom of the shaft as seen just to the right of the output drive belt. These four identical sets of shafts with their pairs of weights spin two or three times per second and produce the whole of the output power.

As far as I am aware, Skinner never patented his design or disclosed how it worked. However, the operating principle is very simple indeed although it may take you a while to grasp how it works. You can check this out quite easily for yourself if you have access to an old-fashioned chair with four rigid legs like this:

Tilt the chair over so that it is balanced on one leg. You will notice that almost no effort is involved in keeping it in that position as all of the weight is supported by the floor through just one of the legs. Now, move the top of the chair by a very small amount and keep the top of the chair in that position. You will notice two things: first, very little effort was needed to move the top of the chair and second, the chair now swings around and becomes stationary on the same side that the top of the chair was moved to.

Notice two other things: the chair swung around because of your moving the top slightly and **you** did not swing it around, and if the chair is heavy, the amount of energy in the swinging chair is very much greater that the amount of energy which you applied to the top of the chair.

If you were to keep moving the top of the chair in a tiny circle, then the chair will spin around continuously for however long that you choose to wobble the top of the chair. The amount of energy in the spinning chair is very much greater than the energy which you are expending to make the chair spin. So from where is that extra energy coming?

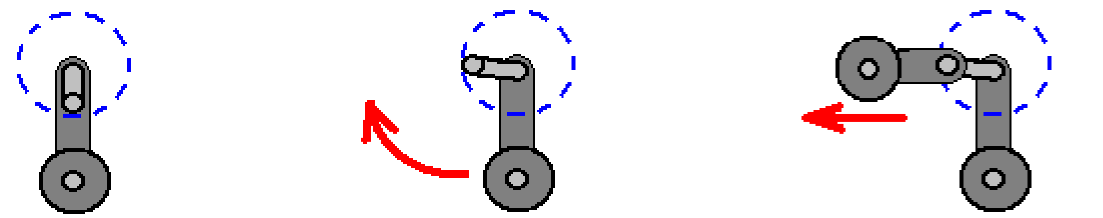
What is happening is that the chair swings round under gravity to reach the lowest possible point for it with the new position of the top of the chair. But, before it can get there, you move the top of the chair further around and so the chair has to swing further in order the reach the lowest point. But before it can get there, you move the top again ….. The chair keeps swinging round and round, pulled by gravity, for as long as you choose to keep moving the top. But, no matter how heavy the chair, very little effort is needed from you to cause the spinning.

Skinner had a mechanism at the top of each vertical drive shaft, and that mechanism kept moving the top of the shaft in a small circle while allowing the shaft to rotate freely at all times. That caused the very heavy weights attached to the shaft to keep spinning around, and he used that power of the heavy spinning weights to power his whole workshop. Moving the top of the shafts required so little power that he used a 93-watt electric motor and to show that he was not even using all the power of that small motor, he used a single cotton thread as a drive band to move the tops of the four power output shafts.

His mechanism looks complicated. This is partly due to the fact that there are four identical power shafts with their weights, mounted in the one compact frame and that makes the device look more complicated than it really is. It is also due to the fact that the system shown in the newsreel is William's fifth version of the device. It is likely that his earlier, much more simple versions worked well and encouraged him to build even fancier versions. It needs to be remembered however, that it is not actually necessary to replicate William's fifth version, but instead it would be quite enough to use the principle of the spinning chair to produce a simple mechanism where the input power is far less than the output power.

If we consider what is happening, then perhaps we can understand Skinner's complicated-looking arrangement. We can consider just one of the four axle shafts The large weight is spinning around in a circle and that motion is then used to power the output shaft. In order to reduce the effort needed to spin the weight, the axle shaft has been made thinner and four bracing rods have been used to brace the shaft in exactly the same way that sailing yacht masts are usually braced with "spreaders" to hold the bracing out from the mast and so give greater overall stiffness. So we can ignore those bracing bars as they have nothing to do with the actual operation of his design, but are merely his choice out of many different construction options.

Remember the spinning chair and consider what has to be done to spin Skinner's heavy weight. The top of the shaft has to be moved in a small circle. Looking down from the top the situation is like this:



Stationary   First move   Assisting weight

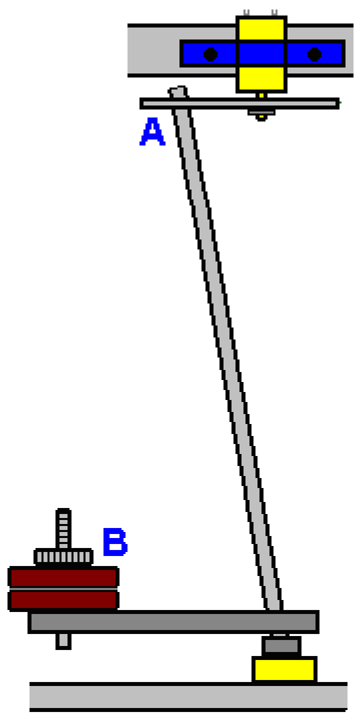
When the system is switched off, the weight attached to the bottom of the shaft comes to rest directly underneath the top of the shaft. When the system is started again, the first move is to shift the top of the axle shaft ninety degrees around. This is the start of the rotary movement and initially, the movement is slow as it takes the heavy weight some time to get moving. To reduce the effort of moving the top of the shaft ninety degrees ahead of the big lower weight, Skinner has added a weight at the top to assist the movement in that direction.

Skinner also took advantage of his very large workshop to use a belt-driven mechanism above the top of the shaft, in order to reduce the effort of moving the top of the axle shaft even further (to the level where it could be driven by a cotton thread). He used four separate identical shafts in his construction for two reasons: first, the overall output power is increased and second, any sideways forces stressing the mounting frame are matched on every side, which is helpful when you have heavy weights on a rotating arm as Skinner did.

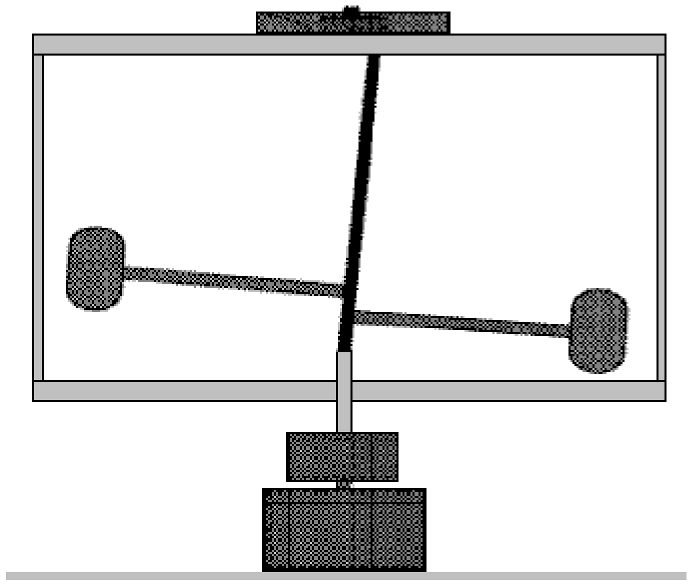
Chas Campbell of Australia made a much smaller and more simple gravity-powered generator. This generator is driven by an AC mains motor of 750 watts, which in turn drives a flywheel through a step-up belt-and-pulley arrangement and then that flywheel drives a 220-volt generator. When everything is spinning at its working speed, the mains motor input is switched from the mains to the output from the generator, making the system self-powered. The excess electrical output is substantial and allows Chas to use other power tools.

Many people have the mistaken impression that it is not possible to extract useful power from what they call "gravity". They say that a falling weight can indeed do useful work, but then the weight has to be raised again in order to perform more useful work. This is, of course, a very mistaken impression, especially since useful work has been produced by practical devices for many centuries now. Water flows downhill under the influence of "gravity" and that water flow powers water mills which grind grain, operate bellows and power hammers. It also powers massive hydro-electric schemes producing many megawatts of electrical energy, so please don't tell me that "gravity" can't do useful work.

The argument about a falling weight needing to be raised up again before it can do 'useful work' again certainly sounds reasonable, but in 1939 William Skinner of America demonstrated that it is possible to have a weight fall continuously without the weight getting nearer to the ground. Initially, that sounds impossible, but it is not impossible if the weight is always falling sideways. William produced substantial power by moving the top of a weighted shaft around in a circle. That unbalances the weight and it falls sideways to reach a stable position. But the weight never gets there because the top of the shaft is moved continuously to prevent that happening:



William's video is at: http://www.britishpathe.com/video/gravity-power and the principle has been taken up recently in the patent application US2014/0196567 of David W. John who shows several variations of that basic arrangement, including this one:

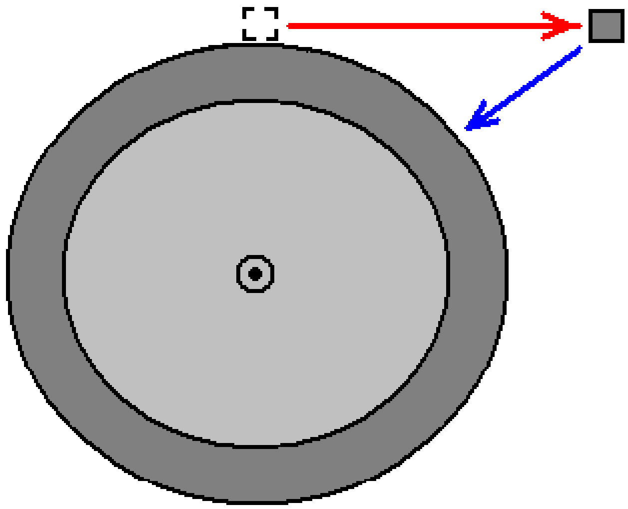


This is the same as William Skinner's method as the top of the shaft is moved in a circle and the weights follow the top of the shaft, falling continuously in a circular path at a far greater level of power than is required to move the top of the shaft. This demonstrates very clearly that it is certainly possible to extract useful work from what we call "gravity", (in passing, there is no such thing as 'gravity' which pulls things towards the Earth, the reality is that the effect is actually an imbalance in the universal energy field in which we live, and that imbalance is a push towards the Earth as Newton correctly deduced. The universal energy field is called the zero-point energy field, the aether or any one of many other names).

Engineers get the impression that a flywheel is just a storage device for kinetic energy and while a flywheel does indeed store energy, even to the extent that some city busses are powered by a flywheel, that is not the only important thing that flywheels do – they also rotate on an axle. Big shock ! Flywheels rotate on a pivot point. I would be very surprised if you didn't already know that. But, are you aware that rotation at a constant speed produces continuous acceleration? Like the William Skinner design, it takes some explaining as to how a constant rotational speed produces acceleration. It's all Newton's fault !!

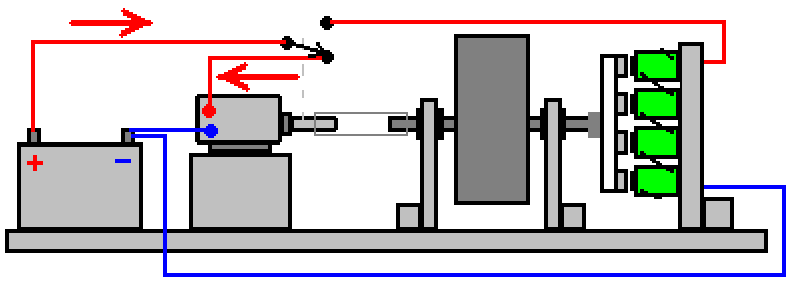
Newton pointed out that if something is started moving, then it will continue moving in a straight line until some force or other acts on it to change its movement. This is a little difficult to understand as we live on a planet whose 'gravity' affects all moving objects very considerably, and the air surrounding the planet also acts on moving objects very considerably. We are so used to these things that we find it difficult to understand that in deep space an object will tend to continue moving in a straight line for a very long time indeed.

Suppose then, that we have a flywheel and we have glued a block of steel to the rim. We spin the flywheel at a speed so high that the glue joint breaks and the steel block flies off on its own. It would be like this:

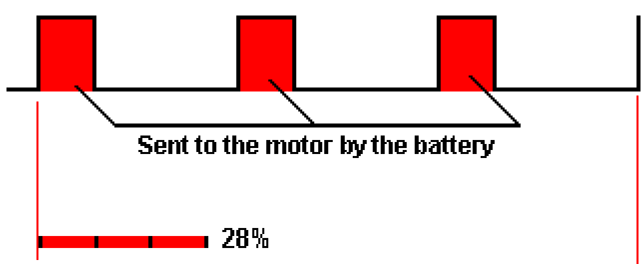


The steel block flies off (horizontally in this case) as shown by the red arrow. That is what the steel block would do if left alone and not bothered by any other forces. But, if the glue joint did not fail, being attached to the flywheel, the steel block would be in the position shown by the blue arrow. University professors who specialise in this subject, describe this as "an acceleration" inwards along the blue line, so although the flywheel is rotating at a constant speed, every molecule of steel in the flywheel is constantly accelerating inwards and acceleration produces an increase in energy. The larger the flywheel, the greater the effect

There is also another factor which is often ignored and that is inertial impact (the impact of two things colliding) and the energy gain from that is substantial. To give you some idea of how powerful this is, if you spin an unbalanced rotor it produces twenty times more thrust than the engine of a jet aircraft. For example, John Bedini has run a small motor/generator in self-powered mode for years on end, using both a small flywheel and the inertial drive of a pulsed DC motor:

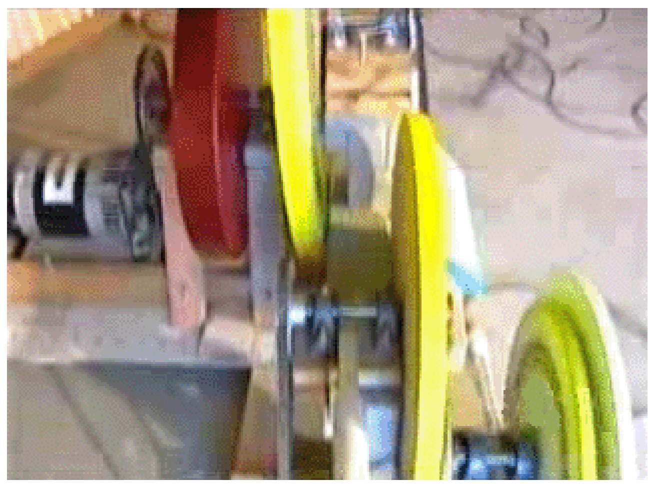


The DC motor is provided power in three short pulses per turn of the motor shaft, the switching being performed by contacts on the motor shaft. The timing of the pulses is like this:



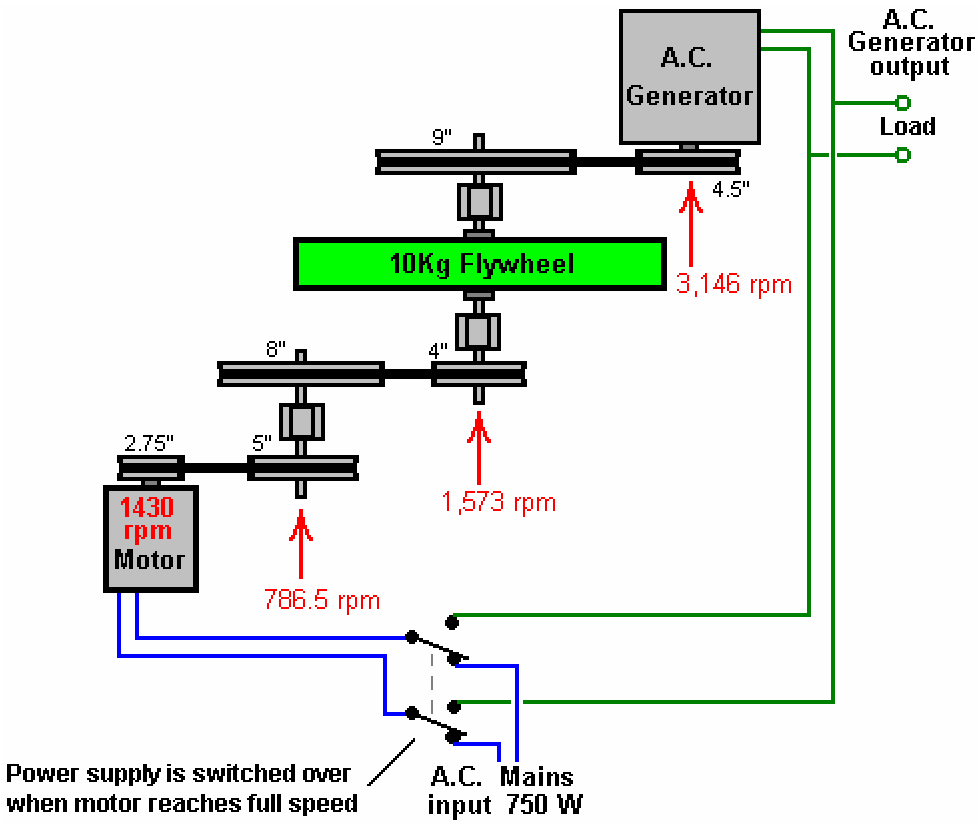
We need to be careful not to underestimate the effect of inertial impulses, and John's pulsing of his DC motor causes it to keep the flywheel spinning for three times longer than the duration of the pulses. There is a distinct inertial gain in energy when the motor is suddenly powered and applies a short thrust to the flywheel axle. In passing, it might be noticed that while those motor pulses are only there for a quarter of the time, the motor is receiving some 3000 pulses per second, so the energy gain from the pulsing seems almost continuous.

So, overall, we can get an energy gain from ‘gravity’ and from acceleration and from inertia. Chas Campbell of Australia who is experienced in building successful gravity-powered generators has very kindly agreed to explain to us, step by step, how to construct a self-powered generator of his latest design. Initially, Chas built a very successful motor/generator design which looks like this:

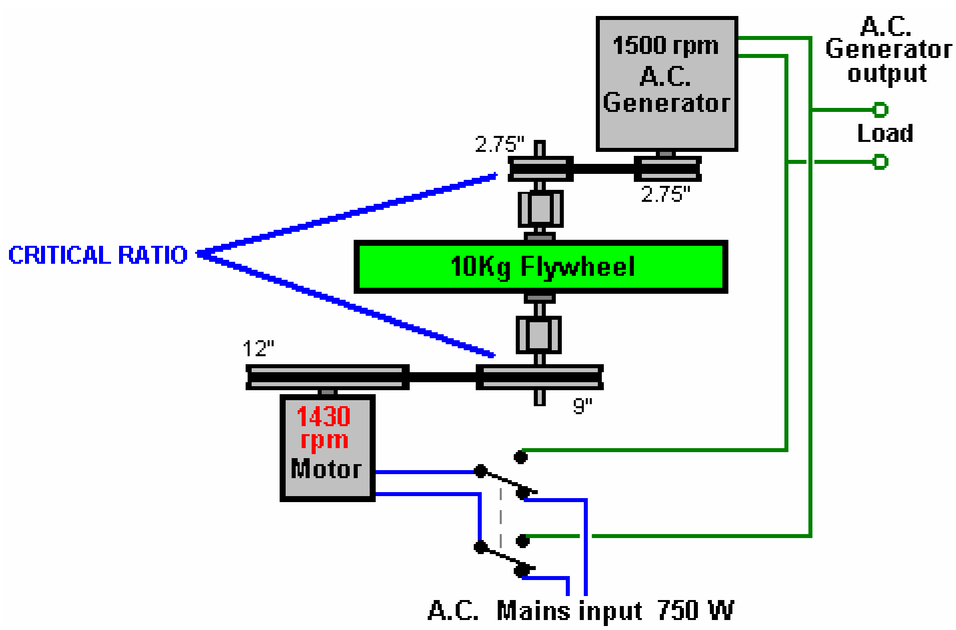


Driven by an AC mains motor, once running, this generator can be powered from its own output and when powered like that it can also supply power for other pieces of equipment. That generator gains power from the acceleration effect of the flywheel and from the inertial impacts of the mains motor pushing one hundred times per second. In my opinion, it would probably work more effectively if powered through a mains dimmer light switch. Those switches are available in powers of up to one kilowatt and they can be turned down slightly to give a more noticeable On/Off effect for those one hundred pulses per second.

The first design by Chas looks like this:



In 1998, Jacob lodged a patent application for a design of the type shown by Chas Campbell. Jacob has analysed the operation and he draws attention to a key design factor:

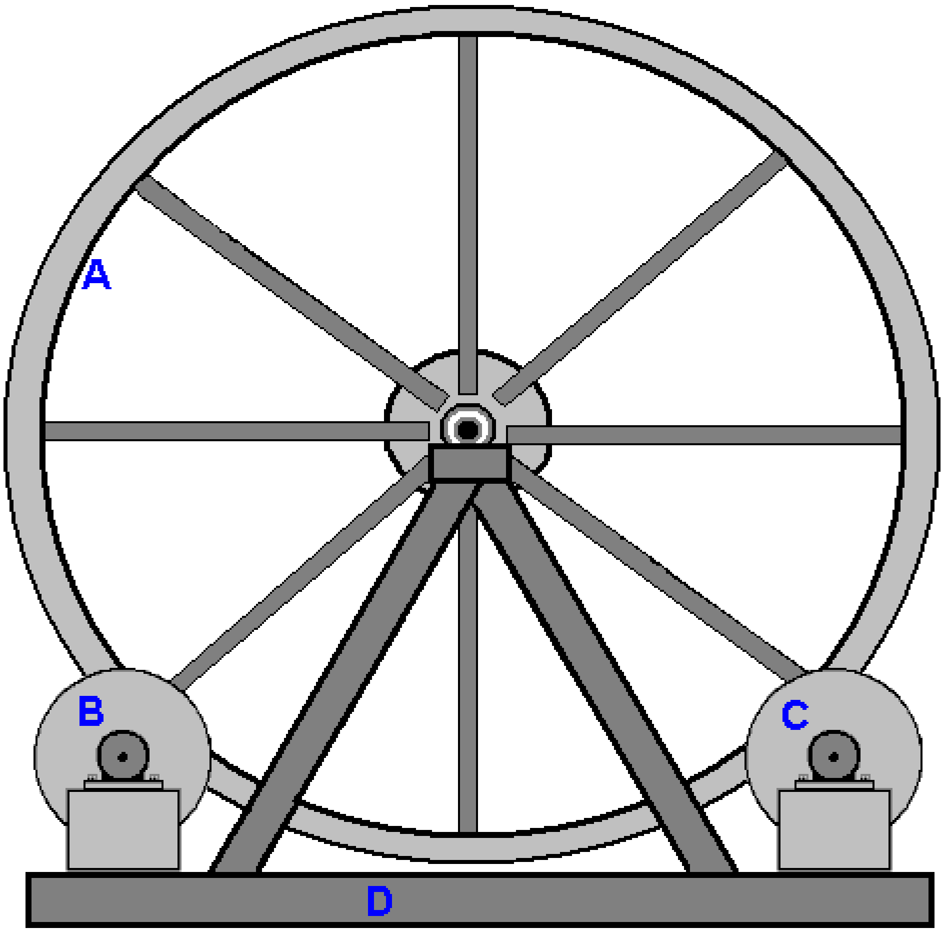


Jacob states that a very important feature for high performance with a system of this kind is the ratio of the diameters of the driving and take-off pulleys on the shaft which contains the flywheel, especially with systems where the flywheel rotates at high speed. The driving pulley needs to be three or four times larger than the power take-off pulley. Using Chas' 1430 rpm motor and a commonly available 1500 rpm generator, the 12:9 step-up to the shaft of the flywheel gives a satisfactory generator speed while providing a 3.27 ratio between the 9-inch diameter driving pulley and the

2.75" diameter power take-off pulley. If a generator which has been designed for wind-generator use and which has it's peak output power at just 600 rpm is used, then an even better pulley diameter ratio can be achieved.

Chas has very kindly agreed to share his latest flywheel design so that anyone who wants can make and use one for himself. As people's circumstances and skill levels vary so much around the world, we will explain three different ways to build his design – two ways when building in steel and one when building using wood.

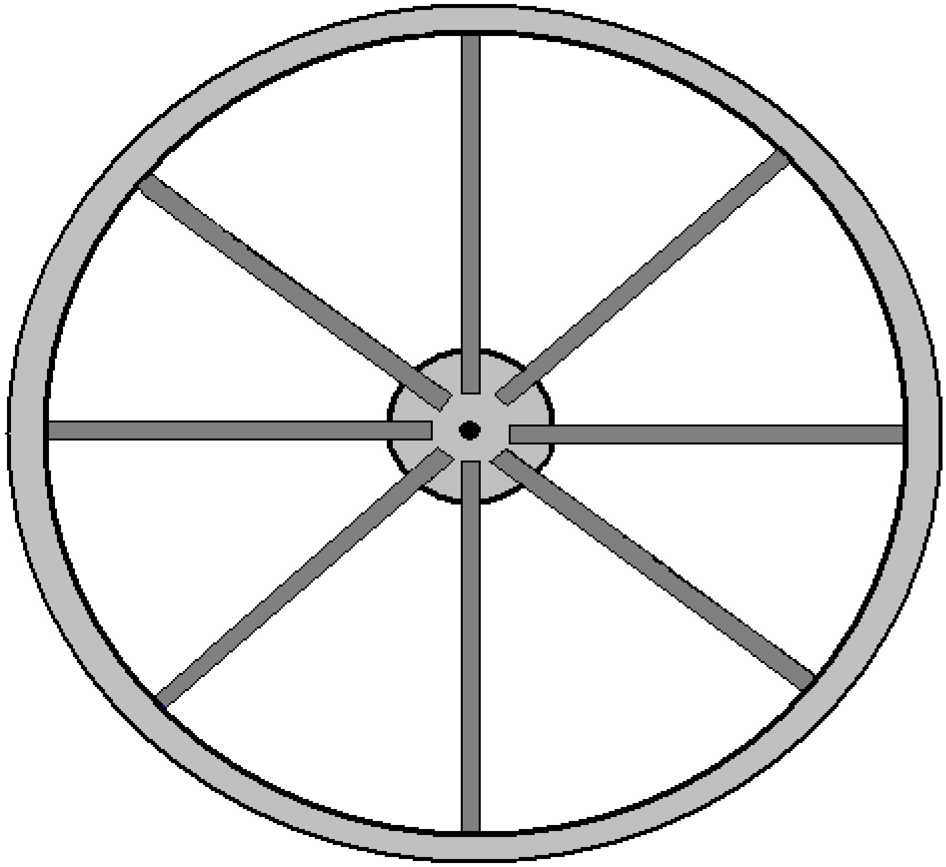
Chas' latest design uses either two or three flywheels – one large one to drive the output generator and either one or two small flywheels to keep the large flywheel rotating. An additional inertial effect is produced as the small flywheels use a drive mechanism which is not continuous. The arrangement looks like this in broad outline:



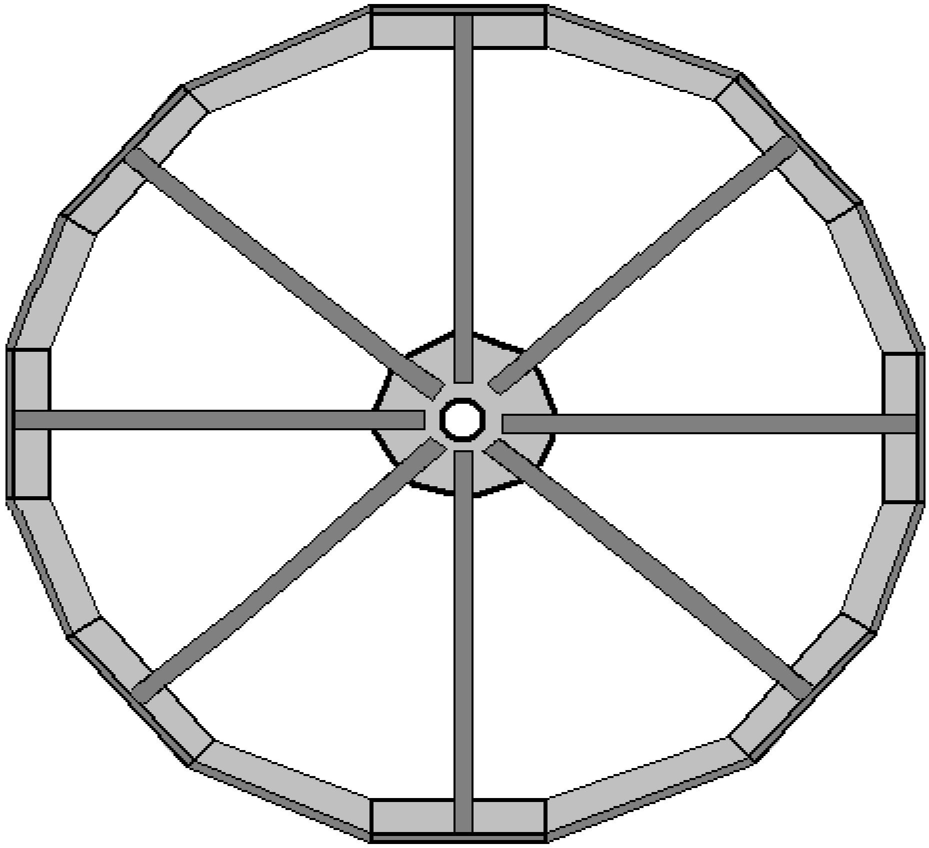
Here, the large flywheel "A" is supported on a triangular frame "D" and smaller flywheels "C" and possibly "B" give the large flywheel a brief push on its way twice per revolution. The target speed of rotation for the large flywheel is just one revolution per second, so this is not an intimidating generator design and it is well within the constructional ability of most people.

To be really effective, a gravity-powered generator has to be heavy (and usually, large in size as a result of the weight) and so, although alternative methods can be used, it is normally built in welded mild steel.

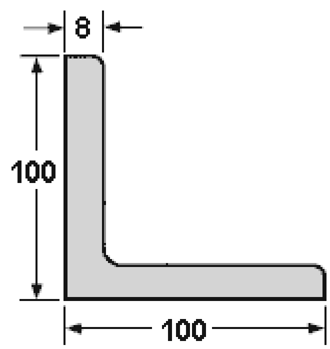
The large flywheel which Chas prefers, looks something like this:



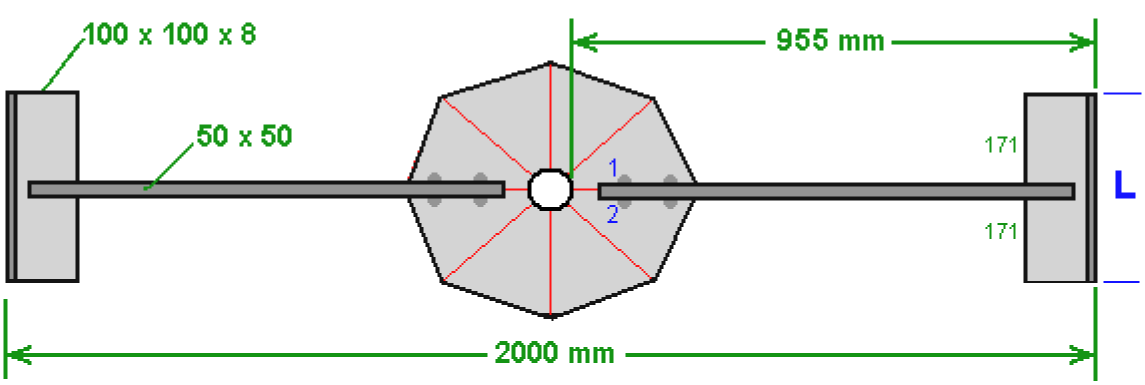
The wheel has a diameter of two metres (six and a half feet) and is a central hub with an axle, eight spokes of 50 x 50 mm steel box section welded to the 200 mm diameter hub and to the rim of the wheel. What is unusual about this design is that the axle bar is stationary and the flywheel rotates around it. However, bearing in mind that some people building this generator will be located where there are no local steel fabrication businesses, Chas has produced a much more simple design which will work well using straight edges like this:



For this construction, each of the eight spokes has a square-cut length of 100 x 100 x 8 mm angle iron welded to it. The angle iron which weighs about 12.276 Kg per metre is shaped like this:



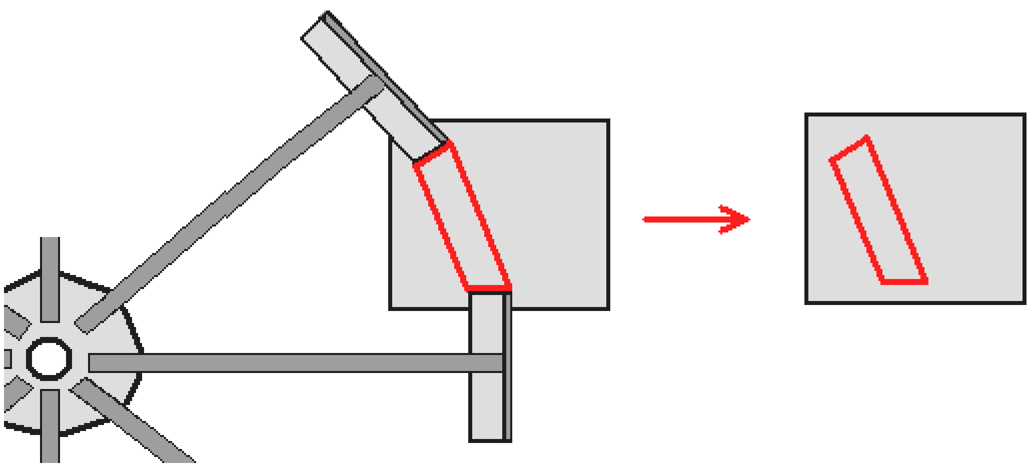
With two spokes welded to the central hub the basic construction will look like this:



The spokes are made with 50 mm x 50 mm steel box section which has good rigidity in all directions. As the overall diameter is 2000 mm that means that the length around the rim will be 2000 x 3.1416 = 6283 mm (if construction is very accurate) and the rim angle iron will have a weight of about 77.13 kilos (170 pounds) which means that in the later stages of building this flywheel most people will need a second person to help lift and manoeuvre it into position. The flywheel weight can easily be increased at any later date by welding additional steel pieces to the inside of the rim – just remember to keep the wheel perfectly symmetrical and balanced around the axle by always matching any additional piece with an identical piece exactly opposite it (that is, 180 degrees away around the rim).

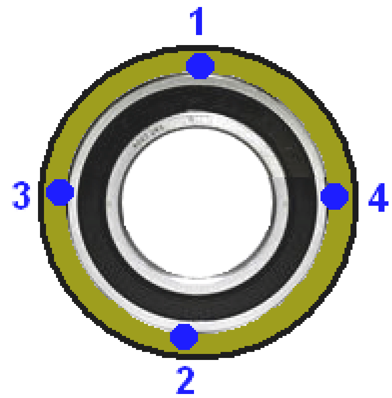
When attaching the 50 x 50 mm box sections to the hub plate be sure to align them exactly and clamp them in place very firmly with steel clamps and double check the position before welding them. This is done by drawing accurate parallel lines on each side of the existing lines, 25 mm out, so that when the 50 x 50 steel is clamped in place, those lines show that the positioning is correct. Also, be very sure that you make two opposing welds to avoid the pieces being pulled out of position. So, in the diagram above, when weld "1" is made, then weld "2" is made immediately so that they can cool down together and heat distortion avoided.

We now need to work out the length of the strip of angle iron marked as "L" in the diagram above. The overall circumference is 6283 mm and it will be divide up into 16 equal lengths, so each length will (hopefully) be 392 mm long. We start by attaching square cut 392 mm lengths to the ends of the box-section spokes and then cut a template in some stiff material such as 3 mm Medium Density Fibreboard. This is done by sliding the flat template material under two successive rim pieces and marking the shape, showing the angles and lengths involved:

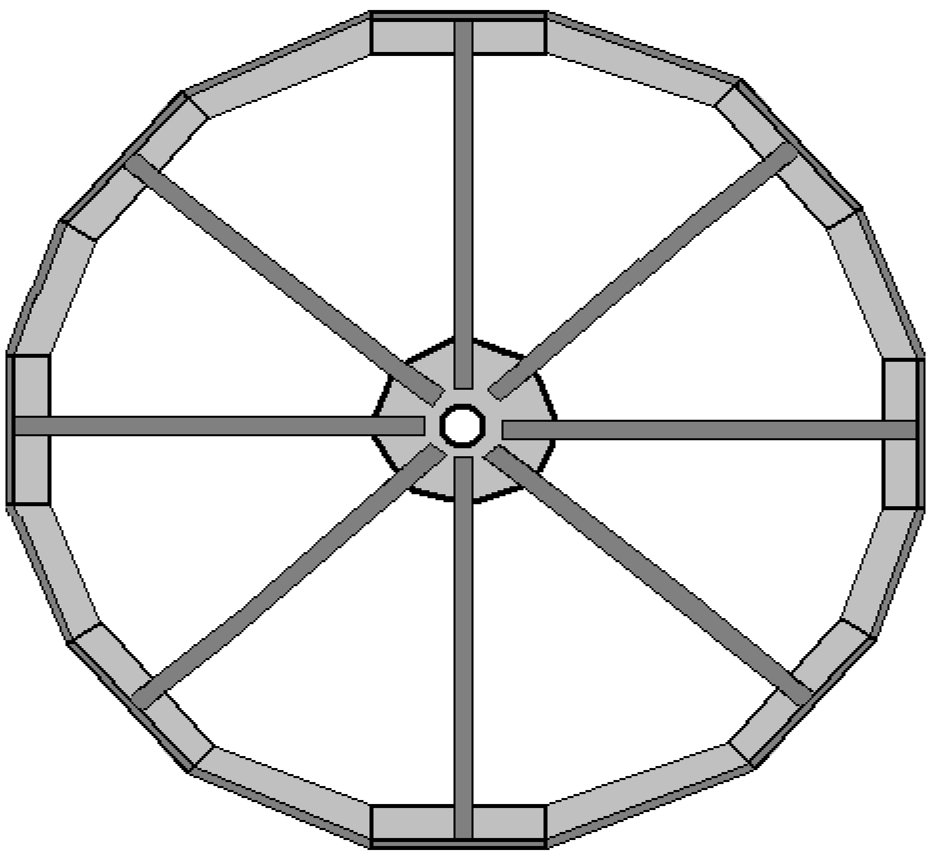


Cut out the template shown in red in the diagram above and check it for accuracy between the two steel pieces to make sure that it is correct before using it to mark the piece of angle iron which will be welded in place to close the gap in the wheel rim. The angle iron has the slanted faces cut and then verticals are marked on the vertical face and those are cut separately. Check the piece in place and if the fit is not perfect, use the angle grinder to make the fit as good as possible.

The flywheel is completed by inserting the bearings into the ends of the pipe, making sure that they are exactly flush with the end of the pipe and applying two pairs of spot welds to each bearing. The bearings end up with four spot welds spaced at 90-degree positions:



There are a few additions to be made, but this is the basic wheel which forms the heart of the generator. The overall easy-build flywheel (roughly sketched) looks like this:

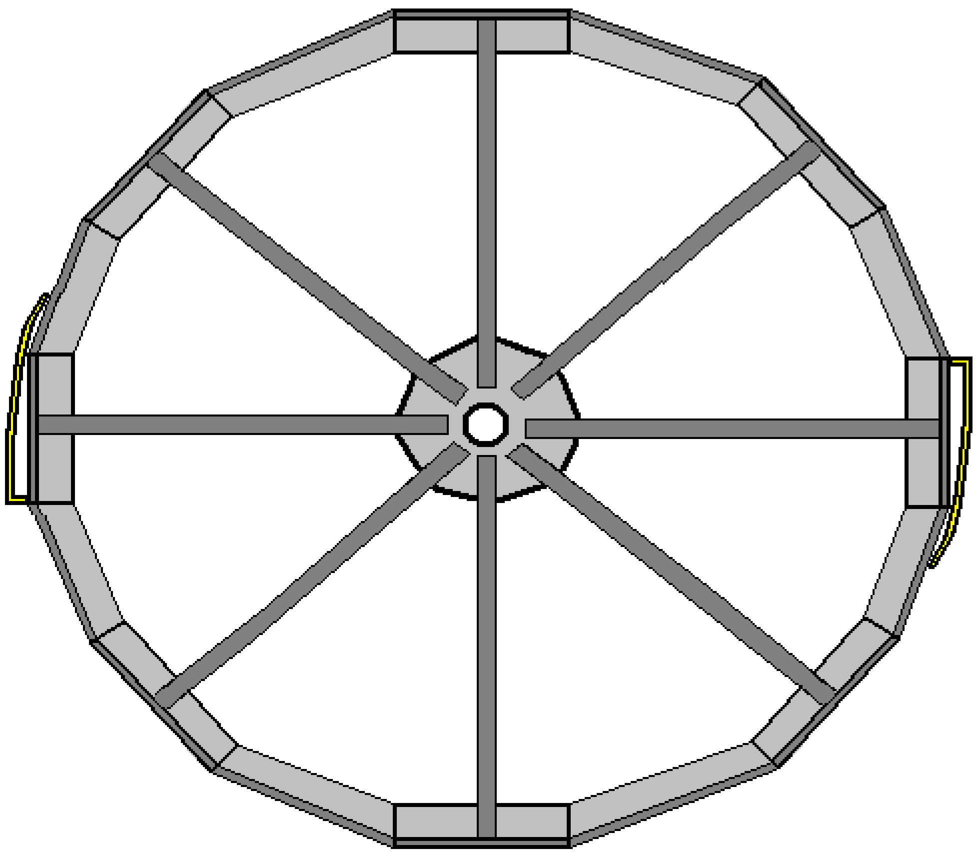


Please remember that when completed, this 2-metre diameter flywheel weighs more than 80 kilos and so to raise it into a vertical position means that you have to lift 40 kilos. While that is by no means impossible, it would be much more convenient to have two people lifting and maneuvering the flywheel into position, if that is possible

The additions to this large flywheel are two pressure strips which are used to drive the main flywheel. The power for the complete system is supplied to one, or preferably two small flywheels and those flywheels which are easy to spin, pass a thrust to the main flywheel each time that they encounter a pressure strip. As a general rule, (provided that you are not building a space drive) you always keep a flywheel balanced, and so, if you attach something on the right hand side you should attach an equivalent weight on the other side to keep the flywheel balanced. We have the option to add one drive strip and a counterbalancing weight opposite it, or to have two drive strips positioned 180 degrees apart.

With one drive strip and one small flywheel, the main flywheel gets one drive pulse once per revolution. With one drive strip and two small flywheels the main flywheel gets two drive pulses per revolution. With two drive strips and one small flywheel, the main flywheel gets two drive pulses per revolution. With two drive strips and two small flywheels the main flywheel gets four drive pulses per revolution.

The main flywheel drive is caused by making each small flywheel press a rubber-covered cylinder against a rubber-covered steel strip attached to the large flywheel.   The additional strips are arranged like this:



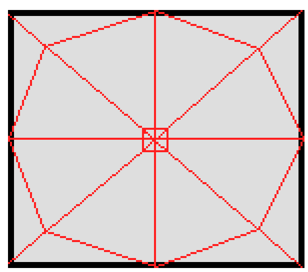
The final detail is something which will prevent the flywheel sliding along the stationary 50 mm diameter axle shaft, which it will do if the axle is not exactly horizontal. If the axle shaft is even 1 degree off the horizontal, the flywheel will keep edging towards the lower end. It is possible to stop the movement with a collar on both sides of the flywheel, Those collars are nice and cheap in the common small sizes but at a 50 mm inner diameter they are very expensive, and the continuously rotating flywheel will be pressing against the stationary collar, causing friction and wear. A suitable way of dealing with this is to use a 51110 size end-thrust bearing like this:

This allows the flywheel to rotate freely even if the axle shaft is not quite horizontal. It is just necessary to lock the outer sides of the two end-thrust bearings to the stationary axle and that can be done cheaply and effectively using a hosepipe clip also known as a Terry Clip or a Jubilee Clip:

Just position the tightening bolts 180 degrees apart even though the whole clip is light.

All right, that is the first way to build the main flywheel and it is the method preferred by Chas, because he lives in an area where there are steel fabrication workshops with experienced welders and professional tools and equipment. However, many people live where there are few facilities and where the Customs charge exorbitant fees which can triple the cost of anything delivered through the postal service. So, here are two other ways of building the flywheel which may be more suited to areas where the conditions are more difficult.

The first method is very much the same, building in welded steel, but this time we will assume that the nicely sized steel pipe is not available. There are various ways around this problem, but probably the easiest is to attach the 50 mm diameter axle shaft directly to the hub plate and let the axle rotate along with the flywheel. For this, we set out and mark up the hub plate as before:



But this time around, the central square is 50 mm in size, and both sides of the plate are marked to produce that exactly centred square. The axle shaft is cut into two equal lengths, but we use the factory machine-cut end and position it in our central square, using four of the magnets to hold it exactly perpendicular to the hub plate. We make two quick welds on opposite sides of the axle, attaching it to the hub plate, positioning the welds half way between the magnets. When the welds have cooled, we make two more quick welds so that the axle is attached at 90-degree positions all around the shaft.

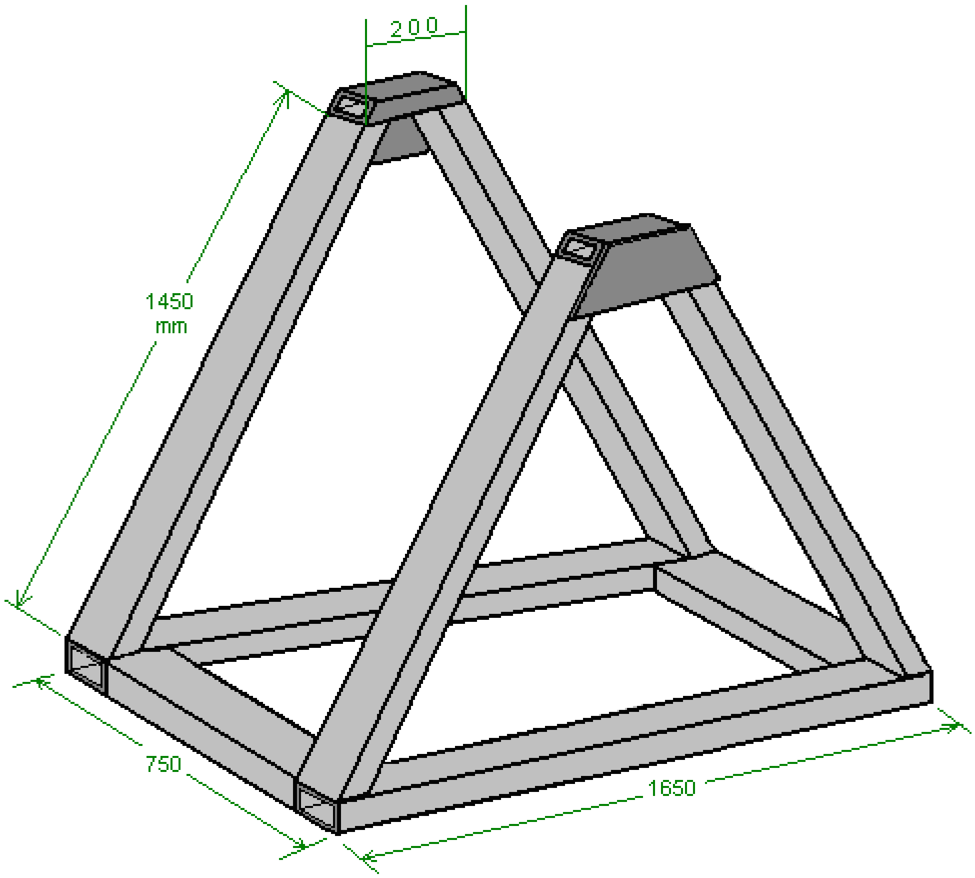
When the welding has cooled down completely, remove the magnets and turn the piece over, clamping the attached axle section in the workbench to hold the hub plate steady. Position the factory-cut end of the second axle piece exactly in the centrally marked box and use the magnets to hold it exactly vertical. Again, two pairs of quick welds are made to attach the axle to the hub plate.

When everything has cooled fully we need to check to see if the result is usable. For this, support the two axle pieces in a piece of timber with a V-notch cut in it. That is, the axle is positioned horizontally, supported near each end in a notched piece of timber. Spin the axle and watch the hub plate very carefully as it spins around. If the hub plate stays steady and doesn't wobble, then your work is excellent and ready to progress further. If the plate wobbles, then scrap it and start again as you will never make a satisfactory flywheel with that plate forming the hub. Every alignment error will be magnified many times at the rim of the flywheel due to the length of the spokes.

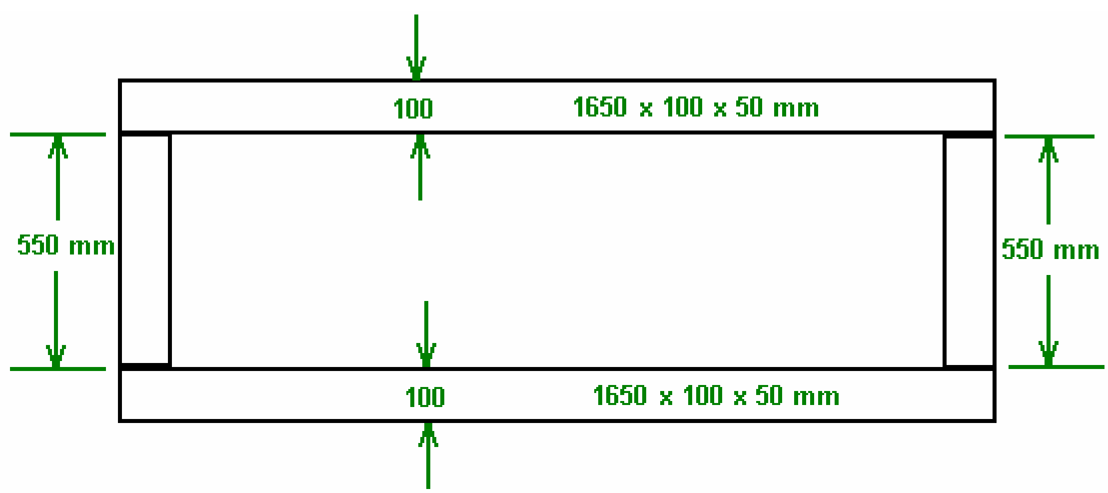
The rest of the flywheel construction is the same except that the 50 x 50 mm spokes are not welded to the hub plate, but instead are bolted there using two 10 mm diameter bolts per spoke. That allows the hub plate and axle to be removed from the flywheel to make things easier if you need to transport the flywheel to a new location at a later date. It is perfectly possible to transport the whole generator fully assembled, using the sort of lorry which transports building blocks for new houses.

The only other difference for this style of build is that the two bearings are positioned on the support frame rather than being part of the flywheel itself.

The next step is to build the base support for the generator, and that support is mainly for the large wheel. If you are working in steel, then it is constructed by welding together some pieces of box steel to form a shape like this:

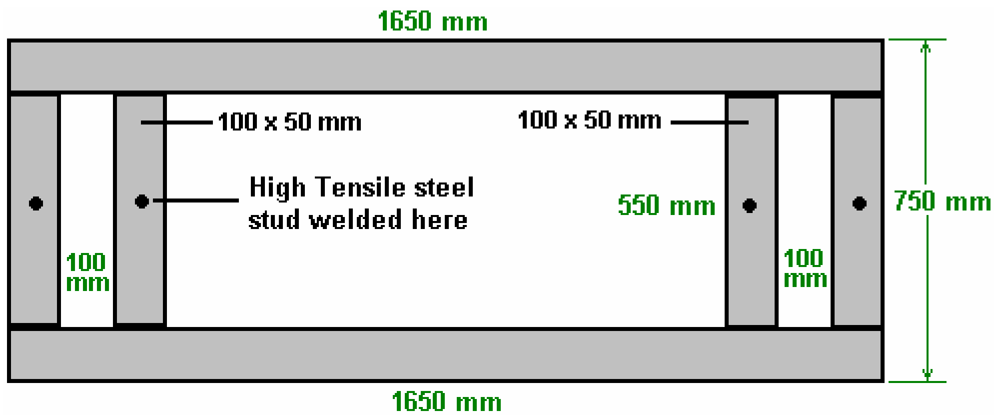


If working in timber, keep the same overall size of the components (which are solid timber) and be sure to make the two triangular parts very robust with both epoxy and screw attachments for each join. Otherwise, we start by constructing the base using steel "channel" which is a box section material. The size we want is 100 x 50 mm which is (4-inch x 2-inch as there are 25.4 mm in one inch) and we join two 1650 mm long pieces using two 550 mm long pieces to form the base rectangle:



It is not at all easy to take a welded joint apart, even if that welded joint took only a tenth of a second to make, so it pays to get the job done exactly right every time. Place the two pieces to be joined on a flat surface such as concrete (which is not flammable) and get them in exactly the right position. Then weight them down so that they can't move. Then, and only then, weld them together. Probably the most difficult thing about welding is the fact that it is very hot and the heat makes the metal expand. I suggest therefore, that you make a short weld of perhaps 20 to 25 mm long and then stop and wait for that weld to cool down before welding the next short length. If you have a long weld to do, then weld the start. Let it cool. Then weld the end. Let it cool. Then weld the middle and let it cool. Those welds hold the piece securely against further movement as you gradually fill in the distance between those first three welds with short welds, letting each one cool before making the next weld and spacing those welds apart as much as possible to let each weld area cool as much as possible between welds.

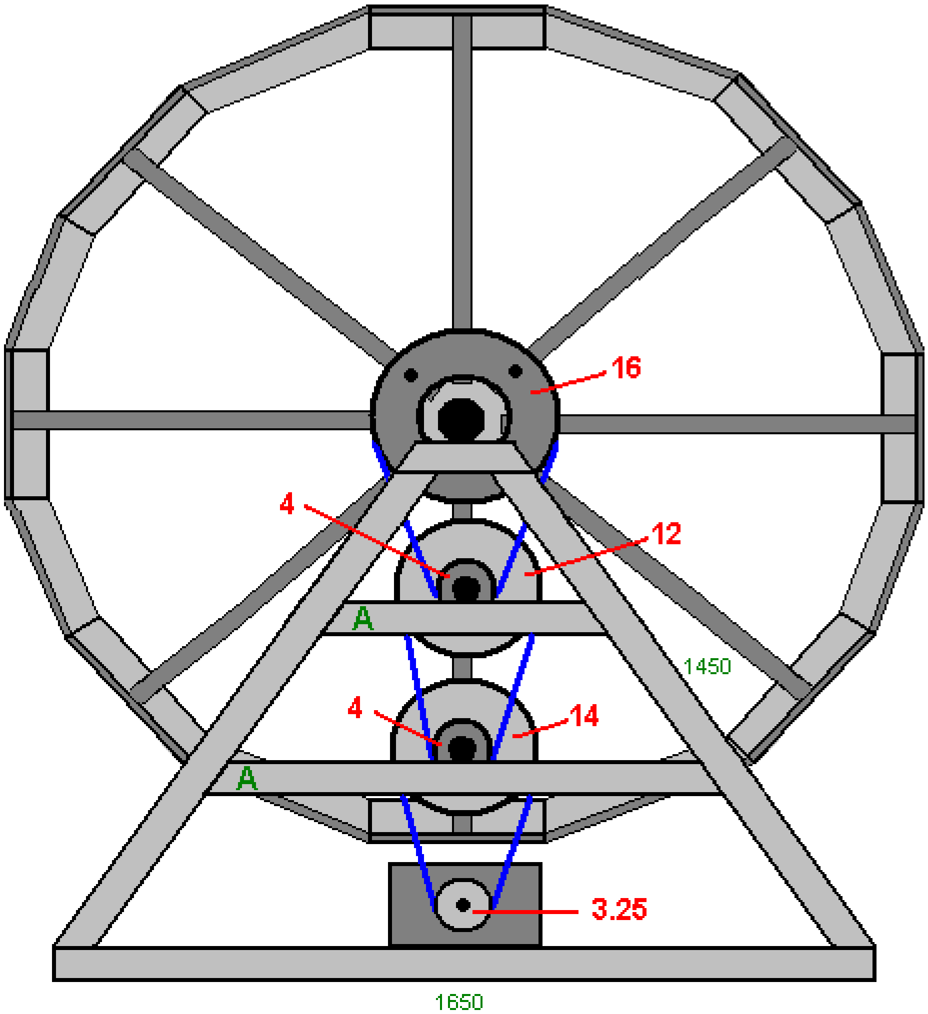
When the main base is completed, two additional pieces 550 x 100 x 50 mm are welded in place as shown here:



Also, a strong threaded stud is welded in the middle of each of the cross pieces. A stud is effectively a threaded bolt without a head, and where the head would have been is welded to the base members as shown above. These studs are like those used to attach car wheels and in this application they are there to allow something to be bolted to the base.

One of the things bolted to the base is the alternator. Chas used a "Genelite" 3.5 kilowatt alternator which is a single-phase, 220 volt, 50 Hz unit which needs its shaft to be spun at a nominal 3000 rpm in order to generate the normal mains voltage and frequency. As the flywheel spins at just one revolution per second, Chas uses three V-belt pulleys (shown in blue) to generate the wanted shaft speed on the alternator. In his area, the pulley sizes are specified in inches and he uses 16 inch driving 4 inch. Followed by 12 inch driving 4 inch. Followed by 14 inch driving a 3.25 inch diameter pulley on the alternator shaft. That gives ratios of 4:1, 3:1 and 4.3:1 which combine to drive the alternator shaft at 51.6 revolutions per second which is 3096 rpm.

The large flywheel and pulleys are mounted on the support frame and drive the output generator like this:

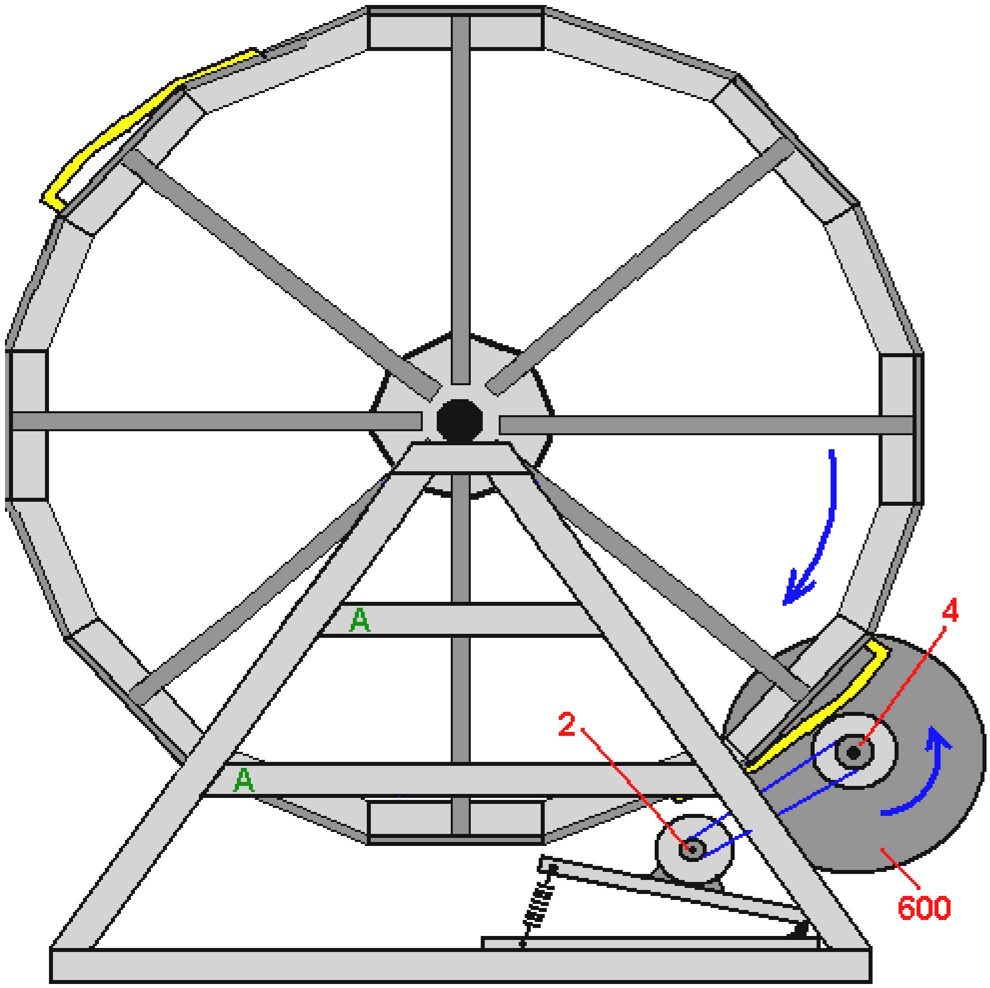


To support the intermediate pulley axles, additional support members “A” are added to the inside of the frame to support the additional bearings or “pillow blocks” which form the mounting for the additional pulley axles. For Chas’ design and the solid wood version where the main flywheel axle is stationary and the flywheel rotates around that stationary axle, the largest pulley (16 inch diameter in Imperial units or 450 mm diameter in metric units) is adapted so that it doesn’t touch the axle and is bolted directly to the flywheel, using spacers to align it with the pulley train below it. The pulley is larger than the flywheel hub and so needs to be attached to four of the spokes.

In the version where the 50 mm diameter axle rotates, the largest pulley is available with a 50 mm central boss and so it can be attached directly to the axle in the required position. Where your pulleys are bought depends on where you live. One such supplier is http://www.bearingstation.co.uk/Products/Pulleys/V_Pulleys/SPA_V_Pulley but there are many similar suppliers around the world.

While the diagram above shows the gear train from the flywheel to the generator in a logical vertical alignment, there is no particular need to do that and the drive train can zig-zag if you wish. As long as the flywheel continues to rotate at its one rotation per second, the generator shaft will spin at 3000 rpm (or perhaps slightly faster than that) and the system will output continuous AC electricity which can operate power tools, lights, heaters, refrigerators, etc. This is a continuous system which can operate at all times, day and night. It can charge a bank of lead-acid batteries, but lead-acid batteries are only 50% efficient and so they waste half of the power that you feed into them, so if you feed 10 amps into your lead-acid battery for 10 hours, your battery will only be able to provide 5 amps for 10 hours, and there seems little point in throwing away half of your generated power, quite apart from the fact that the batteries are heavy, expensive and will need to be replaced every four years or so.

So, we need to keep the flywheel spinning and do that with as little power as necessary. In this design, the main flywheel is made to spin by a rubber covered drum pressing briefly against a rubber covered ramp attached to the main flywheel. As we want to keep the flywheel balanced, we actually attach two ramps to it, spaced out so that they are exactly opposite each other, that is, at 180 degrees apart. That means that the large flywheel receives two thrusts per revolution. The arrangement looks like this:



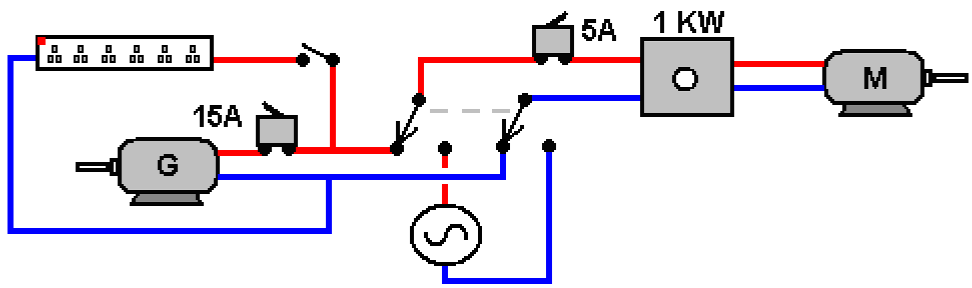
This diagram shows only one drive motor and while the system will work with one motor it is more powerful with two and so an identical unit can be mounted on the left hand side of the support frame. The motor used by Chas is the Australian built CMG one-horsepower AC mains motor which runs on 240 volts 50 Hz, at 1410 rpm, drawing 750 watts under full load and has a 5/8 inch (16 mm) drive shaft which has a 2-inch diameter pulley mounted on it, connected to a 4-inch diameter pulley on the small flywheel. The motor is mounted on a hinged plate with a spring pulling the plate away from the small flywheel. The main reason for this is to allow the small 600 mm diameter flywheel with its 180 mm diameter rubber covered drive cylinder, to move outwards slightly when it comes in contact with the drive ramp attached to the large flywheel. This is effectively an automatically adjusting arrangement

As you can see from the diagram, the main flywheel rotates clockwise while the 600 mm diameter flywheel rotates counter clockwise. If you wish that they went around in the other direction, then just walk around to the other side of the generator and your wish is magically granted with the main flywheel going counter clockwise and the small flywheel going clockwise !!

The current drawn by the drive motor (or motors) is far less than their full working load current draw of 4.5 amps, probably around 2.2 amps. Chas also reduces the current by switching the supply to the motor and allowing 3 seconds of current flow followed by two seconds with the motor disconnected, where the shaft rotation is driven by the momentum of the small flywheel. Chas achieves this switching by gearing down the movement of the main flywheel to give one rotation in five seconds. While that works, it is a mechanical switch which has one fixed setting and is subject to wear as time goes by. I suggest that there is no gearing down, but instead that the current flow to the motor is controlled electronically, using an ordinary light dimmer switch which is available in powers up to one kilowatt and which allows continuous adjustment of the current so that the most effective current flow for the motor can be set by the turn of a knob and no moving parts are involved.

It is quite possible that if the alternator output power is connected to the drive motors and no other load, that spinning the main flywheel by hand would be sufficient to get the system running. An alternator is very much like a bicycle dynamo in operation as electricity is produced by moving coils through magnetic fields. In the case of an AC alternator used here, if the rate of rotation of the alternator drive shaft is lower than expected, then the alternator output voltage will be lower than it is at full speed, but it still can produce considerable voltage. Most drive motors are capable of working with a much lower voltage than they are supposed to have and that means that the drive cylinders can progressively build up the speed of the small flywheels which in turn can help the manual spinning of the main flywheel until the system progressively works up to its full operational speed.

The electrical connections are very simple. The mains connection is fed to the drive motor through a 2-pole, 10 amp, changeover switch so that the supply can be switched from the mains to the generator output when the flywheels are spinning at their normal speed. For additional control of speed, a 1 kilowatt light dimmer switch can be placed between the switch and the motor. Contact breakers should also be used and the generator output should have an On/Off switch as well. This gives an arrangement like this:



In the position shown, the Generator is feeding current to the drive motor "M". The 15-amp circuit breaker protects the generator "G" from a short-circuit anywhere else in the circuit. The 5-amp circuit breaker protects the 1-kilowatt dimmer switch and the Motor "M". With the switch in the other position, the mains (or the output from a battery powered inverter) is fed through to the motor when the system is being started.

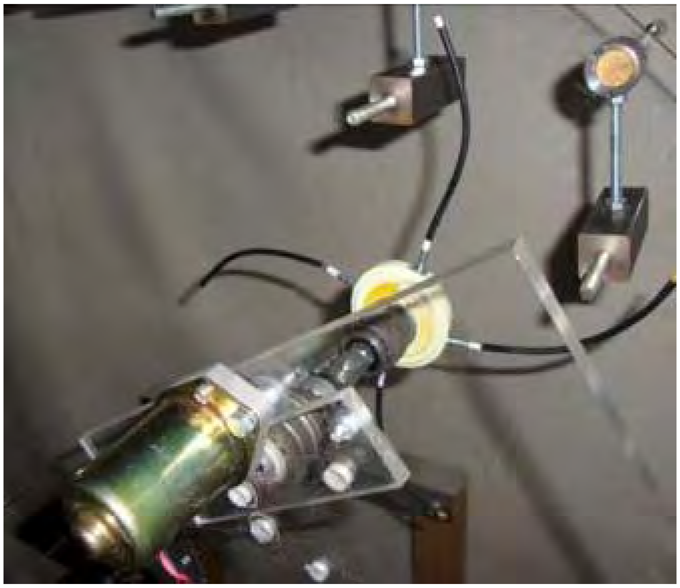
Mikhail Dmitriev of Russia has produced a gravity-powered design which I'm told that several other people have used to power their homes. Mikhail uses a small electric motor to push hinged weights out to one side and so create an asymmetrically loaded rotor, causing it to rotate under the effects of gravity. His work is shown on Sterling Allan's web site: http://peswiki.com/index.php/Directory:Mikhail_Dmitriev_Gravity_Wheel where there are videos and photographs of several of his prototypes. It is envisaged that large versions which generate 6 to 12 kilowatts of excess power will become available for purchase in 2011. Each of his various designs is based on the principle of having weights attached to a wheel and arranging for those weights to be offset outwards when falling and offset inwards when rising. Because of the different lever arms involved, that gives a force imbalance which causes the wheel to rotate continuously and if the weights are of a considerable size, then the rotation is powerful and can be used to generate electrical energy. In order to arrange for the weights to be offset as the wheel goes around, each weight is suspended on a pivoted arm:

For the device to operate as required, that suspension arm needs to be moved to (say) the right when falling and be centred or deflected to the right when rising. Mikhail has chosen to use a small amount of electrical power to make this happen, because the energy provided by gravity in turning the wheel far outweighs the small electrical input needed to make the wheel rotate.

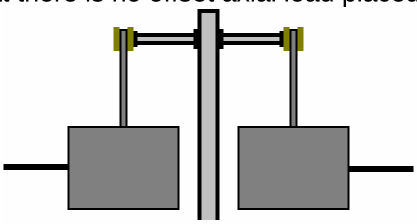
Several mechanisms for making this happen have been tested as you can see from Sterling's presentation. One method is to push the lever arms to the right with a simple rotating disc which has deflector arms attached to it:

After being given the sideways push, each weight stays off centre until it reaches the bottom of it's travel. Please remember that while the weights show here are tiny, a full-size working device will have weights which weight a total of perhaps 130 kilograms and the forces involved are then large. The picture above is a little difficult to make out as the rotating disc is transparent and the support for the rotating arms is also transparent. The horizontal metal arm is there to support the transparent panel on which the 'arms wheel' bearing is mounted.

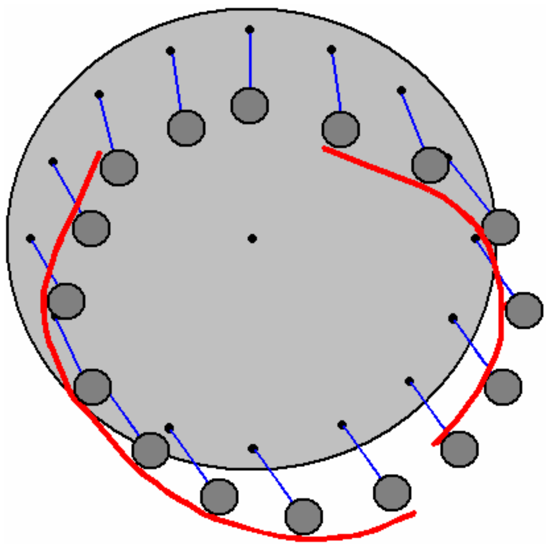
An alternative method is to use a small motor which drives the arms directly as shown here:



Each weight is held rigidly and so when the motor arm presses against it, the lever arm is pushed out sideways without the weight twisting away from the motor arm. These prototype weights are not heavy, but when a working unit is being built they will have considerable weight, so to get a well balanced arrangement, it might be advisable to have weights on both sides of the wheel so that there is no offset axial load placed on the shaft which supports the wheel:



Mikhail's arrangement works well when it relies on the swinging movement of the weights to keep them off centre during the time when they are falling and you can watch a video of that happening. I understand that Mikhail intends to sell a four kilowatt version. However, it makes one wonder if it would not be possible to arrange for this movement without the need for a motor, although using a motor is a very clever and sensible method of ensuring rotational power. Perhaps if two stationary deflectors were used, one to keep the weights out to the right when falling and one to keep them out to the right when rising, a viable system might be created. Perhaps something like this:



Admittedly, the deflector pieces would have a smoother shape than drawn here, but the principle is shown in spite of the poor quality of the diagram. Where heavy weights are involved, each could have a roller bearing pressing between the weight and the deflector shield in order to minimise friction as the weight slides past. Alternatively, the deflector shield could be faced with powerful magnets opposing similar magnets attached to the weights which would give a no-contact, very low friction movement.

James Kwok of Australia, offers commercial buoyancy systems from 10 kW to 1 MW. His web site http://www.hidroonline.com/ shows the general construction style:

The operating principle is buoyancy, where compressed air is used to cause floats to rise through a column of water.

James made a patent application in December 2010 (US 2010/0307149 A1) and it shows how he achieves such a high energy output;

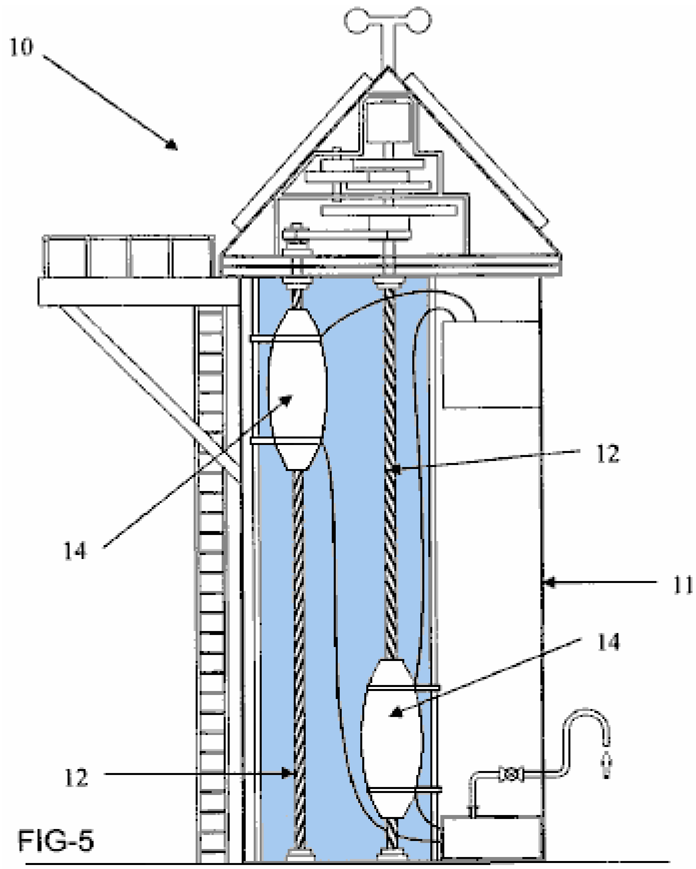
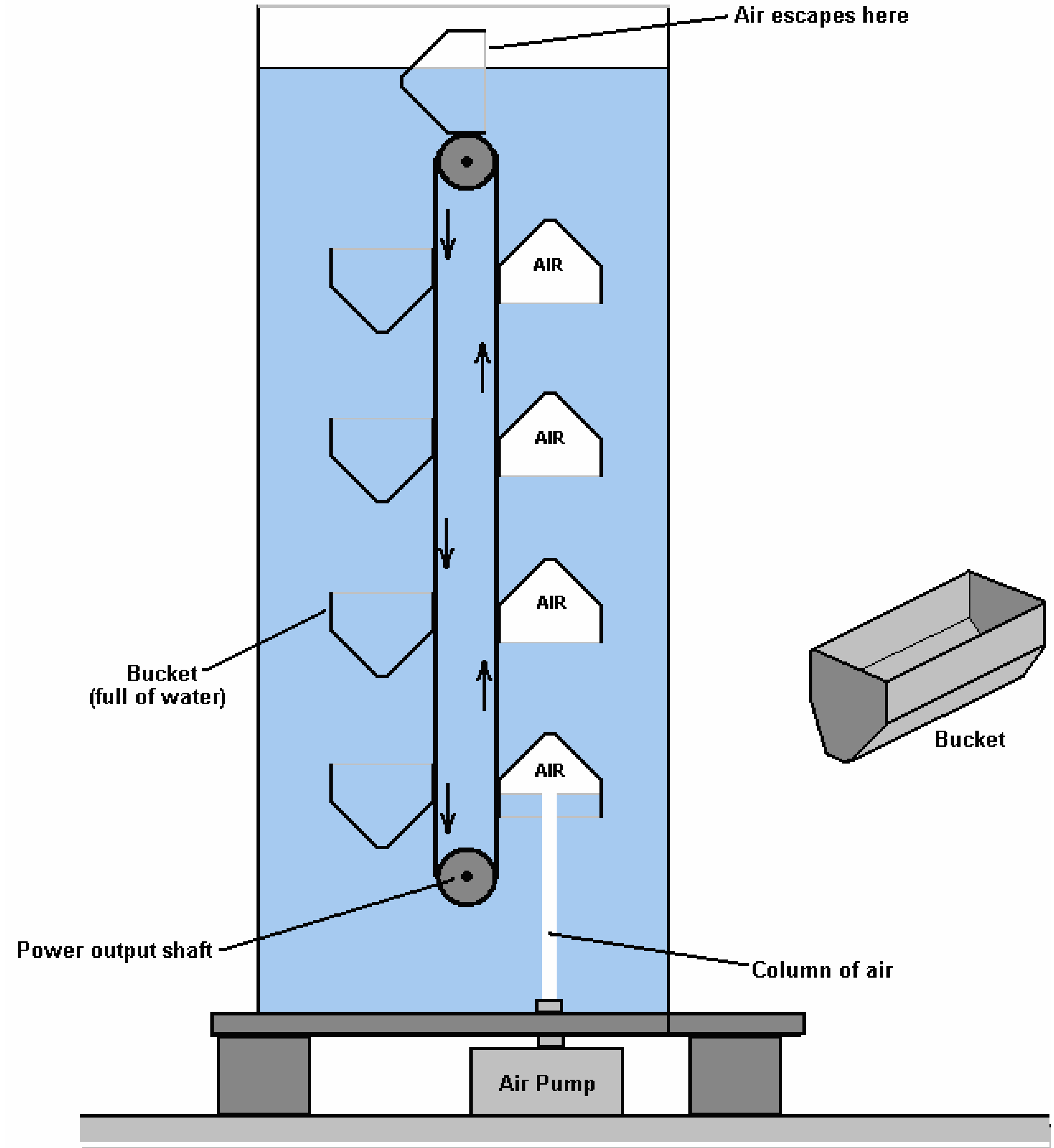


FIG-5

His buoyancy floats "14" moves up and down shafts "12" and the grooves cut in those shafts cause them to rotate and via gearing spin a generator. In spite of its mechanical complexity, the Hidro design is offered as a commercial generator with tens of kilowatts of excess power, indicating that buoyancy is a significant method of generating power, based on the fact that water is hundreds of times heavier than air. Due to its weight, movement in water is slow but can be very powerful. The helical groove method of converting the vertical movement of the floats into rotational power is used because of this as it has a very high ratio between shaft turns and movement along the shaft. This can be understood when you consider the fact that a complete revolution of the shaft is caused by the float moving up just one step to the next thread position directly above. The turns ratio for the complete float movement is determined by the angle of the groove cut into the drive shaft.

Rather than oscillating containers which rise and fall, it is possible to simplify the mechanism by using a continuous chain loop like this:

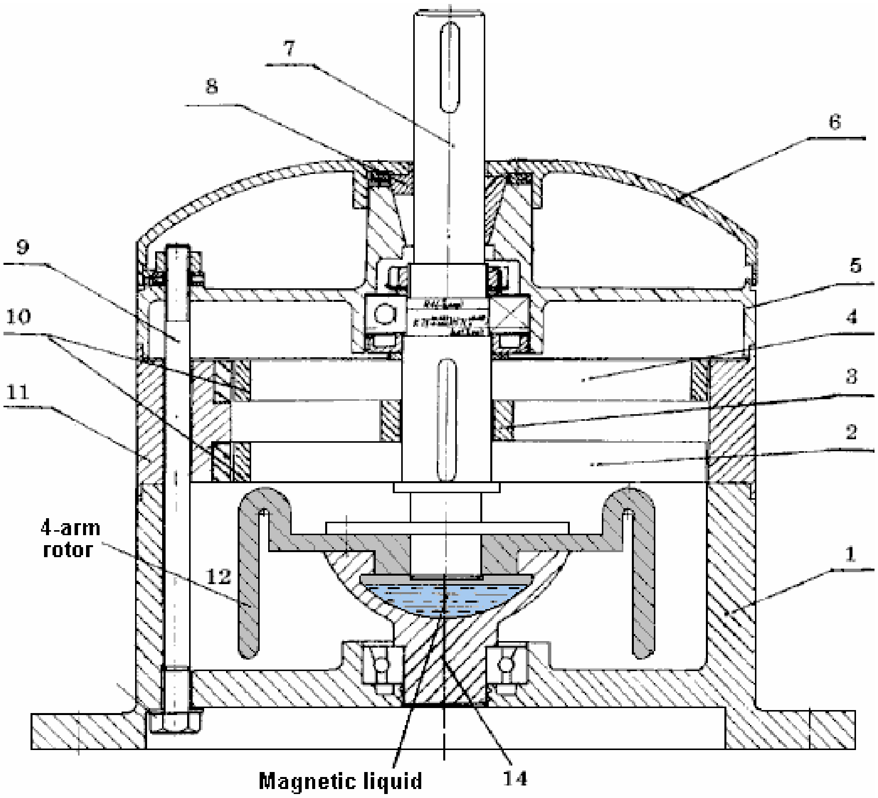


There are many other gravity-powered systems not mentioned here.

Chapter 4 - Permanent Magnets

A permanent magnet is a room-temperature superconductor of magnetism. It is tricky to arrange magnets in such a way that they produce a thrust in only one direction, but it can be done. If you can do that, then you can build a motor which has no moving parts other than its rotor. Alternatively, if you are cunning, then you can achieve an excellent result by shielding or moving some of the magnets.

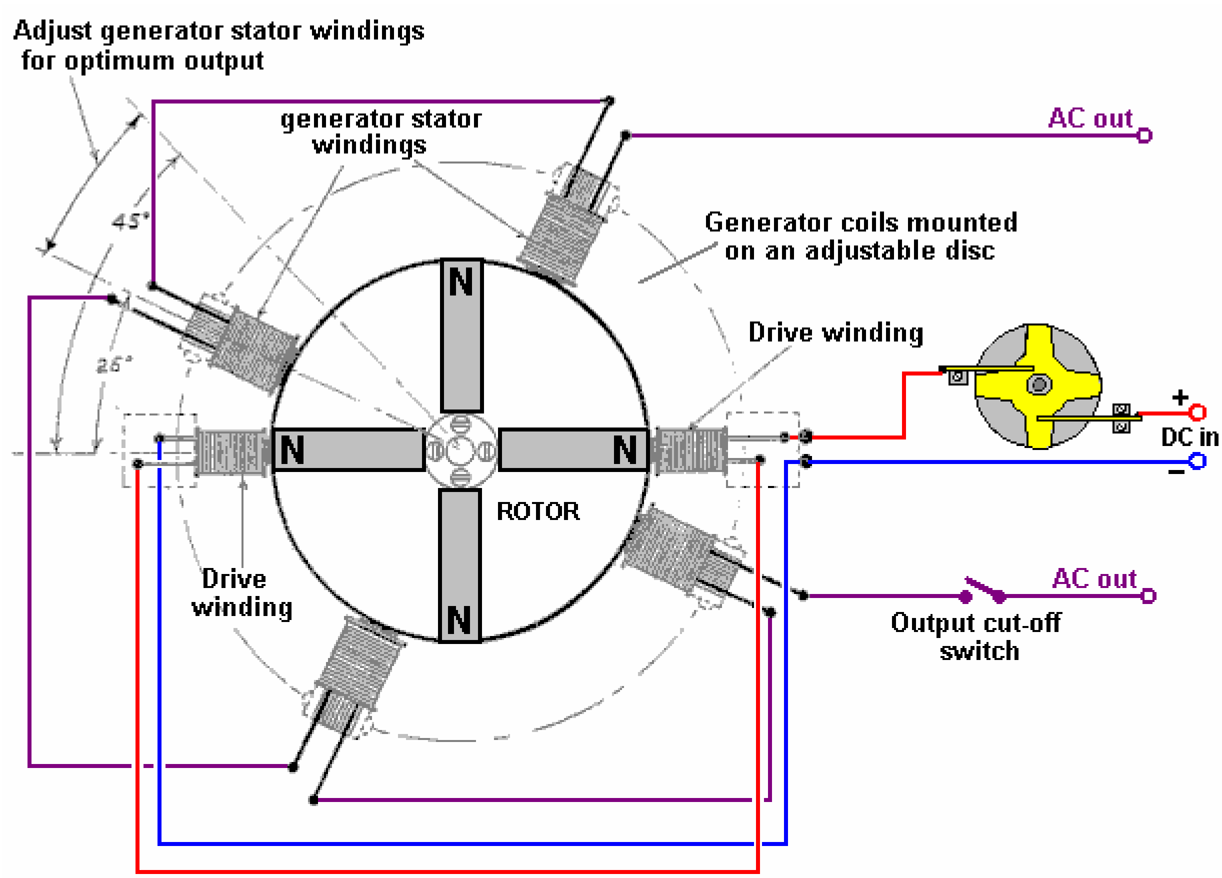
A Chinese man called **Shen He Wang** spent forty years developing a permanent magnet motor-generator. It is like this:



The key feature here is the magnetic liquid shown in blue. That forms a pivot which allows the four-arm rotor to rotate freely as well as providing the magnetic effect which drives the rotor around. These motor-generators are constructed in sizes from 1 kilowatt up to 100 kilowatts. This is the smallest:

Some information on the construction of the Wang motor is available here: http://www.free-energy-info.tuks.nl//Wang.pdf

A completely different style of operation was used by **Robert Adams** of New Zealand. His motors are sophisticated rotors with very clever switching of the output coils. Most people glance at his design and immediately assume that it is a motor driven by short pulses in much the same way as a John Bedini wheel is driven. That is completely wrong as Robert's motor is essentially a permanent magnet motor with efficiencies of 800% or more. One replication claimed to generate 32 kilowatts of excess power which was used to power both a house and business premises. The arrangement is like this:

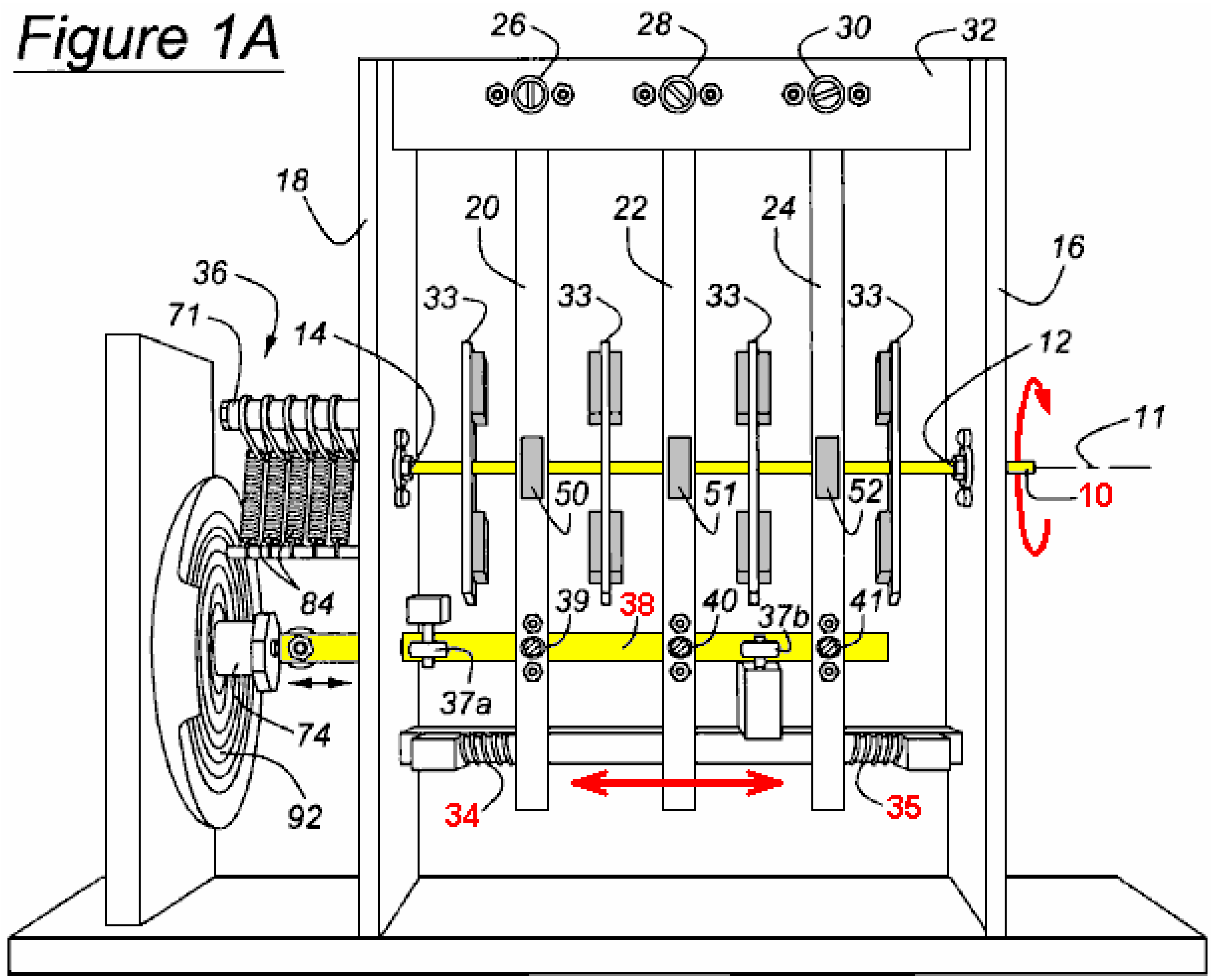


You will notice that there are six coils of wire. The two shown horizontally are used for driving the rotor around, but that drive is caused by the rotor magnets being attracted to the stationary iron cores of the drive coils. When the rotor turns around so that two magnets face the drive coil cores directly, the coil winding is powered up very briefly and with the minimum amount of power needed to stop the rotor magnets being attracted backwards to those cores as soon as they pass by. When the rotor has passed by far enough, that current is cut off and the resulting back-EMF pulse is captured, rectified and returned to the drive battery.

The remaining four coils are the output coils and they are mounted on a circular ring so that their position can be adjusted by a few degrees when the device is being tuned for optimum performance. These coils are normally disconnected and so have little effect on the rotor movement. However, they are switched in so that they deliver output power to the load and the timing of that switching is a major factor in the performance of the device.

When they are switched out again, there is a major back-EMF spike and that causes each coil to become an electromagnet for a very brief moment and that polarity opposes the rotor magnet, pushing it away and boosting the rotation. Further, that back-EMF is captured, rectified and passed back to the drive battery. This collection of the drive current is very effective in that it returns some 95% of the drive current to the drive battery, making the operation very effective indeed.

An effective permanent magnet motor was designed by **Stephen Kundel**. It uses a simple oscillating motion to position the "stator" magnets so that they provide a continuous rotational force on the output shaft:



Here, the yellow arm marked **38**, rocks to the right and left, pushed by a solenoid coil **74**. There is no obvious reason why this rocking motion could not be achieved by a mechanical linkage connected to the rotating output shaft **10**. The three arms **20**, **22** and **24**, being pivoted at their upper points, are pushed into a central position by the springs **34** and **35**. The magnets **50**, **51** and **52**, are moved by these arms, causing a continuous rotation of the output drive shaft **10**. The movement of these magnets avoids the position where the magnets reach a point of equilibrium and lock into a single position.

Figure 2

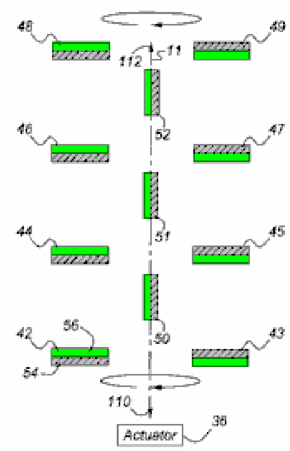
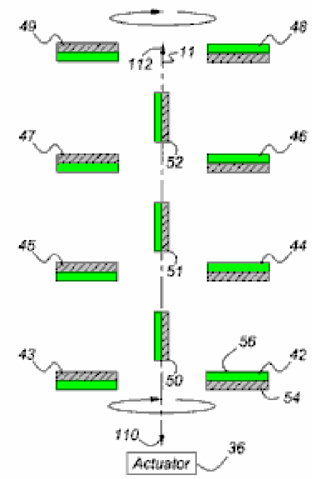
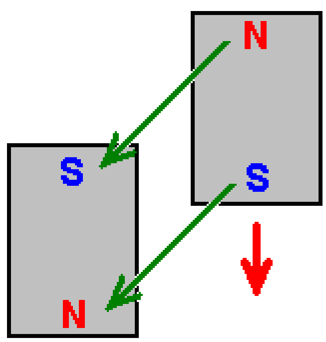


Figure 3

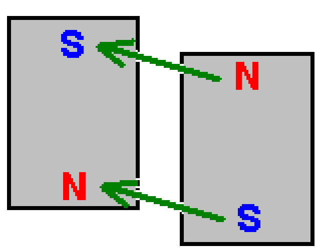


Figures 2 and 3 show the position of the magnets, with the Figure 3 position showing a point in the output shaft rotation which is 180 degrees (half a turn) further on than the position shown in Figure 2.

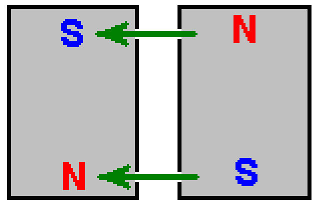
This design does not seem to appeal to many constructors in spite of the fact that it must be one of the easiest magnet motors to set up and make work. The output power level can be as big as you want as additional layers of magnets can be added. The operation is very simple and it can, perhaps, be seen more easily if just one lever arm is considered. The lever arm has just two working positions. In one position it acts on one set of rotor magnets and in the second position it acts on a second set of rotor magnets. So, we will look at each set in turn. If there are two magnets near each other, one fixed in position and the other free to move like this:



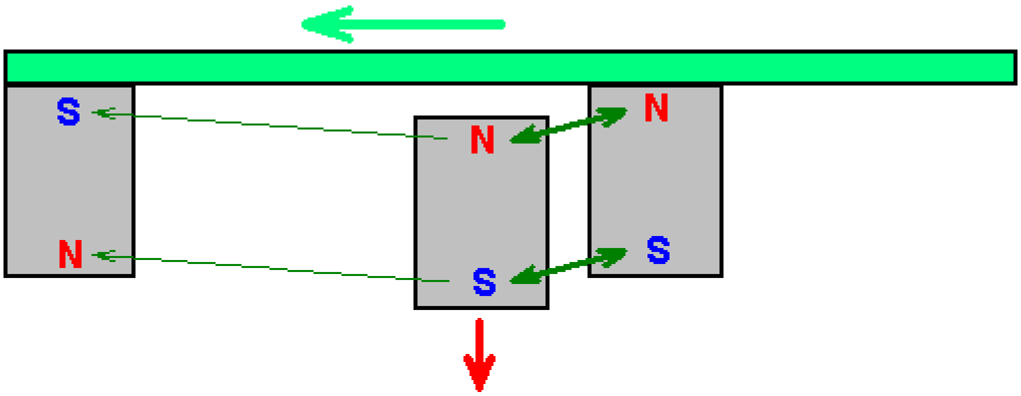
The magnets have a strong attraction to each other because of the North and South poles attracting each other. However, as the two South poles repel each other, the movement of the approaching magnet is not directly along the green arrows shown but initially is in the direction shown by the red arrow. This situation continues with the moving magnet approaching he fixed magnet and the pull between them getting stronger all the time. But, the situation changes immediately the moving magnet reaches it's closest point to the fixed magnet. Momentum starts to carry it past, but at that point the direction of the pull between the magnets starts to oppose the onward movement of the moving magnet:



If the fixed magnet remains in that position, then the moving magnet will oscillate briefly and come to a halt directly opposite the fixed magnet like this:



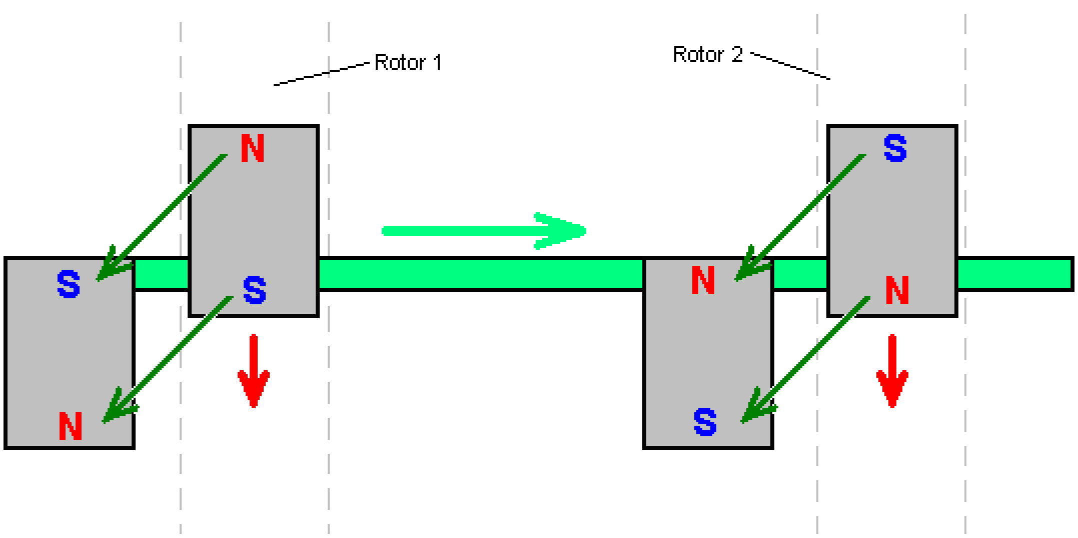
The attraction forces between the two magnets is now wholly horizontal and there is no force on the movable magnet to cause it to move. This is simple stuff, understood by anyone who has examined permanent magnets in order to see what they do. Stephen Kundel is well aware of this, and so he moves the "fixed" magnet rapidly out of the way before the reverse-direction pull slows the moving magnet down. He moves the magnet sideways and slides another one into position like this:



The new magnet is now much closer to the moving magnet and so has a much greater influence on it. The poles of the new magnet match the poles of the moving magnet which causes them to push apart very strongly, driving the moving magnet onwards in the direction it was moving in. The moving magnet moves very quickly and so gets out of the range of the fixed magnets quite quickly, at which point, the "fixed" magnets of the stator are moved back into their original position where they act in the same way on the next moving magnet attached to the rotor.

This very simple operation only requires a small force to move the stator magnets sideways between their two positions, while the force between the stator magnets and the rotor magnets can be high, producing considerable rotational power to the axle on which the rotor discs are attached.

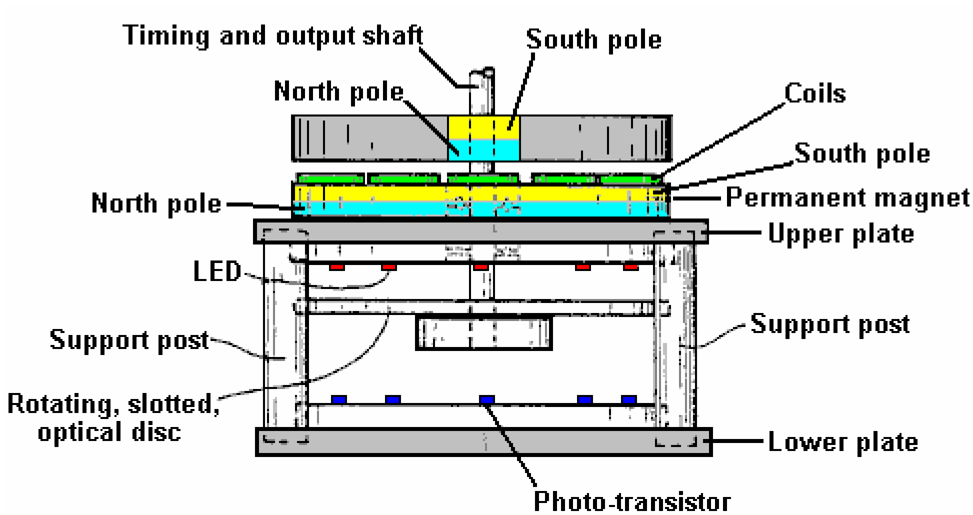
The efficiency of the system is further boosted because when the stator magnets are in the first position shown, the second "fixed" magnet is not sitting idle but instead, it acts on the magnet of the next rotor disc:



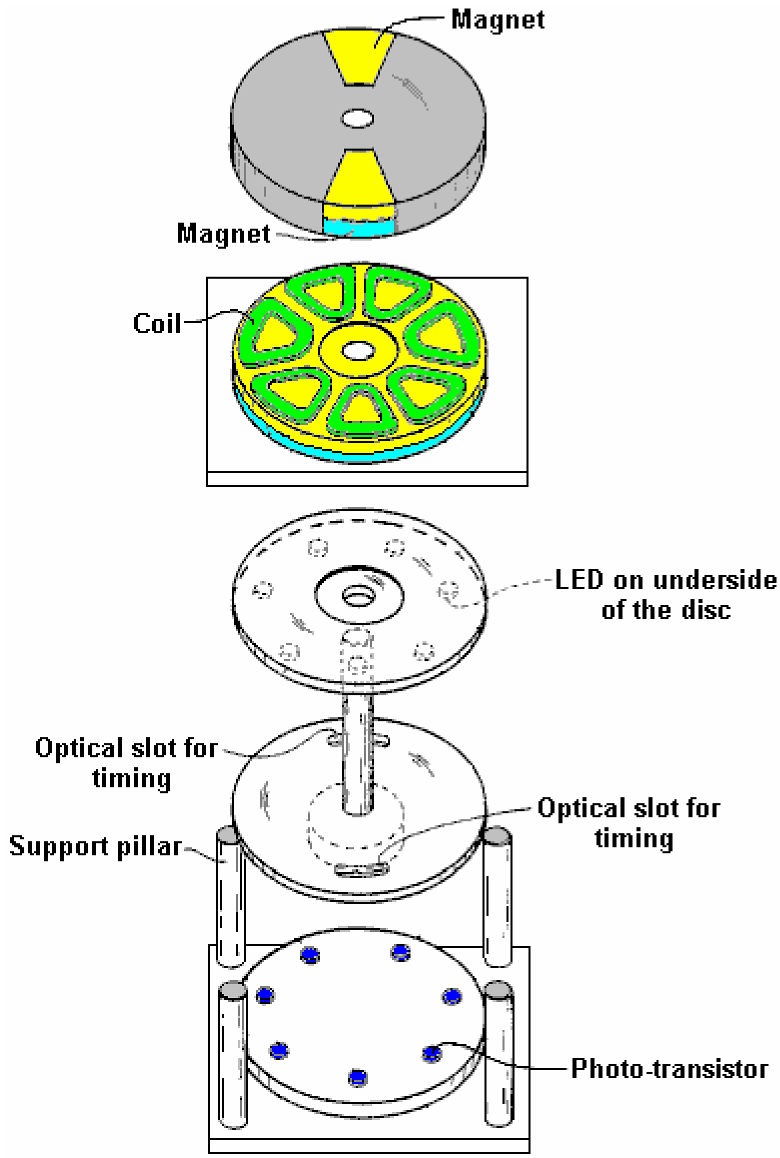
For this, the magnets attached to Rotor disc 2 have to be positioned so that their poles are the reverse of those attached to Rotor disc 1. Stephen uses a loudspeaker to wobble the horizontal bar on which the stator magnets are mounted, backwards and forwards as a loudspeaker has that mechanism already built into it. Don Kelly's permanent magnet motor also uses this very simple idea of moving the stator magnets out of the way at the appropriate moment.

Charles Flynn One of the best known inventors where magnetics are concerned is Charles Flynn whose patent US 5,455,474 dated 3rd October 1995, gives details of this interesting design. It says: "This invention relates to a method of producing useful energy with magnets as the driving force and represents an important improvement over known constructions and it is one which is simpler to construct, can be made to be self starting, is easier to adjust, and is less likely to get out of adjustment. The present construction is also relatively easy to control, is relatively stable and produces an amazing amount of output energy considering the source of driving energy that is used. The present construction makes use of permanent magnets as the source of driving energy but shows a novel means of controlling the magnetic interaction or coupling between the magnet members and in a manner which is relatively rugged, produces a substantial amount of output energy and torque, and in a device capable of being used to generate substantial amounts of energy."

The patent describes more than one motor. The first one is like this when seen from the side:

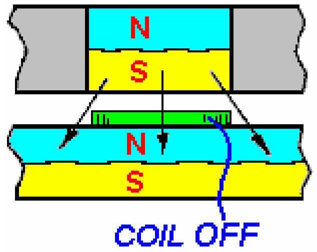


An exploded view, shows the different parts clearly:

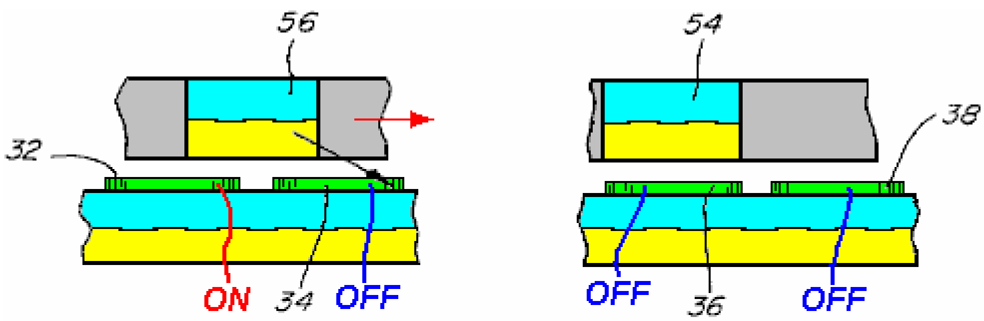


This construction is relatively simple and yet the operation is powerful. The power is provided by three magnets, shown shaded in blue and yellow. The lower magnet is in the form of a disc with the poles arranged on the large, circular, flat faces. This is the stator magnet which does not move. Positioned above it is a disc made of non-magnetic material (shaded in grey) and which has two magnets embedded in it. This disc is the rotor and is attached to the central vertical shaft.

Normally, the rotor would not rotate, but between the two discs there is a ring of seven coils which are used to modify the magnetic fields and produce powerful rotation. The powering up of these coils is very simple and it is arranged by shining a beam of Ultra Violet light from one of the Light-Emitting Diodes through a slot in an optical-timing disc attached to the rotating shaft. The LEDs and the photo-transistors are aligned with the centres of the seven coils. The position and width of the slot controls which photo-transistor gets switched on and for how long it remains powered up. This is a very neat and compact arrangement. The really interesting part of the design is how the coils modify the magnetic fields to produce the output power of the device. The orientation of the magnet poles can be swapped over, provided that this is done for all three magnets.



Shown here is the situation when one of the rotor magnets has rotated to where it is above one of the coils which is not yet powered up. The South pole of the rotor magnet is attracted to the North pole which is the entire upper face of the stator magnet as shown by the three arrows. If a voltage is applied to the coil, then this magnetic coupling is disrupted and altered. If any torque is developed as a result of the coil being powered up, then it will be developed to either side of the energised coil. If the coil is not powered up, then there will be full attraction between the magnets and no rotational force will be produced. You will notice that there are two rotating magnets (an even number) and seven coils (an odd number) so when one of the rotor magnets is above a coil, then the other isn't. This staggering of the two positions is essential for generating smooth, continuous rotational torque and self-starting without any need to rotate the shaft manually.

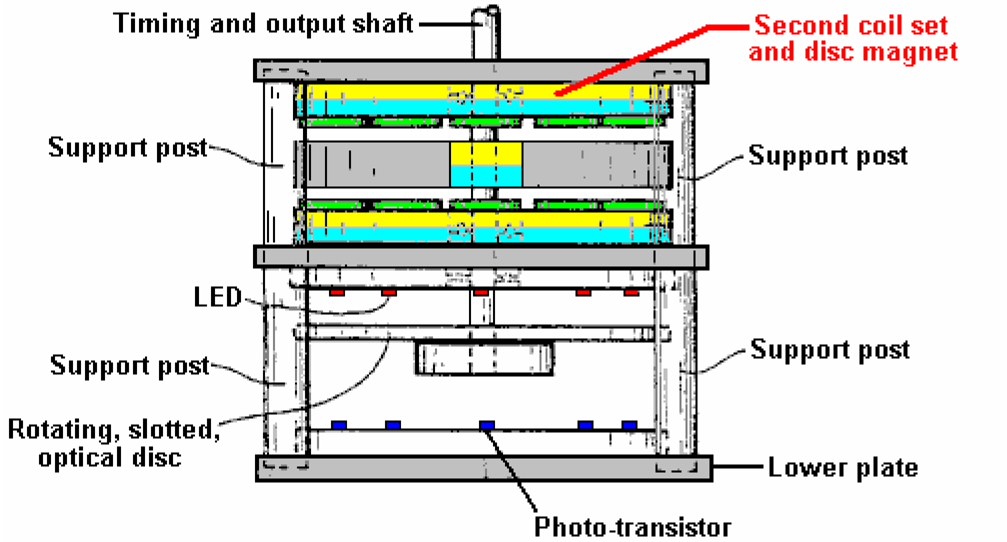


The diagram above shows a piece from both sides of the rotor disc, to explain the operation of the coils. On the left, magnet **56** overlaps coil **32** and coil **34**. Coil **32** is powered up and this breaks the magnetic link on the left hand side of magnet **56**. But, coil **34** is not powered up, so the attraction between magnet **56** and the disc magnet under the coils remains. Even though this attraction is at a downward angle, it creates a push on the rotor, driving it towards the right as shown by the red arrow.

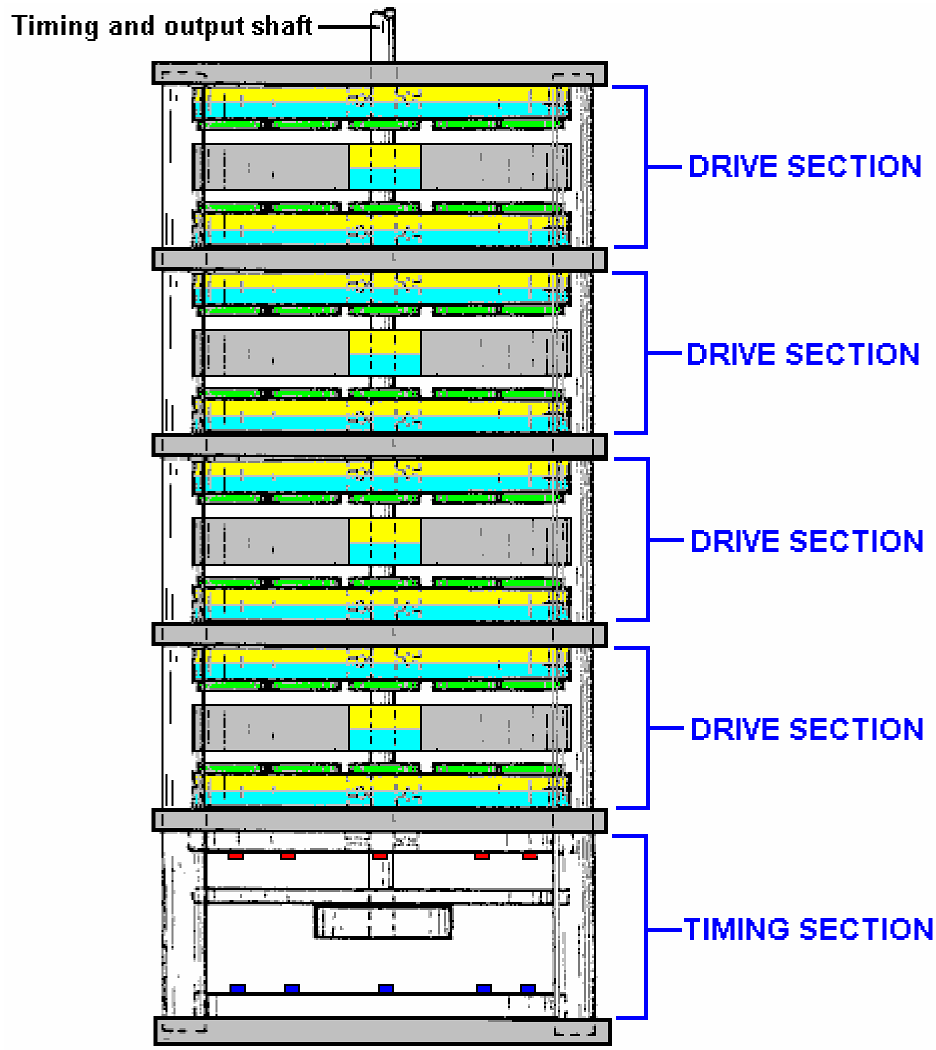
While this is happening, the situation around the other side of the rotor disc, is shown on the right. Here, magnet **54** is above coil **36** and that coil is not powered up, so there is no resulting drive in either direction - just a downward pull on the rotor magnet, towards the stator magnet below it. The adjacent coil **38** is also not powered up and so has no effect on the rotation. This method of operation is **very** close to that of the motor design of Robert Adams described in the next chapter. It is important to understand that this method of operation is nothing like that of the John Bedini pulsers where the rotation of a disc is caused by the electrical pulse applied to a coil creating a repulsion thrust to a rotor magnet. Instead, here, the coil acts as a magnetic shield, being provided with the minimum possible power to do its job. The coil is, in effect, a shield which has no moving parts, and so is a very clever mechanism for overcoming the tendency for the rotor magnets to lock on to the stator magnets and preventing rotation.

At any moment, six of the seven coils in this design are inactive, so in effect, just one coil is powered. This is not a major current drain. It is important to understand that the power of this motor is provided by the permanent magnets pulling towards each other. Each of the two magnets applies a horizontal pull on the rotor every seventh of a turn, that is, every 51.1 degrees in the rotation. As the coils are an uneven number, the rotor gets a magnetic pull every 25.5 degrees in the rotation, first from one rotor magnet and then from the other rotor magnet.

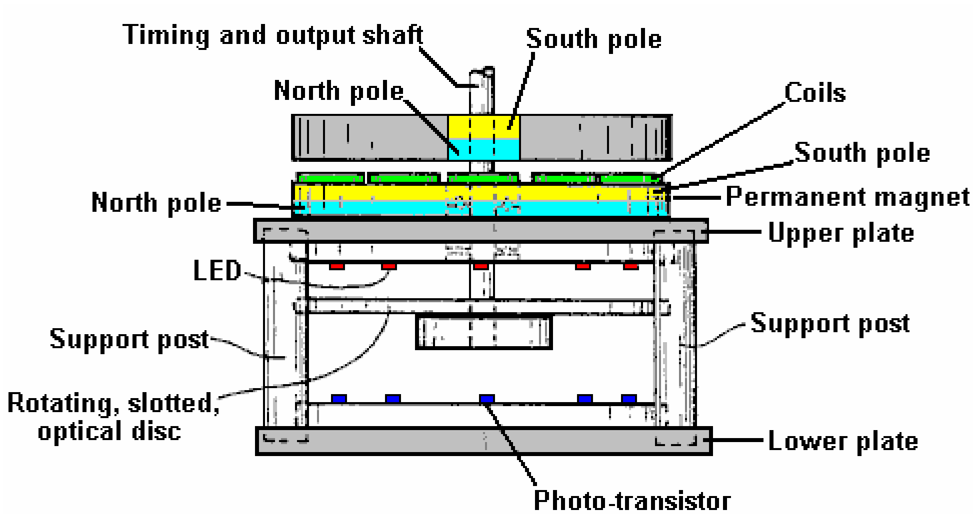
It follows then, that the power of the motor can be increased by adding more magnets. The first step in this search for additional power is to add a second disc magnet and coils on the other side of the rotor, so that there is a second pull on the magnet. This has the added advantage that it balances the downwards pull of the first disc magnet with an upward pull, giving an enhanced and balanced horizontal thrust as shown here:



This motor can be increased in power almost indefinitely as the drive sections can be stacked together like this:



Driven by a dry cell battery, a motor of this type reaches 20,000 rpm and is powerful.



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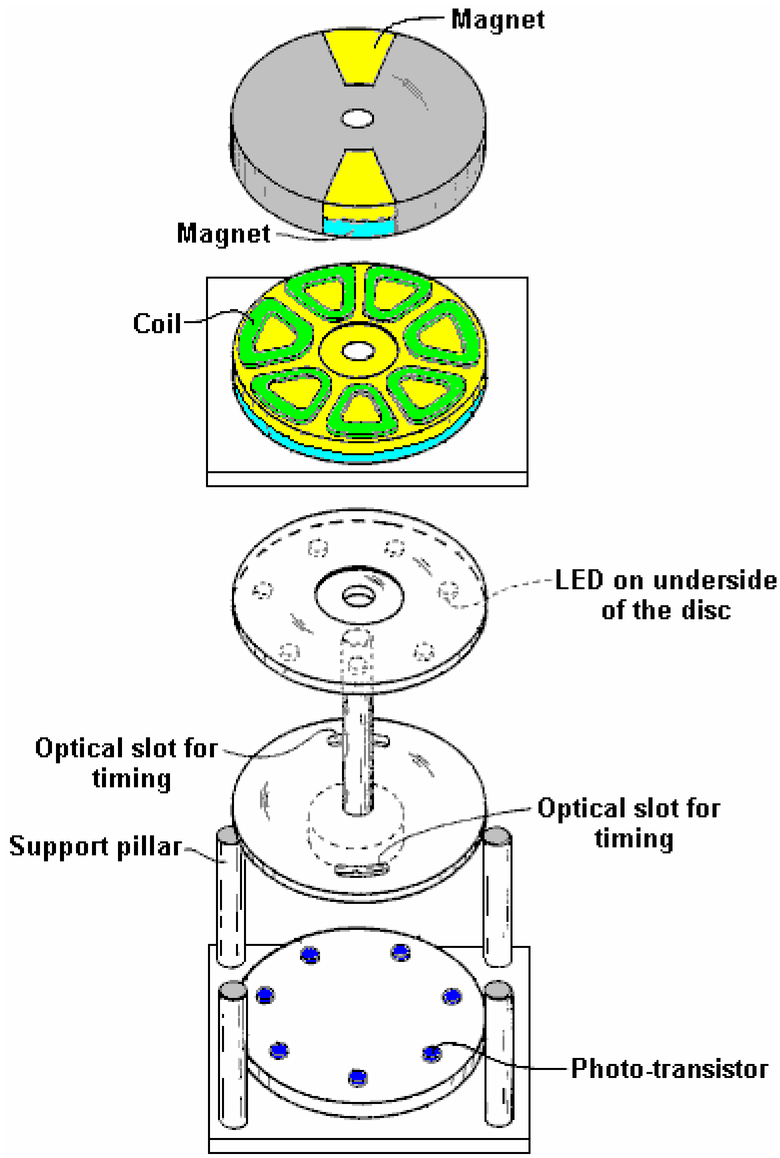

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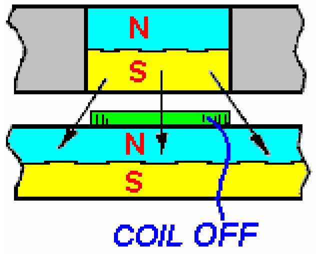

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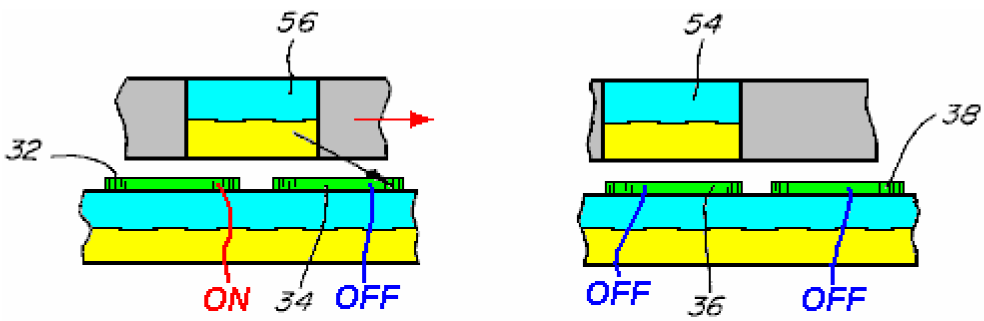

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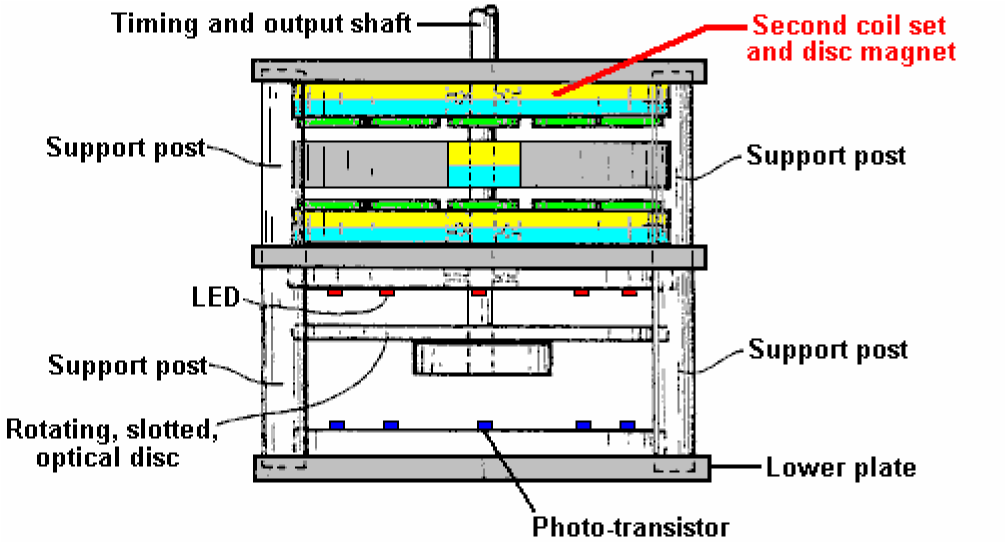
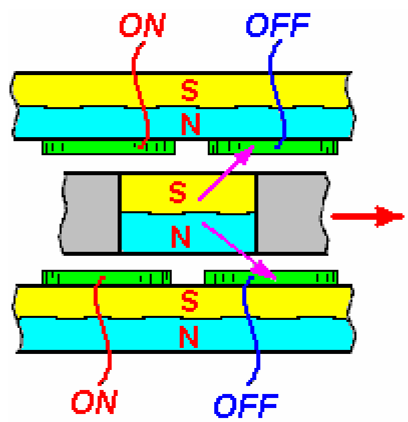
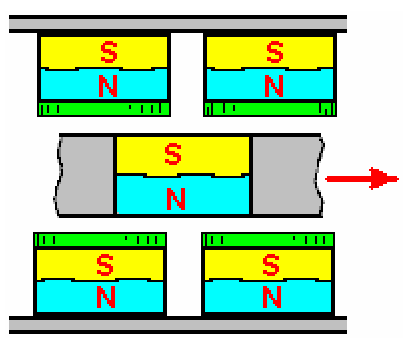


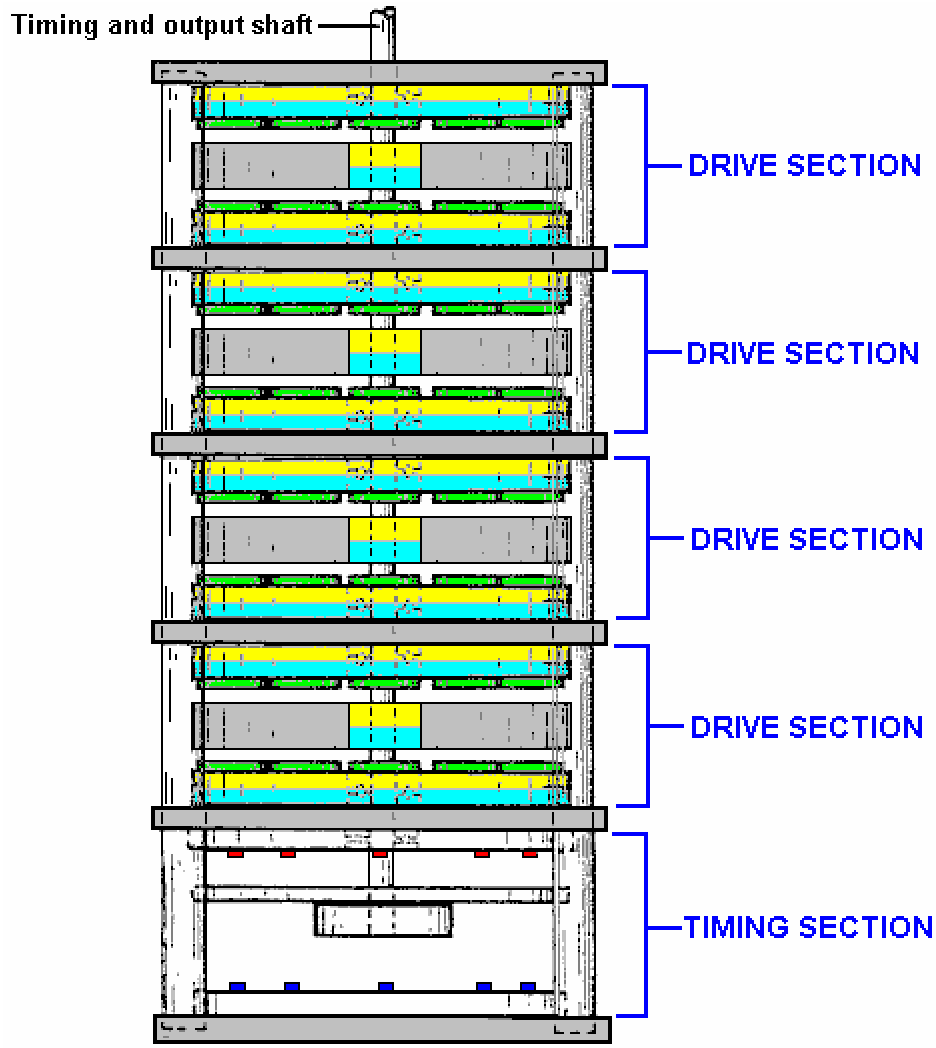
The coil switching with the additional layer of coils is shown here:



This produces a larger horizontal thrust. While this design goes for optimum performance, I suggest that a much more simple form of construction with a ring of standard circular neodymium magnets could be used instead of one large disc magnet, and ordinary circular coils placed on top of the circular magnets, and this allows large diameter rotors to be constructed, the larger diameter giving greater output shaft power:

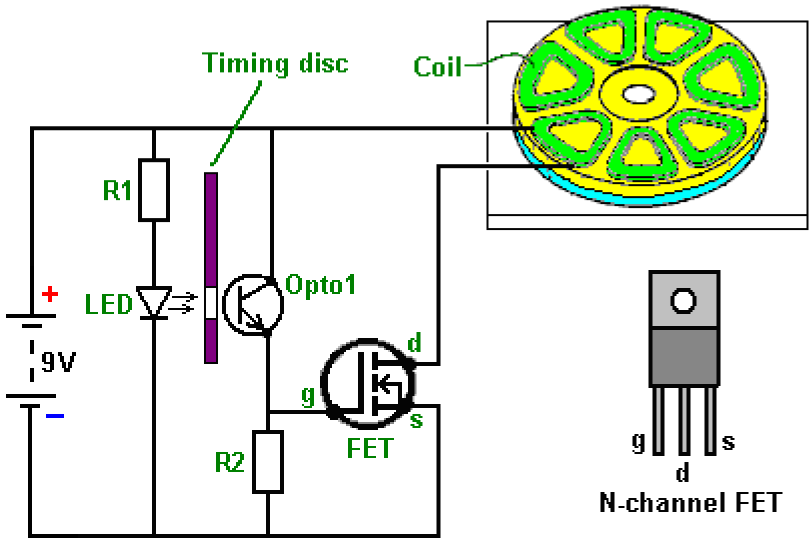


To increase the power of the output shaft further again, additional sets of magnets and coils can be added as shown here:



It should be remembered that the timing section shown above could be replaced by a NE555 timer circuit which generates a steady stream of On / Off pulses. When those pulses are fed to the coils, the motor rotates, slaving itself to the pulse rate. This gives an immediate speed control for the motor as well as avoiding the need for the precise positioning of the slotted disc which allows the LEDs to shine directly on to the phototransistors at the appropriate instant. If that approach is taken, then the timing section shown above would be omitted.

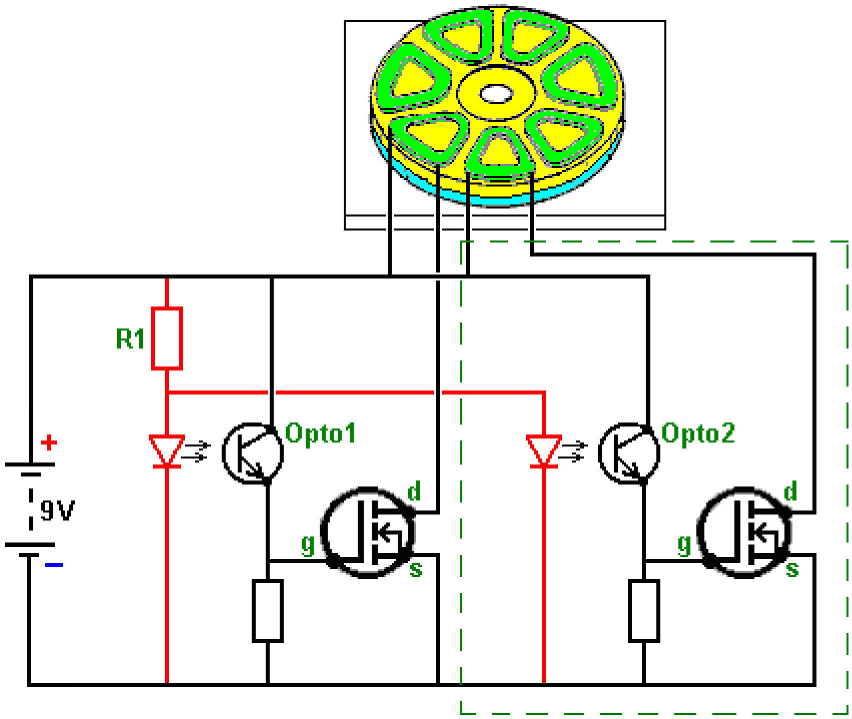
The circuitry that Charles specifies for powering the coils to block the magnetic fields of the permanent magnets uses N-channel MOSFETs and is very simple. Here is his circuit for driving one of the coils:



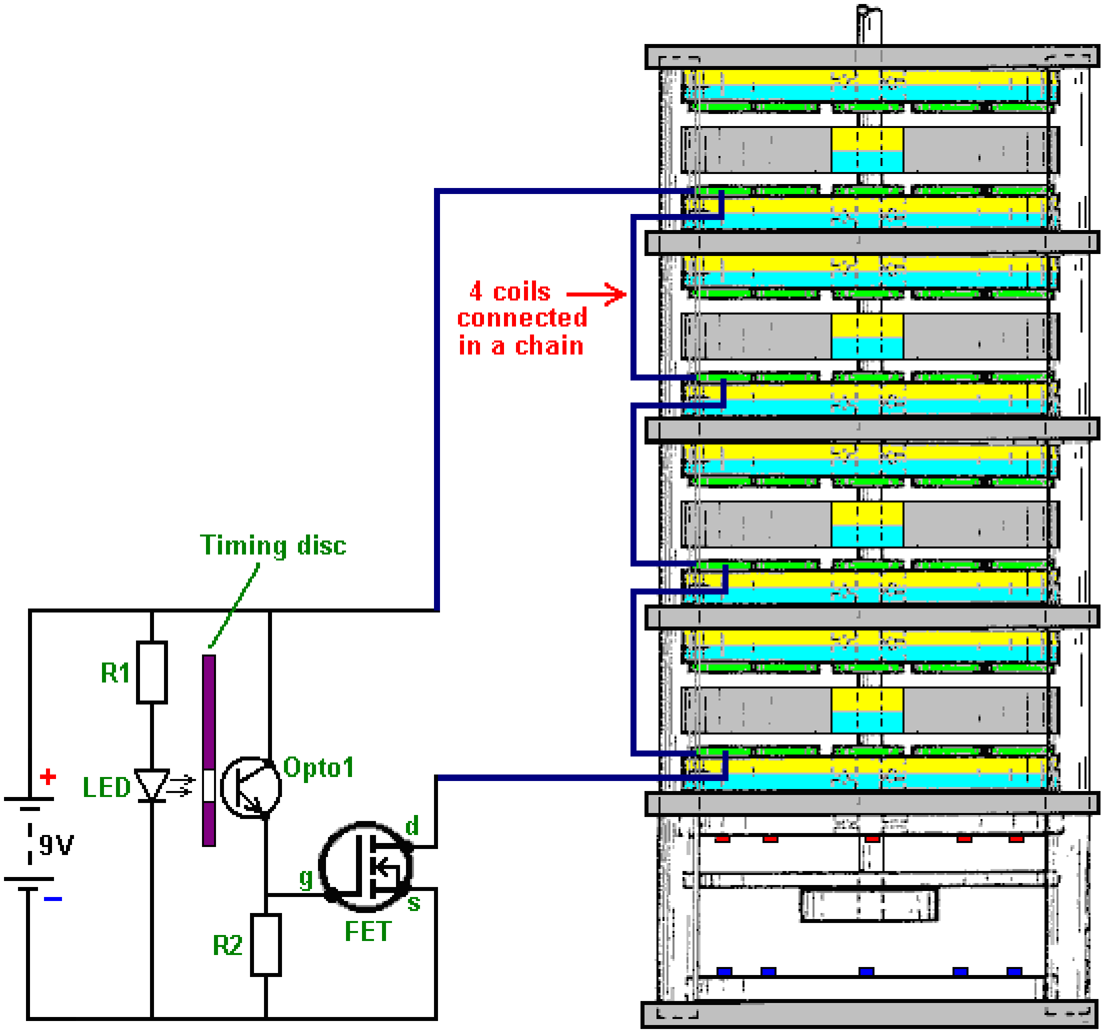
Just five components are used. The current through the coil is controlled by a transistor. In this case it is a Field-Effect Transistor usually called a "FET". The most common type of FET is used, namely an "N-channel" FET which is the rough equivalent to an NPN transistor as described in Chapter 12. A FET of this type is switched off when the voltage on it's "gate" (marked "g" in the diagram) is 2.5 volts or lower. It is switched on when the voltage on it's gate is 4.5 volts or more.

In this circuit we want the FET to switch on when the motor's timing disc is in the right position and be off at all other times. This is arranged by shining the light from a Light-Emitting Diode or "LED" through a hole in the timing disc which rotates with the shaft of the motor. When the hole is opposite the LED for the coil which is to be powered up, light shines through the hole and on to a light-sensitive device, Charles has opted to use a Light-Sensitive transistor, but a light-dependent resistor such as an ORP12 could be used instead. When the light shines on the "Opto1" device in the circuit diagram, it's resistance falls dramatically, raising the voltage on the gate of the FET and switching it on. When the timing disc hole moves past the LED, the light is cut off and the FET gate voltage drops down, switching the FET off. This arrangement causes the coil of the motor to be switched on and off at just the right time to give a powerful rotation of the motor shaft. In the circuit, the resistor "R1" is there to make sure that the current flowing through the LED is not excessive. The resistor "R2" has a low value compared to the resistance of "Opto1" when no light falls on it, and this holds the gate voltage of the FET down to a low value, making sure that the FET is completely off.

As you can see, this is basically a very simple circuit. However, as one of these circuits is used for each coil (or each pair of coils if there is an even number of coils in this slice of the motor), the circuit in the patent looks quite complicated. It is actually very simple. The resistor "R1" is used to limit the current flow through all of the LEDs used and not just one LED. You could, of course, use one resistor for each LED if you wanted to. The circuit for powering two coils (and not showing the timing disc) looks like this:



The section inside the green dashed line being the identical circuit for the second coil. This addition to the circuit is made for each coil, at which point, the motor is ready to run. If, as would be normal, several layers of magnets are being used, then the coils positioned above each other can be connected in a chain like this:



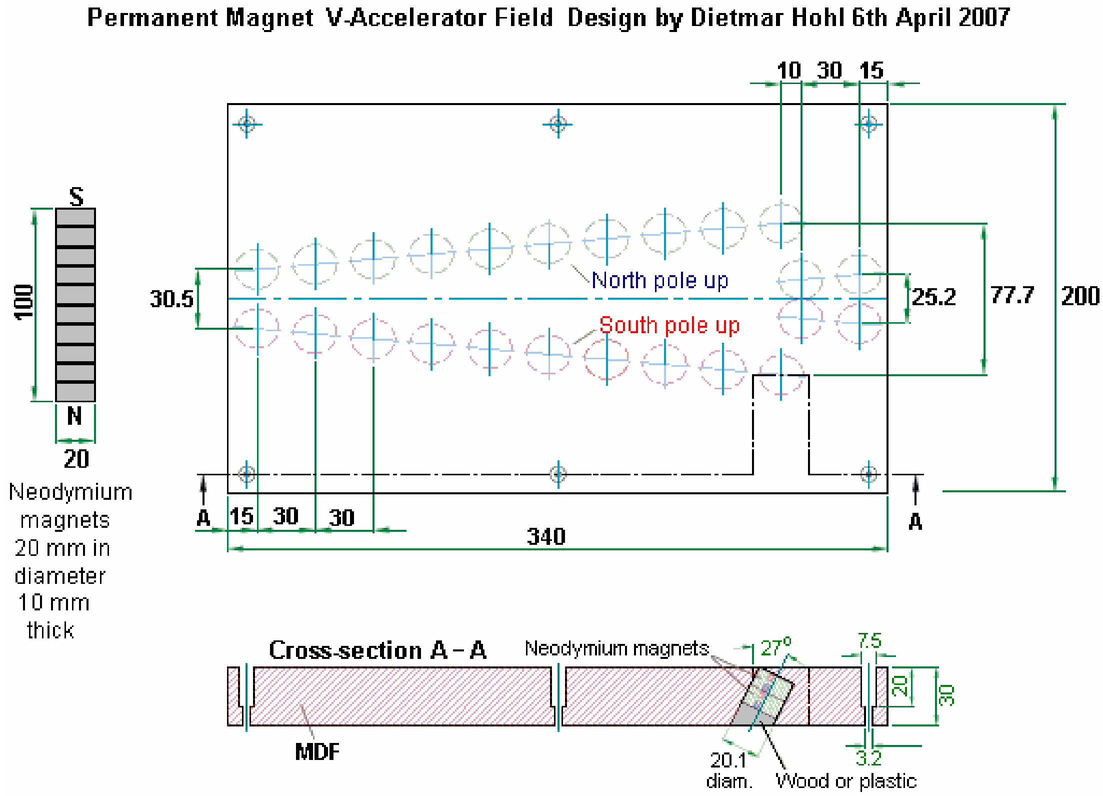
Connecting several coils "in series" (in a chain) like this, reduces the number of electronic components needed and it makes sure that the pulses to each of these coils is at exactly the same instant. Alternatively, it is possible to wire these coils across each other "in parallel", the choice is generally dictated by the resistance of the coils. The patent drawing shown above seems to indicate that there is a big gap between the LEDs and the optical devices. This is probably not the case as most people would choose to keep the gap between the LED and the light-dependent device as small as possible, mounting them so that they are just clear of the timing disc on each side of it.

In this patent, Charles Flynn remarks that this magnet motor can be used for almost any purpose where a motor or engine drive is required and where the amount of energy available or required to produce the driving force may vary little to nil. Charles has produced motors of this type which are capable of rotating at very high speed - 20,000 rpm and with substantial torque. Lesser speeds can also be produced, and the motor can be made to be self-starting. Because of the low power required to operate the device, Charles has been able to operate the motor using just a nine volt, off-the-shelf dry battery.

One application which seems most appropriate for this motor design is the Frenette heater shown in Chapter 14. Using this motor to drive the discs inside the heater drum would produce a heater which appears to be driven by just a nine-volt battery. However, while that is the appearance, the reality is that the power of this motor comes from the permanent magnets and **not** from the battery. The battery current is only used to prevent the backward pull of the magnets and it is **not** used to drive the motor.

Dietmar Hohl

There are many different types of Permanent Magnet motors which operate perfectly well. One easy-build type is shown by Dietmar Hohl and his diagram gives all of the details:



A well-made version of this looks like this:

Muammer Yildiz has developed a powerful permanent magnet motor, patented it, and demonstrated it to the staff and students of a Dutch university. During the demonstration, the mechanical power output was estimated at 250 watts and immediately after the demonstration, the motor was completely taken apart to show that there were no hidden power sources. There is a video showing this demonstration, at: http://pesn.com/2010/04/22/9501639_Yildiz_demonstrates_magnet_motor_at_Delft_University/

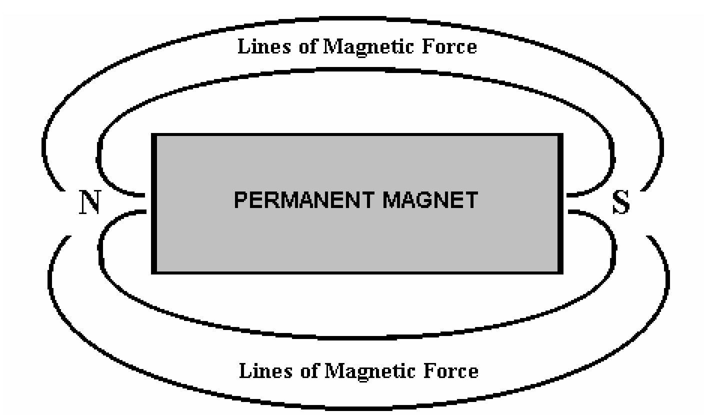
 

The patent involved is Patent EP 2,153,515 from February 2010 and I understand that Muammer intends to market a permanent magnet generator based on the design.

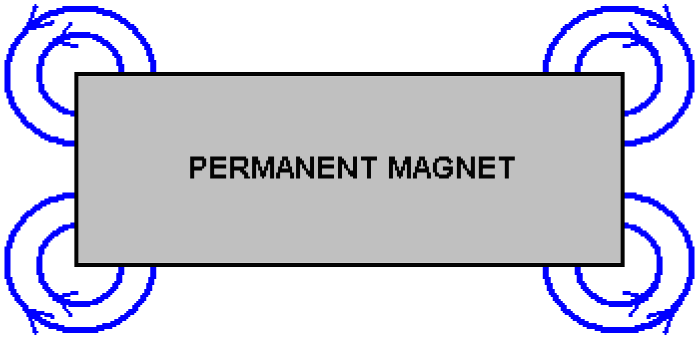
Simple Permanent Magnet Motors

It is very difficult to use the power of permanent magnets to make a motor powered by them alone. The Dietmar Hohl design shown above is one of the very few which can readily be made and tested at home. The problem is that almost all magnets have a symmetrical magnetic field, while what is needed for a magnet-powered motor is an asymmetrical magnetic field. Consequently, magnets have to be combined in ways which distort their normal field shape. You will notice that in the Hohl motor, the drive magnets are angled and that is an important feature of using magnets in motors.

Schools currently teach that the magnetic field surrounding a bar magnet is like this:

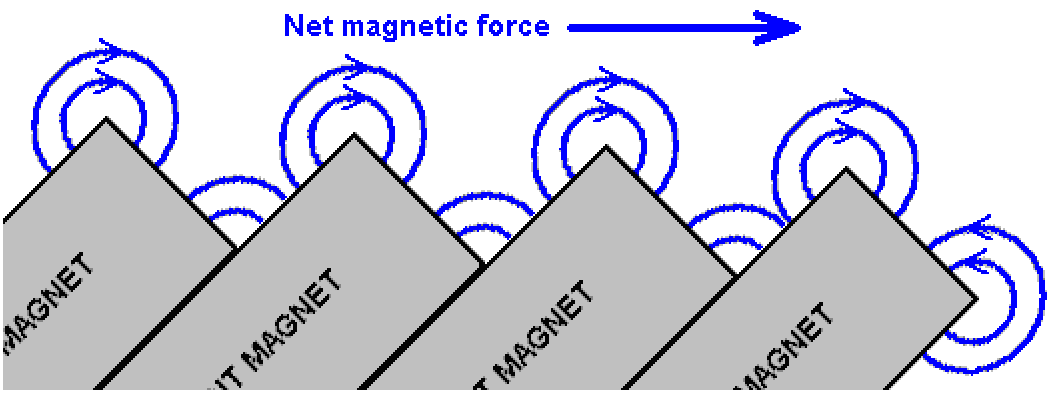


This is deduced by scattering iron filings on a sheet of paper held near the magnet. Unfortunately, that is not a correct deduction as the iron filings distort the magnetic field by their presence, each becoming a miniature magnet in it's own right and alters the magnetic properties of the space around the magnet in the plane of the iron filings. More careful measurement shows that the field actually produced by a bar magnet is like this:



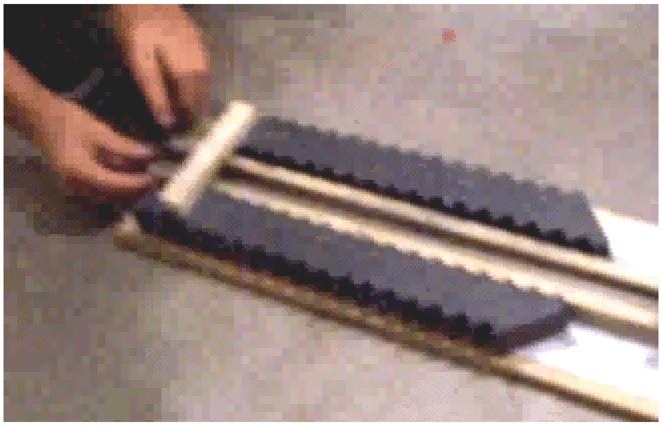
There are many lines of force, although these diagrams show only two of them. In reality, the lines of force at the corners fan out in three dimensions, with curved, circular-flowing lines above the top of the magnet, circular lines below the lower face of the magnet. These lines of force are roughly in the shape of a football with the corner of the magnet in the centre of the football. Actually, there are many layers of these lines of magnetic force, so it is like having a whole series of gradually bigger and bigger footballs all centred on the corner of the magnet. It is extremely difficult to draw those lines and show them clearly. Howard Johnston's book "*The Secret World of Magnets*" will give you a good idea of the actual lines of force around a bar magnet. The arrangement of these lines of magnetic force is not generally known and if you Google 'magnetic lines of force images' you will only find the fiction taught in schools. However, the important fact is that there is a rotating magnetic field at each corner of a typical bar magnet. It follows then that if a row of magnets is placed at a an angle, then there will be a resulting net field in a single direction.

For example, if the magnets are rotated forty five degrees clockwise, then the result would be like this:



With this arrangement, the opposing corners of the magnets as shown here, are lower down and so there should be a net magnetic force pushing to the right just above the set of magnets. However, the situation is not as simple and straightforward as you might imagine. The additional lines of magnetic force which have not been shown in the diagram above, act further out from the magnets and they interact, creating a complex composite magnetic field. It is frequently found that after four or five magnets that a short gap needs to be left before the line of magnets is continued on.

Two boys; Anthony and Andreas, have used this magnet arrangement to create a magnetic track and they have a lot of fun, sending a magnet sliding between two of these rows of angled magnets. Initially, they used the cheaper ceramic magnets and got a very satisfactory movement when using a neodymium magnet as the moving component:



You will notice that they have managed a row of 18 ceramic magnets on each side of their track and the results which they are getting are very good. They have three videos on the web at the present time:

https://www.youtube.com/watch?v=Vo2-Qb3fUYs

https://www.youtube.com/watch?v=VeXrFfw4RSU

https://www.youtube.com/watch?v=VTbFfEEE_qU

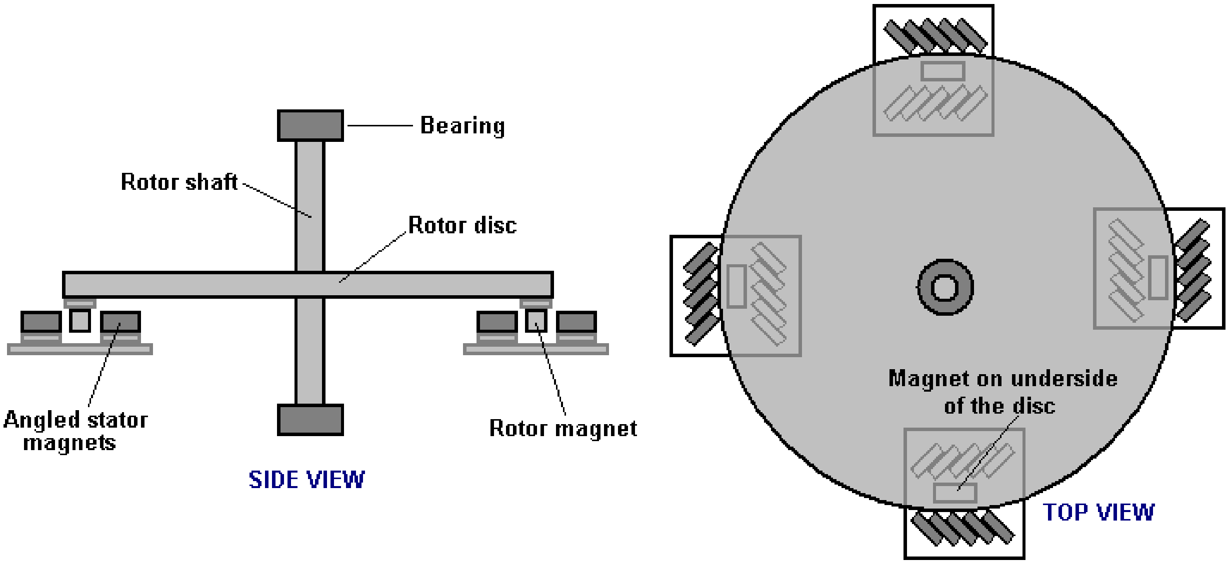
The moving magnet is made up of four 12 mm x 12 mm x 12 mm (or half-inch by half inch by half inch) neodymium magnets attached North - South - North - South - North - South - North - South:

They have not disclosed all of the details of what they are using (accidentally rather than by intention). The ceramic stator magnets are 48 mm x 20 mm x 10 mm with the poles on each of the main faces. They position each magnet with it's North pole facing towards the track and they angle the magnets at 45 degrees. There is a 15 mm gap between the stator magnets and the moving magnets on both sides of the track. Wooden strips direct the moving magnets.

Neodymium magnets have very different characteristics to those of ceramic magnets (and that is not just strength of the magnetic field). It is not unusual for experimenters to find that devices will work well with one type of magnet but not with the other type. Here the developers have also tried using two sets of five angled neodymium magnets on each side of their track and the result was a more powerful thrust on their moving magnets.

The magnets are held in place in this picture, by wooden dowels driven into the base plank. They used these in order to avoid any magnet-fastening material which could alter the magnetic field.

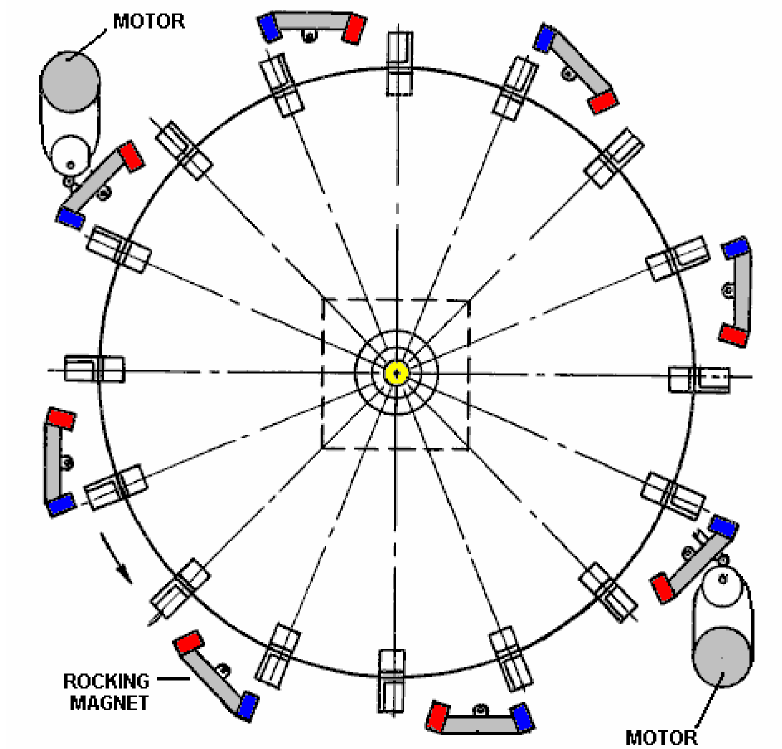
The next step would be for them to power a motor using their magnetic track technique. However, this has been tried many times and the conclusion is that it is **VERY** hard to change a straight magnetic track into one which forms a complete circle. Therefore, I would suggest the following arrangement:



Here, a simple disc rotor has four magnets (of the type used to move down the magnetic track) attached to the underside of the disc and positioned so that they move through four short sets of four, or at the outside, five angled stator magnets as the disc spins. It does not matter if the rotor shaft is horizontal or vertical. If the disc spins well, then sets of two air-core pick-up coils can be positioned between each of the stator magnet arrays so that electricity is generated as the rotor magnets pass by overhead. If a constructor decides to attach two rotor discs to the one rotor shaft, then the two rotors should be positioned so that the rotor shaft gets pushed every 45 degrees of rotation rather than every 90 degrees as shown here. This style of motor is definitely within the scope of the average person to build should they be inclined to do so.

Donald Kelly's Permanent Magnet Motor.

In 1979, Donald Kelly was granted a patent on a permanent magnet motor design. He comments that apart from it being very difficult to generate sufficient power to mechanically move the stator magnets slightly to achieve continuous rotation, the resulting rate of revolutions is very low. For those reasons, he has opted to move the stator magnets slightly using small DC motors. His design is included here as it is a concept which is relatively easy to understand. The overall idea is not unlike that of Stephen Kundel who rocks the stator magnets with a solenoid, as shown earlier in this chapter. The objective here is to use a small electrical current to generate a powerful rotation far greater than would be possible from the electrical current itself, and so, produce what is in effect, a power multiplication through the use of permanent magnets.

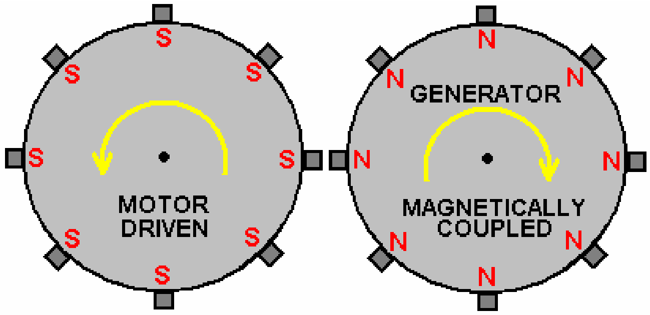


The operation is a simple strategy. Eight sets of magnets are mounted on rocker arms. These have two main positions. In the first position, the rocker magnets attract the magnets mounted on the rotor. When the rotor moves because of this attraction and reaches a point where there is about to be a backward drag on the rotor, the position of the rocker arms is altered so that the first set of rocker magnets are moved out of the way to a position where they have little effect due to their increased distance from the rotor magnets. This rocker movement also moves magnets of the opposite polarity which push the rotor magnets on their way. In this design, the attraction and the push are applied to different sets of magnets. If the attraction is on magnets 1, 3, 5, etc. then the push is on magnets 2,4,6, etc. But, in spite of this, the pull and push are applied to every rotor magnet as it passes. The power needed to operate the electric motors is minimal as the power of the motor is provided by the magnets. Instead of two tiny motors, it would be possible to operate the rocker arms using small solenoids and if the motor is used to power an electrical generator, then the design could be made self-powered by using some of the electrical output to provide the necessary input power. The sketch above shows just one layer of the motor, but there can be as many layers as you like, each driving the single output shaft, and increasing it's power with every layer.

Raoul Hatem's Magnetic Coupling System.

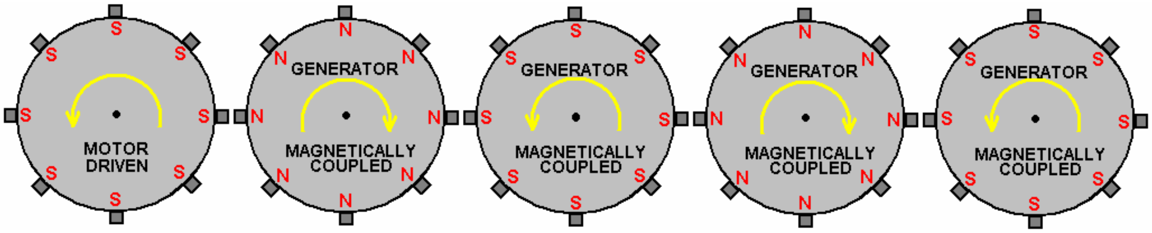
In 1955, Raoul Hatem showed a method of creating an energy gain which conventional science will not accept because according to current theory, any such energy gain has to be "impossible" and so, cannot happen no matter what evidence there is:

Raoul Hatem's heretical statement is that using spinning magnets draws in energy from the environment, allowing a system to have COP>1. His method is to use a motor to spin a heavy rotor disc with 36 powerful rare-earth magnets mounted on it. Then, using an identical heavy disc with magnets mounted on a generator to give a magnetic coupling between the motor and the generator can give not just coupling, but an energy gain as well, an energy gain which Hatem says is 20 times:

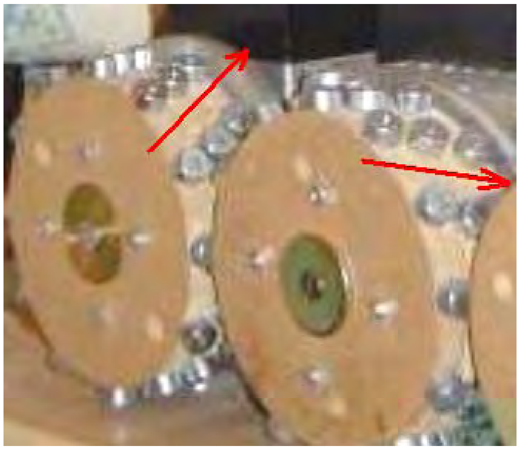


The heavy rotor provides some flywheel effect which helps with the operation of the system. Even with one motor as shown above, there is an energy gain as demonstrated in a recent video demonstration of the effect at http://www.dailymotion.com/video/xi9s9b_moteur-magnetique-de-leon-raoul-hatem_webcam#.UaGyVTcr6Bo where a simple system produces 144 watts of excess power. However, the really big gains are got when several generators are driven by just the one motor. In passing, it may be remarked that there are two separate energy gain systems operating here. Firstly, the rotating magnetic field acts directly on the excess electrons in the local environment, drawing them into the system just as the fluctuating magnetic field of the secondary winding of any transformer does. Secondly, the rotors are receiving a rapid stream of drive pulses, and as Chas Campbell has demonstrated, that draws in excess energy from the gravitational field.

Anyway, you will notice that the powerful magnets used have their North poles outwards on one rotor while the adjacent rotor has the South poles outwards. The very strong attraction between these opposite poles cause the generator disc to rotate in step with the motor disc. This process allows many generators to be driven by just the one motor as shown here and in the photograph above:



For ease of drawing, the diagram above shows only eight magnets per rotor disc, but you will notice in the photograph (and in the video) that there are three stepped rows of magnets on each rotor:

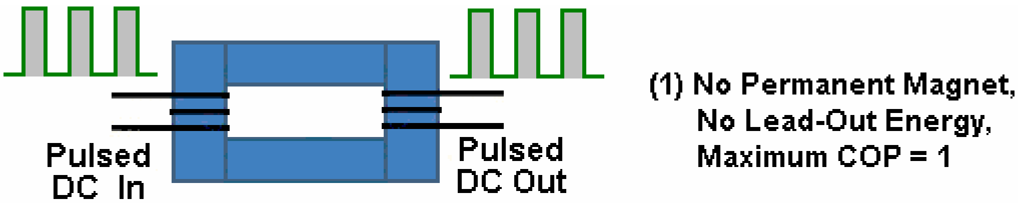


You will also notice that direction of the stepping is reversed on every second rotor disc in order for the magnets to match each other in position as they rotate in opposite directions. The relevant patent on this is FR 2,826,800 of January 2003. Hatem has an interesting video at:
https://www.youtube.com/watch?v=3UJZ9hDQnyA&ebc=ANyPxKp3VkSBvwv2Iy9UZEWfogEY_TYOSbbmUFDqYa5zZ88hiyiitlyUlniyVjlUzu6hUluHgoT2 .

Lawrence Tseung's Magnetic Frame.

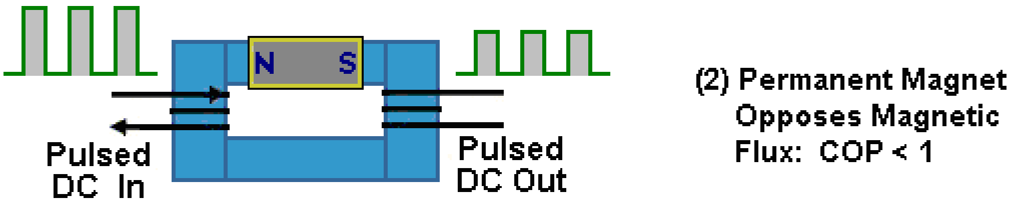
Lawrence Tseung has recently produced a subtle design using a motionless iron or ferrite frame with a permanent magnet embedded in it. He inserts a permanent magnet in one of the arms of the frame. He then applies sharp DC pulses to a coil wound on one side of the frame and draws off energy from a coil wound on the other side of the frame.

He shows three separate operating modes for the devices as follows:

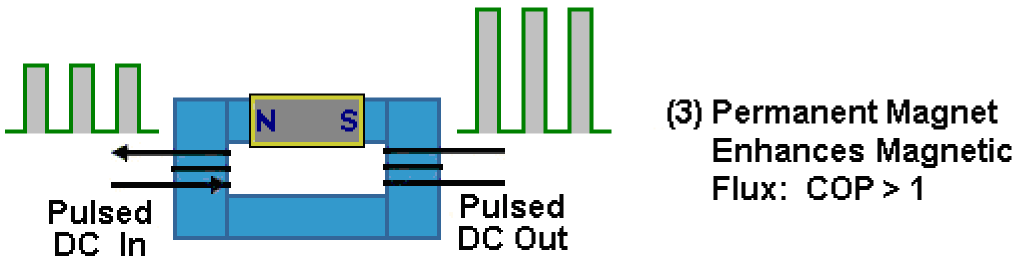


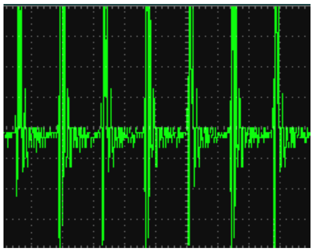
Lawrence comments on three possible arrangements. The first on shown above is the standard commercial transformer arrangement where there is a frame made from insulated iron shims in order to cut down the "eddy" currents which otherwise would circulate around inside the frame at right angles to the useful magnetic pulsing which links the two coils on the opposite sides of the frame. As is very widely known, this type of arrangement never has an output power greater than the input power.

However, that arrangement can be varied in several different ways. Lawrence has chosen to remove a section of the frame and replace it with a permanent magnet as shown in the diagram below. This alters the situation very considerably as the permanent magnet causes a continuous circulation of magnetic flux around the frame before any alternating voltage is applied to the input coil. If the pulsing input power is applied in the wrong direction as shown here, where the input pulses generate magnetic flux which opposes the magnetic flux already flowing in the frame from the permanent magnet, then the output is actually **lower** than it would have been without the permanent magnet.



However, if the input coil is pulsed so that the current flowing in the coil produces a magnetic field which reinforces the magnetic field of the permanent magnet then it is possible for the output power to exceed the input power. The "Coefficient of Performance" or "COP" of the device is the amount of output power divided by the amount of input power which the user has to put in to make the device operate. In this instance the COP value can be greater than one:





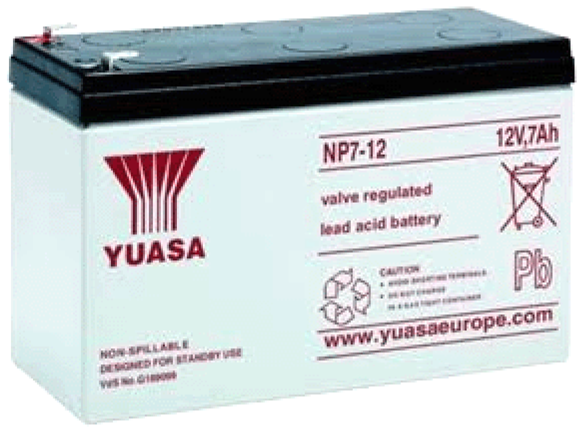
As it upsets some purists, perhaps it should be mentioned that while a square wave input signal is applied to the input of each of the above illustrations, the output will not be a square wave although it is shown that way for clarity. Instead, the input and output coils convert the square wave to a low-quality sine wave which only becomes a pure sine wave when the pulse frequency exactly matches the resonant frequency of the output winding. The oscilloscope display shown here is a typical output power waveform which has nearly 390,000 of these pulses per second.

There is a limit to this as the amount of magnetic flux which any particular frame can carry is determined by the material from which it is made. Iron is the most common material for frames of this type and it has a very definite saturation point. If the permanent magnet is so strong that it causes saturation of the frame material before the input pulsing is applied, then there can't be any effect at all from positive DC pulsing as shown. This is just common sense but it makes it clear that the magnet chosen must not be too strong for the size of the frame, and why that should be.

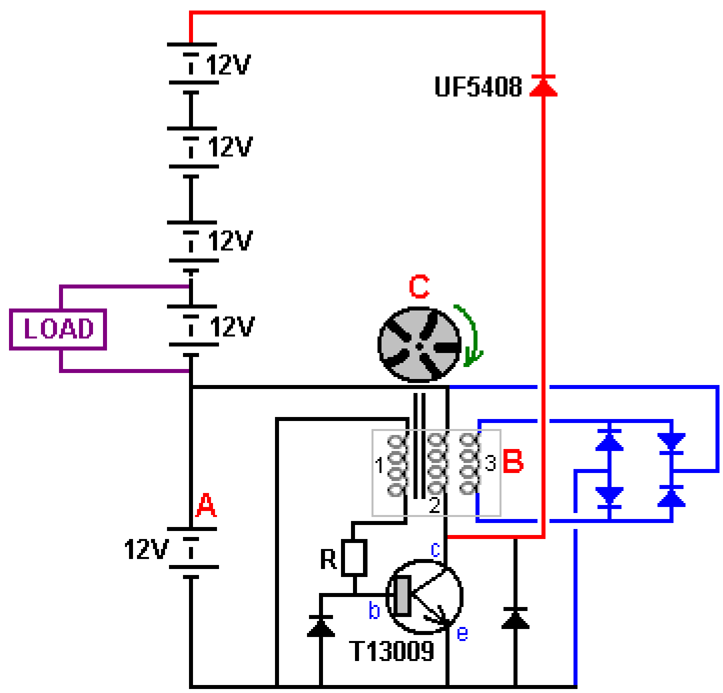
As an example of this, one of the people replicating Lawrence's design found that he did not get any power gain at all and so he asked Lawrence for advice. Lawrence advised him to omit the magnet and see what happened. He did this and immediately got the standard output, showing that both his input arrangement and his output measuring system both worked perfectly well. It then dawned on him that the stack of three magnets which he was using in the frame were just too strong, so he reduced the stack to just two magnets and immediately got a performance of COP = 1.5 (that is, 50% more output power than the input power).

Continuous Power

A free-energy developer working in South Africa where it is difficult to find electronic components, has very kindly shared the details of his compact self-powered generator so that you can build one if you choose to do so. Using a small inverter, the output of the prototype is 40 watts at mains voltage and frequency and the generator is a small table-top unit which is not difficult to build. The generator uses five small 12-volt 7 Amp-Hour lead-acid batteries like this:



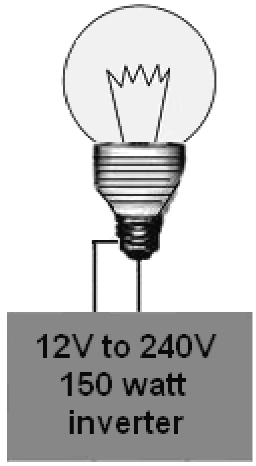
While this sounds like a lot of batteries, bear in mind that this is a generator which has a continuous electrical output, day and night and the batteries never have to be charged – a bit like a solar panel which works at night as well as during the day. Even if you are not familiar with electronics circuit diagrams (chapter 12 can fix that for you if you want), please try to follow along as we run through the circuit diagram and explain how the generator works. This is the circuit diagram:



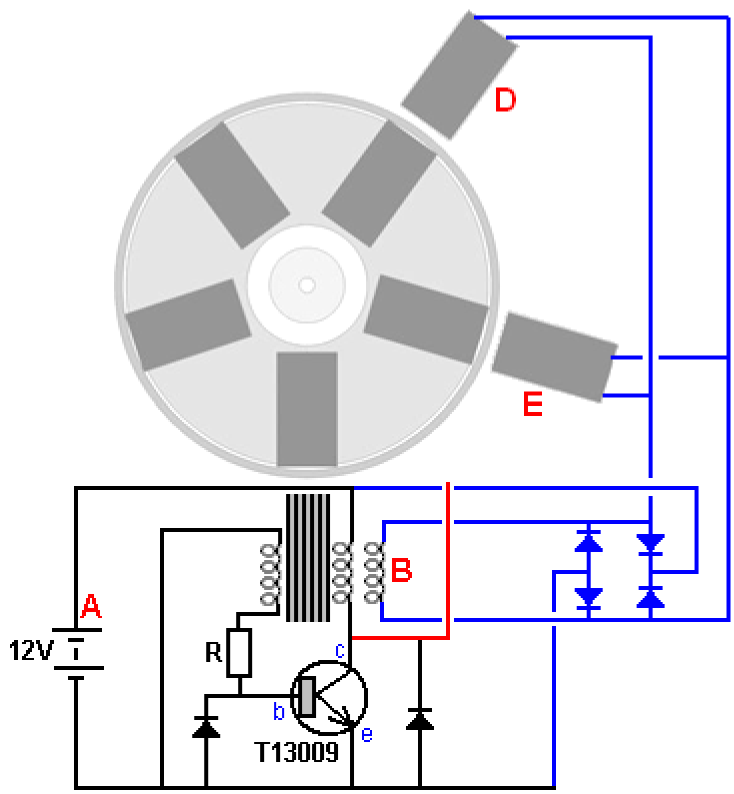
The battery marked "A" powers the circuit. A rotor "C", containing five magnets is moved so that one of the magnets passes near the coils. The coils set "B" has three specially-wound coils and the magnet moving past those three coils generates a small current in coil number "1" which then flows through the resistor "R" and into the base of the transistor, causing it to switch on. The power flowing through the transistor coil "2" causes it to become a magnet and that pushes the rotor disc "C" on its way, keeping the rotor spinning. It also induces a current in the winding "3" and that current is rectified by the blue diodes and passed back to charge battery "A", replacing the current drawn from that battery.

When the magnet in rotor "C" passes away from the coils, the transistor switches off, moving its collector voltage very quickly up to the +12 Volt line, starving coil "2" of current. Because of the way that coils are, the coil drags the collector voltage on up and it would reach 200 volts or more if it were not connected through the red diode to all five batteries which are connected in one long chain. The batteries will have a combined voltage of just over 60 volts (which is why a powerful, fast-switching, high-voltage T13009 transistor is being used. As the collector voltage passes the voltage of the battery chain the red diode starts conducting, passing the available energy in the coil into the battery chain. That current pulse passes through all five batteries, charging all of them. The higher voltage caused by so many batteries means that higher power is fed into all the batteries from coil “2”. Loosely speaking, that is the generator design.

In the prototype, the load for long-term testing was a twelve volt 150-watt inverter powering a 40-watt mains light bulb:

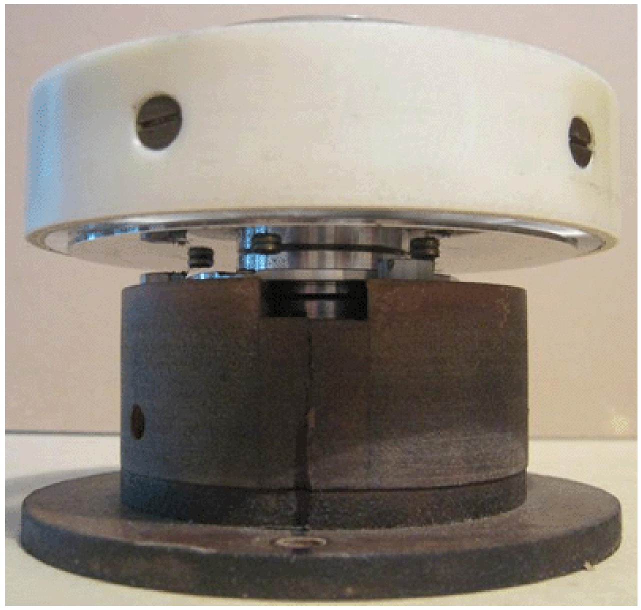


The basic design shown above was then modified by the addition of two additional pick-up coils:



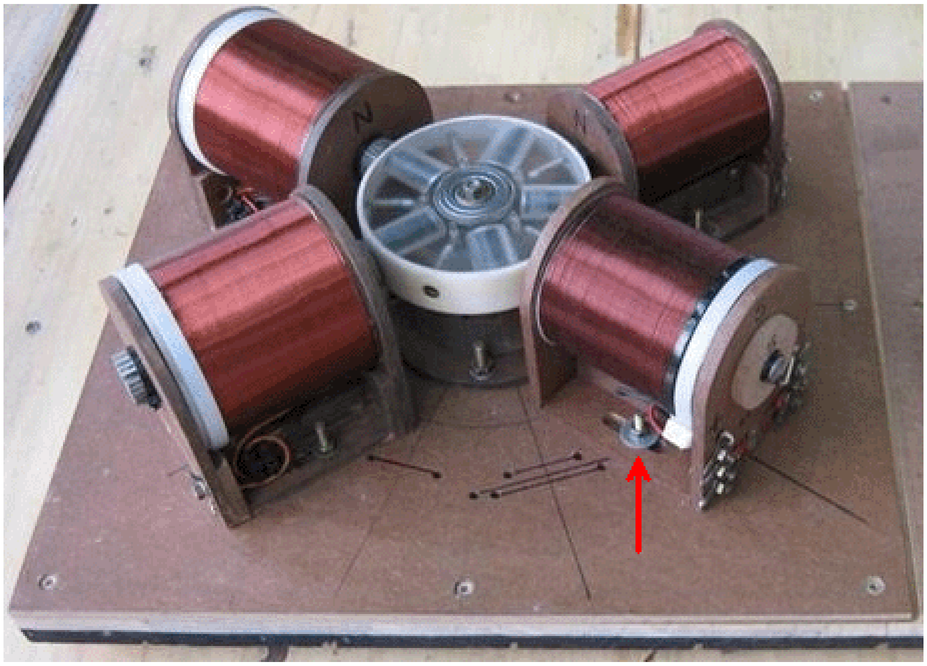
Coils “B”, “D” and “E” are all triggered at the same time by three different magnets. The electrical energy produced in all three coils is passed to the four blue diodes to produce a DC power supply which is used to charge battery “A” which powers the circuit. That additional input to the drive battery and the addition of two more drive coils to the stator, makes the system operate securely as self-powered, maintaining the voltage of battery “A” indefinitely.

The only moving part of this system is the rotor which is 110 mm in diameter and is a 25 mm thick acrylic disc mounted on a bearing taken from an old computer hard disc drive. The arrangement looks like this:



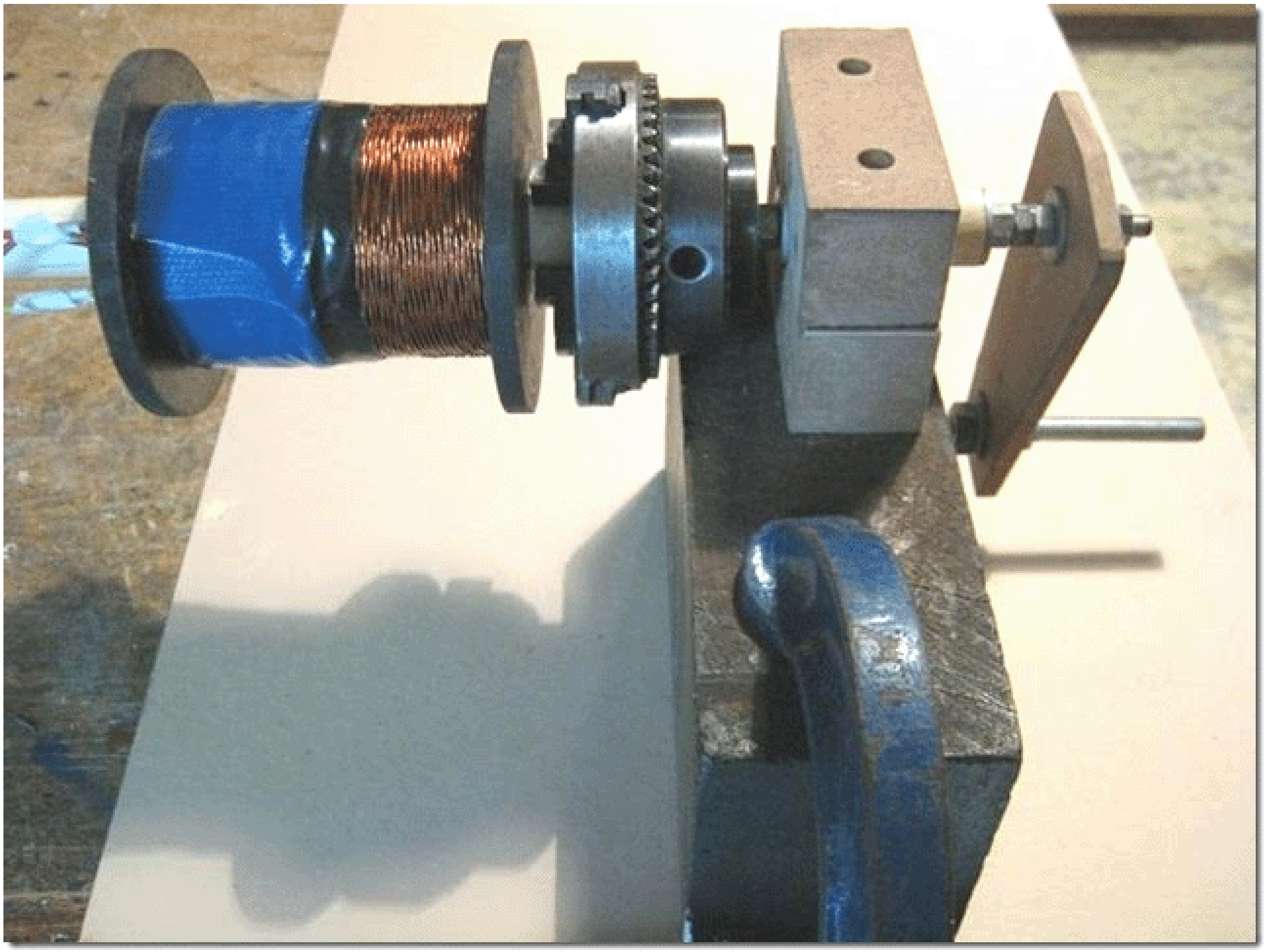
In the pictures, the disc looks to be hollow but in actual fact it is solid, very clear plastic. The disc has been drilled at five evenly spaced points around the circumference, that is, at 72 degree intervals. The five main holes drilled in the disc are to take the magnets which are sets of nine circular ferrite magnets, each 20 mm in diameter and 3 mm thick, making each stack of magnets 27 mm long and 20 mm in diameter. The magnet stacks are positioned so that their North poles face outwards. When the magnets have been installed, the rotor is placed inside a strip of plastic pipe which prevents the magnets escaping when the disc is spun rapidly. The plastic pipe is secured to the rotor using five bolts with countersunk heads.

The gap between the rotor and the coils can be set as anything from 1 mm to 10 mm as the coils have slotted mounts as can be seen from this picture of an earlier version of the generator:



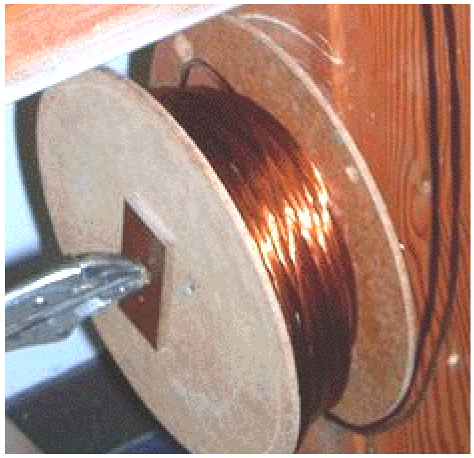
Notice the way that the coil mounts allow the distance between the coils and the rotor to be changed. The working gap between the rotor and the coils can be adjusted so that the performance can be maximised by finding the most effective gap.

The spools of the coils are 80 mm long and the ends are 72 mm in diameter. The centre shaft of each coil is made of a length of plastic pipe with a 20 mm outer diameter and an inner diameter of 16 mm. giving a wall thickness of 2 mm. After being wound, that inner diameter is filled with a series of welding rods with their welding coating removed, and which are then encased in polyester resin although a solid bar of soft iron is a good alternative:



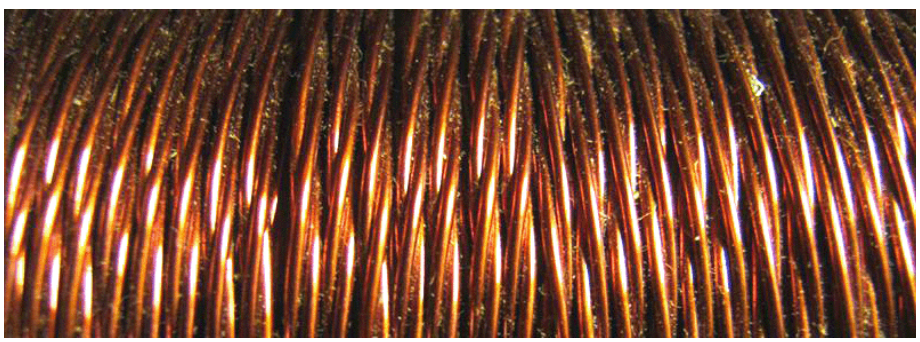
The three strands of wire which form coils “1”, “2” and “3” are 0.7 mm diameter wire and they are twisted together to become a “Litz” wire before being wound into the coil “B”. This produces a much thicker composite wire strand which is easy to wind accurately on to the spool. The winder shown above uses a chuck to grip the coil core for winding, but any simple winder will work well.

The developer does the Litzing by stretching out three strands of wire, each coming from a separate 500 gram reel of wire. The three strands are clamped at each end with the wires touching each other at each end and with three metres between the clamps. Then, the wires are clamped in the middle and 80 turns applied to the middle. That gives 80 turns for each of the two 1.5 metre lengths held between the clamps. The twisted wire is wound on to a makeshift reel to keep it tidy as this twisting has to be repeated 46 more times as the entire contents of the reels of wire will be needed for this one composite coil:



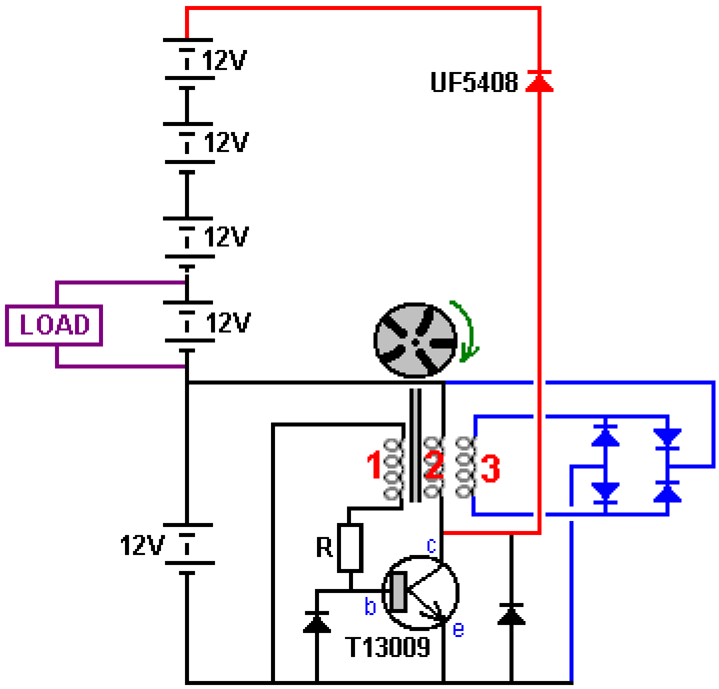
The next 3 metres of the three wires is now clamped and 80 turns applied to the central point, but this time the turns are applied in the opposite direction. Still the same 80 turns, but if the last length was 'clockwise' then this stretch of wire will be turned 'counter-clockwise'. This alternation of direction gives a finished set of twisted wires where the direction of twist reverses every 1.5 metres along the length. That is the way that commercially produced Litz wire is made, but I seriously doubt that the resulting performance is any better than if the direction of wind was never changed and the twisted wire had the same direction of twist along its whole length.

This very nice twisted group of wires is now used to wind the coil. A hole is drilled in one spool flange, right beside the central tube and core, and the start of the wire fed through it. The wire is then bent sharply at 90 degrees and fed around the shaft of the spool to start the winding of the coil. The wire bundle is wound carefully side by side along the length of the spool shaft and there will be 51 turns in each layer and the next layer is wound directly on top of the first layer, moving back towards the start. Make sure that the turns of this second layer sit exactly on top of the turns beneath them. This is easy to do as the wire bundle is thick enough to make positioning very easy. If you prefer, a single thickness of white paper can be placed around the first layer, to make it easier to see the second layer as it is wound. There will be 18 of these layers to complete the coil, which will then weigh 1.5 kilograms and in 2016 prices in the UK, the wire in this coil will cost £45 and the winding looks like this:

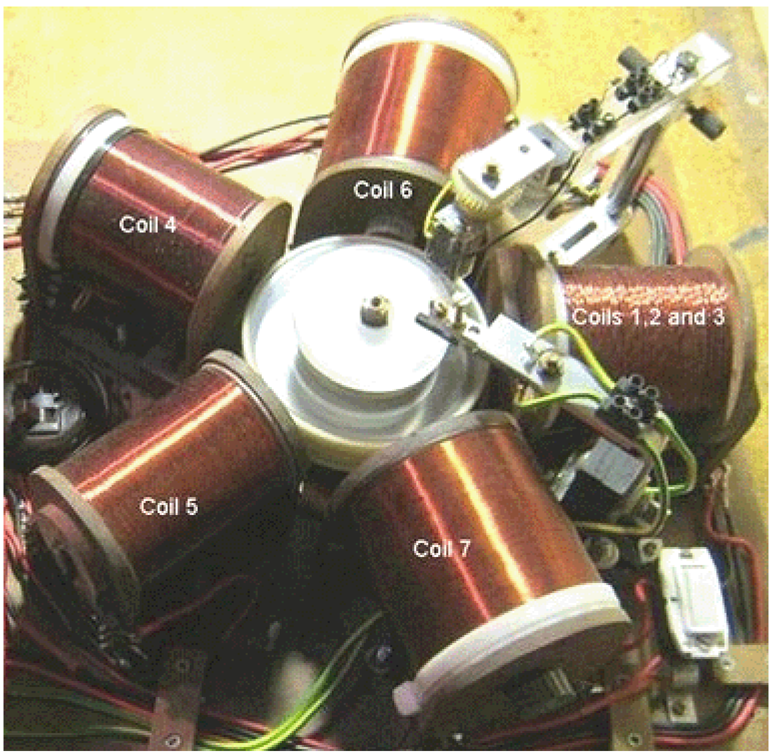


This completed coil now contains three separate coils in very close proximity to each other and that arrangement is excellent when one coil is powered up, for inducing energy in the other two coils. This winding now contains coils 1,2 and 3 of the circuit diagram. There is no need to concern yourself with marking the ends of each strand of wire as a simple ohmmeter will tell you which two ends have a winding between them.

Coil 1 is used as the trigger coil which switches the transistor on at the right instant. Coil 2 is the drive coil which is powered by the transistor, and Coil 3 is the first of the output coils:



Because of the coils which were already to hand during the development of this highly successful system, coils 4 and 5 are simple helical-wound coils which are wired in parallel with drive coil 2. They boost the drive and they are necessary. Coil 4 has a DC resistance of 19 ohms and coil 5 a resistance of 13 ohms. However, investigation is underway at present to determine the best coil combination for this generator and it is probable that the additional coils will be the same as the first coil, coil "B" and that all three coils are connected in the same way and the driving winding in each coil driven by the one powerful, fast transistor. The present arrangement looks like this:

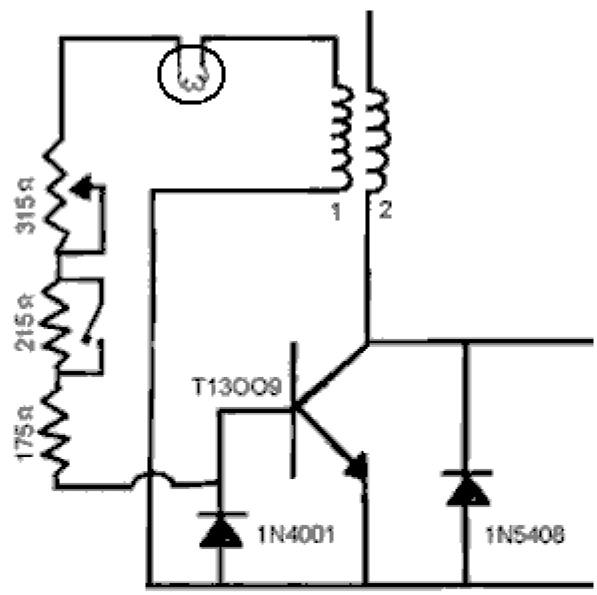


The two gantries can be ignored as they were only for investigating alternative ways of triggering the transistor and they are no longer used.

At this time, coils 6 and 7 (22 ohms each) are extra output coils connected in parallel with output coil 3 which is 3 strands each with 4.2 ohm resistance. They can be air-core or have a solid iron core. Testing indicates that the air-core version works slightly better than having an iron core. These two coils are wound on 22 mm diameter spools and each has 4000 turns of 0.7 mm (AWG # 21 or swg 22) enamel or shellac insulated solid copper wire. All of the coils are wound with this size of wire.

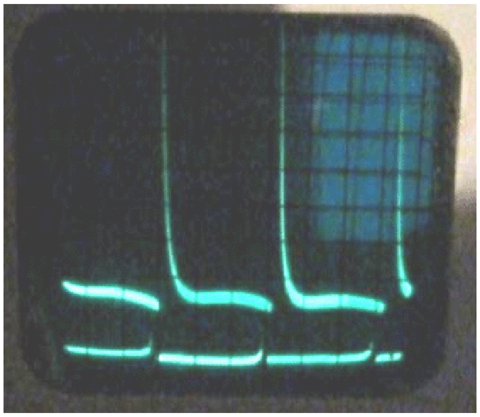
With this coil arrangement, the prototype has run continuously for three weeks, maintaining the drive battery at 12.7 volts all the time. At the end of the three weeks, the system was stopped so that it could be altered and tested with a new configuration. In the configuration shown above, the current flowing from the driving battery into the circuit is 70 milliamps, which at 12.7 volts is an input power of 0.89 watts. The output power is either 40 watts or close to it, which is a COP of 45, not counting the fact that three additional 12V batteries are being charged at the same time. That is very impressive performance for the circuit. However, those three additional batteries could probably sustain identical loads, raising the output to 160 watts or COP=180 without any changes at all, but at this time, that has not been tested and the circuit is undergoing other tests and modifications. Even using a 24V inverter across two of the four batteries should give an enhanced output with 80 watts of usable power.

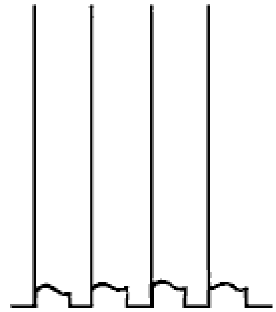
The drive method has been used so often by John Bedini, that the developer decided to try out John's method of tuning for maximum performance. For that, the transistor's base resistor shown as "R" in the circuit diagrams was altered to this:



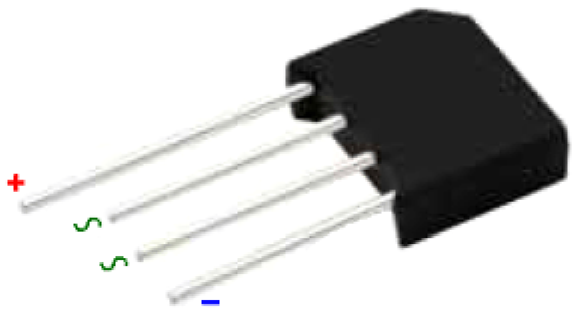
This arrangement allows the value of the base resistor to be adjusted over a wide range, and car's rear light bulb gives a visual indication of the current flow into the transistor. This is an important adjustment and the current flowing into the base of the transistor can be very high. For that reason, the resistors shown need to be heavy duty wire wound types and they get very hot until the optimum adjustment is found. At that "sweet spot" as it is known, the current flowing into the base of the transistor reaches its minimum value and the magnetic drive in the coil group reaches its maximum value, and at that most efficient adjustment, the resistors and transistor become cool and stay that way continuously afterwards.

For people already familiar with electronic circuits, the waveform produced by the magnets spinning round in the rotor is the classical battery-charging pulse waveform which looks like this:

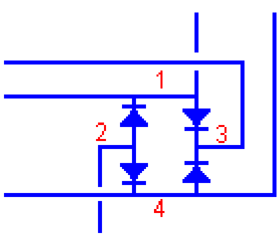


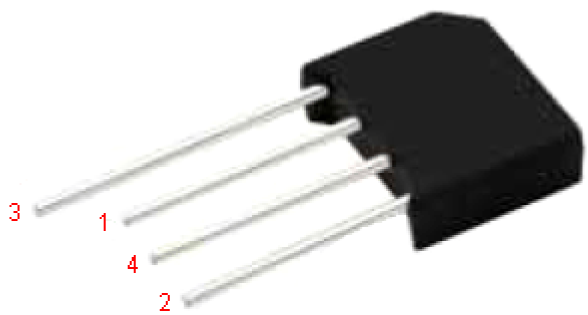


The four blue diodes shown in the circuit diagram are contained in a single plastic package as just one component called a “diode bridge”. This particular one has the reference number RS405L which can handle voltages up to 600 volts and a constant current of 4 amps. It can also handle short current surges up to 200 amps which might be significant in this circuit with its very sharp charging voltage pulses. The component looks like this:



It is connected into the circuit like this:



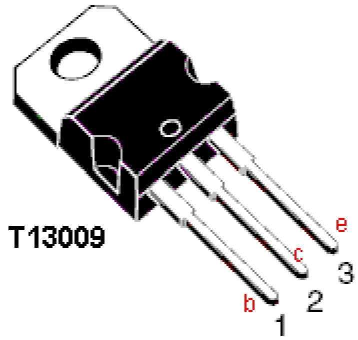


The other major component in the circuit is the transistor which has the reference number T13009. It looks like this:

This is a fast switching transistor able to handle 400 volts and 12 amps of continuous current or 24 amps in brief pulses. The base current can be up to a massive 6 amps, power dissipation 100 watts and a current gain probably between 20 and 40 in this circuit.

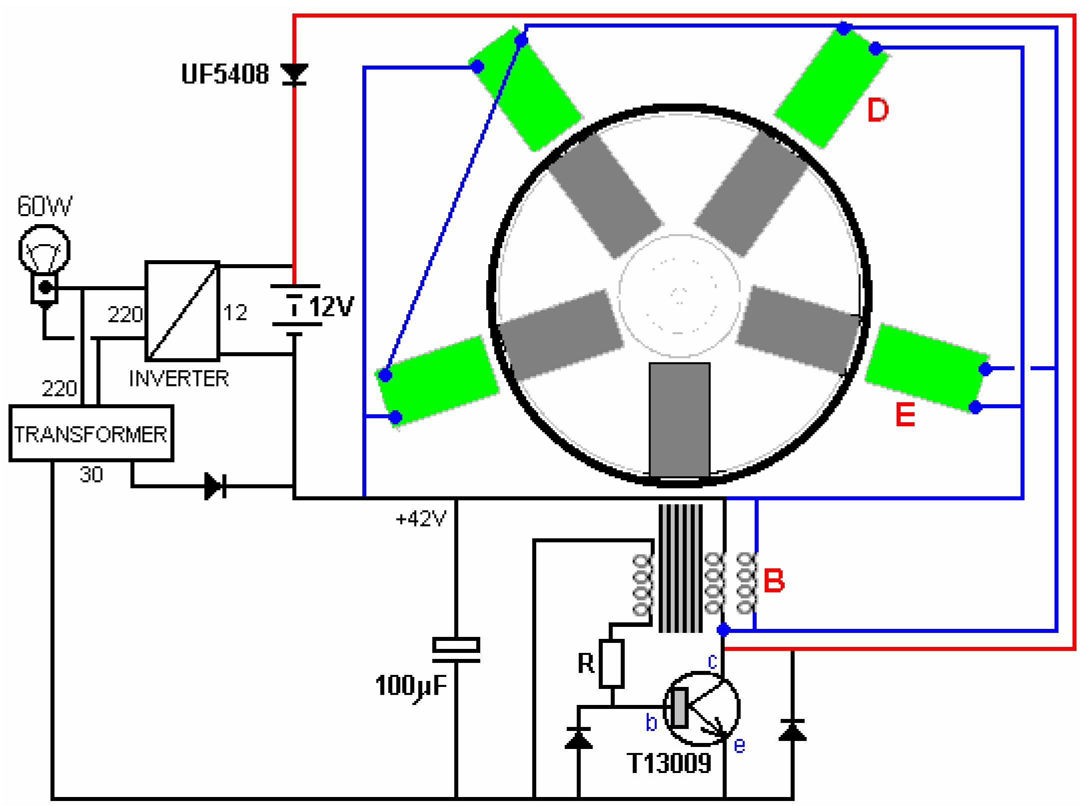
Let me stress that the unit described above is self-powered, drawing its energy from the surrounding environment and as shown it outputs 40 watts of power continuously day and night, day after day. To confirm this, the prototype was run continuously for three weeks. In common with almost all inventors or developers, there is a major inclination to experiment further, and so that three weeks shows remarkable restraint on the part of the developer. If you want to build a replication and don't have any friends who know electronics and so could help, then a tutorial on the details of how to build these things is in the Appendix.

The description of this self-powered generator is now complete and built as described, it is a genuine self-powered device which you can replicate and use.



The T13009 transistor is not readily available in some parts of the world. If you have to use a substitute, then its switching speed, voltage rating and current rating rare probably the most important factors to match. The switching speed is difficult to assess but after a 2.5 microsecond delay, the switch off time is 110 nanoseconds. The voltage rating is 400V (although that is probably not used in this application with its 60V load, and the current rating is 12 amps continuous and 24 amps for pulses, it has a 100 watt dissipation rating. Other manufacturers use different designations and it is likely that your local supplier may call this transistor the MJE13009.

Again, our thanks go to the developer for freely sharing this most important circuit which he developed and for his future modifications, the first of which is shown here:



In this arrangement, coil “B” is also pulsed by the transistor and the output from the coils around the rotor is now directed to the output inverter. The drive battery has been eliminated and a low-power 30V transformer and diode run from the inverter output as suggested by Jonathan Foucher replaces it. Spinning the rotor generates sufficient charge on the capacitor to get the system running without a battery. The output power has now risen to 60 watts which is a 50% improvement. The three 12-volt batteries have also been eliminated, and the circuit can run with just one battery. Continuous power output from a single battery which never needs to be recharged is a very satisfactory situation.

Chapter 5 - Inertia

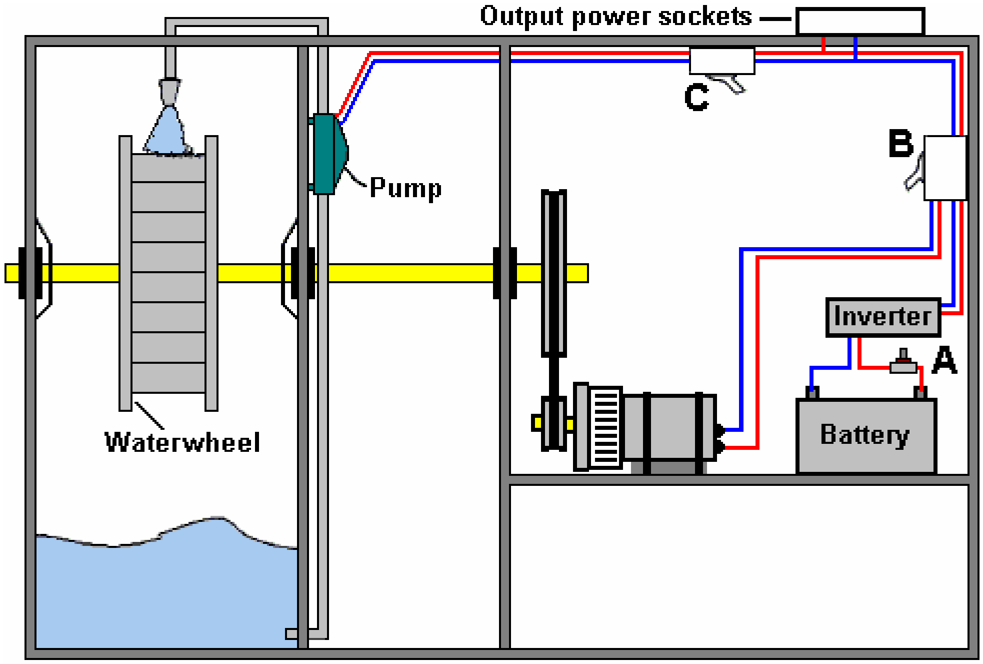
James Hardy's Self-Powered Water-Pump Generator.
There is a video on Google which shows an interesting self-powered water-pump driven, electrical generator at: http://www.youtube.com/watch?v=IGpXA6qhH_Q

This is a very simple device where the jet of water from the pump is directed at a simple water-wheel which in turn, spins an electrical alternator, powering both the pump and an electric light bulb, demonstrating free-energy.

Initially, the generator is got up to speed, driven by the mains electrical supply. Then, when it is running normally, the mains connection is removed and the motor/generator sustains itself and is also able to power at least one light bulb. The generator output is normal mains current from a standard off-the-shelf alternator.

James has Patent Application US 2007/0018461 A1 published in 2007 on his design. In that application he points out that a major advantage of his design is the low noise level produced when the generator is running. In the video and the pictures above, the demonstration has the housing opened up in order to show how the generator system works, but during normal use, the compartments are completely sealed.

In his document, James shows the overall system like this:



The housing is divided into three separate compartments. The first compartment has a strong axle shaft running through it, supported on ball or roller bearings – possibly ceramic for this environment. The bearings are protected by being covered by splash guards which keep the water (or other liquid) off them. A waterwheel of almost any type is mounted on the shaft and a high-capacity water pump directs a stream of liquid on to the waterwheel, striking the paddles at right angles in order to provide the maximum impact.

This first compartment is sealed in order to contain all of the liquid inside it and the bottom is effectively a sump for the liquid. A pipe located near the bottom of the compartment feeds the liquid to the pump which is located in the second compartment. The pump boosts the liquid through a nozzle, directing it at the waterwheel. While almost any nozzle will work, it is usual to choose one which produces a concentrated jet of liquid in order to generate the largest possible impact. One would expect that the larger the diameter of the waterwheel, the more powerful the system would be. However, that is not necessarily the case as other factors such as the overall weight of the rotating members might affect the performance. Experimentation should show the most effective combination for any given pump.

The rotating shaft is given a third bearing supported by the side of the final compartment. The shaft then has a large diameter belt pulley mounted on it, the belt driving a much smaller pulley mounted on the shaft of the generator. This raises the rate at which the generator shaft is rotated. If the pump operates on AC mains voltage, then the generator will be one which generates mains voltage AC. If the pump operates on, say, 12 volts, then the generator will be one which generates 12 volts DC. The diagram above, shows the arrangement for a mains voltage system as that is probably the most convenient. If a 12-volt system is chosen, then the inverter can be omitted.

The generator is started by pressing the 'normally open' press-button switch marked "**A**" in the diagram. This passes the battery power through to the 1-kilowatt inverter which then generates AC mains voltage. The switch marked "**B**" is a "changeover" switch, and for starting, it is set so that it passes the AC power through switch "**A**" to the pump. This causes the pump to turn on and direct a powerful jet of liquid at the waterwheel, forcing it around and so powering the generator. When the generator gets up to full speed, switch "**B**" is flipped over, disconnecting the inverter and feeding the generator power through to the pump, keeping it running and supplying additional power to the output power sockets mounted on top of the housing. The press-button switch is released, disconnecting the battery which is no longer needed. Switch "**C**" is an ordinary On/Off mains switch which is needed if you want to turn the generator off.

A major advantage of this generator system is that the main components can be bought ready-made and so only very simple constructional skills and readily available materials are needed. Another advantage is that what is happening can be seen. If the pump is not working, then it is a simple task to discover why. If the generator is not spinning, then you can see that and sort the problem. Every component is simple and straightforward.

James suggests that a suitable pump is the 10,000 gallons per hour "Torpedo Pump" from Cal Pump, web site: http://www.calpumpstore.com/products/productdetail/part_number=T10000/416.0.1.1:



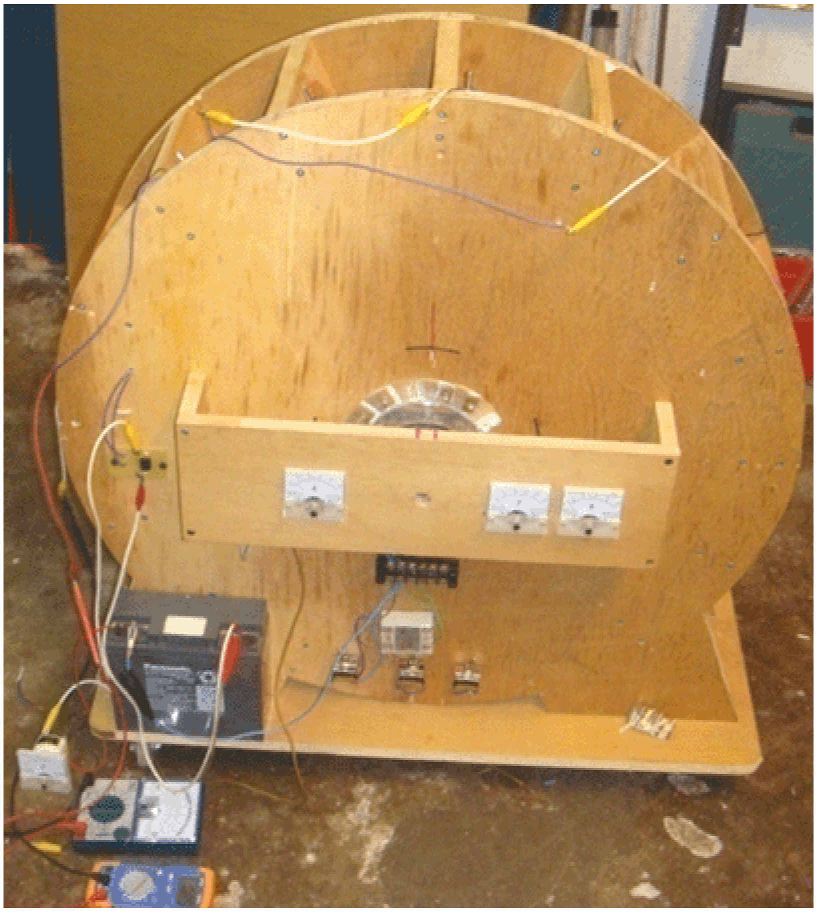
An Easy-Build Generator.

Many people want a simple project which they can build and which demonstrates free-energy. Let's see if this need can be met. You must understand that most generators, whether free-energy or conventional energy, are not particularly low-cost to make. For example, if you wanted a device which showed that burning a fuel could propel a vehicle, then building a car could do that, but making a car is not necessarily cheap. However, let's see what we can manage here.

However, please understand that you, and you alone, are responsible for whatever you do. This presentation is NOT an encouragement for you to make or build anything. It is merely some suggestions which you might find helpful if you have already decided to build something. This means that if you injure yourself, neither I nor anyone else is liable in any way. For example, if you are cutting a piece of wood with a saw and are very careless and cut yourself, then you, and only you are responsible for that – you should learn to be more careful. If you drop something heavy on your toe, then you, and only you, are responsible for that. Normally, constructions of this type do not result in any kind of injury, but please be careful if you decide to build.

There is a rotary generator design by Lawrence Tseung which was built by Mr Tong Po Chi and his colleagues. Being an open and straightforward construction, it has been demonstrate publicly, on many occasions as having 330% efficiency, that is, the output power is 3.3 times greater than the input power. Another way of saying this is to say that it's Coefficient of Performance is 3.3 (or COP=3.3). Hopefully, we will achieve much better performance than that in this construction. No drawings in this document are to scale.

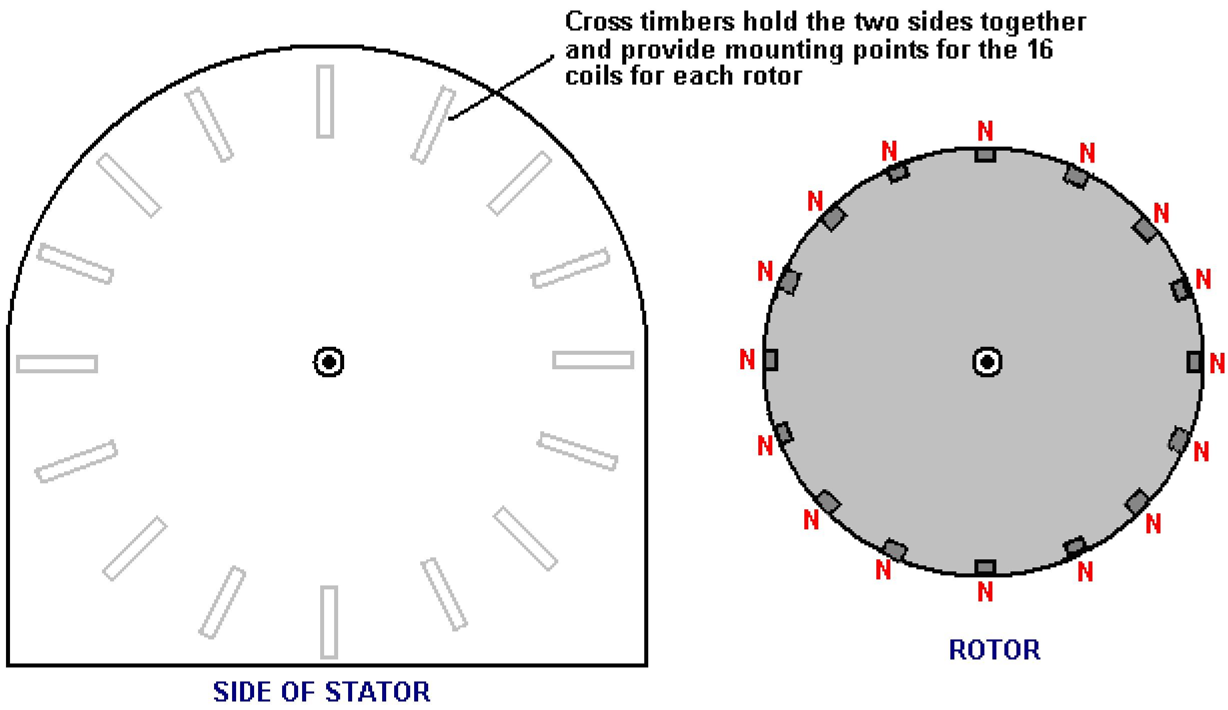
I suggest that we start by replicating the original design, and then apply some modifications step by step in order to raise the output power. The original construction looks like this:

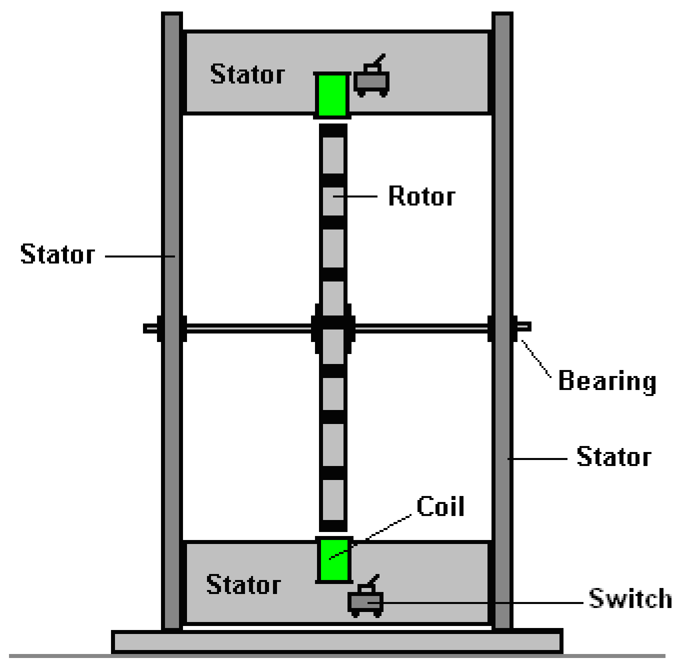


In the version shown above, there are six electrical meters, but those are not necessary and they were included to help when demonstrating the device to members of the public. Built in October 2009, the unit shown has a 600 mm diameter rotor (which is not visible in the photograph). It has 16 permanent magnets mounted on the rotor rim and 16 air-core coils mounted on the stator, one of which is used as a timing sensor. The coils can be switched to act as either rotor powering coils or as power collecting coils.

Initially, power is provided by a small lead-acid battery. The power is applied through the very simple switching style shown in the 1974 patent of Roger Andrews US 3,783,550 where a passing magnet activates the circuit which powers the system. The rotor magnets trigger the operation and the fifteen main coils mounted on the stator can be switched to be either electromagnets pushing the rotor on it's way, or as energy-gathering coils producing a power output.

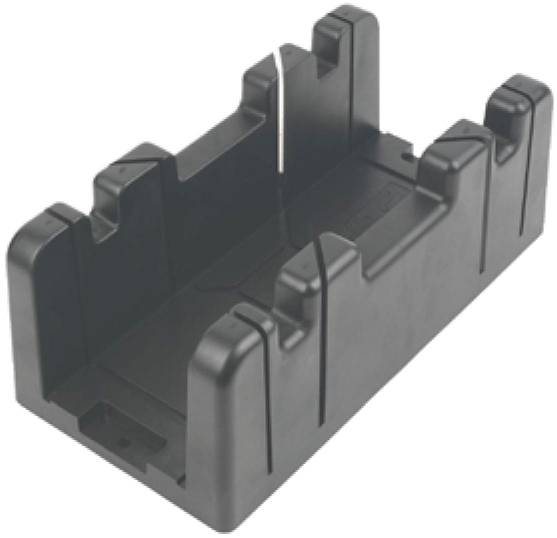
If you are a skilled constructor of new devices, then please excuse me for making so many constructional suggestions aimed at first-time constructors. The main generator components are like this:





The wooden planks holding the two sides together, are chosen to be wide enough to give stability, and more importantly, to allow space so that three rotors could be mounted on the axle if using multiple rotors is chosen as one of the various upgrade options. The two stator sides are connected together by sixteen lengths of wooden plank and to a much lesser extent, by the baseboard. The dimensions of all components will be suggested later, but for the time being, let's concentrate on connecting the stator pieces together properly.

Each plank is supplied with a factory cut straight edge top and bottom. The end of the plank supplied has a perfectly square edge, but we have to cut the required length and get a good cut every time. It is easy enough to mark a perfectly square line across the width of the plank, but cutting along that line is not sufficient as the cut needs to be absolutely square as it moves through the thickness of the plank. If the cut isn't properly square, then that face will not form a good fit against the stator piece and the workmanship will be very inferior. For somebody who does not have a cutting table, it is a very good idea to use a mitre box in order to get a good quality cut:



The width of the mitre box limits the width of the plank which can be used and a common size for the mitre box channel is just over 90 mm. Allowing the box to guide the saw blade without forcing it and sawing gently, produces a properly square cut in the two planes needed. Planed Square Edge timber is available with a width of 89 mm and thickness 38 mm, and that should be suitable:

If we choose to use threaded rod for the axle:

then it is available in various lengths, and while it is perfectly possible to cut it to whatever length is chosen, we might as well pick a 500 mm length and save having to cut a longer length to get what we need. I suggest a 10 mm diameter rod and if the overall length is 500 mm, then the gap between the two stator pieces might be 430 mm and the overall length of timber used would then be 16 x 430 = 6880 mm or 22.5 feet. However, as it is most unlikely that any timber supplied would be exactly a multiple of the 430 mm chosen, then a slightly greater length will be needed and there will be offcuts. One big advantage of using a threaded rod as the axle is that nuts and washers can be used to clamp a rotor exactly square to the axle and then lock nuts used to clamp it permanently in place.

The axle needs to be supported in a low-friction bearing and the most readily available type is the sealed ball or roller bearing:

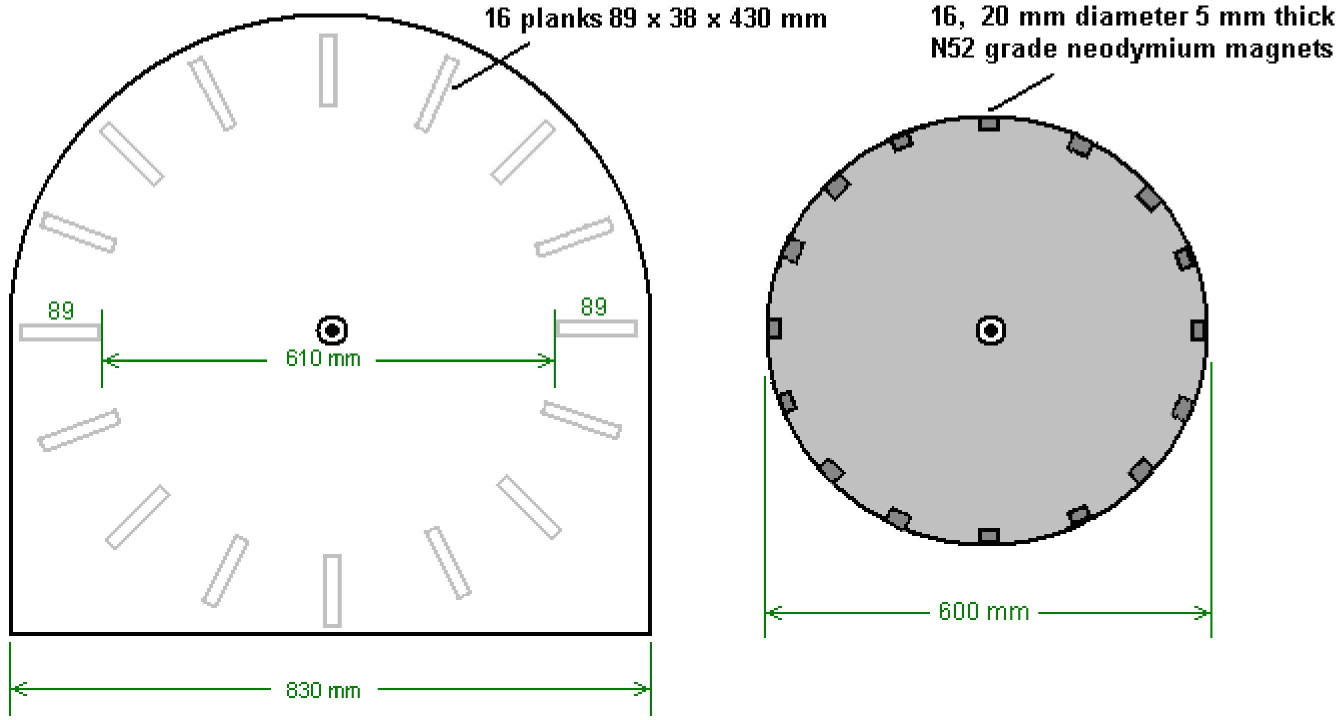
These have a rubber seal to keep dust and dirt out of the grease packed around the ball bearings inside and that spoils the free movement. One way to overcome this has the bearing outer ring clamped stationary and an electric drill used to spin the inner ring until the movement becomes low-friction. A 10 mm inner diameter bearing is often referred to as a type 6200. An alternative method is to remove the rubber seals and remove the grease by immersing the bearing in paraffin (known as 'kerosene' in the American language). Then the ball bearings or rollers inside the bearing are lightly oiled to give a very free-running bearing.

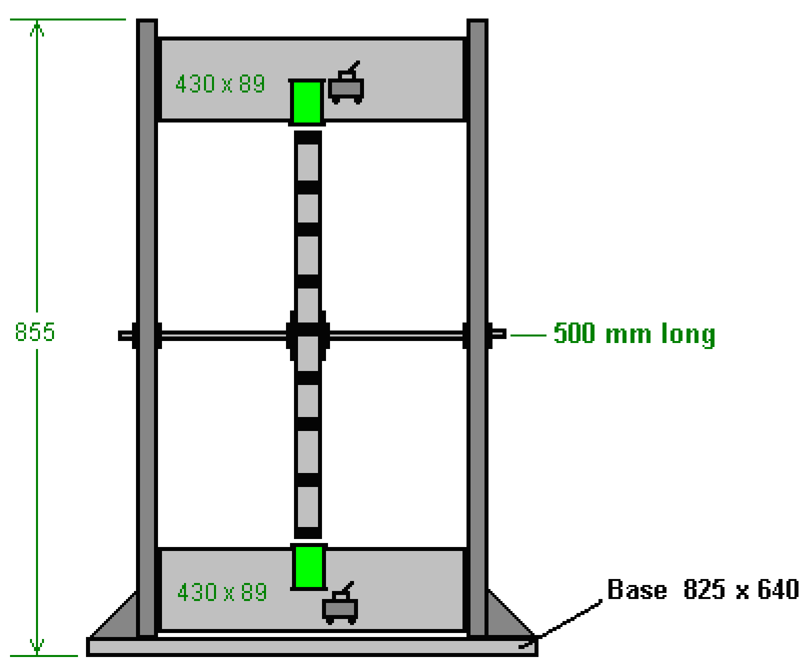
The active part of this design is the magnets attached to the outside of the rotor. We need these magnets to be powerful, and the neodymium types generally available are rated as types N35, N45, N50 and N52 with the type N52 being the most powerful. There is a substantial pulling-power difference between the different grades. I would suggest using 20 mm diameter 5 mm thick, N52 grade magnets:

There is no need for the hole in the magnet, but if there is one, then a steel wood screw can be used to help secure the magnets to the edge of the rotor, in addition to glue. Please be very careful when handling these magnets as N52 is so powerful that they can injure you. If you have one in your hand and move your hand within 150 mm or so of another one lying on a bench, the loose one will jump off the bench and try to attach to the one in your hand. Unfortunately, your hand is in the way and the result is painful. If the flying magnet catches the skin at the edge of your hand or finger, then the grip can be strong enough to cause bleeding.

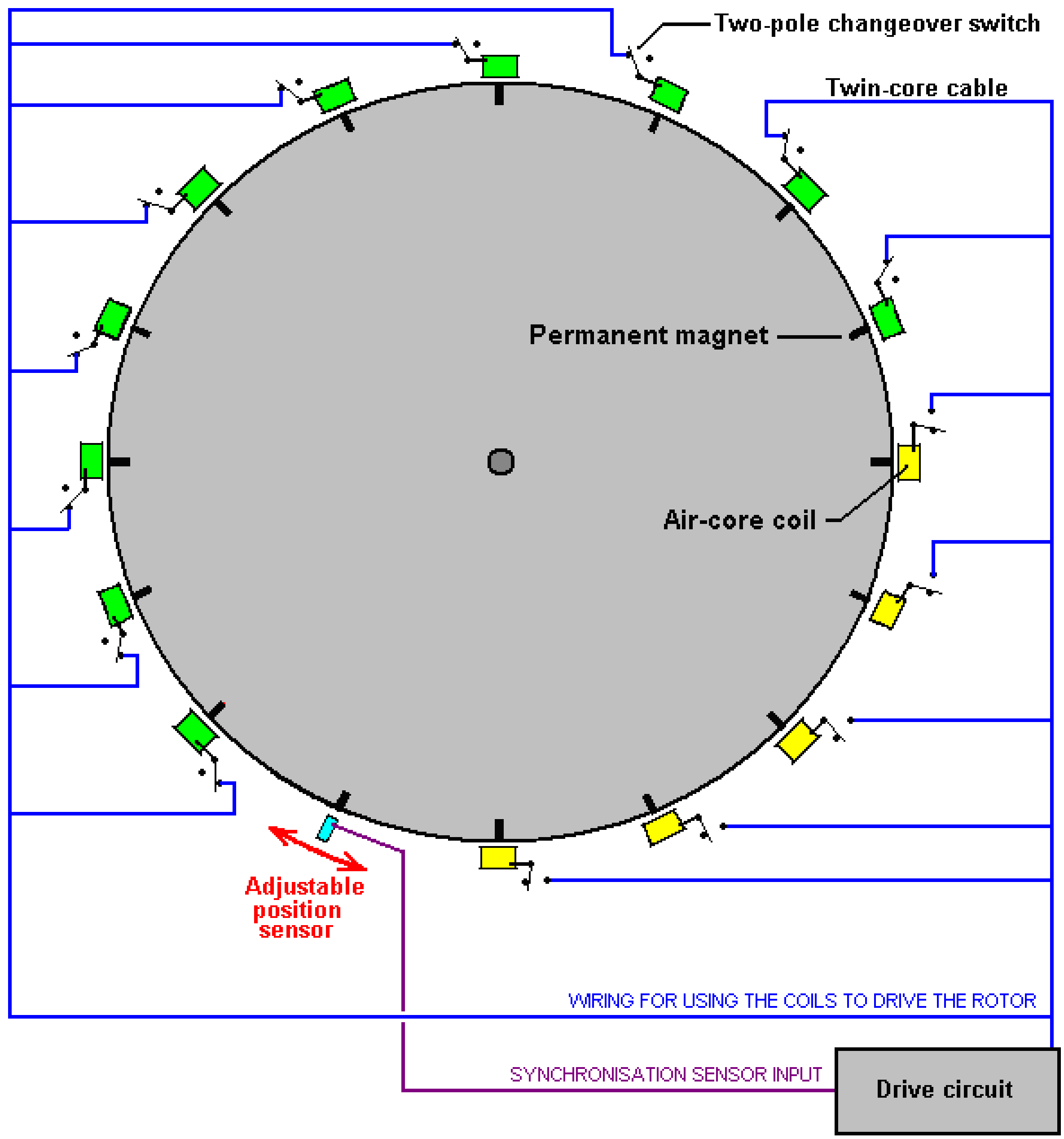
Also, when these magnets attach in a roll as shown in the picture above, it can be very hard to pull them apart. The way to deal with the situation is to slide the end magnet sideways as far as possible and then pull it away diagonally from the roll.

We are now in a position to be a bit more specific about what we want to construct:





It is suggested that the rotor is driven round by pulsing most of the coils and using the remainder of the coils to collect the output power generated by the magnets moving past them. The general arrangement is expected to be like this:

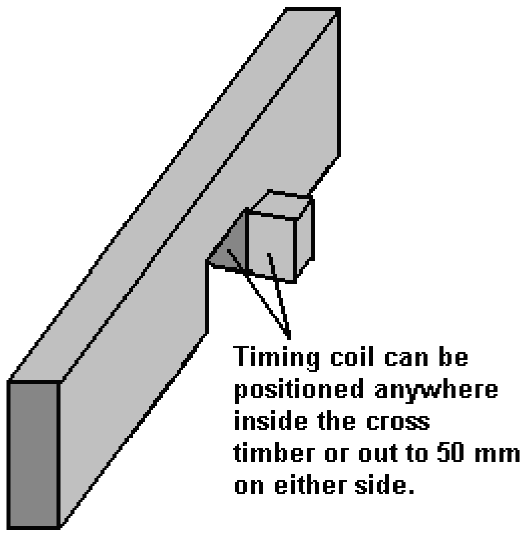


With this arrangement which was intended to be a development and demonstration unit, a single pole two way ("changeover") switch is used with every coil. This allows any coil to be changed from acting as a power collection coil to be a rotor-powering coil by just changing the switch position. If the positions of the switches are as shown in the diagram above, then ten of the fifteen coils act as drive coils and are coloured green in the diagram.   The sensor is adjusted so that the drive circuit delivers a brief energising pulse to those coils just after the magnets have passed their exact alignment position with the coils. This causes them to generate a magnetic field which repels the magnets, pushing the rotor around.

Before going any further, we need to note the fact that in this particular design, the pulse timing is controlled by the physical position of the sixteenth coil. The coil movement has to be in the direction of the rotor movement, whether in the direction of rotation or alternatively directly against the direction of rotation. When setting up the device, the timing coil position (shown in blue) is moved very slowly to find the position which gives the best performance. While the original builders wanted to demonstrate an output power greater than the input power, we would like to achieve a good deal more than that, getting the device to power itself and have a useful power output for other equipment.

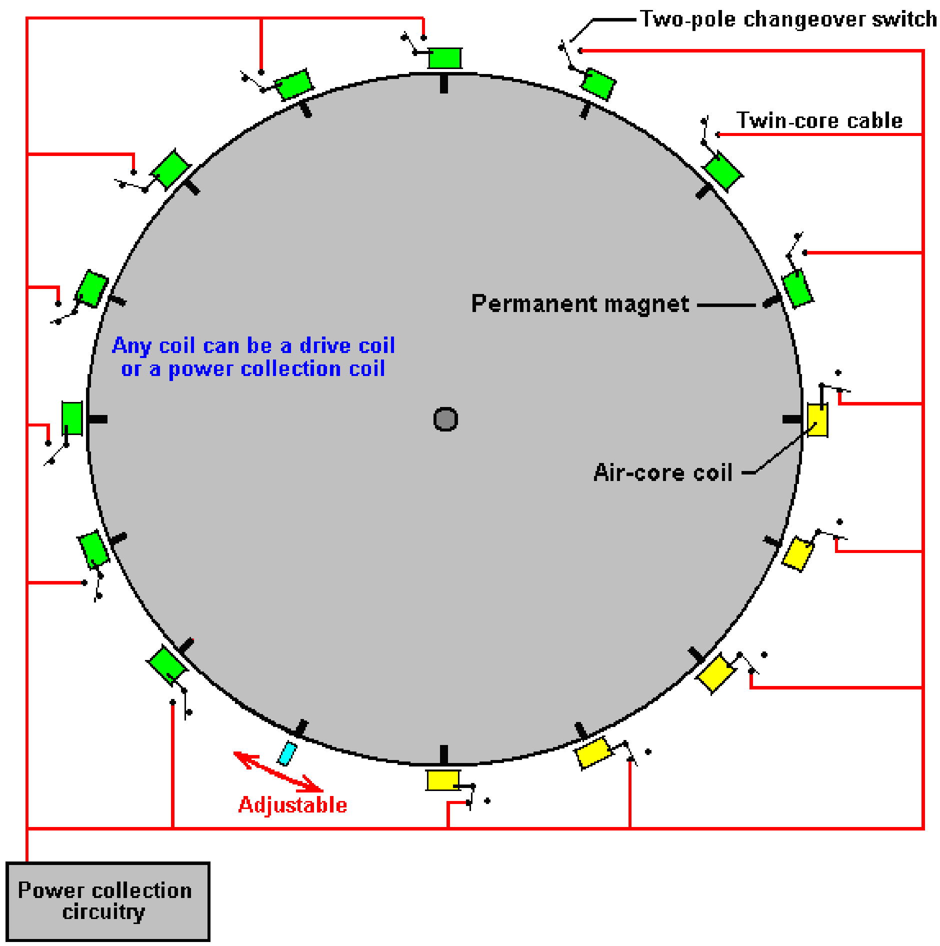
Consequently, having an adjustable timing coil would be a good idea. For that, we can cut a slot in one of the cross timbers of the stator and attach a strip at right angles so that the timing coil can be supported and moved either towards the incoming magnet to get an earlier pulse, or away from the incoming magnet so that the pulse is generated later.

As adjustments will be made to this setting, it is probably easiest if the adapted plank is at the top of the set of sixteen planks, rather than at the bottom as shown in the electrical diagram. The arrangement might be like this one which gives the sensor coil a 138 mm wide mounting area:



A really major advantage of this type of drive using a pulsed coil to push a magnet on its way, is that the working voltage does not have to be maintained at or near any particular design voltage. In the original case, a small lead-acid battery was used to drive the generator. I am not a fan of lead-acid batteries although they have their uses. I dislike them because they are big, heavy, expensive and they waste half of the power which you feed into them. If you feed one amp into a lead acid battery for one hour, you can only draw one amp from that battery for half an hour. That is an efficiency of only 50% and other batteries do better than that. NiMh batteries are 66% efficient, so you could get your 1 amp of current back for 40 minutes. The best of all is a capacitor as it is 100% efficient, but more about that later.

Each pulse powering the rotor is very brief, so very little power is needed to accomplish this pulsing. As mentioned before, any number of coils can be switched to provide this driving force. With the original wheel construction, the best number of drive coils was found to be ten.



With that particular arrangement, five of the coils gather energy while ten provide the drive. For the sake of simplicity, the diagram shows the five collection coils adjacent to each other and while that would work, the wheel is better balanced if the drive coils are evenly spaced out around the rim. For that reason, this switching would actually be selected to give five sets of two drive coils followed by one pick-up coil as that gives a well balanced thrust on the wheel.

However, we may choose a more powerful arrangement. Firstly, the power-gathering air-core coils are wound without any kind of power enhancing core, probably with the notion that there will not be any drag when a magnet passes a coil of that type. That is the case if the coil is unconnected and so is useless. That is not the case if the coil is connected and is contributing output power, because doing that causes a current to flow in the coil, and current flowing in a coil produces a magnetic field and that magnetic field definitely interacts with the passing rotor magnet.

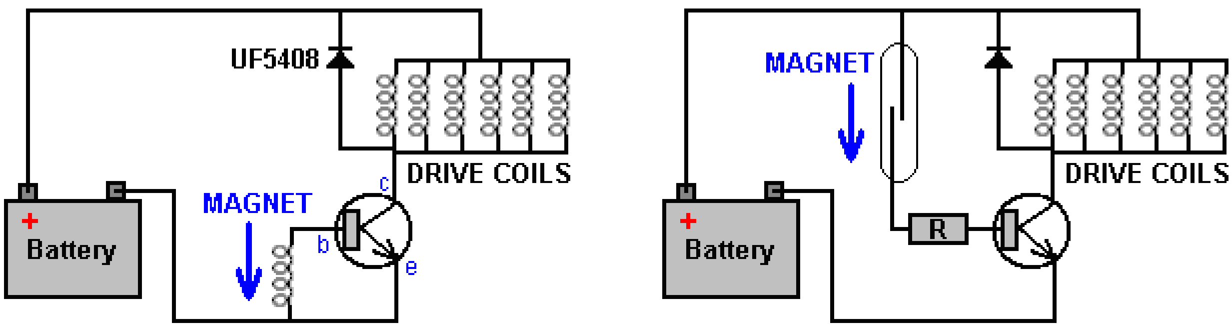
I will suggest a few alterations which I suspect will make a major difference. You can ignore them and replicate the original build exactly, or you can try some or all of them either as part of the build or as future modifications. It is your project and you are free to do whatever you choose.

As a first step, I would upgrade the coils. A coil is generally considered to be one long length of wire wound around a tube of some kind, to form a helix. Nikola Tesla patented a bi-filar coil design which has much stronger magnetic properties, and I suggest that the drive coils (if not all coils) are wound in that way. To wind a bi-filar coil, you use two strands of wire simultaneously. That is a great advantage because the coil spool only needs to be turned once to get two turns on the coil, and that halves the effort if you are winding your coils by hand. When the coil is wound, then the end of strand 1 is connected to the beginning of strand 2. That results in a helically wound coil just as before, but the major difference is in the physical position of each turn inside the coil. Tesla's patent US 512,340 describing this technique, puts it forward specifically for electromagnet coils as the magnetic effects of the current flowing through the coil are considerably increased by using a bi-filar coil.

The coils powering the rotor are driven by a transistor. The transistor is switched on by the passing rotor magnet. That switching can be done with a coil of wire feeding the generated current into the Base (or Grid) of the transistor.

That current flow turns the transistor on, but as soon as the magnet passes by, the current is no longer generated and so the transistor switches off again.

An alternative is to use a reed relay which is just two strips of thin metal inside a glass tube. The strips form a switch which closes when the rotor magnet comes near. That switch can be used to feed a small current from the battery into the Base (or Grid) of the transistor through a current-limiting resistor “R”. These two arrangements look like this:

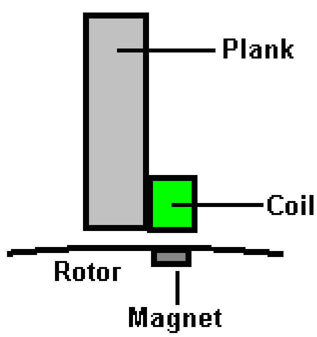


If you are familiar with electronics, then a Hall-effect magnetic switch or an optical switch could be used as alternatives. Personally, I think that the pick up coil is the most simple and effective way of timing the drive pulses from the battery.

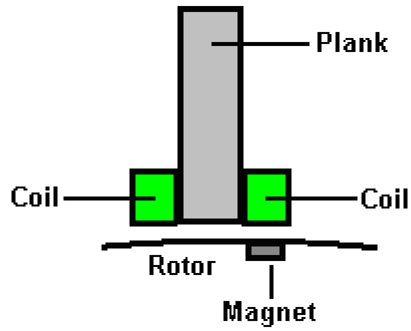
Both of the circuits shown above have a diode placed between the transistor collector and the Plus of the battery. Most people will tell you that it is there to protect the transistor, but in this circuit, the diode also feeds back-EMF power from the drive coils back into the battery and Robert Adams usually places a capacitor across the diode when doing this.

As an additional method of boosting the power of the unit I suggest that additional power output coils are used. If the build has a 600 mm diameter then the magnets are spaced out at 117.8 mm centres and the gap between the magnets is 97 mm (4.6 inches) and the gap between adjacent cross planks is 60 mm (2.3 inches).

Another potential upgrade is to mount an extra pick-up coil on the reverse side of each plank. The original build had a construction like this:

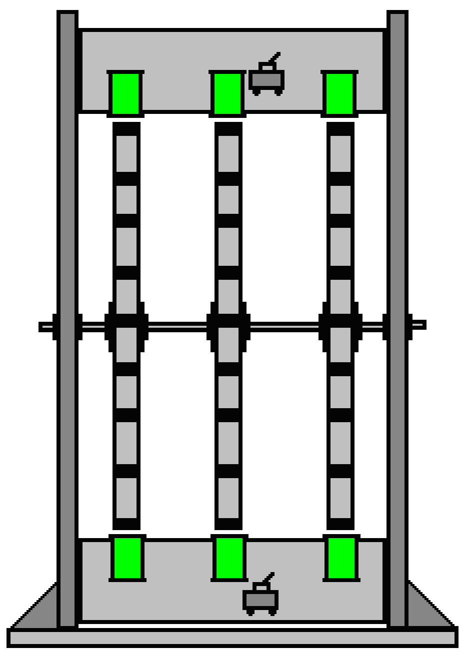


This arrangement has sixteen coils, each mounted one per plank. That is a very simple construction. However, it is possible to double the number of coils while still maintaining the great simplicity of the construction. The way to do that is to mount a second coil on the other side of the plank like this:



If the rotor is 600 mm in diameter, then the coils should not have a diameter of more than 38 mm. If 40 mm (1.5 inch) diameter coils are wanted, then make the rotor diameter 620 mm. Using these additional coils with this method does not have all the coils spaced out evenly around the rotor, but that does not matter in the least. Leaving the driving circuitry unchanged, there will still be 16 evenly spaced pulses for every 360-degree movement of the rotor. The additional coils are passive and pick up energy from the magnets as they pass by. However, with a coil on both sides of the plank, the new coils are only about 5 mm away from the next of the original coils and that is close enough to pick up the magnetic field from that coil when that drive coil is pulsed.

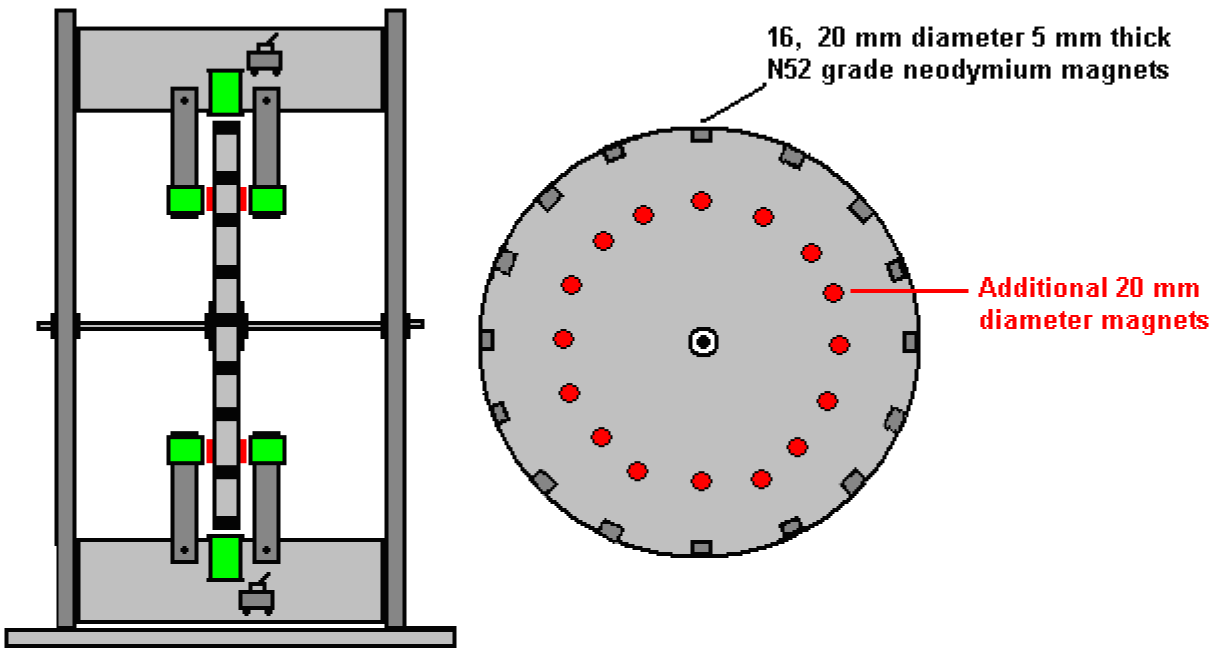
One additional power upgrade would be to have two or three rotors on the one shaft. Doing that has considerable advantages, not the least of which is that each additional rotor can be added at a later date when it is convenient to do so. The arrangement looks like this:



There is no need for any additional circuitry as the original rotor controls the timing of the pulses from the drive coils and the magnets on the rotors are aligned exactly. The additional rotors can have drive coils, power gathering coils or any mixture of the two types.

While the original diagram shows both the drive coils and the power gathering coils as being connected in parallel, it is likely that the power gathering coils at least would be better off connected in chains of twos or threes in order to raise the output voltage before being connected in parallel to increase the available current.

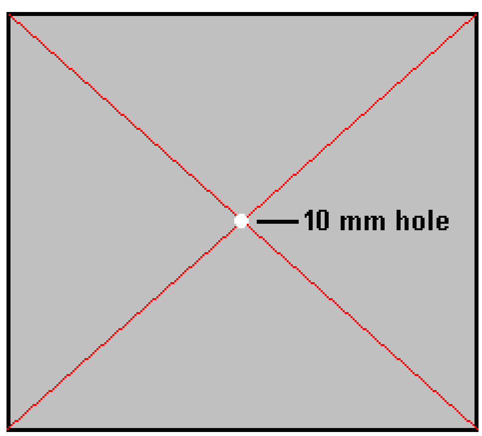
There is also the possibility of putting additional magnets in the face of the rotor and additional coils on both sides of the rotor, the coils being supported on arms coming off the planks:



But this level of modification is probably more advanced than is needed at this point in the development, so let's add some more detail to the most simple version.

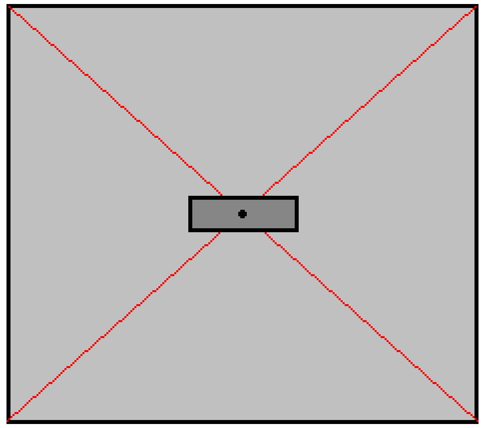
The rotor can be made from any non-magnetic sheet material which is rigid and which will not warp. The sheet needs to be larger than 600 x 600 mm in size. Measuring carefully, you mark a point which has 300 mm clear on all sides. If the sheet is nearly the correct size and the offcuts are not likely to be much use for anything else, then marking where the diagonals from the edges cross gives a suitable point.

Next, you drill a 10 mm diameter hole at that central point:



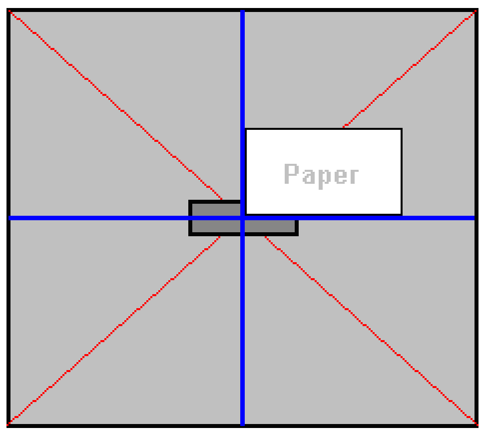
While this sounds easy, it is probably the single most difficult part of the entire construction. It is very difficult to hold a hand drill perfectly vertically, especially when you have to look at it from one side because the body of the drill blocks the view from vertically above. The board is too wide to use a normal drill press, and the notion of using something drilled in a drill press as a guide to the vertical while attempting to get the drill bit on the marked point which the guide now obscures is usually a recipe for disaster. To get over this problem, we will drill a sloppy hole by hand and use two nuts and two washers to force the rotor into an exactly vertical position as well as holding the rotor in place permanently. However, even though it is going to be a sloppy hole, do your best to drill it as square and upright as possible.

Next, cover the hole over with tape pulled into a smooth surface and mark the exact centre of the hole on the tape:

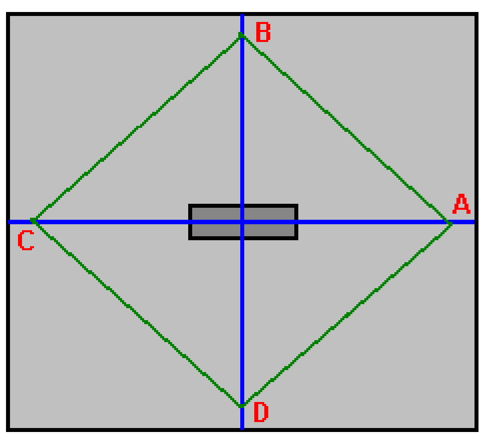


Forget all previous markings. This central dot is what we work from now as everything is exactly related to that point, and only that point.

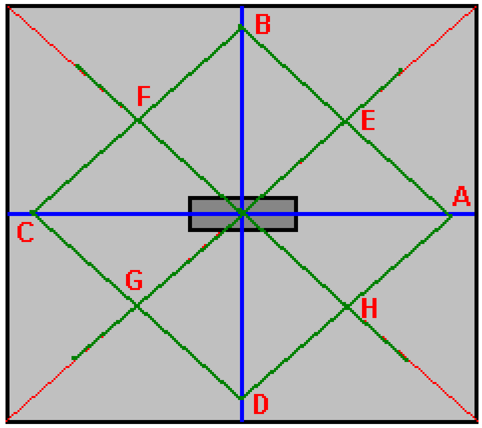
Now, draw a line through the centre point, at any convenient angle. Then a second line through the point at exactly 90 degrees to the first line. If you wish, you can use a sheet of paper to get the 90 degrees:



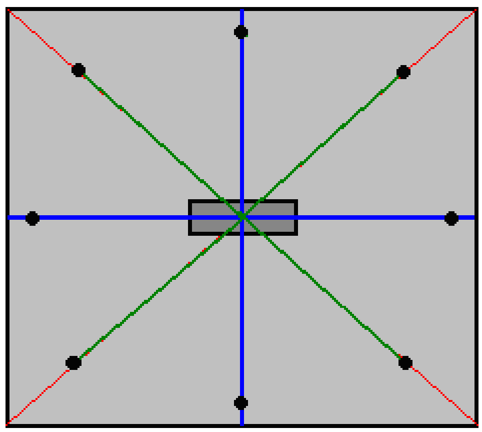
The next step is to measure off exactly 300 mm from the central point along each of those four lines and connect those points "A", "B", "C" and "D" with straight lines:



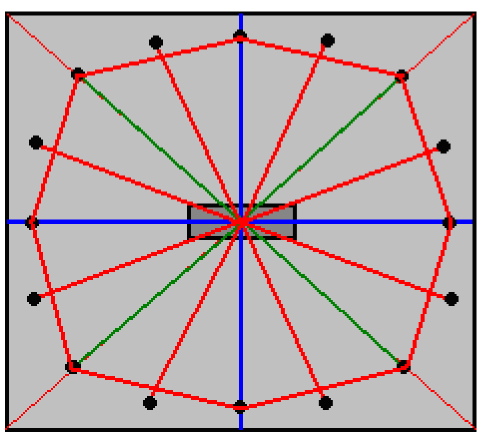
Measure the length A to B, B to C, C to D and D to A. Those lengths should all be exactly the same. Now, mark the centre point of each of those four lines (points E, F, G and H):



and draw a straight line from the centre point through those four points and mark off exactly 300 mm from the centre point on each of those lines. This has now located 8 of the 16 magnet positions in exact relationship to the central hole:



The next step is to join each of those 8 points to the next one, mark the centre point on each and draw a 300 mm long line from the centre point through those points to show the positions of the final 8 magnets:



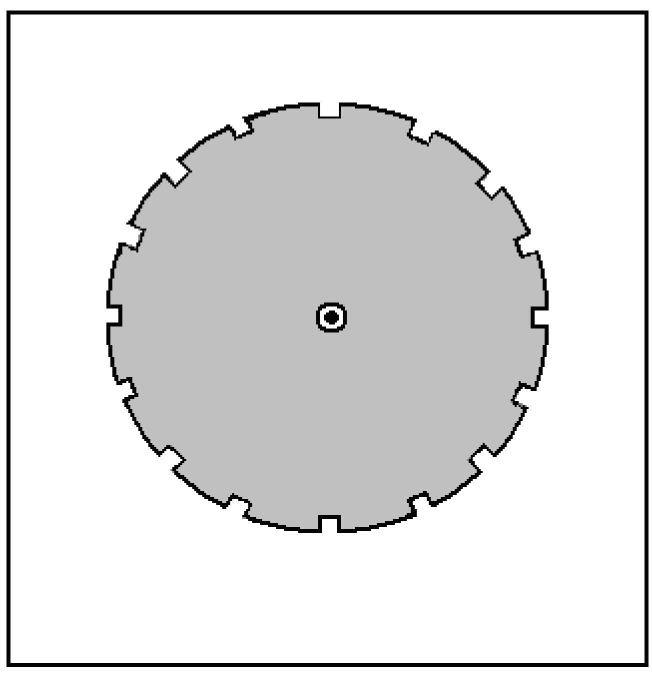
We now have the exact positions of all sixteen of the magnets, so remove the piece of tape and push your 10 mm diameter drill bit into the hole. Tie a loop in a piece of string and put the loop over the drill bit. Take a pencil and place the tip on one of your marked magnet positions, and then with the string wrapped round the pencil low down near the board, adjust the string so that it is tight and mark a 300 mm radius arc through all of the magnet positions. This is the edge of the rotor.

Why didn't we just do that instead of all the measuring? Because the string method is very easy to get badly wrong and we want the rotor to be as accurate as we can make it.

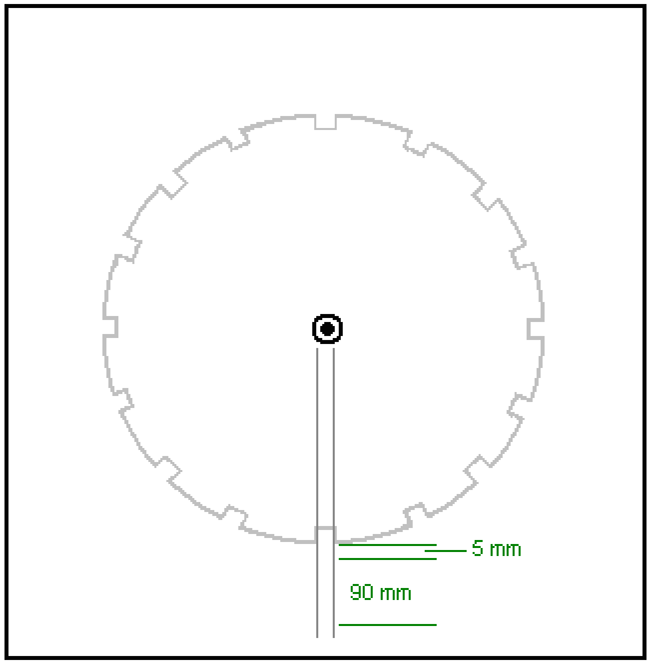
We now want to cut out the rotor (being careful not to erase the lines showing where the magnets are to be attached) and the inclination is to grab a power jig saw as that is the easiest way. However, I recommend that you don't do that as power tools are very good at getting things wrong in less than one second. Cutting carefully and slowly using a coping saw should give you a perfect rotor whose edges can then be sanded. The advantage of a coping saw is that the blade angle can be set to allow very long cuts near the edge of a piece of material:

When the rotor has been cut out, mark 20 mm lengths at the magnet points and use the coping saw to remove a 5 mm deep slot the full width of the rotor material along each 20 mm length. This allows the magnets to be flush with the edge of the rotor. The rotor is the only precision item in the entire construction, so the most difficult part has now been completed.

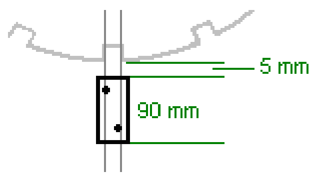
As it is more convenient to attach the coils to the cross planks before assembling the outer frame of the stator, we will cut the necessary pieces but not assemble them until after the coils have been completed. To cut out the side pieces, place the rotor on a thick sheet of material such as chipboard, Medium Density Fibreboard, plywood, block board or similar, in a position where there is 135 mm (5.5 inches) clear all around it. As the rotor is 600 mm in diameter, the side panel needs to be at least 830 mm square:



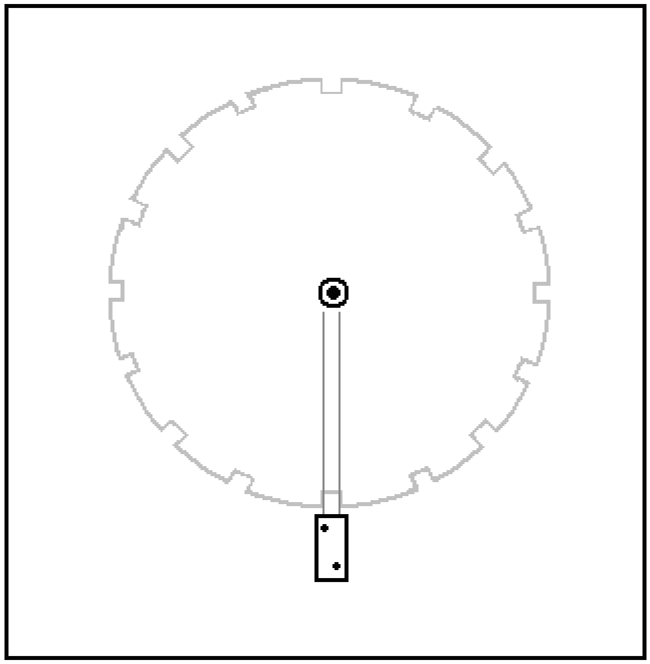
Mark the sheet through the rotor hole, remove the rotor and drill a 10 mm hole through the sheet. Place the drill bit in the hole in the sheet and slide the rotor down on to the drill bit. This matches the rotor exactly with the stator side panel. Carefully mark around the rotor with a pencil and remove the rotor and the drill bit.



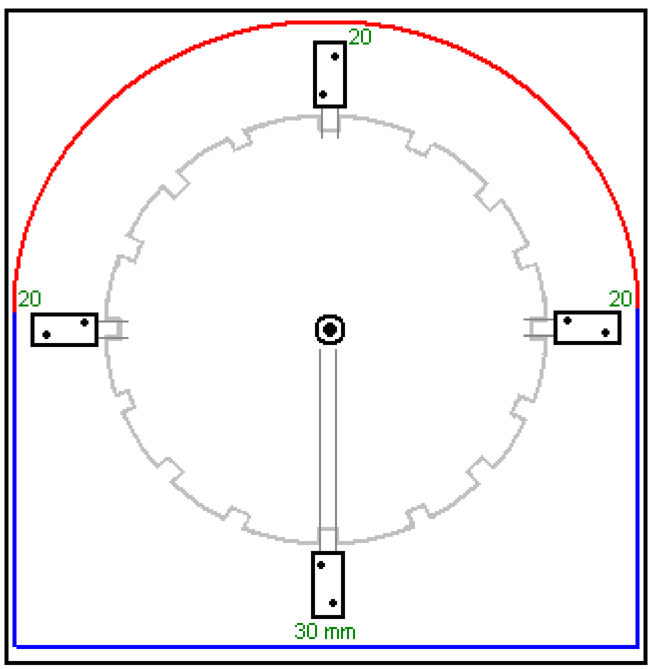
Draw parallel lines 20 mm apart, running from the centre of the rotor outline, through each of the magnet slots. Allow for a 5 mm gap between the rotor and it's matching plank and mark off a 90 mm length as shown above. This is to mark out the position where the plank will be attached to the side panel of the stator. As the plank is 38 mm wide, it will extend 9 mm outside the lines like this:



After the position of the plank end has been outlined, drill two holes to take the screws which will hold the two stator side panels together. When the first one has been completed, it will look like this:



That process is repeated for all sixteen planks, and that outlines the stator side panel well enough to allow it to be completed:



Leave 30 mm below the lowest plank position and 20 mm at each of the two side planks, and draw the horizontal and vertical lines shown in blue in the diagram above. Then, putting the drill bit back in the hole and using a piece of string and a pencil to improvise a very large compass, draw the red arc shown above. That completes the outline of the side panel of your stator, which can now be cut out. This cutting is not critical in any way, but it would be nice to have it looking neat. The completed side panel is now placed on a second panel and a pencil mark is made to show the position of the drilled hole. The second panel is drilled with a 10 mm diameter hole and the drill bit is used to make sure that the two holes align perfectly. A pencil line is now traced around the outside of the completed side and the second side panel is then cut out along that line.

The 10 mm drill bit is now used to align the rotor and the second side panel, taking great care to align the rotor in exactly the same position as on the first side, and the end positions of the planks marked out and drilled ready to take the screws.

Next, you take your two bearings and treat them to make them as free-spinning as possible, then, measure carefully out from the hole drilled in each of the two stator side panels and mark a circle of exactly the same diameter as the outside of the bearings. Use a power jig saw to cut out the circle staying just inside the line. This gives a rough opening which is just too small for the bearing to fit into. Enlarge the hole very gradually using a wood rasp or coarse sandpaper until a bearing can just be forced into the hole. Leave the bearing in place but don't do anything further to attach it at this time – that will be done later when the axle is in place and the rotor has been proved to spin freely.

The base panel is just a rectangle 850 x 500 mm in size, but we are not ready to assemble the unit just yet as we need to wind the coils and attach them to their support planks ahead of assembling the generator.

We need to choose a wire diameter, coil dimensions, number of turns per coil and style of winding. Those items are the things which are changed when a builder says that he is "tuning" his generator to get maximum performance. It sounds much more impressive to say that you are "tuning" rather than to say that you are experimenting with different coils. So, let's get started with our choices.

The thicker the wire used, the greater the current which it can carry, but the fewer turns which will fit on to any particular coil spool. Also, the thicker the wire, the shorter the length which you get when buying it by weight.

The thinnest wire, say, SWG 40 which is about one tenth of a millimetre in diameter, is liable to break when you wind it unless you are very careful and wind gently. The really thick wire is a bit stiff and can be a bit difficult to wind. However, we are not going to encounter those problems in this job as current handling capacity needs to be taken into account. The question we need to answer is "how much current can we draw from a coil when we swing a magnet past the coil?" and the answer is "probably not much". So, we take a look at the table which shows the currents which the different wire sizes can carry comfortably:

AWG	Dia mm	Area sq. mm	SWG	Dia mm	Area sq. mm	Max Amps	Ohms / metre	Metres Per 500g	Max Hz
1	7.35	42.40	2	7.01	38.60	119			325
2	6.54	33.60	3	6.40	32.18	94			410
3	5.88	27.15	4	5.89	27.27	75			500
27	0.361	0.102	28	0.376	0.111	0.288	0.155	500 m	130 kHz
28	0.321	0.0804	30	0.315	0.0779	0.226	0.221	700 m	170 kHz
29	0.286	0.0646	32	0.274	0.0591	0.182	0.292	950 m	210 kHz
30	0.255	0.0503	33	0.254	0.0506	0.142	0.347	1125 m	270 kHz
31	0.226	0.0401	34	0.234	0.0428	0.113	0.402	1300 m	340 kHz
32	0.203	0.0324	36	0.193	0.0293	0.091	0.589	1900 m	430 kHz
33	0.180	0.0255	37	0.173	0.0234	0.072	0.767	2450 m	540 kHz
34	0.160	0.0201	38	0.152	0.0182	0.056	0.945	3000 m	690 kHz
35	0.142	0.0159	39	0.132	0.0137	0.044	1.212	3700 m	870 kHz

Looking at the smallest wire size shown, it can carry 44 milliamps, but it is so thin that it would be difficult to handle. I have wound successfully with SWG 40 but it is not the most convenient. I would suggest SWG 36 which is AWG 32 and has a diameter of nearly one fifth of a millimetre. It can carry 91 milliamps continuously and a good deal more when it is the pulsed current produced by a magnet passing by. The table shows that if we buy two 500 gram reels of SWG 36, then we receive a length of three thousand eight hundred metres of wire for winding our coils. Every extra coil that we wind, increases the power of the generator, so we will be winding a lot of coils.

It is not at all difficult to wind these coils, but it will take a few days. For people living in the UK, the best supplier is the Scientific Wire Company who manufactures the wire. In November 2015 they sell two 500 gram reels of SWG 36 wire (their Ref: SX0190-2x500) for just £18 including tax at http://wires.co.uk/acatalog/SX_0190_0280.html and that is 'solderable' enamel which just burns away when you solder to it, which is enormously helpful, especially with very thin wire.

Alternatively, if you choose two 500 gram reels of SWG 37 wire with 72 milliamp current carrying capacity (their Ref: SX0170-2x500) at http://wires.co.uk/acatalog/SX_0140_0180.html then the cost is £19.72 but the wire length has increased to four thousand nine hundred metres, which is an extra 1,100 metres of thinner wire.

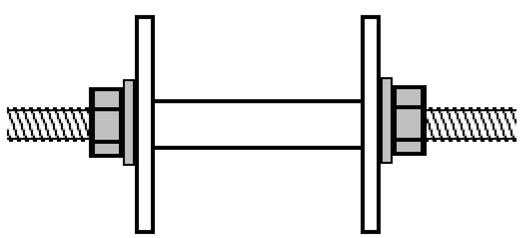
Please remember that the wire current carrying capacity is not all that important as many coils are involved. For example, if each coil is contributing 30 milliamps (which is well inside the ability of the wire to manage) and there are ten coils connected in parallel, then the combined current is 300 milliamps which is well outside the capacity of any single wire to carry. Just remember that if they are connected in parallel and feeding the power away, then you need a much larger diameter wire to carry that combined current from the set of coils to its destination.

When winding a coil, you need to choose the starting diameter of the coil. The magnetism produced by a coil increases with the number of turns, more turns produces more magnetism. The magnetism also increases with the area inside each turn of the coil, the bigger the area the bigger the magnetism. The snag is that the bigger the enclosed area, the greater the wire length needed to complete each turn of the coil wire. So, the question is should we use a small diameter coil shaft or a thick coil shaft? In this case we want a large number of turns on a coil of not more than 38 mm diameter, so we will choose a narrow tube for our coils.

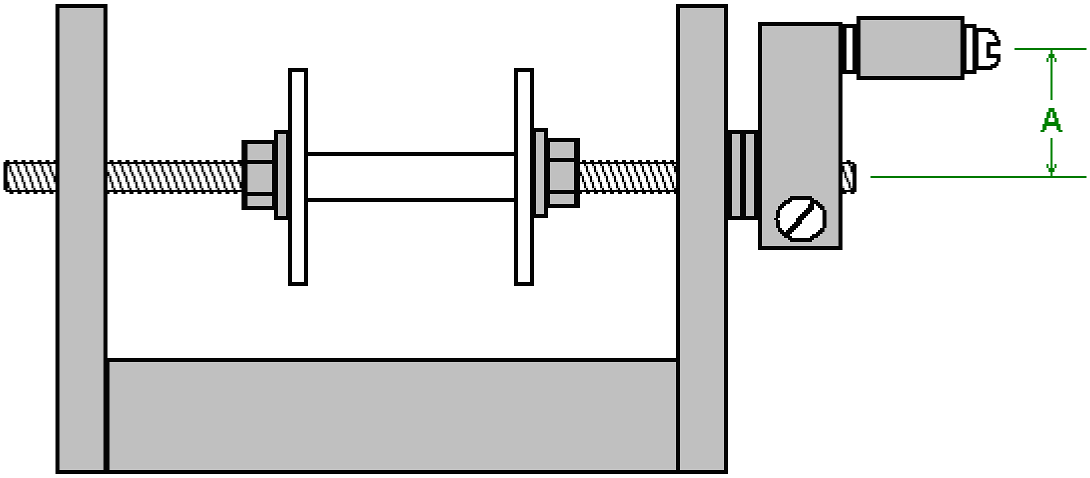
We can make up coil spools quite easily if we use a power drill and a hole saw set like this:

These saw sets normally have a saw which has an inner diameter of 35 mm. That doesn't sound very large but the wire being used does not build up much depth of turns when being wound, even with a large number of turns in the coil. A small sheet of 3 mm thick Medium Density Fibreboard ("MDF") can easily be drilled using the hole saw, and each drilling produces one perfectly round disc with an exactly centred hole in the middle. Two of those can be glued (at exact right angles to the central shaft) on to a tube to form a spool of the size wanted. If it is available, plastic sheet could be used instead of the MDF. Plastic tube of 8 mm diameter and an inner diameter of 6 mm is often available on eBay, but failing that, it is actually quite easy to drill a 6 mm hole through a short length, say, a 30 mm length of 8 mm diameter dowel rod. The piece of dowel is held in a vise and because it is easy to see, drilling a reasonable hole down the length of dowel is not actually that difficult.

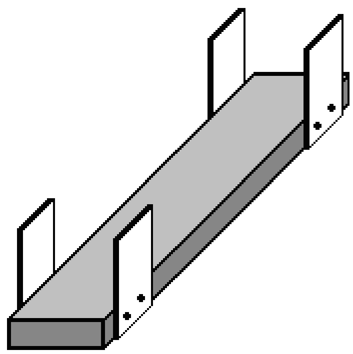
The spool can be clamped on to a standard 6 mm diameter threaded rod using two washers and two nuts or wing nuts:



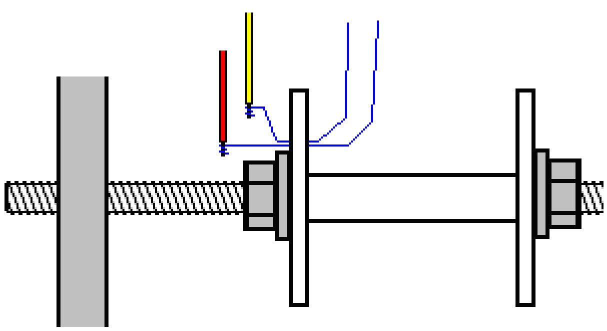
Then the threaded rod can be clamped at one end with a simple crank handle formed out of a small piece of timber, a clamping screw to grip the rod and a 20 mm length of drilled dowel on a screw to form the rotating winding handle:



A simple drilled hole in the vertical sides works perfectly well as a bearing, but keep the length "A" short as that needs less wrist movement and with it short, it is quite easy to turn the handle four times per second. A plank around 600 mm long makes a good base for the winder:



The winding handle part is at the near end and the two 500 gram spools of wire are placed one above the other at the far end. The longer the plank, the easier it is to draw wire from the large supplying spools as the angle between those spools and the spool being wound is smaller. The supplying spools are each just mounted on a dowel pushed through holes in the side pieces. Be sure to make those dowels horizontal so that the spools don't keep moving to one side or the other.



To start winding a coil, drill a very small hole in the left hand flange, just outside the washer. Thread the two wires through the hole and wind each a few times around the bared end of a short length of plastic covered wire, and join each wire to the copper winding wire by soldering it. This only takes a moment and if you have never soldered, it is very easy to learn and easy to do. Next, use a piece of duct tape to attach the thin wires firmly against the outer face of the flange of the coil spool and wrap the spare plastic covered wires around the threaded rod a few times so that they won't catch on anything when being whirled around. Trim the duct tape so that it is all on the outside of the flange and so will not get in the way of the wire which is being wound on to the coil spool.

The coil is wound by gathering the two strands in your left hand and turning the crank handle with your right hand. If you wish, you can clamp the winder to the table or workbench which you are using. The preferred way of winding is to turn the crank handle so the that wire entering the coil spool feeds on to the underside of the spool. That method of winding is called “Counter-Clockwise”. If you want a clockwise wound coil, you just turn the crank handle in the opposite direction so that the wire enters the spool at the top. Counter-Clockwise is considered to be the better way to wind these coils.

When starting to wind, guide the wires close to the drilled flange. This is to keep the starting wire taught, flat and out of the way of the following turns. As winding continues, the wires are directed very slowly to the right until the spool shaft is fully covered. Then the wires are directed very slowly to the left for the next layer, and that is continued, right, left, right, left until the coil is completed. Then the two wires are duct taped to the plank so that they are kept controlled while you are busy with other things. Then the wires are cut, a few turns taken around the stripped end of a short length of thicker wire and soldered to make an electrical and mechanical join between the thick wire and the thin wire. The body of the coil is now wound with electrical tape so that none of the wire is visible, and then the duct tape is removed from the spool and the two starting soldered joints are epoxied to the flange.

There is no need to mark the wires as the start of the wires are the ends coming through the drilled hole and the ends of the wires just stick out from under the electrical tape, and a meter will tell you which start and which finish are the same wire. You need to check that anyway to ensure that the wire connections are good and that the resistance of each of the two wires in the coil is exactly the same.

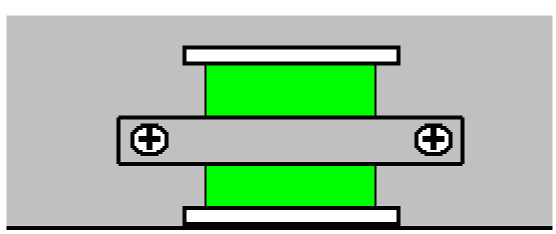
What hasn’t been mention so far is the number of turns in the coil. The larger the number of turns the higher the voltage produced when a magnet passes by. A larger number of turns produces a larger amount of output power, or if it is being used as a drive coil, the greater the strength of the magnetic field produced.

There are various winding methods. One method is to choose the number of turns and count the turns as they are being wound, perhaps counting to 100 and then marking down that count and starting on the next 100 turns. That method works well enough even though it does not give identical results from one coil to the next, due to the wires not being directed in exactly the same way due to human error. I would suggest at least 3000 turns in any coil.

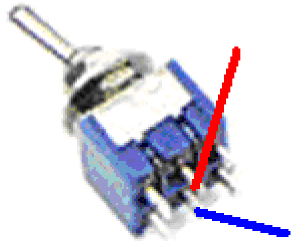
One idea which occurs to me is to take our 30 mm long, 35 mm diameter coil spool and wind two separate bifilar coils on it, one on top of the other. If that is done, then there is the option to use the inner coil as a drive coil and the outer coil as a power collection coil. The drive coil pushes the passing rotor magnet away as before, but that drive pulse also produces a magnetic field around all of the drive coil and that field will be picked up by the collection coil, in addition to the power collection from the passing rotor magnet. If it is found that this arrangement is not particularly good, then the second bifilar coil can be joined to the first one to make a much larger single bi-filar coil.

One tempting option is to just wind the coil until the spool is completely full. That is not a technique which is commonly used, but it is definitely possible. It will result in coils which have slightly different characteristics. The pushes from the drive coils will not be exactly the same, but I doubt that it would cause any great problem. The voltages from the power gathering coils will be slightly different. This means that current draw will start from the coil with the highest output voltage, but the load will quickly draw that voltage down until the on-load voltage reaches that of the second highest voltage coil, and then both will be drawn down to the third highest voltage, and so on.

So, the choice of winding style is yours. No matter which method you use, you end up with a set of 16 or 31 coils ready for installation. Irrespective of the number of coils being installed, mark the centre point on both sides of every plank. If your coil winding has left an unused section of flange on the coil spool, cut it off on one side so that the turns of wire can be attached directly to its plank. Position the coil on the middle mark and attach it to the plank in a non-permanent way, such as using a metal strap or wooden strap screwed to the plank, straddling the turns of the coil. The attachment has to allow you to adjust the coil position towards, or away from, the rotor.



Join the end of the first strand of the coil winding to the start of the second strand. If you want to use switches (and that is really unnecessary in our construction) then solder the remaining wires to the central contact of each side of a miniature two pole changeover switch:



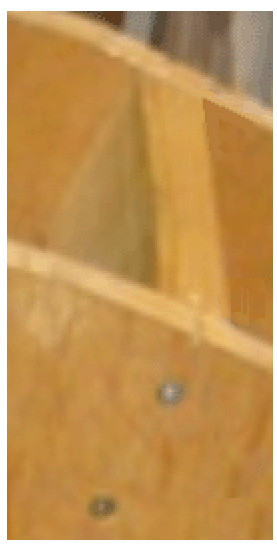
Glue a small spacer 15 mm thick, to the side of the switch and then glue the spacer to the plank. That lifts the switch up high enough to make soldering other wires to the switch much easier. The original build used single pole switches, assuming that there would be a common negative line to all of the coils. In this implementation, we would use double pole switches so that the coil can be switched into more advanced circuit configurations as we want to experiment with power collection coils connected in separate groups. We really do not need switches.

If a coil is being used on both sides of each plank, then attach the second coil to the centre of the plank's other face.

The magnets need to be attached to the rotor. It is said that the North-seeking pole is four times stronger than the South-seeking pole of any permanent magnet when used in an application of this type. If you don't know which face of the magnets is North, then take a stack of two or four magnets and suspend them on a thread so that they are roughly horizontal. After a few minutes, the magnets will align along a definite line and the magnet face which is facing towards the North is the North-seeking pole face. If you don't know which direction is North from where you are, consult a map, of if the Sun rises in the morning and you face the rising Sun, then North is on your left. Once you have established which magnet pole is North, then the attraction or repulsion of the other magnets shows which is their North pole face.

Epoxy the magnets in place on the rotor edge with the North pole face facing outwards. Some people are inclined to put duct tape around the rotor outside the magnets to make sure that the magnets don't fly off the rotor when it is spinning. It is my experience that rotors of this type spin slowly at one revolution per second or slower, and that speed will never, ever, dislodge a rotor magnet, and if it did, there would be no significant energy in the loose magnet anyway, but if you feel inclined to do so, apply a 20 mm wide strip of duct tape on top of the magnets.

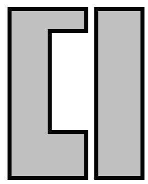
We are now ready to assemble the main components of the generator. People will have different ideas about how this should be done and there are various opinions about the best way. The cross planks will be attached to the sides of the stator using two screws on each side of every plank. That allows the unit to be taken apart later on if that should be necessary. The screws of the original were placed like this:



Personally, I would like the screws to be offset so that neither is on the centre line of the plank as that is the weakest arrangement, and so I suggest that the two screws are positioned one third of the way in from the plank edge as that gives a stronger connection with the screws 13 mm apart and not stressing the timber along one plane.

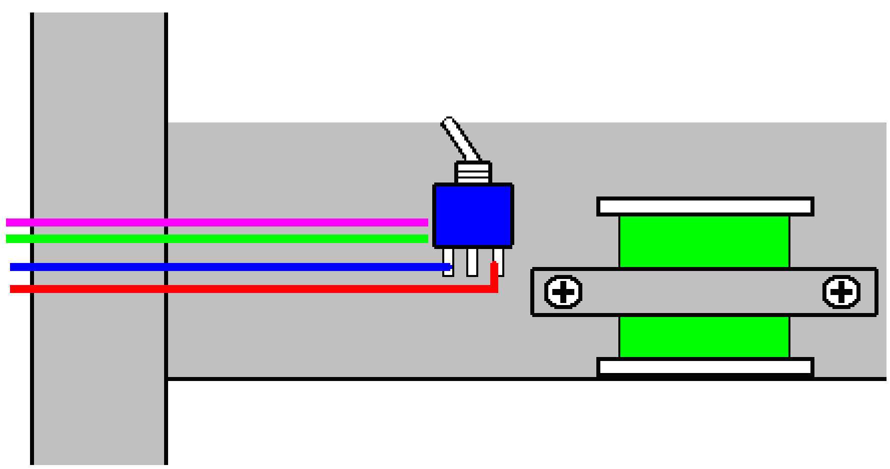
When the two stator sides are connected together by the planks, it is quite difficult to get at the planks half way up the stator. To overcome that difficulty, we can attach the planks to one side and make all wiring connections to the coils and switches. Those wires can then be run along each plank and through the stator side so that they will be easily accessible when the unit is fully assembled. It is very much easier to have the wiring on the outside, both for understanding it initially and for making changes afterwards if experiments are tried in the search for optimising the performance of the generator.

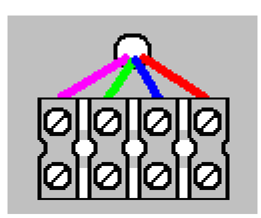
You would think that connecting a cross plank to the stator side would be ever so easy. It actually isn't all that easy and getting the screws set correctly and the plank exactly in place is not a trivial task as the screws tend to push the plank out of position. One way to overcome this and get an accurate result is to clamp the end of the plank firmly in place before driving the screws into the plank. That can be done using two pieces of scrap timber:



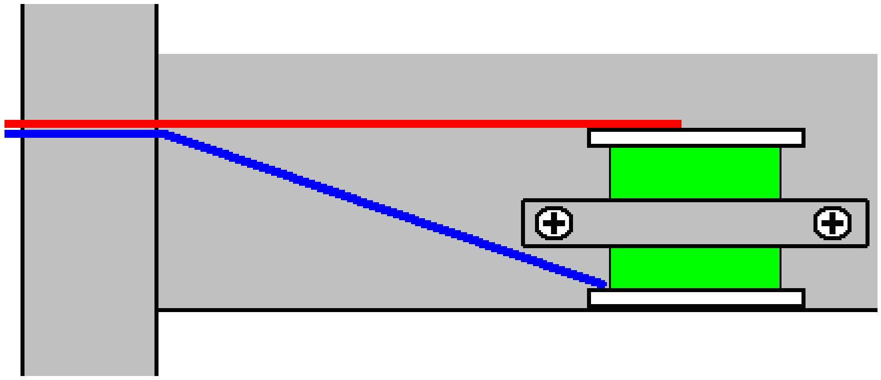
The piece on the left is cut so that a plank fits tightly in the cut out. The opening is positioned exactly where the plank should go and the piece clamped securely to the stator. The second piece is then clamped to the stator so as to complete the enclosure. This allows the plank to be pressed securely into place against the stator and the screws driven in while pressure is applied to keep the plank pressed securely against the stator with no chance of movement or any gap allowing screws to be driven in at an angle and causing a mismatch and the subsequent weakness of an inferior join. Clamping becomes impossible for the lower part of the side panel because of the increasing distance of the plank from the edge. In that area, the guide can be screwed to the inside of the side panel using short screws which do not go all the way through the side panel. The guides have to be kept fairly narrow as there is not much clearance between adjacent planks.

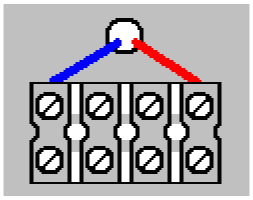
The four switching wires from the switches, or the two coil wires if switches are not being used, are run through the side of the stator and connected to an ordinary screw terminal strip:





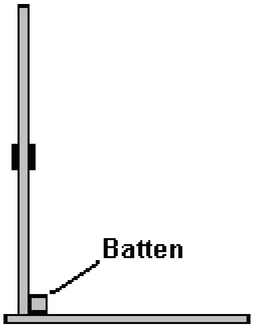
This arrangement allows complete flexibility for any arrangement of interconnections, but there is a more simple arrangement which needs no switches and that is to run the two coil wires directly out to a screw terminal strip and then make all of the subsequent interconnections with a screwdriver:



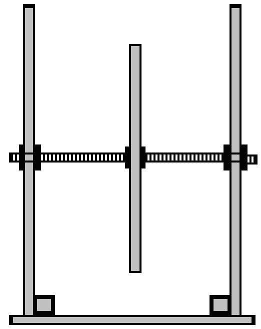


Although some coils can be connected with just two screw terminals, I suggest that four are allocated to every coil. That allows circuitry to be constructed using the terminal strips themselves.

When all of the cross planks have been attached to one of the stator side panels, attach that side to the base plate. That can be done by screwing a wooden batten to the base plate and then screwing the side panel to the batten, ensuring that the side panel is exactly vertical.

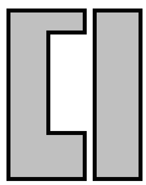


Then, put the rotor in position, through the bearing in the stator side panel, slip the other end of the axle through the bearing in the second side panel and attach the second side panel to the base plate:



This diagram does not show the planks attached to one side as including them would not be helpful as they would conceal the main details.

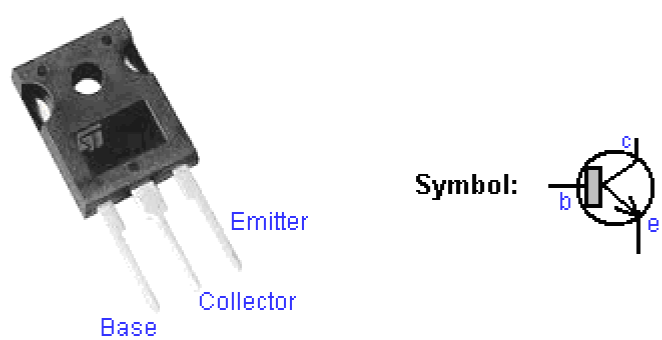
Ensure that the base is horizontal and both sides are exactly vertical and then attach the planks to the second side panel using the clamping pieces:



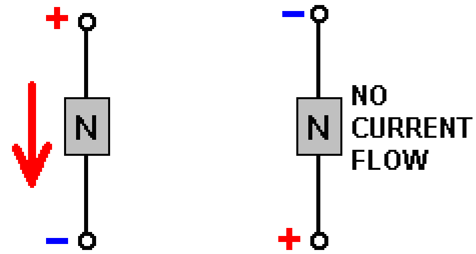
Once most of the planks have been attached, the base (with the battens attached) can be removed temporarily in order to make the remaining plank attachments easier to reach.

At this point, most of the construction is completed with the base, two side panels, rotor with magnets, sixteen planks and one full set of coils with their connections carried through one stator side to screw connector terminals. So now we are ready to wire up the connections and run the generator.

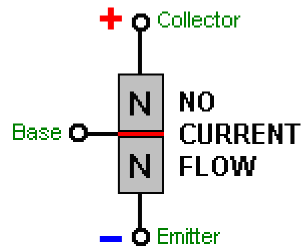
We use a transistor to power the generator. There are lots of different transistors and so we need to choose one. A very popular and powerful one is the 2N3055 which in its more convenient more recent packaging is called the TIP3055 transistor looks like this:



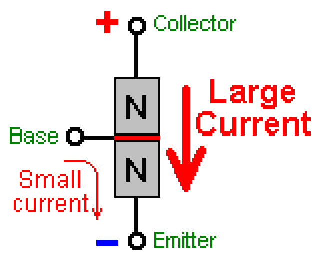
This transistor is popular and is available in many different countries. Transistors are basically, very simple devices to understand. They are made of two pieces of N-type silicon separated by a very thin layer of P-type silicon. The "N" and the "P" just stand for "Negative" and "Positive". It works like this: If you have a block of N-type silicon (which we call a 'diode') and connect a battery across it, current will flow **provided** that the battery is connected the right way round:



A transistor is two of those N-type silicon blocks separated by a very thin layer of P-type silicon to control the operation. The P-type forms a barrier when the N-type silicon would normally conduct a current:



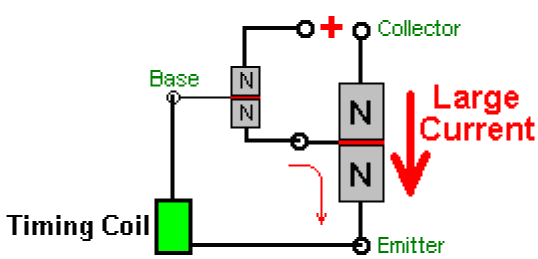
However, if a small current flows into the Base and out through the Emitter, then the barrier effect is reduced by a large amount and a current starts flowing from the Collector to the Emitter:



The ratio of the base current to the Collector current which it triggers is called the DC power gain. For example, if one milliamp of current flows into the base and causes a current flow through the transistor of 30 milliamps, then the gain is said to be 30, and that is about the gain which we can expect from a TIP3055 transistor.

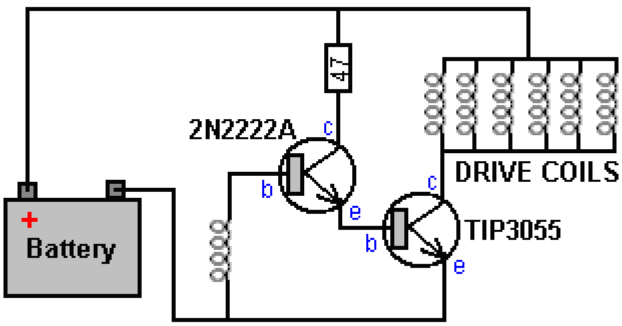
That is not a very high gain and it would be nice if it were much higher. We can arrange that increase in gain by using one other transistor – a low power transistor which has a high gain of about 200, say, a BC109C or a 2N2222A transistor. If we use one of those to amplify the current going into the base of the TIP3055, then the overall gain becomes 200 x 30 which is six thousand. A gain of 6000 should work very nicely for our generator.

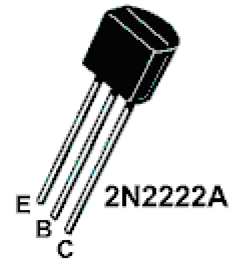
The way that we use the transistors is we have one coil act as a synchronisation or timing sensor. It detects a rotor magnet passing by because the magnet generates a voltage in the coil and we use that voltage to switch on our pair of transistors:



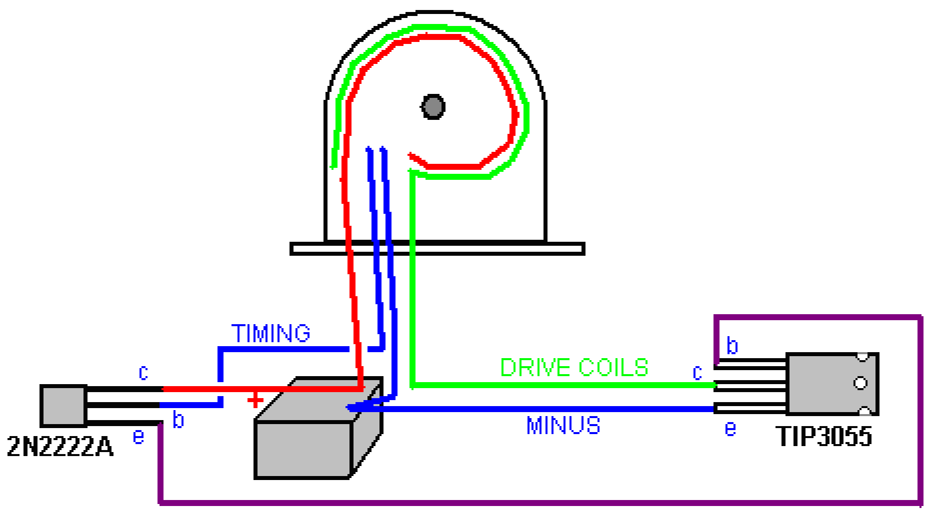
This works as follows. When the rotor magnet passes the timing coil, it generates a voltage in that coil. Each transistor needs about 0.7 volts to switch on, so if the voltage generated in the timing coil exceeds 1.4 volts (which is pretty certain for a coil with many turns in it) then that voltage will cause a current to flow through the Base of the small transistor. That turns the small transistor On, feeding a generous current into the base of the big transistor through the 47 ohm resistor which limits the size of that current, turning the TIP3055 transistor On and causing a large current to flow through it.

If we connect the generator's drive coils between the collector of the large transistor and the battery Plus terminal, then that big current will flow through those coils, powering the rotor on its way. By adjusting the position of the Timing Coil, we can control exactly when the drive coils get powered up, and so we can adjust the position to get the very best performance from the generator. The circuit diagram for this is:



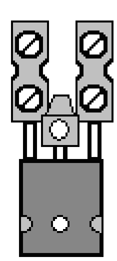


Physically, that is:

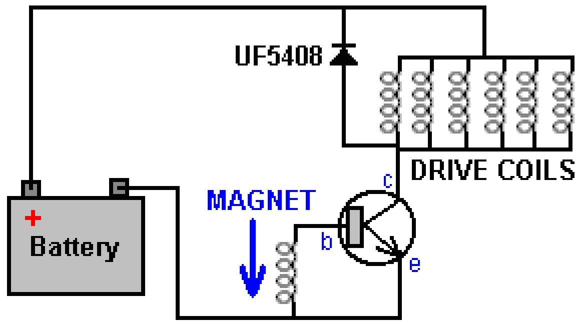


Here, the red positive connection to the battery goes to the Collector of the 2N2222A transistor and to one side of all of the drive coils. The green wire connects to the other side of all of the drive coil connections and on to the Collector of the TIP3055 transistor. The Minus of the battery goes to the Emitter of the TIP3055 and to one side of the single timing coil and the other side of the timing coil goes to the Base of the 2N2222A transistor.

If you don't want to solder connections to transistors, then you can bend the centre leg upwards and use individual, trimmed down screw terminals, one on each leg:



I suggest that initially, you ignore the power take off circuitry and concentrate on getting the rotor spinning satisfactorily. However, just before starting on that, consider the first circuit diagram shown and consider the difference:

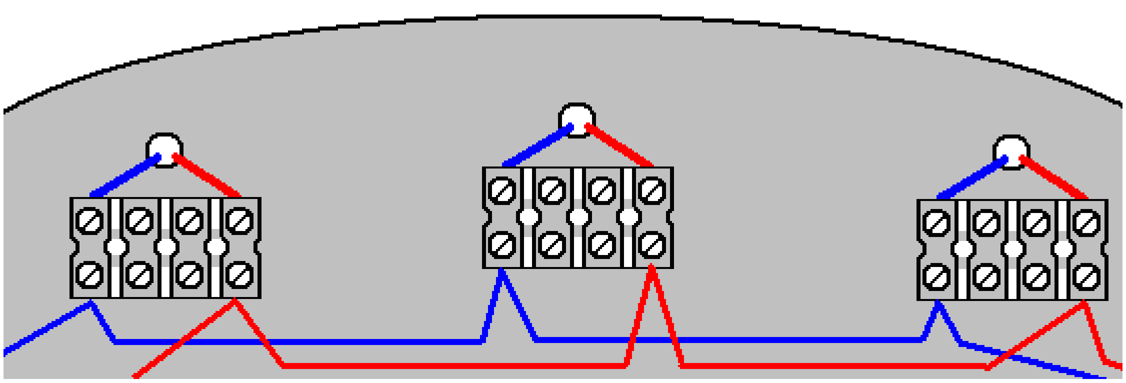


You will notice that there is a diode between connected across the drive coils. The direction of the diode will not allow current to flow from the battery through it (it would have to be connected the other way round if we wanted that to happen – which we don't). A feature of coils, especially coils with lots of turns, is that if they have a current flowing through them, they really, really don't like that current flow to be stopped. If it is, then they generate a large voltage spike in the reverse direction.

If the battery is a 12-volt battery and the transistor is switched hard On, that connects the full battery voltage across the coils and so causes strong current flow through the coils. When the transistor switches Off it stops the current flow through the coils, which promptly generates a major reverse voltage in the coils. Because one side of the coils is connected to the battery Plus, that voltage drags the collector of the transistor to a much higher voltage than the voltage of the battery. This worries circuit designers as the transistor might not be able to survive such a high voltage, and so they connect a diode from the battery Plus to the transistor Collector. The thinking behind this is that once the transistor Collector is dragged to 0.7 volts or more, above the battery voltage, then the diode will start to conduct and that will collapse the voltage spike of the coils and prevent the voltage getting much above the battery voltage.

That does happen, and yes, it does protect the transistor from being damaged by excessive voltage. But, consider the current flow through the diode. It is connected to the battery Plus, and so any current flows back into the battery as it has no alternative flow path. That recovers some of the current used to drive the generator, so the diode is much more useful than just protecting the transistor (especially since we could use a transistor able to withstand the high voltage generated). Please note that the diode is a UF5408. The "UF" stands for Ultra Fast, meaning that the diode is able to switch On and Off very quickly indeed. That is important when we are dealing with very fast, very sharp voltage spikes like those generated by our coils, so please don't assume that any old diode will do the job for us, as we need a fast one.

Just before we leave the drive coils to move on to the power gathering coils, let me confirm how they are connected. Initially, we need the biggest possible push from the coils and so they are connected 'in parallel'. That is, like this:



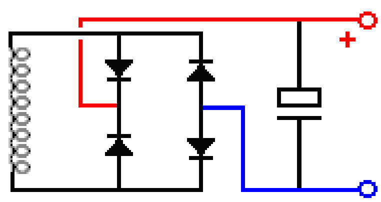
The start of each drive coil is connected to the start of every other drive coil (the blue line) and the end of each drive coil is connected to the end of every other drive coil (the red line). The TIP3055 power transistor applies the full battery voltage to all drive coils simultaneously. Initially, I would suggest that you try ten drive coils as that was what suited the original build, although it is highly unlikely that those coils are the same as your coils.

To get the rotor started requires giving it a push in the right direction. That will start the pulsing drive pushing the rotor around and it will accelerate to its working speed all on its own. Some people may feel that the rotor could rotate in either direction. That would be the case if, and only if, the timing coil is positioned centrally without any movement when the wheel performance is optimised after the power collection coils have been wired up and are contributing output power. So, choose a direction of rotation and stay with it at all times.

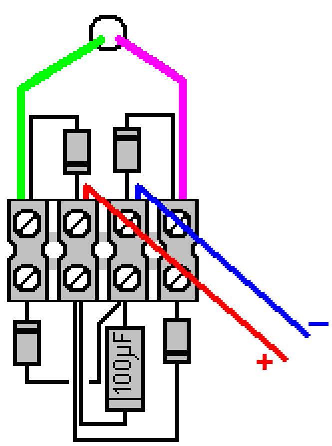
When a magnet passes close to a coil of wire, the result is a voltage between the ends of the coil. That voltage varies with time and is generally a sine wave shape which varies slowly compared to the voltage spikes of the rotor-powering coils when they are switched Off, and so, any diode can be used to convert that voltage to Direct Current.

Ideally, you have 3000-turn coils mounted on the second side of the fifteen active planks (the sixteenth plank being exclusively for timing and adjusting for the best possible performance, certainly on the first rotor, any additional rotors don't need a timing coil as we already have that). For the moment, leave the remaining five rotor-powering coils unused as we can decide later if they are to be powering coils or power-gathering coils. We won't know that for sure until we start drawing current from the generator, because that current flowing in the output coils causes a magnetic field which alters conditions for the rotor. So, we need to see how it goes when we are drawing current from the generator.

I suggest that every power output coil is treated exactly the same as all of the other power gathering coils. First, we use four diodes to convert all of the coil power from AC to DC. This is done with a standard bridge configuration like this:



This arrangement may look a little strange. The four diodes are not a bridge although electronically they do form one. These can be four separate, discrete diodes such as the 1N4148 or the 1N4007 both of which are incredibly cheap as they are so popular. Alternatively, a 1.5 amp 100V single-package diode bridge can be used nearly as cheaply. The capacitor shown is very helpful for testing as well as for producing a good output. It can be quite small in value, perhaps 100 microfarads or 1000 microfarads if you prefer. It is easier to check the output voltage on each power gathering coil when there is a capacitor in place, and you get an increased capacity smoothing capacitor with every output coil added. A possible physical layout is:

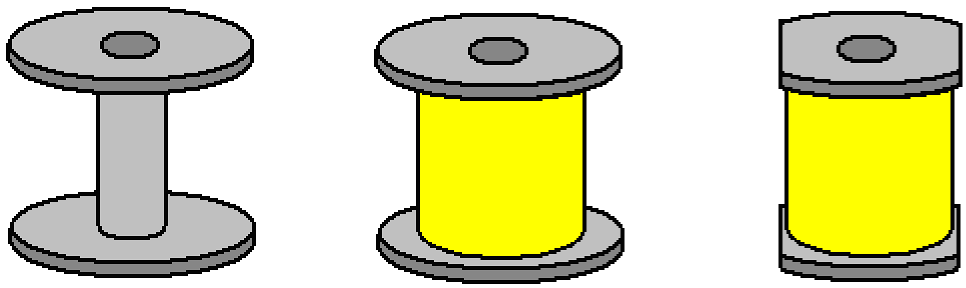


The original build was to show conclusively that the generated output power was greater than the input power. That was the reason for all of the meters used on the original. As the input power was DC and the output power was DC, measuring the input voltage and current gave the input power, while measuring the output voltage and current gave the output power and the demonstrations showed that the output power was more than three times larger than the input power.

That being the case, we should be able to get the generator running and then switch from battery input to feeding the input from a capacitor powered by several of the output coils. This type of rotor drive is really good for doing this, because the drive voltage is not particularly important. I can see no reason why this generator cannot be self-powered and still supply power for other uses. With three rotors, many magnets and many coils, it should be possible to extract significant power from this generator. Even if that were not the case, there are various devices in chapter 14 (“renewable energy systems”) which need very little power to be useful – lighting, cooling, etc.

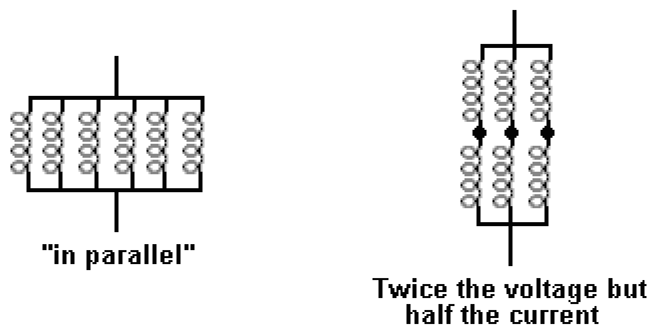
One really big advantage of this design is that it is easy to understand, easy to expand, and does not need any specialist skills. Also, while a number of hand tools have been used in the construction, if you do not already own those tools you don’t necessarily have to buy them. It is likely that a friend has them and can lend them to you or alternatively, a local hire shop can rent you those tools for a day or even half a day at a very low charge.

If you prefer not to make coil spools for yourself, then it is possible to buy the wire on a large number of 50-gram reels. The reels supplied by the Scientific Wire Company are good quality plastic, 40 mm diameter, 30 mm tall, with 2 mm thick flanges, which leaves a shaft length of 26 mm. You can wind the wire off one spool on to any suitable temporary holder, giving you one empty spool. That spool can then be wound from two of the full spools and that gives you two empty spools. Every spool wound, gives you an extra empty spool. As the 40 mm diameter flange is wider than we need, **after** the coil has been wound, the excess flange width can be cut off with your coping saw:



The hole through the shaft of the spool is 10 mm in diameter but that is no problem as the 6 mm diameter threaded rod of your winder can easily be expanded to 10 mm by wrapping a length of masking tape, duct tape, electrical insulating tape or any other similar tape, around the shaft to align the spool which is then clamped in place by the nuts and washers.

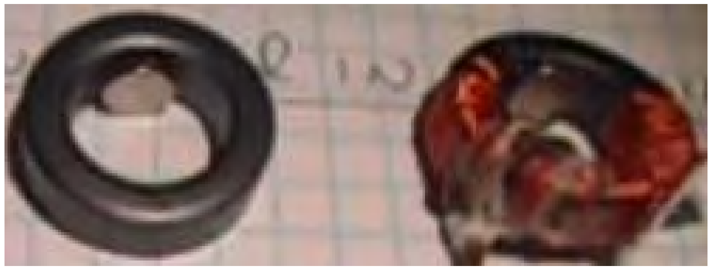
If your particular build of this generator produces a voltage which is lower than you want, then instead of connecting the output coils in parallel you can start by connecting them in pairs before making the parallel connections:



The second arrangement is called connected “in series parallel” and naturally, as they are only half the number of pairs of coils as there are single coils, the overall current is only half of what it is when the coils are connected in parallel. However, the power is exactly the same no matter how the coils are wired together.

To tune the generator for best output, you can connect a voltmeter (usually a multimeter set to it’s 20-volt DC range) across any output coil’s capacitor and move the timing coil slowly to find the position of the timing coil which gives the greatest output. That is why it is probably best to have the timing coil on the top plank where it is easiest to get at.

There are a couple of additional things which you may care to try out to see if they work well. They both are a different style of drive coil. The first comes from what is known as the Thomas Motor as shown in the video https://www.youtube.com/watch?v=9s7sM3csFHM&feature=youtu.be. This drive is a strong but small permanent magnet which is placed inside a wire wrapped ferrite toroid. When the toroid winding is energised by passing a current through it, the resulting magnetic field circling around the toroid blocks off the field of the permanent magnet, acting as a very effective magnetic shield:



The toroid used is probably the 22.5 x 13.5 x 10 mm toroid from China, currently selling at £5.01 for a pack of ten toroids delivered from China:

The above video has some errors in it so please use common sense and use the technique rather than paying undue attention to what is said.

The toroid is wound with one continuous helical counter-clockwise coil going all the way around the core. The one shown is wound with approximately 10 metres of 38 gauge enamelled copper wire which has a diameter of 0.15 mm. The permanent magnet used is 6 mm diameter and 3 mm thick. If the rotor magnets have the North pole facing the coils, then the North pole of the magnet inside the toroid, faces the rotor and the coil is energised until the rotor magnet has just passed and then the current is cut off to allow the toroid magnet to push the rotor on its way through repulsion.

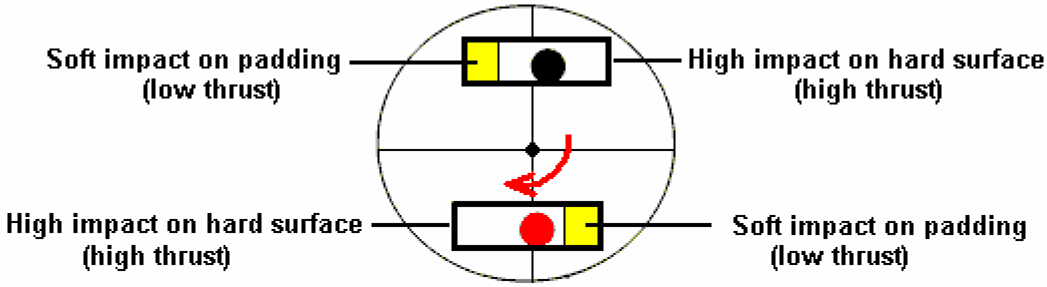
The second method is using the Steorn 'Orbo' style coils (with no toroid magnets). These toroids are also wound in the same way using ferrite toroids as shown here: https://www.youtube.com/watch?v=aCpniBm9i_M and described in chapter 1. With no current flowing through the winding, the rotor magnets are attracted towards the ferrite toroids. When the rotor magnets align with the toroids, the current is switched on, blocking the ferrite toroid from the rotor magnets and letting the momentum of the rotor carry the rotor magnets half way towards the next toroid, where the current is cut off and the attraction starts all over again. For best effect, the hole in the centre of the toroids faces towards the rotor and not as shown in the above video. This technique of letting the rotor magnets provide the power which spins the rotor is the method used by Robert Adams in his COP=8 motor generators shown in chapter 2.

If you are confused by the many possible options for making a generator of this general type, then I would suggest that you choose to have just one rotor with sixteen magnets on it, and 31 coils each with 3000 bi-filar wound turns (that is, one coil on both sides of each plank except for the timing coil plank).

If you choose to construct this generator, then good luck with your project. Remember that increased power comes with more coils, more rotors, more coil turns. I would expect you to have a lot of fun adjusting and optimising this generator.

Lawrence Tseung's Gravity Wheel

Behind this device is Lawrence's "Lead-out" theory and for this he suggests a simple arrangement to demonstrate the principle. He presents the case of a rotor which has two substantial weights contained in two cylinders attached to the rotor:

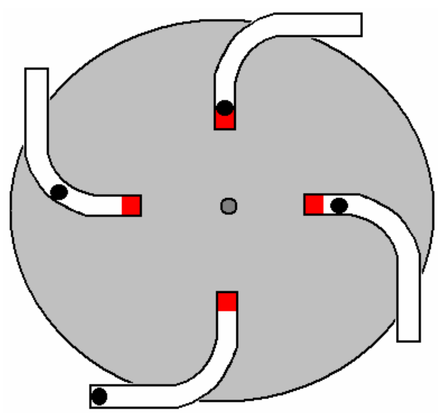


As the disc rotates, the ball falls down the length of the tube. At one end, the tube has a rigid cap which causes a significant impact when the ball hits it. The other end of the tube is padded and that cushions the impact which causes a net imbalance in the impacts and that maintains the rotation.

There is a prototype implementation on YouTube but the implementation is not adequate and the disc stops rotating after five minutes. The YouTube video slot is located at:
http://www.youtube.com/watch?v=zykButGc22U&feature=related and there are two significant problems with that particular build. Firstly, the tube rotation is too slow to be effective and instead of the weight falling under gravity and accelerating to a good speed before the impact, the weight just rolls gently down a minor slope and does not make a major impact.

Secondly, the weights are far too small for the size of the wheel and there are only two weights providing impacts very widely spaced apart as the wheel rotates only slowly. One man made a ten-foot version and it rotated steadily for ten months after which time his wife insisted that it be taken apart as it was too noisy.

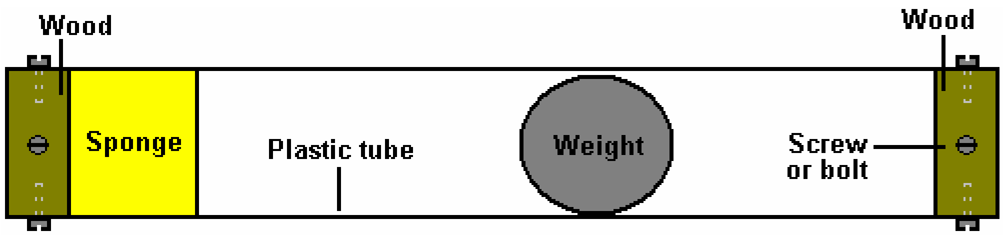
I would suggest some modifications to the wheel as Lawrence is far too busy with developing his COP>1 pulse implementation. Firstly, the movement of each weight should be delayed until the tube is much nearer the vertical. This can be achieved by curving part of the tube like this:



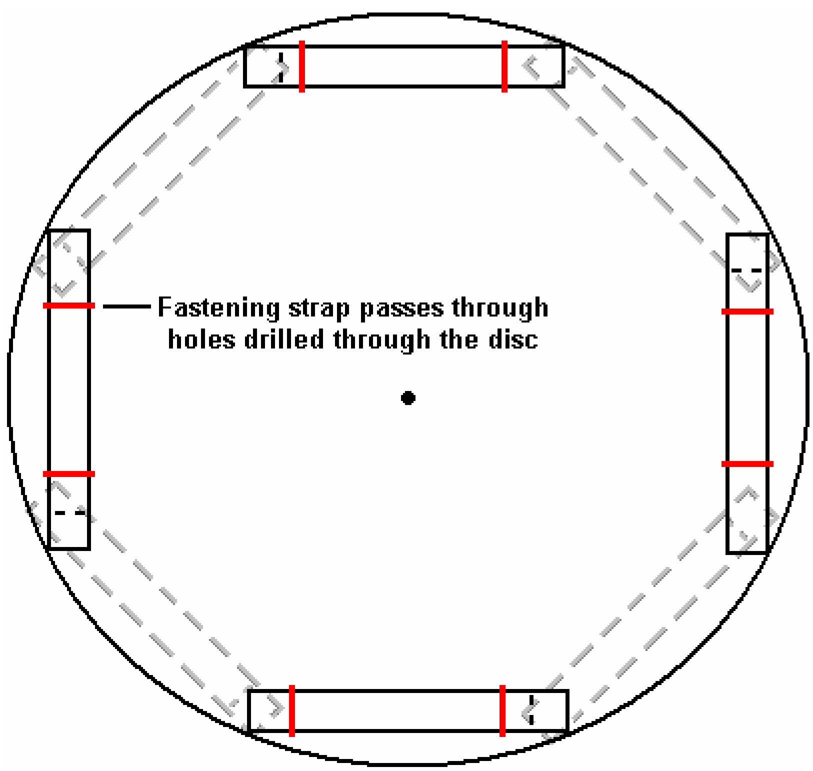
This way, the ball does not start rolling until the main part of the tube is near vertical. This allows a much greater acceleration and impact. The weighted ball should be much larger, say 2" (50 mm) in diameter and made of lead, in order to generate a significant thrust. Also, the cushioned ends of the tubes should be aligned with the pivot of the wheel so that any residual impact does not generate a turning force in the wrong direction. there is a negative turning effect due to the lever arm of the bottom weight. This turning force is only there for a small arc of rotation as the weight will roll inwards as soon as the tube section rises above the horizontal and as the tube then transitions into a circular curve, the movement inwards is gentle. It probably would be better if the tubes were angled slightly more in the clockwise direction, rather than exactly as shown in the diagram.

Secondly, there should be eight tubes on the disc, four on each side and one side staggered by 45 degrees so that there is a driving impact every 45 degrees instead of the 180 degrees of the version shown in the YouTube video. With that arrangement of four times as many impacts, each substantially greater, and no significant reverse impacts, the wheel has a much better chance of successful rotation without needing to be particularly large. The wheel itself should not be light as it acts as a flywheel and a pulsed flywheel has already been shown to produce excess power. The wheel bearings should be ball races and not the closed variety because those ones are packed with grease and have a serious resistance to rotation. Instead, the open-sided variety of ball bearing should be used as they rotate very freely.

Using straight tubes for illustration, each tube could be like this:



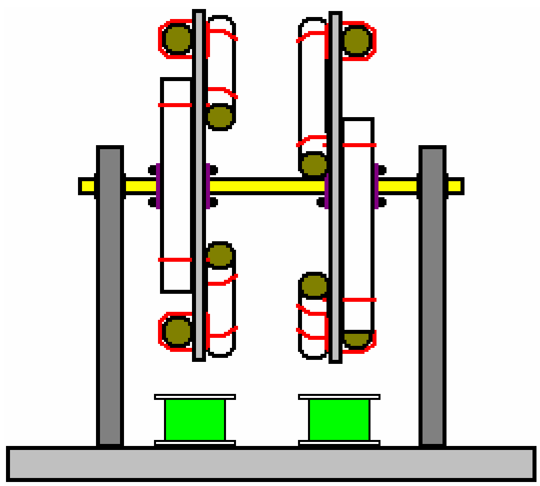
Here, a wood disc is fitted to each end of a piece of plastic tube and held securely in place with screws or bolts which pass through small holes drilled in the plastic pipe and screw into the wooden disc. A piece of thick sponge is glued to the disc at one end and the heavy weight inside the tube is not a tight fit so that it can move very freely inside the tube. Four of these tubes are fitted to each side of each disc used in the device as shown here:

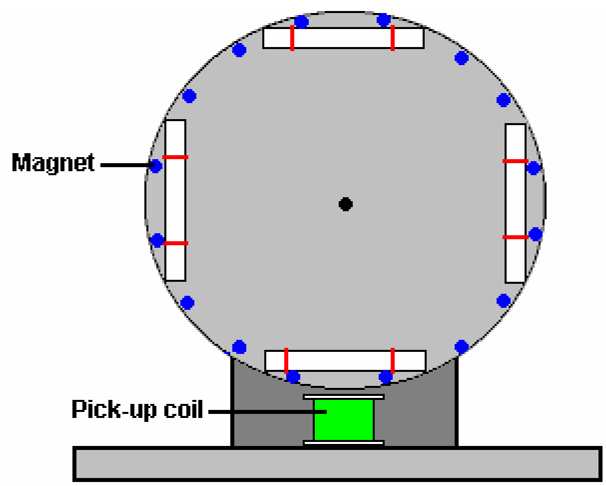


The four tubes attached to the back of the disc are 45 degrees away from the tubes mounted on the front of the disc. Each tube is attached securely in place with straps which pass through the disc and are secured on the far side. The tubes can also be glued in place to further strengthen the attachment. These eight tubes give an unbalanced impact for every 45 degrees of rotation.

One man who replicated this design with a ten-foot diameter disc, ran it for ten months continuously until his wife got him to take it apart due to the clicking sound that it makes when running.

If two of these discs are attached to a common rotor shaft, then the second disc can be positioned 22.5 degrees around from the first one. That arrangement gives an unbalanced impact for every 22.5 degrees of rotation. If three discs were placed on a common rotor shaft and evenly positioned, then there would be an unbalanced impact every 15 degrees of rotation, which is 24 impacts per rotation. A two-disc arrangement might look like this:





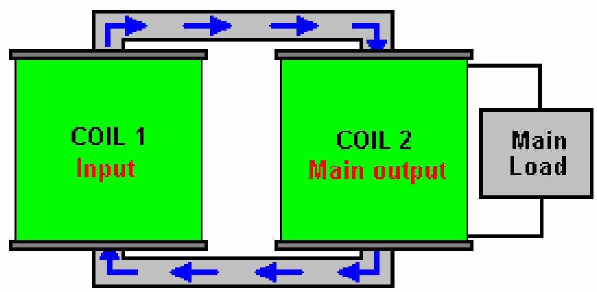
If the rotor spins well, then it would be worth while attaching a series of magnets to the discs, being careful to keep each disc perfectly balanced. One or more air-core coils can then be used to determine if current can be drawn from the device without stopping the rotation. The coils should not have a magnetic core as that would cause a major drag on the rotation whether current was being drawn or not.

Chapter 6 - Voltage Pulses

The Transformers of Thane Heins.
Thane has developed, tested and applied for a patent for a transformer arrangement where the output power of his prototype can be more than thirty times greater than the input power. He achieves this by using a figure-of-eight double toroid transformer core. His Canadian patent CA2594905 is titled "Bi-Toroid Transformer" and dated 18th January 2009. The abstract says: The invention provides a means of increasing transformer efficiency above 100%. The transformer consists of a single primary coil and two secondary coils.

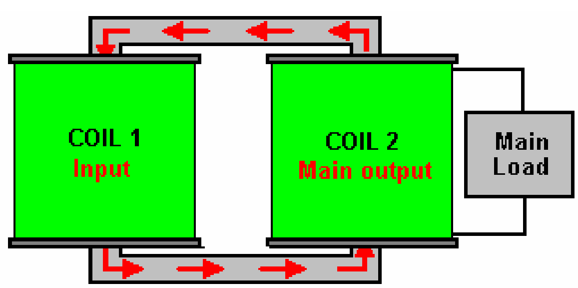
Magnetic flow is a thousand times easier through iron than it is through air. Because of that fact transformers are generally constructed on a frame made of iron or a similarly magnetic material. The operation of a transformer is nothing like as simple as school teaching would suggest. However, leaving parametric excitation aside for the moment, let us consider the effects of magnetic flow.

The way that off-the-shelf transformers work at the moment is like this:



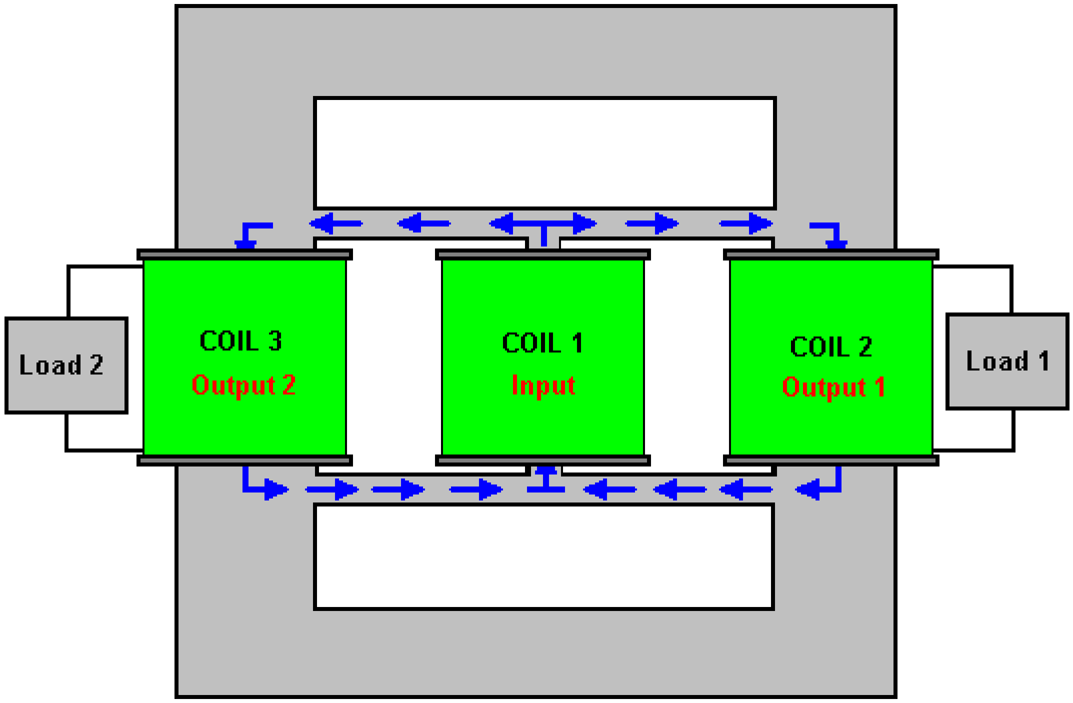
When a pulse of input power is delivered to Coil 1 (called the "Primary winding"), it creates a magnetic wave which passes around the frame or "yoke" of the transformer, passing though Coil 2 (called the "Secondary winding") and back to Coil 1 again as shown by the blue arrows. This magnetic pulse generates an electrical output in Coil 2, which flows through the electrical load (lighting, heating, battery charging, video displays, or whatever) providing it with the power which it needs to operate.

This is all well and good but the catch is that when the pulse in Coil 2 finishes, it also generates a magnetic pulse, and unfortunately, that magnetic pulse runs in the opposite direction, opposing the operation of Coil 1 and causing it to have to boost it's input power in order to overcome this magnetic flow in the opposite direction, shown here by the red arrows:

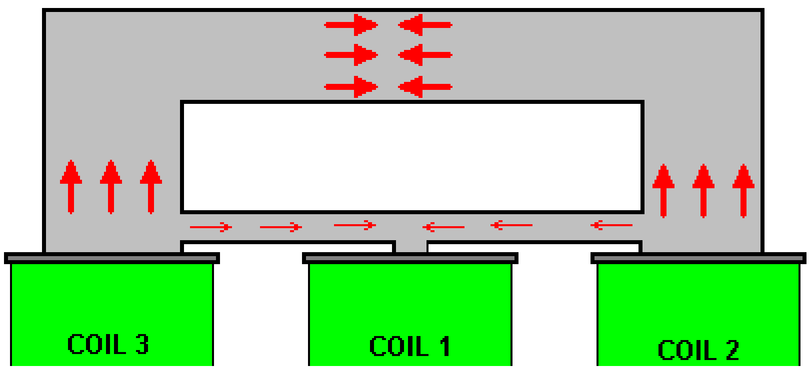


This is what makes current scientific "experts" say that the electrical efficiency of a transformer will always be less than 100%. This effect is caused by the magnetic path being symmetrical. Like the flow of electricity, magnetic flow passes along every possible path. If the magnetic path has low magnetic resistance (generally due to having a large cross-sectional area), then the magnetic flow through that path will be large. So, faced with several paths, magnetic flow will go along all of them in proportion to how good each path is for carrying magnetism.

Thane Heins has made use of this fact by making a transformer like this:



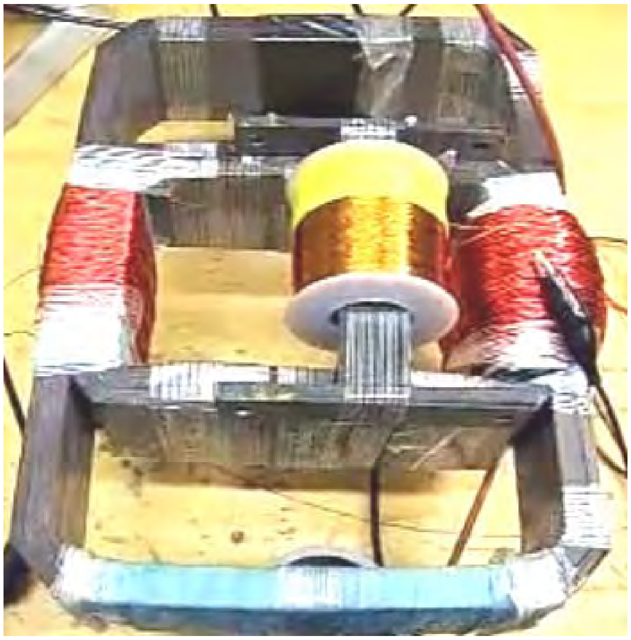
This style of transformer has got quite complicated magnetic flows when it is operating, although the diagram above only shows some of the flow paths generated when the input coil "Coil 1" is pulsed. The really interesting result is seen when that input pulse cuts off and we expect return magnetic flow from coil 2 and coil 3. What happens is this:



Assume that coil 2 and coil 3 are identical. The reverse magnetic flux coming out of coil 2 immediately encounters a junction with one path being far easier to use than the other. As a result, the vast majority of that magnetic flow follows the broad path, and only a small percentage flows through the narrow path. The broad path flow meets and is opposed by an identical large flow coming from coil 3, and those flows effectively cancel each other out. This produces a major improvement over an ordinary transformer. But, the small flow reaching the entrance to Coil 1 encounters two identical paths, and only one of those paths goes to coil 1, so the flux divides with half going towards coil 3 and half going through coil 1. That halves the strength of the already small percentage of the original, unwanted reverse magnetic flow into coil 1. The other half runs into the reduced flow from coil 3 and those halves cancel each other out. The overall effect is a really major improvement in the performance of the transformer as a whole.

In the patent document, Thane quotes a prototype test which had a primary coil winding with 2.5 ohms resistance, carrying 0.29 watts of power. The secondary coil 1 had a winding with 2.9 ohms resistance, receiving 0.18 watts of power. The Resistive load 1 was 180 ohms, receiving 11.25 watts of power. The secondary coil 2 had a winding with 2.5 ohms resistance, and received 0.06 watts of power. Resistive load 2 was 1 ohm, receiving 0.02 watts of power. Overall, the input power was 0.29 watts and the output power 11.51 watts, which is a COP of 39.6 and while the document does not mention it directly, the primary coil should be driven at it's resonant frequency.

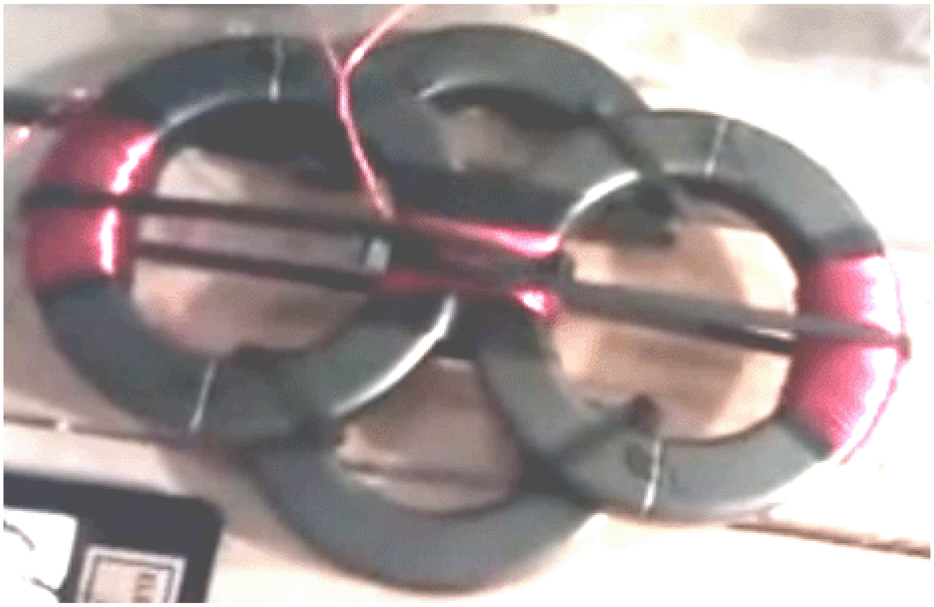
A variation of this arrangement is to attach an outer toroid to the existing bi-toroid arrangement, like this:



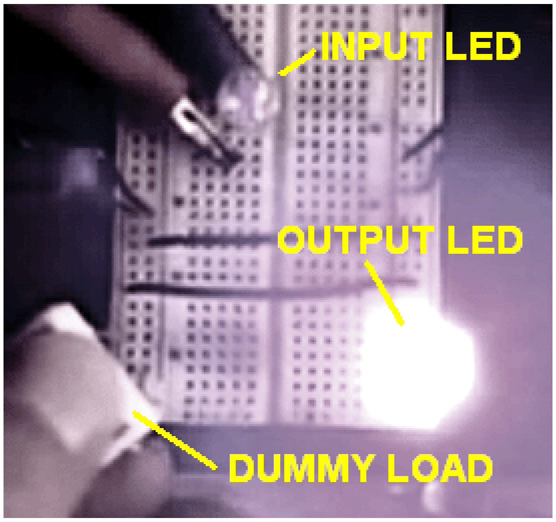
This prototype, as you can see, is fairly simple construction, and yet, given an input power of 106.9 milliwatts, it produces an output power of 403.3 milliwatts, which is 3.77 times greater.

This is something which needs to be considered carefully. Conventional science say that "there is no such thing as a free meal" and with any transformer, you will get less electrical power out of it than you put into it. Well, this simple looking construction demonstrates that this is not the case, which shows that some of the dogmatic statements made by present day scientists are completely wrong.

At https://youtu.be/-LBnnL4v8MQ?list=PLkH1zLdXy1Sy3_St1tUwtY_6qiusDkyG9 Thane shows a video where his bi-toroidal transformer is constructed from three ordinary toroids held together with cable ties:



Thane then goes on to demonstrate the performance of this combination:



The LED associated with the power being fed to the primary winding is so low that no light is visible. The output LED is lit so powerfully that the camera has difficulty in displaying it. The dummy load is a single resistor placed across the third winding and there is a major performance difference when it is plugged into place. This video demonstrates very clearly, the difference caused by using a bi-toroidal transformer.

This simple and elegant modification of the humble transformer, converts it into a free-energy device which boosts the power used to drive it and outputs much greater power. Congratulations are due to Thane for this technique and for his sharing it openly with anyone who is interested.

Motor Design

The same level of silliness is shown in the construction of motors as they are made perfectly symmetrically so that any load applied increases the internal magnetic field of the motor, opposing the input current and so requires greater input power. It has been pointed out that there is absolutely no need for this and I have even been told of a German engineer who rewound a motor so that it became self-powered!

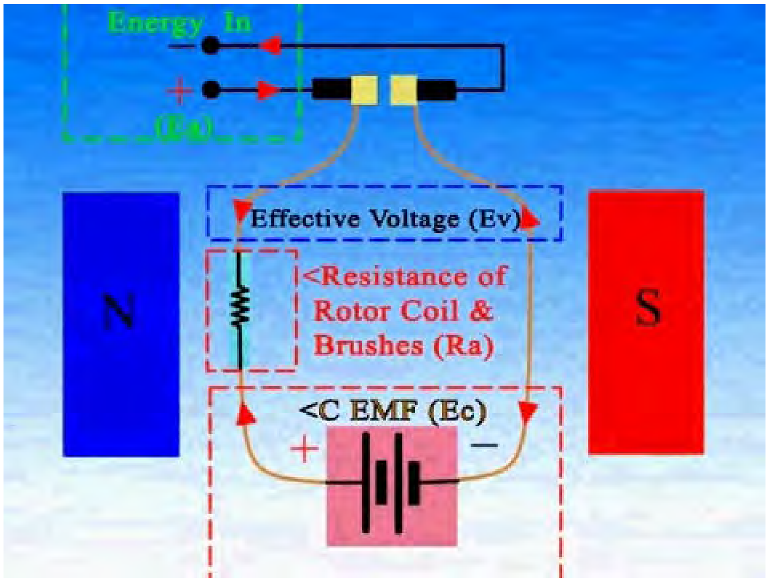
The video: http://torrentdb.in/95d95cff2bbC8039ed9/Peter-Lindemann-Electric-Motor-Secrets.torrent is available on the web and I strongly recommend that you watch all of it. It presents the basic facts very nicely. In brief outline, present day motors act both as a motor and as a generator of electrical power, but they are deliberately wound so that the power generation is used to oppose the input power and so produce a completely crippled output. During World War II, a German Engineer re-wired a standard electric motor and made it self-powered, that is, it ran and produced mechanical output power without the need for any input power once it had been started. That shows the potential of a properly constructed electric motor with the same size and general structure of any commercial electric motor.

Presumably, he did that by adding extra brushes and using some of the windings in generator mode with their output powering the drive windings which were arranged asymmetrically. There was also one other man who achieved self-powered re-wiring of a motor, but neither of those men made their information public knowledge.

The con job which has been run on us for many decades now is to wind the motor in such as way that the magnetic fields inside the motor oppose each other. When a current is passed through a coil of wire, it stores energy in that coil, and when the current flow is cut off, that energy needs to flow back out of the coil and it will do so in the reverse direction. This is sometimes called back-EMF ("Electro-Motive Force") although many people are not happy with that description. However, no matter what you call it, there is energy stored in the coil and that energy can be used to do useful work. But, the motor manufacturers choose to wind the motor so that instead of extracting that useful power, they use it to oppose a major part of the input power, creating a weak motor which heats up due to the wasted energy.

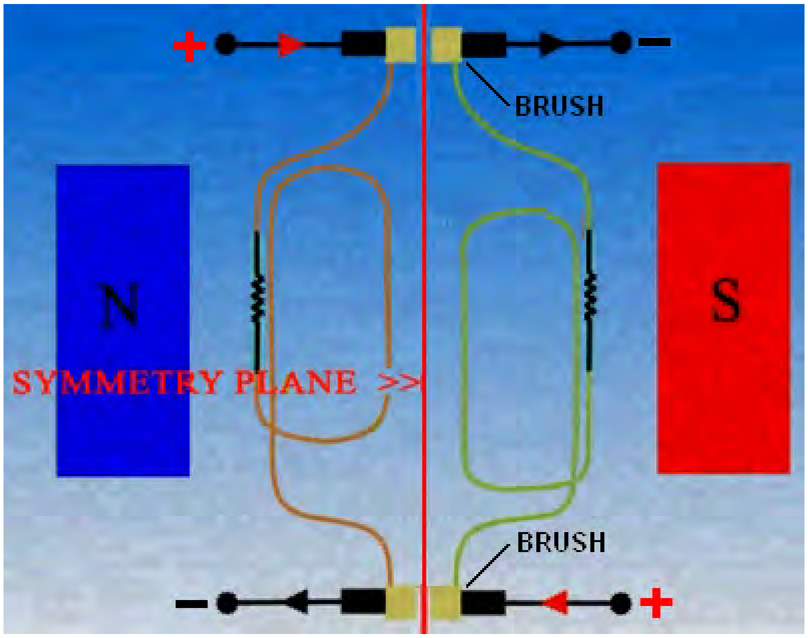
Contributor "UFOpolitics" points out that a deliberate mis-design of electric motors has, for the last 130 years, been presented to us as the only way to make and operate such motors. He states that because the windings are arranged in a symmetrical way, that a braking effect is produced which reduces the output power of the motor by anything from 50% to 90%. That is, a properly wound motor would have anything from twice to ten times the output power for the same input power. This mis-design guarantees that present day motors are always less than 100% efficient and always heat up when run. This mis-design is caused by using symmetrical windings in the motor.

Standard motor wiring is quite different and the killer effect is caused by having two windings which face each other, powered simultaneously with currents flowing in opposite directions. This causes a complete conflict between the magnetic fields and that destroys the efficiency of the motor: A very experienced experimenter has started a forum thread on the energetic-forum, both to explain this and to show new and more advanced construction methods and to answer questions and encourage replications and further developments. The forum is at: http://www.energeticforum.com/renewable-energy/11885-my-asymmetric-electrodynamic-machines.html and is definitely worth visiting, especially if you are good with mechanical devices. The experimenter uses the forum ID of "UFOpolitics" and he has produced an animated video in an attempt to explain the basic problems with present day DC electric motors: http://www.youtube.com/watch?v=Mj4rV0AoI-Q&feature=channel&list=UL. He points out that a problem winding in the standard DC motor looks like this:



The input current for any winding is fed in through a single pair of brush contacts. The generated electrical power "Ec" is not extracted and is forced to oppose the input energy "Ea", leaving only a fraction of the input power to actually run the motor. It is likely that a motor of this type will only operate at 25% of it's potential efficiency.

"UFOpolitics" has produced and demonstrated a simple way of overcoming this problem while using the existing motor housing, magnets and brush contacts. He does this by extracting the generated electrical power as a useful output and so preventing that useful power being used against the motor's operation. To implement this, he adds one additional pair of brushes and re-winds the motor coils like this:



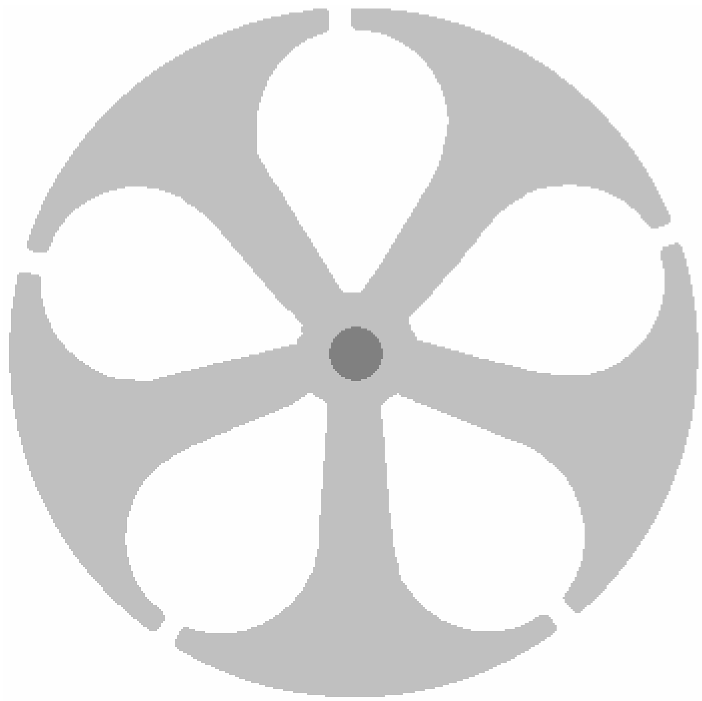
Here, one pair of brushes is at the top and one pair at the bottom of the 'armature' (the bit that rotates inside the motor housing and provides the mechanical power output). The coils are rewound to form a series of separate vertical coils, connecting to one brush terminal at the top and one brush terminal at the bottom as shown above.

The input power is between the terminals on the left and flows through the coil shown in brown. The current flow generates a magnetic field, causing rotation because of the Permanent magnets marked "N" (for a magnet which has it's North pole facing the coils) and "S" (for a magnet which has it's South pole facing the coils). The black zig-zag line represents the resistance to current flow of the wire and brush contacts.

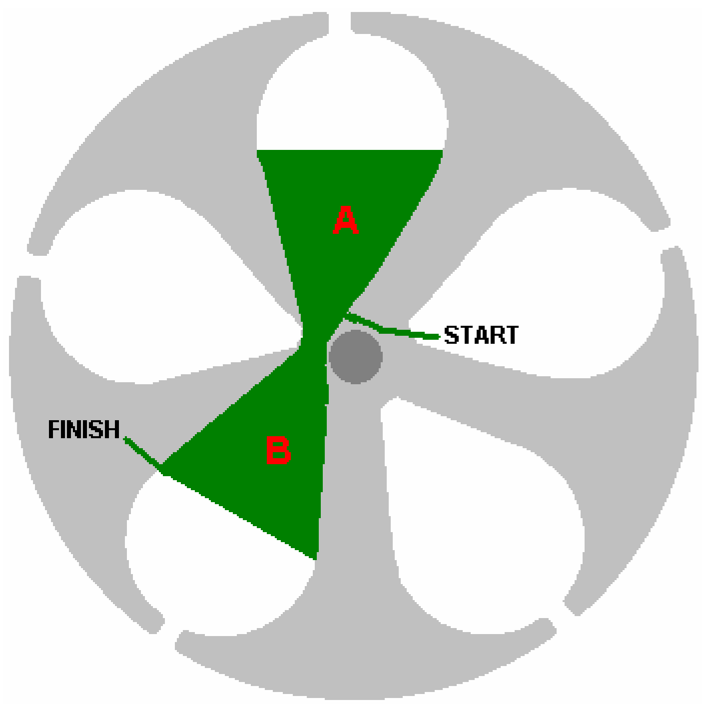
The coil shown in green on the right represents that same coil at a later moment when it has been disconnected from the power supply and rotated until it reaches that position, at which point, the energy stored in it is taken off as a useful output via the right hand pair of brushes. However, this is just an explanatory diagram and it does not show the very important fact that the discharging coil **must not** directly face a driving coil, because if it does, then the energy discharge would create a magnetic field which would interfere with the magnetic field of the driving coil and create a major problem.

Right, to say that again, any one coil is powered on the left hand side to drive the armature around and provide the output shaft with turning power ("torque"). Then that rotation disconnects that coil from the input power, leaving the coil charged with energy which has nowhere to go. That charged coil continues round until it hits the second set of brushes, which allow it to discharge through a load and do useful work.

The really clever part of the adaption of the motor is best seen from above the vertical rotor. If, for example, you were to take a five-pole DC motor apart and remove the windings, the shaft and armature body might look like this:

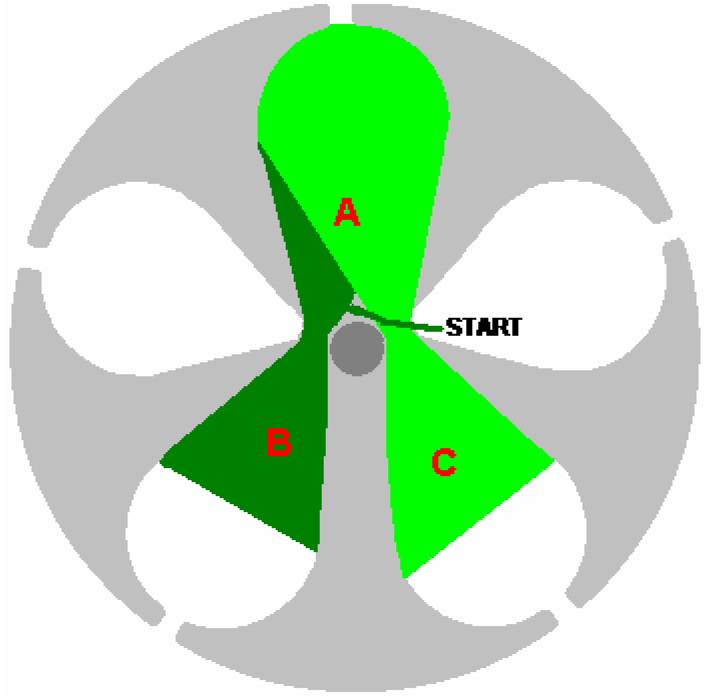


When making an asymmetrical wound rotor, the windings go like this.

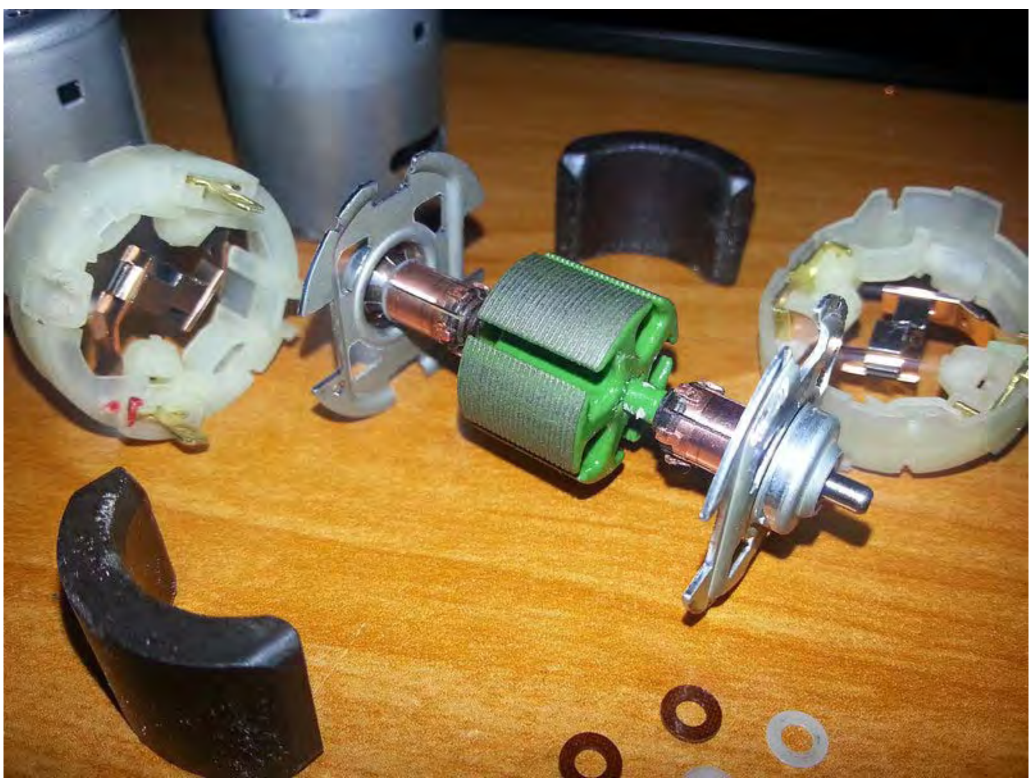


The start of the wire is secured at the top and then fed downwards through the opening “A” and back up through the opening “B”. For the small Radio Shack motor, this winding would be 25 turns of # 30 AWG wire (described as radio Shack ‘red’ wire, with a copper wire diameter of 0.255 mm). If you are re-winding a motor armature, please understand that each wire turn needs to be pulled tight in order to make a tight, solid and robust coil which will not vibrate unduly when the armature is spinning.

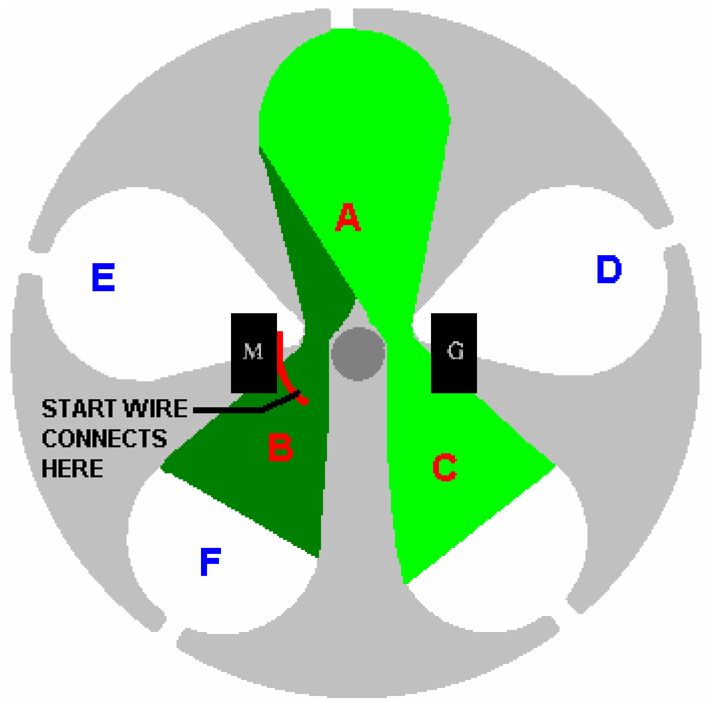
The end of the wire marked “FINISH” is **not** cut, but is taken down through opening “A” and this time, up through opening “C”. For clarity, these continuing turns are shown in a different colour, but please realise that it is the same single strand of wire being used throughout:



The final wire turn goes down through opening "A" and finishes at the other end of the body of the armature. In these views, the wire runs down into the paper, each turn forming a cylinder. This view may give you a better visual picture of what the coils are wound on:



The next step is to connect the START and FINISH wire ends of this V-shaped double coil to the "commutator" slip rings which allow current to be passed through the coil at just the right moment. Seen again from one end of the armature, the connections are like this:



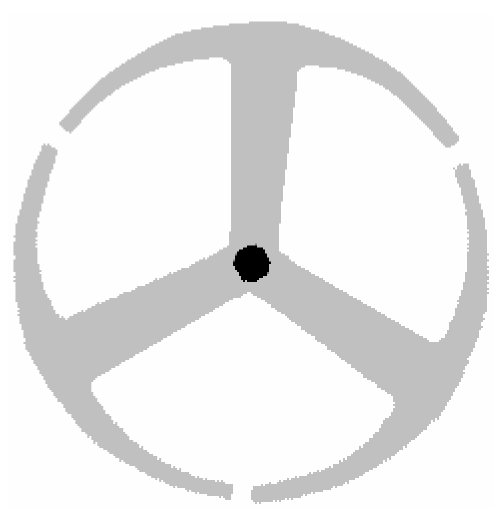
The commutator slip rings are connected further up on the drive shaft and the start of the winding wire (shown previously in dark green) is connected to the top commutator sector in the position shown here. The finishing end of the wire is connected to the corresponding commutator sector at the far end of the shaft – that is, the sector directly in line with the upper sector just connected to the start of the wire.

This completes the first of five identical V-shaped coils. The next coil is wound in the same way. The armature is rotated one sector counter-clockwise so that sector “D” replaces “A” at the top and the next coil is wound with the wire starting at the top and going down through opening “D” and up through opening “E”, repeating the same number of turns, and then, without cutting the wire the next set of wires are wound going down through opening “D” and back up through opening “F”. The start of the wire is then connected to the commutator sector which spans between openings “A” and “E” and the end connected to the corresponding commutator sector at the other end of the shaft..

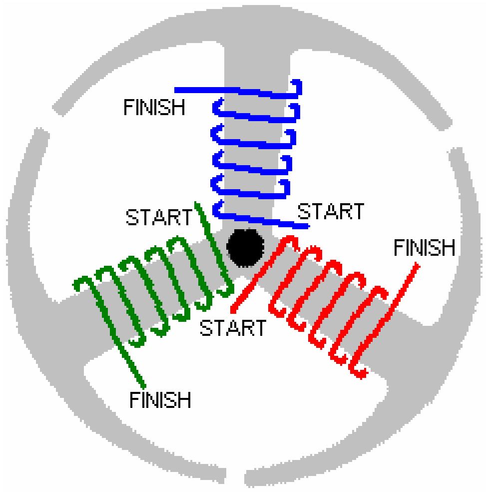
For each of the remaining three windings, the shaft is rotated one position counter-clockwise and the same winding and connecting procedure carried out. When completed, no matter which opening is placed at the top of the view along the shaft, the windings and commutator sector for the wire connections will be identical.

3-Pole Motors

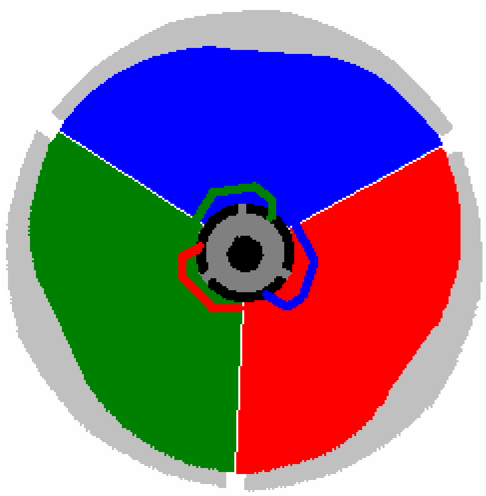
The winding arrangement is slightly different for motors which have three poles (or multiples of three poles such as 6, 9, 12, etc poles). For the very simple 3-pole motors, the armature looks like this:



and with this style of armature, the winds are around the three arms, like this:



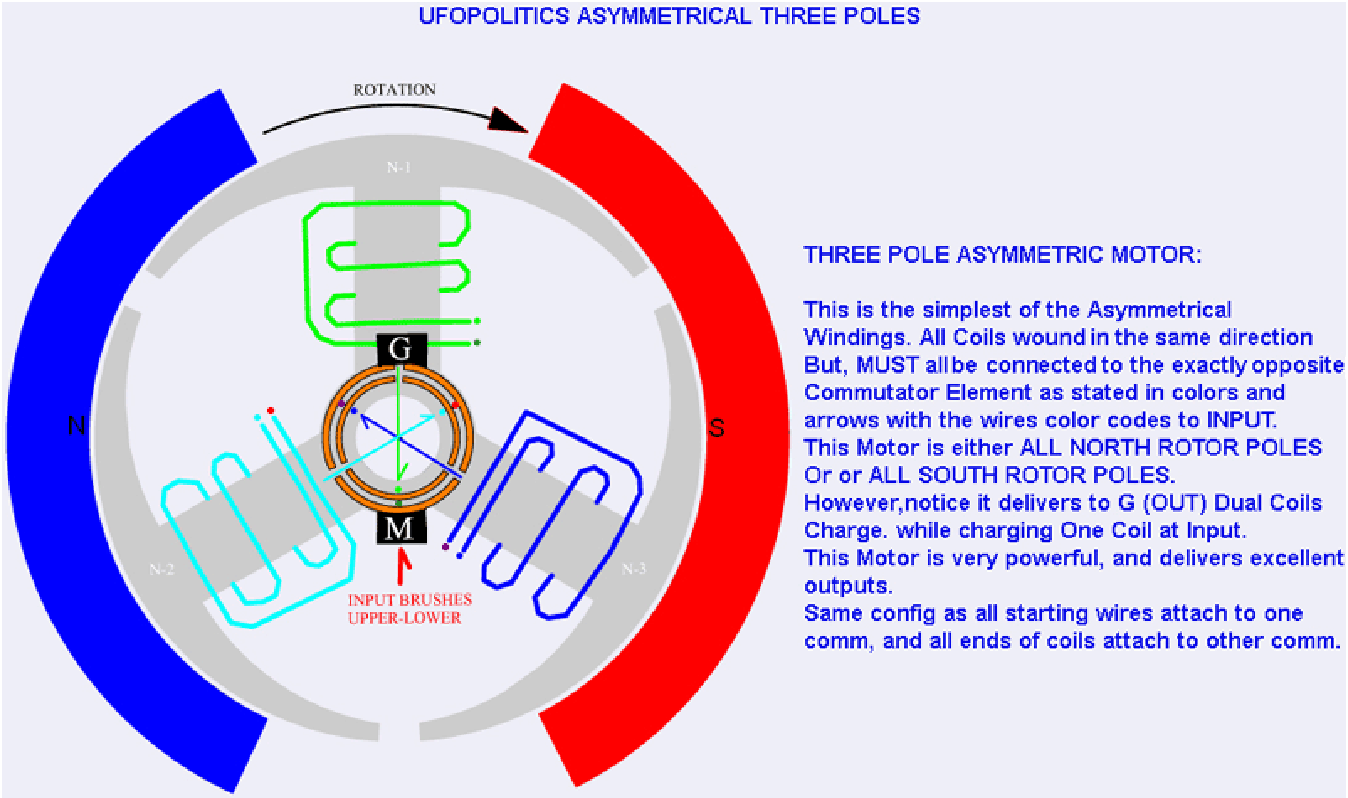
And as before, the commutator sectors at the top are duplicated at the bottom, allowing separate input and output circuits for each of the three coils. The windings have many turns, filling the available space and each winding is connected to the slip ring sector directly opposite it, like this:



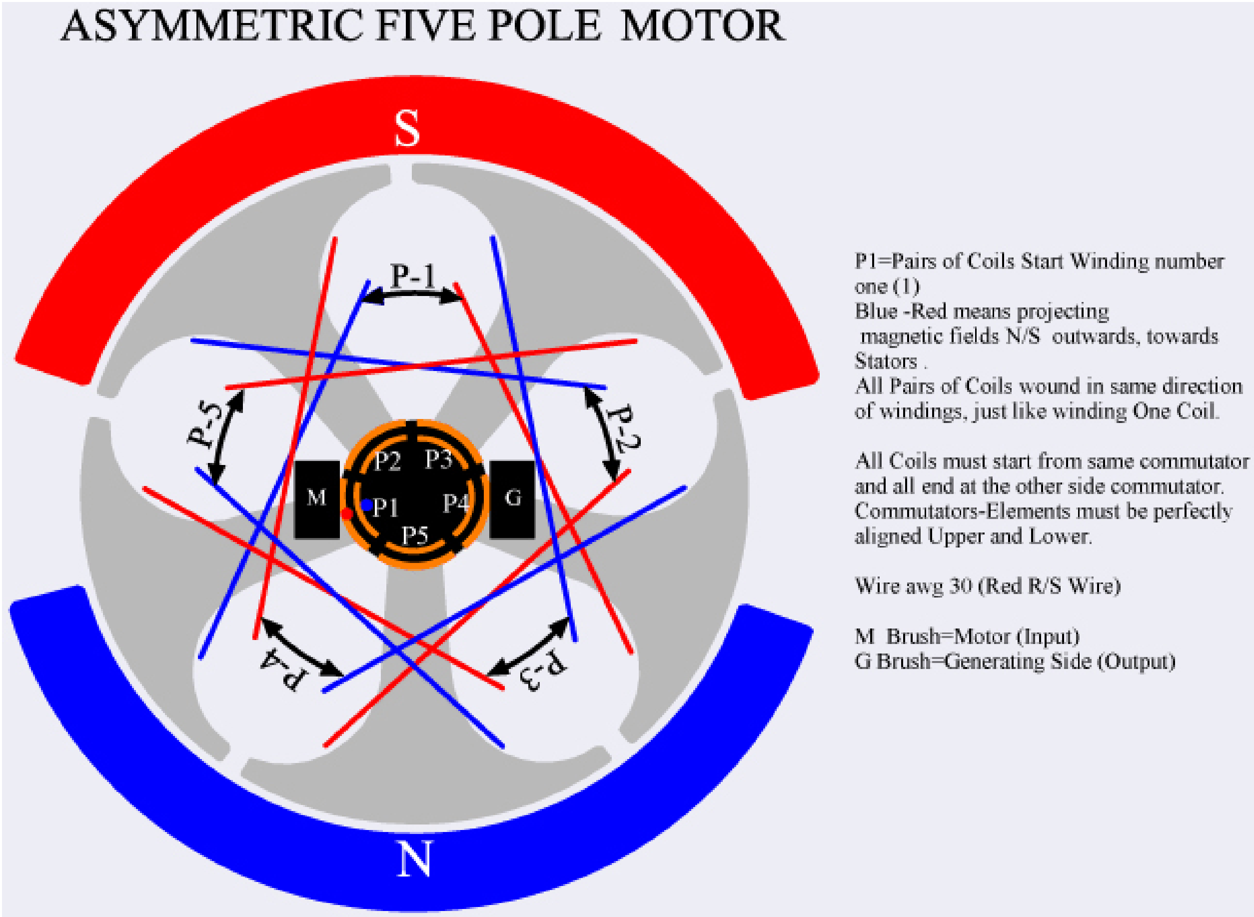
The Start of each winding is connected to the commutator slip ring sector at the top of the armature and the Finish is connected to the slip ring sector directly below it, that is, the sector which is at the same angle as the top one where the Start of the wire is connected. This allows the brushes which press against the slip ring sectors to connect to both ends of each coil in turn as the armature rotates. Three pole motors are particularly powerful and motors with six poles can be re-wound with pairs of adjacent sectors amalgamated to give three larger sectors. Nine pole motors can have three adjacent sectors wound as a single coil to provide the same effect as a three pole motor, and twelve pole motors can have four adjacent sectors wound as a single coil.

The positioning of the brushes is important. With the three-pole and five-pole arrangements, the brushes are aligned with the gaps between the magnets which surround the armature. However, the re-wound motor can be 'tuned' for improved torque and reduced drive current by adapting the motor housing to allow some adjustment of the position of the brush and commutator slip rings relative to the coils. This adjustment need only be slight as the angular movement of the brushes will be small. It is, of course, essential that the upper and lower adjusted positions move by exactly the same angular amount so that every upper commutator slip ring sector remains exactly above it's corresponding lower slip ring sector. In other words, the commutator slip ring sector at the top and bottom of each coil, must be exactly aligned vertically so that the electrical connections are made and broken at exactly the same instant

The commutator and brush arrangement are shown here in UFOpolitics' diagrams:



The Commutator brush marked "G" (for "Generator") takes away the energy stored in each coil and passes it to an electrical load. The Commutator brush marked "M" (for "Motor") feeds energy into the coil from the battery which is driving the motor. The red and blue stripes surrounding the armature are two permanent magnets. The magnet shown in red has it's South pole facing the armature and the magnet shown in blue has it's North pole facing the armature. This creates a magnetic field flowing horizontally across the armature. The five-pole arrangement is like this:



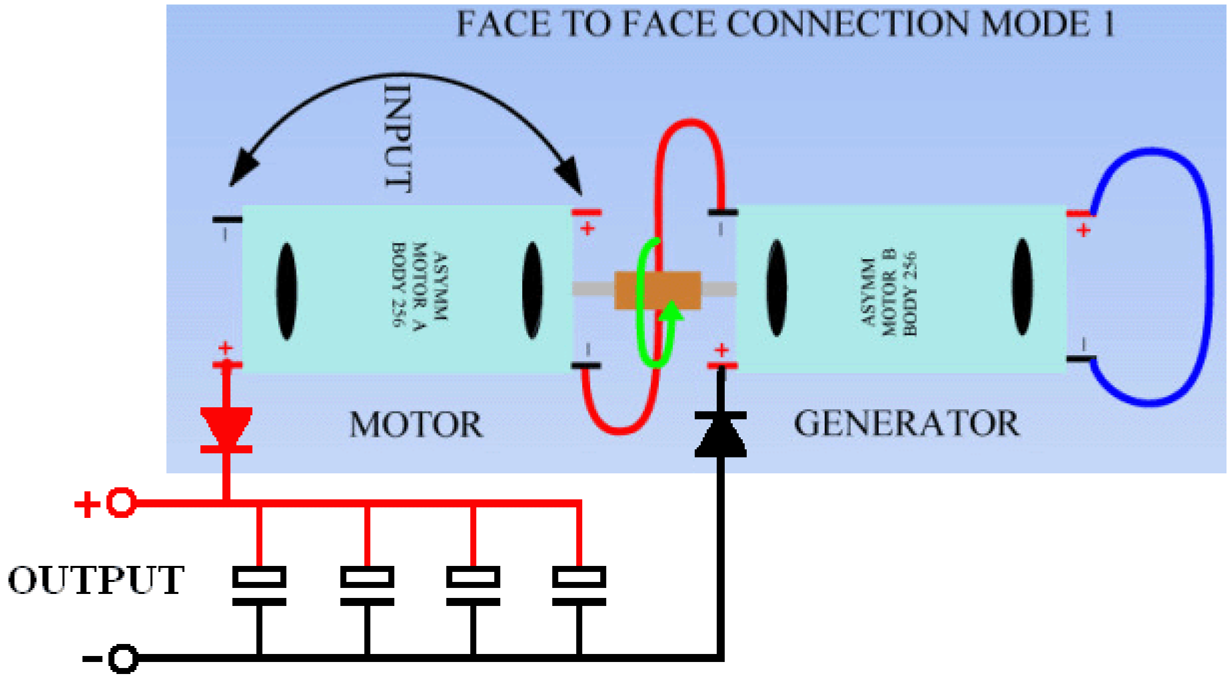
Here, the designation "R/S" stands for "Radio Shack" which is a chain of stores in America. In the forum, that is sometimes changed to "RS" and should not be confused with the large electronics outlet "Radio Spares" whose trademark is "RS". UFOpolitics has suggested that the cheap 5-pole DC motor available from Radio Shack should be used by experimenters to become familiar with re-winding DC motor coils. Being a cheap product, those motors do not have a particularly high build quality, but they are suitable motors for experiments. Forum members share the details of how they dealt with adapting these and other motors.

I have to admit that motor windings and operation tend to confuse me and I sometimes find it difficult to understand what 'UFOpolitics' means when he talks about different winding strategies. However, it seems reasonably clear at this early stage of forum development, that his objective is to produce two things:

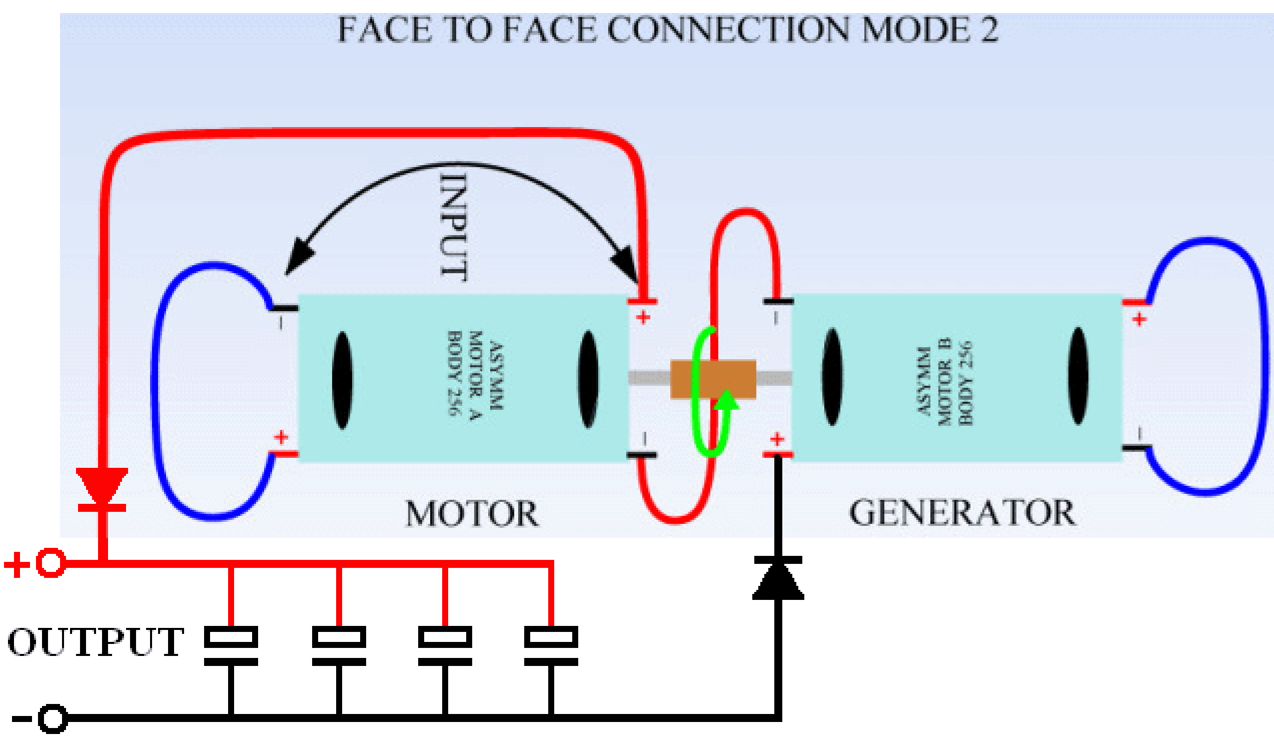
1. A very powerful electric motor which can be used in serious forms of road transport as well as for other practical applications, and

2. A powerful motor/generator combination which can produce useful generated electrical power.

While 'UFOpolitics' is very patiently going through many of the possible variations on how a DC motor can be wound and connected, and showing various forum members where they have failed to get some of their windings positioned correctly, he has also shown some of the best ways of connecting a re-wound motor used as a driver or "Prime Mover" as some people like to call it, and a re-wound motor which is to be used as an electrical generator. He shows two important ways for making a very effective Motor/Generator combination, as shown here:



It needs to be realised that these arrangements are not conventional arrangements and that the re-wound motors operate in a different way to motors bought 'off the shelf'. For this reason, it is necessary to isolate the electrical output to prevent current flowing through the load from affecting the operation of the Motor/Generator combination. This can be done by placing a diode in each of the output lines and charging a capacitor bank which is then used to feed whatever load is to powered. If my understanding is correct, then feeding any cold electricity produced into a capacitor causes the current to become conventional hot electricity. It is not clear if that action is part of this arrangement although the circuitry shown should be used. This is the second version:



‘UFOpolitics’ comments on these arrangements as follows: As we excite the input of the Motor, the Generator will start producing energy and that additional energy will flow through the Motor Output side because they are connected in series here. Two rectifiers must be connected at both output terminals, Positive and Negative, to avoid back flow from closing the circuit through the load.

As the Motor accelerates, the Generator boosts the energy flow which then runs through the Motor augmenting the Output Fields and when the output is loaded then an ‘Engagement’ of both Machines occurs as they start to compensate each other through their output flows. It should be understood that the Output should be Capacitor Banked in a dedicated Reservoir.

When designing a Generator for a specific, existing Asymmetric Motor machine, it must be understood that Generator Interactions should be considered to run as “Counter Rotation” to the Motor Machine’s originally conceived rotation (which is easily done by just moving brush-lines passing stator bisector angles to the opposite of those needed for a Motor, or alternatively, setting the timing backwards). This will definitively enhance the assisted rotation of both Machines when connected together in this Face-to-Face mode.

As I do not find the forum comments easy to understand, I recommend that you visit the forum and read the posts as you may well understand the conversations easier to follow than I do.

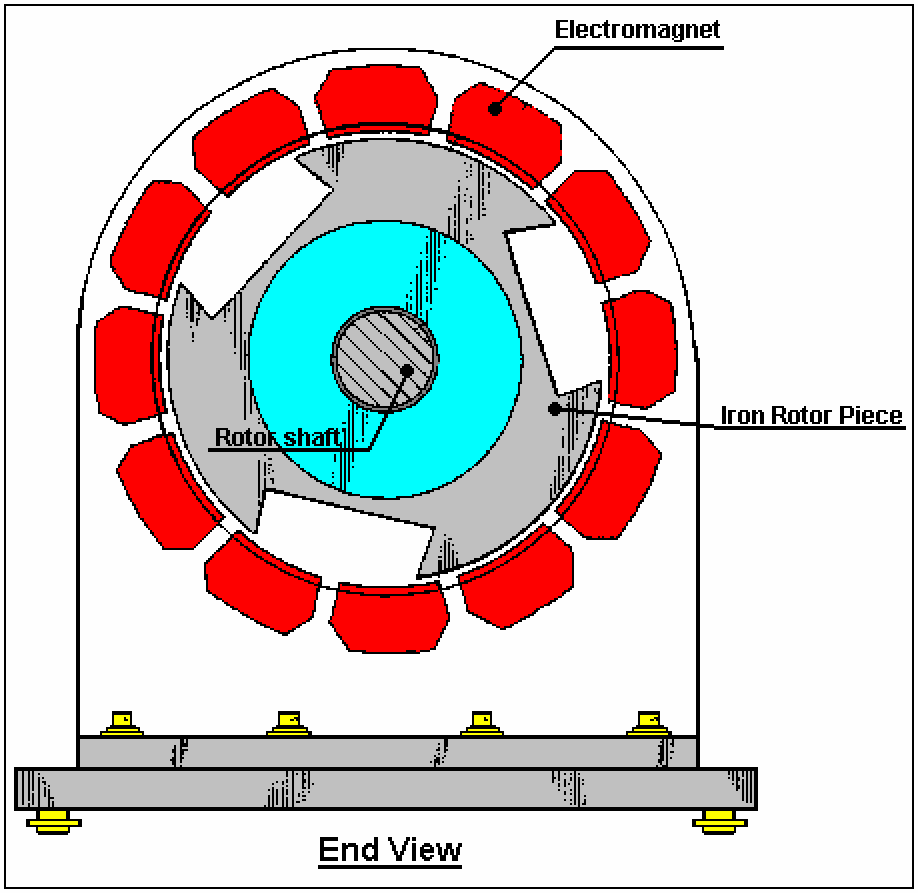
On the forum, ‘Sanskara316’ states “I have re-wound a small 3-volt 3-pole motor. I used an almost dead, 6-volt sealed lead-acid battery to power the motor. This battery just sits at around 4 volts and if given a load, even a small LED, it’s voltage drops to 1 volt. The re-wound motor started very slowly - barely spinning, then after a minute or two it started to spin faster, and I noticed that the voltage on the battery was slowly climbing. I connected a small LED flashlight to the generating side and it lit up. Now the battery voltage under load is around 2+ volts. It’s been running for an hour now and the machine squeals a lot. It is conditioning the battery and the meter cannot be showing what really is happening. The motor draws 300 ma?? – That’s not possible as the battery just doesn't have that power”. To which ‘UFOpolitics’ remarks: “Well I am glad you have witnessed some of the ‘Effects’... these re-wound motors do recondition batteries...remember, Radiant Energy is taking over the Machine...so Radiant Energy comes out through the Input also… which is the reason why we get high Volts-Amps reading on a meter ...these motors use very small amounts of current and volts. Inside the motor, every coil is being ‘Self-Electromagnetically-Pulsed’ because they auto-disconnect from the power source, then the next coil in the sequence is assisted by the first coil when it has rotated to it’s next position, and so on. The commutator switching has become a ‘Self-Oscillator’ for every independently-energised coil.”

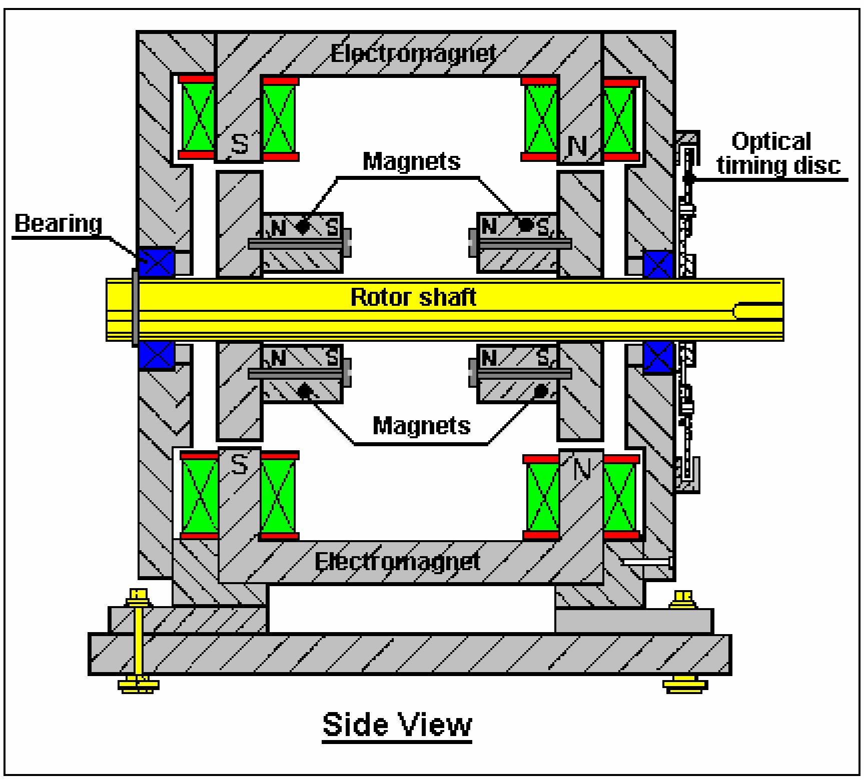
Another forum member ‘prochiro’ says: “I have also replicated the battery-charging events that ‘Sanskara316’ indicated. I started with a 12-volt 4 Amp-Hour battery which I had been using with another circuit two weeks ago and had not recharged it after using it for hours. It was sitting at 12.40 volts. I took my best-running re-wound motor, plugged it in direct and ran it. The battery voltage dropped to 12.24 volts and stayed at that level for 30 seconds. The battery voltage then started to rise 1/100 of a volt per minute. When it was at 12.27 volts, I disconnected the motor (the total run time was less than 5 minutes). I then let it rest for five minutes. At the end of the five minutes, the battery voltage had risen to 12.43 volts and is still at that voltage now. Just think what a larger motor would do on a big battery bank. Everybody needs to document this test as it proves what ‘UFOpolitics’ said.”

New DC motors, and particularly cheap motors, will have brushes which do not mate cleanly with the commutator slip ring sectors and so, when the modification has been made, running the motor for some time allows the brushes to wear in and that raises the efficiency of the electrical connections which in turn, improves the performance of the motor. If you wish to build and test one of these motors, then you can find help and support in the forum with your questions answered and numerous videos and photographs from different experimenters to help you.

Teruo Kawai’s COP=3.18 Magnetic Motor

In July 1995, US patent 5,436,518 was granted to Teruo Kawai for an electric motor. In the patent, Teruo states that a measured electrical input 19.55 watts produced an output of 62.16 watts, and that is a COP of 3.18.





In this motor, a series of electromagnets are placed in a ring to form the active stator. The rotor shaft has two iron discs mounted on it. These discs have permanent magnets bolted to them and they have wide slots cut in them to alter their magnetic effect. The electromagnets are pulsed with the pulsing controlled via an optical disc arrangement mounted on the shaft. The result is a very efficient electric motor whose output has been measured as being 318% in excess of its input. That sort of performance can make an electric motorcycle self-powered. Teruo travelled to America to discuss manufacture of his motor when he was intimidated and his motor was never produced.

The High-power Motionless Generator of Clemente Figuera

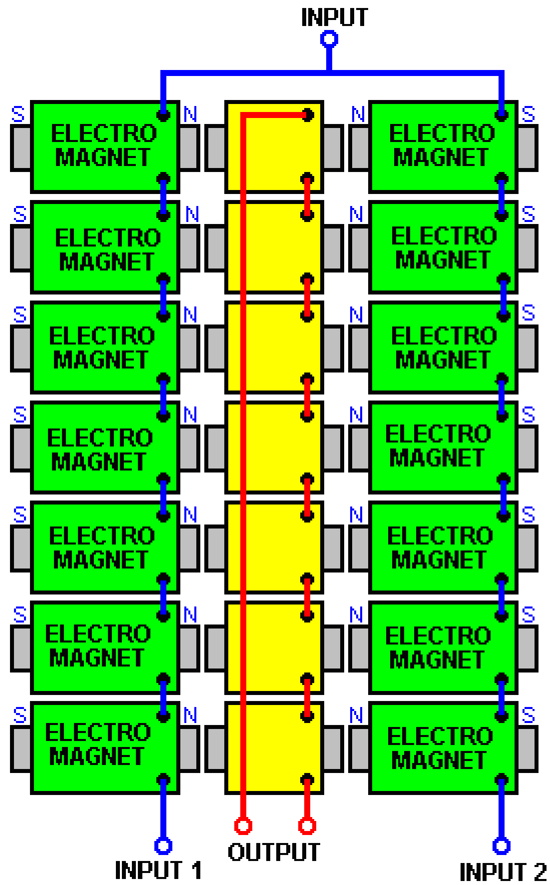
In 2012 a contributor who uses the ID 'Wonju-Bajac' started a forum to investigate the work of Clemente Figuera at http://www.overunity.com/12794/re-inventing-the-wheel-part1-clemente_figuera-the-infinite-energy-achine/#.UXu9gzcQHqU and member 'hanlon1492' contributed enormously by producing English translations of Figuera's patents.

Clemente Figuera of the Canary Islands died in 1908. He was a highly respected individual, an Engineer and University Professor. He was granted several patents and was known to Nikola Tesla. Figuera's design is very simple in outline.

In 1902 the Daily Mail announced that Mr. Figuera, a Forestry Engineer in the Canary Islands, and for many years Professor of Physics at St. Augustine's College, Las Palmas, had invented a generator which required no fuel. Señor Figuera has constructed a rough apparatus by which, in spite of it's small size and it's defects, he obtains 550 volts, which he utilises in his own house for lighting purposes and for driving a 20 horse-power motor.

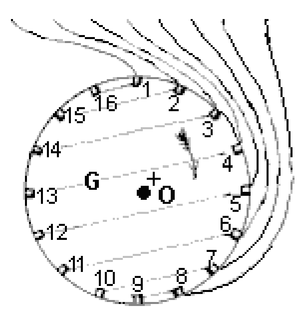
The Figuera Device looks like a complicated transformer, but in fact, it isn't. Instead, it is two sets of seven opposing electromagnets with an output coil positioned between each opposing pair of electromagnets. The physical position of the electromagnets and output coils is important as they are positioned very close to each other and there are induced magnetic fields between adjacent electromagnets and between the output coils due to their close proximity.

The two sets of electromagnets are wound with very low-resistance, high-current wire or possibly, even with thick foil. The information given in the Figuera patent states that the electromagnets will be referred to in the patent by the letters "N" and "S" and it is now thought that those two letters are deliberately misleading as people tend to think of those letters referring to "North magnetic pole" and "South magnetic pole" while in reality, the electromagnets almost certainly oppose each other, that is, with North poles facing each other or possibly, with South poles facing each other. The arrangement is believed to be like this when seen from above:



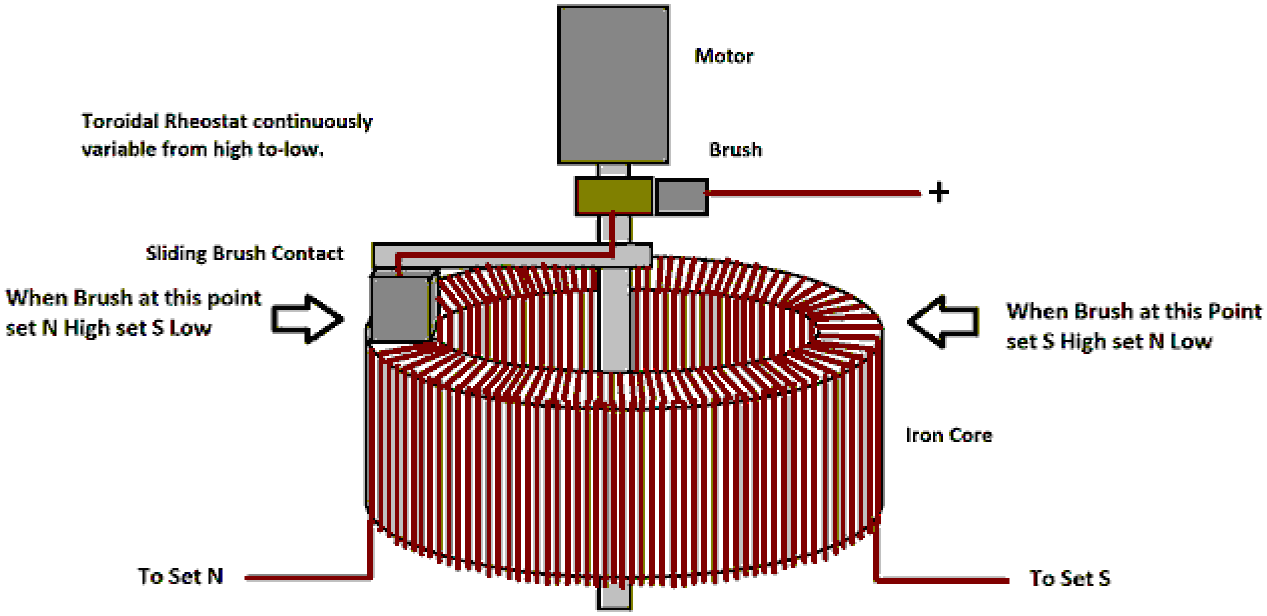
This arrangement creates a magnetic Bloch wall (or magnetically null point) in the centre of the yellow output coils and the position of that magnetic balance point is very easily moved if the power supply to the two sets of electromagnets is altered slightly and any movement of that magnetic balance point creates a substantial electrical output due to the alteration of the magnetic lines cutting the turns of wire in the yellow output coils. While the sketch shown above indicates a small gap between the electromagnets and the output coils, it is by no means certain that any such gap is needed and while winding the three coils is more convenient if they are separate, when wound and being assembled, their cores may well be pushed together to form one continuous magnetic path.

Another thing which has confused people (including me), is the drawing in the patent which looks like an electrical commutator, but which is **not** part of the Figuera generator design. It looks like this:

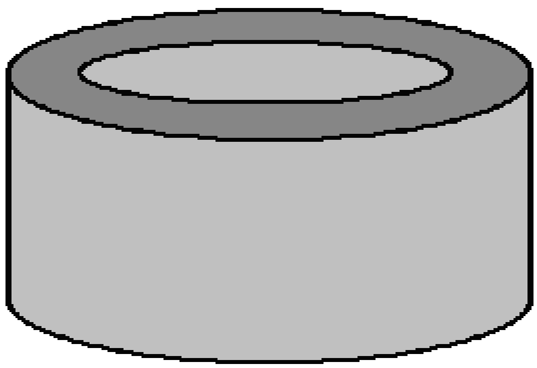


The dotted lines indicate internal electrical connections, so for example, contact 14 is connected to contact 3, but let me stress again that this unit is **not** part of the design and while it is used to “explain” the actual operation, I would not be surprised if it were not intended to misdirect people from the actual operation.

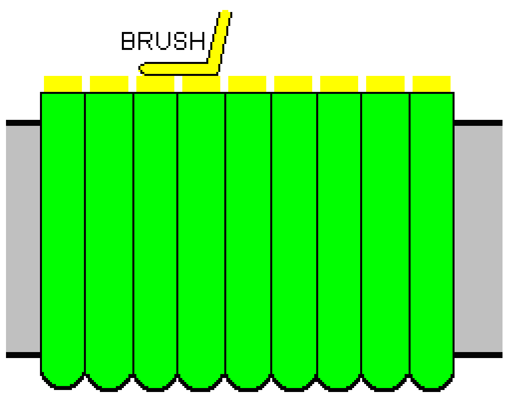
This point has been stressed and it has been suggested that the actual working device is magnetic in nature and could be constructed like this:



This looks like a very simple device but it is an item of major importance in the Figuera design. First, the core is solid iron (sometimes called "soft iron" but if you were beaten with a bar of it you certainly wouldn't call it "soft"). The most important characteristic of such a core is its magnetic properties as it is able to store energy. Please remember that this switching device is primarily magnetic in nature. It looks like this:



This core is then wound with thick wire – perhaps AWG #10 or 12 SWG (2.3 x 2.3 mm square wire) . The turns of wire should be tight, side by side and sit exactly flat on the top surface as the wire there will be contacted by the sliding brush:



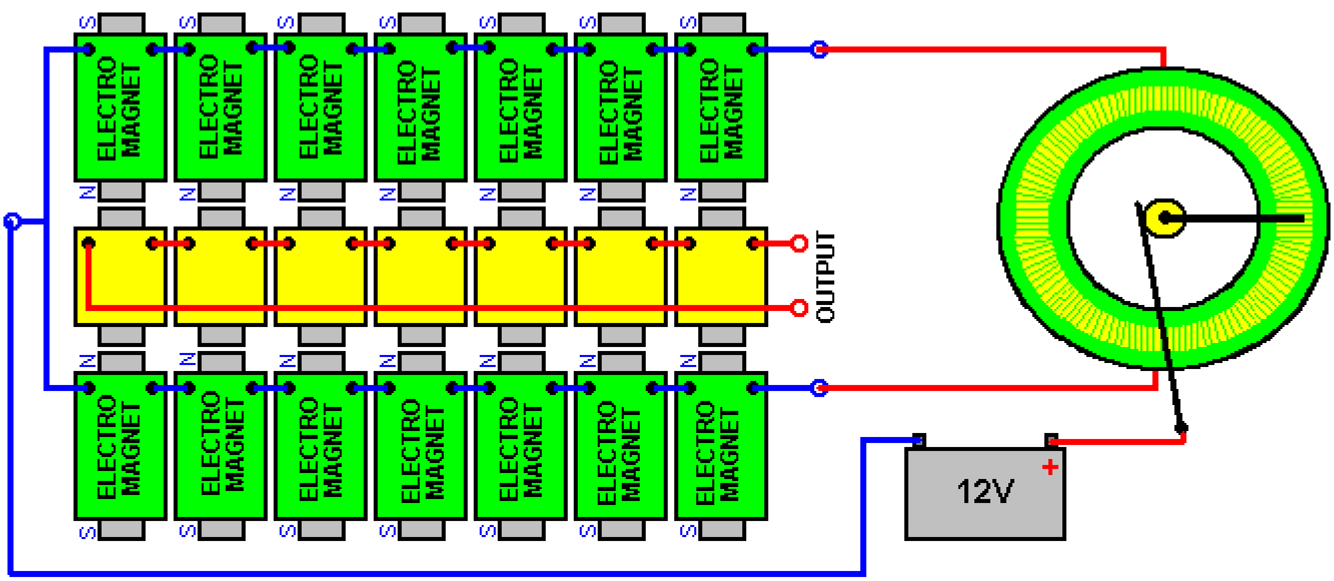
The sliding brass contact or "brush" is dimensioned so that it connects across two adjacent wires so that there is never any sparking as the brush contact slides around the circle of wires. The brush is driven by a small DC motor. In order for the sliding brush to contact the wire, the plastic insulation needs to be removed from the top half of the wire with the remaining insulation keeping the turns from short-circuiting together. The wire is wound half of the way around the iron core and a short length of wire is left to make an electrical connection. An additional winding is then made to cover the remaining half of the core and again, a length for connection is left before cutting the wire. This gives you two windings each covering 180 degrees around the core. The wire turns are strapped tightly with tape or cord wound around the side of the core as that holds the wires securely in place. The two wire ends on each side are connected together, giving a 360 degree winding with good electrical connections 180 degrees apart.

There are many ways to arrange the small DC motor so that it drives the brush slider. The motor could be mounted on a strip passing over the core, or on the baseboard, or to one side using a belt or gearwheel drive link. It does not matter which direction the brush moves around the core. The speed of rotation is not critical either although it does determine the alternating frequency of the output. In most cases, the output will power a heating element or will be converted to DC to give the local mains frequency and voltage.

When we first look at a device like this, we immediately think of the flow of electric current passing through the wire wound around the iron core. It appears as if the current is limited by the overall length of the wire between the brush position and the two outputs, but the reality is that while that is correct to a certain extent, the main control of the current flow is the magnetic field inside the circular iron core, and that field causes reluctance (resistance to current flow) proportional to the number of coil turns between the brush and each output. This alters the current flow to the set of "N" electromagnets compared to the current flow to the set of "S" electromagnets.

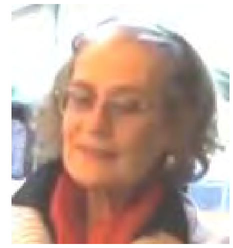
As the magnetic intensity generated by the set of "N" electromagnets increases, the magnetic intensity generated by the set of "S" electromagnets decreases. But, as the magnetic power of the set of "N" electromagnets overcomes the magnetic field of the set of "S" electromagnets, that magnetic field gets pushed back into the soft iron core of the commutator device, essentially storing energy in that core. When the system needs to replace the energy lost in heating, it can use that stored magnetic energy in the commutator core, raising the overall efficiency. In this design, the current flowing through the electromagnets is always in the same direction and never drops to zero, merely oscillating in its intensity.

The overall arrangement is like this:



While the sketch above shows a 12-volt battery, there is no great reason why it should not be 24-volt or higher, especially if the wire used to wind the electromagnets is smaller diameter. The amount of power needed to create a magnetic field is not related to strength of the magnetic field and a larger number of turns of thinner wire with a small current flowing through the wire can create a stronger magnetic field than few turns of thick wire with a large current flowing through those turns.

Rosemary Ainslie's COP=17 Heater.



As Kevin Ashton states in his book *How To Fly A Horse*, 16th April 1958 saw the death of the scientist Rosalind Franklin at the age of thirty-seven. Rosalind was a talented X-ray crystallographer working on the problem of how viruses reproduce (essentially, how life works, as her work was understanding the mechanics of life). The following day the World's Fair opened in Brussels with the main attraction being a scale model of a virus. That model was built by Rosalind as she was dying.

She held a research position at the University of London, and later, an appointment, at Birkbeck College, where she studied the tobacco mosaic virus. For a long time, the only people who knew what she had really accomplished were the three men who had secretly stolen her work: James Watson, Francis Crick, and Maurice Wilkins. Watson and Crick were researchers at Cambridge University. Wilkins had been at King's College. All three men wanted to be first to answer the question of the age: what is the structure of DNA, the acid that carries the information of life, and how does it work?

Rosalind Franklin was educated at Cambridge University's Newnham College. Had she been born a few generations earlier, she would not have been admitted to Cambridge. Even when women were admitted, the university believed that women were not equal to men and despite being placed first in the university's entrance exam for chemistry, Franklin could not be a member of the university or an undergraduate. Women could not earn a degree. The number of women allowed to attend Cambridge was capped at five hundred, to ensure that ninety percent of students were men. Science, while pretending to be dispassionate and rational, has long been an active oppressor of women. Britain's 'Royal Society' of scientists barred women for almost three hundred years, on grounds including the argument that women were not "legal persons".

This disgraceful attitude was, and still is, widespread. Lise Meitner discovered nuclear fission only to see her collaborator Otto Hahn receive the 1944 Nobel Prize for her work. Things have changed little since then. This is not because women have less aptitude for science than men have. For example, Rosalind Franklin took better pictures of DNA than anyone had taken before, then used a complex mathematical equation called the "Patterson function" to analyse them. The equation, developed by Arthur Lindo Patterson in 1935, is a classic technique in X-ray crystallography. The two main properties of electromagnetic waves are their intensity, or "amplitude," and their length, or "phase". The image created by an X-ray shows amplitude but not phase, which can also be a rich source of information. The Patterson function overcomes this limitation by calculating the phase based on the amplitude. In the 1950s, before computers or even calculators, this work took months. Franklin had to use a slide rule, pieces of paper, and hand calculations to work out the phases for every image, each one of which represented a slice of the three-dimensional crystal molecule which she was analysing. While Rosalind Franklin was concluding this work, without her consent or knowledge, Maurice Wilkins showed her data and pictures to James Watson and Francis Crick. Watson and Crick leapt to the conclusion which Franklin was diligently proving, that the structure of DNA was a double helix. They published it, and shared the Nobel Prize with their secret source, Wilkins. When Rosalind Franklin died, they still did not credit her.

This attitude to women scientists does not appear to have changed much and the reluctance of humans as a whole to accept anything new in science is widespread. Not only science is opposed to women. The very successful book *Fifty Shades of Grey* was published under the name "E L James" as the author Erika Mitchell stated that she wanted her pen name to avoid implying that the author was a woman. Is it a major stretch of imagination that the highly successful *Harry Potter* series of books by Joanne Rowling was published under the name "J K Rowling" which also avoids any indication of gender?

I, personally, was never in any doubt that Rosemary Ainslie would encounter fanatical opposition to her scientific paper, not just because "scientists" (for want of a better word) are unwilling to accept her simple system with vastly more power output than the user's power input, but also because of the (highly offensive) opposition to women scientists.

Rosemary Ainslie has produced a pulsed heater system which has been measured at a performance of COP = 17 which means that the output power is 1700% greater than the input power. This is a recent design and as far as I am aware, has not yet been replicated by other people. Panacea-bocaf.org are working with Rosemary's original developers to produce an independent implementation of the heater. At this point in time, the heater has been built to a prototype testing scale for laboratory examination and measurement and not been produced in the kilowatt range, which, hopefully, will come at a later date.

Panacea have produced a 250-page document describing the research, the testing, the theory, etc. and that can be downloaded free using this link:
http://www.panaceatech.org/Rosemary%20Ainslie%20COP17%20Heater%20Technology.pdf

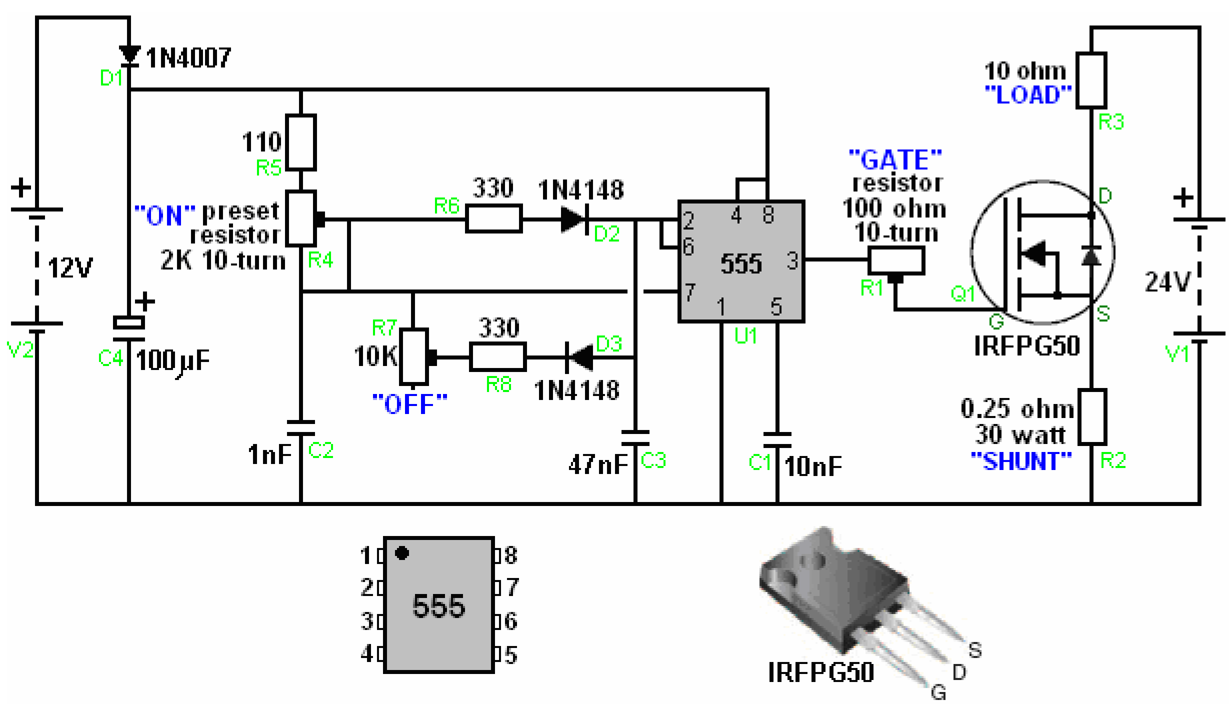
As that document contains the details which scientists need to see for serious testing and development, it may be a little technical for some people, so Panacea have produced a simplified description aimed at the average home-build investigator and that can be downloaded free using this link:
http://www.free-energy-info.tuks.nl/Ainslie_heater_circuit.pdf.

In very broad outline, the circuit produces the same very short, very sharp voltage pulses that are the basis for so many "free-energy" devices. The circuit used looks very simple but in spite of that, the way that it operates is not at all simple. The circuit is shown below and to a quick glance, it looks like a standard 555 timer chip circuit, used in many existing applications. However, if the circuit is operated as a 555 pulsing circuit, then the output is not COP>1.

Looking more closely, we notice that the link between the output of the 555 chip on pin 3 and the input gate pin of the Field-Effect Transistor, is unusual as it is not the usual voltage divider between pin 3 and the 0-volts ground line. Instead, the gate is directly coupled to the 555 chip output by a single, low-resistance preset resistor.

Normally, an NE555 chip struggles to reach 50,000 cycles per second and a large number of 555 chips on the market can't even operate at even that frequency. To get Rosemary's circuit into it's COP>1 operation, the resistor marked "**GATE**" is adjusted very slowly to find the point at which the circuit becomes unstable, over-rides the normal operation of the 555 chip and starts oscillating at the resonant frequency of the overall circuit, forcing the 555 chip to become a feedback component. The circuit then produces the sharp, short voltages spikes at more than ten times the operating speed of the 555 chip and pulsing the 10-ohm heating element marked "**LOAD**" at about 500,000 pulses per second.

That rate of operation is clearly well outside the possible performance of an NE555 chip, besides which, the timing elements of the chip should be producing a much lower frequency, as indeed it does before the "**GATE**" resistor adjustment causes the circuit to break out of its normal design-mode operation and start the high-speed spike generating, resonant performance. The circuit used is shown here:



As Panacea-bocaf are working to test and develop this circuit further, it would be a good idea to download their free documentation on the design and keep an eye on their progress in this field. The two documents give very considerable detail on the work which has already been done, and of course, you can yourself experiment with this circuit and see what results and adjustments you can discover yourself.

The Self-powered Free-Energy Generator of Carlos Benitez

The Mexican Civil Engineer Carlos Benitez devised what is essentially the 3-battery switch discussed above. He was working at a time when solid-state electronics was not available and so his design is all the more impressive for that. Here is some of his patent information:

Carlos Benitez Patent GB 17,811 13th May 1915

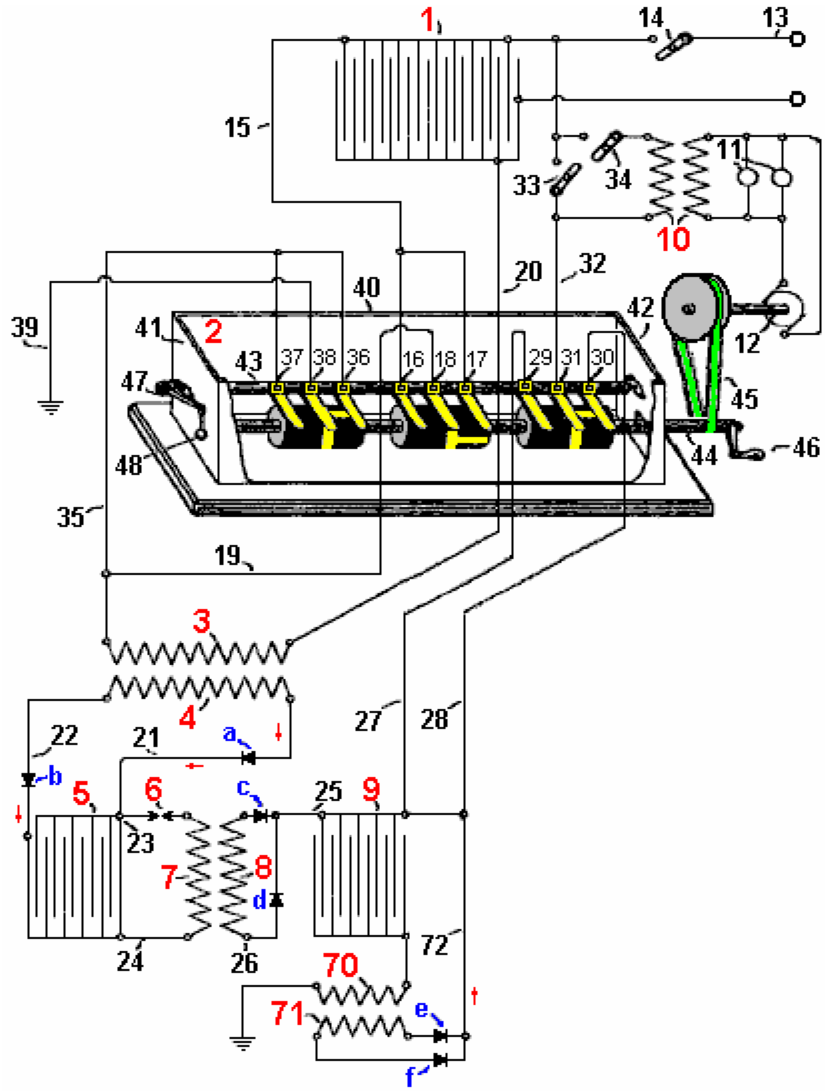
System for the Generation of Electric Currents

I, Carlos F. Benitez, Civil Engineer, 141 Ocampo Street, Guadalajara, Mexico, do hereby declare the nature of this invention:

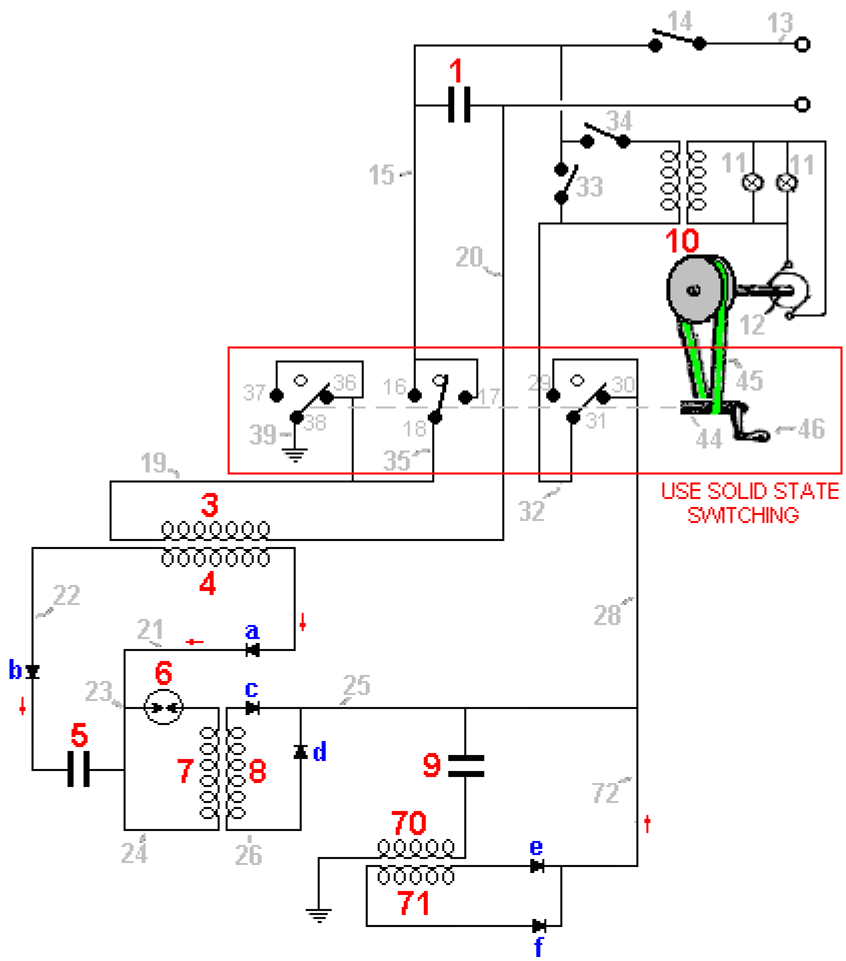
The invention relates to a new process for obtaining electric currents under unusually simple, economic and practical conditions. I use synthetically in combination: apparatus for the production of electric currents for charging one or several capacitors whose collectors or inner coatings are connected to one of the terminals of the primary winding of one or several induction coils and the other coatings of those capacitors are alternately grounded through the primary winding of a transformer, or connected through the transformer primary to the above collectors, appropriate means for collecting the currents produced in the secondary windings of these transformers and for applying charging to the above collectors, and an appropriate means for discharging those collectors, and for the application of all or part of its energy to the successive replication of the process already described, in this way, increasing the generation of electrical energy, or maintaining a constant, pre-determined electrical output.

Furthermore, the invention consists of a new combination of parts from which are derived advantages which will be fully understood by the consideration of the two different cases illustrated in the accompanying drawing, in which:

1 is a bank of capacitors.
2 is a rotating commutator to make and break the circuit connections at the appropriate instants.
3 is the primary winding of a transformer or induction coil.
4 is the secondary winding of that transformer or induction coil.
5 is a second bank of capacitors.
6 is an oscillator spark gap.
7 is the primary winding of a second transformer.
8 is the secondary winding of that transformer.
9 is a third bank of capacitors.
70 is the primary winding of a third transformer
71 is the secondary winding of that transformer.
10 is a fourth transformer.
11 is a series of incandescent lamps.
12 is an electric motor.
(a), (b), (c), (d), (e) and **(f)** are mercury-vapour converters or cathodic valves, allowing electric current flow only in the direction shown by the arrows.



Or using current day symbols:



The capacitor bank **1**, is connected through wire **13** to a source of electric current, providing the initial charge to capacitor bank **1**. This initial charge is used to start the system running and can be disconnected at any time by means of switch **14**.

Wire **15** connects the inner leaves of capacitor bank **1** with poles **16** and **17** of the commutator **2**, and it's pole **18** is connected via wire **19** to one of the terminals of transformer primary winding **3**, whose other end is connected through wire **20** to the outer leaves of capacitor bank **1**. The secondary winding **4**, of this transformer, is connected by wire **21** to the inner plates of capacitor bank **5**, and by wire **22**, to the outer plates of capacitor bank **5**. In the same manner, wires **23** and **24** pass those connections on to the two sides of the primary winding **7** of the second transformer. Wire **23** also contains an oscillator spark gap **6**, and wires **21, 22, 25, 26** and **72** contain the one-way cathode valves **a, b, c, d, e** and **f**. The secondary winding **8**, of this second transformer, connects to the inner plates of capacitor bank **9**, whose outer plates are connected to ground through the primary winding **70** of the third transformer. The secondary winding **71**, of this third transformer is also connected through wire **72**, to the inner plates of capacitor bank **9**. Wires **27** and **28** also connect these inner plates to commutator poles **29** and **30**, which form a change-over switch through commutator contact **31** which is connected to the inner plates of capacitor bank **1** through wire **32**. Switches **33** and **34**, allow the connection or disconnection of the primary winding of transformer **10**, whose secondary winding supplies current to the incandescent lamps **11** and motor **12**. Finally, one of the ends of primary winding **3** is connected through wire **35** to both pole **36** and pole **37** of the commutator **2,** and their corresponding commutator contact **38** is connected to ground by wire **39**.

As the construction and use of all of these components (with the exception of the commutator) is perfectly understood, it would be pointless to describe them. The commutator **2**, is enclosed in a tank **40**, whose end walls **41** and **42** support the ends of the contact-mounting bar **43,** and the bearings of the rotating shaft **44**. The contact bar is made of a non-conducting material to which are immovably attached, the copper contact strip brushes **16**, **17** and **18**, **36**, **37** and **38**, and **29**, **30** and **31**. Secure contact between these brushes and the rotating cylinders mounted on shaft **44** is ensured by the rotating lever arm **47** and its associated weight **48.**

The three rotating cylinders mounted on shaft **44**, are made of a non-conducting material and have a conducting strip around their centre. This strip has two conducting spurs running outwards, one to the right and one to the left, positioned 180 degrees apart around the circumference of the cylinder. When shaft **44** is rotated, this causes the central contact (for example, **18**) to connect first to one of its associated contacts (say, **17**) and then disconnect and connect to the other contact (say, **16**) forming a change-over switching mechanism.

The switching strips on the central cylinder are positioned 90 degrees around the circumference when compared to the position of the switching strips on the two outer cylinders which are aligned with each other.

This can be seen in the diagram, where in the shaft position shown, **38** and **36** are connected and **31** and **30** are connected, while **18** is not connected to either **16** or **17**.

When shaft **44** is rotated through 90 degrees, **18** will be connected to **17**, while **31** and **38** will both be isolated.

When shaft **44** is rotated through an additional 90 degrees, brush **18** will be isolated while brush **38** will be connected to **37** and brush **31** will be connected to **29**.

When shaft **44** is rotated through an additional 90 degrees, brush **18** will be connected to brush **16**, while brushes **31** and **38** will be isolated.

[Note: if the diagram is correctly proportioned, there will be four positions in each rotation where the three central brushes are not connected to any of the outer brushes, producing the switching sequence Make, Break, Make, Break, Make, Break, Make, Break for each revolution. These breaks in the switching sequence have been shown to have a significant effect when batteries are being charged. This mechanism would be built as solid state switching nowadays.]

Shaft **44** is elongated and projects through the end wall **42**, so that a belt drive **45**, or other suitable method, may be used to rotate the shaft, driven by motor **12** or possibly by crank handle **46**. The tank **40**, is filled with oil or any other insulating liquid, in order to prevent sparking between the brushes, which would lower the efficiency of the system.

This system is operated as follows:

With the commutator in the position shown in the drawing, that is, with brush **36** connected to **38** and brush **30** connected to **31**, and supposing capacitor bank **1** is connected through wire **13** to a source of electric power (say, a Wimshurst Machine), switch **14** being closed, electric current passes through wire **13** to charge capacitor bank **1**, causing a current to flow through wire **20**, primary winding **3**, wire **35**, brush **36**, brush **38** and wire **39** to earth. This current flow through primary winding **3** induces an inverse current in secondary winding **4**, which flows through wire **21**, charging capacitor bank **5** and then a direct induced current flowing through conductor **22**, charging capacitor bank **5**.

The current flow to both sets of plates in capacitor bank **5**, charges it and creates a spark across the spark gap **6**, causing a very sharp current pulse through primary winding **7**. This in turn, causes a considerable number of high-frequency oscillating current flows in the secondary winding **8** and these pass along wires **25** and **26**, and via diodes **c** and **d**, thus charging capacitor bank **9** and causing a corresponding set of high-frequency pulses to flow to ground through the primary winding **70**. This induces current flow in the secondary winding **71**, which flows through diodes **e** and **f**, and onwards via wire **72**, further boosting the charge on capacitor bank **9**.

Therefore, capacitor bank **1** being charged by an external source, capacitor bank **9** will be charged indirectly and successively re-charged several times, resulting in a quantity of electricity considerably greater than that of capacitor bank **1**. By this means, the system can be self-powered with no need for the power source used to start it, which means that switch **14** can be opened.

When shaft **44** rotates through 90 degrees, brush **17** connects with brush **18**, while brushes **31** and **38** are both disconnected. This causes capacitor bank **1** to be completely discharged through transformer primary **3**, causing the already described process by which capacitor bank **9** receives a substantially larger electrical charge. This results in capacitor bank **1** being totally discharged and capacitor bank **9** being highly charged with a great deal of electricity. Consequently, if we now close switch **33** and rotate shaft **44** through another 90 degrees, the following situation results:

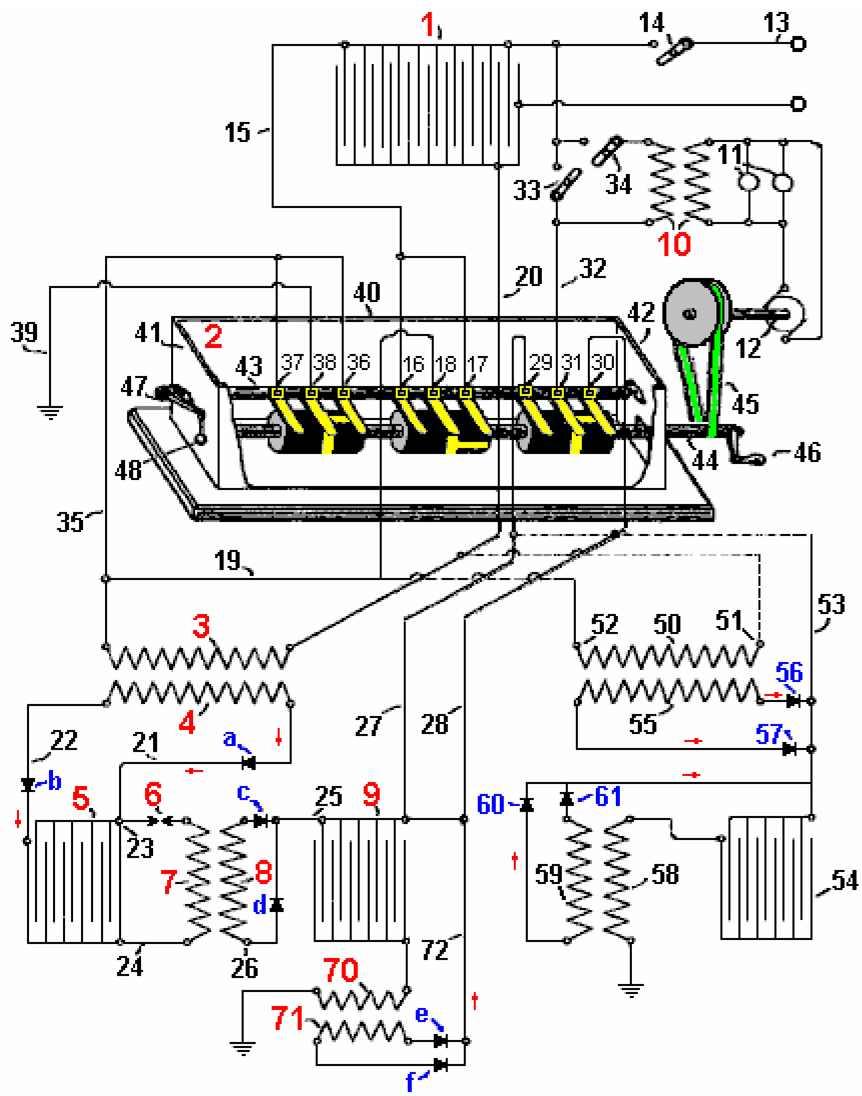
1. Brushes **17** and **18** will be disconnected.

2. Brushes **37** and **38** become connected which in turn connects the outer plates of capacitor bank **1** to ground. Brushes **29** and **31** are connected, which then connects the inner plates of capacitor bank **9** to the inner plates of capacitor bank **1**.
3. Part of the high charge on capacitor bank **9** will flow as an electric current, through wire **32** and into capacitor bank **1**.
4. This current flow from the inner plates of capacitor bank **9** causes an immediate matching negative charge to flow from ground through primary winding **70**, to offset the charge imbalance.
5. This induces a current flow in the secondary winding **71**, which passes additional electrical power to the outer plates of both capacitor bank **9** and capacitor bank **1**, and that further intensifies the current flow through primary winding **70** quite considerably.
6. Further, as capacitor bank **1** has just been newly charged, it drives additional current through primary winding **3**, causing new induced currents which will, as before, produce much increased charge on the inner plates of both capacitor bank **5** and capacitor bank **9**, as described earlier.

If shaft **44** is rotated through a further 90 degrees, then a connection between brushes **16** and **18** will be made and all other circuits will be opened, causing capacitor bank **1** to be discharged again, thus repeating the entire process described above provided that shaft **44** is rotated continuously.

This system produces a constantly increasing supply of electric current flowing through wire **32**, and so, switch **34** can be closed, allowing transformer **10** to provide the electrical power to run motor **12** which maintains shaft **44** in continuous rotation, making the system self-powered with no requirement for any form of outside power supply. Additional transformers inserted in wire **32** can be used to power additional equipment.

Without employing the high-frequency currents described above, similar results may be attained by means of the arrangement shown at the lower right hand side of the following drawing:



Here, primary winding **50** is connected as shown by the dashed lines, with wires **19** and **20** of the former arrangement, and wire **53** connects to both wire **27** and wire **28**. This arrangement has primary winding **50** connected through its end **51** to wire **20** and so is permanently connected to the outer plates of capacitor bank **1**, and its other end **52** being connected to wire **35** will be intermittently connected to ground. Wire **53** being connected to wires **27** and **28** will intermittently connect together, the inner plates of capacitor bank **54** and the inner plates of capacitor bank **1**.

With this arrangement, both ends of the secondary winding **55** are connected through diodes **56** and **57**, to wire **53**. The outer plates of capacitor bank **54** are permanently connected through primary winding **58** to ground. Both ends of the secondary **59** are connected through diodes **60** and **61**, back to wire **53**. As a result, if capacitor bank **1** is charged, it drives a current through wire **20** and so, through primary winding **50**, and on to ground through wires **35** and **39**. This induces current in secondary winding **55** which gets stored in the inner plates of both capacitor bank **54** and capacitor bank **1**, as in this moment, the circuit is closed between brushes **29** and **31**, and so, wire **53** is connected to wire **32**. On receiving these new charges, both capacitor bank **1** and capacitor bank **54** will create new induced electric currents flowing through primary windings **50** and **58**. These multiple charging pulses will decrease with time until they are insignificant, at which time, due to the rotation of shaft **44**, the connection between brushes **29** and **31** and between brushes **36** and **38** will no longer be maintained, and instead, brushes **18** and **17** will become connected, discharging capacitor bank **1** through primary coil end **50** which is a very strong discharge, charging capacitor bank **54** as wire **53** is now disconnected from wire **32**. This, in turn, causes powerful current flow through primary winding **58**, further charging capacitor bank **54** which then feeds capacitor bank **1** when shaft **44** rotates further, making the system both self-powered and capable of supplying useful electrical power to other equipment.

It should be clearly understood that the use of mercury-vapour converters or cathodic valve diodes as described, are not in any manner indispensable in the system as those devices can be replaced by a suitable arrangement of capacitors which would receive separately, the direct and inverse currents of the secondaries.

When a bell is struck just once, it vibrates many times, passing those vibrations to the air and so, making the sound which we hear. The bigger the bell, the slower the vibrations and the lower the pitch of the note which we hear. The same thing happens when a sharp voltage pulse is applied to a coil of wire as just one pulse causes many vibrations in the coil. Like the bell, the frequency of the vibrations depends on the structure of the coil and not on how it is pulsed, although, like a bell, a sharp pulse for a coil or a sharp blow for a bell, produces a greater effect.

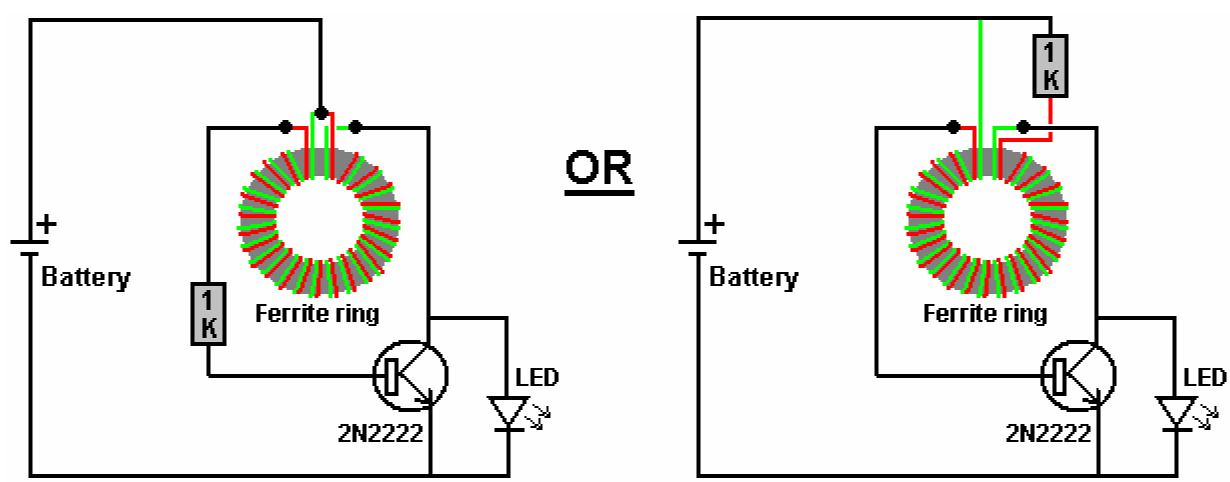
You will notice here that Carlos uses the resonant 'ringing' of an air-core coil to get an energy gain which is then used as positive feedback to further charge a capacitor bank. A single sharp pulse generated by one spark, causes a large number of coil oscillations, each of which contributes output power, producing an energy gain. The ringing frequency is liable to be around 3 MHz. It is also worth noting that with this design, electricity generation can be achieved without any battery and just the manual turning of a Wimshurst electrostatic generator and the initial operation of the commutator shaft **44**.

Lawrence Tseung's "FLEET" Generator.

The "FLEET" ("Forever Lead-out Existing Energy Transformer") device is a self-powered electrical generator which has no moving parts and which can be constructed cheaply. It has been developed by a Hong Kong based team of people: Mr Lawrence Tseung, Dr. Raymond Ting, Miss Forever Yuen, Mr Miller Tong and Mr Chung Yi Ching. It is the result of some years of thought, research and testing and it has now reached an advanced stage of testing and demonstration and is nearly ready for commercial production.

Mt Tseung has applied his "Lead-out" theory to the category of low-power circuits known as the "Joule Thief" circuits. These circuits originated with an article by Mr Z. Kaparnik, in the "Ingenuity Unlimited" section of the November 1999 edition of the "Everyday Practical Electronics" magazine.

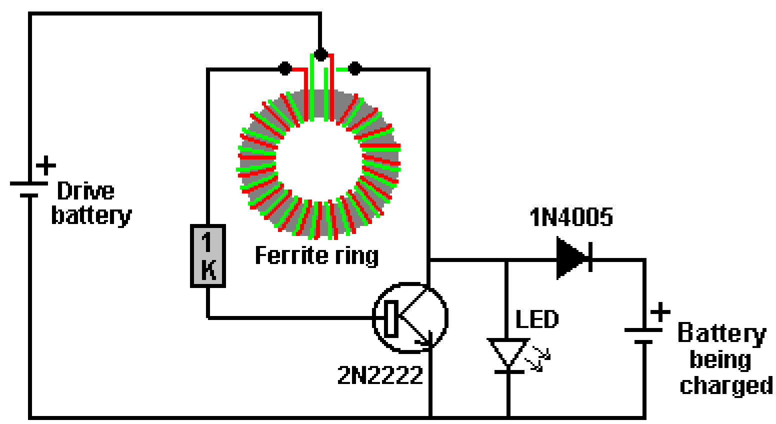
The initial circuit allowed the very last energy to be drawn from any ordinary dry-cell battery, and used to light a white Light-Emitting Diode ("LED") for use as a small torch. It allows a battery which is considered to be fully discharged, to drive the circuit until the battery voltage drops right down to 0.35 volts. The initial circuit uses a bi-filar coil wound on a ferrite ring or "toroid". Bi-filar means that the coil is wound with two separate strands of wire side by side, so that each adjacent turn is part of the other coil. A coil of that type has unusual magnetic properties. The Joule Thief circuit is like this:



It is important to notice how the coil is wound and how it is connected. It is called a "toroid" because it is wound on a ring. The ring is made of ferrite because that material can operate at high frequencies and the circuit switches On and Off about 50,000 times per second ("50 kHz"). Notice that while the wires are wound side by side, the start of the red wire is connected to the end of the green wire. It is that connection which makes it a "bi-filar" coil instead of just a two-strand coil.

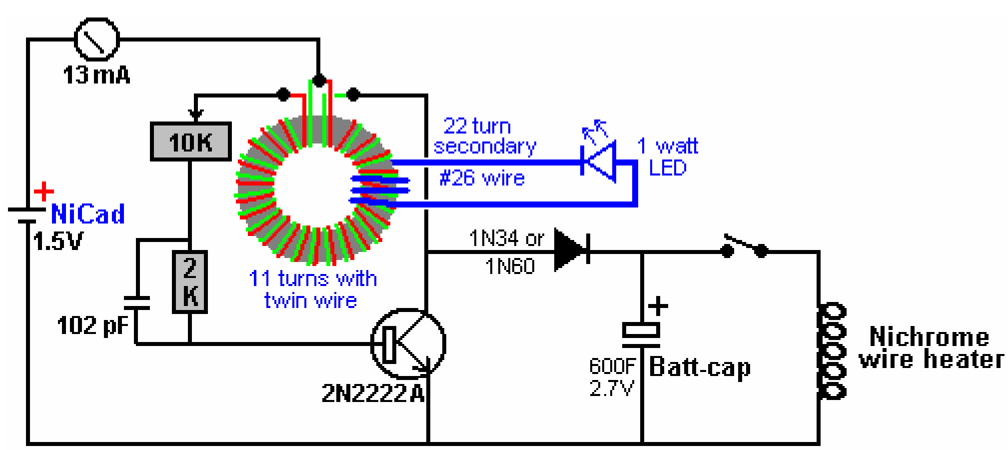
This "Joule Thief" circuit was then adapted by Bill Sherman and used to charge a second battery as well as lighting the Light-Emitting Diode. This was achieved by adding just one more component - a diode. The diode used was a 1N4005 type because that was to hand at the time, but Bill suggests that the circuit would work better with a very fast-acting Schottky-type diode, perhaps a 1N5819G type.

The circuit produced by Bill is:



When driven by a 1.5 single cell battery, this circuit produces about 50 volts with no load and can supply 9.3 milliamps of current when the output is short-circuited. This means that you could charge a 6-volt battery using a 1.5 volt battery.

"Gadgetmall" of the www.overunity.com Joule Thief forum has taken the circuit further and found a very interesting situation. He has modified the circuit and used a "batt-cap" which is a very high capacity, very low-loss capacitor. This is his circuit:



He has added an additional winding to his one-inch (25 mm) diameter ferrite toroid, and he uses that to power a 1 watt LED. Why he has done this is not immediately clear to me, except possibly, that it shows when the circuit is operating. He runs the circuit driven by a small rechargeable battery, which feeds 13 milliamps into the circuit, for a period of fourteen hours. At the end of that time, the batt-cap has gathered enough energy to fully recharge the driving battery in a minute or two, and then power a heater winding of nichrome wire (as used in mains-powered radiant heaters) for four and a half minutes. Alternatively, that amount of extra power could boil a kettle of water. The really interesting thing about this is that the driving battery gets recharged every time and so the circuit is self-sustaining although it is not a powerful circuit.

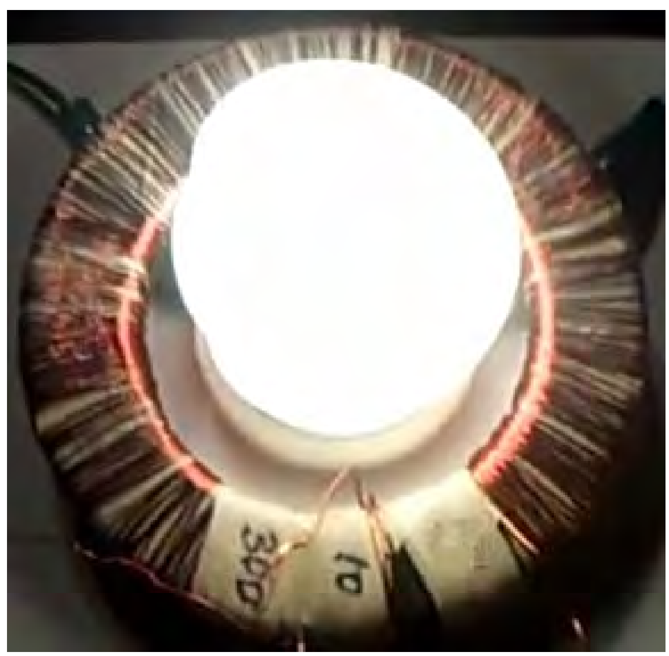
However, Jeanna has developed the circuit significantly as she shows in her series of videos:

http://www.youtube.com/watch?v=Y4IMgDRGpHE
http://www.youtube.com/watch?v=1tVlCJiuWH4
http://www.youtube.com/watch?v=y6pbzrhBR-8
http://www.youtube.com/watch?v=tNoZrV3w4f8
http://www.youtube.com/watch?v=XzhbsLBwc54
http://www.youtube.com/watch?v=4gj7IFCXw9Q

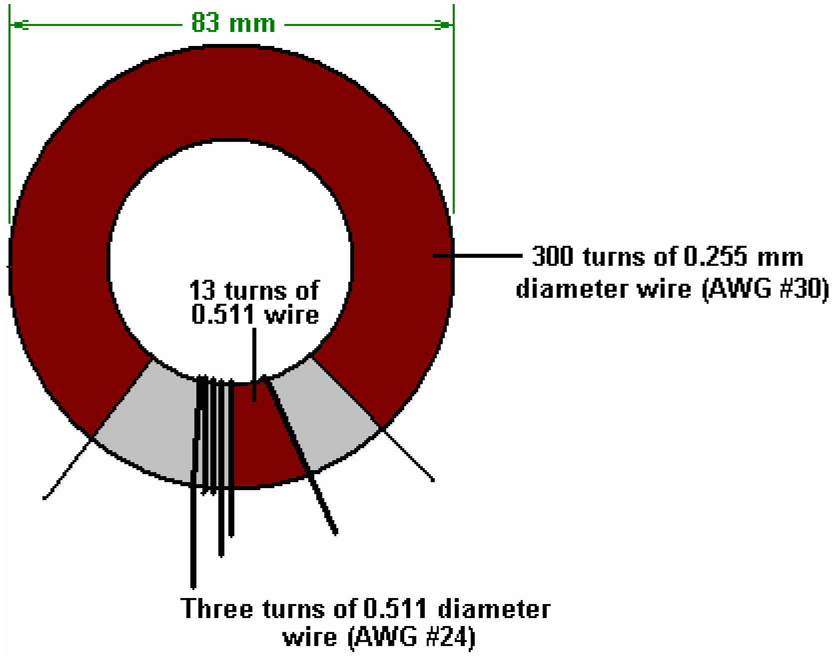
Her main point is that using the collector of the transistor as the power take-off point of the circuit, is inefficient as that draws a lot of input current without a corresponding increase in output current. She adds a 74-turn secondary winding on top of her two 11-turn Joule Thief bi-filar windings, and that appears to give a far better power output. She uses the very small AAA size 1.2V battery and further drops the output (because “the light is too blinding”) by putting a resistor in series with the battery and using many LEDs in series. She has recorded the following results:

With no resistor, the output voltage is 58V peaks at 62.5 kHz (open circuit output, with no load at all)
With a 10 ohm resistor, the output voltage is 49V peaks at 68 kHz.
With a 33 ohm resistor, the output voltage is 25V at 125 kHz.

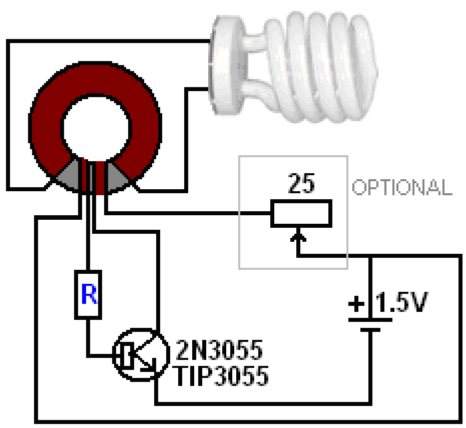
‘LidMotor’ states that Jeanna also produced a Joule Thief circuit which could light a 15-watt straight fluorescent tube for about five hours when being driven by a single AA battery. He states that he was not satisfied with that level of lighting and at https://www.youtube.com/watch?v=KAakZTR_4LE he shows a version (which he thinks is Jeanna’s design and which Jeanna thinks is his design) driving a 10-watt Compact Fluorescent Light which has had the ballast circuitry removed. The build uses an expensive 3.25 inch (83 mm) outer diameter ferrite toroid, and the lighting from a single AA battery looks like this:

The ferrite ring is wound like this:



The main winding is 300 turns of AWG #30 enamelled copper wire with a diameter of 0.255 mm. Please notice the gap between the ends of that winding. That gap is important as high voltage is developed between the two ends of the winding and if the winding were continued all the way round the toroid, then the insulating enamel coating the wire would be liable to burn out due to the very high voltage difference between the first and last turns, causing a short-circuit. The two other windings are with AWG #24 enamelled copper wire which has a diameter of 0.511 mm and those two windings are positioned closely side by side in the middle of the gap between the ends of the 300-turn winding. The circuit is like this:



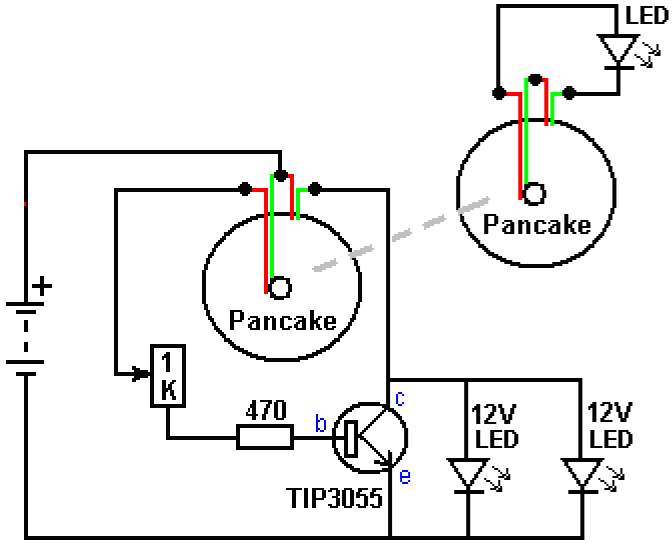
The optional 25 ohm wire-wound variable resistor wastes power but creates a voltage drop across it, reducing the voltage reaching the circuit and so, dimming the light progressively, all the way down to zero. The base resistor "**R**" has been set at 22 ohms by 'Lidmotor' who says that it really should be 100 ohms but he has lowered it to get brighter lighting. Please note which side of the 3-turn and 13-turn windings are connected in the circuit as the direction of winds is very important for those two windings.

It is not uncommon for people to comment on the faint whistling sound make by a Joule Thief circuit (especially a low-voltage version like this). It is my experience that the sound is caused by the transistor resonating with the frequency of oscillation of the circuit, the TIP3055 being particularly prone to this. I suggest therefore, that bolting on a heat sink (which is most definitely not needed to dissipate heat produced by this circuit) will alter the resonant frequency of the transistor/heat sink combination and so stop the whistling.

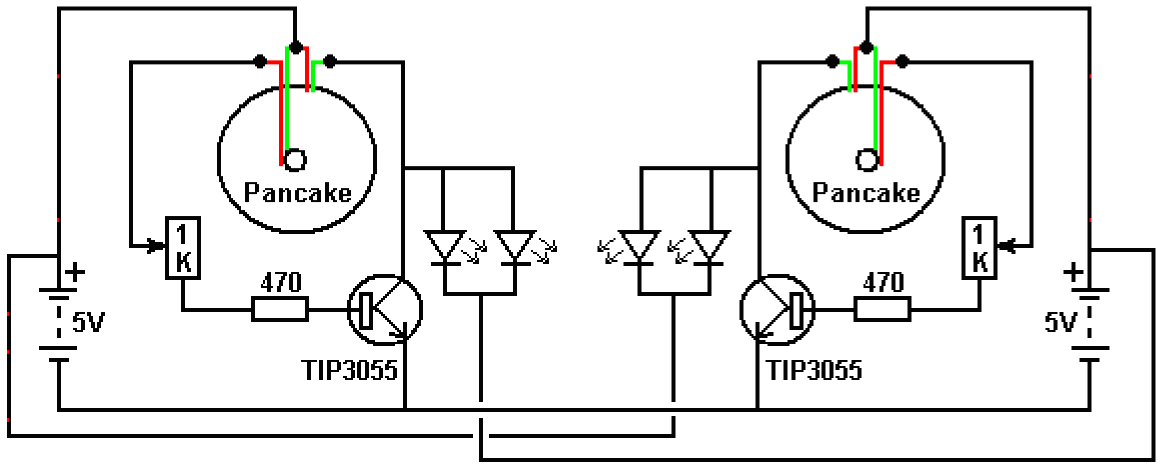
Personally, I have always had the greatest difficulty in getting any satisfactory light out of a Compact Fluorescent Lamp when driven by a Joule Thief circuit and so, for me, the best light source is one of the "G4" LED arrays with a "5050" driver chip. These look like this:

Quite good lighting can be had from a single Joule Thief circuit driving up to twelve of these simultaneously. The larger lighting area produces a more even and more gentle light which is quite effective in total darkness.

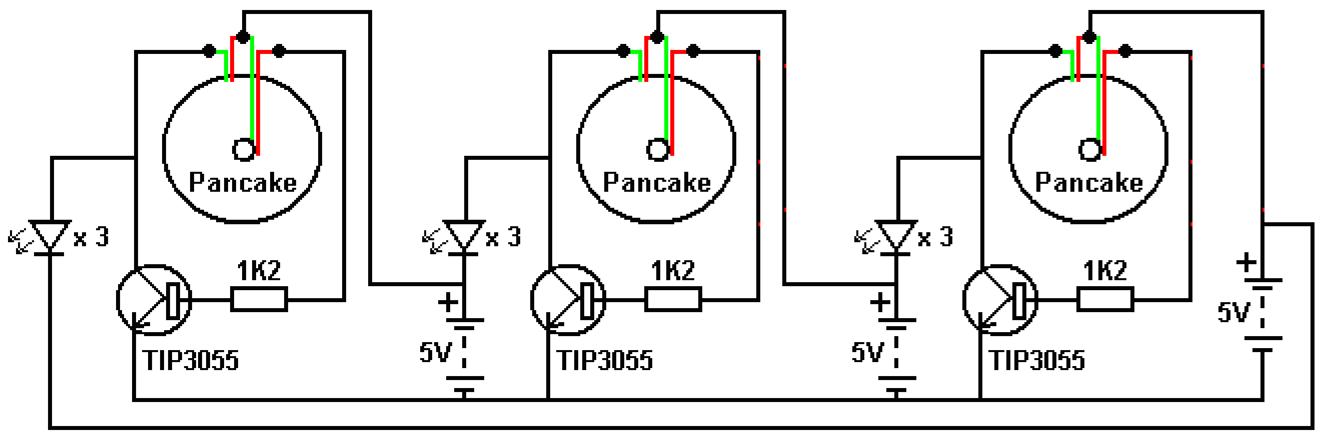
Most Joule Thief circuits specify a ferrite toroid, but a 75 mm diameter pancake coil also works well, and interestingly, pressing a second pancake coil tightly against the Joule Thief pancake coil, allows an additional LED array to be powered without increasing the current draw of the Joule Thief circuit:



It is also possible to cross-connect two or more Joule Thief circuits so that as well as producing 12V LED array lighting, each charges the battery being used by the other circuit:



And this works well with three circuits cascaded:



When working with these circuits, I bought a light-meter to take the guesswork out of assessing light levels as the human eye is very bad at doing that, although the visual impression of the lighting produced by any arrangement is actually more important than the measured lighting level. For example, there are 1-watt tiny LEDs, which have a theoretically high light output, but due to their tiny lit area are pretty useless for home lighting.

When I used the light meter (which measures in lux) I got a considerable shock. I used it with a light box to measure the light produced by two G4 LED arrays side by side, first with straight battery input and then with a Joule Thief input. The major shock was that the G4 LED arrays are actually more efficient at converting electric current to light than when a Joule Thief is used to drive those same LED arrays. That was completely unexpected. The figures for voltage / current draw / light produced using 1.2V (nominal) NiMh batteries were:

9 batteries 11.7V 206 mA 1133 lux: 2.41 watts 470 lux per watt (the manufacturer's intended performance)

8 batteries 10.4V 124 mA 725 lux 1.29 watts 562 lux per watt

7 batteries 9.1V 66 mA 419 lux 0.60 watts **697** lux per watt (a very realistic performance level)

6 batteries 7.8V 6 mA 43 lux 0.0468 watts 918 lux per watt

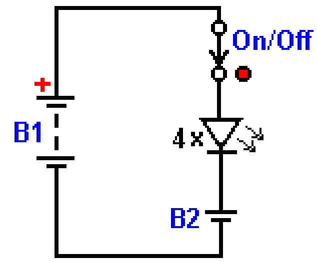
A Joule Thief circuit driving two G4 LED arrays powered by 4 batteries giving 5.2V with the current draw controlled by selection of the transistor's base resistor:

358 mA 259 lux 1.86 watts 139 lux per watt
200 mA 212 lux 1.04 watts, 204 lux per watt

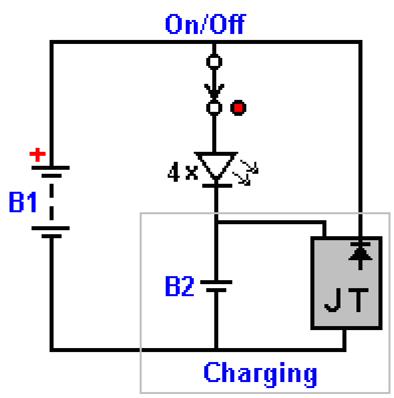
180 mA 200 lux   0.936 watts 101 lux per watt
158 mA 182 lux   0.822 watts 221 lux per watt

This was quite startling, and the surprising conclusion is that using just four LED arrays driven by a 9V battery supply, produces a very respectable 800 lux for just 135 milliamps which is about 1.2 watts total – a very unexpected result. When the four LED arrays are fitted into a desk lamp and covered with frosted plastic to give a diffused light, the result is an excellent level of desk lighting which also lights the rest of the room quite well.

If you choose to do that, then it is possible to collect all of the current passing through the Joule Thief circuit, like this:

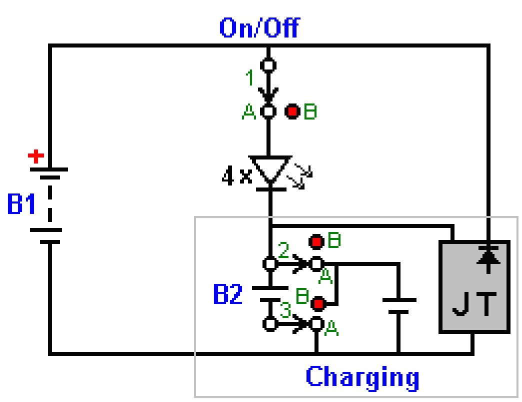


Here, the drive battery “B1” is made up with one battery more than the wanted voltage and all of the current passing through the four LED arrays is used as charging current for one additional battery which can be used to power a Joule Thief charging circuit:

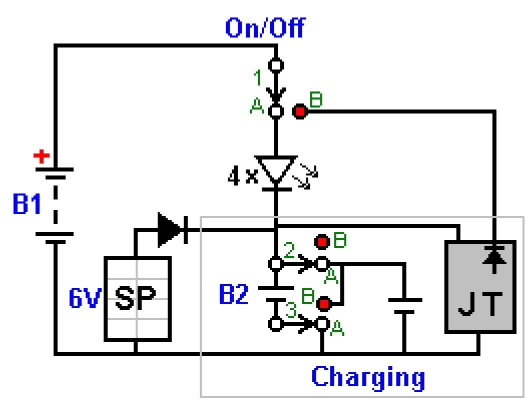


As the LED array lights are essentially diodes anyway, they have no problem with being supplied with current from a battery which is being pulse-charged by a Joule Thief, so there is the option of leaving the Joule Thief circuit connected all the time as shown above. That, of course, is optional.

One further thing which can be done is to allow for doubling the Joule Thief voltage when the light is off. While the Joule Thief charging circuit is perfectly capable of charging the “B1” battery when driven by a 1.2V battery, it can charge faster if its voltage is doubled, which can be done quite easily using a standard 3-pole, 4-way rotary switch:



or



Here, the “B2” battery is made using two 1.2V batteries connected in parallel when the light is on, and when the light is switched off, the two batteries are connected in series, driving the Joule Thief charging circuit with double the voltage. Another option is to connect in a 6V or higher solar panel to charge the “B2” battery during the day. It appears that although the charging circuit can run at all times, it is actually more effective if the battery charge is stored and the pulse-charging only starts when the light is switched off.

It needs to be remembered that NiMh batteries are only 66% efficient, which means that when they are driving a load, you will only ever get back again, two thirds of the current fed into them. Where the above circuits show just one Joule Thief charging circuit, there will normally be two, three or more charging circuits to raise the rate of charging during daylight hours. Also, if the battery powering the Joule Thief has a higher voltage than the battery being charged by it, extra diodes will be needed so that their combined voltage drop will prevent the charging battery feeding a large current directly into the battery being charged.

Mr Lawrence Tseung has taken the Joule Thief circuit and modified it to become a circuit with a very serious output, moving it into a completely different category.

As a first step towards what the team calls their "Fleet" device, the toroid has been enlarged to a much greater diameter. The coil is now wound on a section of plastic pipe, 170 mm (6.5 inches) in diameter and 45 mm (1.75 inch) deep:

This section of pipe is "bi-filar" wound with two wires side by side as already described for the Joule Thief construction. As before, the start of one wire is connected to the end of the other wire. Then, the winding is given a layer of electrical tape to hold it in place and to provide an easy working surface for a second winding.

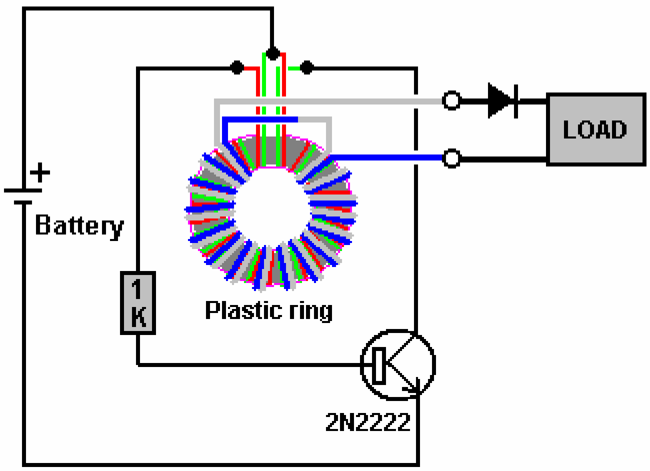
The wire used for the winding is the widely available red and black pair of wires, sometimes called "figure of eight" because the cut end of the wires looks like the numeral 8. The wire should be able to carry 2.5 amps. It must be side-by-side wire and **not** one of the twisted varieties. It looks like this:

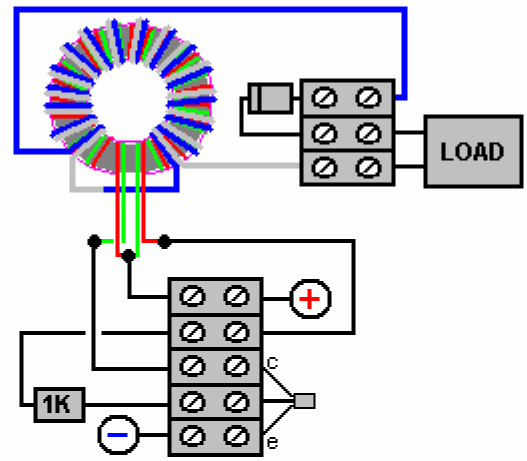
The second winding is made in the same way but the connections are slightly different. As before, the end of the first wire is connected to the start of the second wire, but that connection is then insulated and not used in the following circuitry. This just connects the two windings one after the other, known technically as being connected "in series" and is the equivalent of making the winding with just a single strand of wire. The completed coil may look like this:

This particular design is still in it's early stages and so many different coils sizes and constructions are being tested:

The arrangement is for the inner winding of the toroid to be oscillated by the Joule Thief circuit already described. This causes a pulsating magnetic field to envelope the outer winding of the toroid, producing an electrical output which is capable of doing useful work. The really important thing about this arrangement, is the fact that the amount of power coming out of the circuit is very much greater than the amount of power needed to make the circuit operate. The additional power is led out of the local environment and drawn into the circuit, becoming available to do useful work.

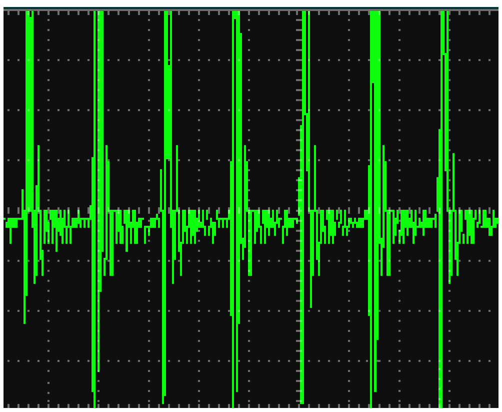
The overall circuit then looks like this:





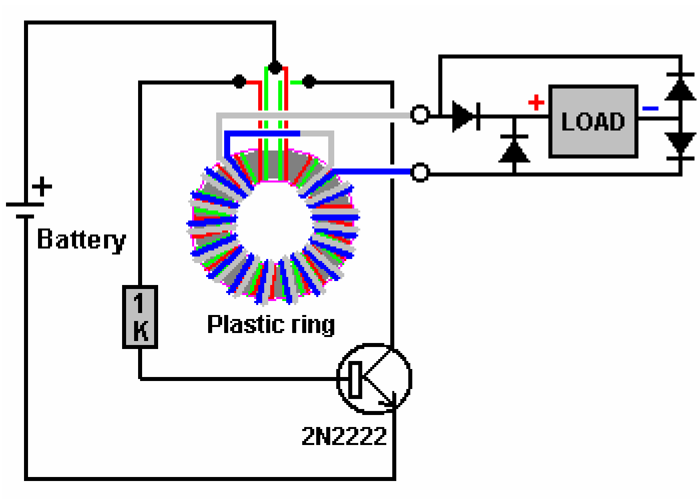
While the outer winding is shown here with thicker wire of a different colour, this is only to make the arrangement easier to understand. In reality, the outer winding is with exactly the same wire as the inner winding, and it will normally go all the way around the toroid. The total amount of wire needed to make the windings is about 70 metres and so it is normal to buy a full 100 metre reel of the twin-core wire, which allows both windings to be made and leaves spare wire for other things.

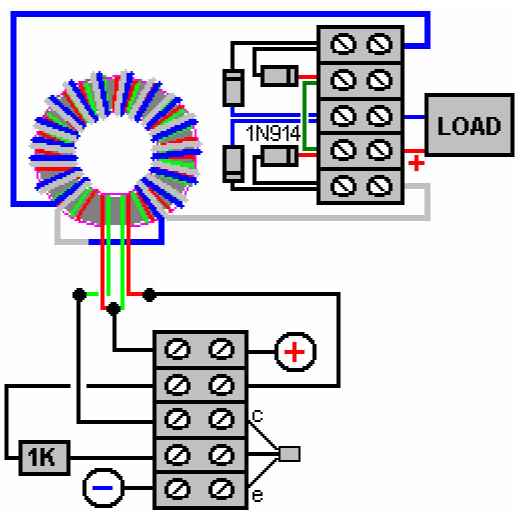
For those of you who are **very** technically minded, the output waveform looks like this:



and the voltage pulses in this output are occurring about 290,000 times per second.

What has worked better for me is using a bridge of four diodes rather than a single diode:





I have used this circuit, driven by a 1.5 volt battery, to charge 12-volt batteries, but the best results are in the five to six volt range. I have used this circuit to confirm COP>1 by charging one small 12V lead-acid battery with an identical battery, swapping the batteries over and repeating the process several times. The result was that both batteries gained genuine, usable power. I suspect that the effect would have been much greater if I had charged two or more batteries in series. The toroid was an 8-inch diameter, 10 mm by 12 mm offcut from a plastic pipe which happened to be to hand and the wire used was plastic covered 6-amp equipment wire, again, because it was to hand at the time. Winding the toroid and setting up the circuit was done in a single evening.

Overall, this is a very simple, cheap and easily constructed COP>2 device which has the potential of providing large amounts of free, useable, electrical power. With further development, it may well be possible to produce a version which could deliver the power needed by a whole household. It is also likely that these devices will become available for purchase a quite a low cost. All in all, this is a very important device and full credit must go to the development team who have carried the research to this point and who are continuing to refine the design to produce more power.

Chapter 7 - Power From The Ground

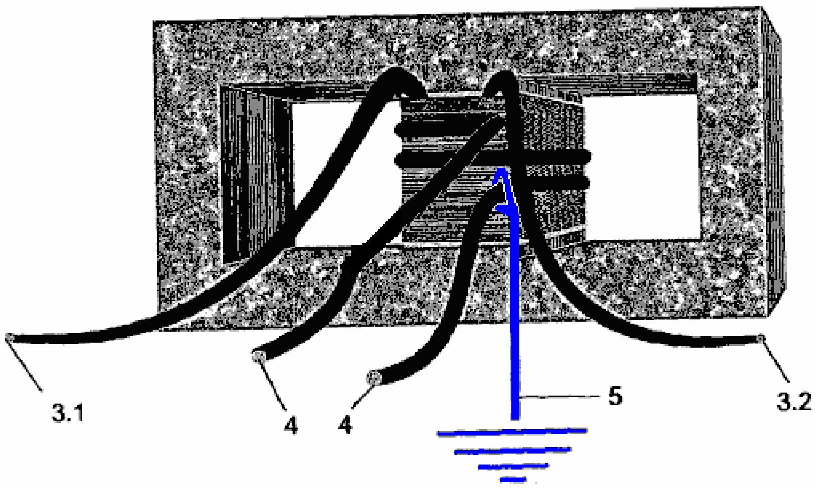
The Self-Powered Generators of Barbosa and Leal

In July 2013, two Brazilian men, Nilson Barbosa and Cleriston Leal, published a series of patents which appear to be very significant. Their patent WO 2013/104042 published on 18th July 2013, is entitled "Electromagnetic device for Capturing Electrons from the Ground to Generate Electricity" and has some very interesting features. It describes a simple device which they describe as an "electron trap". Their patents are written in Portuguese.

They also demonstrated their design and explained it. The demonstration showed 193 kilowatts of power being drawn from the ground by their equipment which drew less than 1% of that current:

Here is one of their patents:

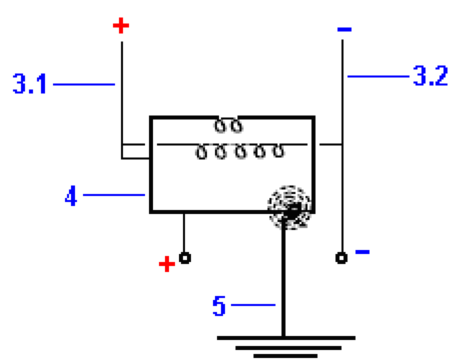
An unusual feature of this design is the fact that it has a continuous conductive loop, in which it is claimed, current flows continuously, even without the need for an applied voltage. Instead, it is the magnetic fields of electromagnets which keep the current flowing. They state that an insignificant amount of input power produces a substantial power output, and they consider a COP of 100 to be about the minimum performance which can be expected from the design. That is a 1 watt input for a 100 watt output. One version of the electron trap looks like this:



The inventors describe their device like this: "this electromagnetic-field-generating device, powered by a power source, produces an electromagnetic field which induces an electric current in a closed conductive circuit, creating an interaction between the magnetic poles of the equipment and the magnetic poles of the earth - through both electromagnetic attraction and repulsion. An endless supply of electrons is drawn from the earth into the conductive closed loop, which is connected to the ground through a conductive interconnected grid. The attracted electrons add to the current already flowing in the conductive closed loop, making power available for driving high-power loads, although the device itself is supplied with only a small amount of power."

One very interesting feature is that the continuous-loop coil formed by wire **4** in the diagram above, is literally, only two turns of wire. The power-gaining mechanism, amazingly, is the earth wire (shown in blue) which is merely wrapped around wire **4** and not directly connected to it as the electron-transfer link is by induction. With this arrangement, the current circulating in the closed loop wire **4**, attracts more electrons from the ground, flowing through the wrapped connection of wire **5,** into wire **4**, augmenting the current flow there by a major amount. Wire **3** can have an alternating voltage applied to it in order to get alternating current in wire **4**, but please understand that the current flowing in wire **4** is **not** the result of the current in wire **3**. If the current in wire **3** is DC, then the current in wire **4** will be DC as this is **not** a conventional transformer, but instead, it is an electron trap, operating in an entirely different way.

The electron trap can be connected in an AC circuit of this type:



Here, the earth wire **5** is wrapped around the continuous loop wire **4**, feeding it additional electrons captured from the ground. The ends of wire **4** are connected together to form the loop, and that connection also forms the positive side of the output (where a DC output is being produced). The magnetic field produced by the current flowing in wire **3**, acts on the electron flow coming from the earth, but as it does not provide any of the electric power flowing in wire loop **4**, the current flowing in wire **3** can be tiny, without affecting the power output.

In their patent WO 2013/104043, also of 18th July 2013, they show several different ways of connecting their electron trap in a useful circuit. For example, like this:

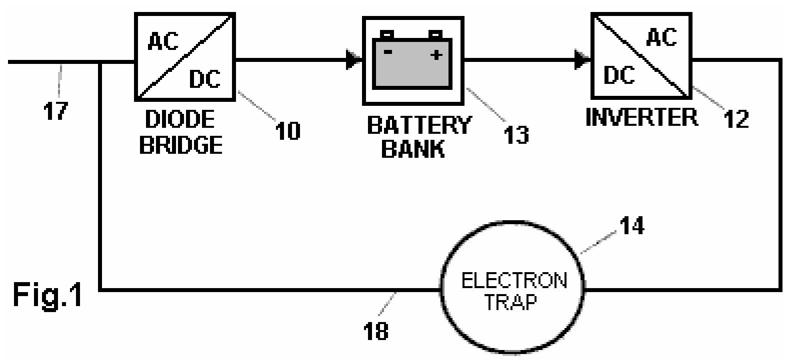
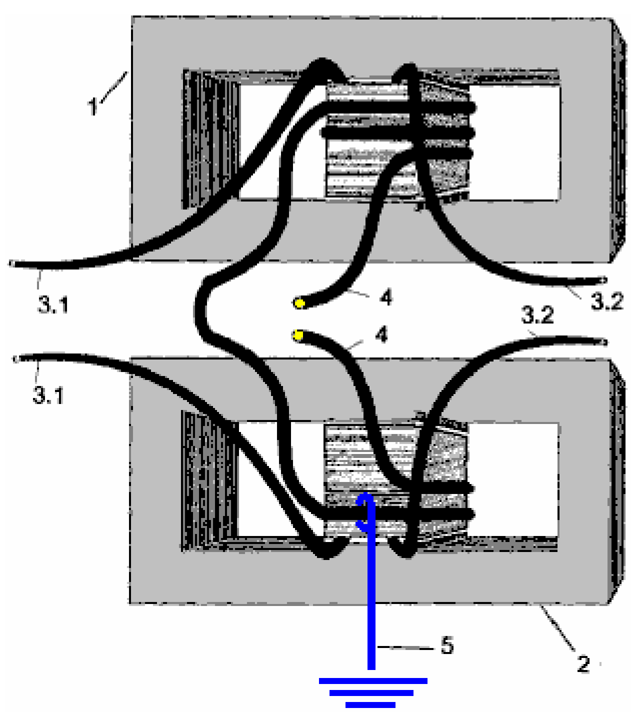


Fig.1

Here, the battery **13**, is used to power an ordinary inverter **12**, which produces a high alternating voltage, in this case, at very low power. That voltage is applied to the wire 3.1 to 3.2 of the electron trap, creating an oscillating magnetic field, which creates an oscillating inflow of electrons into the closed loop wire (4), which creates an amplified electrical output at the same frequency – typically 50 Hz or 60 Hz as those are the common mains frequencies. That amplified power output from the electron trap **14**, is passed along wire **18** to an ordinary diode bridge **10**, and the pulsing DC from the bridge is smoothed and used to replace the battery input to inverter **12**. The battery is now switched out of the circuit and, as well as making the overall circuit self-powered, the power coming from the electron trap is used to recharge the battery if it needs recharging (and/or, perhaps, to charge the batteries of an electric car). Because the electron trap needs almost no input power at all, the input power to the inverter is very small, and so a good deal of additional AC power can be drawn off through cable **17**, and used to drive powerful electrical loads, with no electrical power being needed from the battery. Being self-powered, the COP value for the circuit is infinity.

Just as there are several different ways of using an electron trap in a circuit, there are several ways of constructing and connecting an electron trap. While it is possible to arrange the components so that the power output is 2-phase or 3-phase, here we will just deal with the ordinary, household, single-phase power supply.

The first variation is to use more than one frame. Two frames can be connected like this:



This is the actual drawing from the patent and it presents a slight problem in that it is not physically possible to implement the number **4** wire in the way shown. Each frame will have two complete turns wound on it, although the drawing does not show this. Because of the inaccuracy of the drawing, I am not able to say if the coil turns on frame **2**, are in the same direction as those on frame **1**. There are four possible ways of winding these 2-turn coils when interconnecting them, so perhaps experimentation can be used to determine which method works best.

With this two-frame arrangement, there is just the one earth wire **5**, as before, again, it is wrapped around wire **4** rather than being physically connected to it. The continuous wire loop **4** has two ends as before, but there are now two **3.1** wire ends and two **3.2** wire ends. The Portuguese translation programs produce highly questionable results for this area of the patent, but I gather that the inventors intend the two 3.1 ends to be connected together and the two 3.2 ends to be connected together, and then the joined ends are treated exactly as before, effectively putting the two windings in parallel.

One disadvantage of this design is that it is not portable due to the earth connection. Barbosa and Leal deal with this problem in their patent WO 2013/104041 of the same date where they show a method of constructing an electron trap which collects excess electrons from the air. If you feel that there are no excess electrons in the air, then consider the fact that all of the aerial designs in chapter seven all extract and use those electrons. Also, consider the amount of electricity in a lightning strike, where much of the electrical energy comes from the air, and remember that world wide, there are between 100 and 200 lightning strikes every second.

The free-electrons-in-the-air electron trap is somewhat more complicated than the earth-wire electron trap, with four pairs of coils (**3** and **4**) being mounted inside two aluminium hemispheres (**1**):

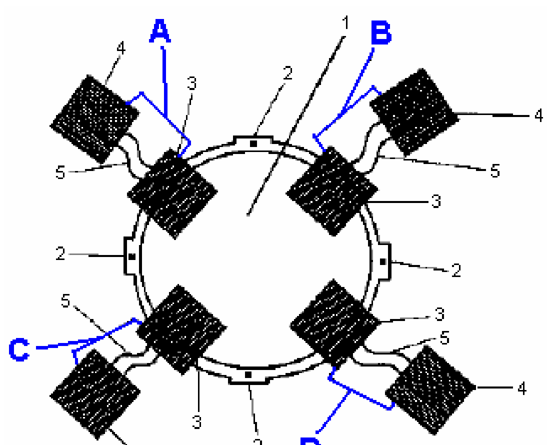


Fig. 6

The methods for using the air-electrons trap are the same as those for the earth-wire electron trap.

An earth-wire video demonstration is here: http://www.youtube.com/watch?v=iRSP7h73u-Q with 22 watts producing 6 kilowatts.

An attempted translation of one of the three Barbosa/Leal patents is here:

WO Patent 2013/104043 18th July 2013 Inventors: Nilson Barbosa and Cleriston Leal

ELECTRIC ENERGY GENERATION SYSTEM WITH FEEDBACK

Note: These three patents are in Portuguese and what is shown here is a low-quality attempt at translation into English using a translation program. The originals can be downloaded free from: http://worldwide.espacenet.com/singleLineSearch?locale=en_EP.

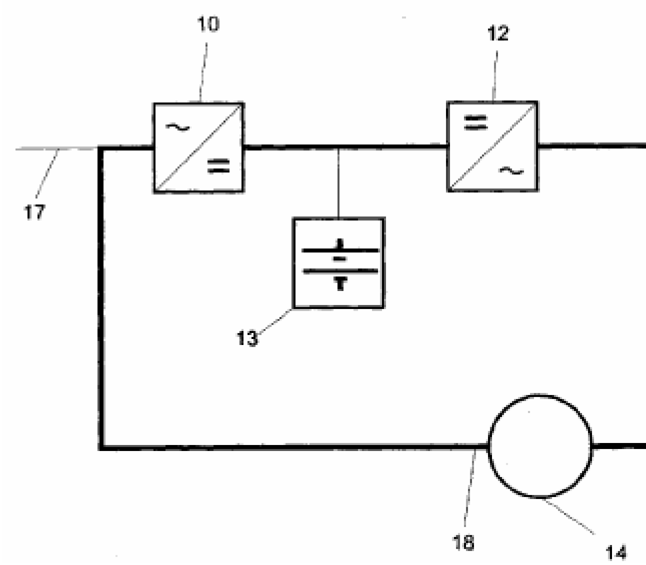


Fig 1

Abstract:
The present invention relates to electric energy generation equipment comprising a basic circuit formed by a rectifier (**10**), for example, an AC/DC converter connected in series to an inverter (**12**), for example, a DC/AC converter, and a bank of batteries (**13**) connected in series between the rectifier (**10**) and the inverter (**12**). An electron-capturing element (**14**), which can be either a free space electron-capturing element or, alternatively, an earth electron-capturing element, is connected in series to the basic circuit formed by the rectifier (**10**), the inverter (**12**) and the battery assembly (**13**). The bank of batteries (**13**) powers the basic circuit because it is connected to the system. Consequently, the inverter (**12**) converts direct current into alternating current and supplies this current to the electron-capturing element (**14**). After receiving the electric current from the inverter (**12**), the electron-capturing element (**14**) starts capturing electrons from the alternating current and powering the rectifier (**10**), which converts the alternating current into a direct current in order to recharge the bank of batteries (**13**) and power the inverter (**12**) which powers the electron-capturing element, closing the feedback loop, and also providing electric energy for consumption by external loads.

WIPO Patent Application WO/2013/104043 Filing Date: 01/11/2013
Application Number: BR2013/000016 Publication Date: 07/18/2013

Assignee: EVOLUÇÕES ENERGIA LTDA (Rua Santa Tereza 1427-B Centro - Imperatriz -MA, CEP -470 - Maranhão, 65900, BR)

SELF-POWERED ELECTRICITY GENERATOR.

Technical field
The present invention relates to a device for generating electricity, in particular self-powered equipment for generating electricity.

Description of the Related Art
There are many methods for generating electricity using electromagnetism, but all of these are electromechanical devices using magnets and have limited generating capacity and an ecological impact which makes them unsuited to large scale projects.

Objectives of the Invention
The aim of this invention is the sustainable generation of electricity, using a generator which is able to produce large amounts of electricity from an extremely low input current, which initially is supplied by a bank of batteries, but subsequently is supplied by the output from the generator which is also able to power external loads.

The above objective, and other objectives, are achieved by the present invention through the use of a typical Uninterruptible Power Supply circuit comprising of an AC/DC rectifier feeding a battery bank which powers a DC/AC inverter, which is connected to a device to trap electrons from space (as described in Brazilian patent application No. BR1020120008378 of 13th January 2012) or alternatively, a device which extracts electrons from the Earth (as described in Brazilian patent application No. BR1020120008386 of 13th January 2012), which then passes the extracted electrons to the AC/DC rectifier, charging the battery bank, thus closing the loop as well as providing electricity to power external loads.

The self-powered system for generating electricity from the present invention can be fixed or mobile. It is fixed when using electron capture from the earth due to the ground connection, or mobile when using electron capture from space.

The self-powered electricity generating system of this invention may be configured in several different ways, each using the same inventive concept but using different arrangements of components. Different versions include single-phase, two-phase or three-phase versions, producing outputs of any power and voltage.

Brief Description of the Drawings
The present invention will now be described with the aid of drawings, but this patent is not limited to the versions and details shown in these drawings, although they show additional details and advantages of the present invention.

The drawings:

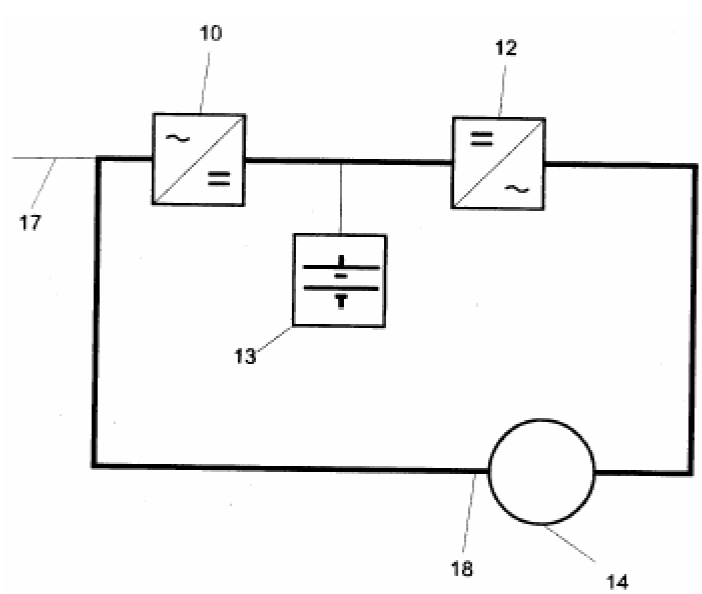


Figure 1 - shows a basic circuit system for self-powered electricity generation of the present invention

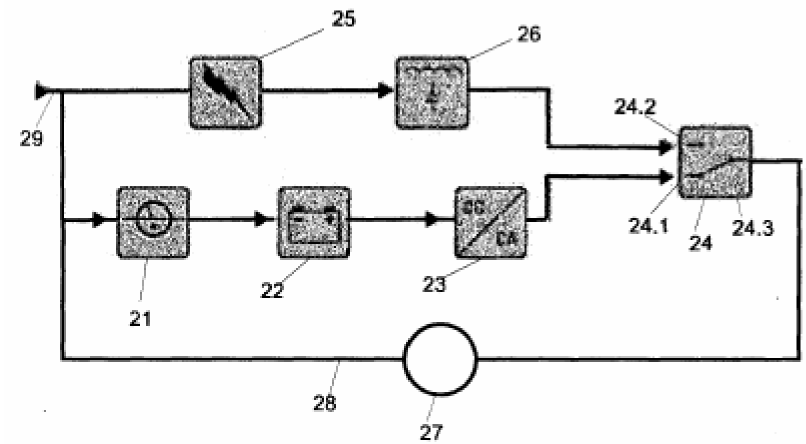


Figure 2 - shows a first embodiment of the constructive system for self-powered electricity generation of the present invention;

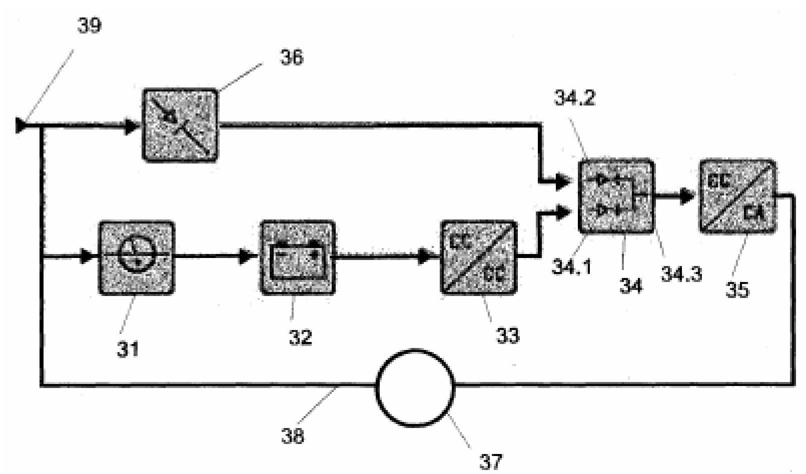


Figure 3 - shows a second embodiment of the self-powered system for generating electricity of the present invention;

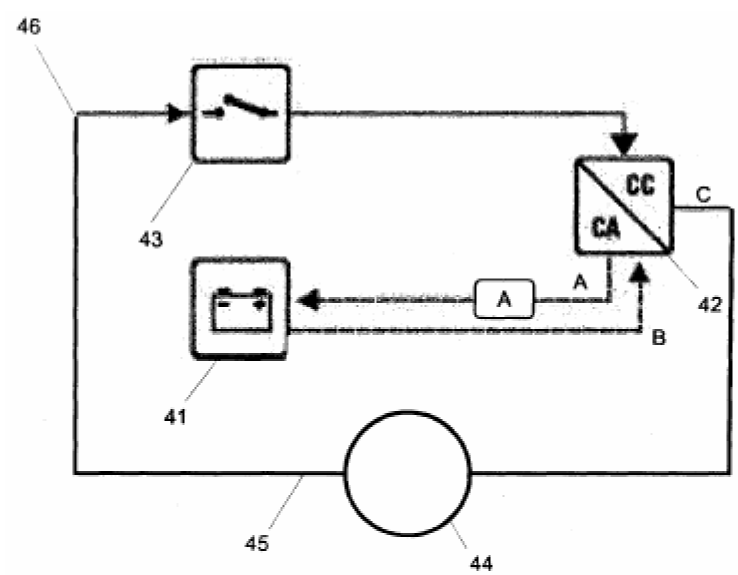


Figure 4 - shows a third embodiment of the self-powered system for generating electricity of the present invention;

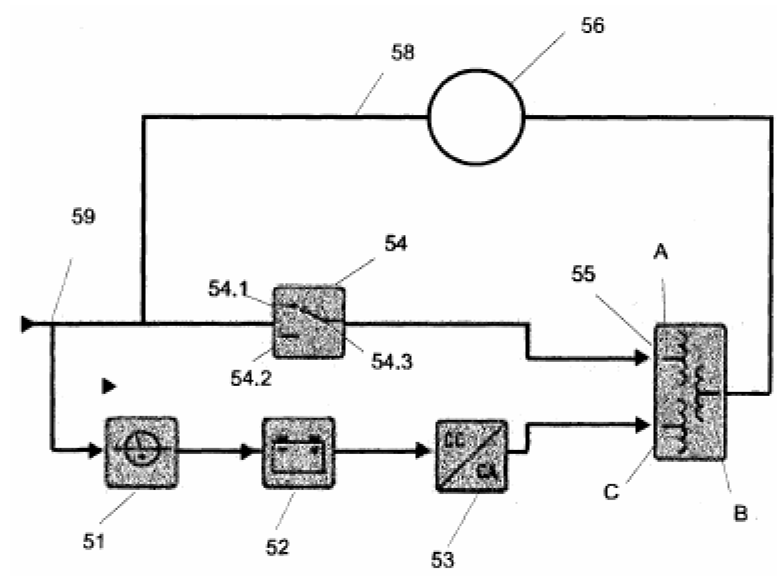


Figure 5 - shows a fourth embodiment of the self-powered system for generating electricity of the present invention;

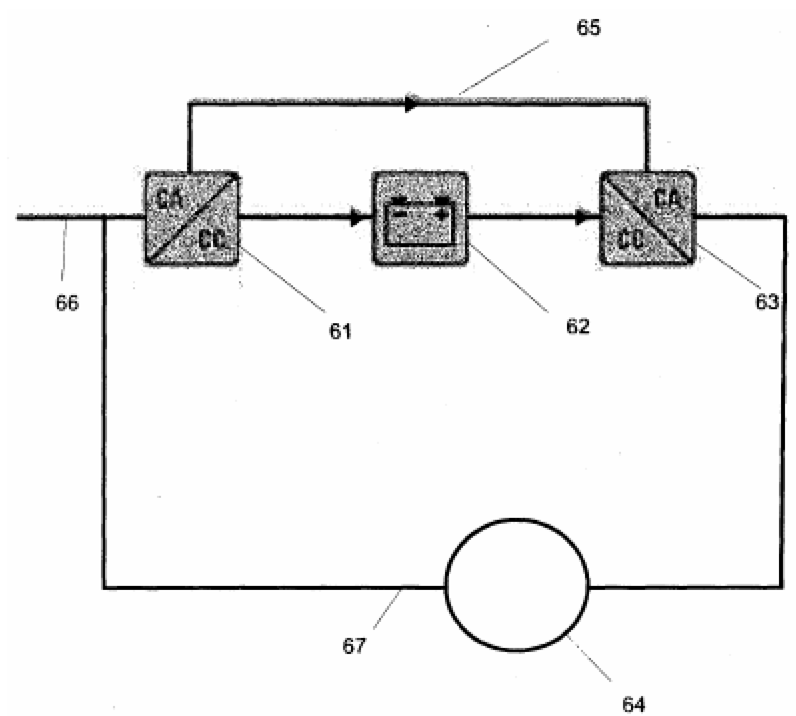


Figure 6 - shows a fifth embodiment of the self-powered system for generating electricity of the present invention;

Detailed description of the Invention:

There are different ways of closing the self-feeding cycle depending on the circuit configuration chosen. Some of these arrangements are shown in **Figures 2** to **6**, wherein the main circuitry continues to oscillate, continuously generating instant electricity.

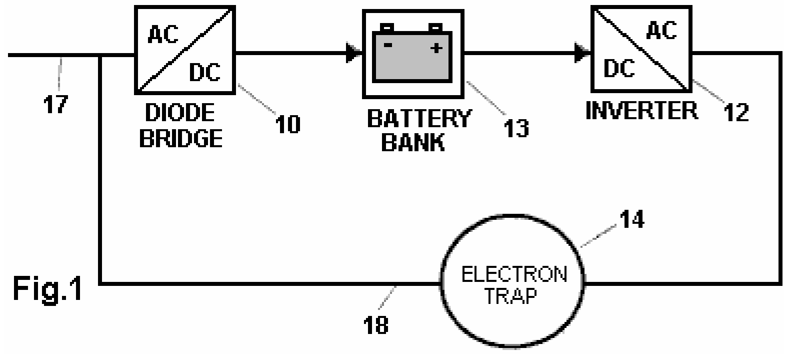


Fig.1

As shown in **Fig.1**, the self-powered system for generating electricity comprises a basic circuit consisting of a rectifier (AC/DC converter) **10** which is connected in series to an inverter (DC/AC) **12**. A bank of batteries **13** is connected between the rectifier **10** and the inverter **12**. The output from the DC/AC inverter **12**, connects to an electron-trap **14** which can extract electrons from space (as described in Brazilian patent application No. BR1020120008378 of 13th January 2012) or alternatively, extracts electrons from the Earth (as described in Brazilian patent application No. BR1020120008386 of 13th January 2012).

When connected, the battery bank **13** provides power to the DC/AC inverter **12** which converts the direct current into alternating current and provides current to the electron-trap **14**. The output of the electron trap **14** is passed through wire **18**, to the AC/DC bridge rectifier **10**, which keeps the battery bank charged as well as powering the DC/AC inverter **12**. Additional power is passed to external equipment through wire **17**.

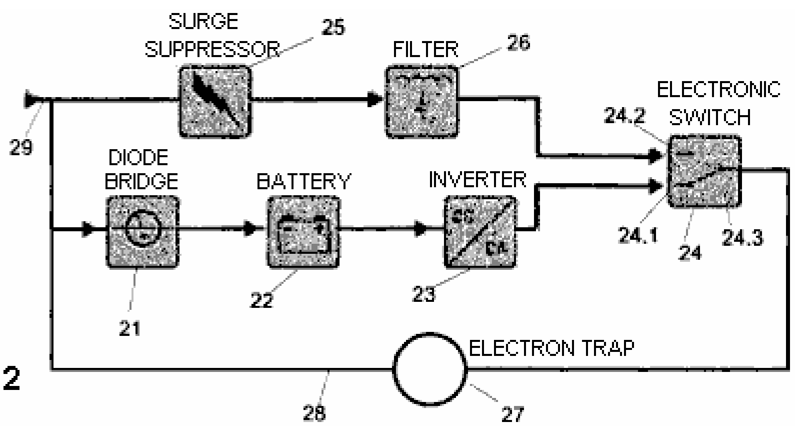


Fig.2

Fig.2, shows another embodiment of the system of this self-powered electric power generation equipment. It comprises a typical Uninterruptible Power Supply circuit of a battery charger (AC/DC converter) **21** connected to a drive device (a DC/AC inverter) **23** and between them, a battery bank **22** forming the basic circuit. Additional devices are an electron-trap **27** which may collect free electrons from space (as defined in Brazilian patent application No. BR1020120008378 of 13th January 2012) or, alternatively, collects electrons from the Earth (as described in Brazilian patent application No. BR1020120008386 of 13th January 2012). The 3-phase electronic switch **24** normally connects **24.1** to **24.3** connecting the electron trap **27** to inverter **23**. Connected in parallel is the surge suppressor **25**, which, when activated, via filter **26**, causes switch **24** to disconnect the **24.3** to **24.1** link and instead, connect **24.3** to **24.2**.

An alternative arrangement for use in emergency situations, is to use the system no longer self-powered. For this, the system is comprised of a power input from an external power source, directly to the interconnection point **29** to provide power to surge suppressor **25**, which provides power to feed the power output point **28** in order to power external loads. When the electron-trap **27** is turned off, the electronic transfer switch **24** reverts to its default position which connects point **24.1** to point **24.3** causing the circuit to function, once again, in its self-feeding mode. As soon as the electron sensor **27** provides sufficient power to the over-voltage sensor **25**, it operates the transfer switch **24** through filter **26**, ending the self-feeding phase and supplying energy directly to the power output point **28**, in order to feed external loads.

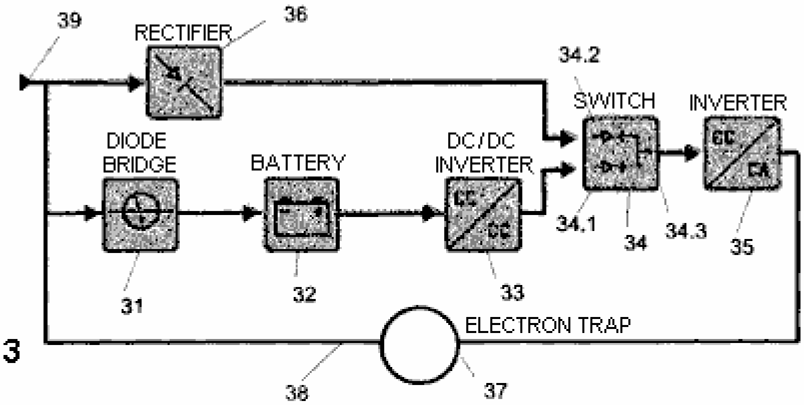


Fig. 3

Fig.3 shows another embodiment of the self-powered system for generating electricity, comprising a device which includes the basic circuit of a typical Uninterruptible Power Supply, consisting of a battery charger (AC/DC converter) **31** connected to a drive device (inverter DC/AC) **35** and attached to them, a battery bank **32.** This basic circuit together with other devices is connected to an electron-trap **37** for collecting free electrons from surrounding space or, alternatively, an Earth-connected electron trap **37**. We have then, a bank of batteries **32** connected to the DC/DC converter **33**, which is connected to the phase transfer switch **34 / 34.1** which is connected to point **34.3**, which connects to the inverter **35**, and so, the electron-trap **37**.

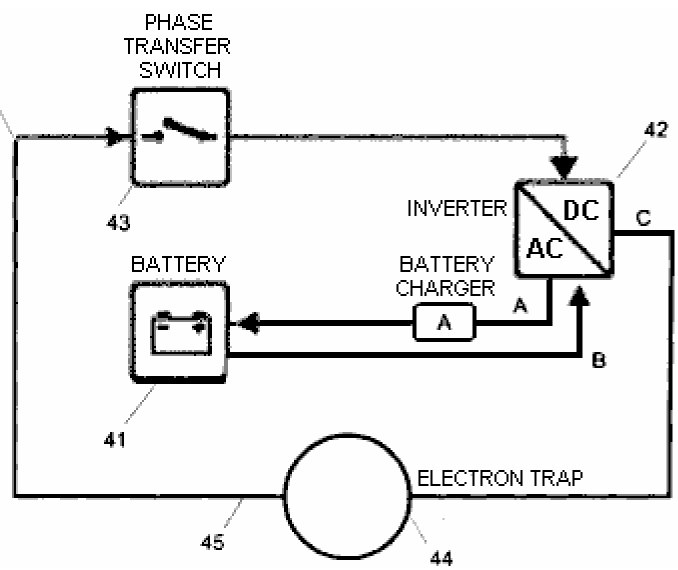


Fig. 4

Fig.4 shows another embodiment of the system for self-powered electricity generation which is comprised of a basic circuit of a typical uninterruptible power supply, consisting of a battery charger (AC/DC converter) **A** connected to an inverter (DC/AC) **42** and attached to them, battery bank **41**, and this basic circuit together with other devices are connected to a free space electron-capture device **44** or an earth-connection electron-trap **44**. Comprising thus, a battery charger **A** connected to a battery bank **41**, which is connected in series with inverter **42** at point **B** which is in series with point **C** of inverter **42** which is in series with the electron sensor **44**, which is in series with the phase transfer switch **43** via the three-phase load output connection point **45**. The phase transfer switch **43** is in series with the inverter **42**, which is connected in series the (AC/DC converter) battery charger **A** feeding the battery bank **41.**

An alternative construction for use in emergency situations, in which the system ceases to be self-powered, the system may include power input from an external power source, via the interconnection point **46**, thus providing electricity output **45**, to power external loads. The battery bank **41** provides power to the inverter **42** which converts the direct current into alternating current and feeds the electron trap **44**. The phase transfer switch closes when the batteries need recharging.

Sensor **44** captures electrons, producing alternating current, which feeds the phase transfer switch **43** with alternating current input power. The phase transfer switch **43** feeds the inverter **42** which charges the batteries, closing the self-powering loop which provides power at the output **45**, feeding both the power input and any external loads.

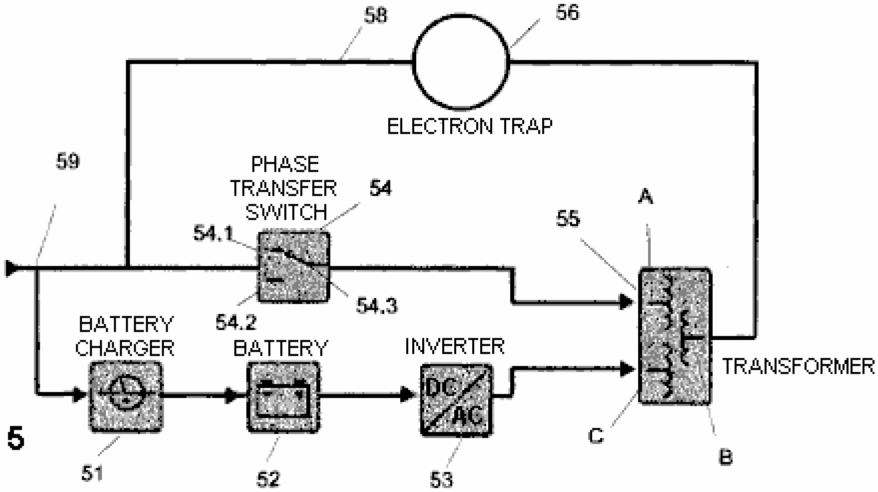


Fig. 5

Fig.5 shows another embodiment of the system for self-powered electric power generation equipment comprising a circuit which includes a typical uninterruptible power supply comprising a battery charger (AC/DC converter) **51** connected to a DC/AC inverter **53** and attached to them, a battery bank **52**. This basic circuit together with other devices are connected to a space free-electron capture device **56** (as defined in Brazilian patent application No. BR1020120008378 of 13/1/12) or, alternatively, an earthed free-electron collector **56** (as defined in Brazilian patent application No. BR1020120008386 of 13/1/12). This then comprises a battery charger **51** which is connected in series with a battery bank **52**, which is connected in series with the inverter **53**, which is connected in series with the transformer **55** at its point **C**, which is in series with its point **B** which is in series with the electron collector **56**, which is in series with the battery charger **51** which is connected to the load exit point **58**, which is also the circuit entry point **59**, which is in series with the phase transfer switch **54** section **54.1**, which is connected to terminal **54.3**, which is in series with point **A** of the transformer **55** which exits at point **B**. Points **A** and **54.3** as well as the parallel points **54.1** and **54.2**, are all parallel to the battery charger **51**, the battery bank **52**, the inverter **53** and to point **C** of the transformer **55**.

An alternative construction for use in emergency situations, in which the system ceases to be self-powered, the system may include an external power input point **59**, allowing phase transfer switch **54** to provide power output **58**, to feed external loads. Battery bank **52** provides power to the inverter **53**, which converts the direct current into alternating current, feeding point **C** of the transformer, which comes out at points **B** and **A** of the transformer **55**. Point **B** of the transformer feeds the electron-trap **56** producing alternating current which feeds the battery charger **51**, recharging the battery bank **52**.

The battery charger **51** is connected in parallel with the transfer switch **54** via connection points **54.1** and **54.3**, feeding point **A** of the transformer, which comes out at point **B**. Point **A** of the transformer and the switch transfer points **54.3** and **54.1** are in parallel to the battery charger **51**, the battery **52**, the inverter **53** and point **C** of the transformer **55**.

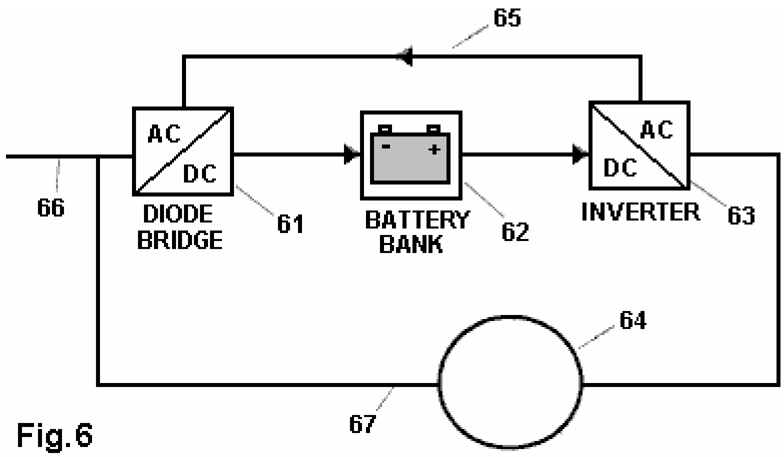


Fig.6

Fig.6 shows another embodiment where a rectifier **61** is connected to an inverter **63** and a battery bank **62**, and to a space free-electron trap **64** or alternatively, an earth electron trap **64** comprising thus, a delta (AC/DC) converter **61**, which is connected in series to a battery bank **62**, which is connected in series with the (DC/AC) inverter **63**, which is in series with the electron collector **64** which is connected in series with the delta converter (AC/DC) **61** whose AC part is in series with the alternating AC current inverter **63** via a connecting wire **65** which is in parallel with the DC part of the delta converter **61** with the battery bank **62** and the DC part of inverter **63**. An alternative construction for use in emergency situations, in which the system ceases to be self-powered, the system may comprise a power input from an external power source, via the interconnection point **66** connected to the delta converter **61**, the output **67** supplying power, to the external loads.

Battery bank **62** provides power to the inverter **63**, which converts the direct current into alternating current, powering the free-electron collector **64**. The captured electrons from collector **64** form an alternating current which feeds the delta converter **61** via an output power load wire **67**.

The alternating part of the three-phase delta converter **61** is fed with alternating current from inverter **63** via connecting wire **65**, which is connected in parallel to the continuous DC delta converter **61**, which feeds the battery bank **62** and with the continuous portion the inverter **63**, closing the cycle of self-feeding and supplying power at the output **67**, which is the output power point.

Having described examples of preferred embodiments, it should be understood that the scope of the present invention encompasses other possible forms of construction, using the electron collectors connected to a basic circuit of a typical uninterruptible power supply of energy, known as a UPS, comprising a rectifier device (an AC/DC converter) **10**, connected to one inverter (DC/AC converter) **12**, and attached between them, an energy storage device (typically, a battery bank).

A very important part of the above patent is the device described as a "collector of free-electrons", either from the earth or from space. We have to go to the patent applications mentioned above to find the details of these designs:

Application Number: BR2013/000015, Publication Date: 07/18/2013, Filing Date: 01/11/2013

Assignee: EVOLUÇÖES ENERGIA LTDA (Rua Santa Tereza 1427-B Centro - Imperatriz, MA- CEP -470 - Maranhäo, 65900, BR)

ELECTROMAGNETIC ELECTRON TRAP FOR ELECTRIC POWER GENERATION

Technical Field

The present invention refers to electromagnetic equipment for electric power generation or alternatively for thermal power generation. More specifically equipment capable of producing abundant electricity and thermal energy from a tiny amount of input electrical energy

Description of the Related Art

According to Lenz's law, any induced current has a direction such that the magnetic field it generates opposes the change in magnetic flux which produced it. Mathematically, Lenz's Law is expressed by the negative sign (-) that appears in the formula of Faraday's Law, as follows.

The magnitude of the induced emf (ε) in a conducting loop is equal to the rate of change of magnetic flux (Φ_B) with time:

$$\varepsilon = -\frac{d\Phi_B}{dt} \qquad \text{Equation 1}$$

As an example of application of Faraday's Law, we can calculate the electromotive force induced in a rectangular loop that moves in or out, with constant speed, a region of uniform magnetic field. The magnetic field flux through the surface limited by the loop is given by:

$$\phi = xLB \qquad \text{Equation 2}$$

and its variation in time:

$$\frac{\Delta\phi}{\Delta t} = \left(\frac{\Delta x}{\Delta t}\right)LB = vLB \qquad \text{Equation 3}$$

So:

$$\varepsilon = vLB \qquad \text{Equation 4}$$

and if the coil has a resistance (R) and the induced current:

$$i = \frac{\varepsilon}{R} = \frac{vLB}{R} \qquad \text{Equation 5}$$

A conductor traversed by an electric current immersed in a magnetic field undergoes the action of a force given by:

$$F = IL \times B \qquad \text{Equation 6}$$

Thus, the effect of the current induced in the loop appears as forces Ff, and F - FM. The first two cancel each other out and the third is cancelled by an external force P_{EXT} needed to maintain the constant speed loop.

As the force FM must oppose the force F_{EXT}, current (i) induced in the loop by varying the magnetic flux must have the meaning indicated in **Fig.3**. This fact is a particular example of Lenz's Law.

Considering the experimental activities discussed with Faraday's law, when a magnet approaches a coil, the induced current in the coil has a direction as shown in **Fig.1**. This generates a magnetic field whose north pole is facing the north pole of the magnet, that is, the field generated by the induced current opposes the motion of the magnet.

When the magnet is moved away from the coil, the current induced in the coil has a direction opposite to that shown in **Fig.1**, thereby generating a magnetic field whose south pole is facing the north pole of the magnet. The two poles attract each other, that is, the field generated by the induced current opposes the movement of the magnet away from the coil. This behaviour is present in all current power generators, and known as 'engine brake' is highly undesirable as it increases the resistance and so, the energy loss.

When two electromagnetic coils are placed facing each other, as shown in **Fig.2**, there is no current in either of them. At the instant of power-up of one of the coils, the current in the coil, generates an induced current in the second coil. When powered up, the current in the coil goes from zero to its maximum value, and then remains constant.

Thus, when the current is changing, the magnetic field generated by it, (whose north pole faces the second coil) is also changing and so the magnetic flux of this field through the second coil is also changing. Then there is a current induced in the second coil whose sense is such that the magnetic field it generates tends to decrease the flow mentioned above, that is, its north pole confronts the north pole of the first field coil.

When the power switch is opened, the current in the first coil drops from its maximum value to zero, and correspondingly its magnetic field decreases. The flux of the magnetic field in the second coil also decreases, and the induced current now flows in the opposite direction. This current flow direction produces an enhancing magnetic field, that is, it has a south pole facing the north pole of the field of the first coil.

Thus, there is a realisation of the principle of conservation of energy, expressed by Lenz's law, wherein any induced current has an effect which opposes the cause that produced it. Assuming that the induced current acts to favour the variation of the magnetic flux that produced the magnetic field of the coil, it would have a south pole facing the north pole of the approaching magnet, causing the magnet to be attracted towards the coil.

If the magnet were then released, it would experience an acceleration toward the coil, increasing the intensity of the induced current and thus create an enhanced magnetic field. This field, in turn, would attract the magnet with increasing force, and so on, with a continuing increase in the kinetic energy of the magnet.

If energy were to be withdrawn from the magnet-coil system at the same rate at which the kinetic energy of the magnet increases, then there would be an endless supply of energy. So it would be a perpetually operating motor, which would violate the principle of conservation of energy. Therefore, it can be concluded that current generators feature a large energy loss during the generation of electricity.

Objectives of the Invention

An objective of the present invention is to contribute to the generation of sustainable energy, proposing an electromagnetic machine capable of producing abundant electricity from an extremely low input of electrical energy.

The above objective and other objectives are achieved by the present invention by a device comprised of at least one electromagnetic field-generating device (without a core or with at least one core) powered by an electrical power source (without a core or with at least one core) having their coils, or sets of coils, wound on at least one common conductive member in a closed circuit which itself has a polarised voltage which is connected to at least one conductive interconnection element which is connected to a grounding grid, these interconnections creating a new technical effect, namely, the appearance of an electric current which keeps circulating in a closed conductive loop, and which can therefore be used to power external loads.

The device which is the object of the present invention operates as follows: the electromagnetic field generating device, powered by a power source, produces an electromagnetic field which induces an electric current in a closed conductive circuit, creating an interaction between the magnetic poles of the equipment and the magnetic poles of the earth - through both electromagnetic attraction and repulsion. An endless supply of electrons is drawn from the earth into the conductive closed loop, which is connected to the ground through a conductive interconnected grid. Attracted electrons add to the current already flowing in the conductive closed loop, making power available for driving high-power loads, although the device itself is only supplied with a small amount of power. Thus, advantageously, the device which is the object of the present invention, acts as a trap for electrons from the earth and this allows the generation of electricity.

Advantageously, the present electromagnetic equipment generates either electricity or thermal energy, providing access to this new source of energy is through an electromagnetic field. The interconnections of the components of the electron-trap of the present invention, cause an advantageous new technical effect, namely, the appearance of an electric current which keeps circling in the conductive closed circuit, with or without voltage being applied and even without a load being connected to the loop - provided that the electron-trap is connected.

The proposed sensor can also be used to generate thermal power, depending on the form in which you want to use the effect of the flow of electrical current produced in this electromagnetic equipment.

For the generation of thermal energy in amounts proportional to the power of the electron-trap, through the movement of electrons in the conductive closed loop itself, the resistance should be increased by increasing the number of turns around the cores in the conductive element of the closed circuit, and in that instance, the coils of the electromagnetic field generating device, will then be made of heat-insulated electrical circuit components, bearing in mind the required temperature which is to be produced. The thermal energy generated by the electron-trap can be used in any application from domestic to industrial applications.

This technology can also be used for various technical purposes in electric machines. By "electrical machines", it should be understood to include: static electrical machines, transformers, ballasts, rotating electrical machines, synchronous machines, dual power supply machines, current rectifiers in synchronous cascade, external pole machines, synchronous current machines alternating current machines and/or direct current machines, electronic equipment and electrical resistances. The capture of electrons can provide single-phase, two-phase or three-phase supplies, operating at low, medium or high voltage.

The capture of electrons by induction, does not impact on the environment. The fact is that we use as the capturing force, only a negligible amount of electricity relative to the current captured by the sensor. The relationship between power input and the quantity of electricity generated by the electron-trap is at least 1 to 100, that is, for each 1 watt provided to the sensor, there is at least 100 watts of power available for external loads. This relationship, however, is not limited, as it depends on the mounting of the electron-trap and the objectives of the circuit, and so, the generated power can be greater than 100 times the input power.

Another advantage of the earthed electron- trap proposed in the present invention is that the electron-trap can transport electrons from point "A" to point "B" without a voltage drop across the closed-loop conductive element - if it is biased with a voltage - regardless of the distance between the points depending on the strength and quantity of the electromagnetic field generating devices. It is also possible to transport electrons when the conductive element in a closed circuit is itself not polarised. Thus, the electric current is transported without voltage, just by the magnetic field formed between the device and the generator of the electromagnetic field.

Brief description of the Drawings

The present invention will now be described with the aid of drawings, but the design is not limited to the implementations shown in these drawings, although they show other details and advantages of the present invention.

The figures show:

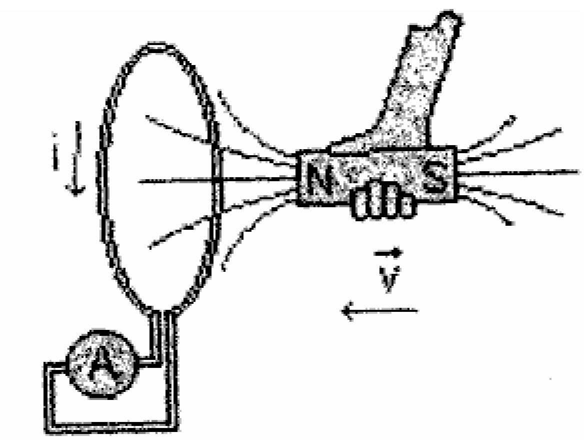


Fig.1

Fig.1 - illustrates Faraday's law.

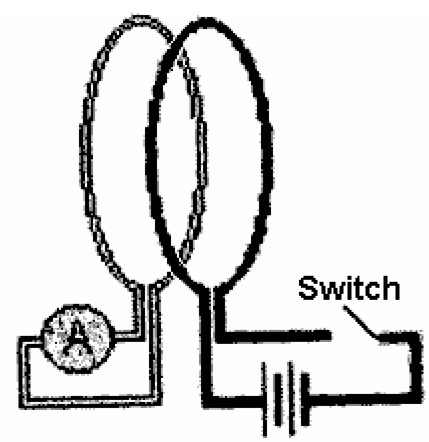


Fig.2

Fig.2 – is a representation of Faraday's law.

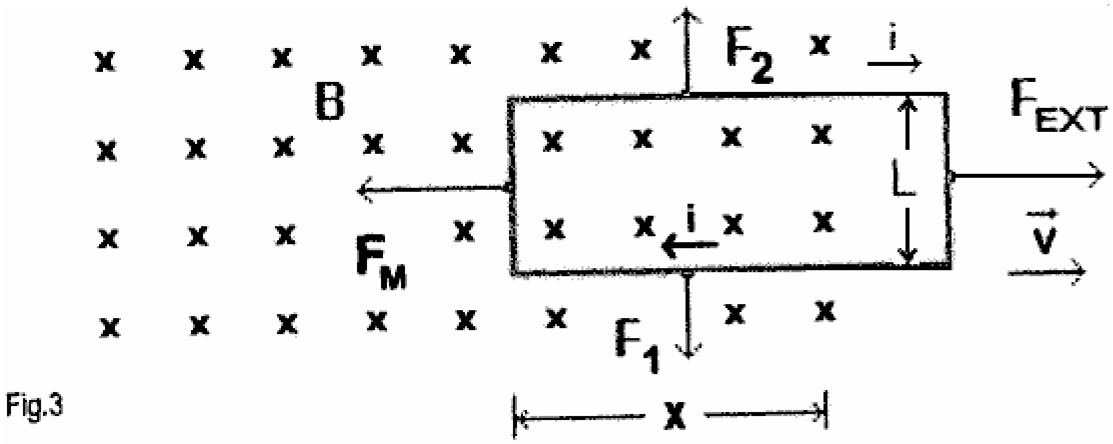


Fig. 3 – is a representation of Faraday's law.

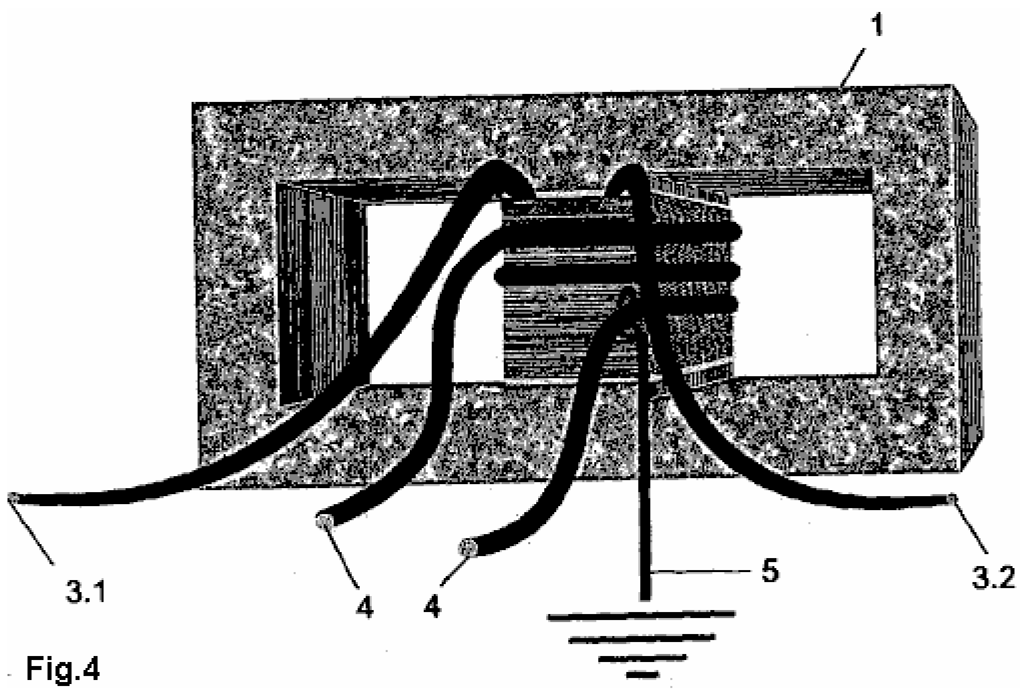


Fig. 4 - is a perspective view of an electron-trap with a single phase coil.

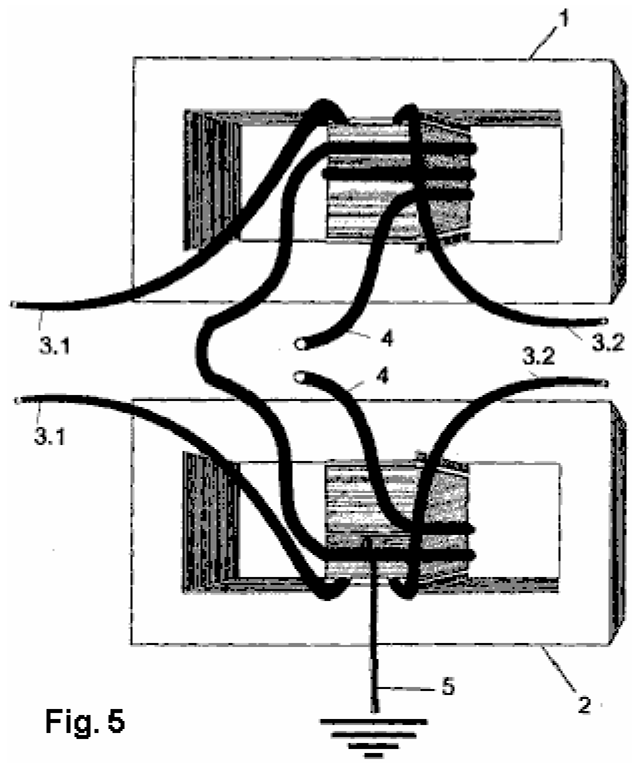


Fig.5 – is a perspective view of a single-phase electron trap with two coils.

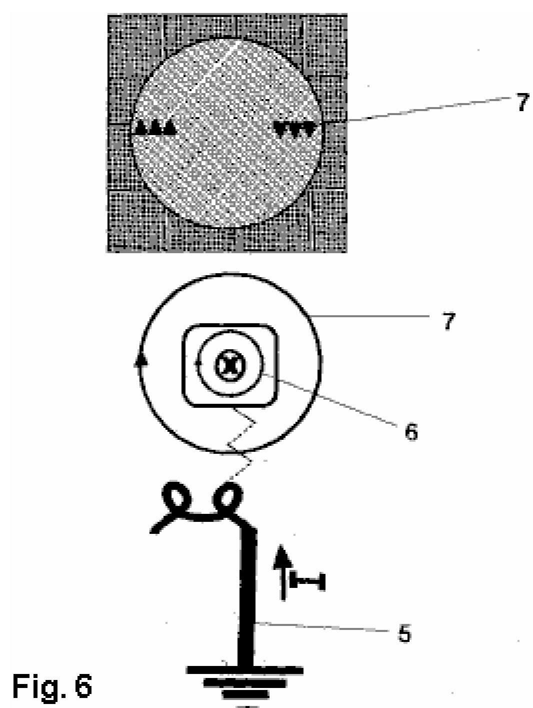


Fig.6 - is a representation of the effect of electromagnetic flux in the coils around the cores of the electron trap.

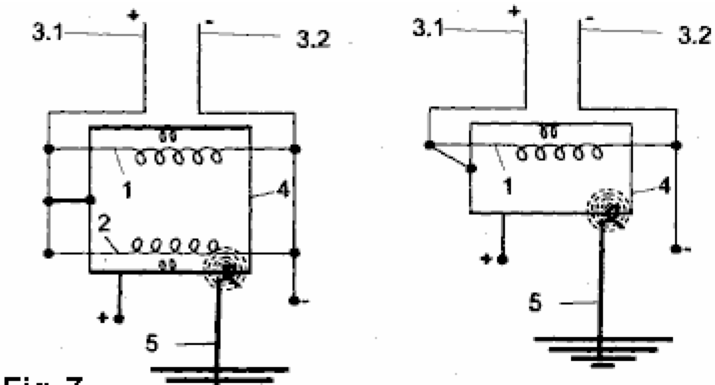


Fig. 7

Fig.7 - is a representation of an electrical circuit with two coils of the link/coil conductor polarised.

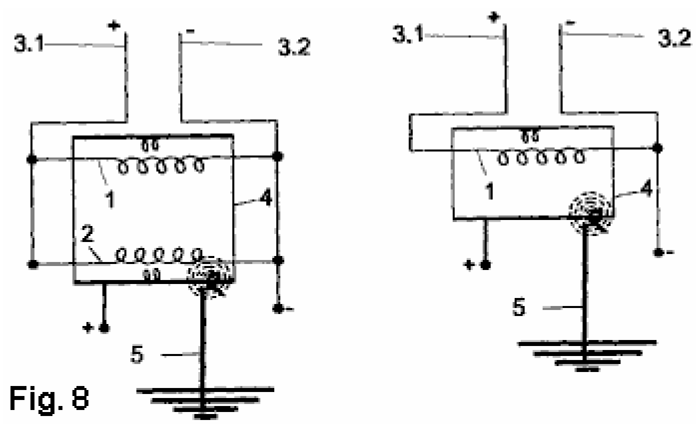


Fig. 8

Fig.8 - is a representation of an electrical circuit with two coils of the link/coil conductor not polarised.

__**Detailed Description of the Drawings**__

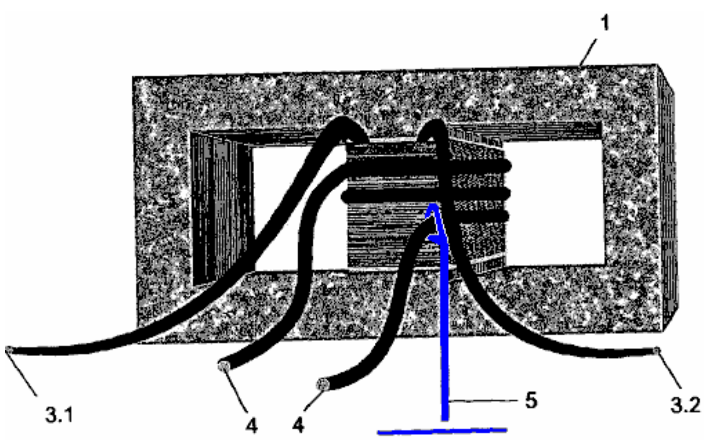


Fig.4

Fig.4 shows one of several types of electron-trap proposed by the present invention, where the electron-trap is single-phase and consists of at least one electromagnetic field-generating device with at least one set of coils, in this case it happens to be an electromagnetic type coil with one common magnetic core, but it could alternatively have any number of windings of any kind and shape. However, the electron-trap proposed by the present invention can be constructed with a different type of electromagnetic field generating device, such as an electromagnetic inductor or magnet of any type or shape, or any combination of them, and in unlimited numbers for each phase of the electron trap.

When winding these coils, for example, coil **4-4**, each coil must have at least one complete turn, preferably two turns if the objective is to generate electricity, and preferably four turns if the objective is provide thermal energy. The number of turns in the coils wound around the common core, is directly related to the amount of current to be generated.

At least one conductive interconnection element, in this case the driving member **5** - which can be copper or any other suitable conductive, material whether insulated or not insulated, connects or loop-links wire **4** to the ground grid. The connection between the conductor **5** and wire **4** is by electromagnetic induction. Winding **4** is also the power supply for the loads which are to be powered by the captured electrons.

Also in **Fig.4**, the power wires **3.1** and **3.2** (live phase and neutral) have an input from an external power coil **1** which can be energised from any external source of electricity such as a power grid. The trapped electrons can be configured to supply DC or AC current. Thus, if the coil **1** power source is alternating electrical current - AC, then the electron-trap provides alternating electrical current. If the power source is continuous electrical current - DC, then the electron-trap provides continuous electrical current - DC. The electrical supply provided by the trapped electrons can be single-phase, two-phase or three-phase, and at low, medium or high voltage.

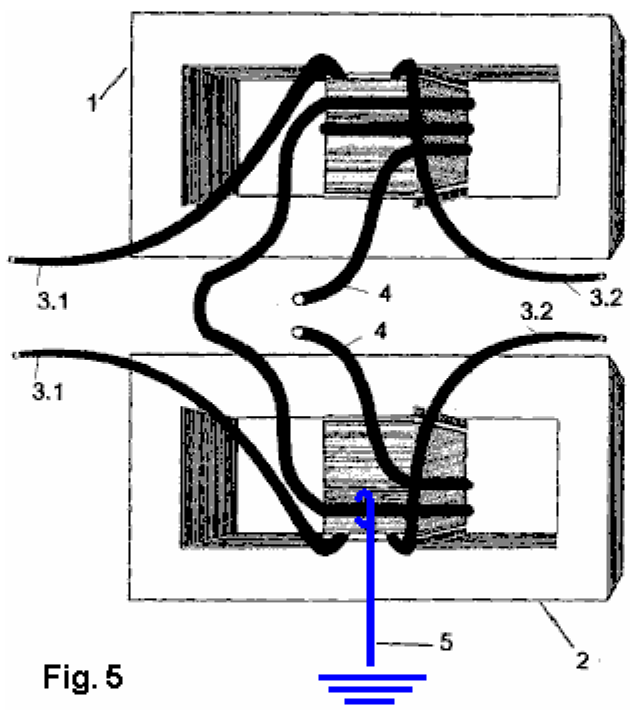


Fig. 5

Fig.5 shows an electron-trap with two single-core phase coils: **1** and **2**, although these coils may be of any type and shape. However, the electron-trap proposed by the present invention can be constructed with other types of electromagnetic field generating device, with at least one electromagnetic inductor or electromagnet which can be of any type and shape, with any combination of them, and in unlimited quantities in each phase of the electron-trap.

The coils on frames **1** and **2** may have other shapes, but they must each have at least one complete turn, particularly in coil **4**. The number of turns in this winding are directly related to the amount of current to be generated. This coil also makes the interconnection between the coils **1** and **2** forming the link between their two cores.

At least one conductive interconnection element, in this case the driving member **5** - which can be copper or any other suitable conductive, material whether insulated or not insulated, connects or loop-links wire **4** to the ground grid. The connection between the conductor **5** and wire **4** is by electromagnetic induction.

In electron-traps which have numerous sets of coils **1** and **2**, the ends of all of the power-supply conductors **3.1** can all be connected to each other, and all of the **3.2** conductor ends may be connected together. Thus, all of the coils **1** and

2 can be fed exactly the same voltage. The power to energise coils **1** and **2** can be provided from any external source of supply of electricity such as a power grid.

In electron-traps which have numerous coils **1** and **2**, a single coil winding **4** connects the cores of all of the coils **1** and **2**.

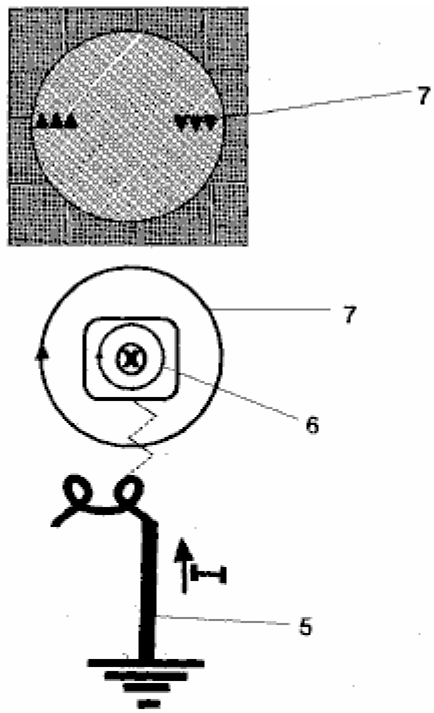


Fig. 6

The diagram shown in **Fig.6**, illustrates the magnetic induction **6** around the core "**X**" of the coil **1**. This induction causes electrical current flow in the conductor coil link **7/4**, attracting electrons from the earth, through the conductive member **5**, to the magnetic field of the electron-trap, where those electrons are added to the current generated by induction in the link coil **4** conductor loop circulating between north and south magnetic poles.

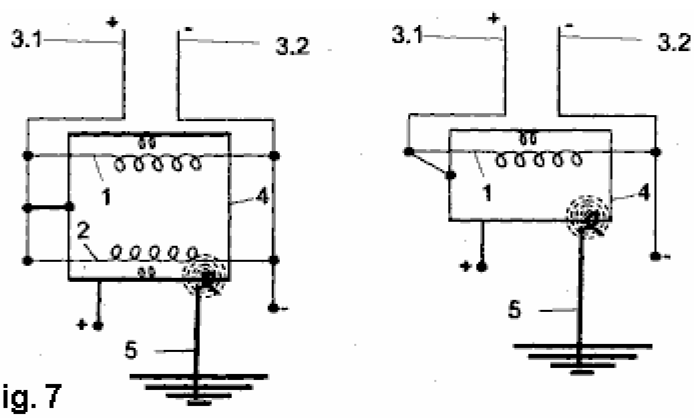


Fig. 7

Fig.7 shows how the connections should be made in one version of the electrical circuit of the electron-trap proposed in this invention. The diagram shows the electrical circuit of an electron-trap where the link/coil driver **4** is polarised with a voltage. This is one form of construction for an electron-trap which has two coils **1** and **2**, where a link/coil loop conductor **4** is biased with a voltage, that is, there is a link connecting the coil conductors **4** of a power supply **3.1** or **3.2**, whatever the stage.

In this way, earth electron-traps, by adopting this circuit, that is, with the link/conductor loop **4** and polarised voltage on coils **1** and **2**, besides being used as a power source for external loads, can also be used for thermal power generation.

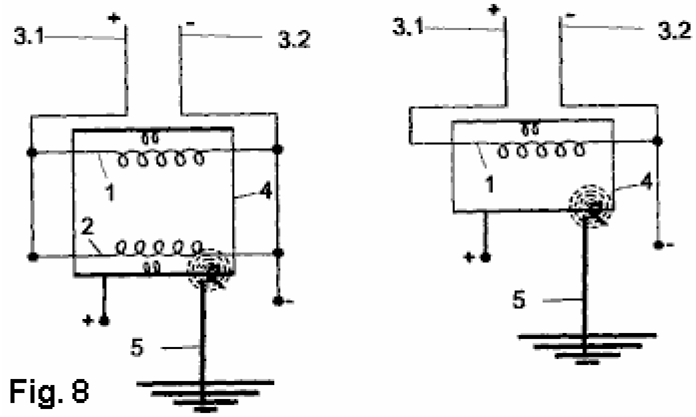


Fig. 8

Fig.8 shows how connections should be made in another electric circuit electron-trap proposed in this invention. the circuit illustrates a circuit of an electron-trap with a non-polarised link / coil driver **4**. This is one form of construction of the electron-trap where a link / coil conductor **4** of the spiral conductor coils **1** and **2** is not polarised, that is, there is no such link connecting conductor / conductor coil conductors **4** of a coil **3.1** or **3.2**.

Thus, earth electron-traps adopting this circuit, that is, with the link coil not polarised, the current flows without there being voltage in the link/coil conductor **4** joining the first and second coils by electromagnetic induction. They can also be used for generating thermal energy.

The structure of the circuit - in the open or closed coils **1** and **2**, and always in the closed link / loop lead **4** - makes it possible to generate current by induction and electron capture by electromagnetism on the link conductor **4 -** where current is generated and stays in motion with or without voltage, as the coils **1** and **2** are being fed. Thus, the present invention provides a new concept for electrical energy generation, since it is obtained from an electric current circling without consumption and even without an output load being attached to it.

Additionally, because the induced electrical current flows regardless of the voltage present, it can be used as a current stabiliser for electrical networks whether they be single-phase, two-phase or three-phase, with low, medium or high voltage.

The relevant Barbosa and Leal patents in Portuguese can be downloaded here:

http://www.free-energy-info.tuks.nl/Barbosa1.pdf

http://www.free-energy-info.tuks.nl/Barbosa2.pdf

http://www.free-energy-info.tuks.nl/Barbosa3.pdf

The First Barbosa and Leal Replication

While many people have tried to replicate the Barbosa and Leal power generator design which draws power from the Earth, and failed. One man whose forum ID is “Clarence” read the relevant patents and knew immediately how the design works and what items in the patents are misdirection by Barbosa and Leal. He has built his own implementation of the circuit and it works perfectly. He has generously shared the relevant details. Please understand that what follows is not a description of where to start experimenting, but instead it is an actual working design. Build it as described and it will work. Build it differently and it won’t work. Clarence has this to say:

In the Barbosa and Leal patent they make a vague reference to the Lenz Law. It just so happens that this is the **key** to the whole device. On the overunity forum, a circuit diagram posted by member “ZeroZero” showed the exact and complete method of defeating the Lenz Law, although most forum members did not seem to understand the importance of the circuit. However, I knew immediately that Lenz’s Law was just another name for back-EMF. The Lenz Law effect is overcome by winding the single primary coil in a clockwise direction and the AWG #4 2.5 turn windings are wound on the bare core in an anti-clockwise direction and that totally negates the Lenz Law.

What does this achieve? It gets rid of the voltage component in the secondary windings, leaving only the amperage component! When you wind two toroids exactly the same using this method and connect them as shown below, you create a loop similar to a horseshoe magnet with a keeper on it and the amperage in the loop just goes on circulating round and round as shown by Ed Leedskalin. This is the same principle. The loop has the ability within itself to add unlimited amperage, instantaneously to the neutral green Ground Return wire accordingly as the load requires. The only limit to the available amperage is the current-handling capacity of the looped black wire.

You can touch the black wire loop connections with bare hands because as there is no voltage, there is no resulting shock. The connecting of the AWG #10 phase wire to the bottom loop wire only serves to orient the polarisation of the amperage.

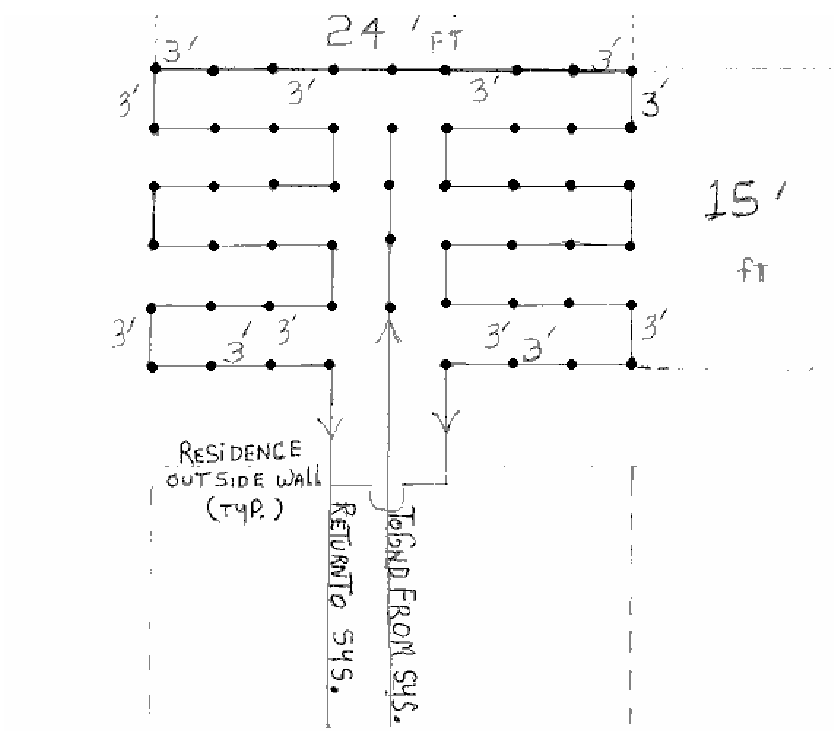
The oriented spinning of the amperage in the loop **induces** the amperage needed by the load, into the Captor output. This little toroid can allow the loop to load an AWG #4 wire enough to **melt** it !!

The toroid primary wires Live to Live and Neutral to Neutral should be powered from the inverter by a separate circuit

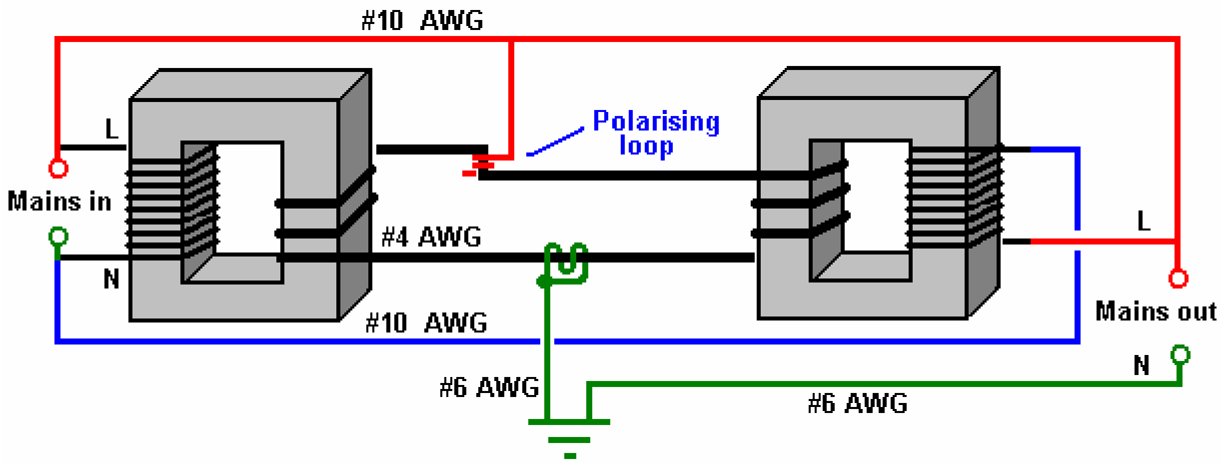
Another separate circuit should be used with the Live connected to the bottom black looped wire in order to polarise it. The Neutral powers the input to ground.

The return ground rods are linked in a series loop and then, from a convenient ground rod to the green 2.5-turn loop around the black captor loop and then on to serve as the captor Neutral to the load.

You will know that you have enough ground rods when the Captor rms output voltage **matches** the rms voltage of the inverter, and then, you will probably have to add about another ten ground rods in order to keep the rms voltage of the Captor output from dropping. If the Captor rms output voltage drops – simple – add more ground rods. Please understand clearly that without sufficient ground rods, the apparatus just will **not** work. Here is a connection pattern where many 6-foot (1.8 m) long earthing rods are used:



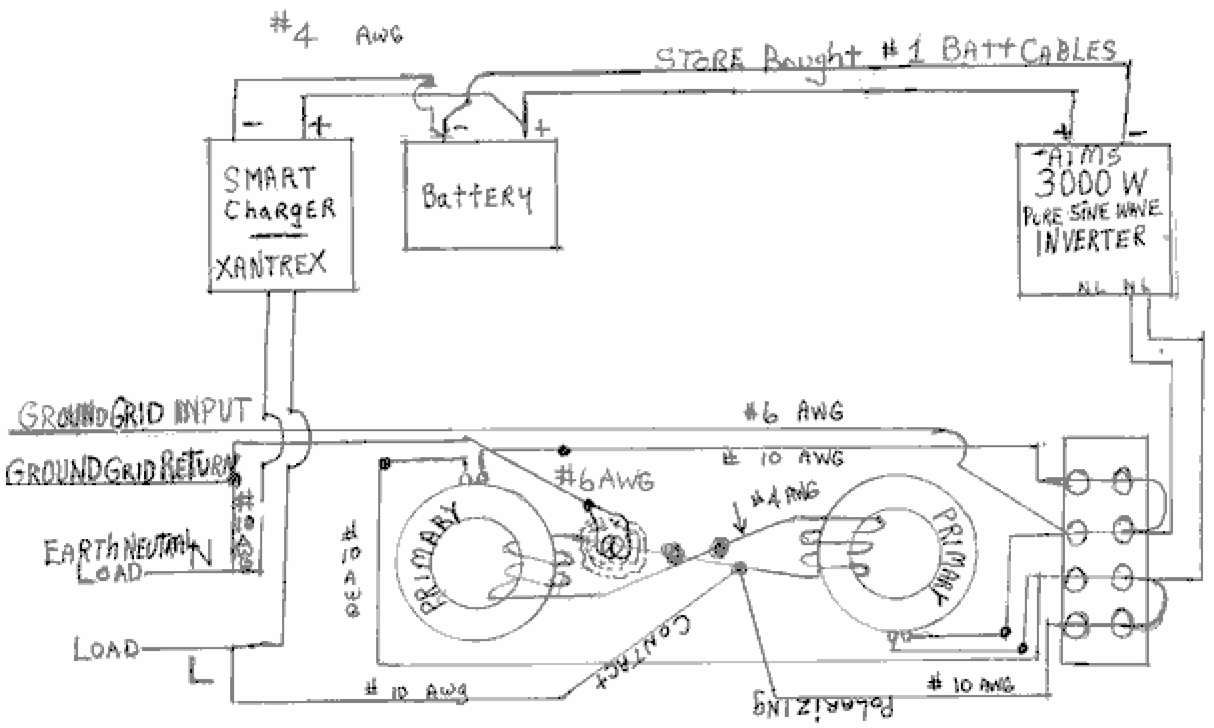
The circuit diagram from ZeroZero shows this arrangement:



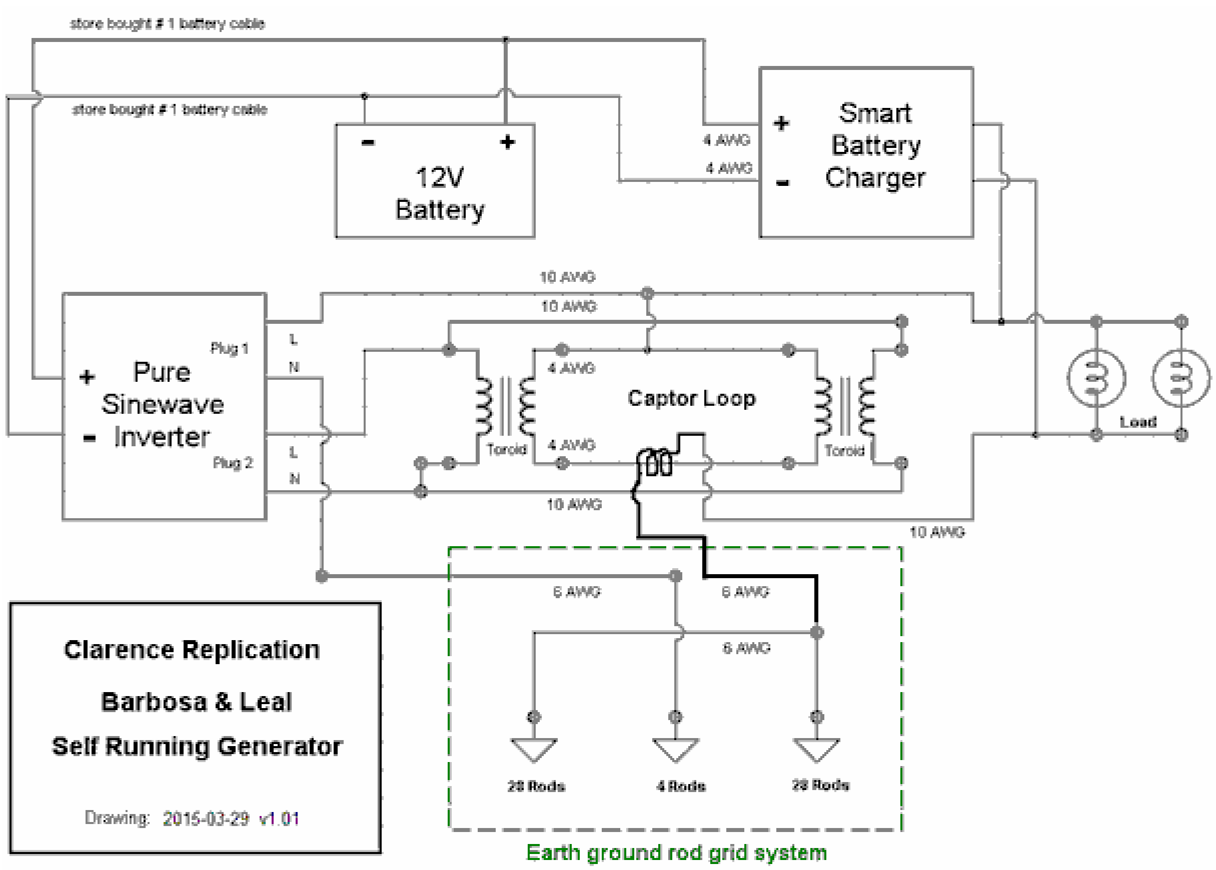
The direction of winding is vitally important as are the wire sizes. You will notice that the windings on the two magnetic frames are in opposite directions, **and**, the thick wire loop windings are both in opposite directions, **and**, the thick wire winds also oppose the thin wire winding on the same frame. Looking from above, the thick wire forms the shape of the numeral 8. The thick wire is AWG #4 with a diameter of 5.19 mm and the other core windings are AWG #10 with a diameter of 2.59 mm. The "polarising loop" is produced by taking a few turns of the AWG #10 wire around the insulation of the AWG #4 wire – the wires inside the cables are **not** actually joined together. The input and output are marked as "mains" as either 110V or 220V can be used, however, not actually fed from the mains as that would create a ground loop, but instead, the input is from an inverter. The earth wire is AWG #6 with a core diameter of 4.11 mm.

While the magnetic frames above are shown as rectangular, they are actually circular toroids (which was what Barbosa and Leal used but failed to mention). The ones used by Clarence are type TD300 1120 toroids with a diameter of 5.2 inches (132 mm) and a thickness of 2.3 inches (58 mm) each weighing 6.2 pounds (2.8 Kg) and available from http://www.tortran.com/standard_isolation_transformers.html. Clarence remarks that building this power generator replication is not cheap and he has spent more than US $2000 on his replication. Mind you, with an output power of 3 kW, this unit meets all of his household electrical requirements.

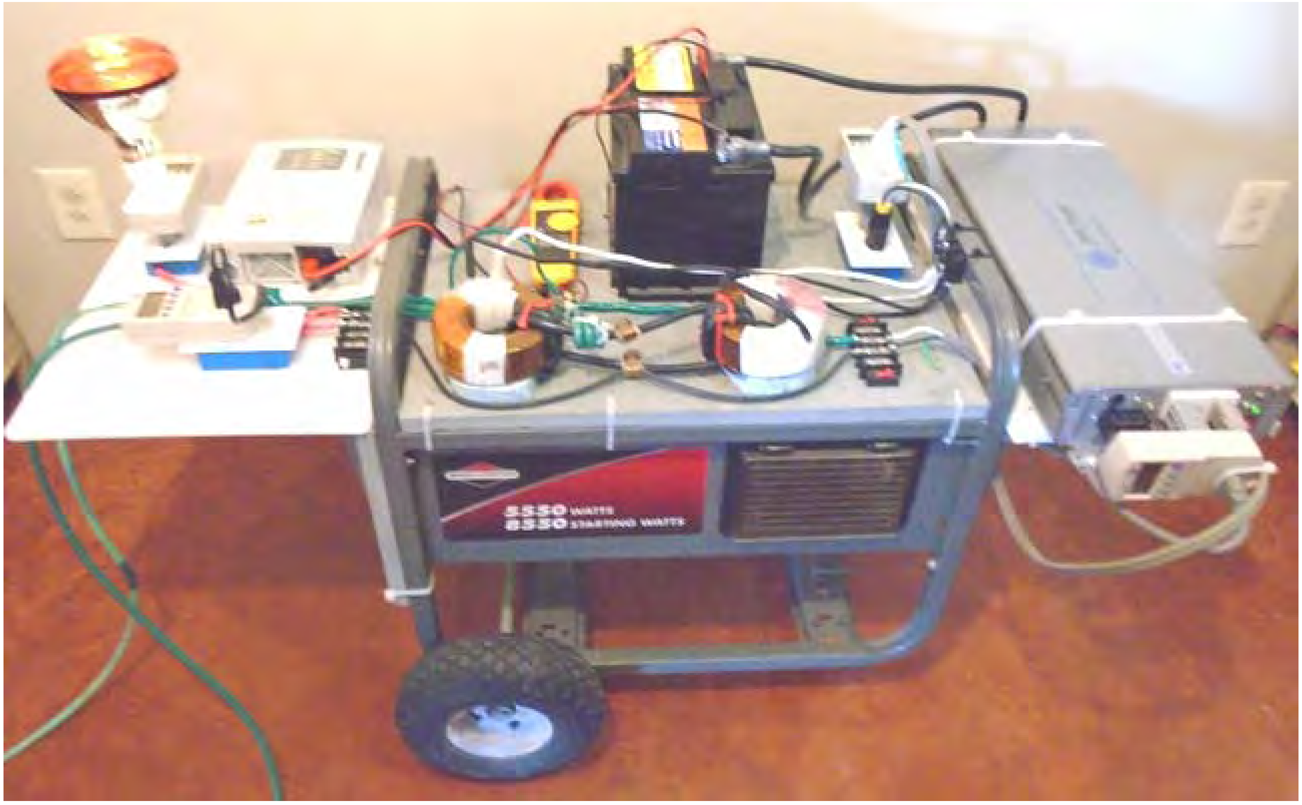
It is said that all builders should get a global or national Geomagnetic Map of their area before building, but Clarence says that he is in a "dead" area anyway, so there is probably little point in this as the number of earthing rods needed in your area is found by trial anyway, and knowing in advance does not change that number.

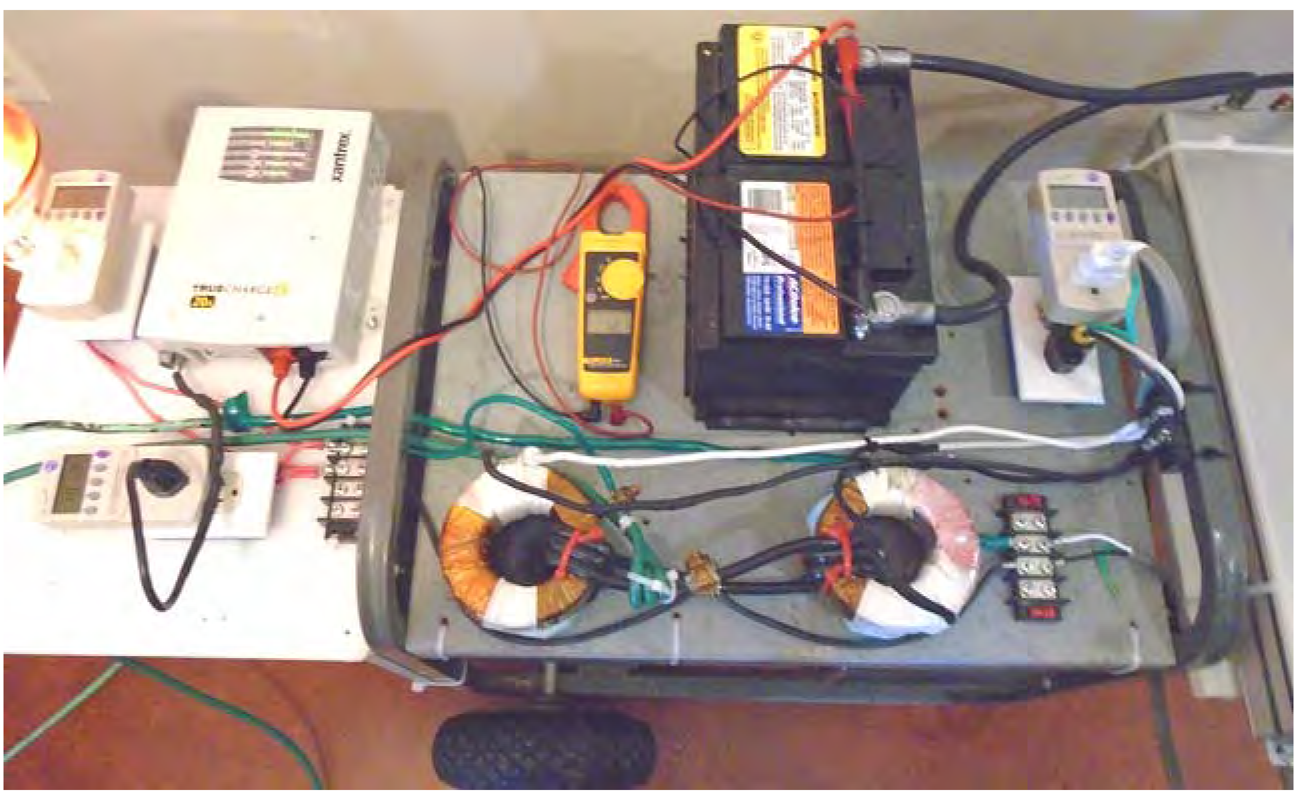


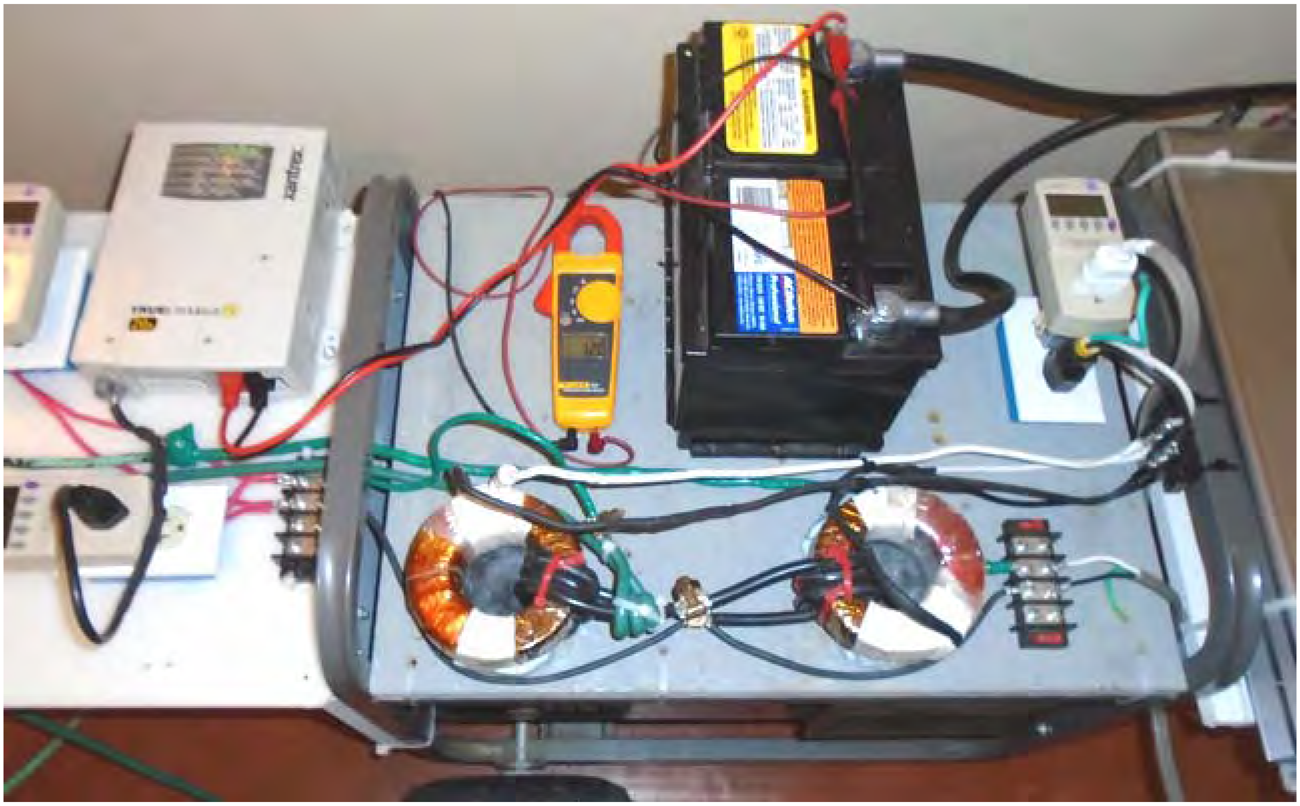
Another edition of the circuit diagram is:



Here are some pictures of Clarence’s successful build:


5550 WATTS
8550 STARTING WATTS


xantrex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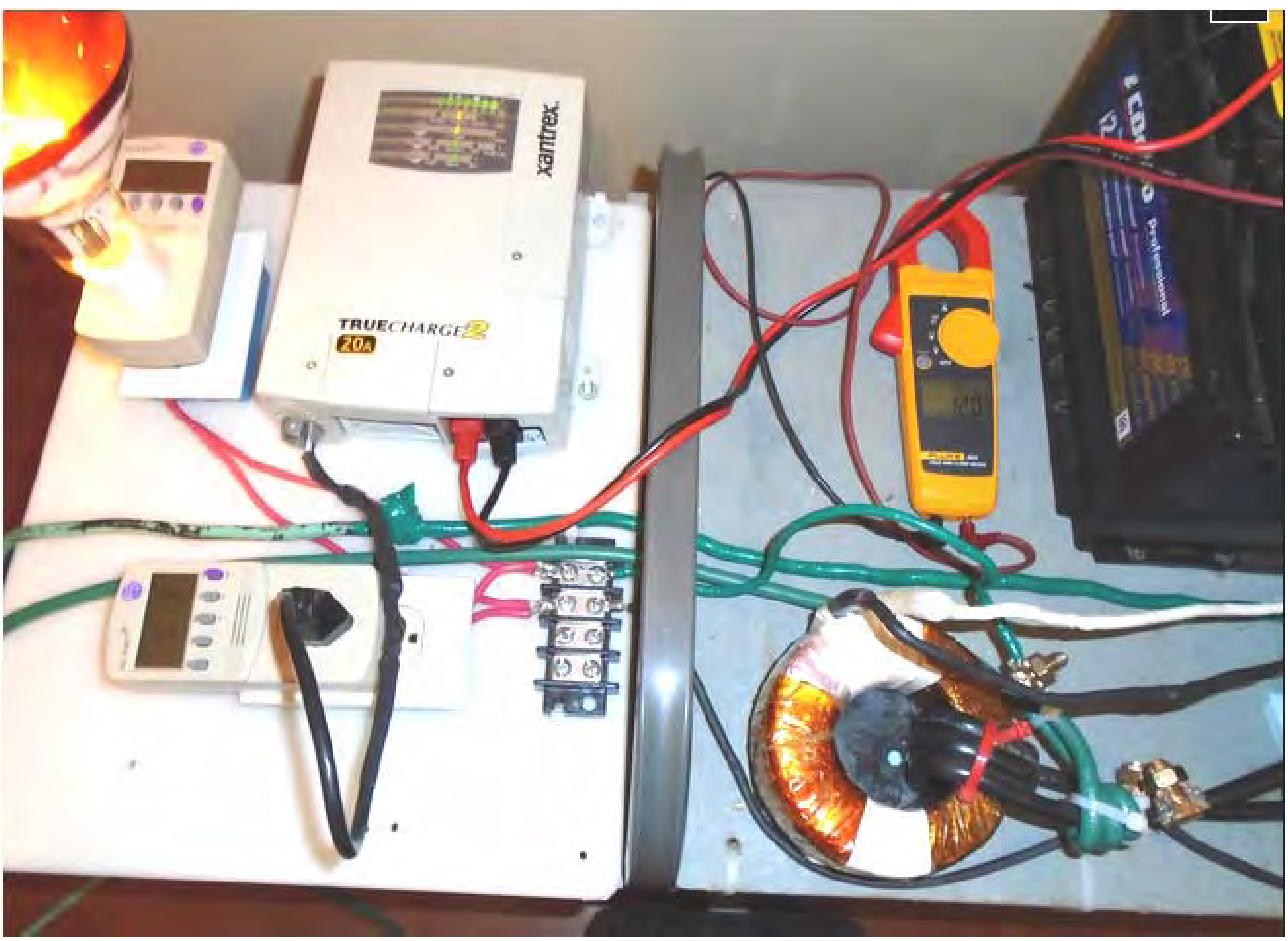

xantrex
TRUECHARGE2
20A

Components used were:

Toroids:

Bridgeport Magnetics :
Tortran - In Stock Standard Design Toroidal Isolation Transformers - Bridgeport Magnetics Group
Contact: Michael Kharaz E-mail: sales@bridgeportmagnetics.com
Tortran Division- Contact us - Bridgeport Magnetics Group
Custom ordered toroid (2 required):
TD300-1120-P, 300VA, 60Hz, Primary 120V, 160 degrees winding on toroid surface, no secondary winding - $125 USD each

Smart Battery Charger:

Xantrex TrueCharge2 Battery Charger - 20Amp model
Website: Truecharge Battery Charger | Truecharge2 20A, 40A, 60A | Xantrex
Xantrex Dealers list:
Where to Buy - N. America

Available from Amazon.com:
Amazon.com: Xantrex 804-1220-02 TRUECharge2 12V 20A Parallel Stackable Battery Charger: GPS & Navigation
Looks like the price is around $260 to $300 USD - depending where you order from.

Minimum recommended battery bank size for use with the 20Amp Charger model is 40 Ah

12V Pure Sinewave Power Inverter

AIMS POWER 3000 Watt 12VDC Pure Sine Wave Power Inverter - Model: PWRIG300012120S
Website: http://www.aimscorp.net/3000-Watt-Pu...-Inverter.html

Available from:

InvertersRUs - $699 USD http://www.invertersrus.com/aims-pwrig300012120s.html

Amazon - $799 USD http://www.amazon.com/AIMS-Power-PWR...+wave+inverter

Forum moderator "Level" who has done an excellent job of retrieving and displaying Clarence's material here: http://www.energeticforum.com/renewable-energy/20091-barbosa-leal-devices-info-replication-details-2.html, says:

Stick to the battery and inverter method as the power source, as that is the only way you can avoid a ground loop to the mains electrical power system. The one exception is you might be able to avoid such a problem when powering from the mains if you use an isolation transformer, but isolation transformers can be expensive and have a limited capacity as well.

Caution: Also beware that an inverter with an output of 120 volts or 240 Volts can kill you if you touch live wires, so don't build such a setup if you don't understand such things. You need to take the necessary safety precautions.

The 3-Kilowatt Earth Battery

This battery does not need charging as such. Earth batteries are well known. They are pairs of electrodes buried in the ground. Electricity can be drawn from them, but they are generally of little interest as the power levels are not great. However, in his patent of 1893, Michael Emme, a Frenchman living in America determined how to get very serious levels of power from an earth battery of his design. In this particular unit which he describes in his US 495,582 patent, he gets 56 amps at just under 54 volts, which is three kilowatts or 4 HP. At that early date, there was generally, not much need for electricity, but Michael states that by selecting the number and connection method of the individual components, any desired voltage and/or current supply can be had. This, of course, is a simple system which involves no electronics.

Disclaimer: This document is for information purposes only and must not be considered to be a recommendation or an encouragement for you to actually construct an earth battery of this kind. If you choose to do so in spite of this warning, then all responsibility for the results is entirely yours. Please bear in mind that some forms of construction utilise strong acids and careless handling of strong acid can result in skin and other damage. Protective clothing should be used when handling acids and an alkali should be ready for immediate use if careless handling causes splashes.

Summarising his patent, Michael says:

My invention relates to chemical generators of electricity where a prepared body of earth is the support and excitation medium for the electrodes or elements. Any number of elements can be assembled in the same piece of ground and connected in a chain or series of chains in order to produce the desired voltage and/or amperage.

I find that several straight chains of elements can function separately provided that the gap between the chains is much greater than the gap between the elements which form the chain. Being quite separate, those chains can be connected in series to increase the voltage, or in parallel to increase the available current.

It is necessary to prepare the soil in the ground in the immediate area around the electrodes which form each element in the chain.

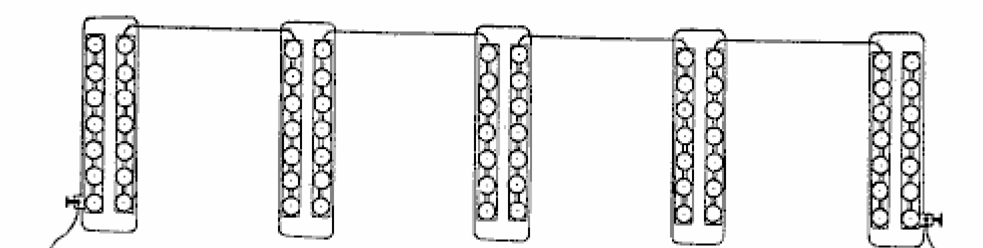


Fig.1

Fig.1 shows five elements connected in a chain. This view is from above with the rectangles indicating holes in the ground where each hole contains seven separate pairs of electrodes.

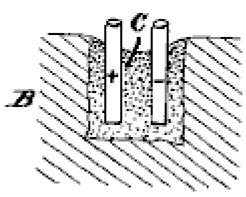


Fig 2

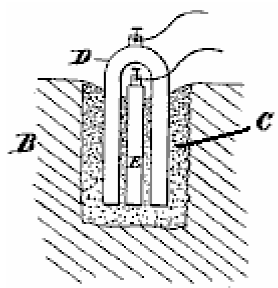


Fig 3

Fig.2 and Fig.3 show how individual electrodes are inserted into the prepared soil "C" which is surrounded by untreated ground "B". Electrode "D" is made of iron and "E" is made of carbon.

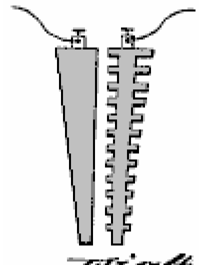


Fig.4 shows how wedge-shaped electrodes can be used as an alternative construction. The advantage is that it is easier to pull a tapering electrode out of the ground.

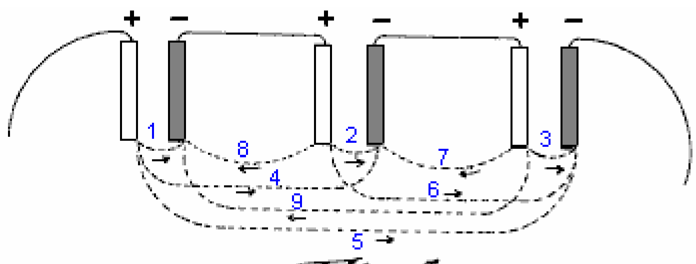


Fig.5 shows the internal current flow circuits which operate when a chain of elements is used. The arrows indicate the direction of current flow.

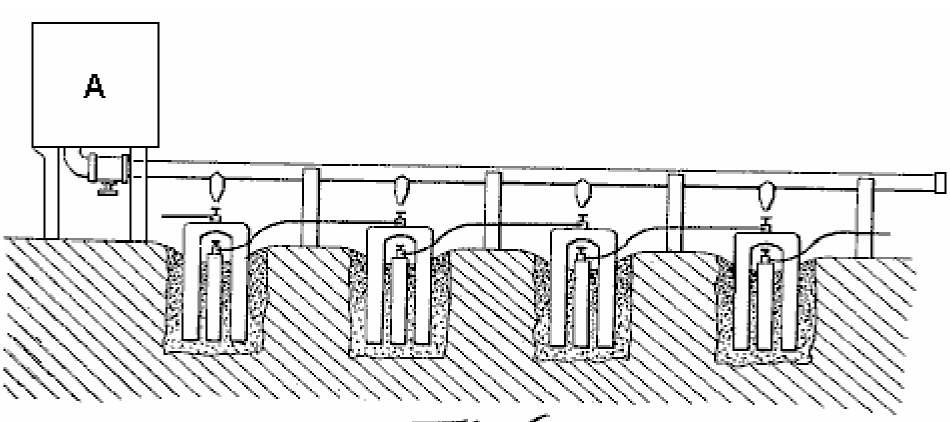


Fig.6 shows a convenient method for periodically moistening the prepared soil areas.

Soil of any type can be adapted for use with an electrical generator of this kind by saturating the soil immediately surrounding each pair of electrodes with a suitable solution which is rich in oxygen, chlorine, bromine, iodine or fluorine, or with a solution of a salt of an alkali.

For the electrodes, I prefer to use soft iron for the positive electrode and hard pressed coke carbon for the negative electrode. The positive electrode is preferably a U-shaped bar of iron which has a circular cross-section. The two limbs of the U straddle the rod of carbon. Cast iron can be used but it gives a lower voltage, presumably due to the carbon and other impurities in it.

Magnesium gives excellent results, producing 2.25 volts per electrode pair where carbon is the negative electrode.

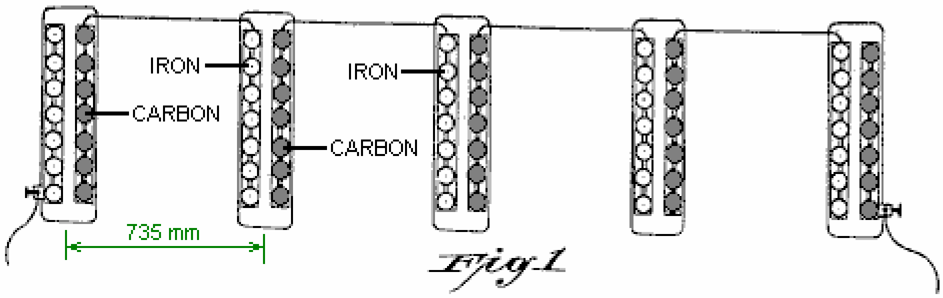


Fig.1

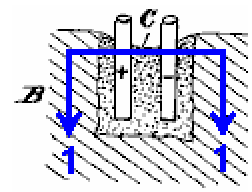


Fig.2

In implementing my invention, I level a piece of ground of sufficient area to contain the generating chain or chains. For instance, for three hundred positive elements each twenty inches (500 mm) long and two inches (50 mm) in diameter, bent as shown in Fig.3, the length of the piece of ground should be about 107 feet (32 metres) and 3 feet (1 metre) wide. I dig 43 holes at a distance of 30 inches (735 mm) apart (centre to centre) in a line. Each hole is 10 inches (250 mm) wide and 30 inches (750 mm) long and deep enough to contain the seven pairs of electrodes.

The loose soil dug from the holes is mixed with the chosen salt or acid in order to make the generator active. For instance, if the ground is a vegetable mould, then commercial concentrated nitric acid should be added in sufficient quantity to saturate the soil, and manganese peroxide or pyrolusite should be mixed with the mass. If the soil has a sandy character, then hydrochloric acid or sodium carbonate ("washing soda") or potash can be used. If the coil is a clay, then hydrochloric or sulphuric acid and sodium chloride may be used, the salt being dissolved in water and poured into the hole before the acid is mingled with the soil. The bottom of the hole is moistened with water and the prepared soil mixed with water to the consistency of a thick paste is then placed in the hole, surrounding the electrodes. The 43 groups of electrodes when wired in series as shown in Fig.1, will yield 53.85 volts and 56 amps, developing a total of 3015 watts.

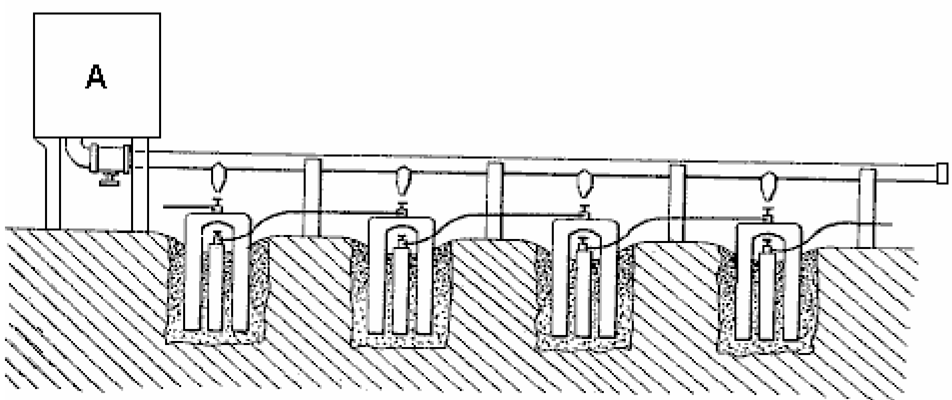


Fig.6.

By increasing the number of cells, the capacity of the generator may be correspondingly increased to any desired power output. The prepared body of soil should be periodically moistened, preferably with the acid with which it was treated when first prepared for action. In a generator intended for continuous use, I prefer to provide a reservoir as shown as "A" in Fig.6, and run a pipe made of a material which is not attacked by the acid, along the chain of elements, with a nozzle over each element so that they all can be moistened very easily. Any accumulation of oxides or other products of the reaction between the prepared soil and the electrodes may be removed by raising the positive electrode and then forcing it back into place again. The carbon electrode can be cleansed by simply turning it without lifting it from its place.

I find that the period of use of the generator during which no addition of salt or acid is needed, increases with the period of use. For example, during the first day of use, the acid or salt should be added after 10 hours of use, after which it will yield 26 hours of service, and then after another moistening it will operate for 48 hours, and so on, progressively increasing in duration between being moistened. This generator operates very consistently and reliably.

* * * *

Nowadays, we find mains voltage alternating current to be the most convenient to use. For a system like this, we would be inclined to use an ordinary inverter which runs on twelve volts or twenty-four volts. However, it needs to be remembered that the working input current is high and so, the wire used to carry that current needs to be thick. At 12V, each kilowatt is a current of at least 84 amps. At 24V that current is 42 amps (the inverter itself is more expensive as fewer are bought). Considerable household usage can be had from a 1500 watt inverter.

The soft iron / carbon construction described by Michael Emme produces 54V from 43 sets of electrodes, indicating around 1.25V per set at high current draw. It seems reasonably likely that ten or eleven sets of electrodes would give around 12V at high current and three of those chains connected in parallel should be able to power a 1500 watt 12V inverter continuously at extremely low running cost.

Chapter 8 - Battery Power

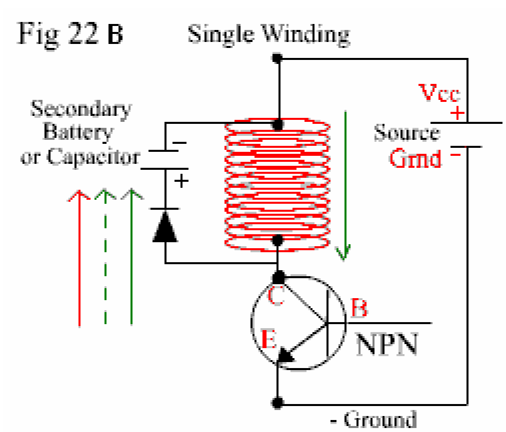
Personally, I am not a fan of batteries. The most common batteries in 2016 are lead-acid types and they are only 50% efficient. That means that the battery wastes half of the energy which you put into it. NiMh batteries are not that much better at 66% efficient, meaning that they waste one third of the energy which you put into them.

A much better although much more expensive solution is to use super capacitors as they are 100% efficient. This version of nanotechnology is changing the style of electronic circuits and when the price comes down further, the effect will be seen much more strongly.

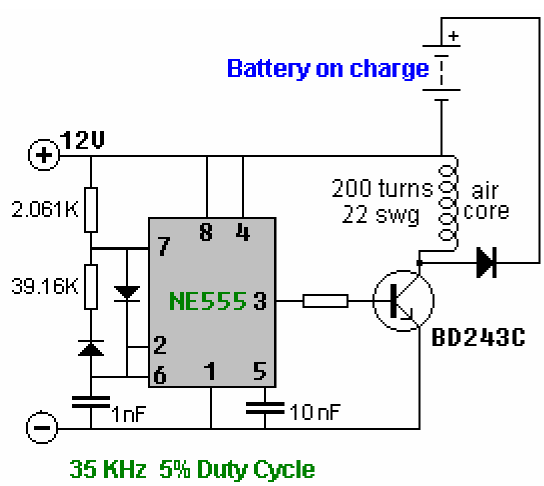
However, batteries are already in use to such an extent that they will be with us for some time, and many are already in use in off-grid household power solutions. There are two obvious ways to charge a battery. The first is with conventional "hot" electricity drawn from the mains supply (if there is one where you are) and the second is with "cold" electricity from one of the many pulsing circuits. It is very rare for any pulsing circuit to be less than 100% efficient. So let's start with a simple circuit from Russian developer "Alexkor" who shares most of his work quite freely:

An 'Alexkor' Solid-State Battery Charger

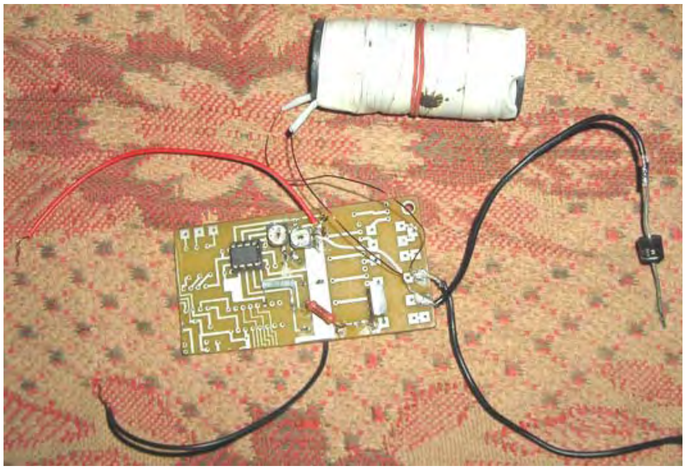
This "Alexkor" battery-charging system is very effective, cheap and easy to build. It is a version of the system described in Fig. 22B on page 7 of the http://www.totallyamped.net/adams/ web page:



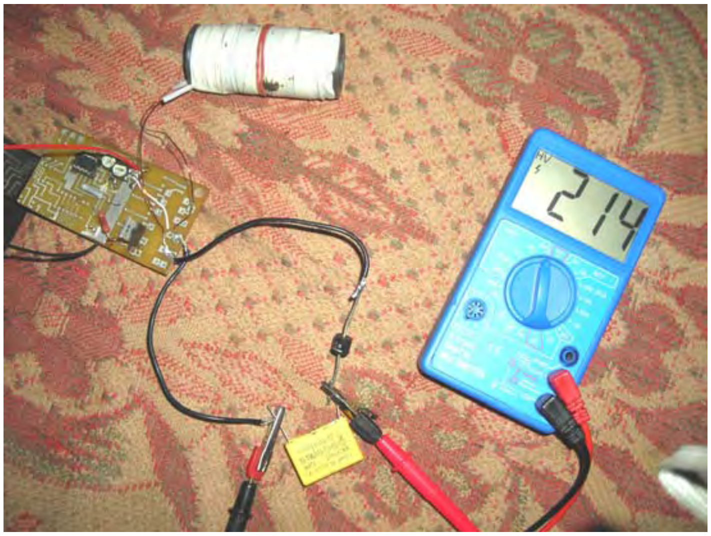
While this description has been around for years, it is part of a discussion on the principles of the operation of EMF magnetic fields and pulsing in coils. 'Alexkor' has developed a practical circuit which he says works very well. It can be constructed as a single unit as shown here:



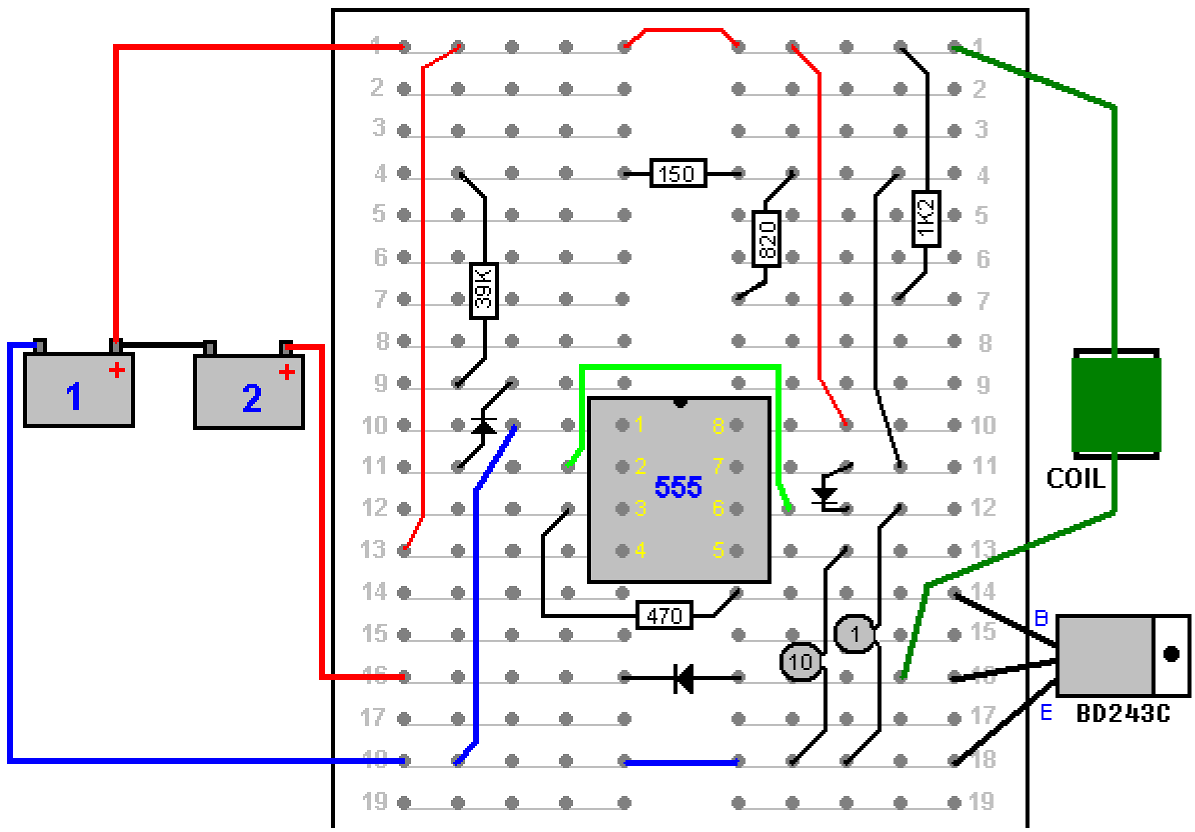
Here, the coil is wound with 200 turns of 0.7 mm enamelled copper wire and the actual construction is compact:



And to get an idea of the performance, Alex uses a capacitor to see the size of the voltage spikes produced by the circuit:



If building a circuit with a soldering iron and one of the commercial versions of prototyping board with copper strips is too difficult, then the circuit can be set up using a plug-in board like this:



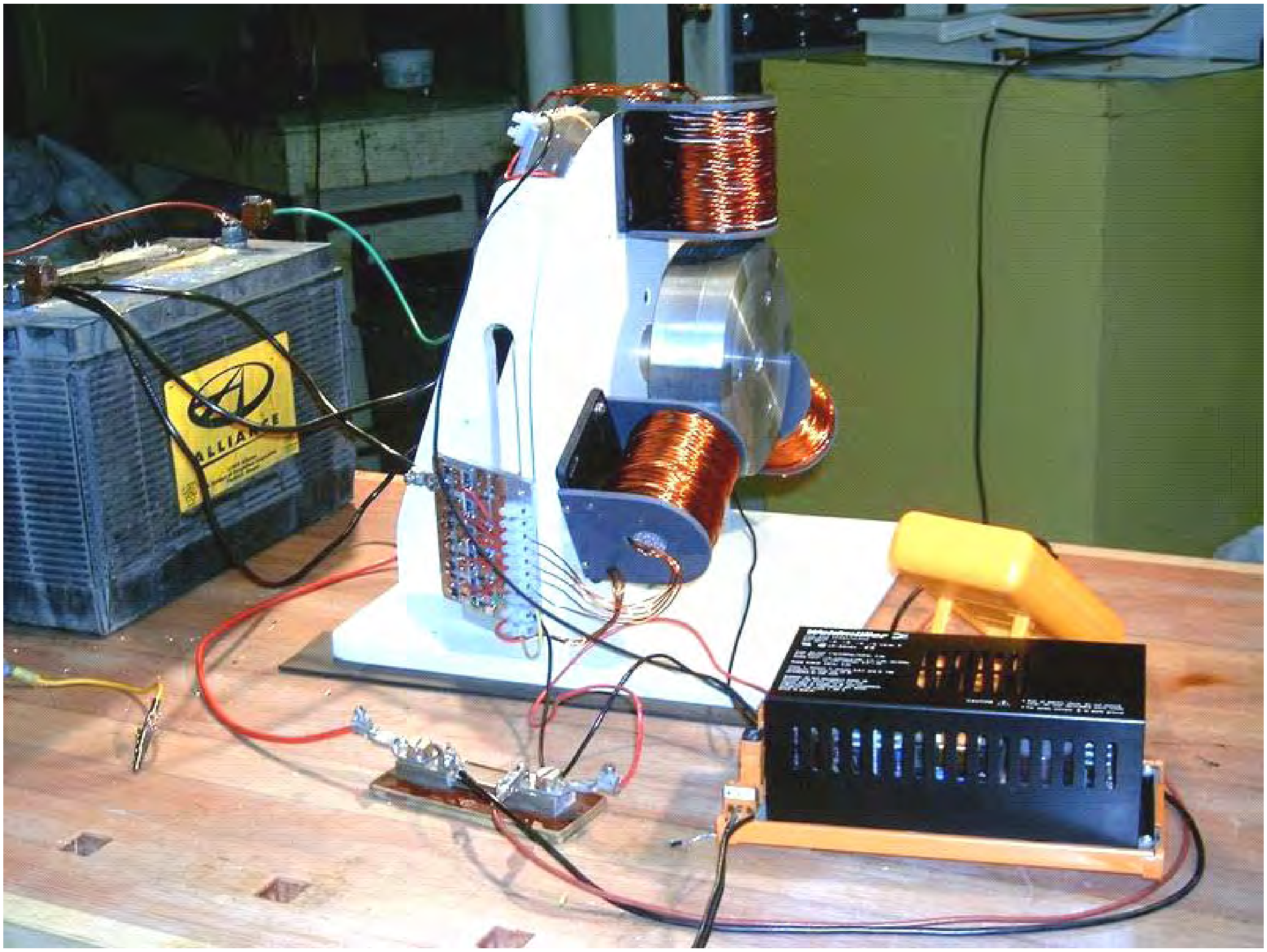
The battery marked “1” provides power to run the circuit and the battery marked “2” gets charged. The resistors are all quarter watt. The enamelled copper 22 swg wire has a diameter of 0.711 mm and the coil can easily be wound on a cardboard tube. With a 30 mm (1.25 inch) diameter tube about 20 metres of wire would be needed and that weighs about 70 grams. I would like the output diode to be a UF5408 diode as the “UF” stands for “Ultra Fast”, but the wire leads are too thick to plug into a board like this and so the 1N5408 can be used, it is rated at 1000 volts and 3 amps.

The circuit uses the very popular and cheap NE555 integrated circuit to generate a continuous stream of pulses. The speed and length of each pulse is determined by the two resistors and two diodes which feed the 555 chip. The chip output is on pin 3 and that powers a BD243C transistor, switching it on briefly and holding if off for most of the time. The third diode feeds the battery being charged and that battery can't be connected to the negative line of the circuit because if you do that, then your drive battery just drains into the charge battery and we do not want that to happen.

The circuit produces sharp pulses of more than 200 volts and those draw in energy from the local environment. I have been e-mailed by one man who used to charge his battery directly from the mains with an ordinary battery charger. He then built this Alexkor circuit, powered it with his mains charger and found that his battery charged fully in half the time. So, although it is a very simple circuit, it is very effective.

Ron Pugh’s Battery Charger.
John Bedini’s designs have been experimented with and developed by a number of enthusiasts. This in no way detracts from fact that the whole system and concepts come from John and I should like to express my sincere thanks to John for his most generous sharing of his systems. Thanks is also due to Ron Pugh of Canada who has kindly agreed for the details of one of his Bedini generators to be presented here. Let me stress again, that if you decide to build and use one of these devices, you do so entirely at your own risk and no responsibility for your actions rests with John Bedini, Ron Pugh or anyone else. Let me stress again that this document is provided for information purposes only and is not a recommendation or encouragement for you to build a similar device.

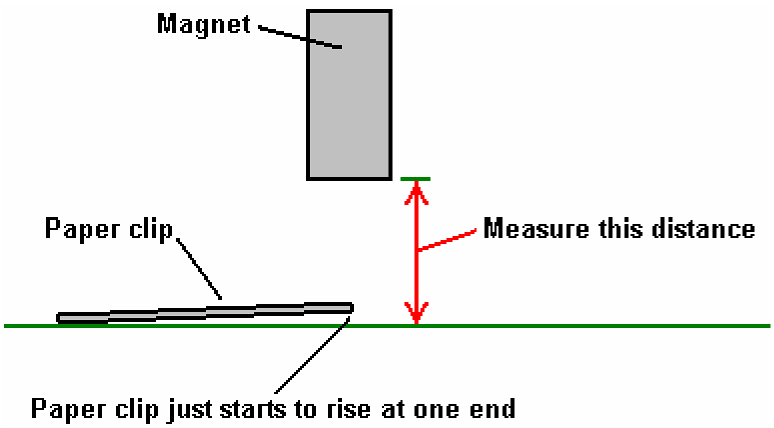
Ron’s device is much more powerful than the average system, having fifteen coil windings and it performs most impressively. Here is a picture of it rotating at high speed:



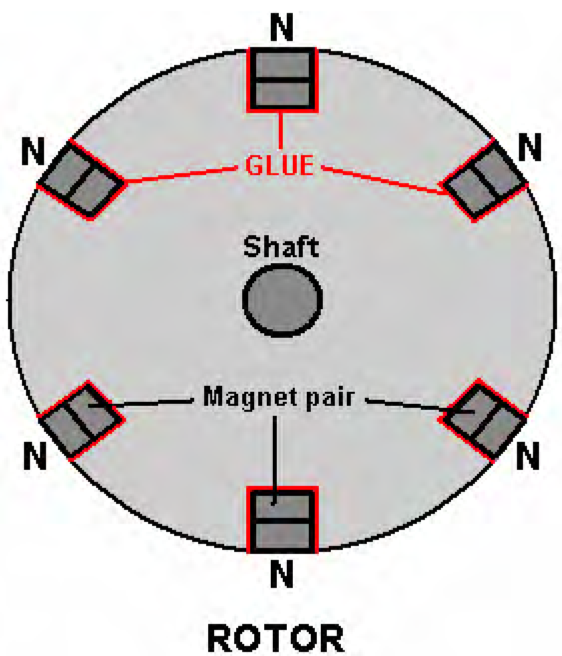
This is not a toy. It draws significant current and produces substantial charging rates. When running at 24 volts, this unit has been measured to output 13 times more power than its own input power.

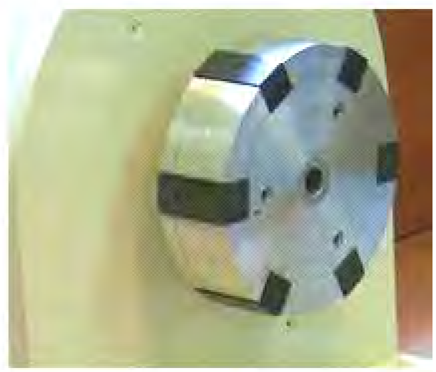
This is how Ron chose to build his device. The rotor is constructed from aluminium discs which were to hand but he would have chosen aluminium for the rotor if starting from scratch as his experience indicates that it is a very suitable material for the rotor. The rotor has six magnets inserted in it. These are evenly spaced 60 degrees apart with the North poles all facing outwards.

The magnets are normal ceramic types about 22 mm wide, 47 mm long and 10 mm high. Ron uses two of these in each of his six rotor slots. He bought several spare ones and then graded all of them in order of their magnetic strength, which varies a bit from magnet to magnet. Ron did this grading using a gauss meter. An alternative method would have been to use a paper clip about 30 mm in size and measure the distance at which one end of the clip just starts to rise up off the table as the magnet is moved towards it:

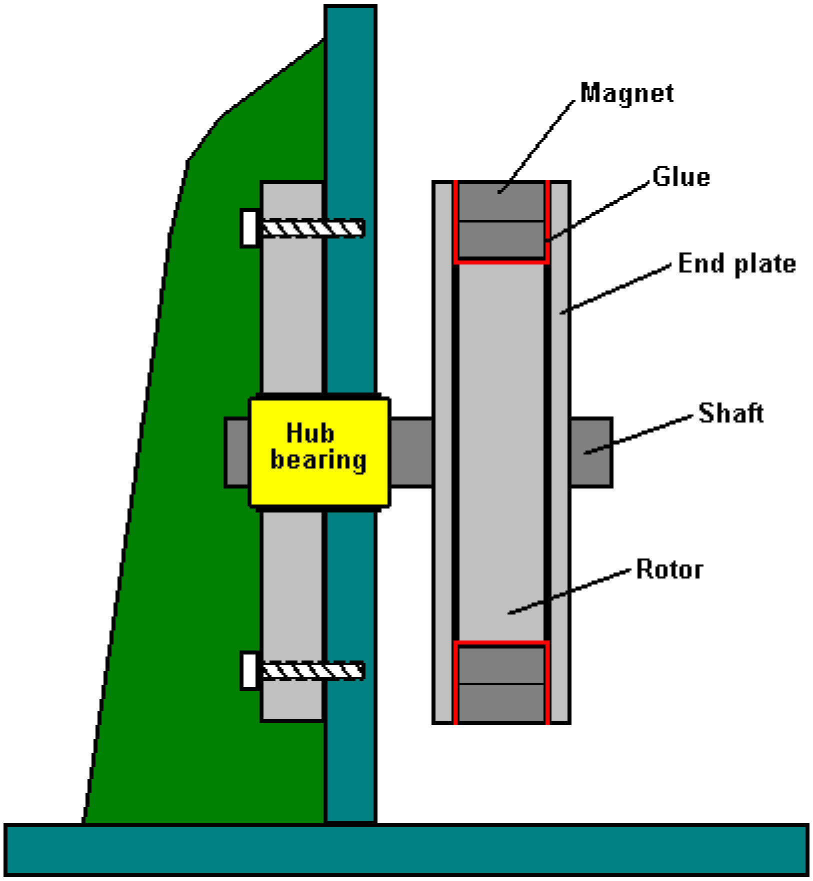


Having graded the magnets in order of strength, Ron then took the best twelve and paired them off, placing the weakest and strongest together, the second weakest and the second strongest, and so on. This produced six pairs which have fairly closely matching magnetic strengths. The pairs of magnets were then glued in place in the rotor using super glue:



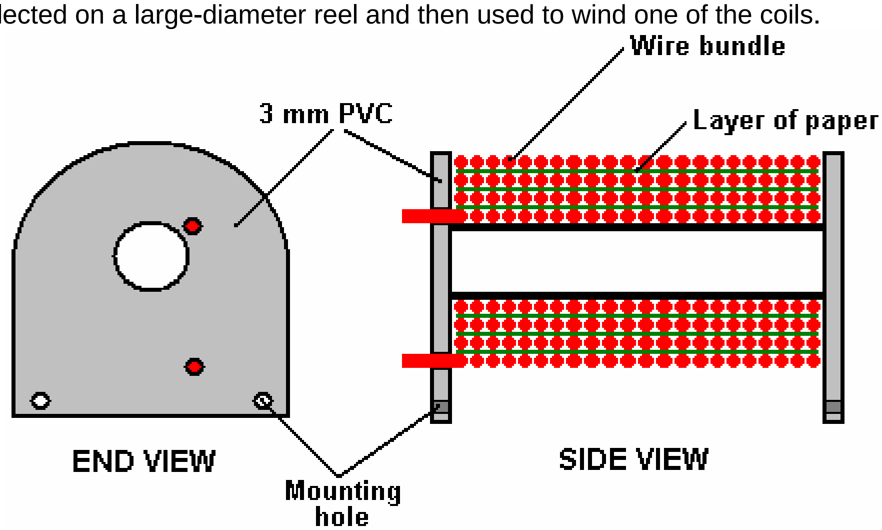


It is not desirable to recess the magnets though it is possible to place a restraining layer around the circumference of the rotor as the clearance between the magnet faces and the coils is about a quarter of an inch (6 mm) when adjusted for optimum performance. The North poles of the magnets face outwards as shown in the diagram above. If desired, the attachment of the magnets can be strengthened by the addition of blank side plates to the rotor which allows the magnet gluing to be implemented on five of the six faces of the magnet pairs:

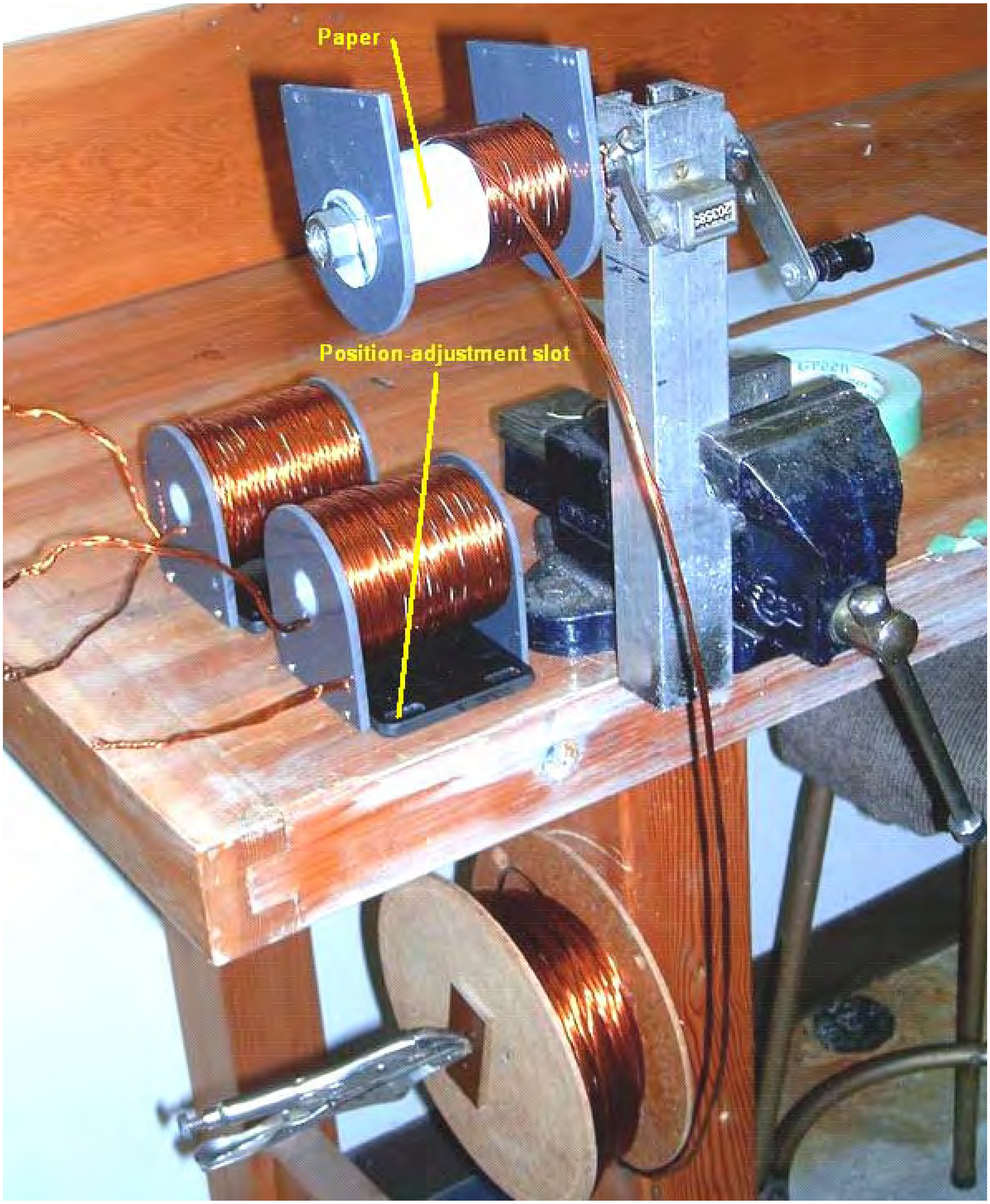


The magnets embedded in the outer edge of the rotor are acted on by wound "coils" which act as 1:1 transformers, electromagnets, and pickup coils. There are three of these "coils", each being about 3 inches long and wound with five strands of #19 AWG (20 SWG) wire of 0.914 mm diametre. The coil formers were made from plastic pipe of 7/8 inch (22 mm) outer diameter which Ron drilled out to an inner diameter of 3/4 inch (19 mm) which gives a wall thickness of 1/16 inch (1.5 mm). The end pieces for the coil formers were made from 1/8 inch (3 mm) PVC which was fixed to the plastic tube using plumbers PVC glue. The coil winding was with the five wires twisted around each other. This was done by clamping the ends of the five wires together at each end to form one 120 foot long bundle.

The bundle of wires was then stretched out and kept clear of the ground by passing it through openings in a set of patio chairs. A battery-powered drill was attached to one end and operated until the wires were loosely twisted together. This tends to twist the ends of the wires together to a greater extent near the end of the bundle rather than the middle. So the procedure was repeated, twisting the other end of the bundle. It is worth remarking in passing, that the drill turns in the same direction at each end in order to keep the twists all in the same direction. The twisted bundle of wires is collected on a large-diameter reel and then used to wind one of the coils.

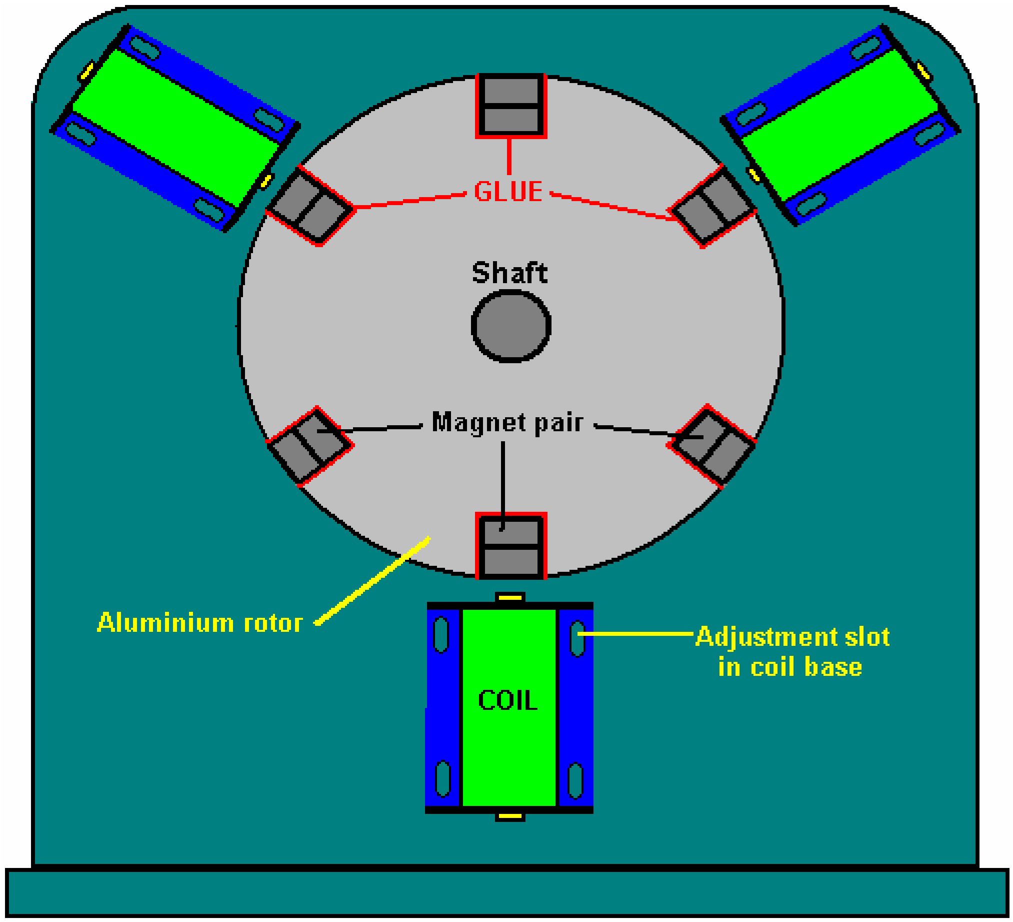


The coils are wound with the end plates attached and drilled ready to screw to their 1/4 inch (6 mm) PVC bases, which are the bolted to the 3/4 inch (18 mm) MDF supporting structure. To help the winding to remain completely even, a piece of paper is placed over each layer of the winding:



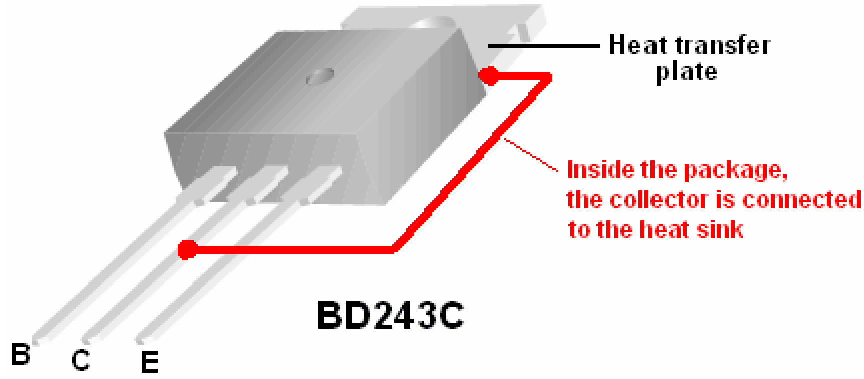
The three coils produced in this way were then attached to the main surface of the device. There could just as easily have been six coils. The positioning is made so as to create an adjustable gap of about 1/4 inch (6 mm) between the coils and the rotor magnets in order to find the optimum position for magnetic interaction. The magnetic effects are magnified by the core material of the coils. This is made from lengths of oxyacetylene welding wire which is copper coated. The wire is cut to size and coated with clear shellac to prevent energy loss through eddy currents circulating inside the core.

The coils are positioned at equal intervals around the rotor and so are 120 degrees apart. The end pieces of the coil formers are bolted to a 1/4 inch (6 mm) PVC base plate which has slotted mounting holes which allow the magnetic gap to be adjusted as shown here:

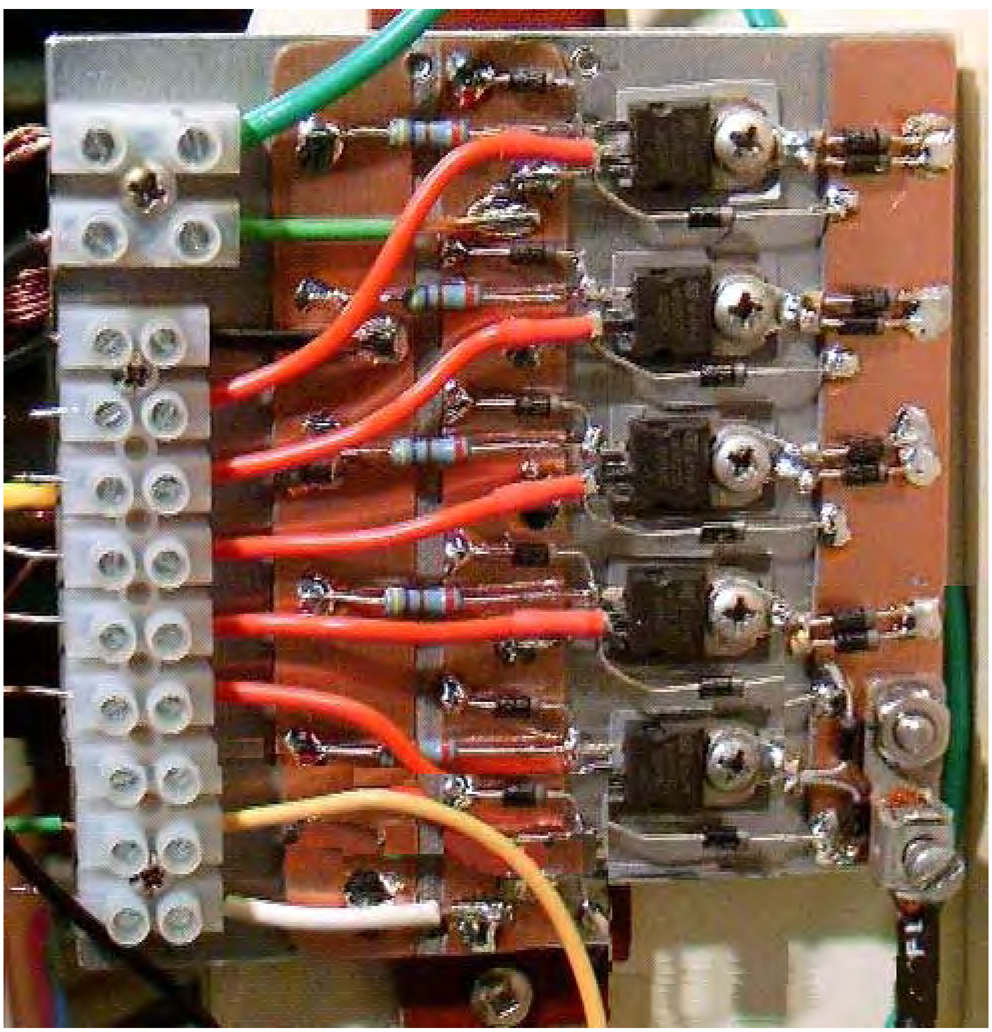


The three coils have a total of fifteen identical windings. One winding is used to sense when a rotor magnet reaches the coils during its rotation. This will, of course happen six times for each revolution of the rotor as there are six magnets in the rotor. When the trigger winding is activated by the magnet, the electronics powers up all of the remaining fourteen coils with a very sharp, pulse which has a very short rise time and a very short fall time. The sharpness and brevity of this pulse is a critical factor in drawing excess energy in from the environment and will be explained in greater detail later on. The electronic circuitry is mounted on three aluminium heat sinks, each about 100 mm square. Two of these have five BD243C NPN transistors bolted to them and the third one has four BD243C transistors mounted on it.

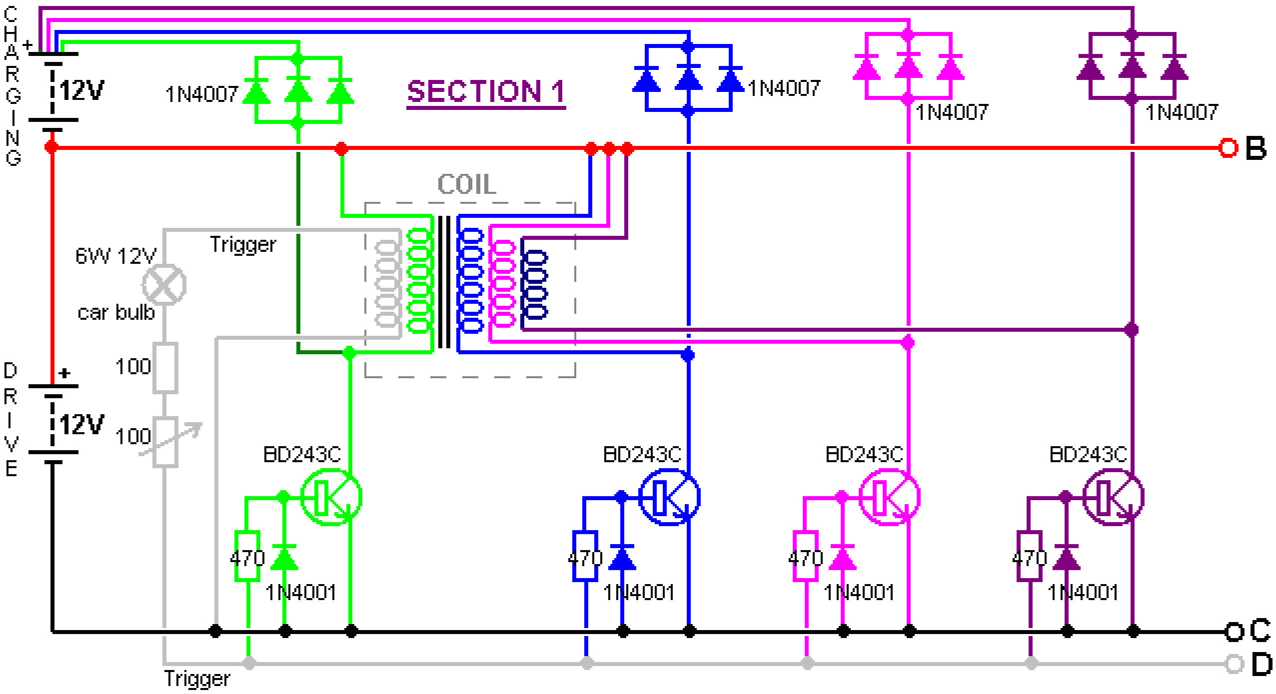
The metal mounting plate of the BD243 transistors acts as its heat sink, which is why they are all bolted to the large aluminium plate. BD243C transistors look like this:

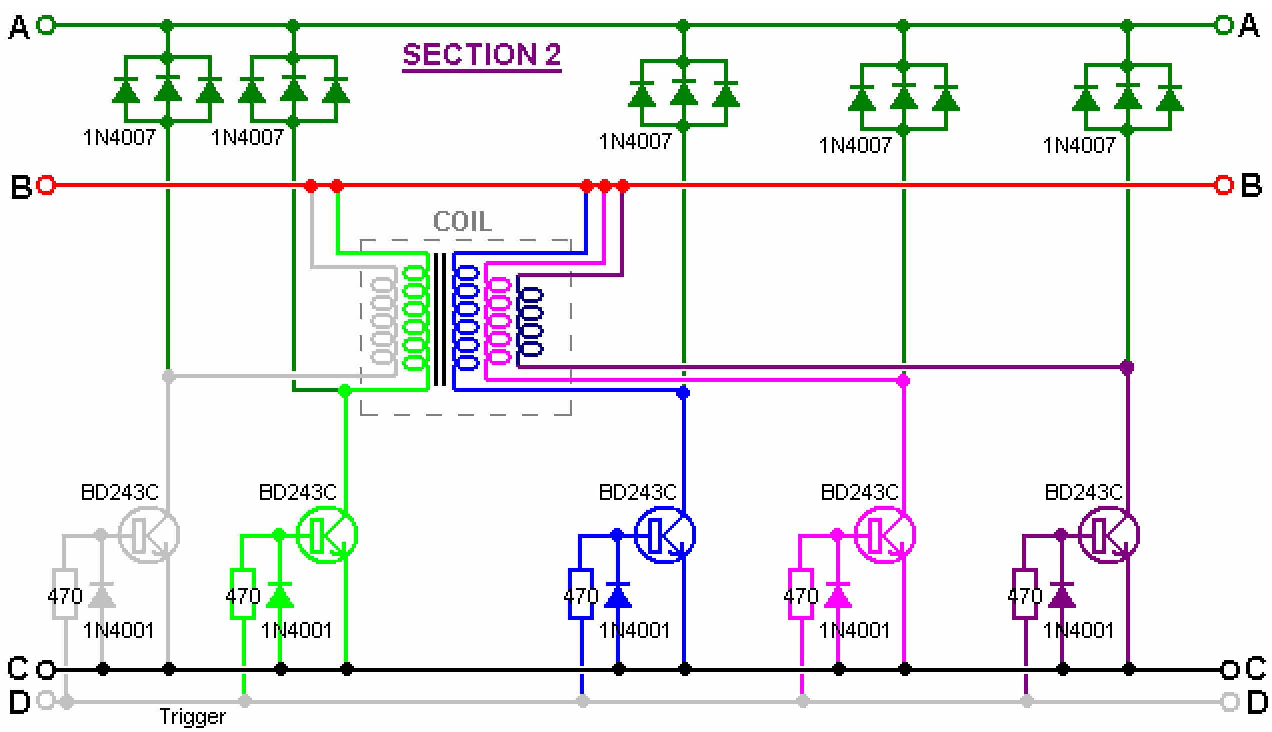


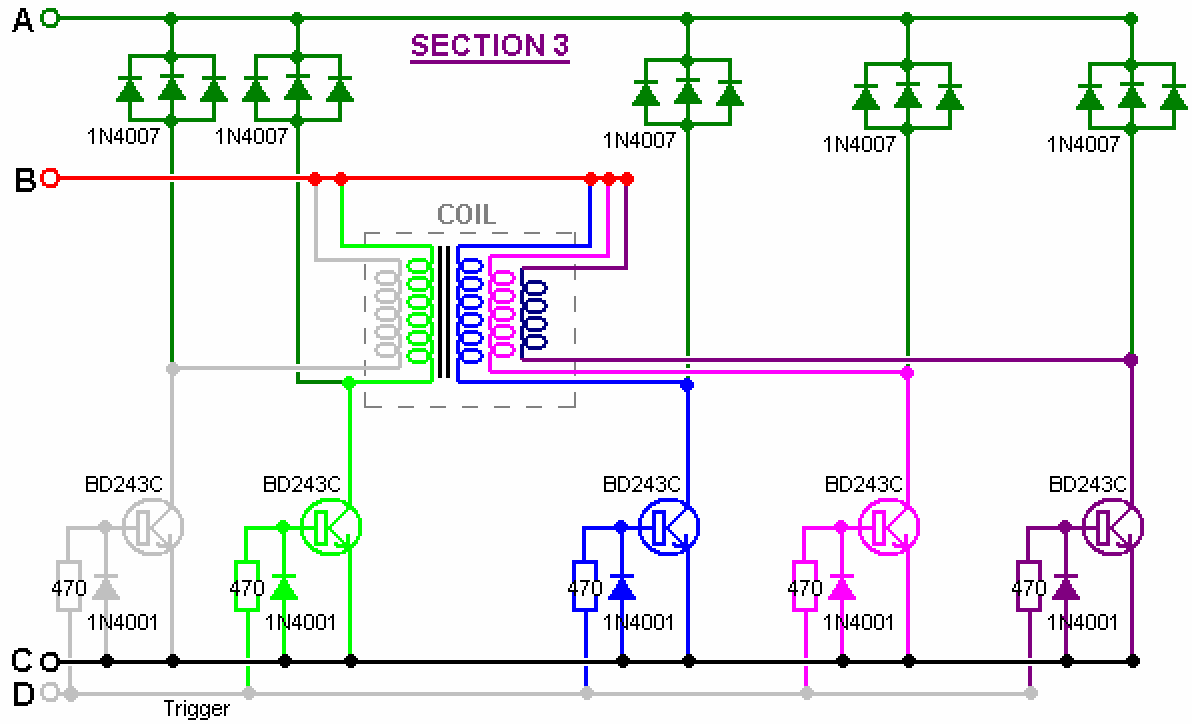
The circuit has been built on the aluminium panels so that the transistors can be bolted directly on to it, and provided with insulating strips mounted on top of it to avoid short circuits to the other components. Standard strip connector blocks have been used to inter-connect the boards which look like this:



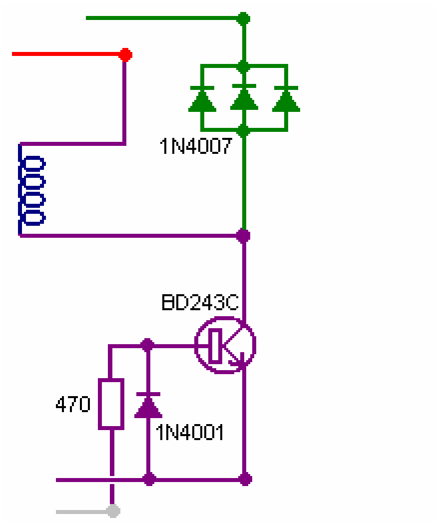
The circuit used with this device is simple but as there are so many components involved, the diagram is split into parts to fit on the page. These diagrams are usually drawn with a common charging wire going to the top of the battery which is being charged. However, it needs to be understood that drawing it that way is just for convenience and better performance is achieved if each charging circuit has its own separate wire going to the charging battery as shown in Section 1 here:





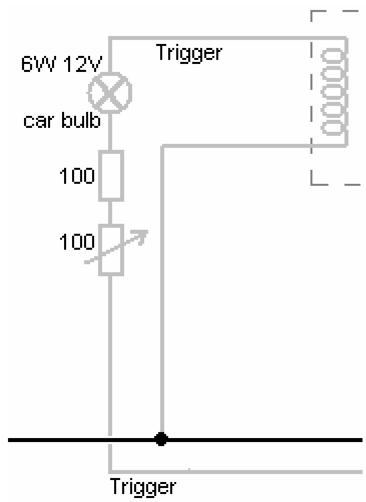


While this looks like a fairly large and complicated circuit, it actually is not. You will notice that there are fourteen identical circuit sections. Each of these is quite simple:



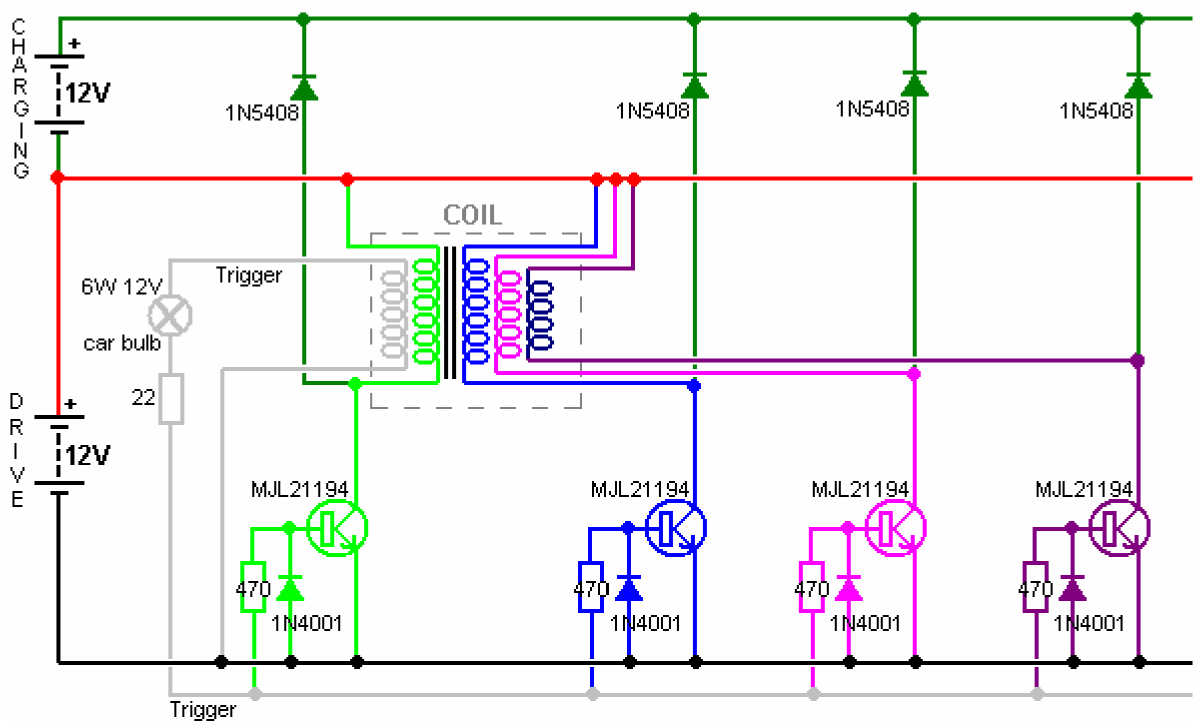
This is a very simple transistor circuit. When the trigger line goes positive (driven by the magnet passing the coil) the transistor is switched on hard, powering the coil which is then effectively connected across the driving battery. The trigger pulse is quite short, so the transistor switches off almost immediately. This is the point at which the circuit operation gets subtle. The coil characteristics are such that this sharp powering pulse and sudden cut-off cause the voltage across the coil to rise very rapidly, dragging the voltage on the collector of the transistor up to several hundred volts. Fortunately, this effect is energy drawn from the environment which is quite unlike conventional electricity, and thankfully, a good deal less damaging to the transistor. This rise in voltage, effectively “turns over” the set of three 1N4007 diodes which then conducts strongly, feeding this excess free-energy into the charging battery. Ron uses three diodes in parallel as they have a better current-carrying capacity and thermal characteristics than a single diode. This is a common practice and any number of diodes can be placed in parallel, with sometimes as many as ten being used.

The only other part of the circuit is the section which generates the trigger signal:

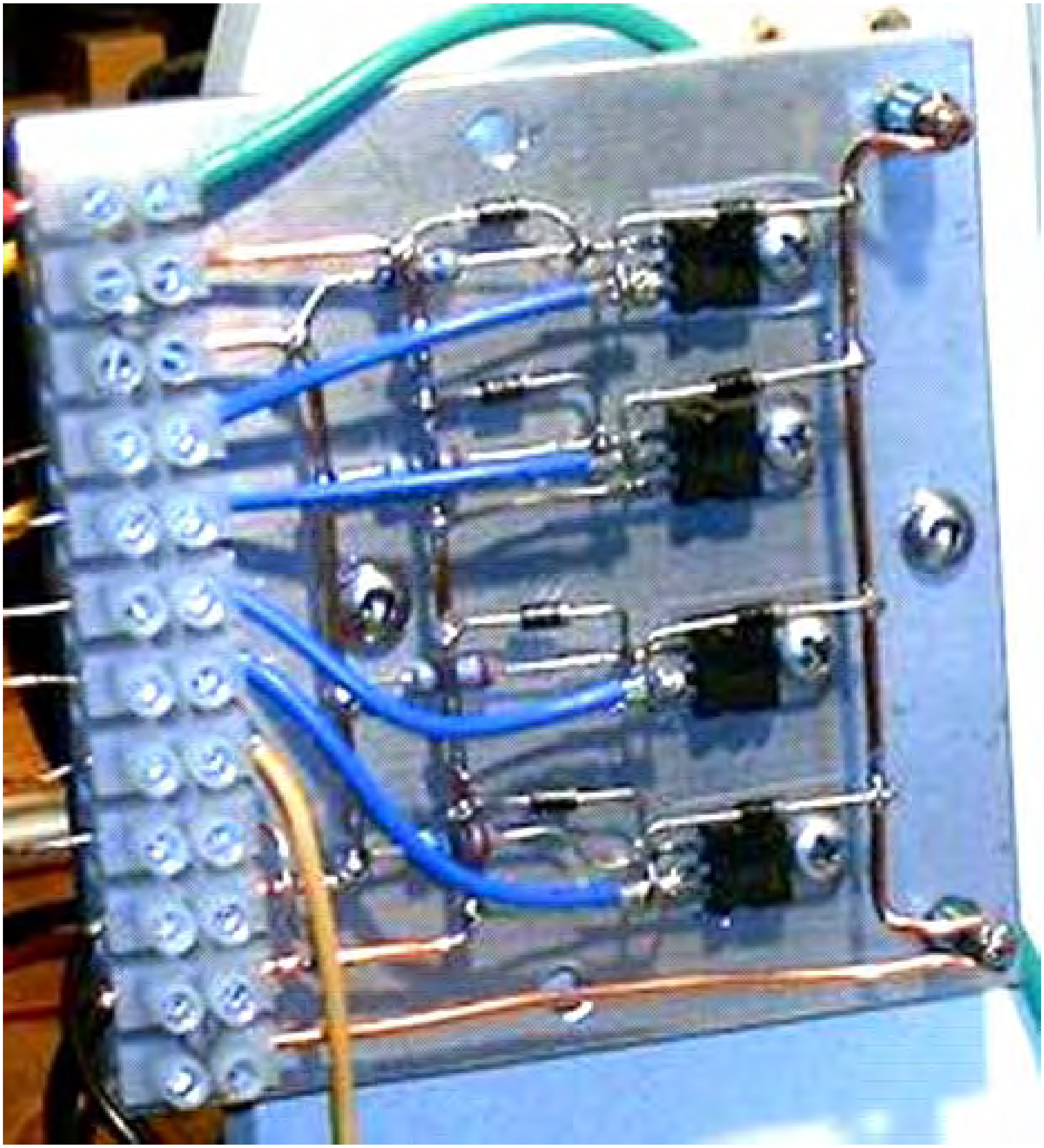


When a magnet passes the coil containing the trigger winding, it generates a voltage in the winding. The intensity of the trigger signal is controlled by passing it through an ordinary vehicle 6 watt, 12 volt bulb and then further limiting the current by making it pass through a resistor. To allow some manual control of the level of the trigger signal, the resistor is divided into a fixed resistor and a variable resistor (which many people like to call a "pot"). This variable resistor and the adjustment of the gap between the coils and the rotor are the only adjustments of the device. The bulb has more than one function. When the tuning is correct, the bulb will glow dimly which is a very useful indication of the operation. The trigger circuit then feeds each of the transistor bases via their 470 ohm resistors.

John Bedini aims for an even more powerful implementation, wiring his circuit with AWG #18 (19 SWG) heavy-duty copper wire and using MJL21194 transistors and 1N5408 diodes. He increases the trigger drive by dropping the variable resistor and reducing fixed resistor to just 22 ohms. The MJL21194 transistor has the same pin connections as the BD243C transistor. This is the starting section of John's circuit:



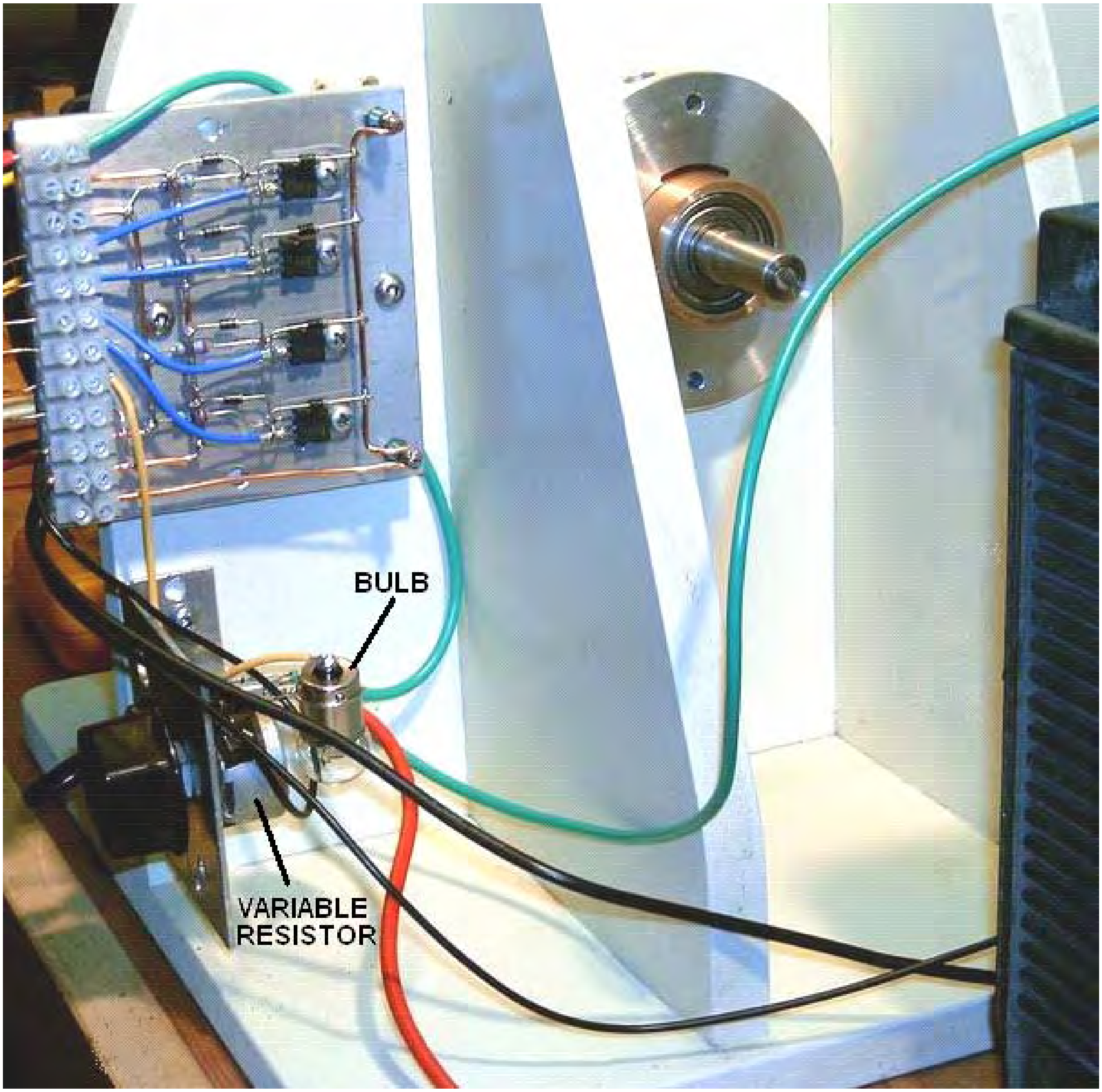
There are various ways of constructing this circuit. Ron shows two different methods. The first is shown above and uses paxolin strips (printed-circuit board material) above the aluminium heat sink to mount the components. Another method which is easy to see, uses thick copper wires held clear of the aluminium, to provide a clean and secure mounting for the components as shown here:



It is important to realise that the collector of a BD243C transistor is internally connected to the heat-sink plate used for the physical mounting of the transistor. As the circuit does not have the collectors of these transistors connected together electrically, they cannot just be bolted to a single heat-sink plate. The above picture might give the wrong impression as it does not show clearly that the metal bolts fastening the transistors in place do not go directly into the aluminium plate, but instead, they fasten into plastic tee-nuts.

An alternative, frequently used by the builders of high-powered electronic circuits, is to use mica washers between the transistor and the common heat sink plate, and use plastic fastening bolts or metal bolts with a plastic insulating collar between the fastening and the plate. Mica has the very useful property of conducting heat very well but not conducting electricity. Mica "washers" shaped to the transistor package are available from the suppliers of the transistors. In this instance, it seems clear that heat dissipation is not a problem in this circuit, which in a way is to be expected as the energy being drawn from the environment is frequently called “cold” electricity as it cools components down with increasing current as opposed to heating them up as conventional electricity does.

This particular circuit board is mounted at the rear of the unit:



Although the circuit diagram shows a twelve volt drive supply, which is a very common supply voltage, Ron sometimes powers his device with a mains operated Power Supply Unit which shows a power input of a pretty trivial 43 watts. It should be noted that this device operates by pulling in extra power from the environment. That drawing in of power gets disrupted if any attempt is made to loop that environmental power back on itself or driving the unit directly from another battery charged by the unit itself. It may be just possible to power the unit successfully from a previously charged battery if an inverter is used to convert the power to AC and then a step-down transformer and regulated power rectification circuit is used. As the power input is so very low, off-grid operation should be easily possible with a battery and a solar panel.

It is not possible to operate a load off the battery under charge during the charging process as this disrupts the energy flow. Some of these circuits recommend that a separate 4 foot long earthing rod be used to earth the negative side of the driving battery, but to date, Ron has not experimented with this. In passing, it is good practice to enclose any lead-acid battery in a battery box. Marine chandlers can supply these as they are used extensively in boating activities.

When cutting the wire lengths for coating and pushing into the coil formers, Ron uses a jig to ensure that all of the lengths are identical. This arrangement is shown here:

The distance between the shears and the metal angle clamped to the workbench makes each cut length of wire exactly the required size while the plastic container collects the cut pieces ready for coating with clear shellac or clear polyurethane varnish before use in the coil cores.

Experience is particularly important when operating a device of this kind. The 100 ohm variable resistor should be a wire-wound type as it has to carry significant current. Initially the variable resistor is set to its minimum value and the power applied. This causes the rotor to start moving. As the rate of spin increases, the variable resistor is gradually increased and a maximum speed will be found with the variable resistor around the middle of its range, i.e. about 50 ohm resistance. Increasing the resistance further causes the speed to reduce.

The next step is to turn the variable resistor to its minimum resistance position again. This causes the rotor to leave its previous maximum speed (about 1,700 rpm) and increase the speed again. As the speed starts increasing again, the variable resistor is once again gradually turned, increasing its resistance. This raises the rotor speed to about 3,800 rpm when the variable resistor reaches mid point again. This is probably fast enough for all practical purposes, and at this speed, even the slightest imbalance of the rotor shows up quite markedly. To go any faster than this requires an exceptionally high standard of constructional accuracy. Please remember that the rotor has a large amount of energy stored in it at this speed and so is potentially very dangerous. If the rotor breaks or a magnet comes off it, that stored energy will produce a highly dangerous projectile. That is why it is advisable, although not shown in the above photographs, to construct an enclosure for the rotor. That could be a U-shaped channel between the coils. The channel would then catch and restrain any fragments should anything break loose.

If you were to measure the current during this adjustment process, it would be seen to reduce as the rotor speeds up. This looks as if the efficiency of the device is rising. That may be so, but it is not necessarily a good thing in this case where the objective is to produce radiant energy charging of the battery bank. John Bedini has shown that serious charging takes place when the current draw of the device is 3 to 5+ amps at maximum rotor speed and not a miserly 50 mA draw, which can be achieved but which will not produce good charging. The power can be increased by raising the input voltage to 24 volts or even higher - John Bedini operates at 48 volts rather than 12 volts

The device can be further tuned by stopping it and adjusting the gap between the coils and the rotor and then repeating the start-up procedure. The optimum adjustment is where the final rotor speed is the highest.

The above text is intended to give a practical introduction to one of John Bedini's inventions. It seems appropriate that some attempt at an explanation of what is happening, should be advanced at this point. In the most informative book "Energy From The Vacuum - Concepts and Principles" by Tom Bearden an explanation of this type of system is put forward. While the description appears to be aimed mainly at John's motor system which ran continuously for three years, powering a load and recharging it's own battery, the description would appear to apply to this system as well. I will attempt to summarise it here:

Conventional electrical theory does not go far enough when dealing with lead/acid batteries in electronic circuits. Lead/acid batteries are extremely non-linear devices and there is a wide range of manufacturing methods which make it difficult to present a comprehensive statement covering every type in detail. However, contrary to popular belief, there are actually at least three separate currents flowing in a battery-operated circuit:

1. Ion current flowing in the electrolyte between the plates inside the battery. This current does not leave the battery and enter the external electronic circuit.

2. Electron current flowing from the plates out into the external circuit.

3. Current flow from the environment which passes along the external circuitry and into the battery.

The exact chemical processes inside the battery are quite complex and involve additional currents which are not relevant here. The current flow from the environment follows the electron flow around the external circuit and on into the battery. This is "cold" electricity which is quite different to conventional electricity and it can be very much larger than the standard electrical current described in conventional textbooks. A battery has unlimited capacity for this kind of energy and when it has a substantial "cold" electricity charge, it can soak up the conventional energy from a standard battery charger for a week or more, without raising the battery voltage at all.

An important point to understand is that the ions in the lead plates of the battery have much greater inertia than electrons do (several hundred thousand times in fact). Consequently, if an electron and an ion are both suddenly given an identical push, the electron will achieve rapid movement much more quickly than the ion will. It is assumed that the external electron current is in phase with the ion current in the plates of the battery, but this need not be so. John Bedini deliberately exploits the difference of momentum by applying a very sharply rising potential to the plates of the battery.

In the first instant, this causes electrons to pile up on the plates while they are waiting for the much heavier ions to get moving. This pile up of electrons pushes the voltage on the terminal of the battery to rise to as much as 100 volts. This in turn, causes the energy to flow back out into the circuit as well as into the battery, giving simultaneously, both circuit power and serious levels of battery charging. This over potential also causes much increased power flow from the environment into the circuit, giving augmented power both for driving the external circuit and for increasing the rate of battery charge. The battery half of the circuit is now 180 degrees out of phase with the circuit-powering half of the circuit.

It is important to understand that the circuit-driving energy and the battery-charging energy do **not** come from the sharp pulses applied to the battery. Instead, the additional energy flows in from the environment, triggered by the pulses generated by the Bedini circuit. In other words, the Bedini pulses act as a tap on the external energy source and are not themselves the source of the extra power.

If the Bedini circuit is adjusted correctly, the pulse is cut off very sharply just before the tapped energy inflow is about to end. This has a further enhancing effect due to the Lenz law reaction which causes an induced voltage surge which can take the over-voltage potential to as much as 400 volts. This has a further effect on the local environment, drawing in an even higher level of additional power and extending the period of time during which that extra power flows into both the circuit and the battery. This is why the exact adjustment of a Bedini pulsing system is so important.

A Battery Charger for Just One Battery

Johan Booysen of South Africa used electrolyser circuitry developed by Bob Boyce of America, to charge a battery. The important thing is that there was only one battery involved as the battery being charged actually powered the charging circuit. The battery involved was a 12-volt 18 Amp-Hour lead-acid battery which therefore has an efficiency of only 50%, which means that the battery has to receive twice as much current compared to the current which it can return afterwards. Johan used the battery to power a toy car which his young daughter played with. He charged that battery overnight so that she could use it the next day to drive around.

While the maximum speed of the car is only two or three miles per hour, the important point is that real, genuine energy is being put into the battery every night, energy which powers the toy car each day. A device of that kind, which can charge a battery without sunlight, without the need for wind and without the need for fuel, has major applications for people living in remote areas where there is no mains power and never will be as it is not economic to run power lines there. The question is: can such a device be made which is reliable and safe to use?

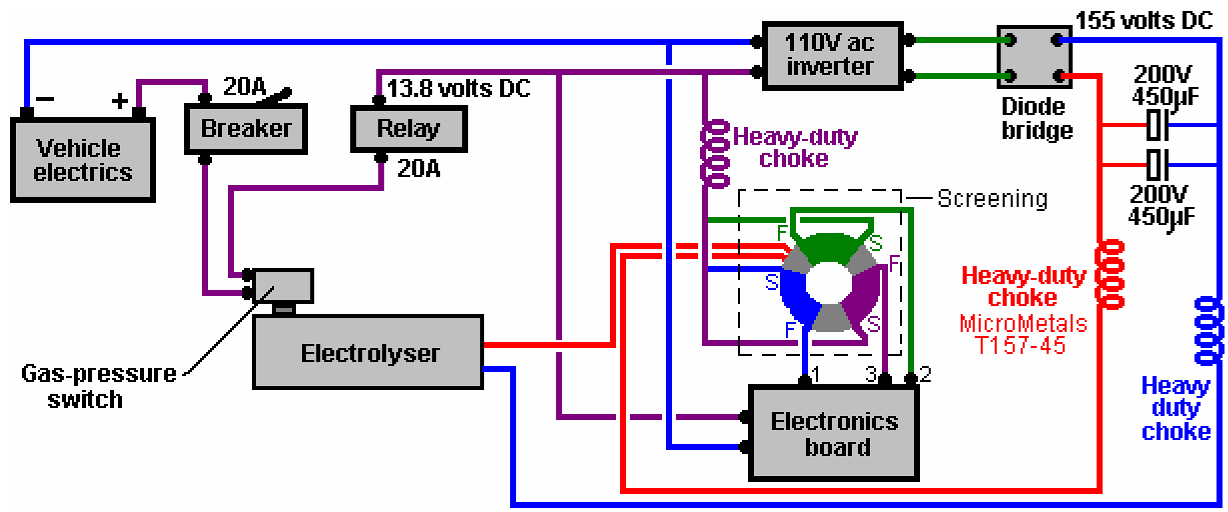
DISCLAIMER: the following information is **NOT** for beginners but is solely intended for people who are experienced in electronics and who are aware of the dangers involved. Please understand clearly that I am **NOT** recommending that you should build anything based on the following information.

First, please understand that you live in a dangerous place. You are surrounded and immersed in a sea of major energy which flows through you at all times. A lightning bolt is millions of volts with a current of ten thousand amps or more. That is a massive amount of power and I'm told that around the world, there are between 100 and 200 of those lightning strikes every **second**. The energy field would not even notice power flows like that even though to us they appear to be massive amounts of power.

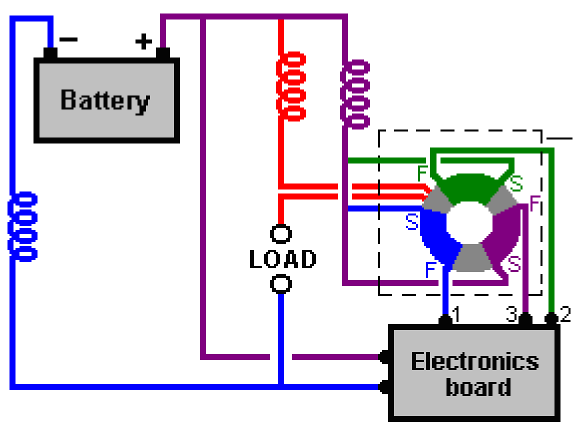
We do not notice the energy field because we have been inside it for all of our lives. It is said, and I'm inclined to believe it although I don't know how to prove it, that it is not possible to create or destroy energy, and the most that we can do is convert it from one form into another (and when we do that, we generally manage to make the energy flow do useful work for us). One way to affect the energy field is to create a very short, very sharp, high voltage spike. That disturbs the surrounding energy field enough to make small ripples in it and we can sometimes gather those ripples and use some of them to do electrical work for us.

Another known way to access this enormous energy field is to create a rotating magnetic field, but you need to be very, very, careful if you try doing that as you are messing around with an energy field of incredible power. You probably have heard of the famous equation E = mC^2 and while most people think that it came from Albert Einstein, the reality is that it was produced years earlier by Oliver Heaviside and Einstein merely publicised it. What the equation says is that energy and matter are interchangeable and that a tiny speck of matter can be created from a very large amount of energy. Oliver Heaviside also calculated that the energy field which I have been trying to describe, fills every part of the universe, and that energy is so great that the amount inside one cubic centimetre is sufficient to create all of the visible matter which we can see in the whole of the universe. You don't mess around with that energy field unless you know what you are doing, and even if you do know what you are doing, you still need to be very careful. Please understand that the electrical energy with which we are familiar, is a **transverse** wave while the universe is filled with **longitudinal** wave energy and those two forms are completely different, so the electrical effects which are familiar to you do **not** apply to the energy which charges Johan's battery.

Bob Boyce is an unusually clever and perceptive man. He experimented with rotating magnetic fields and was hit by lightning as a result. I cannot stress too much, that rotating magnetic fields are very dangerous indeed. Ideally, you want to avoid a rotating magnetic field. Bob developed a very effective and safe toroidal power supply for his high-performance HHO electrolyser. That power supply is an open system which provides more power to the load than is drawn from the battery and it looks like this:

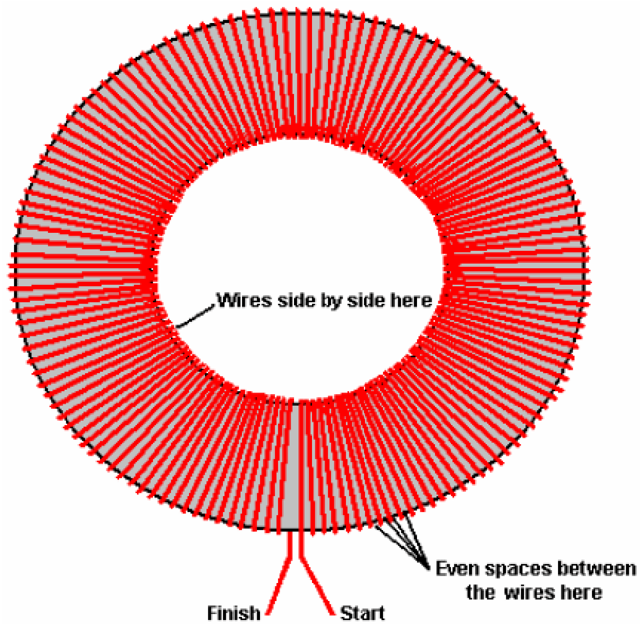


Which for a low-voltage system (not needing high voltage for 100 electrolyser cells in series) would presumably be:



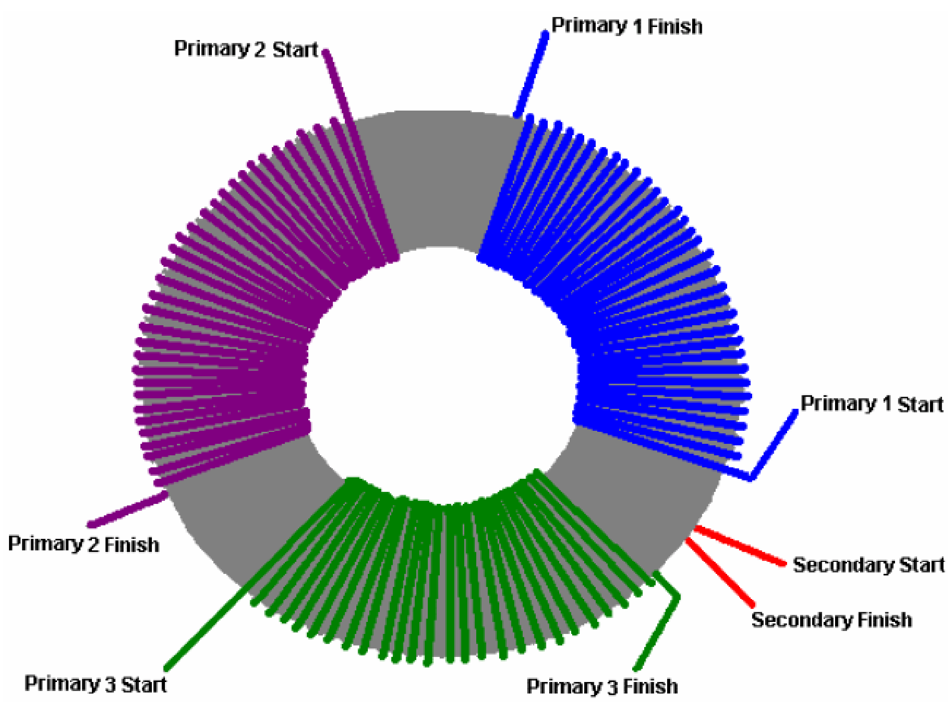
Here, the steady-state DC voltage from the battery has added to it, the waveform generated by the electronics board pulsing the toroid. Regarding toroids, Bob says that he does not consider ferrite or laminated iron to be suitable toroids because it is just not safe to use them in circuitry of this kind unless at very low frequency which means low efficiency. In these systems, there has to be a trade off between control and power and an controlled runaway is highly dangerous. Remember here, that this system is tapping into the energy source which powers the whole universe continuously and what comes out of Bob's toroid is mainly that same longitudinal wave energy. In passing, almost all, and quite possibly all free-energy devices including solar panels, water wheels, wave-power devices, biomass, etc. are powered by this literally universal energy field of longitudinal waves.

Looking at this in more detail, Bob's toroid is a 6.5 inch (165 millimetre) diameter iron powder toroid sold by MicroMetals in America, and it is wound initially with the secondary winding which goes all of the way around the toroid:

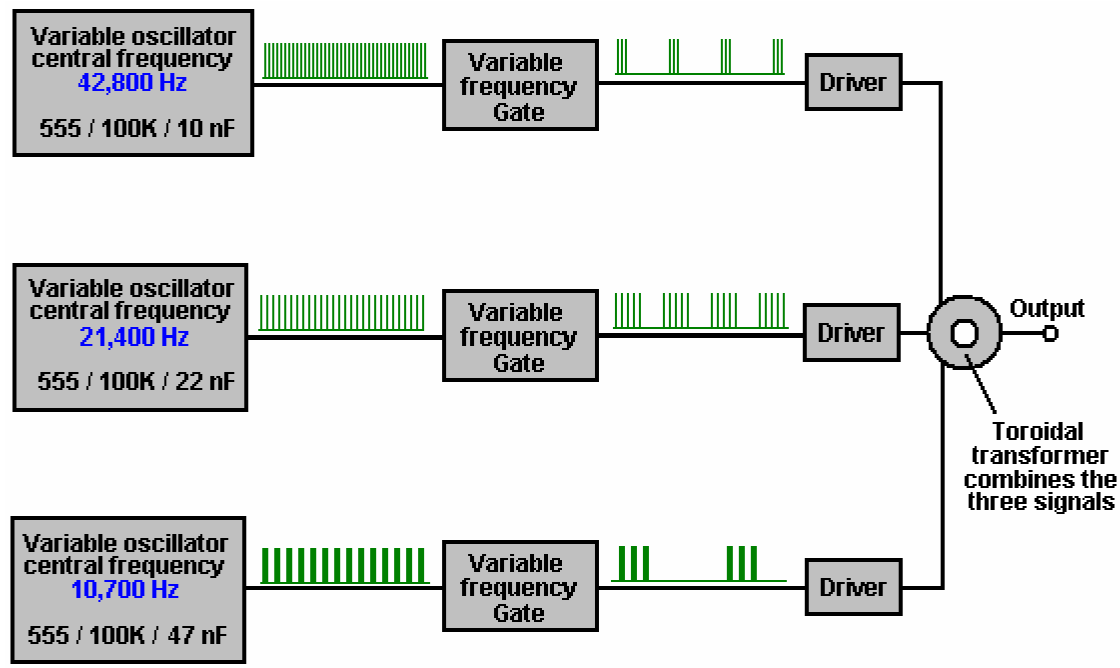


The wire used must be single strand solid copper wire, coated with silver and covered with teflon plastic insulation. Different toroids operate in different ways and so would need experimentation using different wire types and number of turns in the windings. This secondary winding has to be wound with perfect accuracy giving exactly even spaces between turns around the outer edge of the toroid and it is then taped over with ordinary electrical tape (do **NOT** use fibreglass winding tape and do not use multi-strand wire as either of those will prevent the circuit from working properly).

Three primary windings are now wound on top of the tape which is covering the secondary winding (note that the primary winding wire starts over the top of the toroid and is wound from left to right):

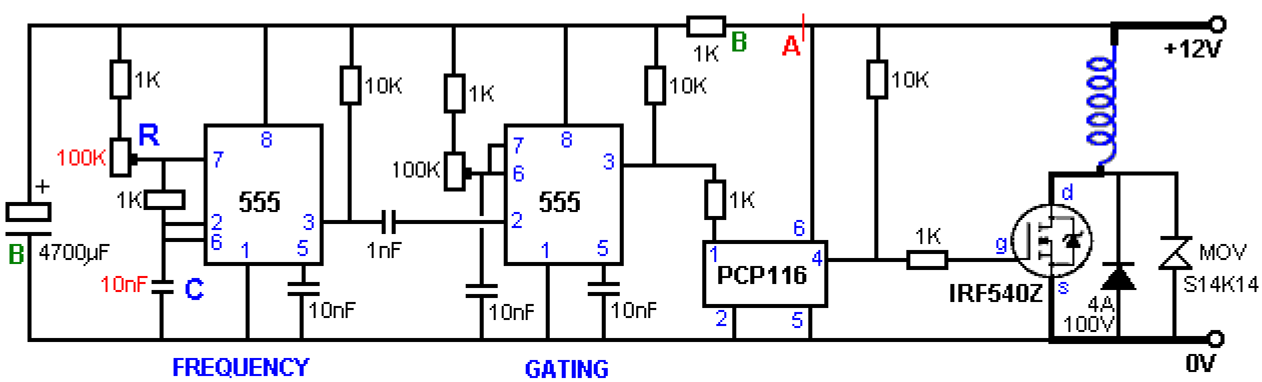


Again, it is essential that the wire used is solid, single-core copper with silver coating and teflon covering. The completed toroid is bound with tape and screened by being placed inside an earthed metal box. The drive signals for the toroid are like this:



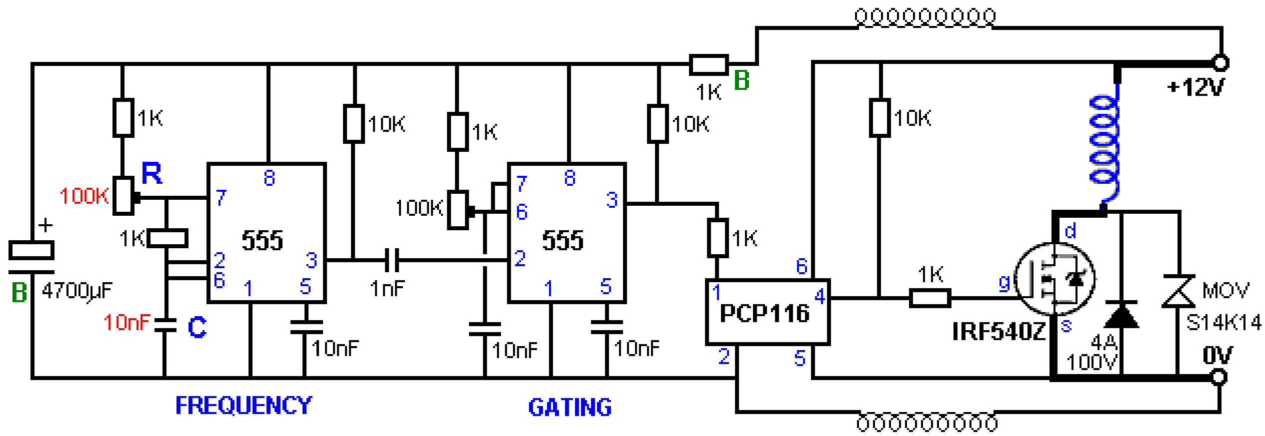
A similar system with a divide-by-two to produce each of the lower frequencies has been tried and it was found that it did not work as well as having three separate oscillators which are near the harmonic frequencies but not an exact harmonic, as that produces a complex series of repeated heterodyning of the signals and the resulting overall waveform is much richer than would be expected. So, if you attempt to replicate the waveform using an Arduino or other PIC microprocessor board, it might be advisable to set the lower frequencies at an odd number of clock ticks so that a complex waveform is produced. It is actually cheaper and more convenient to use discrete components: 555 timer chips with multi-turn preset resistors so that adjustment can be made without stopping a test run. The highest frequency is the key frequency and the two lower frequencies are helpful but of lesser importance. When tuning the circuit, the highest frequency is adjusted to give the best output. Then the gating for that frequency is adjusted to find the lowest input current which still gives that level of output. Then that same procedure is repeated for the second and then the lowest frequency modules.

You will notice here that each primary winding on the toroid is fed with its own separate signal and there is no suggestion whatsoever that the three windings are driven sequentially to form one of those very dangerous rotating magnetic fields. Although the above diagram may look slightly advanced, it is actually, very simple in broad outline. The circuits might be like this:

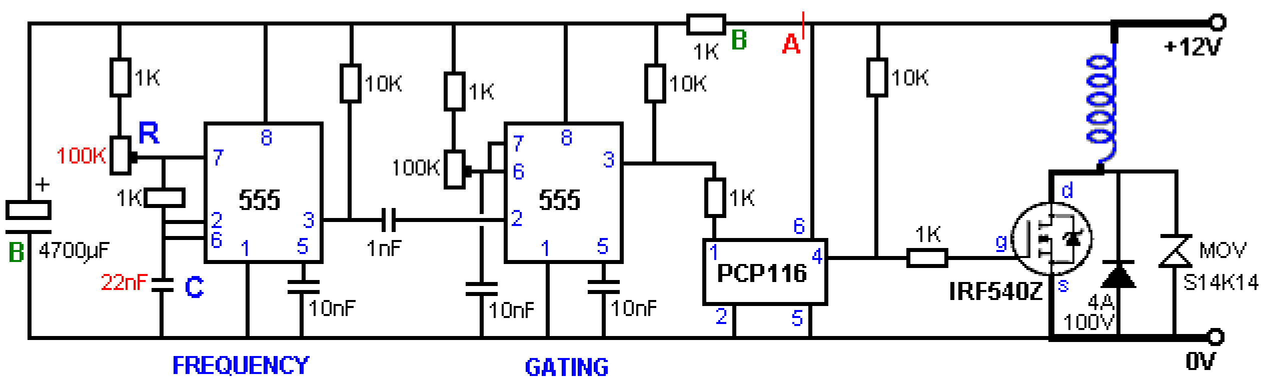


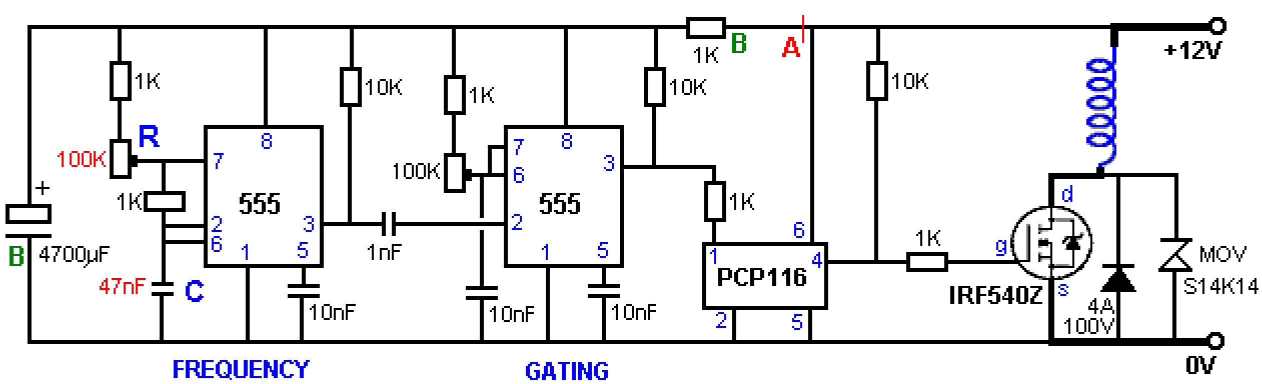
I am not very happy with the above circuit. We are working from a single voltage supply of a nominal 12-volts and the circuit has a signal generation section which operates at low-current, and a high current drive section for the toroid coil. The resistor and capacitor marked "B" are to provide power decoupling for the low current section with the

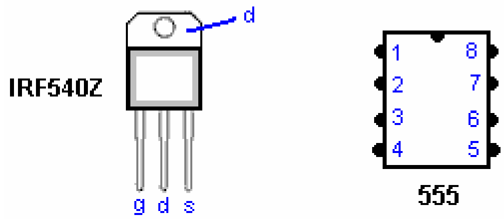
PCP116 opto isolator separating the two sections of the circuit. However, that is not a very good solution as the current pulses along the power supply wire will definitely create high speed voltage fluctuations in that wire. There are a number of solutions. One might be to add in a small choke at point "A", and/or provide a second supply wire connecting at point "A":



All choke windings should be kept well away from the toroid windings to avoid inductive coupling, and they should be outside the screening box containing the toroid. No matter what arrangement is found to be suitable, three of these circuits are needed in order to drive the three separate windings on the toroid. The only difference in the second and third circuits is the frequency capacitor:







Please remember that it is Bob Boyce's technology which is tapping into this extra power of the ambient background energy which surrounds and flows through us. Also, understand that what comes out of the toroid is not just conventional 'transverse wave' energy, but instead, it is mainly longitudinal wave energy which we cannot measure directly. Bob points out that if your load is capable of absorbing longitudinal currents, such as water or to a somewhat lesser degree, a light bulb, then this longitudinal wave power will run it. If the input energy is correctly configured, then that causes modulated longitudinal wave energy to flow out of the toroidal transformer wires because that input energy modulates the local longitudinal wave energy field. When the toroid is wound and driven for peak efficiency, the unit behaves as a Tesla magnifying transmitter and a Tesla radiant energy receiver, all in a single package. There is an energy gain in the process, which is why Tesla called it a 'magnifying' transmitter. This energy gain is produced by the small energy source which we provide, modulating the very much larger energy source which is the longitudinal wave dominant energy source of the entire universe, and then we capture and use this modulated energy to do useful work.

The output of the toroid is a combination of conventional transverse wave energy and non-conventional longitudinal wave energy. It is the characteristics of the load which determines how much energy will be harvested from the longitudinal wave energy component of the output. Water only absorbs longitudinal wave energy if that energy is modulated at the correct frequency. Light bulbs and some motors can run directly on ("cold electricity") longitudinal wave current, but they do so at reduced efficiency. Many modern appliances and items of electronic equipment would need to have the longitudinal wave energy converted to transverse wave energy in order to be able to operate on this energy.

For the HHO gas production, the electronics and the toroid itself have been designed to produce dissociation of water in a relatively safe manner and that is why Bob insists that HHO experimenters stick with a pulsed field mode of operation. It is much lower in gain than a rotational field system would be and because of that lower gain it is much less inclined to go into a runaway condition where the output energy increases the longitudinal energy gain to the point where the system overloads and goes into avalanche runaway. By using water as the load, any increase in output energy is absorbed by the water and so it is a self-stabilising process. Even if an avalanche occurs in an HHO gas system, the low power density of the pulsed mode allows the water to absorb the power surge and that just causes more water to convert into gas. This means that in order to be safe, input energy must exercise full control over the tendency to self-feedback and a load **MUST** always be present when the device is running.

Water is preferred because it does not burn out, it just dissociates. We tune the primary frequency to be one which works well with water. It is a frequency which allows the water to absorb the longitudinal component best. That is why using just pulsing DC does not give the same effect. DC does not contain the longitudinal wave energy to which the water is responding in a resonance drive system. Unfortunately, the best frequency for longitudinal energy absorption by water is affected by many factors, so we must strive to keep the system in tune for the best absorption of that energy. The other two frequencies enhance this energy collection process without greatly increasing the associated risks.

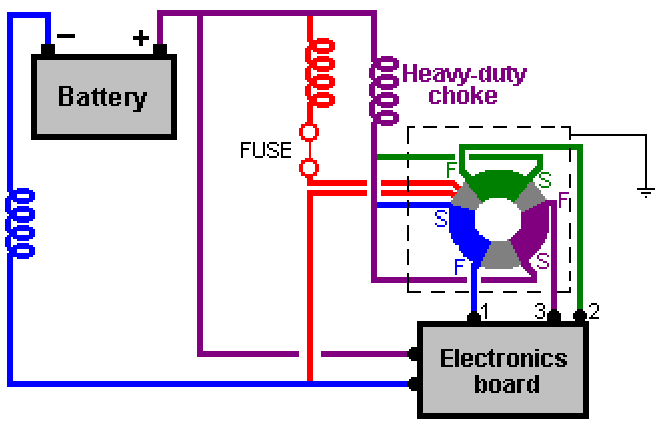
Bob knows that this entire power technology sounds hocus pocus to those educated in traditional transverse wave energy behaviour, but longitudinal wave energy is very real and can be used to our advantage. Many inventions and devices have been built that can tap into this unseen and unmeasured energy. The average water for fuel experimenter has no clue as to how dangerous this energy side of the technology can be, hence the amount of work which Bob expended in trying to make a relatively safe pulsed version which the average experimenter can use safely. Otherwise, experimenters are likely to kill themselves when trying to apply a very dangerous technology to a very simple application, all in the effort to generate more HHO gas on demand. Bob is not the only one to do this. Meyer, Puharich, and others, have managed to tap into this energy is a safe and controllable fashion.

When Johan tries to charge a lead-acid battery, there is no electrolyser filled with water to absorb an avalanche runaway. The only available water is in the acid contents of the battery and it is that which will dissociate into HHO gas inside the battery. That HHO gas mix is in the exact proportions for explosion back into water again. What has not been stressed is that the HHO gas produced is highly charged electrically and will detonate if the gas pressure exceeds about fifteen pounds per square inch. While any mention of an explosion is scary, the reality does not match up to what most people imagine. Earlier in this chapter, Ronald Knight who is an experienced battery tester (using only transverse wave energy), explains the situation clearly:

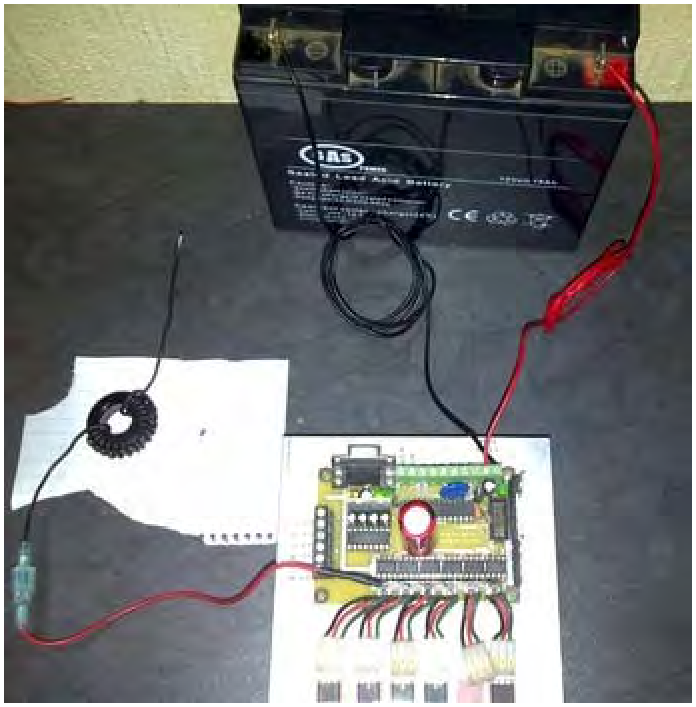
I have not heard of anyone having a catastrophic failure of a battery case in all the energy groups to which I belong and most of them use batteries in the various systems which I study. However, that does not mean that it cannot happen. The most common reason for catastrophic failure in the case of a lead-acid battery, is arcing causing failure in the grids which are assembled together inside the battery to make up the cells of the battery. Any internal arcing will cause a rapid build up of pressure from expanding Hydrogen gas, resulting in a catastrophic failure of the battery case. During the manufacturer's testing, the battery is charged with the maximum current which it can take. If the battery does not blow up due to internal arcing during the initial charge it is highly likely that it will not blow up under the regular use for which it was designed. However, all bets are off with used batteries that have gone beyond their expected life. I have witnessed several catastrophic failures of battery cases daily at work. I have been standing right beside batteries when they exploded and I have only been startled by it.

I would suggest that when testing new, unorthodox circuitry such as this, that the battery is placed in a robust box which has vents covered with baffles so that gas can escape freely but any acid or fragments of case are kept inside the box. Personally, I have never had a battery explode, nor have I ever seen an exploded battery.

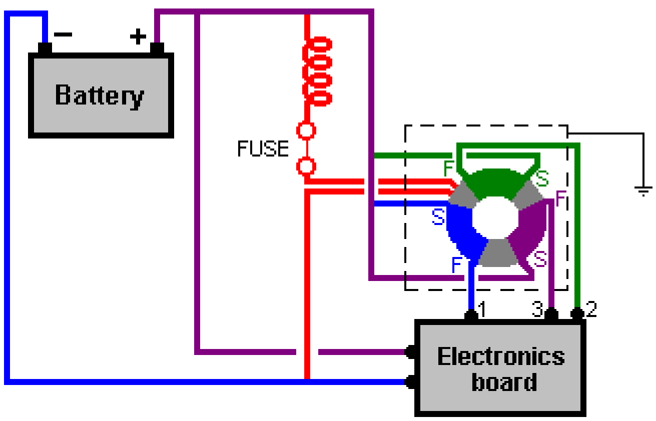
I understand that Johan connects the circuit output back to the battery in this way:



The choke shown in red in the diagram is about 18 turns on a small toroid which seems okay, but the two other coils appear to be just six or seven loops in the connecting leads, not wound side by side on a magnetic former, but just left as if shortening the cable length.



Consequently, it is distinctly possible that those two chokes have been omitted as the inductance of those loops must be very low indeed. The point of a choke is that it will pass DC while blocking sharp (transverse wave) voltage spikes. If those two chokes are as ineffective as they look, then the circuit would be:



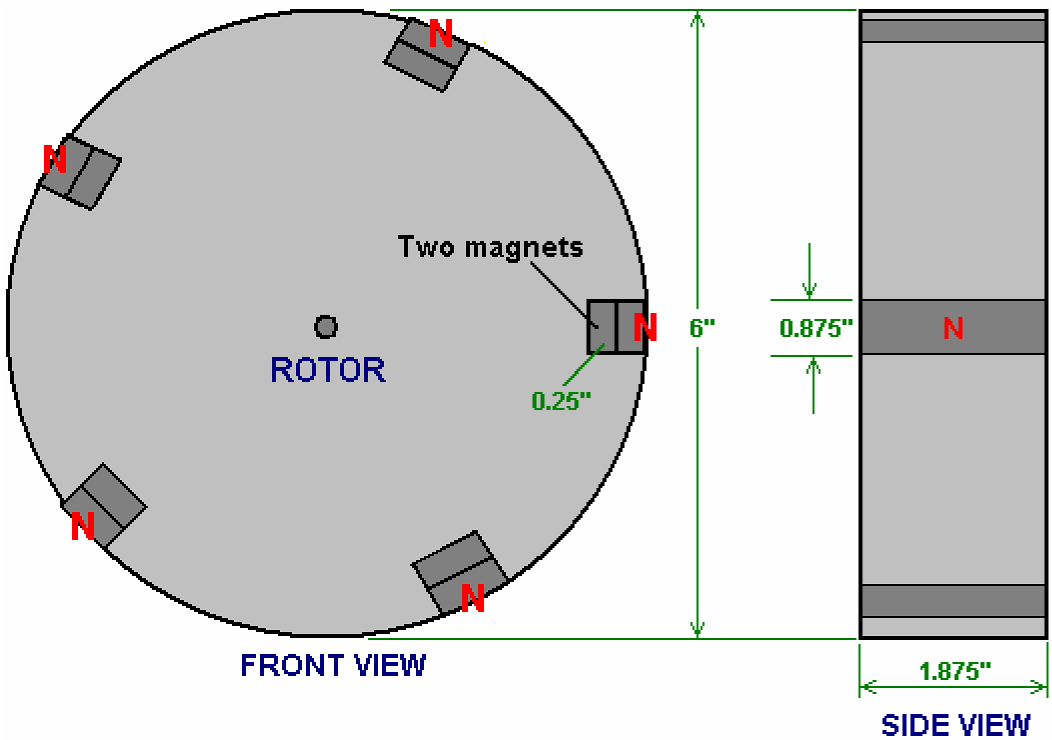
While the photograph above appears to show a fuse placed in the output wire before the choke, I am doubtful about doing that. The speed of longitudinal energy is so great that a fuse is most unlikely to operate fast enough to be any use. Also, longitudinal ("cold") energy has the reverse effect to what is expected with transverse wave ("ordinary") energy. Any fuse has a resistance and is supposed to blow when it burns out through raised heat caused by excessive current flowing through it. Transverse energy would cool the fuse rather than heat it. However, a fuse might well have an enhancing effect on the whole charging process because while a resistance impedes the flow of transverse wave energy it actually boosts the energy flow of longitudinal energy, drawing in additional power from our surrounding energy field. In a runaway power surge, the fuse would not be helpful but when running normally, it might well be. Let me stress here that this is only my untested opinion and, unlike Bob Boyce, I am certainly not an expert in this technology.

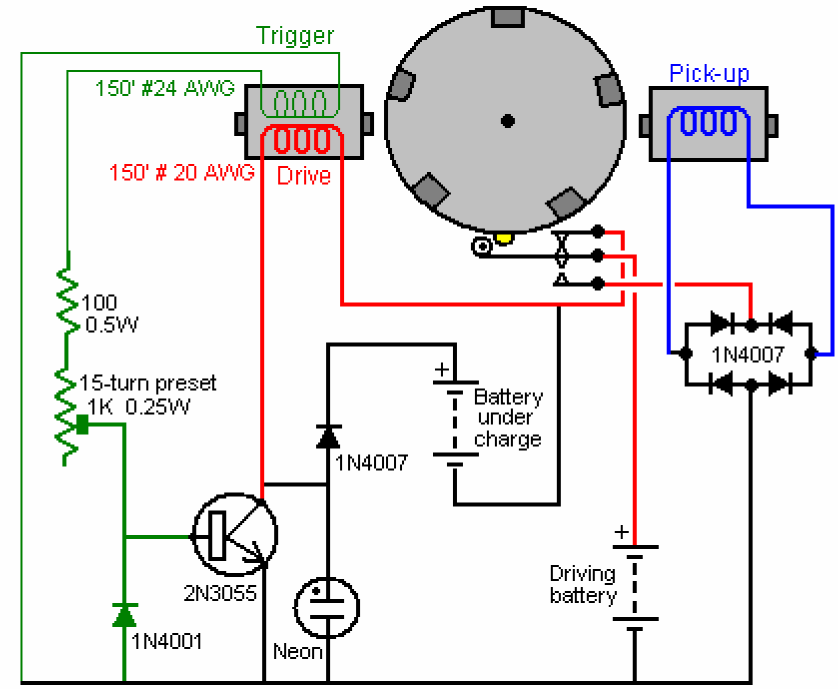
Let me stress again that this is **NOT** a recommendation for you to attempt to build or use something of this nature in spite of the fact that it has worked well for Johan. We need to remember that Johan was using a more advanced version of Bob's electronic circuitry, one whose details have not been released. Because of that, it may be necessary to place a diode between the circuit output and the battery Plus terminal. This information is only a suggestion for experimentation which might just possibly be carried out by experienced electronics experts.

There are many different types of battery charger circuits. It has been spread around that the battery being charged cannot power a load at the same time. I am reasonably sure that that is not actually true as many different people have managed to achieve that. Here is one such circuit:

The Self-Charging Battery Charger.

One major disadvantage of some of these battery pulse-chargers is the fact that it is thought that it is not possible to self-power the device nor to boost the running battery during the battery charging process. This is one variation of the pulse-charger which does actually boost the driving motor as it runs, and one particular implementation of this is shown here:





The rotor weighs about five pounds (2 Kg) and is very heavy for its size, because it is constructed from flooring laminate, and has a thickness of 1.875 inches (48 mm) to match the width of the magnets. There are ten magnets size 1.875" x 0.875" x 0.25" (48 mm x 22 mm x 6 mm) which are assembled in pairs, to produce the most evenly matched magnetic sets possible. That is, the strongest is put together with the weakest, the second most strong with the second weakest, and so on to produce the five sets, each half an inch (12 mm) thick. These pairs are embedded in the rotor at equal 72^{O} centres around the edge of the rotor.

The battery pulsing produced by this circuit is the same as shown in John Bedini's patent already mentioned. As the rotor turns, the trigger winding energises the 2N3055 transistor which then drives a strong pulse through the winding shown in red in the diagram above. The voltage spike which occurs when the drive current is suddenly cut off, is fed to the battery being charged. This happens five times during a single revolution of the rotor.

The clever variation introduced here, is to position a pick-up coil opposite the driving/charging coil. As there are five magnets, the drive/charging coil is not in use when a magnet is passing the pick-up coil. The driving circuit is not actually active at this instant, so the micro switch is used to disconnect the circuit completely from the driving battery and connect the pick-up coil to the driving battery. This feeds a charging pulse to the driving battery via the bridge of 1N4007 high-voltage diodes. This is only done once per revolution, and the physical position of the micro switch is adjusted to get the timing exactly right.

This arrangement produces a circuit which in addition to pulsing the battery bank under charge, but also returns current to the driving battery.

Another variation on this theme is shown on YouTube where an experimenter who calls himself "Daftman" has this video explaining the circuit he uses in his Bedini-style battery-charging motor:
http://uk.youtube.com/watch?v=JJillOTsmrM&feature=channel and his video of his motor running can be seen at: http://www.youtube.com/watch?v=S96MjW-isXM and his motor has been running for months in a self-powered mode.

Chapter 9 - Passive Devices

As we are immersed in a major energy field, it is perfectly possible to gather and use that energy using a passive device. It is also perfectly possible to control the weather to a major degree using a very simple device. However, in this chapter, I will mention three useful passive devices, not including the very effective pyramid technology which boosts growth, discourages pests, revives animals in poor health, boosts humans, etc. So, Let's start with the Joe Cell which is a device that allows a vehicle to run without burning any fuel. First, the old information which does work but is not as good as the current details:

The Joe Cell.

The device called the "Joe Cell" used to be one of the most difficult devices for any experimenter to get operating properly but new design data has changed all that. It is a passive device for concentrating energy drawn from the local environment and it takes great perseverance and patience to use one to power a vehicle. Here is some practical information on the Joe Cell.

In 1992 in Australia, Graham Coe, Peter Stevens and Joe Nobel developed previously patented units which are now known by the generic name of the "Joe Cell". Peter introduced Joe to Graham and they rehashed the patented cells which Graham knew about, using materials from the Local Dairy Production Facility NORCO. A two hour long video showing the Joe Cell was produced by Peter and Joe and the unit shown operating in the video was attached to Peter's Mitsubishi Van. Joe had his equipment stolen and his dog killed, so he decided to keep a low profile, moving out into the wilds and not generating much publicity, in spite of fronting the two hour video recording. A search on the Joe Cell will locate many videos on the subject. This document is an attempt to provide detailed information on a recent Cell built by Bill Williams in the USA and the subsequent constructional advice which has arisen from his experiences.

First, you need to understand that, at this point in time, building and using a Joe Cell of any variety, is as much an art as a science. It might best be explained by saying that creating building plans for it is rather like producing plans for painting a copy of the famous Mona Lisa painting. The instructions for the painting might be:

1. Buy a canvas, if one is not available, then here is how to make one.
2. Buy some oil-based paints, if none are available, then here is how you make them
3. Buy an artists brush, palette and charcoal, if none are available then this is how you make them.
4. Here is how you paint the picture.

Even given the most complete and detailed instructions, many people, including myself, are unlikely to produce a top-quality copy of the Mona Lisa. It is not that the instructions are lacking in any way, it is the skill and ability of the person attempting the task which are not up to the job. It used to be that not everybody who built a Joe Cell had instant success. However, recent advances have changed all that, but let us run through the earlier constructional information as a lead-in to the current technology.

A Joe Cell is capable of powering a vehicle engine without needing to use conventional fossil fuel. So, what does the engine run on? I suggest that it runs on a newly discovered energy field not yet understood by mainstream science. In another couple of hundred years time, it will be a routine subject which every child in school will be expected to understand, but today it looks like the 'witchcraft' of the magnifying glass starting a fire.

It is not unusual for newcomers to the subject to get confused by the Cell itself. The Cell consists of a metal container with tubes inside it. The container has what looks like ordinary water in it and it sometimes has a DC voltage applied across it. This causes many people to immediately jump to the false conclusion that it is an electrolyser. It isn't. The Joe Cell does **not** convert water to hydrogen and oxygen gasses to be burnt in the engine. The water in a Joe Cell does not get used up no matter how far the vehicle travels. It **is** possible to run a car on the gasses produced by electrolysis of water, but the Joe Cell has absolutely nothing whatsoever to do with electrolysis. The Joe Cell acts as a concentrator for a new energy field, in the same way that a magnifying glass acts as a concentrator for sunlight, and both have to be done just right for them to work.

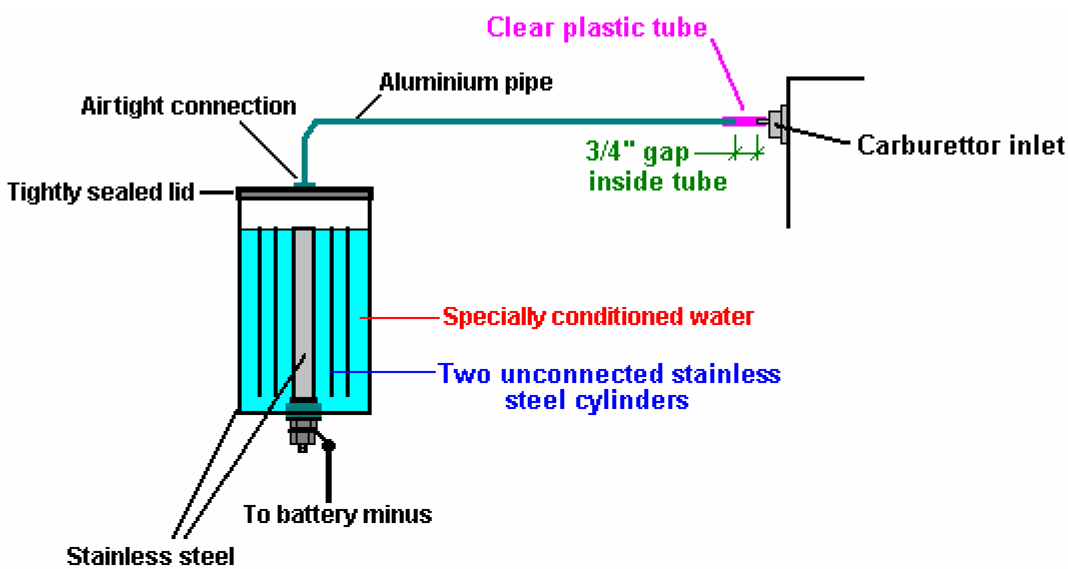
At the present time, there are at least fifteen people who have built Joe Cells and managed to power vehicles using them. Several of these people use their Joe Cell-powered vehicles on a daily basis. Most of these are in Australia. The first Cell-powered vehicle was driven some 2,000 kilometres across Australia.

Disclaimer: The remainder of this document contains considerable specific detail on the design and construction of a Joe Cell. This presentation is for information purposes only and must not be construed as a recommendation that you actual physically construct a device of this nature. The author stresses that he is in no way liable for any damage, loss or injury caused by your future actions. It should also be borne in mind that any alteration to an automotive vehicle, such as changing the fuel on which it runs to HHO gas, natural gas, Joe Cell energy, or anything else, might void the vehicle insurance unless the insurer is informed beforehand and agrees to continue insurance cover on the modified vehicle.

In broad outline, a Joe Cell is a 316L-grade stainless steel container, with a central cylindrical electrode, surrounded by a series of progressively larger stainless steel cylinders, and filled with specially treated water. This arrangement of steel shells and treated water acts as a focusing mechanism for the energy field used to power the vehicle.

The Cell itself is made up with the battery negative taken to the central electrode. The connection to this stainless steel electrode is made at the bottom with the electrical connection passing through the base of the cell container. This obviously needs careful construction to prevent any leakage of the conditioned water or the energy focused by the Cell.

Surrounding the central electrode are two or three cylinders made of either solid or mesh stainless steel. These cylinders are not connected electrically and are held in position by insulating material which needs to be selected carefully as the insulation is not just electrical insulation but is also energy-field insulation. The outside stainless steel cylinder forms the container for the cell:



The picture above shows the general construction of a cell of this type although, unlike the description below, this one does not have the lip which is used for attaching the lid. It is included here just as a general illustration of how the cylinders are positioned relative to each other.

The following information on constructing a Joe Cell, is broken down into the following sections:

1. The Materials needed for construction.
2. Constructing the Cell
3. Getting the Cell working
4. Installing the Cell in the vehicle
5. Getting the vehicle running
6. Suppliers
7. Workarounds

The Materials needed for Construction.

Various vehicles can be powered by a Joe Cell. If you have not built and used a Joe Cell before, then it is worth using the easiest type to convert. The most suitable is an older type vehicle with no computer control of the combustion, a carburettor and a water-cooled engine. If the engine block is aluminium rather than steel then that is also a slight additional advantage.

The Cell is built from stainless steel pipes. The lower the magnetism of the finished unit the better, so 316L grade stainless steel is preferred. However, there is no need to become obsessed with this as most varieties of stainless steel can be persuaded to operate. The length of the tubing is not critical, but about 8 inches (200 mm) is a reasonable choice for the overall length of the inner tubes. The outer pipe which forms the casing, needs to be about 10 inches in length so that there is clearance above and below the inner pipes.

The innermost pipe diameter is 2 inches (50 mm) and the others can be 3 inch, 4 inch, and 5 inches in diameter as that creates a gap of just under half an inch between the pipes, which is a suitable spacing. The wall thickness of the pipes is not critical but it needs to be a practical size with 1 mm being the minimum thickness with the most common thickness being 1/16 inch (1.6 mm or 0.0625 inch). It is important that the walls of the outermost cylinder are completely rigid, so using a greater thickness for that cylinder is an advantage.

Some stainless steel plate is needed for the ends of the outer cylinder. Ideally, the top and base should not overhang the sides but that is difficult to achieve if the cell is to be airtight, so the end pieces will need to be slightly larger than the outside tube and 1/8 inch (3 mm) thick sheet is suggested. The base size is 5 inch square, or possibly slightly larger to facilitate cutting a circular shape out of it. The lid and lip blanks will need to be 6 inch squares, or again, slightly larger to facilitate cutting circles out of them.

The plinth component at the base of the 2-inch inside tube needs to be cut from a piece of stainless steel. If the option of machining the whole plinth as a single piece is chosen, then the piece of 316L stainless steel needed to do this will be substantial, perhaps a section of solid bar 2.25 inches (57 mm) in diameter and some 3 inches (75 mm) long. If the easier and cheaper option of using a standard half-inch (12 mm) 316L stainless steel bolt (if one is available) is selected, then a piece of 316L stainless steel some 2.25 inches (57 mm), or slightly larger, 2 inch (50 mm) thick will be needed. The exact details of this will need to be discussed with the person who will undertake the machining as practical issues come into play, and the optimum size will depend to a certain extent on the lathe being used. If a screw thread is being machined on the spigot of the plinth, then the thread should match the locally available nuts, unless nuts are also being made up.

Some additional steel will be needed for constructing a mounting bracket inside the engine compartment, also, some double-laminated hessian sacking ("burlap") and about 36 inches (1 m) of half-inch (12 mm) wooden dowel to use in the mounting bracket.

Some Ultra-High Molecular Weight Polyethylene material as found in kitchen chopping boards will be needed to insulate between the engine mounting and the cell and between the inside tube's plinth and the base plate.

A length of aluminium tubing typically three quarters of an inch (20 mm) in diameter will be needed for connecting the Cell to the engine, and a short length of strong, clear plastic pipe for the actual final connection to the engine, needed to prevent an electrical short-circuit between the Cell and the engine. This plastic pipe needs to be a tight push-fit as clamping clips are not used. A stainless steel compression fitting to fit the pipe is needed to make the seal between it and the lid of the Cell. It is very important that this fitting is stainless steel as other materials such as brass will prevent the cell from operating. The wrong material for this fitting has been the reason for many Cells not operating. Neither brass nor any other material (other than stainless steel) should not be used anywhere in the construction, whether it be for nuts, bolts, fittings, metal connections, or anything else.

Ideally, natural rubber with no additives or colouring, failing that "Buna-n" (nitrile rubber) o-ring, or teflon, is needed for inter-cylinder bracing and some sheet to make the circular lid gasket. Also some white marine-grade Sikaflex 291 bedding compound. Natural rubber with no colouring or additives is the best insulator and should be used if at all possible. After extended use, Bill has found that teflon spacers work better than the rubber and so has switched to teflon.

Seven or eight stainless steel cones will be needed for the water-conditioning process. These are usually manufactured for machines which separate cream from milk and it is possible to buy them via eBay from time to time. If none are available, then it is perfectly possible to construct them yourself.

There will also be minor items like a few bolts, lengths of electrical wire and the like. To summarise this then:

Stainless steel pipes in 316L grade steel:

- 5-inch (125 mm) diameter 10 inches (250 mm) long, one off
- 4-inch (100 mm) diameter 8 inches (200 mm) long, one off
- 3-inch (75 mm) diameter 8 inches (200 mm) long, one off
- 2-inch (50 mm) diameter 8 inches (200 mm) long, one off

Stainless steel plate in 316L grade steel:

- 5.25 inch (133 mm) square 1/8 inch (3 mm) thick, one off
- 6.25 inch (157 mm) square 1/8 inch (3 mm) thick, two off
- 3 inch (75 mm) strip, 16 gauge thick, two feet (600 mm) long
- One plinth blank as described above, size depending on the lathe and style of construction.

Stainless steel bolts:

- 1/4 inch (6 mm) diameter, 3/4 inch (18 mm) long, twelve off with matching nuts
- One 1/2 inch (12 mm) diameter, 2.25 inch (57 mm) long with two nuts and three washers

Aluminium tubing 3/4 inch (20 mm) in diameter, 3 feet (1 m) long
Plastic tubing to form a tight fit on the aluminium tubing and some 4 inches (100 mm) long
One stainless steel compression fitting to seal the pipe-to-lid connection

Natural rubber with no additives, (or "Buna-n" insulation if natural rubber just cannot be got):

- O-ring tubing, 3 feet (1 m) long
- Sheet, 6 inch (150 mm) square, one off

Miscellaneous:

White Sikaflex 291 bedding compound (available from ships chandlers), one off
Double-laminated hessian sacking ("burlap") 1 foot (300 mm) wide, 6 feet (2 m) long
Wood (ramin) dowel three quarter inch (18 mm) diameter, 36 inches (1 m) long
UHMWP plastic food-chopping board, one off
Sundry connecting wire and ordinary engine compartment mounting bolts, and the like
Stainless steel cones and canister as discussed below

Don't polish the tubes and never, ever use sandpaper or wet-and-dry paper on any of these components as the result is scored surfaces and each score reduces the effectiveness of the Cell.

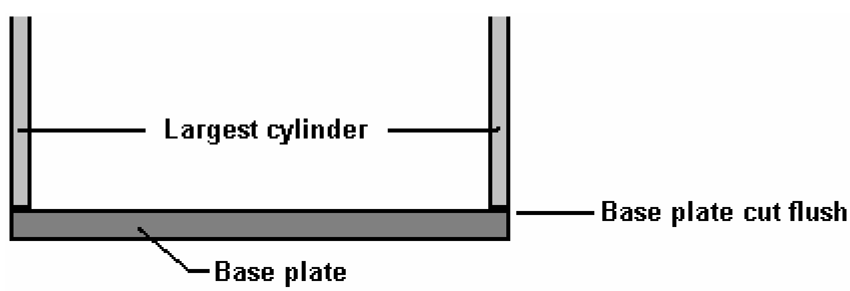
Constructing the Cell

The Joe Cell looks like a very simple steel construction which could easily be made by any amateur. While it can be constructed by an amateur, it is not a simple construction as it is important to keep any acquired magnetic properties to a minimum. Consequently, it is suggested that an angle grinder is not used for any of the metalwork, and hand tools used for cutting and shaping. Also, if the cutting tool has previously been used to cut anything other than stainless steel it should not be used, or at the very least, thoroughly cleaned before use as contamination of your Cell components through particles of another material is critical and can prevent the Cell from working. It should be stressed again that the materials used in the construction of a Cell are absolutely critical if success is to be assured. If you have an experienced friend who has made many Cells work, then you can experiment with different materials, but if this is your first Cell and you are working on your own, then use the exact materials shown here and don't end up with a Cell which doesn't work.

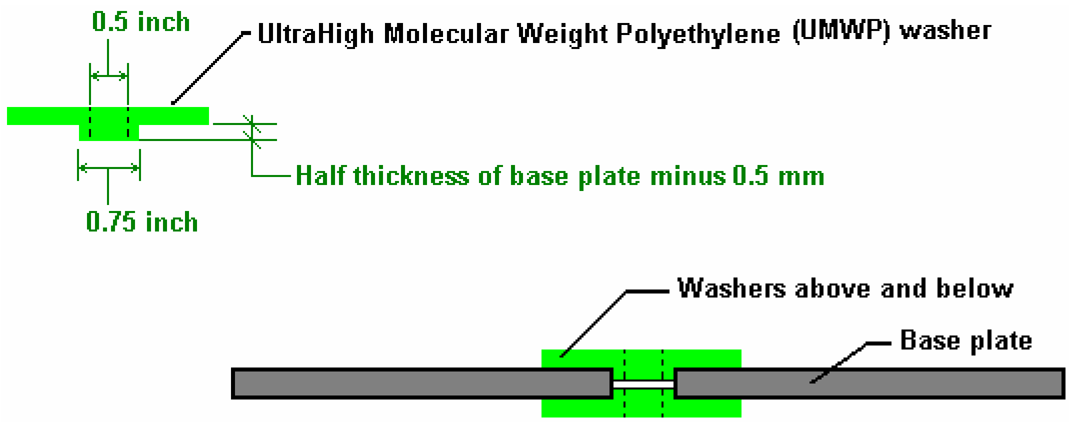
Bill Williams started building a 5 cylinder cell comprising 1", 2", 3", 4" and outer tube 5" but Peter Stevens later advised him to remove the 1" centre tube and go with only two neutrals being the 3" and 4" tubes as the 1-inch diameter is too small for optimum energy pick-up.

Please accept my apologies if the following suggestions for construction seem too basic and simple. The reason for this is that this document will be read by people whose first language is not English and who will find it much easier if plenty of detail is provided.

The first step is to construct the base plate, used to form the bottom of the container. Cut the largest diameter pipe to a 10-inch (250 mm) length. (If you have difficulty in marking the cutting line, try wrapping a piece of paper around it, keeping the paper flat against the tube and making sure that the straight edge of the paper aligns exactly along the overlap, then mark along the edge of the paper). Place the pipe on one of the end blanks and mark the blank around the bottom of the pipe. Cut the blank to form a circular plate which sits flush with the bottom of the tube:



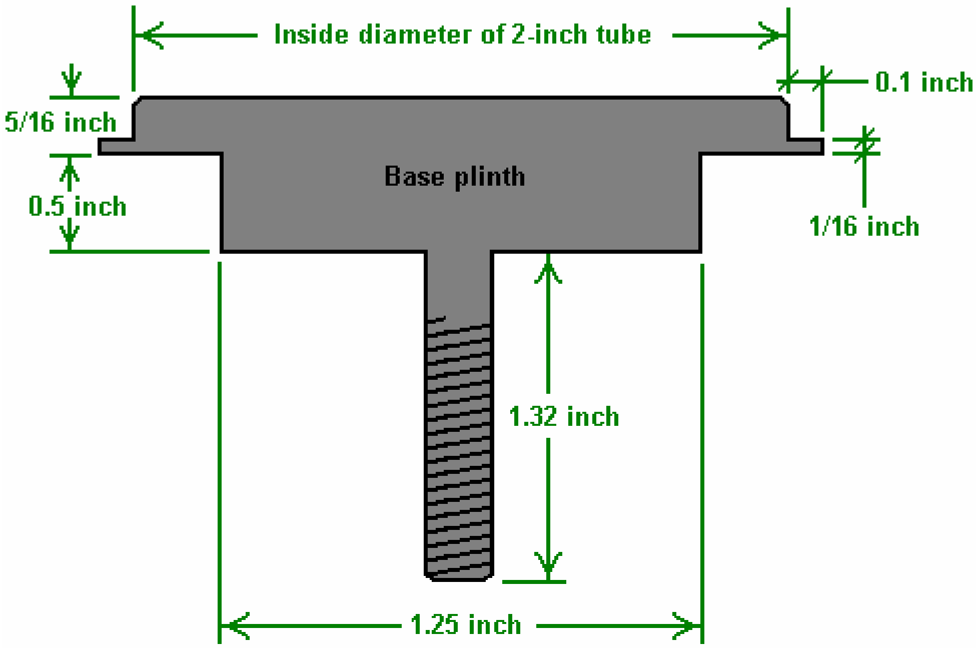
The next step is to mount the innermost 2-inch (50 mm) diameter pipe rigidly to the base plate. Cut the pipe to an 8-inch (200 mm) length. The pipe mounting needs to be exactly in the centre of the plate and exactly at right angles to it. This is probably where the most accurate work needs to be done. To complicate matters, the mounting needs to be connected electrically outside the base, be fully insulated from the base plate, and make a completely watertight fit with the base plate. For that reason, the arrangement looks a little complicated. Start by drilling a three quarter inch (18 mm) hole in the centre of the base plate. Construct and fit two insulating washers so that a half-inch stainless steel bolt will fit through the base plate while being securely insulated from it. The washers are made from Ultra-High Molecular Weight Polyethylene (plastic food-chopping boards are usually made from this material):



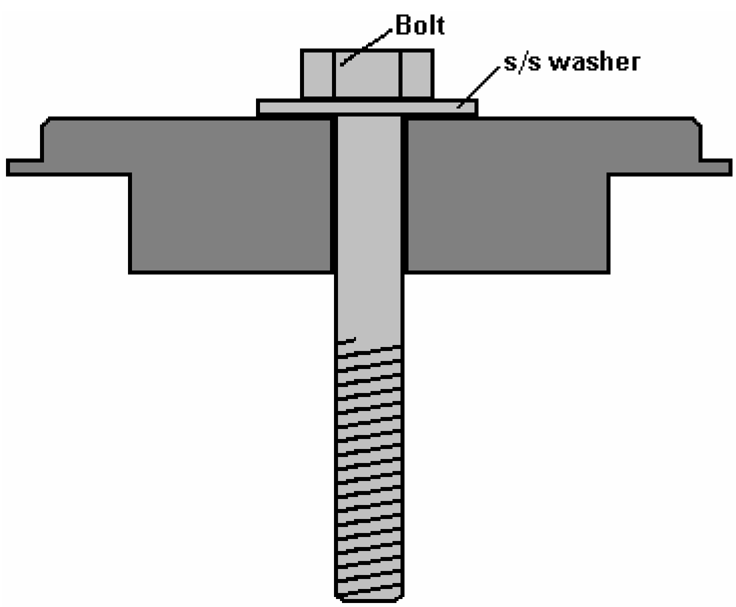
The washers which fit into the hole in the base plate need to be slightly less than half the thickness of the plate so that they do not actually touch when clamped tightly against the base plate, as shown in the lower part of the diagram. Cut another washer, using the full thickness of the plastic sheet. This will act as a spacer.

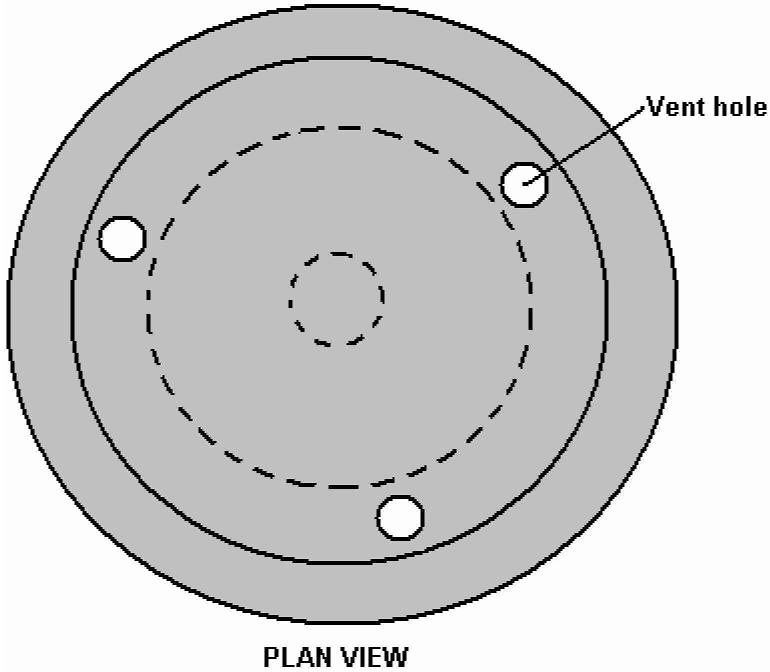
Next, the plinth for the central 2-inch diameter cylinder needs to be made. This is the only complicated component in the construction. It is possible to make this component yourself. The local university or technical college will often be willing to allow you to use their lathe and their staff will usually do the job for you or help you to do it yourself. Failing that, your local metal fabrication shop will certainly be able to do it for you. If all else fails and this equipment is just not available, then the 'workarounds' section below shows how to fabricate an alternative version which does not need a lathe.

A large piece of 316L stainless steel needs to be machined to produce the plinth shown below. The actual 2-inch diameter central cylinder needs to be a tight push-fit on the top of this component. To facilitate assembly, the central boss is given a slight chamfer which helps alignment when the tube is forced down on top of it. Peter Stevens recommends that tack welds (in stainless steel using a TIG welder) are used to connect the plinth to the outside of the cylinder. Three evenly-spaced vent holes are drilled in the plinth to allow the liquid inside the Cell circulate freely inside the central cylinder.

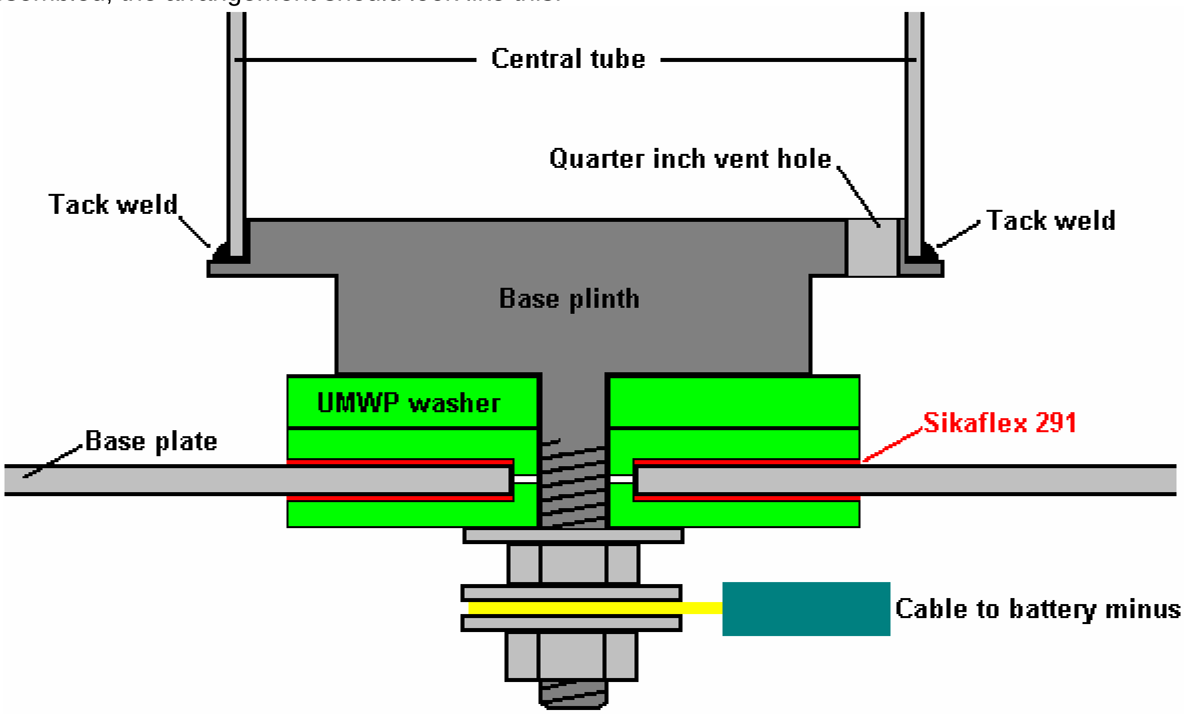


An alternative method of construction which does not call for such a large amount of machining is to machine the plinth to take a standard stainless steel bolt as shown here:



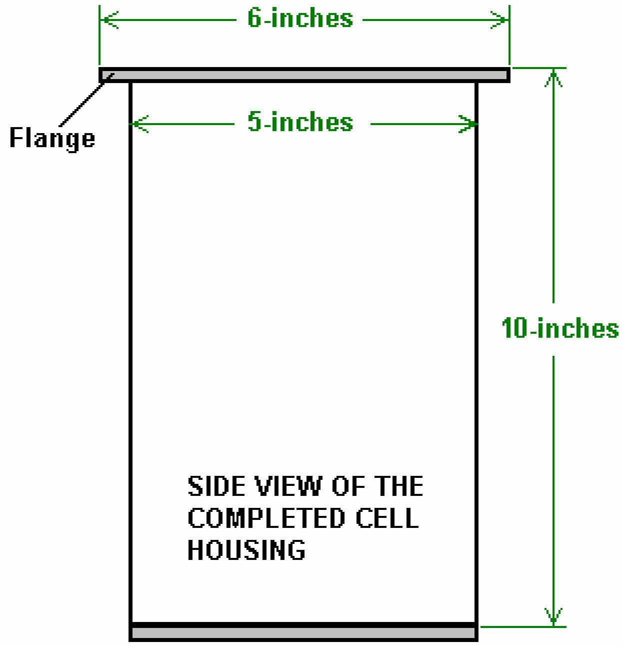


When assembled, the arrangement should look like this:



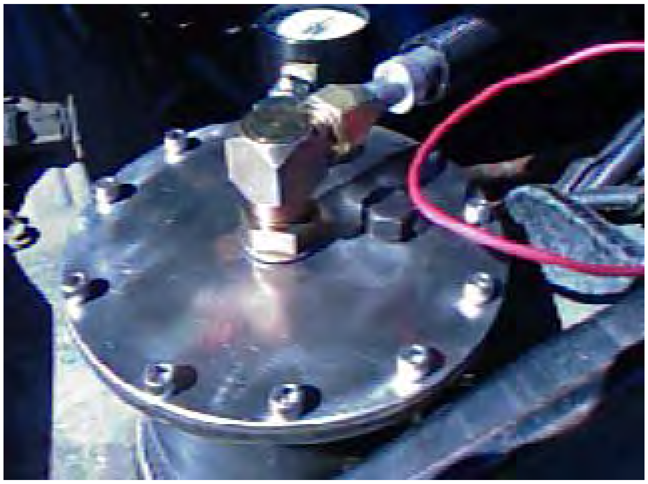
This arrangement looks more complicated than it really is. It is necessary to have a construction like this as we want to mount the innermost tube securely in a central vertical position, with the battery negative connected to the cylinder, by a connection which is fully insulated from the base plate and which forms a fully watertight seal with the base plate, and to raise the central cylinder about one inch (25 mm) above the base plate.

However, as the plastic washers would be affected by the heat when the base plate is joined to the outermost pipe, when all of the components shown have been prepared, they are taken apart so that the base plate can be fuse-welded to the outside tube. Unless you have the equipment for this, get your local steel fabrication workshop to do it for you. Be sure that you explain that it is not to be TIG welded, but fuse-welded and that the joint has to be fully watertight. At the same time, get them to fuse-weld a half-inch wide lip flush with the top edge of the tube. You cut this piece as a 6-inch (150 mm) circle with a 5-inch (125 mm) circular cut-out in the centre of it. When it is welded, it should look like this:



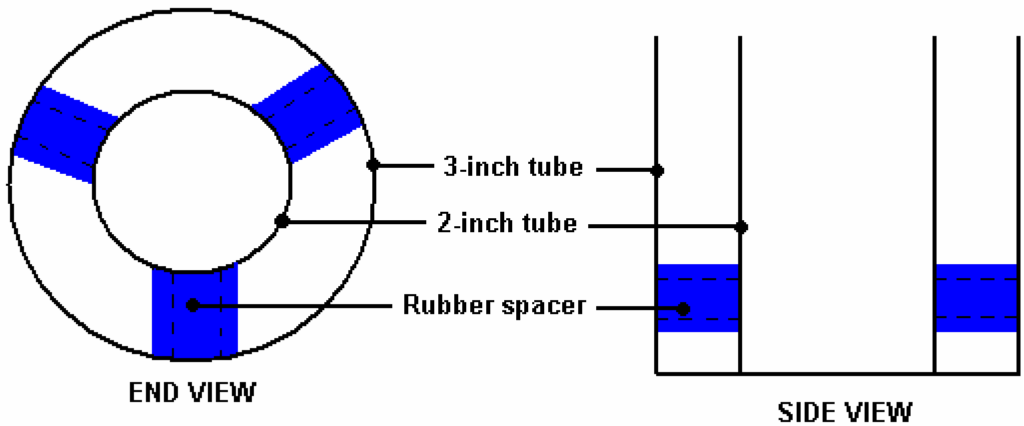
Cut a six-inch (150 mm) diameter lid out of 1/8 inch (3 mm) stainless steel. Cut a matching ring gasket of natural rubber (Buna-n material if natural rubber can't be obtained), place it on top of the flange with the lid on top of it and clamp the lid firmly down on the flange. Drill a hole to take a 1/4 inch (6 mm) stainless steel bolt, through the lid and the middle of the flange. Insert a bolt and tighten its nut to further clamp the lid in place. An alternative to this for the more experienced metalworker, is to drill a hole slightly smaller than the bolt, and when all holes have been drilled, remove the lid, enlarge the lid holes to allow free passage of the bolts, and cut a thread inside the flange holes which matches the thread on the bolts to be used. This gives a very neat, nut-free result, but it calls for a greater skill level and more tools.

If using nuts and bolts, drill a similar hole 180 degrees away and fasten a bolt through it. Repeat the process for the 90 degree and 270 degree points. This gives a lid which is held in place at its quarter points. You can now complete the job with either four more evenly-spaced bolts or eight more evenly-spaced bolts. The complete bolting for the twelve-bolt choice will look something like this when the cell is installed:



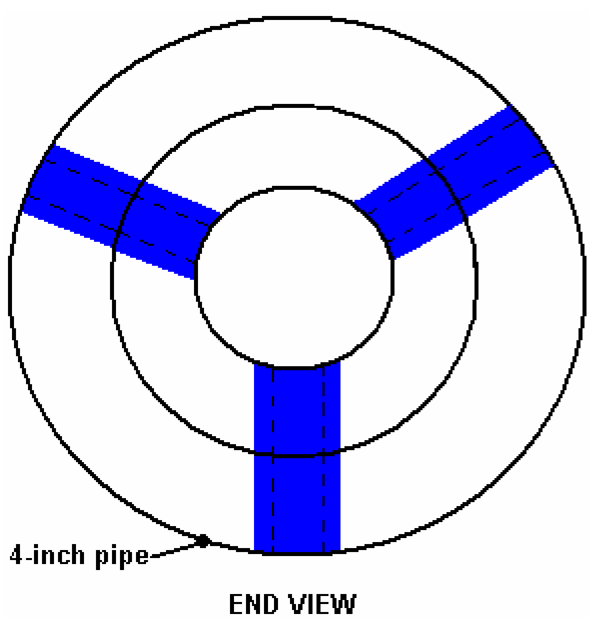
The lid can be finished off by drilling its centre to take the fitting for the aluminium pipe which will feed the output from the cell to the engine. This fitting, in common with every other fitting **must** be made of stainless steel. Video at http://youtu.be/-7075bVmDQo.

The next step is to assemble the neutral pipes. Cut them to 8-inch (200 mm) lengths. These pipes are held in place by the natural rubber insulators. This material comes in an o-ring strip which is like a hosepipe with a large wall-thickness. The gap between the pipes will be approximately half an inch (12 mm), so cut each piece of pipe to a length which makes it a very tight fit in that gap. Cut six spacers, locate the 3-inch diameter pipe exactly over the inner pipe and push three of them between the pipes, about a quarter of an inch from each end and evenly spaced 120 degrees apart around the circumference of the pipes. The hole through the centre of the insulating strip points towards the centre of the cell and the ends of the insulator pieces press against the cylinder walls. These pieces are **not** placed lengthwise:



Place similar insulators at the other end of the two-inch pipe, directly above the ones already in place. If you look down the length of the tubes, then only three of the six insulators should be seen if they are correctly aligned. The spacers will be more effective if the ends are given a thin layer of the Sikaflex 291 bedding compound before the ends get compressed against the cylinder walls.

Do the same for the four-inch pipe, pushing tightly squeezed natural rubber insulators strips between the three-inch and four-inch pipes. Place them directly outside the insulators between the two-inch and three-inch pipes so that when viewed from the end, it looks as if the rubber forms a single strip running through the middle pipe:



Spark off each of the cylinders in the inner assembly. This is done by connecting a 12V battery negative to the inside surface (only) at the bottom of the tube and with a wire from the battery positive, sparking the outside surface of the cylinder at the top of the tube. Give each four sparks in rapid succession.

If you are using a bolt rather than a machined spigot, insert the stainless steel bolt and washer through the bottom of the base to the central pipe. Wedge the bolt in place by inserting a piece of the dowel, or some similar material into the centre of the 2-inch pipe and tape it temporarily in place. Alternatively, force the innermost cylinder tightly over the machined plinth. Turn the inner pipe assembly upside down and place the full-depth UMWP plastic washer on the threaded shaft. Apply a thin layer of white Sikaflex 291 bonding compound to the face of one of the shaped UMWP washers and place it on the threaded shaft with the bonding compound facing upwards.

Carefully clean the surface of the base plate of the outer casing around the central hole, both inside and outside. Under no circumstances use sandpaper or wet-and-dry paper, here or anywhere else, as these abrade and score the surface of the steel and have a major negative effect on the operation of the Cell. Carefully lower the 5-inch outer casing on to the assembly so that the threaded shaft goes through the central hole and the shaped washer fits tightly into the hole in the base of the outer housing. Apply a thin layer of the bonding compound to the face of the second shaped washer, place it over the shaft of the bolt and press it firmly into place to completely seal the hole in the base plate. Add a stainless steel washer and bolt and tighten the bolt to lock the assembly together. If using a bolt, a long-reach box spanner may be needed inside the central pipe for tightening the locking bolt. If one is not available, use a longer bolt through the washers, screw a second nut up on to the shank of the bolt, file two flats on the end of the bolt, clamp them in a vice to hold the bolt securely and tighten the locking nut. When the spare nut is unscrewed, it pushes any damaged fragments of the bolt thread back into place.

Finish the assembly by adding three further rubber insulators between the top of the 4-inch tube and the outer 5-inch casing. Use a thin layer of Sikaflex 291 bonding compound on the cut faces of the insulators as this improves the insulation. Line the new insulators up with the insulators already in place and make them a tight fit. These extra insulators support the end of the tube assembly and reduce the stress on the plinth fitting at the base of the central tube when the unit is subjected to knocks and vibration when the vehicle is in motion.

The construction of the basic unit is now complete, with the exception of the lid fitting for the aluminium pipe which feeds the engine. The construction so far has been straightforward engineering with little complication, but the remaining steps in getting the Cell powering a vehicle are not conventional engineering. If you do not feel confident about this construction, then advice and help can be got from the experienced members at the Yahoo Group http://groups.yahoo.com/group/joecellfreeenergydevice/ or alternatively, the companion Group http://groups.yahoo.com/group/JoesCell2 both of which are very active.

Getting the Cell working

The Cell is not just the container and the inner tubes. A major active ingredient of the "Cell" is the liquid placed inside the container. To a casual glance, the liquid appears to be water and loosely speaking it is water. However, water is one of the least understood substances on the planet. It can have many different molecular configurations which give it widely different characteristics. For example, in one configuration, it will actually burn, but this "burning" is nothing like the burning experienced in an ordinary log fire. The water flame is not hot and it is quite possible to hold your hand just over the flame without feeling any heat from it.

We do not want to "burn" the liquid in the Cell. The "conditioned water", for want of a better description, is not consumed when a Cell powers an engine. Instead, the engine is powered by external energy flowing into it. Here, the Cell acts like a lens, concentrating the external energy and focusing it to flow along the aluminium pipe to the engine. This action is not unlike the way in which a magnifying glass gathers and concentrates the sun's energy into a small area to raise the temperature there. The "conditioned water" in the cell, along with the materials and shapes in the Cell, cause the gathering and concentration of this external energy and channel it into the engine.

At this point in time, nobody knows for sure, what the energy is. Earlier, I called it the Zero-Point Energy field, but I have no direct evidence for that, some people call this energy "orgone". Nobody knows exactly how this energy makes the engine run. Engines powered by this energy sound pretty much the same as when they are running on fossil fuels but they run a lot colder and it is usually necessary to advance the timing of the spark. These engines can tick over at a much lower rate than normal and they have much greater power than when running on fossil fuels. Bill Williams in America found that when he fitted a Joe Cell to his Ford pickup, the performance suddenly became like a Formula One racing car and very gentle use of the throttle was needed. He says:

"Over the summer, I used the truck to haul firewood for this winter's wood supply. I added 5 gallons of fuel to bring the fuel level to the half tank mark. I ran the truck with the cell which I installed a month earlier. Basically, I tried to forget about the cell being installed in the truck. The Ignition timing was set at about 25 degrees before TDC with no vacuum connect to the distributor. The fuel line was still connected so "shandy" mode was being used. The surprising thing is that the truck did not use any fuel during the two and a half months of driving in the woods. In fact, when I parked the truck at the end of the wooding season, I physically sounded the fuel tank (it is a 'behind the seat' tank). It was still showing the half full mark. I pulled the cell for the winter and have it sitting on the bench waiting for spring to arrive for it to be installed again. I don't even pretend to understand this technology, but I keep hoping that someone will come up with a viable explanation of how the cell works".

Anyway, how do we get "conditioned water"? It can be generated inside the Cell, but as the conditioning process usually generates an unwanted residue on top of the water and on the bottom of the Cell, there is an advantage to do the conditioning in a separate container. If water conditioning is done in the Cell, then when the residue is removed, the Cell does not have the correct amount of water and needs to be topped up. That has to be done with non-conditioned water which promptly puts the Cell back to square one. So, use a separate conditioning vat which contains considerably more water than the Cell needs. In the documentary video produced by Peter and Joe, the conditioning procedure is described in some detail.

Joe explains that he conditions the water by suspending an electrode array in the water and applying 12 volts DC to it. Using the water found local to Joe, the current is initially about 10 amps and if left overnight the current drops to anywhere between 2 amps and 4 amps. This indicates that his local water contains a large amount of dissolved material since completely pure water will carry almost no current when 12 volts DC is placed across it. It is almost impossible to get pure water as so many things dissolve in it. Raindrops falling through the atmosphere pass through various gasses and some of these dissolve in the droplets. If the pollution in the atmosphere is particularly bad, then the rain can become acidic and this "acid rain" can rot the trees and vegetation on which it falls. Water on and in the ground, picks up chemical elements from nearly everything with which it comes in contact, so water, any water, needs treatment to reach its "conditioned" state.

Joe's conditioning electrode array is made up from truncated stainless steel cones, positioned vertically above one another. Joe describes it as being made up from seven cones (not strictly true) with the central cone connected to the battery positive and the top and bottom cones connected to the battery negative. That leaves two unconnected cones positioned between the positive and each of the two outer negative cones. His array looks like this:

What Joe does not mention, but what can be seen in the video, is that there is an eighth cone cut-down and tack-welded in an inverted position underneath the bottom cone:

The inverted cone section appears to project underneath the rim of the bottom cone by an amount of about one inch (25 mm), or perhaps slightly less:

The electrical straps connecting to the cones are insulated to prevent contact with either the other cones or the inside of the metal drum which Joe uses to hold the water being 'conditioned'. He says that if this array is suspended in a tank of water (his happens to be a vertical metal cylinder - a significant shape) and provided with 12 volt DC electrical power for a few minutes, then the water becomes 'charged' as he expresses it. Although the water is supposedly clean, Joe gets gas bubbles coming off the surface of the water. These will explode if lit, so it is very important that this process is carried out in the open air and there is no possibility of the gas ponding on a ceiling.

Joe states that the cleaner the water the better the result. Also, the longer the array is immersed and powered up, the better the result. It is likely that the shape of his powered array is causing the energy field to flow through his water in a concentrated fashion. The water absorbs this energy, and the effect increases with the length of time it is being conditioned, until a maximum level is reached. The objective is to achieve unusually pure water in one of its least usual molecular configurations. The overall procedure is as follows:

1. A vertical stainless steel cylinder, with an open top, is obtained and filled with water. Joe uses a steel beer keg but he selects the keg very carefully indeed from a very large choice of kegs, and then cuts the top off it. There is no need to have such a large container, or cones as large as the ones which Joe uses.

2. The array of cones is suspended vertically in the middle of the water and 12 volts applied to it. The Cell is most definitely **not** any form of electrolyser and should never be confused with one. An electrolyser operates by breaking water down into hydrogen and oxygen gasses which are then used for combustion inside an engine, and it requires rapid and continuous replacement of the water which gets used up as the engine runs. The Joe Cell never operates in that way, instead it channels outside energy through to the engine and the water inside a Joe Cell is never used up by the engine running. However, in this conditioning process, some hydrogen and oxygen are produced as a side effect of the purification process. Consequently, the conditioning should be carried on out of doors to prevent any hydrogen ponding on the ceiling and forming an explosive mixture there. The more impure the water, the higher the current which flows and the greater the unwanted electrolysis of some of the water.

3. The procedure for applying the 12V supply to the conditioner electrodes is unusual. First, connect the negative supply, and **only** the negative supply. After 2 to 20 minutes, make the positive connection for just 2 or 3 minutes. A residue of impurities will form from this process. Some, being lighter than water, rise to the surface and form a layer there. Some being heavier than water, sink to the bottom. The surface residue is removed and the process repeated until a surface layer no longer forms. This may take 24 hours. The clean water from the middle section of the container is used to fill the Cell.

Many people are of the opinion that a current of about one amp should flow through the conditioning vat in the early stages of the process. If the current is much less than this, then it may take a considerable length of time to get the processing completed - possibly one or two weeks if the water needs a good deal of work done on it. The process can be speeded up by using higher voltage, 24 volts or 36 volts by adding extra batteries or using an electronics bench power supply. The water can also be pre-processed by placing it in a glass jar in an orgone accumulator for a day or two, but that process is outside the scope of this description.

As the impurities get ejected from the water by this process, the electrolysis element gets stifled progressively and as a consequence, the current drops. As completely pure, molecularly-reconfigured water is the goal, no additives of any kind are normally added to the water used to fill the Cell. However, if citric acid is used to clean the cylinders before assembly, there is no harm in allowing them to be assembled in the Cell with traces of the acid on them.

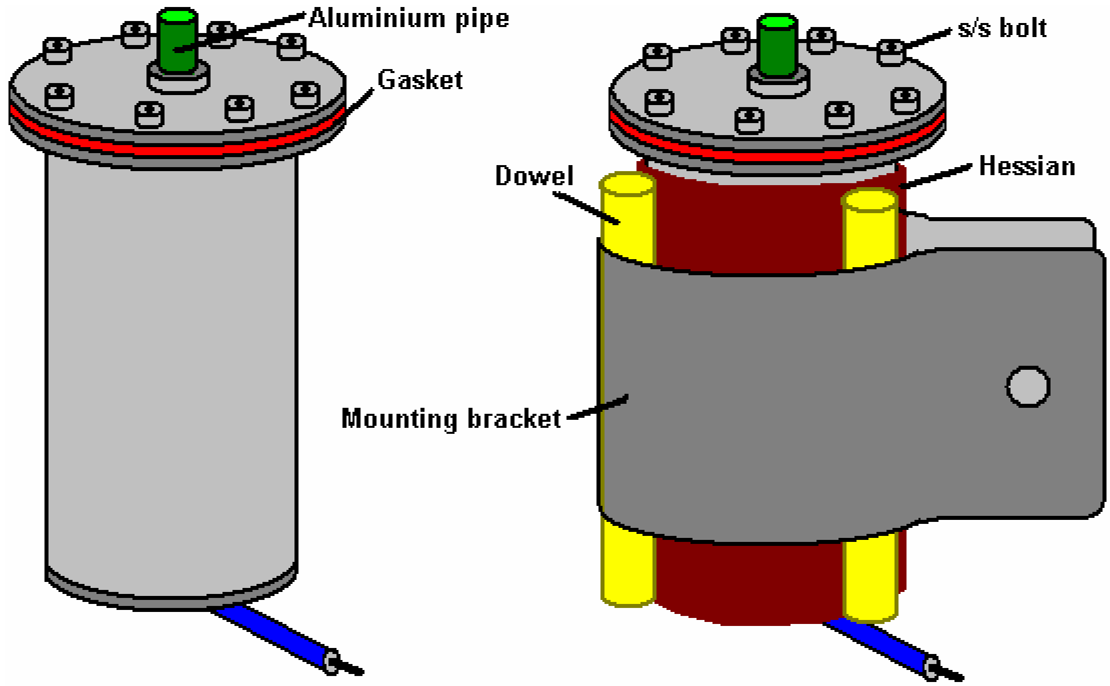
The Cell is filled to just under the level of the top of the inside tube array. This is very important as we need to have separate cylinders of water divided by the steel cylinders. If the water level is over the top of the cylinders, then the whole charging arrangement is destroyed. Further water conditioning inside the Cell may be needed as the cylinders also need to be conditioned. This is done with an easily removable cover replacing the lid of the Cell. The Cell should be kept covered while it undergoes its further conditioning and the lid only lifted briefly to examine the bubbles (unless a glass lid is used). The positive connection to the cell is made to the outside of the 5-inch cylinder and at the top of the cylinder. A length of copper wire tightened around the top of the cylinder is a convenient way to make the connection to the outside (and only the outside) of the cell. Place the cell on a wooden workbench or failing that, on a sheet of high-density plastic such as a chopping board. Connect the negative wire and wait two minutes before connecting the positive wire.

The Cell is ready for use, when it continues to produce surface bubbles for hours after the 12 volt DC power supply is removed from the Cell. The bubbles produced are not part of the energy-focusing process and are themselves unimportant, but they act as an indicator of the outside energy flowing through the Cell. When the Cell is running correctly, the flow of outside energy is sufficient to keep the water in its conditioned state without the need for any external electrical supply. It also maintains its own energy flow through the Cell. There is no point in proceeding any further until the Cell has reached its self-sustaining condition. If it is not happening for you, check out the information in the "workarounds" section below and if that does not get your Cell operational, ask for advice and assistance through the Yahoo groups mentioned above.

Some people concern themselves with the pH of the water. The pH really is not important as the cell will take up the correct pH as conditioning proceeds. A cell of the type described in this document, will have water which is very slightly acid with a pH of about 6.5, but it is not important to know this or to measure it. Do not put litmus paper in the cell water as that will contaminate the cell. Just rely on the action of the bubbles to determine how the cell conditioning is progressing.

Installing the Cell in the Vehicle

When the Cell has reached its self-sustaining condition, it can be mounted in the vehicle. The first step is to insulate the Cell from the engine components. This insulation is not just electrical insulation which is easily accomplished, but it is a case of introducing sufficient separation between the Cell and the engine to stop the concentrated (invisible) energy leaking away instead of being fed to the engine through the aluminium tube. So, wrap the Cell walls in three layers of double-laminated hessian sacking ("burlap"), pulling it tightly around the 5-inch diameter outer tube. Tie (a minimum of) three wooden dowels along the length of the Cell and bend the mounting bracket around the dowels. The purpose of this is solely to ensure that there is at least a three quarter inch air gap between the walls of the Cell and everything else, including the mounting bracket:



The mounting details depend on the layout of the engine compartment. The really essential requirement is that the aluminium pipe running to the engine must be kept at least 4 inches (100 mm) away from the engine electrics, radiator, water hoses and air-conditioning components.

The last four inches or so, of the tube going to the engine cannot be aluminium as that would cause an electrical short-circuit between the (occasional) positive outer connection to the outside of the Cell and the engine itself which is connected to the battery negative. To avoid this, the final section of the pipe is made using a short length of clear plastic piping, forming a tight push-fit on the outside of the aluminium tube and on the connection to the intake of the engine's carburettor. There should be a 3/4 inch (18 mm) gap between the end of the aluminium pipe and the nearest metal part of the carburettor. If it is just not possible to get an airtight fit on the intake to the carburettor and a hosepipe clamp has to be used, be sure that the fitting is non-magnetic stainless steel. If such a fitting cannot be found, then improvise one yourself, using only 316L grade stainless steel.

In the installation shown above, you will notice that the aluminium tube has been run well clear of the engine components. A vacuum gauge has been added but this is not necessary. For the early stages of installation, the aluminium pipe runs to the vacuum port of the carburettor but stops about 3/4 inch (20 mm) short of it, inside the plastic tubing. This method of connection is advisable for the initial setting up of the vehicle modification. At a later date, when the engine has been running with the Cell and is attuned to it, the Cell operates better if the pipe is connected to one of the bolt heads on the engine block, again using the plastic tube and a gap between the aluminium tube and the bolt head. Some people feel that a safety pressure -release valve with a safe venting arrangement should be used if the pipe feeding the engine, terminates on a bolt head. If it is still available, the http://www.youtube.com/watch?v=DexBoYfDoNw video shows Bill Williams operating his Joe Cell.

Getting the Vehicle Running and Driving Techniques

The Joe Cell is not a 'turnkey' system. In other words, just building a Cell and installing it in the vehicle is not nearly enough to get the vehicle running without the use of a fossil fuel. Some adjustments need to be made to the timing and the engine has to become 'acclimatised' to the energy.

Mount the Cell in the engine compartment and connect the Cell to the battery negative. After two or three minutes, take a lead from the battery plus and touch it briefly to the lid of the Cell. This should produce a spark. Repeat this until four sparks have been produced. This 'flashing' process aligns the Cell electrically and directs the energy to flow in the direction of the metal which has been 'flashed'.

The next procedure is dangerous and should only be carried out with the greatest of care. The engine crankshaft also needs to be 'flashed' four times. This is carried out with the engine running and so can be hazardous - take extreme care not to get caught up in the moving parts. Connect the lead from the battery positive to the shaft of a long-handled screwdriver and keep your hands well clear. The procedure is to get a helper to start the engine, then arc the current to the exposed pulley on the crankshaft (where timing adjustments are made). There should be a total of four sparks to the crankshaft in a period of about one second.

Next, for three or four seconds, flash along the length of the aluminium pipe. This encourages the energy to flow along the pipe, reinforcing the natural attraction between aluminium and this energy. Remove the wire coming from the battery positive as the Cell operates with only the negative side of the battery connected (remember that this is NOT electrolysis and the cell just directs the unseen energy into the engine).

Mark the present position of the distributor cap. Loosen the bolt holding it in place and rotate it to advance the timing by 10 degrees. Disconnect the fuel to the carburettor (do not use an electrically operated valve for this). The engine will continue to run on the fuel left in the carburettor and the engine will start to cough. Turn the distributor cap a further 20 degrees (that is now a total of 30 degrees from its original position) and have your helper use the starter motor to assist the engine to keep turning.

Rotate the distributor cap to further advance the spark until the engine starts to run smoothly. There will be a gasping sound and the engine will slow nearly to a stop, then it will pick up again and then slow down. The action is wave-like, something like breathing. Fine-tune the timing to get the smoothest running and then fasten the distributor cap in place. Do not touch the Cell, but leave it undisturbed. You are now ready to drive away in a vehicle which is not using any fossil fuel.

The procedure described here may not end successfully as just described. Some cars are more difficult to get operating on a Cell than others. Experience helps enormously when getting the vehicle started for the first time. Joe mentions in the video that it has taken him a couple of days of sustained effort to get a particular car going for the first time, which is quite something considering that he has years of experience and has got many vehicles and Cells operational.

When the vehicle has been run and is operating correctly on the Cell, it is time to make the final adjustment to the set-up. For this, the pipe connection to the vacuum inlet of the carburettor is moved from there to terminate on a bolt head on the engine block. The Cell works best when completely sealed off from the air in the engine compartment and as no gas is actually being moved from the Cell to the engine, there is no need for any kind of connection to the carburettor. If the engine is a V-type, then the bolt head chosen should be one in the valley of the V, otherwise, any convenient bolt head on the head of the engine block will be satisfactory. Don't forget that the connecting pipe must still be kept well clear of the engine's electrical leads and other fittings as described earlier. Also, the 3/4 inch (18 mm) gap between the end of the aluminium pipe and the top of the bolt head must be maintained inside the clear plastic tube, and the pipe fitting should remain airtight. A slight timing adjustment may be necessary with the new connection in order to get the very best running.

The energy which powers the engine has a tendency to run along magnetic fields. Driving under high voltage overhead power lines can position the vehicle in an area where the energy level is not sufficient to maintain the energy flow through the Cell. If the energy flow through the Cell is disrupted, then it is likely to stop functioning. If this were to happen, then the Cell would have to be set up again in the same way as for a newly built Cell which has never been used before. This can be avoided by attaching an AA ("penlight") dry cell battery across the Cell with the battery plus going to the lid of the Cell. A battery of this type has such a high internal resistance and so little current capacity that no significant electrolysis will take place on the very pure conditioned water in the Cell. But the battery will have the effect of maintaining the integrity of the Cell if it is temporarily moved away from its source of power.

Suppliers

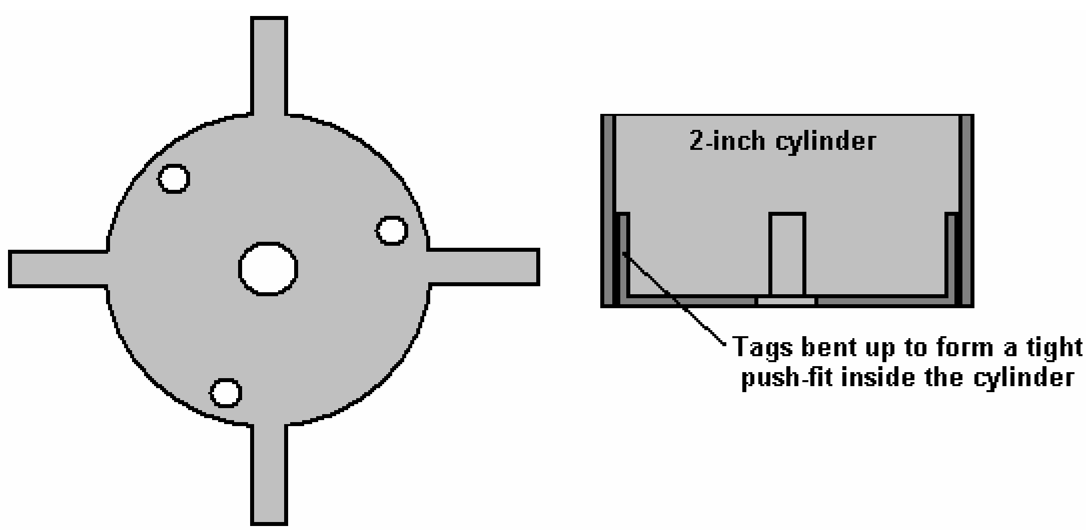
Sheets of nitrile rubber NB70 ("Buna-n") : http://www.holbourne.co.uk
Nylon rod: http://www.holbourne.co.uk
Stainless steel tubing: http://www.stabarn.co.uk
A4 Bolts (316 S31 stainless): http://www.a2a4.co.uk

Workarounds

If it is not possible to get pipes of the desired diameters, then they can be made up by rolling stainless steel sheet and using a TIG welder with completely inert gas, to tack weld at each end and in the middle of each cylinder. Don't weld along the full length of the join unless it is the 5-inch outer casing.

If it is found to be particularly difficult to make the four circular cuts in 1/8 inch (3 mm) steel using hand tools, then I would suggest using a plasma cutter. Make a template to guide the cutting head and clamp it securely in place. You can hire the cutter and compressor quite cheaply as you will only need them for a very short time. If they are not given to you as a pair and you have to select each from a range, take the smallest cutter and a twin-cylinder compressor rated at nearly double the input quoted for the cutter. This is because the cutter is rated by the volume of compressed air, and the compressors are rated by the volume of their uncompressed air intake as that sounds more impressive.

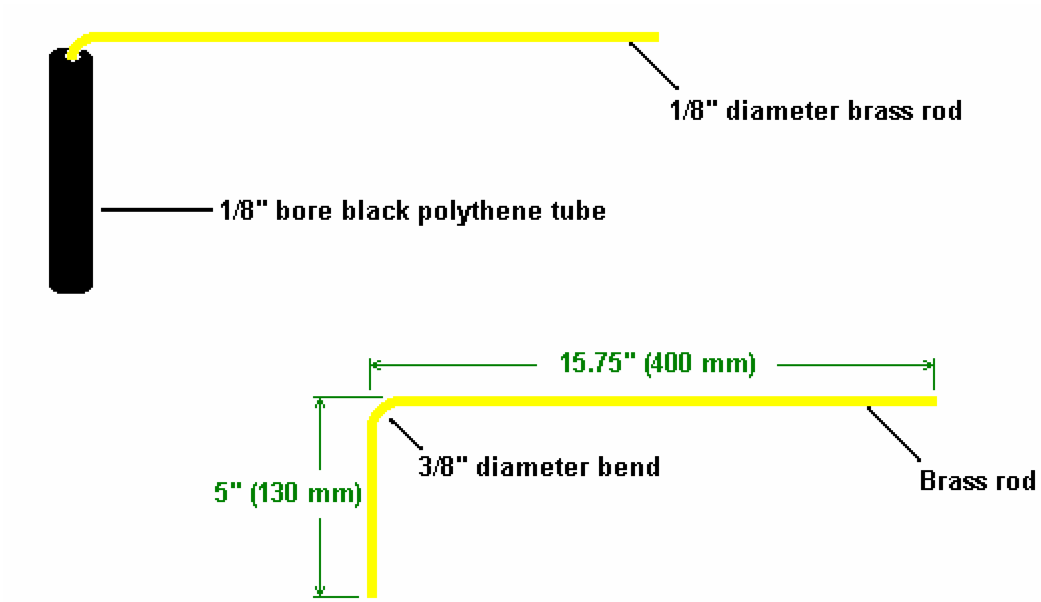
If no lathe is available for machining the base plinth for the central cylinder, then take a piece of 16-gauge stainless steel sheet and cut the plinth out of it as shown below. Bend the projecting tags upwards by holding each tag in the end of the jaws of a vise and tapping the body section square, with a flat-faced hammer and if you consider it necessary, tack-weld the top of the tags to the outside of the central cylinder to give rigidity to the mounting. Extreme heat such as is generated by welding or cutting tends to create permanent magnetism in any ferrous metal being heated, so avoid high temperature operations such as welding wherever possible. If a tight push-fit can be obtained with the base of the 2-inch cylinder, then I suggest that the optional spot welds are omitted.



If tack-welded cylinders have to be used, then it is usually best to line all of the seams up as the seam area does not work as well as the remainder of the tube, so if the seams are all aligned, then there is only one small line in the Cell which is not operating at its optimum value.

Cylinders are best aligned in the same direction. This sounds odd as they are physically symmetrical. However, these cylinders will be used to channel an energy field and each cylinder has a direction along which the energy flows best. To find this, stand all of the tubes upright in a tight group on a table. Leave them for a minute and then place your hand on top of the whole set. If any tube feels hotter than the others, then it is out of energy alignment with the rest and should be inverted. Repeat this test until no tube feels hotter than the rest.

An alternative way to do this test is to use a pair of L-rods. These can be made from two short lengths of rigid black polythene tubing often found in garden centres for use in garden irrigation. This tubing has 1/8 inch internal diameter and so takes 1/8" brass welding rod very nicely. The welding rods should be bent with a radius as shown here:



The curved bend in the brass welding rod helps to prevent the rod fouling the top of the plastic tube handle and it allows free rotation of the brass rod. It is essential that the rod can move completely freely in the handle. If two of these are made up, they can be used to check the cylinders before they are assembled for insertion into the Cell. Place a tube standing vertically on a table well away from all other objects (especially magnetic and electrical items). Hold an L-rod handle in each hand so that the rods are parallel in front of you. The rods must be exactly horizontal so as to avoid any tendency for them to turn under the influence of gravity. Approach the cylinder. The rods should either move towards each other or away from each other as the cylinder is approached.

Repeat this procedure at least three times for each cylinder so as to be sure that a reliable result is being obtained. Invert any cylinder if necessary, so that every cylinder causes the rods to move in the same direction. Then assemble the Cell, maintaining that alignment of the cylinders during the assembly.

If you are having difficulty in getting the Cell operational, then try striking and sparking the cylinders again. This is done as follows:

1. Take a 12V lead-acid battery and position it so that it's negative terminal is pointing towards East and it's positive terminal is pointing towards West (i.e. at right angles to the Earth's magnetic field).
2. Attach a lead from the battery negative to the outside of the base of the tube.
3. Lay the tube on a table and strike it with a hammer along its length. If the tube has a seam, then strike the tube along the length of the seam.
4. Connect a lead to the positive terminal of the battery and spark the inside of the top of the tube. It is essential to spark each tube if they have been polished. It is better not to polish any of the tubes.
5. Repeat this procedure for each tube.

If you consider it necessary to clean the cylinders, then, considering the lengths you went to remove all of the things dissolved in the water, be sure to avoid using any kind of chemical or solvent. You can electro-clean them by using the following procedure:

Starting with the largest cylinder;

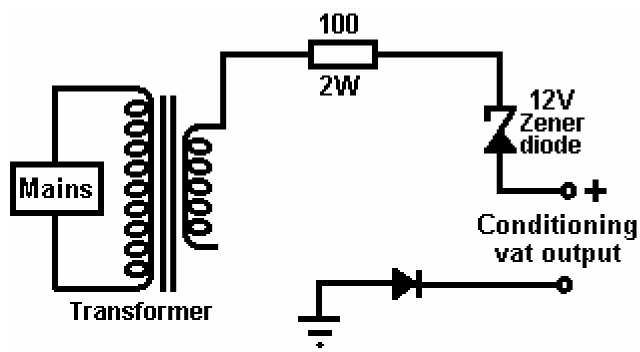
1. Put the battery positive on the inside of the top of the cylinder, and the negative on the outside at the bottom, and leave them in place for one minute.

2. Put the negative on the inside of the top of the cylinder, and the positive on the outside at the bottom, and leave them in place for one minute.

3. Repeat step 1: Put the battery positive on the inside of the top of the cylinder, and the negative on the outside at the bottom, and leave them in place for one minute.

Do this for all cylinders, working inwards.

It has been suggested that an improved method of conditioning water to fill the Cell can be achieved if pulsed DC is used instead of straight DC from a battery. This has not been proven but there is a reasonable amount of information to suggest that this is likely. The following, most unusual circuit, has been suggested, but it must be stressed that it is untried and anybody who is unfamiliar with working with electronics should not attempt to construct or use this circuit without the assistance of a person who is experienced in building and using mains equipment.



This is a most unusual circuit. A 12V step-down mains transformer provides 12V AC which is taken through a limiting resistor and a zener diode which would not normally be connected as shown. The really odd thing is that the circuit which contains the secondary of the transformer appears not to be connected. The expected output from this very odd circuit is pulsing DC of odd waveform, all of which is positive relative to the ground connection, which is a literal, physical connection to an earthing rod driven into the ground.

Notes:

Engines running while powered by a Joe Cell act in a somewhat different manner. They can idle at a very low number of revs per minute, the power available on acceleration is much greater than normal and they appear to be able to rev very much higher than ever before without any difficulty or harm.

The type of Cell described in this document was built by Bill Williams in the USA with the help and assistance of Peter Stevens of Australia. Bill describes his first driving experience with his 1975 F 250, 360 cu. in. (5.9 litre) Ford pickup:

Well, all I can say is "who needs an Indy car when you can drive an old FORD" – WOW!!!! The first five miles after leaving home were wild. I had to be extremely careful on how I pressed the accelerator. I gingerly crept up to 45 mph and that was with moving the pedal maybe half and inch. The throttle response was very crisp or touchy. With about a 1/8" of movement the next thing I new I was close to 80 mph. If I lifted off ever so slightly on the throttle, it felt like I was putting the brakes on and the speed would drop down to 30 mph or so. "Very erratic". If I barely even touched or bumped the pedal it felt like I had pushed a nitrous oxide booster button. WOW !!!

As stated earlier, the first 5 miles were wild and things started to change. The engine started to buck or surge with very large rpm changes and literally threw me against my seat belt. It got so bad I just took my foot completely off the pedal and rode the brakes to stop the truck. The truck left skid marks on the pavement every time the engine surged in rpm. Well anyway, I manage to get it stopped and shut it off with the ignition key - thank GOD !

I retarded the timing, turned the gasoline back on, crossed my fingers and hit the ignition key, and the engine took right off, revving to maybe 4,000 rpm and then gradually decreased to 700 rpm. I took a deep breath and put it into drive and the truck responded close to normal again. I made it into work a little late, but late is better than never the way I see it. After working during the day at the job and thinking what I could do to stop this erratic rpm oscillation, I decided to disable the cell and drive home on gas. WOW !!!

Peter Stevens states that the main reason for the erratic behaviour of the Cell was due to outside air leaking into the Cell, and he stresses that Cells need to be completely airtight. It is also clear that the timing was not set in the correct position. All properly built Cells give enhanced engine power.

Water Conditioning:

Note: With the Cell design shown later, no water conditioning is needed. Please be aware that water quality and purity varies enormously from place to place. One experienced cell builder says: I use water taken from the start of rivers. Further down the river, the water will have encountered influences which are not helpful. My favourite water catchment area well is outside Melbourne, Australia, where there are no roads, power lines, dams, pipes or any man made intrusions, the water flows how and where it wants to in natural, twisty downhill paths it has created, the whole area is green all year round and you can feel the vitality and Nature at work.

This water has a pH of 6.5. That means it is slightly acidic, and perfect for Joe Cells. I bring this water home making sure that I protect it from excessive sloshing and the heat of the sunlight whilst in the car. At home, I store it in 20 litre Pyrex bottles. Do not store it in plastic containers even if the container is marked "suitable for water". Earthenware or wood containers would also be very suitable.

I make an electrolyte solution by dissolving 500 grams of food-grade phosphoric acid and 100 grams of sodium perborate, in three litres of de-ionised water or distilled water. Just a few drops of this solution will provide a current of 1 amp at 12 volts in the conditioning vat. An alternative is to use a 90% acetic acid solution which has no stabiliser in it.

When conditioning the water in the cell, you will need a lid, or some way of sealing of the cell from air. A lid loosely sitting on top of your test jar is sufficient. The seeding and breeding process is hampered by having too great an area of the top of the cell being exposed to air. All lids are not the same as regards to being a obstruction to orgone. If the lid does not seem to be working, place a layer of aluminium foil underneath the lid and use the foil and lid as one unit.

The aim is to modify the conductivity of the water by the addition of acid, so as to get a suitable current flow. If we used de-ionised water with a pH of 7.0, we would have a very low current flow for our electrolysis, and would have to add something to increase the conductivity of the water if we wanted observable results in a short period of time. As we lower the pH, the current flow and electrolysis process will increase together with a heat increase.

We are trying to achieve electrolysis action with the minimum heat generation. As the propagation of orgone is reasonably slow, there is not much to be achieved with excessive current. Slow and steady does it. For the patient experimenter or one that is using neat water, i.e. water without electrolyte, excellent results are achieved with currents as low as 50 milliamps.

The procedure is:

1. Place your cell on a wooden work bench or on a sheet of plastic type material or, as a last resort, on a newspaper. We are trying to insulate the cell from metal paths that may impede the seeding process. Keep the cell well away from electrical sources such as a television set, refrigerator, electric cooker, etc.

2. With a multimeter, measure the resistance between the innermost and the outermost cylinders of your cell. It should be in the high Megohm range. If not, the insulators are conductive or there is a short-circuit. Check for a short-circuit and if there is none, remove the insulators and reassemble the set, checking the resistance between the innermost and outermost cylinders as each cylinder is added. The resistance between every pair of cylinders should be very high.

3. When all is okay in the above step, fill the cell using a funnel containing a paper coffee filter. Fill it only to a level just under the top of the cylinders and no more. The effect that we want to create is a set of water cells separated by metal cylinders. These are your alternate organic and inorganic chambers. Of course, the submerged section of you chambers are flooded, but with this simple cell, the top will be doing all the work. This is why the cylinders should be completely horizontal and true at the top, otherwise the meniscus formed by the water would not work and the water would flow from compartment to compartment. This level is only critical during the seeding process,

as we require maximum orgone capture to seed the cell. Naturally, with a charged cell, the water is sloshing all over the place whilst you are driving the car.

4. Turn on the power supply, and if it is adjustable, set it to 12 volts. Connect the negative end of your power source to one end of your meter that is set up to read a minimum of 2 amps and connect the other end of the meter to the bottom of the central cylinder. Wait for two minutes and then connect the positive end of your power source to the top of the outer cylinder. What you have done is set up the meter to read any current flow into your cell from the power source.

   At this stage, if your water is close to a pH of 7, as previously discussed, the current flow will be zero, or in the low milliamp region. If the current flow is amps, then you are doing something wrong! It is impossible to pass a huge current through ordinary pure water when using 12 volts. Think about it. To draw even 1 amp at 12 volts, the resistance of the water would have to be 12 ohms! No way! You are doing something wrong. Correct the problem and then move on.

5. Presuming that the current is only milliamps, you now want to introduce electrolyte to increase the current flow through the water. The aim is to get a current flow of about one amp. To do this, drip a small amount of your chosen electrolyte into the cell water whilst stirring and watching the current measurement. Use a glass, Perspex or wooden dowel rod as the stirrer - do not use your handy paint-stirring screw driver! Throw away the stirrer when finished as it will have absorbed some of the cell contents. Do plenty of gentle stirring of the water as you add the electrolyte, otherwise you will add too much electrolyte. Stop adding electrolyte when the meter indicates 1 amp. Your water level may rise as a consequence of the addition of electrolyte. Remove some water from your cell. I use a pipette, so as not to disturb the cell. Remove enough water to again just expose the top of the cylinders. At this stage, disconnect your meter and power source and have a bit of a clean up as the next stages are guided by observation.

The charging process is separated into three distinct stages which are called Stages 1, 2 and 3. These stages have both some obvious differences and some subtle ones. For the rest of the charging process, you will be only connecting your power source to the cell for a maximum of 5 minutes at a time. As orgone lags electricity by about 30 seconds, you will know the state of the cell in less than a minute. Do not be tempted to leave the power connected to the cell for long periods! Yes, I know that you are in a hurry and more is better, but in this case you only generate heat, steam, waste power and overheat the cell. You can pick the failures by seeing their cells running non-stop for days with 20 or more amps turning the water to steam, etching the cylinders and ending up with a barrel full of scum. What else would you expect? After all, electrolysis is time and current related. If you have had the misfortune of having your cell left on for a long period with high current, you have probably destroyed your cylinders. You cannot retrieve the situation so throw the cell away and start again. I bet you don't do it next time!

Danger: Do **not** charge any cell that is totally sealed! The cell will explode, with all the resulting consequences. An airtight seal **is not required !** At no stage do I prescribe any form of airtight container.

Stage 1: This stage is plain old electrolysis. Due to passing direct current through a liquid which contains ions, chemical changes will occur. In our case, you will see small bubbles and a cloud of activity that is greater nearest the outside of the innermost negative cylinder. The important observation points are that the activity is greatest nearest the central cylinder and gets progressively less as we move outward via the different chambers formed by the rest of the cylinders. Also, within a short period of turning the power off, all activity stops, the water becomes clear and the bubbles disappear.

Every fool and his dog can reach Stage 1. The secret for progressing further is to restrain your impatience and not increasing the electrolyte concentration to raise the current (and/or leaving the cell on for days on end). Be patient, leave the cell on for no longer than 5 minutes, turn the power source off, remove the leads to the cell, and put the top on the test cell, or partially block off the exit of the car cell. It does not have to be airtight! Go and do something else. It is like waiting for a tree to grow from the seed. Do this on a daily basis for days, or a week, or longer, until you get to Stage 2. You will find that the more "alive" the water is , the quicker is the seeding of the cell. I have found that the storage, age, and source of the water all affect the seeding speed. I have also found that by changing the structure of the water by various means e.g. vortexing, shaking, filtering, etc., you can greatly enhance the water quality to make it more "alive".

Stage 2: You will now notice on your initial powering up of the cell, that the bubbles are getting larger and the white cloud of tiny bubbles in the water are much smaller or more transparent. Also in Stage 1, you had the action occurring mainly near the central cylinder. Now the bubbles form in a regular fashion irrespective of their location in the cell. More importantly, on turning the power off from the cell, the bubbles do not go away immediately but stay there for minutes rather than seconds as in Stage 1. Also, the top of the water assumes a glazed look and the meniscus is higher due to a change in the surface tension of the water. At this stage you may have some brownish material amongst your bubbles. Don't panic - it is only the impurities being removed from the cell. I find that if I wipe the top surface of the water with a paper towel, the bubbles and the deposit will adhere to the paper and can be removed easily. Top up the cell with water from your charging vat, if required, after the cleaning, so that again, the top edges of the cylinders are just showing. No more electrolyte is added! In cleaning the top of the cell as described, it has been observed that some people react unfavourably with the cell. If so, keep that person away, or if it is you, try changing your hand i.e. use your right hand instead of your left or vice versa. If the presence of your hand seems to collapse the surface bubbles, I would suggest you get a friend to do the work for you.

Summary of Stage 2: The result is very similar to Stage 1, but now we have a more even bubble distribution and an increase of surface tension and a longer presence of the bubbles when the power is turned off. There will be no scum in the bottom of the cell and the water will be crystal clear. At this stage the orgone has seeded the cell, but as yet, is not “breeding”, that is, the orgone concentration is not yet great enough to attract additional orgone flow to itself. With the right cell, water and operator, it is possible to go straight to Stage 2 on the first turn on of a new cell.

Stage 3: Not many people get to this stage, or what is worse, get here incorrectly. If you get here following the above steps, your water is still crystal clear with no deposits in the sump. If you get here by brute force, you will have stripped appreciable amounts of material from the cylinders and this material will now be deposited on the insulators and suspended in the water as tiny particles which never settle out, and finally, the material will form a deposit at the bottom of the cell. The low resistance insulators and the metallic particles in the water will create a cell which leaks orgone and consequently it will cause endless mysterious car stoppages or refusals of the car to start.

Right, the miracle of Nature is now breeding in your cell. Upon turning your power on to the cell, within 30 seconds copious beautiful white bubbles will rise from all the surface area of the cell. Before these bubbles cover the water surface, you will notice a slowly rotating and pulsing front in all cylinders, that is synchronised and has a regular rhythm of about 2 pulses per second and a clockwise rotation speed of about 1 revolution every 2 seconds. These effects are very hard to observe for a first time viewer who does not know what to look for. I find it easier to watch these effects with the aid of a fluorescent light, as the 100 cycles per second pulsations of the light "strobe" the water surface and help the observation.

The bubbles may overflow the container and show great surface tension. One of the definite proofs that the cell is breeding is that, on turning the power source off and coming back the next day, most of the bubbles will still be on top of the water as opposed to Stage 1 or Stage 2 where they disappear in minutes. There is no way that you can mistake this stage. The bubbles are larger and pure white, the surface tension is greater, the bubbles are pulsating and most importantly the surface tension remains days after the power has been removed.

I do not recommend any additional tests or measurements. But for those who are incapable of leaving things be, they may measure the voltage across the cell after it has been left standing with the power off for at least 24 hours. A Stage 3 cell will have a residual voltage, or more correctly, a self-generated voltage of around 1 volt. A Stage 1 cell measured under similar conditions will read 0.1 to 0.2 volts. Remember, that unless you know what you are doing, these voltage measurements can be very misleading due to probe materials and battery effects that can easily mask your true measurement. As the cell reaches the maximum density of orgone that it can hold, the result of the breeding process is the conversion of this excess orgone into the formation of electricity. As such, electrical measurement with the correct instruments is a very valuable method in the verification of the efficiency of the cell. If you are conversant with the work of William Reich, you may care to make an orgone meter and thus remove all guesswork. This meter is fully described on some web sites.

I do not recommend any form of bubble exploding. As noted earlier, noise and vibration are orgone-negative. Therefore, these explosions applied during the delicate seeding period will kill your cell. Apart from a dead cell, the chance of fire igniting other gasses in the workshop and injuries to the ears etc. makes this exercise highly unnecessary. I must admit that I too fell for the "go on, ignite it!" feeling. I had a cell that had been at Stage 3 for seven months. It was my favourite test cell. My hands and matches fought my brain and they won. There was a huge "ear-pulling, implosion/explosion", and yes, I killed the cell. It went back to Stage 2 for four days. I will not do it again.

As all water we are using so far has been electrolysed, this water is not suitable for use in non-stainless steel or glass containers due to reaction with the container and the resultant corrosion, but if you have to, or want to, you can use juvenile water with no electrolyte added and still charge it to Stage 3. As the ion count is much lower, the water is not as conductive, i.e. you cannot get as much current flow with 12 Volts as you would if you electrolysed the water. However, if you obtain a power supply of approximately 60 to 100 Volts at about 1 Amp, you will be able to charge "plain old ordinary water". The down side is the additional waiting, in some cases, over 3 weeks, and the cost of the fairly expensive power supply. The advantage is that you will be able to pour it into the radiator of a car with no increase in corrosion as compared to water containing acids.

Do not at any stage short circuit, i.e. join any of the cell cylinders to each other electrically with your charging leads, wedding ring, etc. If you do, the cell will "die"! Your only option, if this occurs, is to connect the cell to your power source and see if you are still running at Stage 3. If the cell does not revert to running in Stage 3 mode within 1 minute, your only option is to completely dismantle the cell and re-clean and re-charge. Huh???, you are kidding us, right??? No, I am serious, that is your only option! So do not do it, do not short out your cell! You will have similar, but not as severe problems if you reverse your leads to the cell.

When the cell is running at Stage 3, you can tip the charged water out of the cell into a glass container and clean, adjust or maintain your now empty cell. Try to keep all cylinders in the same relation that they were in before you dismantled the cell, i.e. keep all cylinders the same way round and in the same radial alignment. This is mainly relevant when dismantling cells over 6 months old as the metal parts develop a working relationship that can be weakened or destroyed by careless re-assembly.

When finished, pour the charged water back and you are back in business. Of course you can pour this charged water into other cells, or use it as you see fit, but, remember, do not leave it out of the cell for periods longer than 1 hour at a time as the breeding has now stopped and you are slowly losing charge.

Troubleshooting.

It is usually quite difficult to get an engine running from a Joe Cell. Many people find it difficult to get their Cell breeding ("at Stage 3"). The following suggestions from various experienced people who have succeeded are as follows:

1. The metal construction of the Cell needs to be of stainless steel and nothing else. Using copper or brass, even for something as simple as the connector between the Cell and the aluminium tube running to the engine is sufficient to cause serious problems as the energy is not directed to the engine and just leaks away sideways.

2. The water is best charged in a separate vat which has a larger capacity than the Cell itself. That way, when the Cell is being conditioned and scum removed from the surface of the water, the cell can be topped up with charged water from the vat. If, instead, ordinary, uncharged water is used, then the whole process is liable to be put right back to square one.

3. Be very sure that the mounting in the engine compartment is electrically insulated from the engine and chassis and be sure that there is serious clearance between the Cell and everything else. Also, the aluminium pipe running to the engine **must** be kept at least four inches (100 mm) clear of the main engine components. Otherwise, the energy which should be running the engine, will leak away sideways and not reach the engine.

4. It can take up to a month to get a steel engine acclimatised to a Cell. Run the engine as a "shandy" where fossil fuel is still used but the Joe Cell is also attached. This usually gives greatly improved mpg, but more importantly, it is getting the engine metal and cooling water 'charged' up ready for use with the Joe Cell alone. Once per week, try advancing the timing and see how far it can be advanced before the engine starts to ping. When the timing gets to a 20 or 30 degree advance, then it is time to try running on the Joe Cell alone.

5. Finally, having conditioned the Cell, the water, the engine and the coolant, if there is still difficulty, then it is probably worth conditioning yourself. Both the idea and the procedure sound like they have come from Harry Potter's classes in Hogwarts School of Witchcraft and Wizardry. However, there is a serious scientific basis behind the method. Use of the Bedini battery-pulsing devices shows that lead/acid batteries act as a dipole for Radiant Energy. Also, the energy flow which powers the Cell appears to move from West to East. Bearing those two facts in mind, makes the following rather bizarre procedure seem slightly less peculiar:

(a) Get a car battery and position it so that it's terminals line up East/West with the negative terminal towards the East and the positive terminal towards the West (along the main energy flow line)

(b) Stand on the North side of the battery, facing South.

(c) Wet the fingers of your right hand and place them on the battery's negative terminal (which is on your left hand side).

(d) Keep your fingers on the terminal for two minutes.

(e) Wet the fingers of your left hand. Place your left arm under your right arm and place the fingers of your left hand on the positive terminal of the battery. Do not allow your arms to touch each other.

(f) Keep the fingers of your left hand on the positive terminal for three minutes.

(g) Remove your left fingers from the positive terminal, but keep the fingers of your right hand on the negative terminal for another 30 seconds.

This procedure is said to align your body with the energy flow and make it much easier for you to get a Cell to "Stage 3" or to get a vehicle engine running. In passing, some people who suffer continuing painful medical conditions state that they have got considerable pain relief from this procedure.

And now, for the more recent details:

Recent Joe Cell Developments.

One of the greatest problems with using a Joe Cell has been to get it operational. The reason for this has probably been due to the lack of understanding of the background theory of operation. This lack is being addressed at this time and a more advanced understanding of the device is being developed. These design dimensions cause ordinary tap water to go immediately to the fully functional "Stage 3" and remain in that state indefinitely, the only way of stopping the Cell is to physically take it apart.

While it is still rather early to draw hard and fast conclusions, a number of results indicate that there are three separate, unrelated dimensions which are of major importance in constructing a properly "tuned" Joe Cell. It needs to be stressed that these measurements are very precise and construction needs to be very accurate indeed, with one sixteenth of an inch making a major difference.

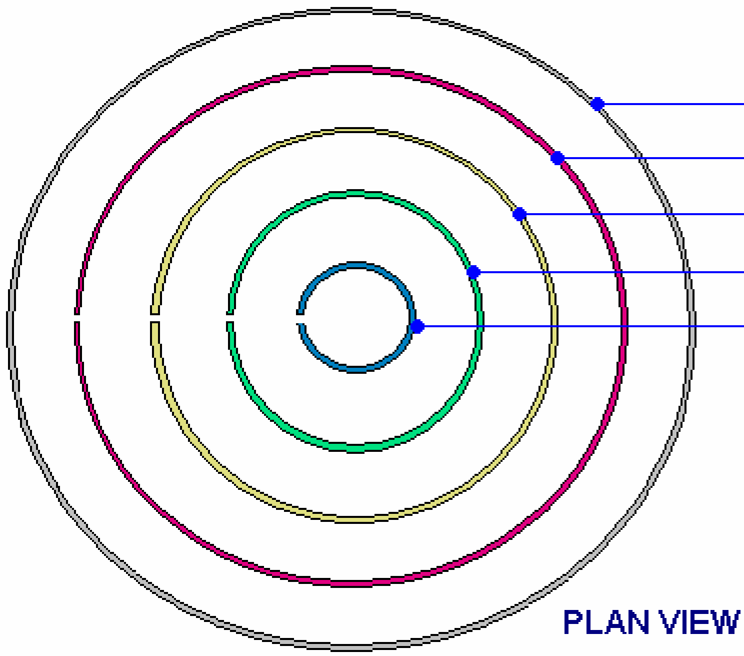
The dimensions are specified to this degree of accuracy as they represent the tuning of the Cell to the frequency of the energy which is being focussed by the Cell. The fact that there are three separate dimensions, suggests to me that there are probably three components of the energy field, or possibly, three separate energy fields.

These three dimensions have been assigned names and are as follows:

Golden dimension: 1.89745" (48.195 mm)
Blue dimension: 3.458" (87.833 mm)
Diamagnetic dimension: 0.515625" (13.097 mm)

It is suggested that a Joe Cell should be constructed with cylinder heights which are a multiple of either the 'Golden' or 'Blue' length. Also, the water height inside the container should be below the tops of the inner cylinders and be a multiple of the basic length chosen for construction. The inner cylinders should be positioned the 'Diamagnetic' dimension above the base of the Cell. They should also be constructed from stainless steel of thickness 0.06445" (1.637 mm, which is very close to 1/16") and there should be a horizontal "Diamagnetic" gap between all of the vertical surfaces.

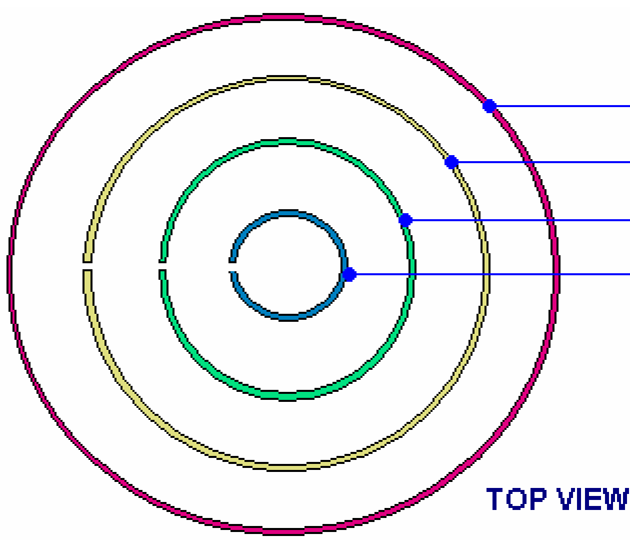
The inner cylinders should be constructed from stainless steel sheet which is tack welded at the top and bottom of the seam, and all of the seams should be exactly aligned. The lid should be conical and sloped at an angle of 57^{o}, with it's inner surface matching the inner surface of the housing and the inner surface of the outlet pipe. The outer casing should not have any dome-headed fasteners used in its construction. The length of the outlet pipe should be made of aluminium and should be 15.1796" (385 mm) for 'Golden' height cylinders or 20.748" (527 mm) for 'Blue' height cylinders. That is 8H for Golden and 6H for Blue and should there be a need for a longer pipe, then those lengths should be doubled or tripled as the single dimensions no longer apply (this being a fractal effect). At this point in time, these are only suggestions as the science has not yet been firmly established. One possible arrangement is shown here



Diameter	Circumference
6"	
4.84375"	15.217089"
3.6875"	11.58462"
2.53125"	7.95216"
1.375"	4.3197"

Metal thickness 1/16"

It is not necessary for there to be four inner cylinders so an alternative might be:

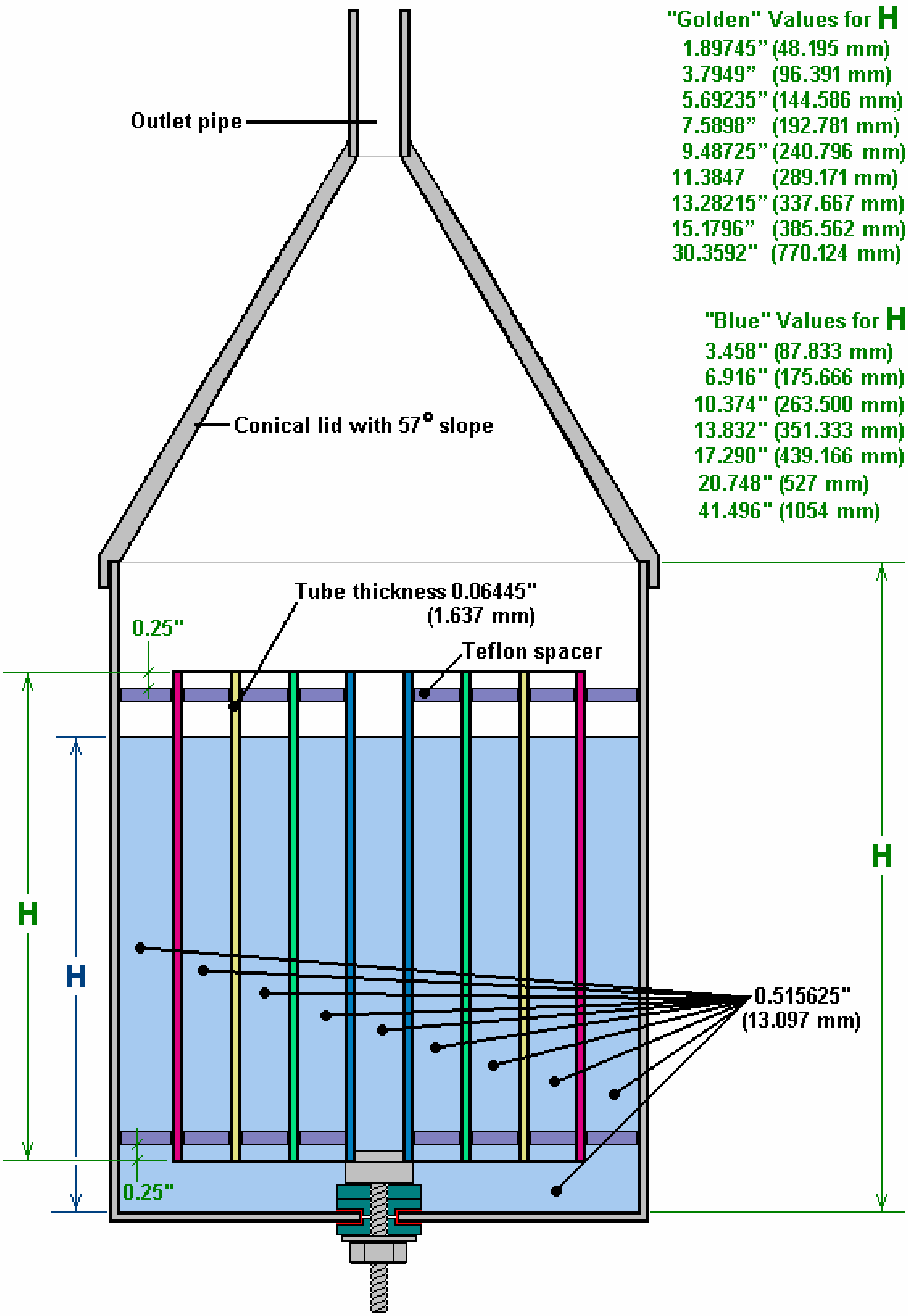


Diameter	Circumference
5"	
3.844"	12.075"
2.688"	8.444"
1.532"	4.812"

Metal thickness 1/16"

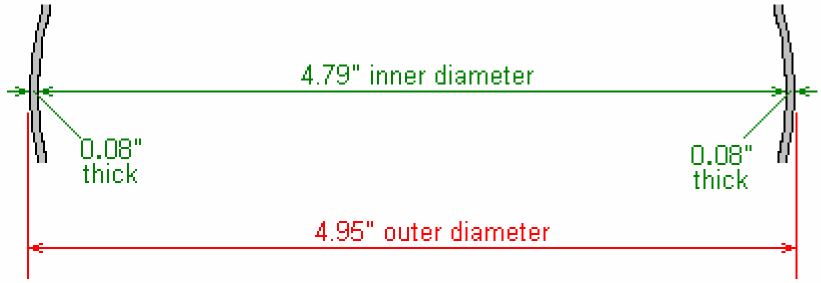
A suggested Joe Cell design is shown below. This diagram shows a cross-section through a Joe Cell with four inner concentric stainless steel tubes. These tubes are positioned 0.515625 inches (13.097 mm) above the bottom of the Cell and the gap between each of the tubes (including the outer casing) is exactly that same 'Diamagnetic' resonant distance.

It should be clearly understood that a Joe Cell has the effect of concentrating one or more energy fields of the local environment. At this point in time we know very little about the exact structure of the local environment, the fields involved and the effects of concentrating these fields. Please be aware that a Joe Cell which is properly constructed, has a definite mental / emotional effect on people near it. If the dimensions are not correct, then that effect can be negative and cause headaches, but if the dimensions are correct and the construction accurate, then the effect on nearby humans is beneficial



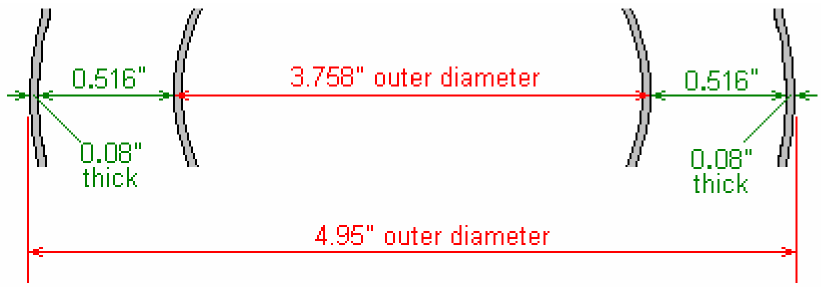
It should be pointed out that Joe Cells will be constructed with the materials which are readily to hand and not necessarily those with the optimum dimensions. If picking stainless steel sheet which is not the suggested optimum thickness, then a thinner, rather than a thicker sheet should be chosen. In case the method of calculating the diameters and circumferences of the inner cylinders is not already clear, this is how it is done:

For the purposes of this example, and not because these figures have any particular significance, let's say that the steel sheet is 0.06" thick and the outer cylinder happens to be 4.95" in diameter and it is 0.085" thick.
People wanting to work in metric units can adjust the numbers accordingly where 1" = 25.4 mm.

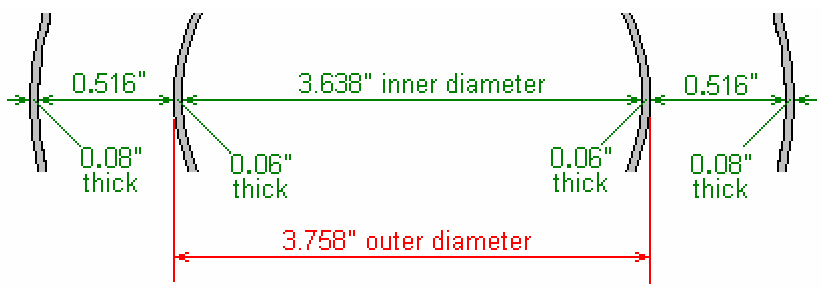


Then, the inner diameter of the outside cylinder will be its outer diameter of 4.95", less the wall thickness of that cylinder (0.08") on each side which works out to be 4.79".

As we want there to be a gap of 0.516" (in practical terms as we will not be able to work to an accuracy greater than that), then the outside diameter of the largest of the inner cylinders will be twice that amount smaller, which is 3.758" :



And, since the material of the inner cylinder is 0.06" thick, then the inner diameter of that cylinder will be 0.12" less as that thickness occurs at both sides of the cylinder, which works out to be 3.838" :



The length of stainless steel needed to form that cylinder will be the circumference of the outer diameter of 3.758" which will be 3.758" x 3.1415926535 = 11.806 inches.

The dimensions of the other inner cylinders are worked out in exactly the same way, bearing in mind that every steel thickness is 0.06". The results for three inner cylinders would then be:

Diameter	Circumference
4.95"	
3.758"	11.806"
2.606"	8.187"
1.454"	4.568"

OR

Diameter	Circumference
125.7 mm	
95.5 mm	299.9 mm
66.2 mm	208.0 mm
36.9 mm	116.0 mm

Comments from an expert in July 2012:

That information is really ancient history and it was Dave's best guess at optimising a cell at that time. Later testing left us disappointed with the 'Blue' lengths, however the 'Golden' lengths make a very nice cell, but not one which is particularly good with an internal combustion engine but one which is better as a learning tool, or for use in healing.

We are into an entirely different approach now, one which entails introducing specific vibrations into the cell. An optimum implementation involves cutting each tube to a specific length so as to make it self-exciting, but that's not necessary because the frequencies can be introduced just using a caliper, or a precise length of metal touched against the tubes in a sequence. Since this approach was totally different from traditional Joe Cell work, we set up a discussion group specifically for it: http://tech.groups.yahoo.com/group/vibrational_combustion_technology/

The nice thing about this approach is that it's ultra stable. Once the vibration is set up the only way to stop it is to take the cell apart. This construction method totally eliminates the human influence factor problem! In fact, a cell can affect the engine even without there being water in the cell. Another nice thing about it is the mathematical design process is implemented in a couple of spreadsheets. My thinking at this time, is that we now need to incorporate specific engine parameters into the design to tune the cell to a particular engine.

We have been a bit sidetracked lately and have been working a lot on the healing aspects of Torsion fields: http://groups.yahoo.com/group/awaken_to_vibration/ but I hope to get back into engine testing soon.

Advances in 2011. In an effort to develop a device to emulate the function of a Joe cell without it's inherent stability issues, Dave Lowrance came up with the idea of a set of 3 concentrically-wound torsion field coils. In early testing it has become apparent that a field **is** being generated, as demonstrated by their effect on two test engines, even with no power being applied to the coils.

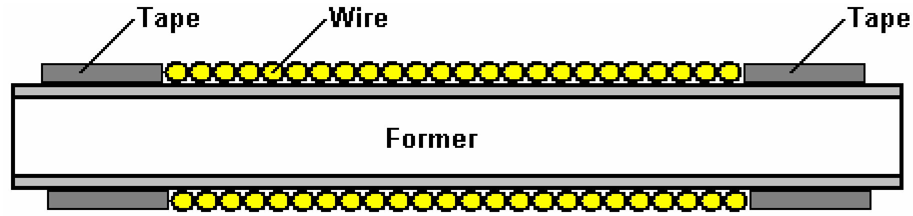
This is the very early stage of the investigation so this initial design is being released with the hope that others will wind and test similar coils and report their results to the appropriate groups, so that we can learn more about them through further experimenting on a variety of different engines.

The initial set of coils were wound on 7/8" (22 mm) diameter stainless steel tubing which happened to be to hand. The use of stainless steel is not significant and two successful replications have used half-inch (12 mm) PVC plastic pipe, as using a non-ferrous material is the main requirement.

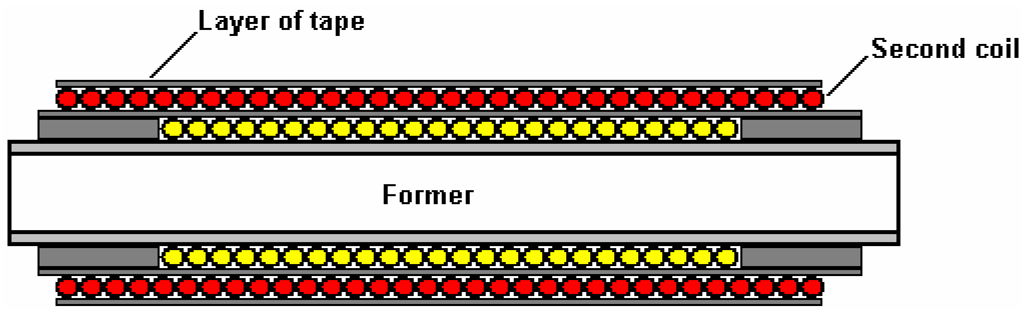
The wire diameter has an effect and while 20 gauge (0.812 mm diameter) enamelled copper wire was used for the coils shown here, coils wound with 12 gauge (2.05 mm diameter) copper wire work much better and it is now thought that the weight of copper in the winding is important.

For the first layer, a length of 311 cm is used and wound on the former in a clockwise direction. The ends of the wire are secured with tape, leaving three or four centimetres of wire exposed at each end of the coil, for connection purposes. This is the first layer wound and secured:

The wire for the second layer is cut to a length of 396 centimetres. This second coil layer will be longer than the first layer, so before winding it, it's necessary to build up the area at both ends of the first layer with tape:



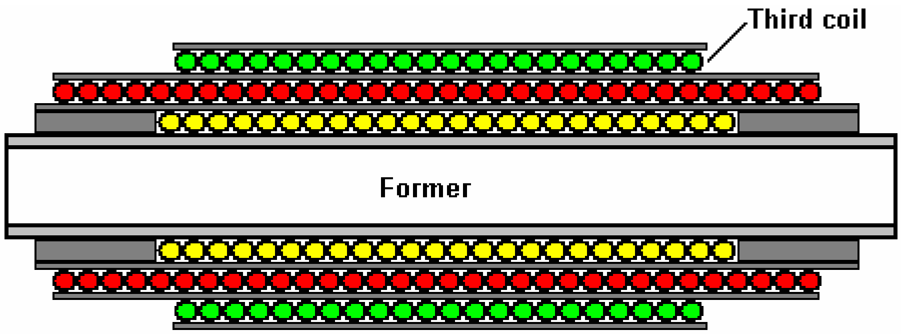
This is so that the second layer of wire will have the same diameter along it's entire length. It is probably a good idea to completely cover the first layer of wire with tape to ensure good electrical insulation.



The second wire layer is also wound in a clockwise direction:

The wire for the third layer is cut to a length of 313 centimetres. Since it will be covering less length along the former, there is no need to build up the ends of the earlier layers. So, simply cover the second winding with tape, and then wind on the third layer, but this time, the coil is wound in a counter-clockwise direction and then the entire coil is covered in tape to protect it.

To be sure that the second and third layers are centred over the earlier layers, it is a good idea to locate the centre of the wire and start winding from the middle outwards in both directions:



It has been found that one end of the centre winding is similar to the centre tube of the Joe cell, and the opposite end of the outer winding functions like the canister of a Joe cell. In theory, this can be tested by connecting a small capacitor between these two points, and checking for a low DC voltage using a digital voltmeter. Like a Joe cell, polarity is really the important issue to test for, since we do want the positive polarity end to transfer the energy, and the negative polarity end to be connected to engine ground. If the polarity is wrong, simply use the opposite ends of both coils.

In the testing the negative end was connected to chassis ground, and the positive end to a Hull-effect type oil probe already installed in each test vehicle. The oil probe is Robert Hull's contribution to this technology. He found that if you apply a torsion field to the oil, it will charge up an engine in a way similar to a Joe cell, but more consistently than a Joe cell would. There are two basic types of Hull-effect probe - the simplest is just a wire inserted down the dipstick tube. However, the preferred method is to remove the oil-pressure sensor and insert a T-fitting, then slide an insulated stainless steel rod into the high-pressure oil at that point. By using an oil probe, one can eliminate the aluminium transfer tube in favour of a length of wire.

The experimenter who wound the 20-gauge coils then wound a larger diameter set using 12-gauge wire on a 1.5-inch (38 mm) diameter former. He fitted these over the original set and connected just two wires, one end of the innermost of the six coils and the opposite end of the outermost coil. This gave about a 25% reduction in the fuel used by an old Honda Accord car with an Electronic Fuel Injection system.

Fuel-less operation has not yet been achieved, but that could just be a matter of getting the engine set up properly. Some of the issues we need to deal with are things like antifreeze, which destroys the dielectric properties of water, and inhibits it from charging up. This has never been discussed, but it is one of the key things which limited the ability of people to succeed with their cells. Oil is a similar issue. Some oils, particularly the ones with all the additives and detergents, simply won't charge up.

There still needs to be a lot of testing done. For instance, with this setup it might be better to connect one end of each coil to ground. Or possibly the coils would do better if the windings were all connected in series. This is all uncharted territory! Dave’s original concept was to use a set of these coils to replace each tube of a Joe cell.

The engine from an old Pinto car is also being used as a test bed. Attempts were made to run it completely fuel-less. It would kick repeatedly, but just wasn't quite there. It would only kick at a very specific timing setting - somewhere between 50-60 degrees before Top Dead Centre. The Pinto has antifreeze and with just water it's more likely to run fuel-less. But that should be a last-resort option, since most people do need antifreeze.

Devices such as the Joe cell tend to work really well on engines which have a carburettor because the spark timing can be adjusted quite easily. They work well on older EFI engines (probably those prior to OBD2) but they can be a real problem on the newer EFI models as they are liable to cause a fuel injection error state to be reached almost immediately. The newer ECUs control everything so tightly that they are almost impossible to work with (which was probably a design objective of the ECU design).

The Pinto engine had not been started for over six months. No T-field devices were connected to the engine during this period, so we can assume that there was little or no residual charge on the engine. The cooling system had only water in it. The crankcase was filled with NAPA brand 30-weight oil. We fiddled with the engine to get it started. At that time the car had a little motorcycle carburettor on it, rather than the stock carburettor and the timing was set quite a bit advanced.

After just a few minutes of idling we realised that the engine was getting extremely hot with the exhaust manifold glowing red. So we shut it down. Being the optimist that I am, we went ahead and connected the coils at this time.

The next morning I took a little compass and found that it didn't point to North anywhere within about 2 feet of the car body - a very good sign! So we went ahead and started it up, and carefully monitored the head temperature with an infra-red thermometer. The temperature rose slowly to about 170 degrees F which is a little below normal. After verifying that the temperature held steady at that value, I tested with the compass again, and now it was messed up out to about 10 feet from the body. So the field strength had jumped up about 500% after starting the engine.

We then played with the carburettor and timing to get the smoothest operation at the lowest RPM at which it would idle smoothly. The RPM appeared to be well below a normal idle RPM., and when I went back and checked the timing, it was very close to 60 degrees before Top Dead Centre. At this point everything was looking so good that we tried a few attempts at fuel-less operation, but the engine died each time.

Due to pressure of other work, the car was ignored for a couple of months. When I finally got back to doing a little further testing, I found it surprisingly easy to get it started again. I didn't have to reset the timing to get it running. It actually started up with little effort, which was amazing, since the timing was still way advanced. It should be nearly impossible to start an engine with the timing set like that. The spark is just occurring at the wrong time in the cycle so it should try to push the pistons in the wrong direction.

Anyhow, it was starting to get cold here, so I decided to install some antifreeze, and that just set everything way back. It reduced the field strength by over 80%.

Since then Dave has come up with a coil-set designed to charge up antifreeze, but I was disappointed when I tried it. It did better with the antifreeze than the original set did, but we came to the conclusion that the antifreeze destroys water's diamagnetic properties to the point that the mixture is just hard to charge up. Working on this problem is the reason why I didn't release the coil info sooner. I kept hoping that we might solve this problem as well, but we didn't. However, this just might not be as big a problem as I thought, because I've heard that well-charged water just might have a significantly lower freezing point. This has not been tested yet to verify it.

An interesting side issue is the fact that the water which I drained out when adding antifreeze, showed no sign of rust. It was perfectly clear. Under normal circumstances, with no additives in the cooling system, this water should have been a horrible orange mess. It wasn't, and that has to be because of the field on the engine.

The Pinto is not roadworthy, so I have no way of knowing what kind of fuel consumption is possible with this setup or what power it might be capable of producing. At this time, I just use it to test different devices, and to try for fuel-less operation. However, if I was to achieve a consistent, repeatable fuel-less operation, it could become roadworthy very quickly, so I could do some actual road testing.

Electrets Constructed from Co-axial Cable.

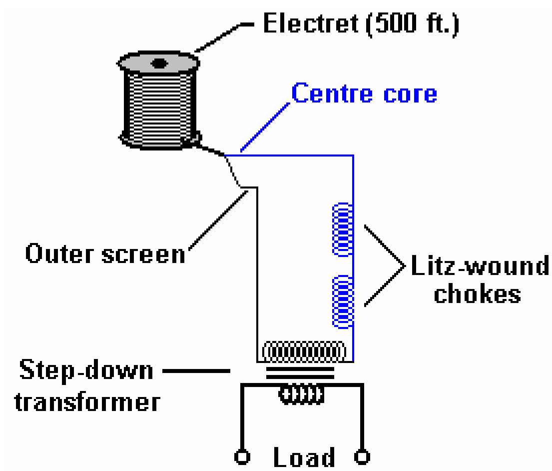
There is a device which is not widely known. It is called an "electret" and I have to confess that my knowledge of them is almost zero. Essentially, an electret is a passive device which pours out electrical energy. I do not know where that electrical energy comes from. The Wikipedia encyclopaedia has some highly technical information on the subject remarking that "tunnel ionisation" is a process in which the electrons in an atom can pass through the atom's potential (voltage) barrier and escape from the atom. In an intense electric field, the potential barrier of an atom is distorted drastically and so the length of the barrier through which electrons have to pass, decreases and electrons can escape quite easily. The atoms spoken of here, might be those of a dielectric which could form an electret.

One method which has been used in the past to make an electret, has been to alter the structure of certain types of wax. A more convenient method is to use a reel of standard co-axial cable which is the sort of cable used to connect television aerials to television receivers:

An electret of that type can produce 10,000 volts at 10 milliamps. The current flow of 10 milliamps sounds trivial and of no consequence, but that is not actually the case as the power of 10 milliamps at 10,000 volts is 100 watts, so imagine a 100 watt light bulb brightly lit and not needing any power input at all to make it shine. That is actually, quite impressive.

PLEASE NOTE THAT 10,000 VOLTS WILL KILL YOU AND INVESTIGATING A DEVICE OF THIS TYPE IS NOT FOR PEOPLE WHO ARE NOT ALREADY FAMILIAR WITH WORKING SAFELY WITH VERY HIGH VOLTAGES. MEASUREMENTS MUST ONLY BE MADE WITH HIGH-VOLTAGE EQUIPMENT. LET ME STRESS AGAIN THAT I AM NOT ENCOURAGING YOU TO MAKE OR EXPERIMENT WITH ANY FORM OF HIGH VOLTAGE DEVICE AND THAT THIS INFORMATION IS FOR YOUR INTEREST ONLY.

The arrangement with a single reel of cable is:



Unfortunately, life being what it is, it has been found that when you try stepping that voltage output down to a more convenient level, there are liable to be losses which can lower the output power to just 50 watts. That sounds disappointing until you put it in perspective. This is a device which has the same output as a 50 watt solar panel in full sunlight, mounted at the optimum angle and positioned near the equator, but a home installation of such a panel gives far lower output, especially so when your home is a long way from the equator. But, note that the electret costs far less, produces that full output at any latitude and at night, while the solar panel is restricted by cloud cover, distance from the equator, needs an expensive mounting system, ideally should rotate to track the position of the sun, and only works when there is a high light level. So, the electret's fifty watts of continuous power is not an insignificant thing when you compare it to the other options available. These electrets can be stacked in parallel and an output in the kilowatts range is possible.

Let me stress that I personally have not yet made or used a co-axial cable electret, and so the information here comes from an experimenter who has done this. Also, while the information here is intended to help anyone who wishes to experiment along these lines, the fact that it is here must not be interpreted as my encouraging you personally to try to make or use an electret of this or any other type. If you choose to do that, then you do so entirely at your own risk and nobody other than yourself is liable should any mishap occur.

The following procedure has been used to convert a full reel of 1/4", type RG6/U 75-ohms, 18-AWG co-axial cable into an electret:

1. Make sure that neither end of the cable has the screen touching the central core.

2. Make an electrical connections to both the screen and the core at both ends of the cable.

3. Place the whole of the spool of cable inside an oven.

4. Heat the oven (a genuine oven and not a microwave) slowly to 350^{o}F (180^{o}C).

5. Maintain the heat until the inner plastic insulation is so soft that it can be permanently indented. This plastic must not get too soft and reach the flowing stage, nor must it get burnt or develop holes which allow arcing - if that happens, then the reel of cable is a throwaway. The objective here is to get the plastic to lose it's polarisation memory.

6. When the inner plastic sleeve has reached this level of softness, apply a steady DC voltage of about 10,000 volts to the connections already made to one end of the cable (to the screen and to the core). Although any voltage from 12V to 20,000V can be used, a 10 mA current draw can be expected when using 10,000V. Maintain this applied voltage at the high temperature for about ten minutes.

7. Turn off the heat and let the oven cool down gradually at its own rate to the 25^{o}C to 30^{o}C region, keeping the high voltage attached to one end of the cable.

8. Disconnect the DC voltage.

9. Connect the cable screen to the central core at both ends of the cable.

10. Leave the cable at room temperature for five to seven days. During this time, the polarisation of the plastic is reorganising. After this time, the electret is ready for use as a power source.

Chapter 10 - Solar Power

A Solar Panel Desk Lamp

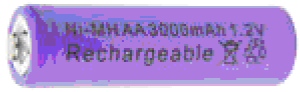
Solar panels can be very useful items in spite of their very low efficiency and high cost. When thinking about solar panels people generally imagine a set of many large solar panels mounted on the roof of a house. The cost of doing that is far too great for most people to consider it. However, at this time, there are one billion people in the world who do not have any electricity at all. It appears that a useful electricity feature for them would be electric lighting at night. With the components which have become available recently, providing good lighting at realistic cost is now possible.

Small solar panels offered for sale as "10 watt, 12 volt" capacity can now be bought reasonably cheaply. Made in China, these panels can provide a current of just over half an amp These panels which have an aluminium frame are typically 337 x 205 x 18 mm in size and look like this:

Tests which I have run show that a 1000 lux very realistic level of lighting can be provided with a total of just 1.5 watts of electrical power. The best lighting source that I have found is the "G4" style, LED arrays made in China using the "5050" chip technology. These are cheap and have a very heavily non-linear light output for current draw, which is a fact which we can use to our advantage. These LED arrays come in "white" or "warm white" versions (my preference is the warm white variety) and they look like this:

With a diameter of 30 mm and pins which are easy to connect to, these are very convenient devices which have an excellent lighting angle of 160 degrees and a light output of 165 lumens for a 1.2 watt electrical input.

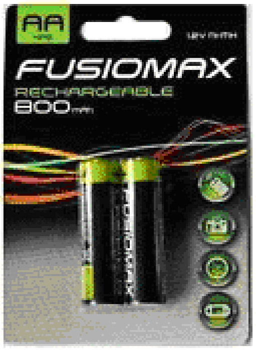
One of the problems with such a unit is the selection of a suitable battery. Lithium batteries are excellent but the cost of a suitable lithium battery is ten times greater than the cost envisaged for the whole unit, effectively excluding lithium batteries. Lead-acid batteries are far too large, too heavy and too expensive for this application. Surprisingly, what appears to be the best choice is the very popular AA size Nickel-Manganese rechargeable battery which is 50 mm long and 14 mm in diameter:



Rated at up to 3 Amp-Hour capacity, they are very low cost, are lightweight and can be placed in a battery box like this:

The battery box can be adapted to hold seven batteries rather than the intended eight batteries, producing a nine volt battery pack with 1.2V batteries. If three of these battery packs are used with the solar panel, then there is no need for over-charging protection as NiMh batteries can deal with overcharging current if it does not exceed 10% of the battery's milliamp-hour rating, and that simplifies the design very considerably.

However, some of these small NiMh batteries do not live up to the maker's claims and so you need to run a load test on any particular make of battery which you may consider using. For example, here are six different types of these batteries tested in groups of four, with a load of about 50 milliamps at five volts. The same load was used to test each of these batteries:



Fusiomax 800

Digimax 2850

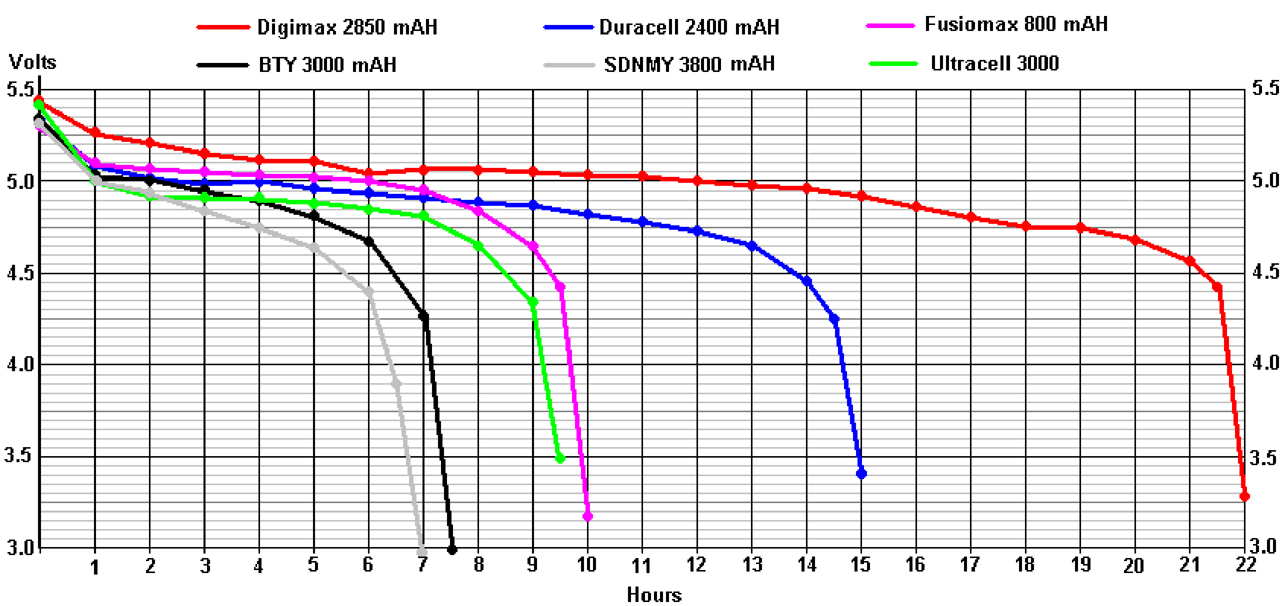
Duracell 2400

SDNMY 3800

BTY 3000

Ultracell 3000

The results were most revealing:



The BTY 3000 batteries do not actually claim on the battery to be 3000 mAHr (although the sellers do) and so, the "3000" could just be a trading name. The tests results for the BTY 3000 were so staggeringly poor that the test was repeated three times with longer recharging time for each test, and the one shown above is the 'best' result. You will notice how far short it falls when compared to the low-cost Fusiomax 800 mAHr batteries. The terrible performance of the BTY 3000 batteries is only exceeded by the incredible "SDNMY 3800 mAHr" batteries which show almost negligible capacity in spite of their amazing claims of 3800 mAHr.

NiMh batteries are 66% efficient. You should only ever charge a 3000 milliamp-hour NiMh battery at 300 milliamps or less and so with a 10-watt solar panel, overcharging is not a problem.

Light meter tests provide some very interesting results for the LED arrays. When using two LED arrays side by side in a light box, the figures for voltage / current draw / light produced using 1.2-volt NiMh batteries were:

9 batteries 11.7V 206 mA 1133 lux: 2.41 watts 470 lux per watt (the manufacturer's intended performance)

8 batteries 10.4V 124 mA 725 lux 1.29 watts 562 lux per watt

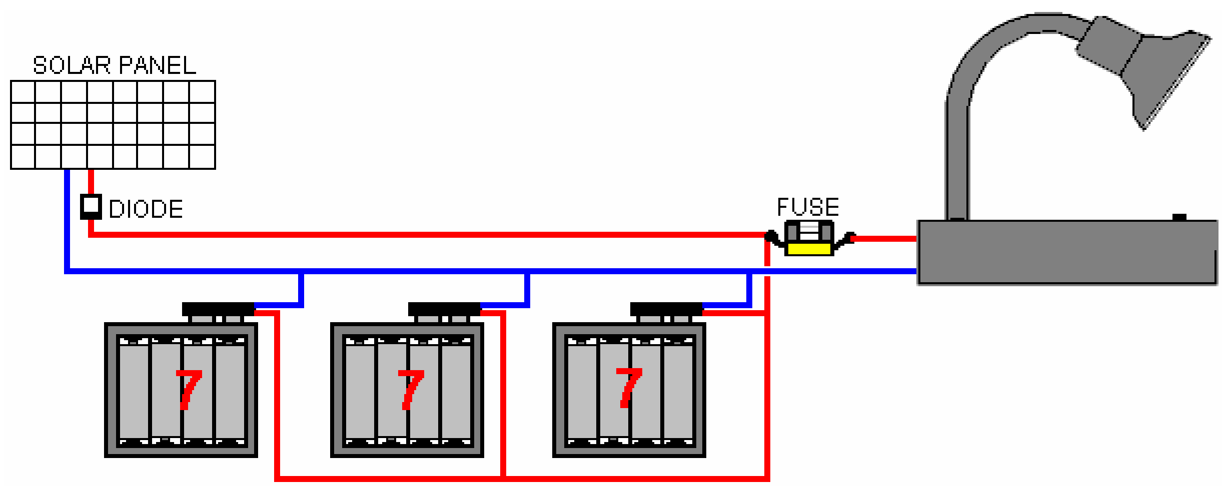
7 batteries 9.1V 66 mA 419 lux 0.60 watts **697** lux per watt (a very realistic performance level)

6 batteries 7.8V 6 mA 43 lux 0.0468 watts 918 lux per watt

This is very revealing information, showing that one of these LED arrays fed with just 33 milliamps can produce very impressive 210 lux lighting at a wide angle of illumination. To put that another way, feeding five LED arrays with 9 volts, generates a very acceptable 1000-lux lighting level for just 165 milliamps which is only 1.5 watts. That is spectacular performance.

Equally impressive is what happens when the battery voltage drops when the battery is nearly fully discharged. The LED performance rises to combat the loss of voltage and even at a ridiculously small 3 milliamps fed into each LED, there is a 21 lux light output from each LED array. The effect is that while the lighting does dim slightly, it does so very gradually in a barely noticeable way. With three sets of genuine high-capacity AA NiMh batteries, we can expect a minimum of eight hours of continuous 1000-lux lighting from our desk lamp. That is a total of twelve watt-hours, and the solar panel feeding 66% efficient batteries at nine volts, is capable of replacing one of those usable watt-hours in twenty minutes. In other words, just two hours forty minutes of good daytime lighting can provide eight hours of 1000-lux lighting every night.

The only moving component in this system is the On/Off switch and the circuit could not be any more simple than this:



All solar panels have a diode to prevent the panel drawing current from the batteries during the hours of darkness and it is not unusual for the panel to be supplied with a diode already connected in place. Personally, I would consider a fuse to be unnecessary but it is standard practice to fit one. The batteries are installed in a base box which supports the solar panel and gives sufficient weight to produce a very stable lamp. The five LED arrays are connected in parallel and fitted into a suitable lamp housing such as this one:

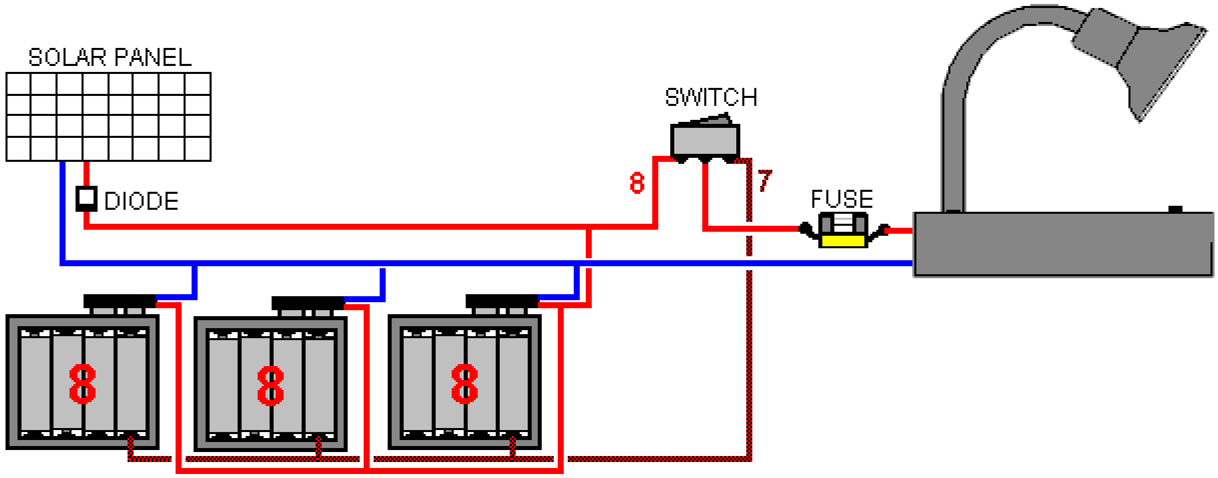
Only the flexible stem, 120 mm diameter lampshade and On/Off switch are used.

While this is an exceptionally simple and robust design, it is actually an affordable and very desirable unit which can provide years of cost-free lighting at a very satisfactory level. The prototype looks like this:

This is, of course, a perfectly ordinary and quite standard type of a solar-powered light. The difference here is that it is a very effective light suited to lighting a desk to a high level all night long. It is mobile and has a wide angle of lighting.

It is also possible to extend the design very slightly, to provide an even longer period of lighting or if preferred, a period of even brighter lighting. This can be done by using eight batteries in each battery holder – which has the advantage that standard battery holders can be used without any need to adapt them to hold just seven batteries.

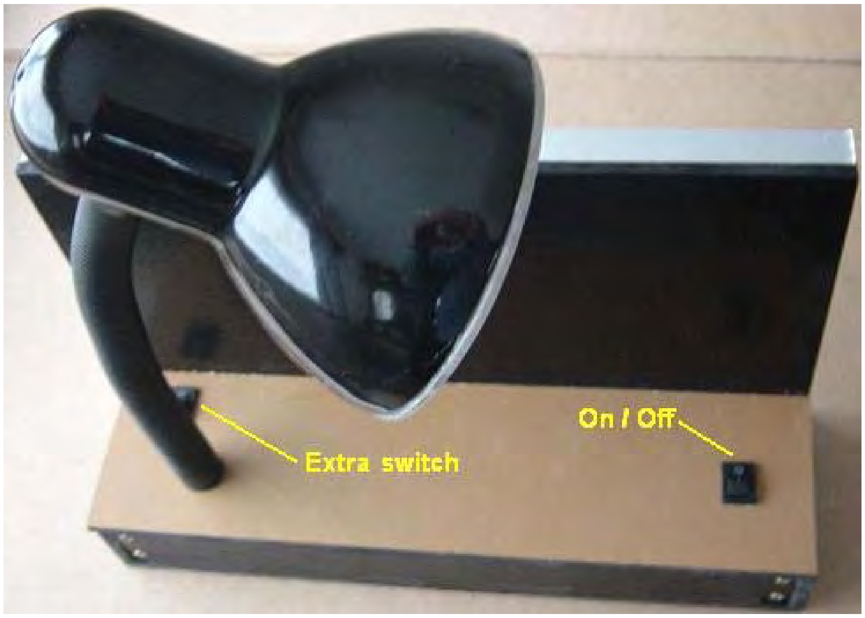
This has the slight disadvantage that we do not want to supply the extra voltage to the LED arrays because doing that would cause a greater current draw than we want. We can overcome this by using an extra change-over switch and having two connections to each battery holder. The circuit could then become:



With this arrangement, the lighting unit is fed by either eight batteries or by seven batteries, depending on the position of the change-over switch. When the solar panel is charging the batteries, all eight batteries per holder get charged no matter what position the extra switch is in.

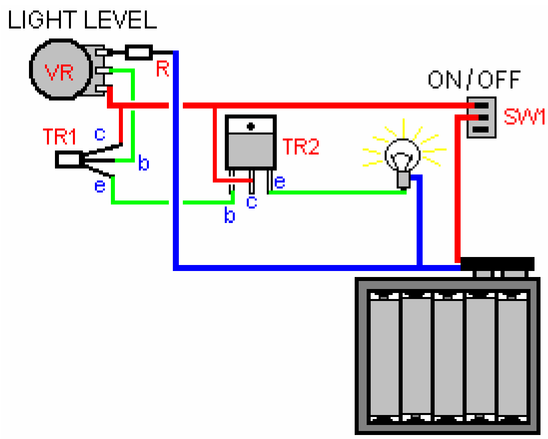
This has the advantage that when the battery voltage starts to drop after a few hours of powering the light, then the switch can be operated, raising the voltage reaching the lamp by the voltage of the extra battery, possibly producing a brightness exceeding the maximum when using just seven batteries in each battery holder. This arrangement has the slight disadvantage that the user could switch in all eight batteries from the beginning, producing a much higher current drain and while that would give a higher lighting level, the overall time is likely to be reduced. Mind you, it is possible that this might suit the user

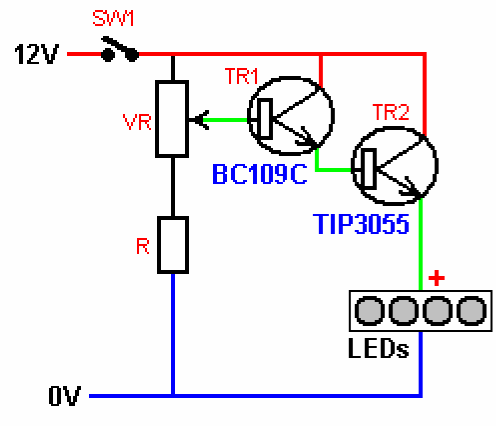
If this style of operation is chosen, then I suggest that the extra switch is located well away from the On/Off switch so that the user does not get confused as to which switch does which job. Perhaps the second switch might be located near the stem of the lamp support, like this:



Without knowing much electronics, it is possible to make a more versatile version of this desk lamp. This can be done by providing a fully adjustable lighting level. For this, we use three 10-battery holders, each containing a full set of ten batteries, producing a nominal 12-volts but in reality, about 13.8 volts when fully charged.

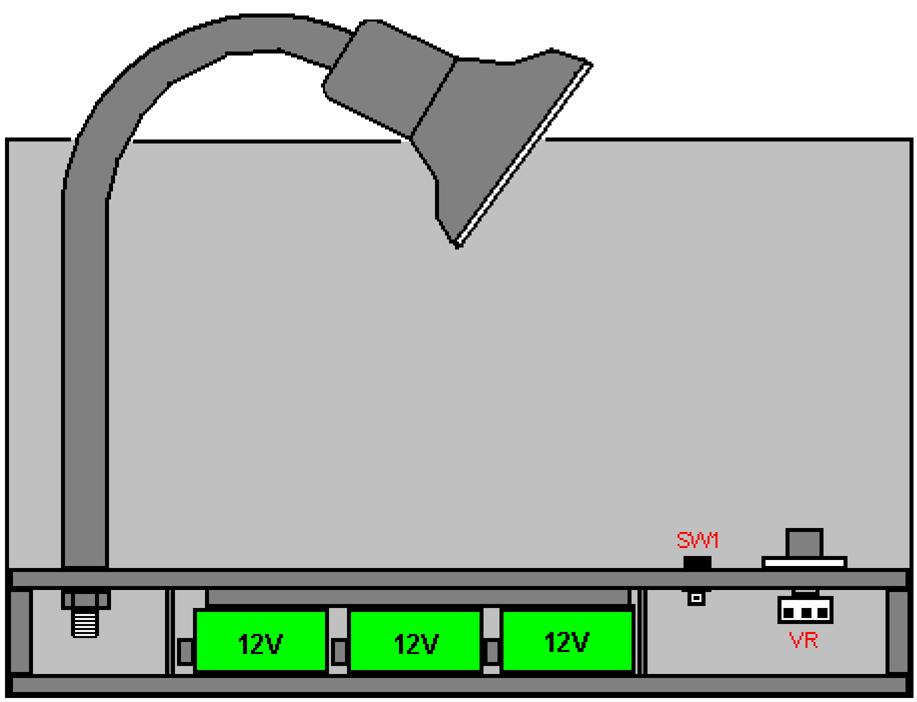
We would like the user to be able to adjust the voltage applied to the LED arrays in order to get the very high current-to-light output efficiency or a higher level for a shorter time, if that style of operation is preferred. This can be done quite easily, in a very simple and cheap way, using this arrangement where just one battery is shown to represent all three battery packs wired in parallel to produce a higher battery capacity:





Here, instead of feeding the battery voltage directly to the LED arrays, two cheap and widely available transistors are placed between the battery and the LEDs. These transistors control the voltage applied to the LEDs and that controls the current through the LEDs and the level of light produced. The chosen light level is set using the variable resistor "VR" and the light level can be turned down gradually, all the way to zero, so the unit could also be used as a night light if that was wanted.

The physical layout of the components could be like this:

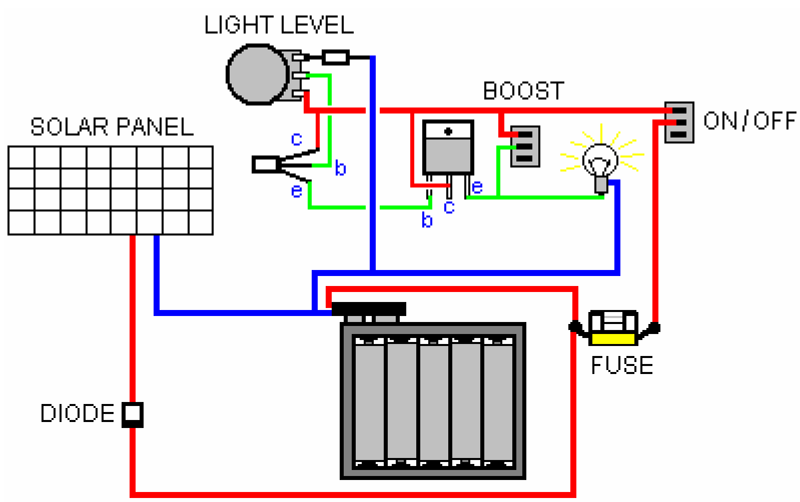


Here, the weight of the solar panel and the three battery packs give the unit stability if the lamp is bent in any direction. With four LED arrays, an excellent level of lighting results, however, I would suggest using five LED arrays as that gives an even wider range of lighting. A big advantage of this arrangement is that if the variable resistor is fitted with a knob like this:

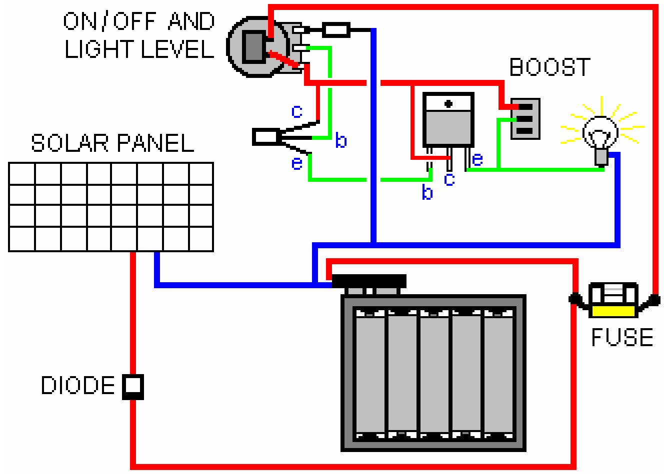
then each user will become familiar with the particular light-level setting which suits the recharging rate. It also allows for short periods of very high level lighting if that ever becomes necessary.

From a practical point of view, when the light is first switched on the battery voltage will almost certainly be over 13 volts. As we want about 9 volts applied to the LED arrays, some four volts need to be dropped off to stop the LEDs drawing excessive current and draining the batteries too quickly. In passing, it might be mentioned that the human eye is very bad at assessing light levels, and so, doubling the LED current (which would more than halve the length of lighting time) does not increase the visual effect by much, and so, controlling the current flow makes a major improvement in the length of time during which the light can be used each night. The lighting period each night is expected to be about eight hours.

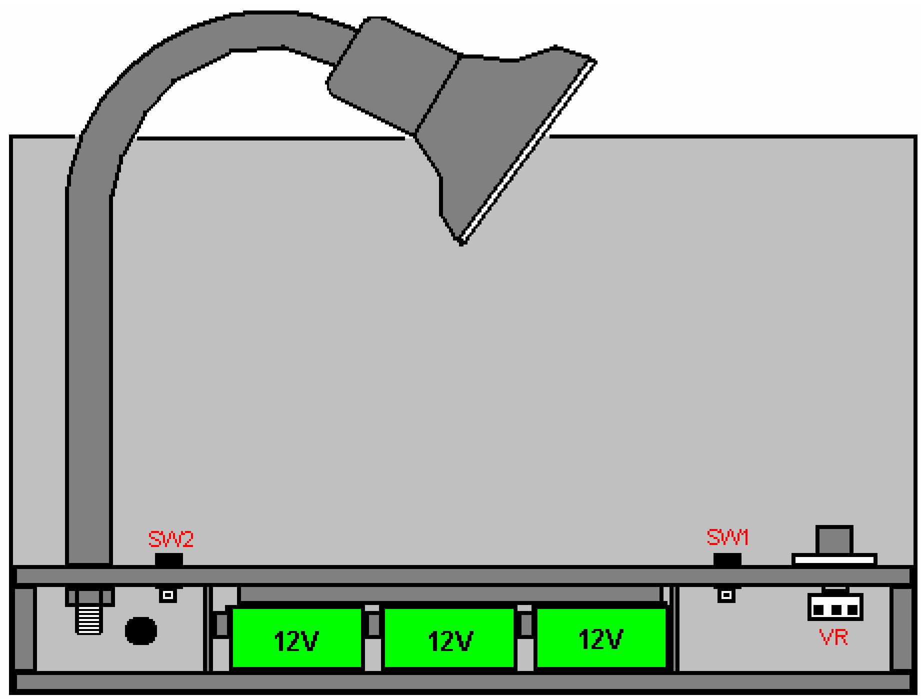
The transistors controlling the light level drop off some 1.4 volts, no matter what the current is. This is not a problem during the normal lighting period. However, if the lighting period is unusually long and the battery voltage is starting to drop, then it is possible to gain that extra 1.4 volts by using another switch to bypass the transistor control. It is wired so that the battery is connected directly to the LEDs in order to extract every last milliamp of current from the batteries. That extra 1.4 volts makes a major difference to a falling light level but it should not be used for any length of time on a fully charged battery (quite apart from the excessive current draw) as it is feeding the LEDs a voltage higher than the LED designer was expecting and while it does produce exceptional lighting, it is being very unkind to the LEDs. The bypass switch would be arranged like this:



Here, the extra switch marked "BOOST" short-circuits across the transistors and so connects the LEDs directly to the battery. The fuse shown is optional but if your wiring is not the best, then it is worth having in case your wiring creates a direct short-circuit across the batteries. A 'slow-blow' fuse rated at 1-amp would be a good choice as the normal current flow, even on BOOST with a fully charged battery, will be less than one amp if five LED arrays are used. It is also possible to use a variable resistor which has the On/Off switch built into it:



Also shown in the diagram is the solar panel which is connected to the batteries at all times, even bypassing the fuse. It is connected through a diode such as a 1N4007 so that the panel will not draw current from the batteries during the hours of darkness. To make sure that the two switches are not mixed up by the user, I suggest that the extra switch "SW2" is positioned well away from the On/Off switch:

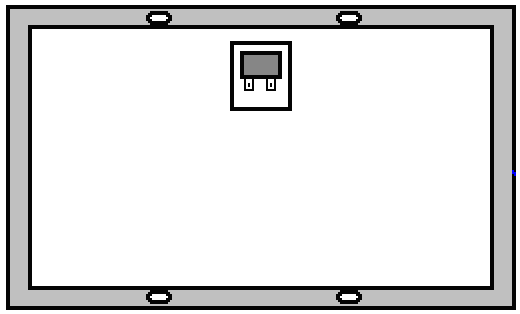


Of course, it is not essential to use a commercial, adjustable lamp such as this. Instead, the LED arrays could be mounted on a home-made strip attached to the back of the solar panel plate and possibly, angled slightly downwards if a desk or table is the main place to be lit. In either case, it is advisable to put a piece of frosted plastic across the LEDs as they can be lit so brightly that they can be difficult to look at. Also, just because this is intended primarily as a desk lamp, there is nothing to stop the user tipping the light upwards to light the whole room. Actually, the room will probably be fairly well lit even when the main lighting area is a desk or table even if that is located at one end of the room.

The construction sequence might be:

1. Lay the solar panel face up on the corner of a sheet of some suitable material such as 6 mm Medium Density Fibreboard ("MDF"). Run a pencil around the edge of the solar panel and cut the sheet along the pencil line to produce a sheet which can be attached to the back of the solar panel. Drill a 6 mm diameter hole about 30 mm in from one corner, that is 30 mm in and 30 mm up so that the hole will be clear of the sides and corner strips when they are attached later on. If it is your intention to paint the desk lamp, then painting this backing sheet before attaching it to the solar panel makes it much easier to do neatly.

2. Lay the solar panel face down on a soft surface and slide the cover off the electrical connection points. It should look like this:

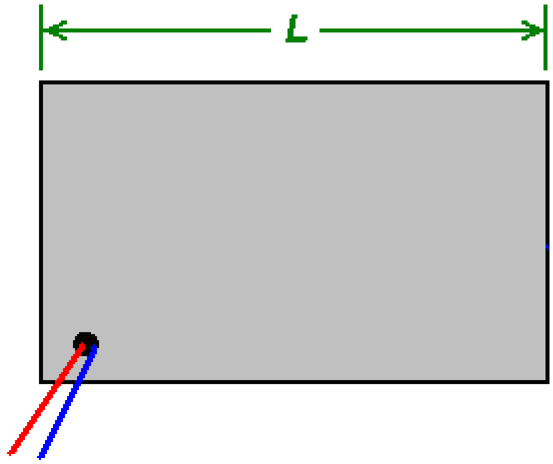
   

   Under the cover, there will be two connection terminals, one marked with a Plus symbol. Some of these panels come with wires already connected and a diode already soldered in place. If there is a diode already there and you are going to remove the cover permanently, it is advisable to embed the diode region in epoxy resin as the diode leads are unduly flexible and could break easily.

   If there are not wires already attached, then you need to solder a wire to each of these two terminals. If you do not know how to solder, and don't have a friend who can, then you can learn quite easily. On the web there are several videos showing how to do it. The connecting wire used should not be solid core but should have several tiny strands of wire inside the insulation. The wire should be able to carry at least 1-amp and ideally two or three amps. The thicker the wire, the better electrically but the more difficult it is to solder. The convention is to have a red wire connected to the Plus and a black wire connected to the Minus of the panel, but so long as you know which wire is which, you can use any colour of wire that is convenient. Even if you forget which is which, a voltmeter will tell you which is the Plus when light shines on the panel. These wires need to be about 600 mm. (2 feet) long.

3. Pass the two wires through the hole drilled in the solar panel backing sheet and with the hole positioned at the bottom left. Attach the sheet securely to the back of the solar panel using a good quality adhesive. I prefer to use Impact Evostick or epoxy resin for this, but each constructor will have his own preferred adhesive.

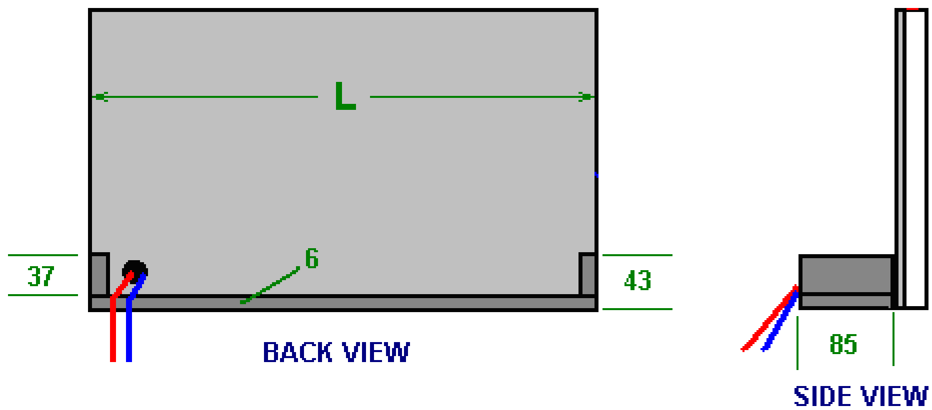
   You don't need the plastic cover which can slide over the terminals and it can be discarded. It is far more important to make good electrical connections to the terminals rather than bothering about keeping under the plastic cover which usually has very, very little clearance and which can get in the way of the backing sheet. The result should look like this:



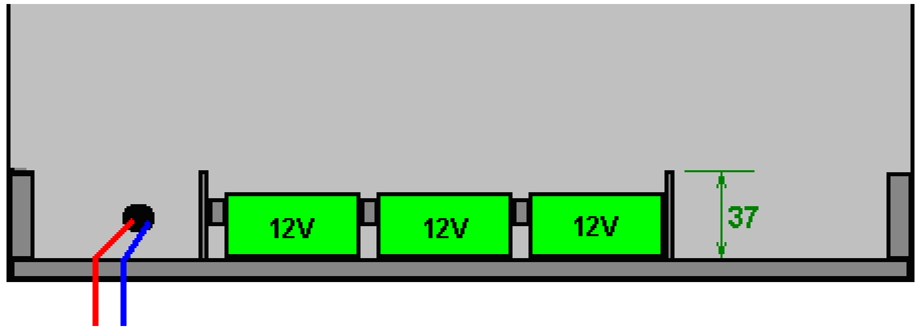
4. We now need to construct the housing for the batteries and other components. For convenience of description, I am going to assume that your sheet material is 6 mm thick. In America, that would be a thickness of one quarter of an inch. Cut a strip of the sheet material "**L**" long ('L' being the length of your particular solar panel). The width of the strip should be width of the battery box (typically 79 mm) plus one thickness of the material, which, with 6 mm thick material is likely to be 85 mm.

5. To make the ends of the box, cut two small strips with a length of that 85 mm (or whatever) and a width of 7 mm greater than the depth of your battery boxes, which are normally 30 mm deep, making the strip typically, 85 mm x 37 mm.

6. Epoxy these three strips to the bottom of the panel backing sheet to form an 85 mm wide, shallow channel like this:

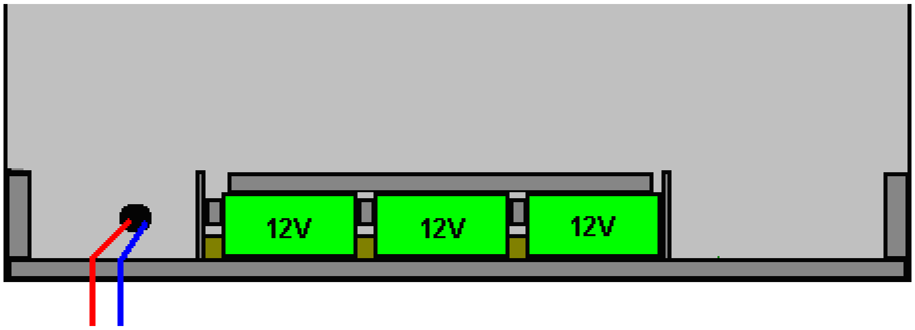


7. Using the same sheet material (or thinner material if convenient), cut two 70 mm x 37 mm strips, and epoxy them one on each side of the three battery boxes. The battery boxes need to have the batteries inserted and the connectors attached to them to ensure that the spacing is right. These dividers connect to the solar panel backing sheet, leaving a gap on the near side as wires have to run from left to right past those dividers. The result should be like this:

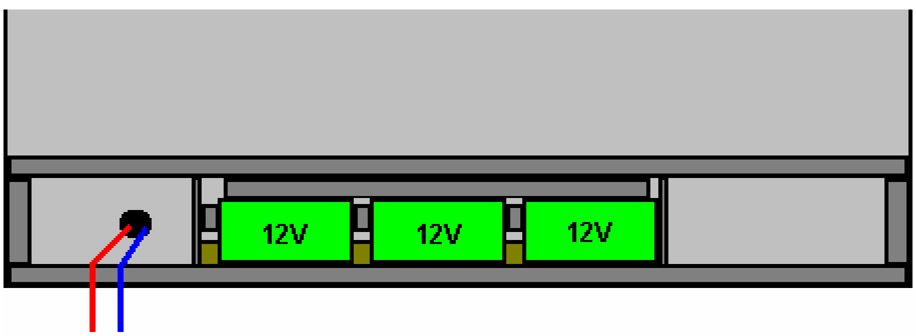


It is important that the batteries are secured so they cannot move at all. As shown above, they can still swivel through an angle due to the gap created by the battery connecting clips. To prevent this, three strips of timber or other suitable material should be attached very firmly to the base to hold the batteries rigidly in place, as shown below.

8. Next, cut a strip of your 6 mm. thick sheet, 65 mm wide and slightly less than the gap between your two dividers. This strip is to hold the batteries securely in place and still allow room for wires to be run past the batteries. The strip will **not** be attached to the solar panel sheet although it will be positioned very close to it. Check that it fits in place. The gap will be on the near side to make the final wiring easier:



9. The next step is to cut the top strip which will hold the lamp, switches and variable resistor. While the lamp fitting is quite light, the length of the arm is so very much greater than the diameter of the screw thread which attaches it to the top plate that any load applied to the lamp arm when adjusting its position, generates many times that stress in the area of locking nut holding it in place. Because of that stress in such a small area, it is suggested that the top plate be particularly strong. A strip of laminate flooring material is very tough and being only 7 mm thick, it is not difficult to work with, so cut a strip to run across between the two end pieces like this:

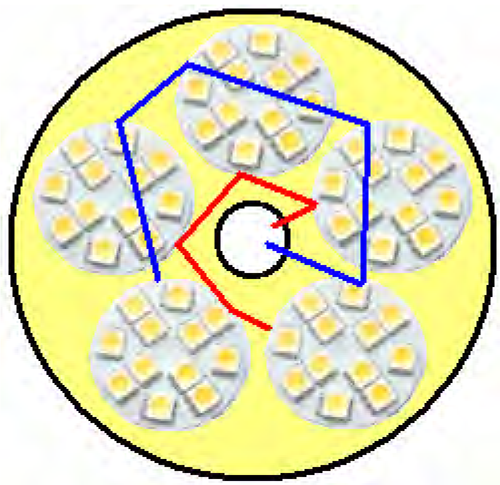


The objective here is to enclose the batteries so that they cannot move, nor can any individual AA cell move out of position. The laminate flooring strip will be used face down as the underside is normally a conservative and attractive matt finish which is particularly suited to this project.

10. It is much easier to work on the laminate strip before it is attached in place, so we will drill the holes for the lamp column and the variable resistor, and cut out the rectangular holes needed for mounting the two rocker switches. In the UK, the rocker switches and variable resistor look like this:

The switches need a rectangular hole of 13 x 19 mm, while the variable resistor needs a 10 mm diameter circular hole and the lamp shown also needs a 10 mm diameter hole. Hold the laminate strip in place and mark the locations carefully, making sure that each item will not foul anything underneath before cutting out the various apertures. Slide the knob on to the shaft of the variable resistor and note the length of shaft inside the knob. Cut the shaft, leaving that same length of shaft remaining. Attach the variable resistor and switches to the laminate strip and slide the knob on to the remaining variable resistor shaft. The skirt of the knob should now be close to the surface of the laminate strip and a V-shaped piece of material can be glued in place to give a reading point for the scale on the knob.

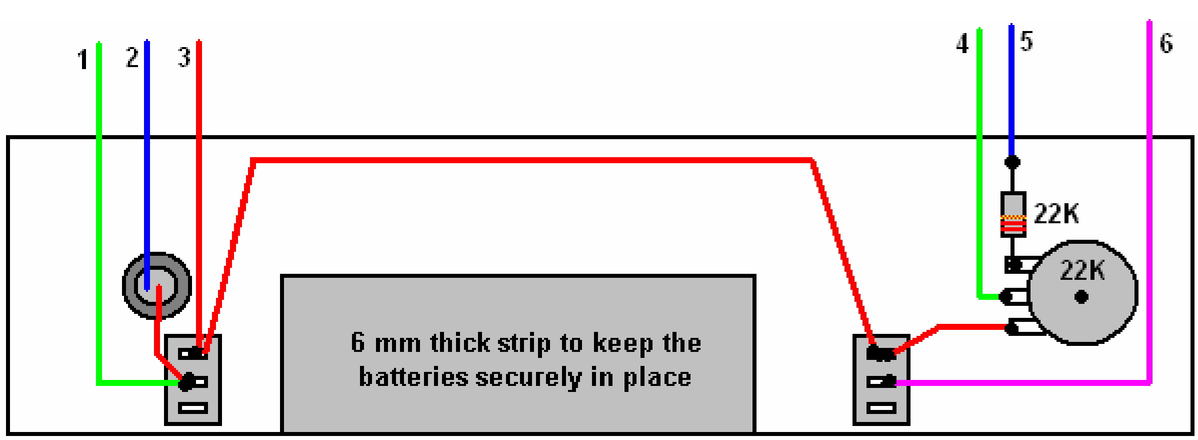
11. If a commercial lamp is being used, then it needs to be taken apart now and prepared for this project. The base is removed, the bulb holder is removed and two wires are fed through the remaining shaft so that the LED arrays can be fitted. A circular disc of any kind of rigid material is cut, the diameter being slightly less than the diameter of the mouth of the lamp. Four or five LED arrays (depending on your choice of numbers) are glued to the disc and wired up in parallel with all of the plus wires connected together and to one of the wires feeding through the shaft of the lamp, and all of the minus wires connected together and attached to the other wire passing through the column of the lamp:



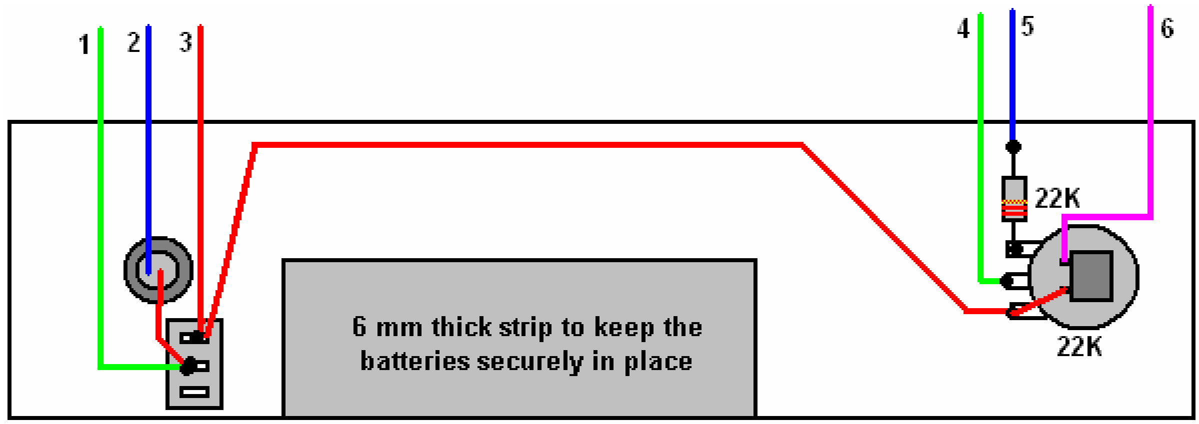
This disc is then eased through the mouth of the lamp shade where it sits about 10 mm below the rim of the shade due to the taper of the shade. Position the disc so that it is square on to the rim of the shade and glue it in position. If frosted plastic is to be used, then mark the sheet around the rim of the shade and cut out the resulting circle, drill some ventilation holes in it although the LED arrays always run cold, and glue the frosted plastic disc to the rim of the shade.

12. Connect the wires to the switches and variable resistor mounted on the laminate strip, and then position the lamp in its hole and fix it in place by tightening one nut. There are two nuts but I have found the locking nut to be less than adequate, so epoxy the tightened nut to the remainder of the screw thread as that keeps the nut securely in place and yet allows the lamp to be rotated quite easily.

To make construction easier, before placing this laminate strip in place, if a separate On/Off switch is being used, then make the connections shown here:

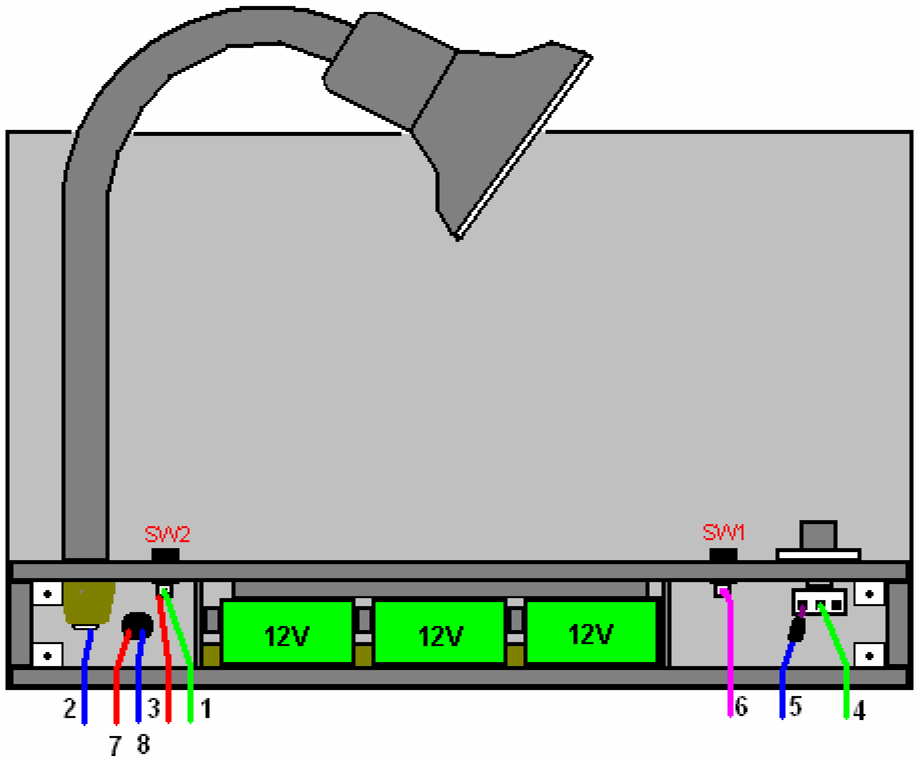


If a variable resistor with an integral On/Off switch is being used, the these connections become:



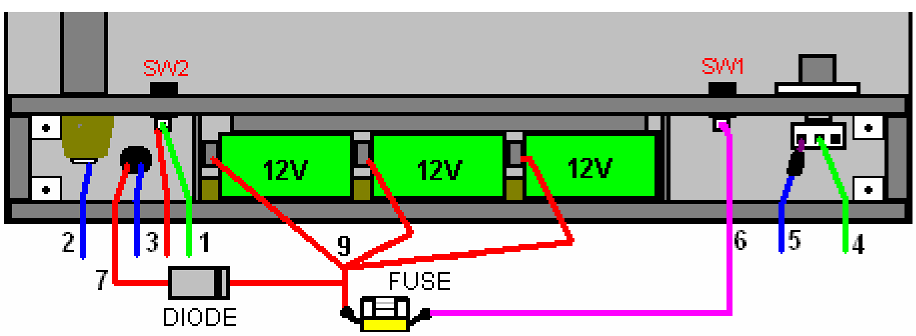
The 22K fixed resistor (colour bands red/red/orange) is connected to one of the outer tags of the 22K variable resistor and wire "5" is connected to the other end. I suggest that all wires coming off this panel are at least 200 mm (8-inches) long. A separate wire "4" is connected to the centre tag of the variable resistor, and the third tag is connected to the On/Off switch as shown, and when making the connection to the switch, also connect another wires to that same tag. The extra wire is run across and connected to the top tag of the "boost" switch along with another wire "3". The wire connecting the switches is run close to the outer edge of the laminate strip so that it will clear the battery packs, as there is very little clearance past the batteries in order to hold them tightly and prevent them moving. The negative wire of the LED arrays is connected to the centre tag of the "boost" switch and another wire "1" is taken out from that central tag. When connected up as shown, there will be six wires coming out from the laminate strip and I will refer to these wires by the numbers shown above, so it might be worthwhile actually tagging those wires temporarily with those numbers.

13. If inclined, apply some glue to the variable resistor and switches (on the underside of the laminate strip) but do **not** epoxy the strip in place until the final connections have been made and the circuit confirmed to be working, including the solar panel charging the batteries.

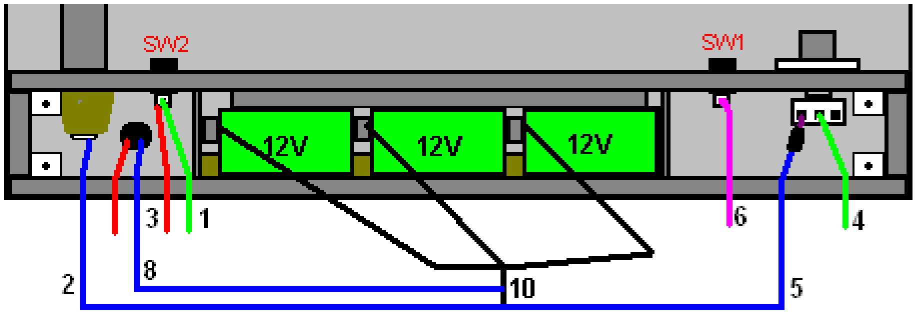


14. The final connections which need to be made are:

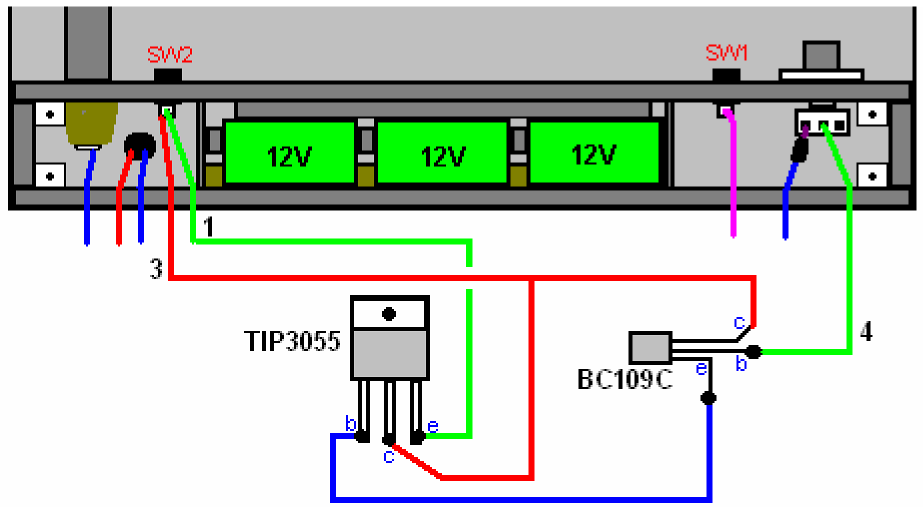
a. The non-striped end of the diode is connected to the Plus wire "**7**" coming from the solar panel and the Plus wire of the three sets of batteries are connected together "**9**" along with the striped end of the diode and one end of the fuse (if no fuse is being used, then wire "**6**" is connected directly instead of to the other end of the fuse). A fuse rated at 1-amp would be suitable as the working current should only be one sixth of that:

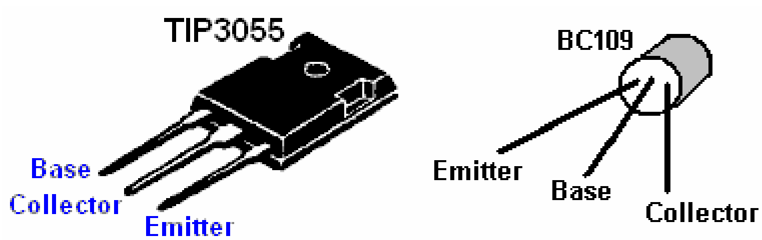


b. Remove the insulation from the Minus wires coming from all three battery packs and twist them together ("**10**"). Connect wires "**2**", "**5**" and "**8**" to this collection of Minus wires and solder them together make a solid joint, and insulate the joint with duct tape, epoxy, or any other robust form of insulation:



c. To complete the wiring, the three remaining wires are connected to the two transistors like this:





Please be aware that transistors are heat sensitive and so soldering transistor leads needs to be completed quickly and where possible, the transistor lead held in a pair of pliers while the solder joint is being made and when it remains hot, as the pliers diverts the heat away from the transistor.

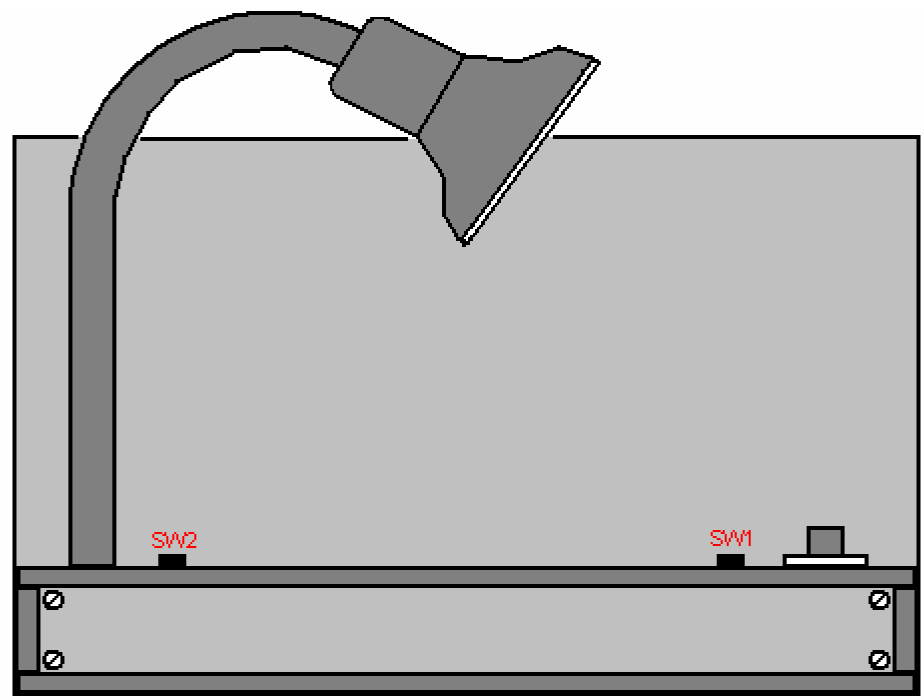
The desk lamp is now ready to be tested.

15. If the light goes on and off when the On/Off switch is operated and the light intensity alters when the variable resistor knob is turned, and if the light level increases when the “boost” switch is closed, then all is well and the laminate strip can be epoxied into its final position. If the desk lamp does not operate as it should, then follow the test procedures below, until the desk lamp is fully functional and then continue with step 16.

16. Epoxy the laminate strip in position and glue four short lengths of timber in the corners. These lengths of timber should reinforce the joint between the four pieces which form the housing and the solar panel backing sheet, and they should stop off 6 mm short of the outside edge so that they both support the final piece as well as holding it in place.

17. Connect a voltmeter across the LEDs and rotate the knob of the variable resistor to get 9V across the LEDs and note or mark the reading on the scale attached to the knob. This is the initial setting for the knob when starting with a fully charged battery.

18. Finally, insulate the transistor circuitry with tape, plastic or whatever method suits you and secure it in place with a little adhesive to make sure that the wiring does not break if the unit is moved a lot. Then, a strip is cut to close the box and screwed at the corners using woodscrews or bolts:



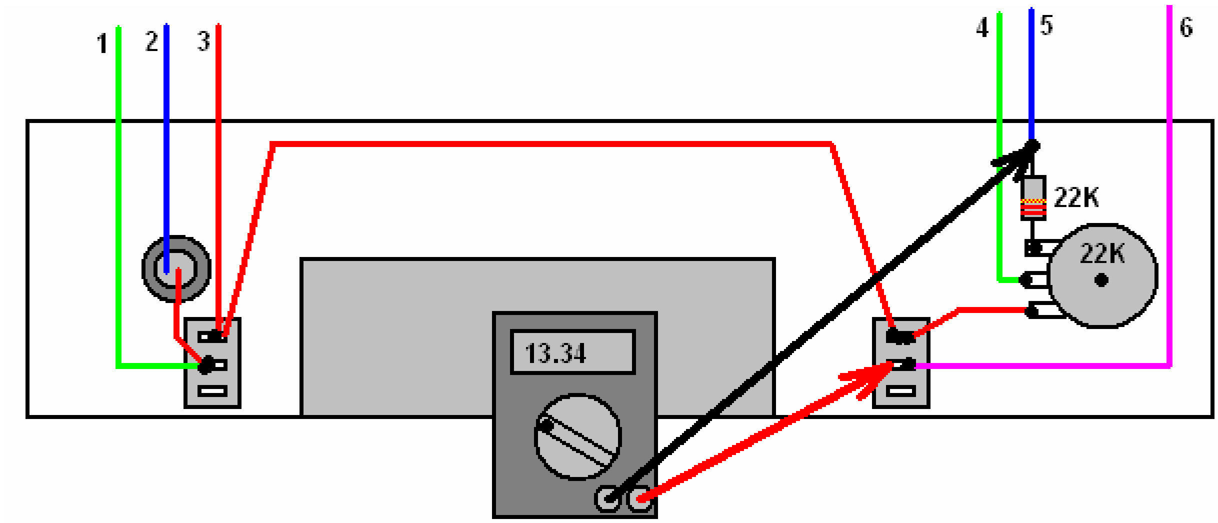
The gap between the two rocker switches provides an easy gripping point for carrying the unit from place to place.

While this solar desk lamp can be built this way at quite reasonable cost even with one-off prices on individual prices, a really major improvement is achieved if they are being manufactured, especially if made in China. Firstly, all the effort of making the housing disappears as a cheap custom plastic case does away with all that time and effort as the solar panel has its wires connected, fed through the existing hole in the case and then the panel is just pushed into place. The battery packs are then assembled and pushed into place, the circuit connections made and the case clicked closed on its own or held in place by self-tapping screws. The component prices drop enormously with bulk purchasing, reducing the not unreasonable one-off price by a major factor, especially since wages in China are very low by our standards. The result is an attractive, useful product with a very large market and a unit price capable of taking full advantage of that large sales base.

Test procedures:

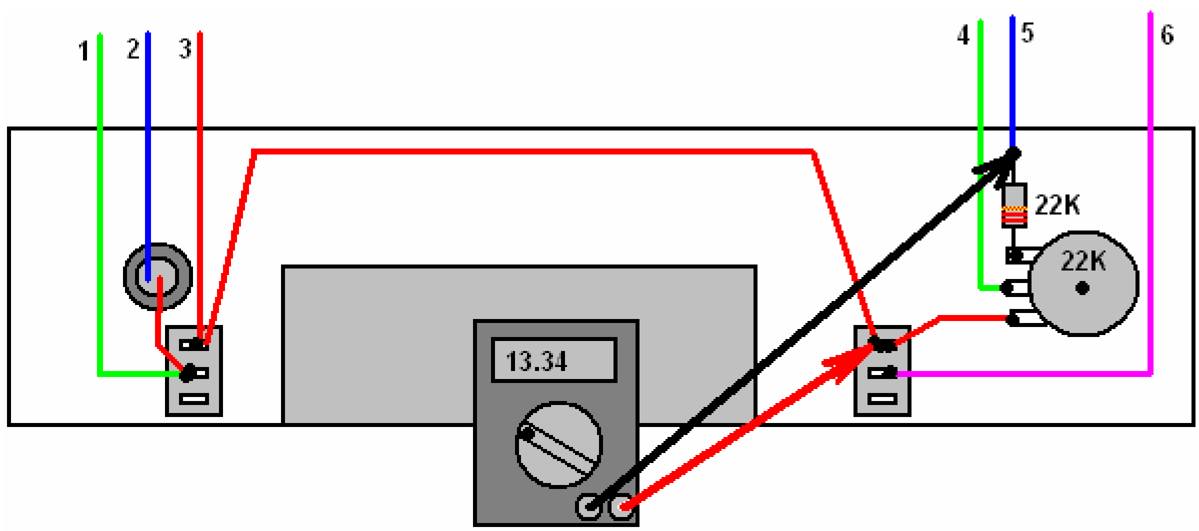
If the unit does not work straight off, then step-by-step tests are needed to locate and fix the problem. These are simple, common sense tests. If you do not have a voltmeter, then it is worth purchasing one as they are now very cheap.

1. We need to confirm that the battery has the electrical power to run the lamp, so open the “boost” switch “SW2” and connect a voltmeter as shown here:



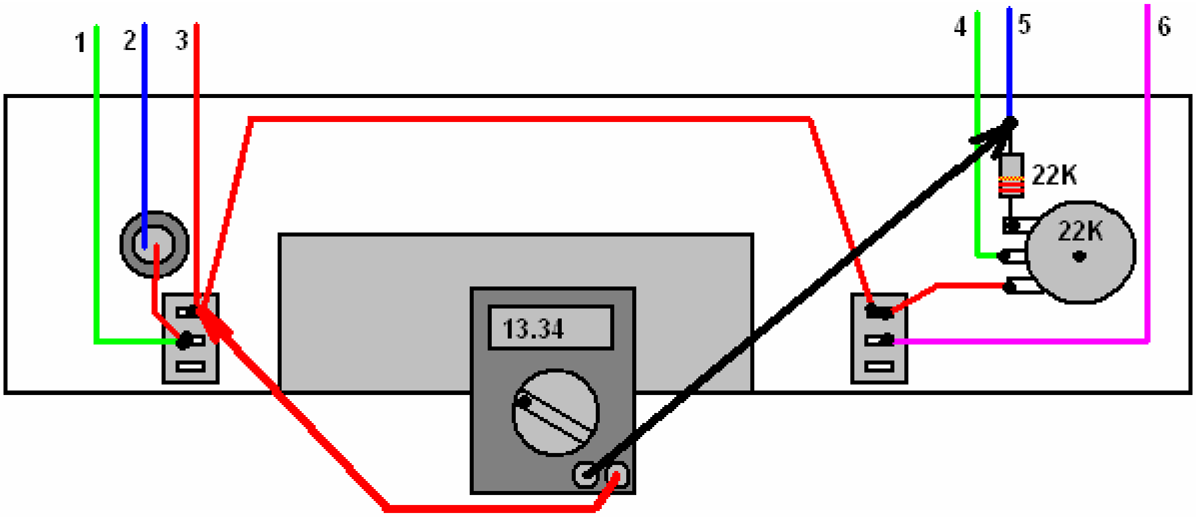
This connects the meter directly across the battery and so the meter should show some realistic voltage around the 12V mark. If it doesn't, then lift out one of the battery holders and check that the batteries are charged and confirm that the fuse has not blown. If the fuse has blown, then it will because of excessive current, probably caused by a direct short-circuit where the battery Plus is being connected directly to the battery Minus. Check the wiring from the battery to these two points until you do get a sensible voltage reading.

2. Next, connect the meter like this:



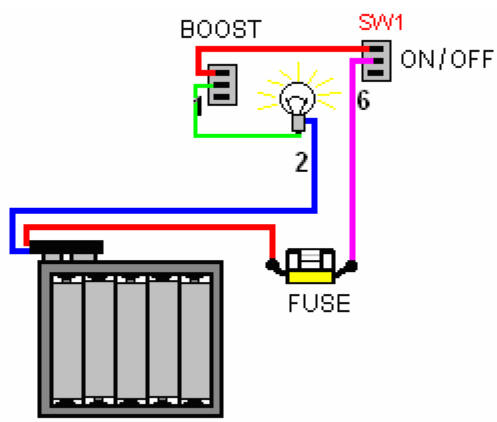
and confirm that the voltage appears and disappears when you operate the On/Off switch. If it does not, then it is highly likely that your connections to the two switch tags are touching and stopping the circuit being switched off. If that is the case, then adjust one of the connections to cure the problem and leave the On/Off switch switched On.

3. The next step is to connect the meter like this:



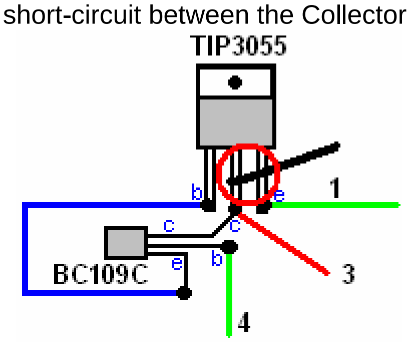
The same voltage reading should be seen. If it isn't, then the wiring between the two switches is almost certainly defective and needs to be corrected.

4. Now close the boost switch, and the light should come on at full intensity because the transistors are being bypassed and the battery connected directly across the LEDs. The circuit is then:



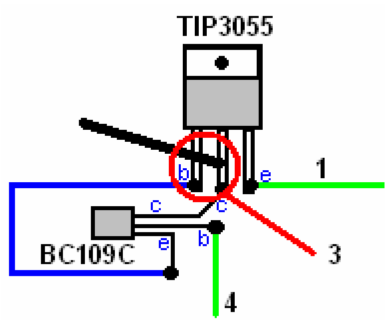
If the light does not come on brightly, then check the wiring around this path – battery Plus – fuse – wire "**6**" - On/Off switch – boost switch – wire "**1**" – LEDs Positive – LEDs Negative – battery Minus (wire "**2**").

5. When the boost switch circuit is working correctly, turn the boost switch off and check the operation of the transistors. First, use a screwdriver to short-circuit between the Collector and Emitter of the TIP3055 transistor:



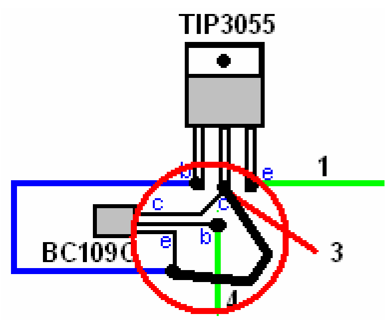
This should have exactly the same effect as closing the boost switch but it is testing your wiring connections to the power transistor and simulating the TIP3055 being switched on fully. If this does not produce the full light output, then you need to check (visually) the wire "1" connection between the centre tag of the boost switch and the Emitter of the TIP3055 transistor. Also check the connection between the Collector of the TIP3055 transistor and the top tab of the boost switch as one or both of those connections has to be faulty if the boost switch works when you switch it On.

6. When you have corrected the wiring and short-circuiting between the TIP3055 Collector and Emitter turns the light on at full brightness and the light-level control variable resistor is still not controlling the light level, then short-circuit between the TIP3055 Collector and Base:



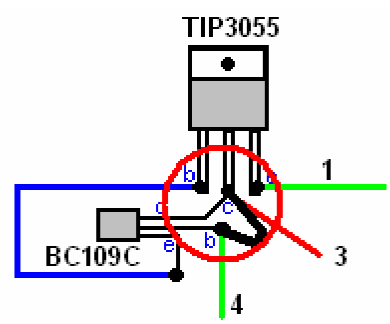
This bypasses the BC109C transistor and should produce the maximum light level. If it does not, then the TIP3055 transistor is defective. This is highly unlikely as the TIP3055 is enormously robust and can survive all sorts of mishandling. However, if this test definitely fails, replace the transistor without connecting its Base and confirm that the new one switches the light on fully when you short-circuit the Base to the Collector. Then connect the BC109C and repeat the TIP3055 Base to Collector short-circuit test to confirm that it is still working with the BC109C in place.

7. If the light-level control still does not work, then short-circuit the BC109C transistor's Emitter to its Collector:



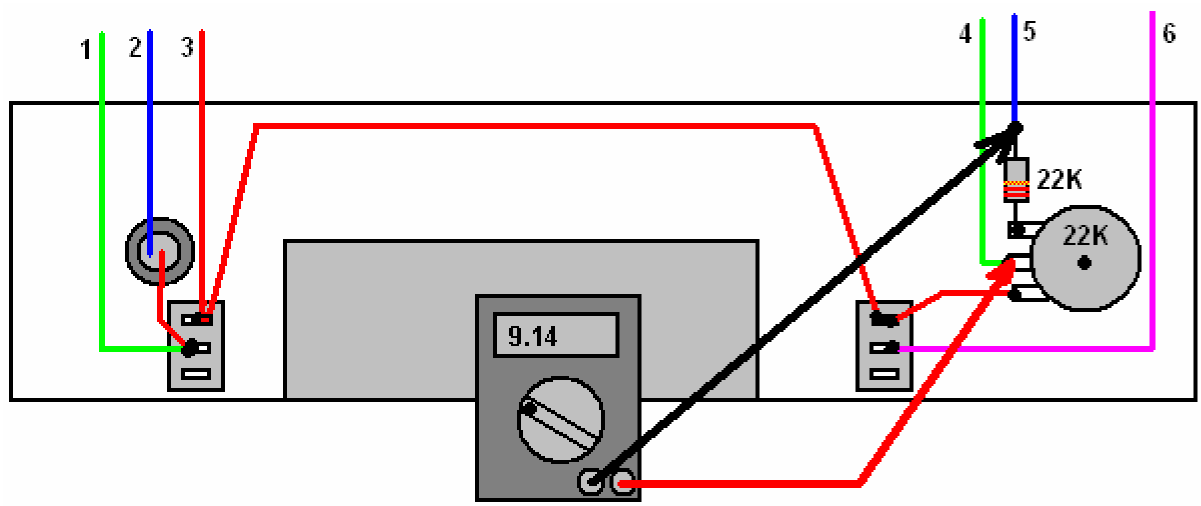
This checks the wiring between the Emitter of the BC109C and the Base of the TIP3055 (shown in blue in the diagram above). If the light comes on at full brightness, then the wiring is okay, otherwise, correct that connection.

8. Now we test the operation of the BC109C transistor. Turn the light-level control knob down to its minimum and short-circuit the BC109C Base to its Collector:

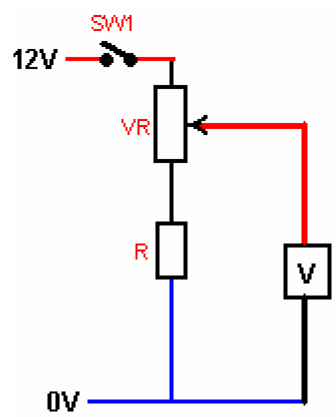


With the short-circuit in place, the light should be fully on and with the short-circuit removed (or if its base is short-circuited to its Emitter), the light should be fully off. If this does not happen, replace the BC109C transistor and repeat the test.

9. If the light-dimming control still does not control the light level, then the wiring of the variable resistor has to be suspect, so connect your voltmeter like this:



This is making a connection between the negative line and the slider of the variable resistor, and that should allow the slider to adjust the voltage fed to the BC109C transistor:



This is the test and unless there is a major problem with the resistor "R", the variable resistor "VR" or the transistors short-circuiting the slider of the variable resistor, your voltmeter should show your full battery voltage when turned up as high as possible, and an evenly falling voltage to around half that voltage at the other end of the variable resistor shaft movement.

If this does not happen, then you need to check over the wiring connections for the variable resistor, fixed resistor and connection to the base of the BC109C transistor.

Components for home-build:

1. One 10-watt, 12-volt solar panel.
2. Thirty AA-size, 1.2V NiMh batteries with a capacity near 3000 mAHr if possible.
3. Three AA battery boxes each holding 10 batteries.
4. Three battery clip connectors to fit the battery boxes.
5. One 1-amp diode type 1N4007 or similar.
6. One 22K Linear variable resistor and graduated knob to fit the shaft diameter.

7. One 10% quarter watt (or higher rated) 22K resistor (colour bands red/red/orange)
8. One BC109C transistor.
9. One TIP3055 transistor.
10. Five G4 LED arrays.
11. One desk lamp (optional)
12. Two rocker switches.
13. One fuse holder (of any type) and a 1-amp fuse.
14. Ten metres of insulated, stranded wire rated for 1-amp or higher current.
15. Rigid sheet material 6 mm thick (possibly MDF).
16. One small off-cut of laminate flooring 85 x ***L*** (typically 337) mm
17. Adhesive.
18. Rubber feet or soft material for the underside of the desk lamp.

Notes:

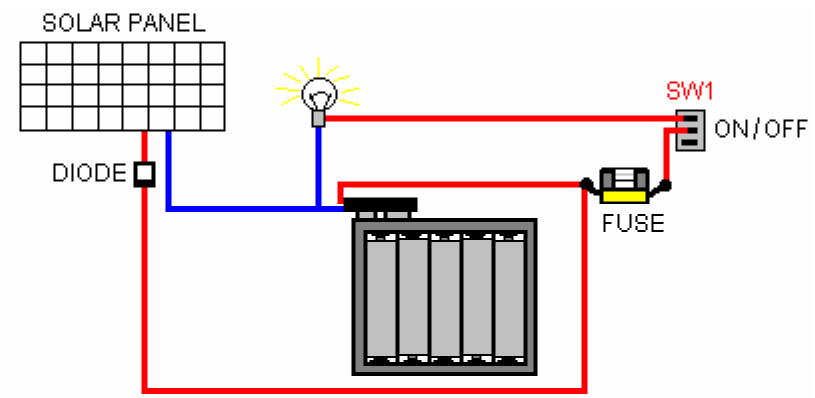
Rocker switches are generally cheaper as the Change-over version with three switch tags, and so these have been shown. For this design, only On/Off action is needed. Press the "1" end of the rocker down, and the two contacts used are then the two farthest away from the "1".

The TIP3055 transistor is the more recent version of the 2N3055 and is a particularly good transistor for this application being much easier to connect to. While the TIP3055 is strongly recommended, other power transistors may be used. No heat sink is needed if the transistor can handle 8 amps or more (the TIP3055 can handle 15 amps and 90 watts).

The BC109C transistor has a very high gain between 200 and 800, which is useful in this application, but a major advantage of it is that it switches off fully with pretty much zero leakage current, while I have some of the very popular 2N2222 transistors which don't switch off properly at all and so are effectively rejects. Most alternative transistors are highly inferior to the BC109C and so, if it is not readily available, then it is worth ordering.

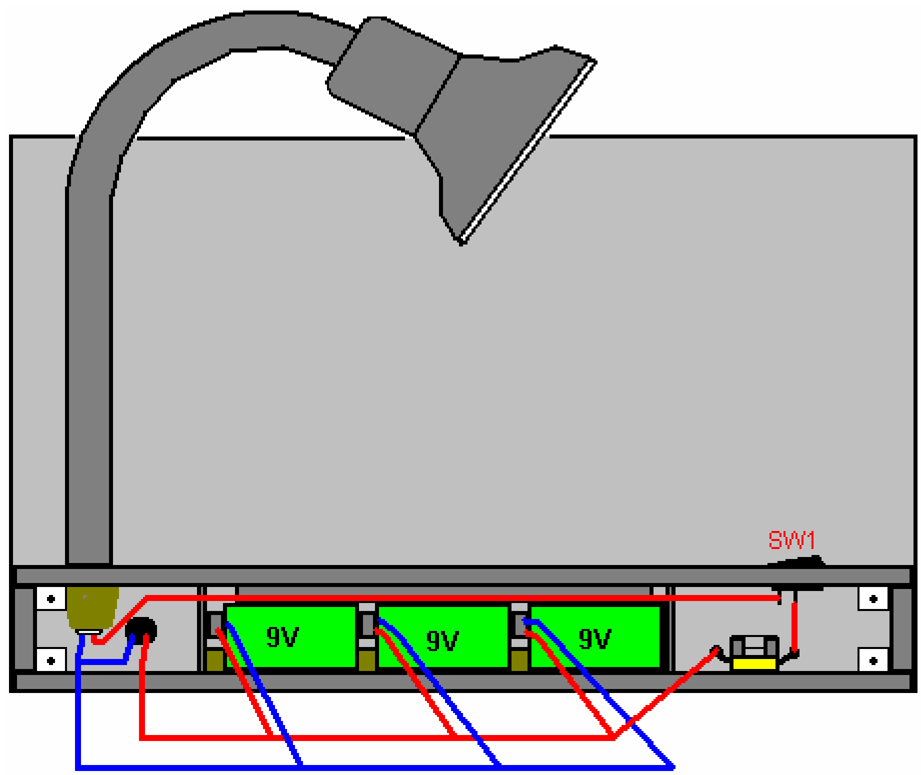
The 1N4007 diode is the cheapest readily available diode. It is rated for 1000-volt operation which is of course, of no interest here and so the lower voltage 1N4001 through 1N4006 diodes are perfectly suitable although slightly more expensive as they are less popular. While one diode is shown in this document, people who are expert in electronics are inclined to use three connected in parallel as that passes current more freely. That would cost an extra 6 pence at 1-off prices in the UK.

Some people are really put off by electronics of any kind, so here is a version of the solar desk lamp which effectively, has no electronics at all:

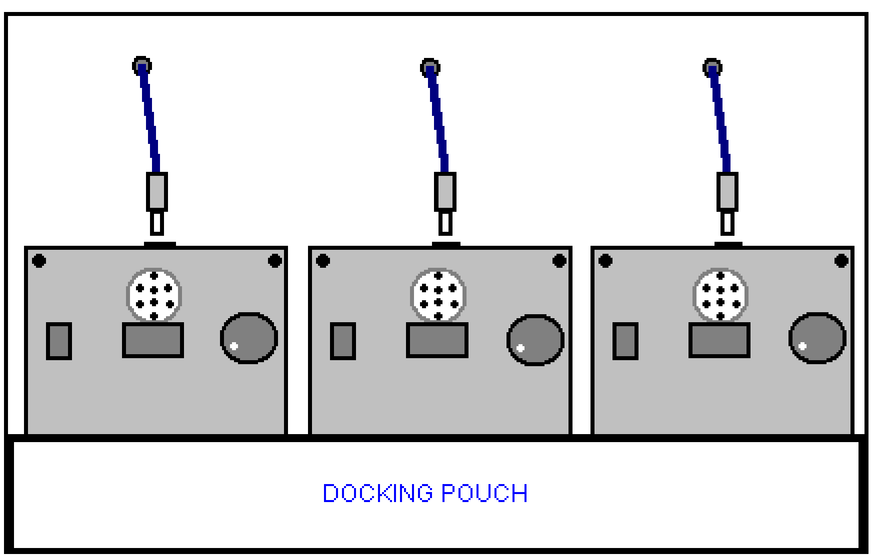


The only control on this version is the On/Off switch. As we no longer have any control over the voltage applied to the LED arrays installed in the lamp shade, and since that voltage controls dramatic changes in current draw, we need to reduce the number of 1.2V NiMh batteries from ten to seven. It is a matter of choice whether you use three or four sets of seven batteries. If 10-battery battery boxes are used, then a wire can be soldered across the gap left by the three omitted batteries.

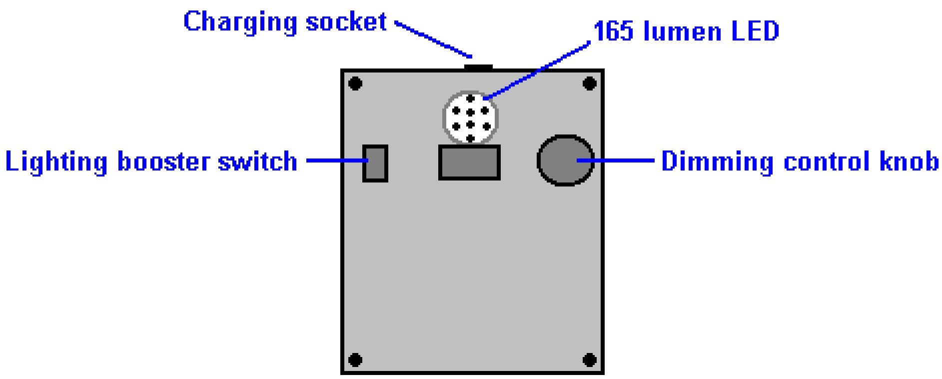
The general construction is the same as before, with a rocker On/Off switch being installed instead of the variable resistor. As with all of these solar units, the important thing is to switch the light off when it is not in use, to avoid the next charging session being hindered by unwanted current draw through the light. The general layout of the unit can be the same:



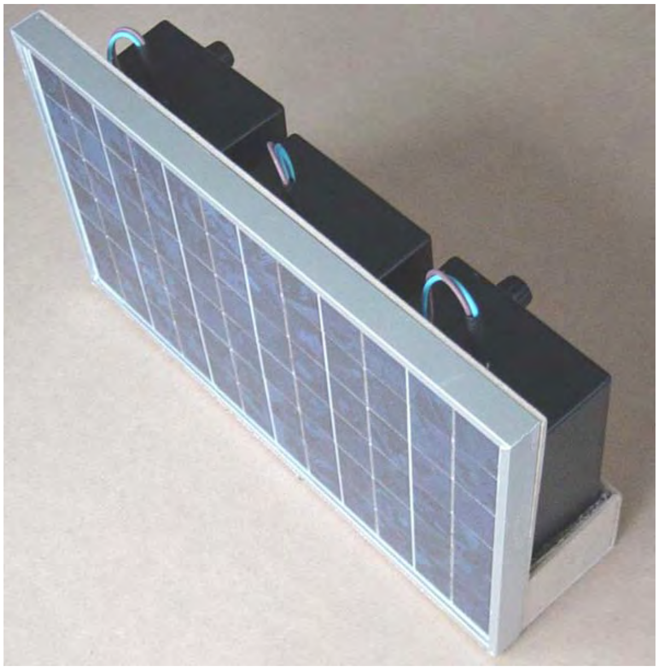
There are other variations which can be low-cost and very versatile. For example, instead of connecting the three battery packs together, they can be kept separate from each other, individually housed with the same circuit, each driving one of the LED arrays:



Here, three identical units are charged from the solar panel, which can be any size or wattage, although a ten-watt panel would be considered to be the minimum for daily use. Each unit is in effect, just a wide-beam, high-intensity, high-capacity solar torch which can be dimmed and which will stand securely when unsupported. It has the advantage that the units can be constructed one at a time, and if necessary due to time constraints, or perhaps, very poor daylight, just two or even one unit can be charged from the entire solar panel output. If manufactured and sold, then the units could be sold separately, allowing a lighting system to be extended and improved when additional funds become available (or when the user has tried one unit and discovered how effective it is). Each unit is easy to understand and use:



A built unit of this type looks like this from the front:

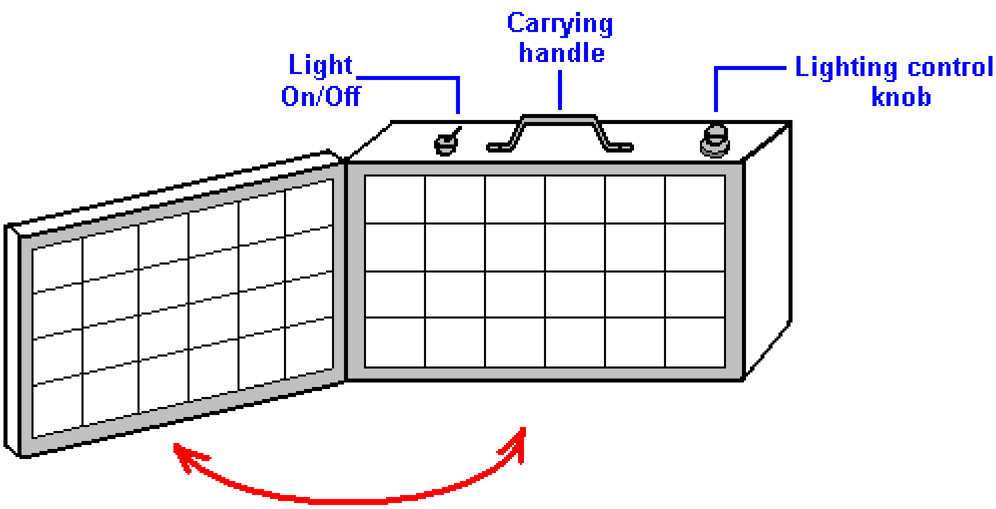


and like this from the back:

While these particular units have just one of the LED arrays each, tests run since that construction show that with manual dimming control, two LED arrays per unit would be more satisfactory. Also, if the second LED array is mounted on the side of the box, then the lighting angle increases from 160 degrees to 250 degrees which should be helpful for indoor lighting of a room. The units could, of course, be used in different rooms simultaneously and there is the option of carrying one around for lighting anywhere. Again, the construction is very simple and the same circuit as for the desk lamp shown above, can be used in each box.

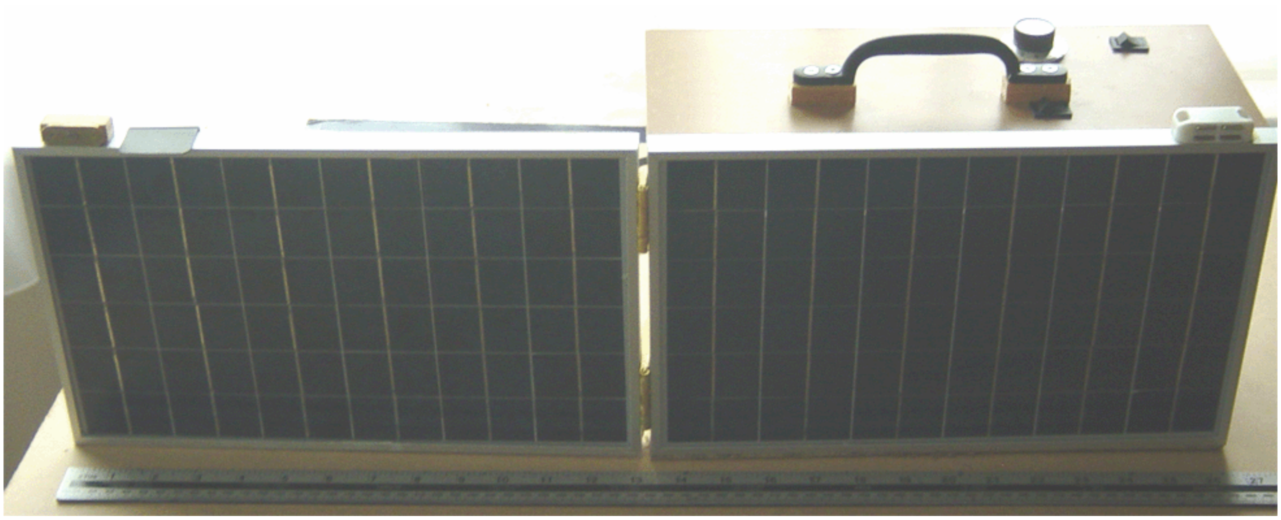
If good-quality NiMh AA-size batteries are used, each of the mobile units is capable of providing good light for eight hours, which means that if it gets dark at 4 pm (16:00), lighting is available until midnight as a minimum, at which point in time, the user should be going to sleep.

If a very powerful single source of lighting is needed, it is possible to use a larger solar panel, or for a more compact unit, two of the 12-volt 10-watt panels shown above. The arrangement can use the same simple manual control of lighting level and the same booster switch for even greater lighting for a few minutes. The arrangement can be like this:



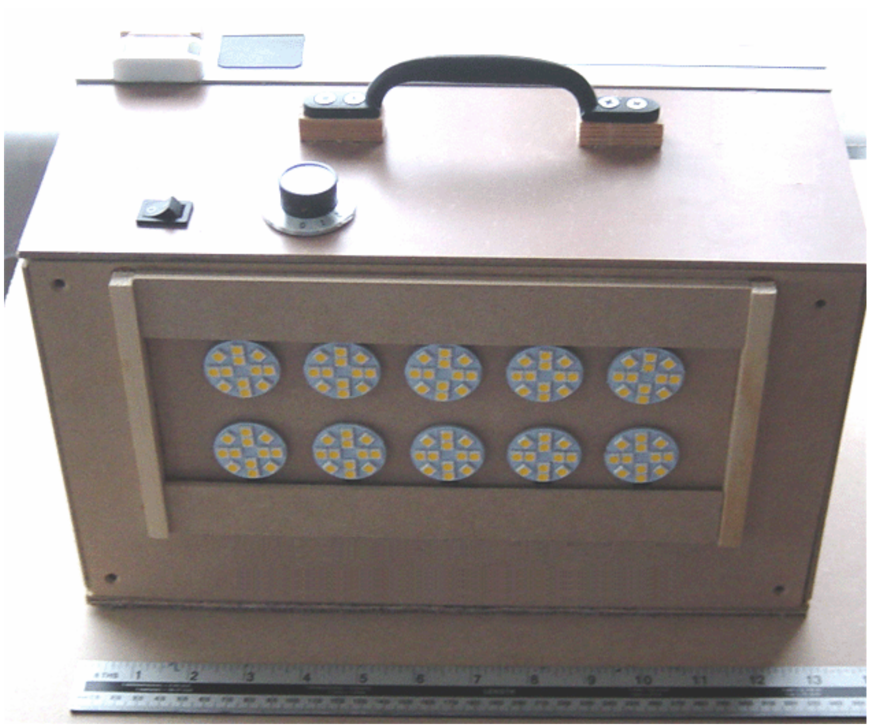
When closed over, the face of solar panel P1 faces that of solar panel P2, protecting both when the unit is being carried.

An early prototype of this style of construction with the panels open, looks like this:



A magnetic catch is used to hold the hinged panel securely closed when the unit is being carried and a small flap is attached beside the magnetic catch to overcome the slightly excessive looseness of the hinges. The unit does not need to be as deep as this experimental model was made.

The front view of the unit, ready to receive the frosted plastic cover for the LED arrays, looks like this:



The underside of the unit is covered with a soft protective layer to ensure that it does not scratch any surface on which it is placed. In order to avoid the need for overcharging circuitry, this unit has six battery packs and so, having ten LED arrays, the duration of lighting is about the same as that of the desk lamp, although obviously, the light output can be much greater. With the greater lit area of ten LED arrays, a lower actual current can be used while still providing a good level of lighting.

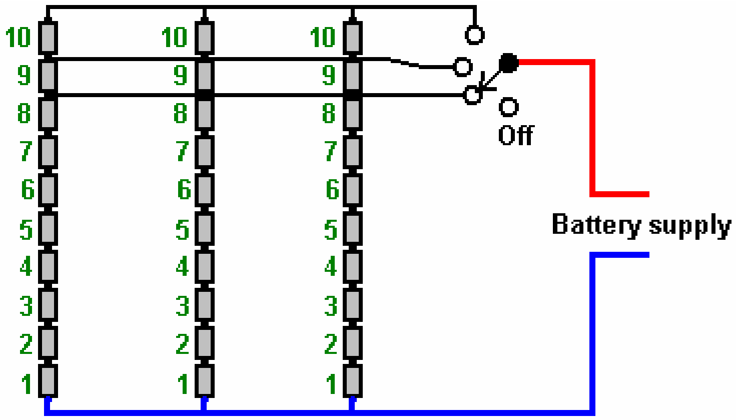
With fully charged batteries switched to the 'boost' setting, this unit puts out more light than a 100-watt incandescent bulb powered by the mains. Tested in daylight, that looks like this:

Let me stress again, that these units are not difficult to build and they don't call for any great knowledge of electronics.

Alternatives:

While the systems shown above are effective and reasonable cost, it is possible to make them more efficient. With battery packs of ten NiMh 1.2V AA cells, when fully charged, we get more than 13-volts, when we actually want 9-volts for effective lighting. We get this by using two transistors to drop the voltage down to 9-volts. The current flow is about 135 milliamps and so, the voltage drop of 4-volts at that current flow is a power loss of 540 milliwatts, which is a significant percentage of the power used to generate the lighting.

By arranging things in a different way, we can reduce that power loss very considerably, IF we don't mind the user being involved in controlling the lighting level. We could do this by tapping into our 10-battery pack and using an extra 3-way switch which allows us to start off with 8 batteries and when the voltage starts to drop, switch to 9 batteries as the extra fully-charged battery would make a major difference to the lighting. Then when the voltage of the 9 batteries starts to get low, the tenth battery can be switched in:



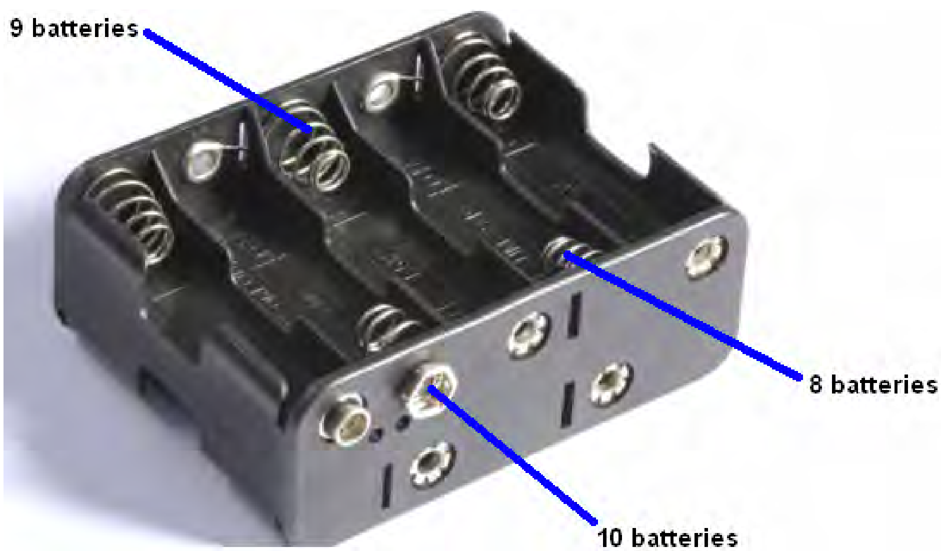
Whether or not this is worth doing is a matter of opinion in spite of the longer and/or brighter lighting. With 8 batteries in use, the power saving is 350 milliwatts and with 9 batteries the power saving is 175 milliwatts. The lighting power is 1215 milliwatts, so these represent 29% and 14.5% of that power. If it is decided to use this arrangement, then the battery boxes can be tapped with additional output wires connected between batteries 8 and 9 and between 9 and 10.

The operational sequence would be:

1. Eight batteries switched in: variable light control.
2. Nine batteries switched in: variable light control.
3. Ten batteries switched in: variable light control.
4. Boost switch closed: fixed lighting level as batteries discharge to their minimum level.

Each of these switched levels gives a new lease of life to the lighting system, but it does require the intervention of the user, although that intervention is very minor.

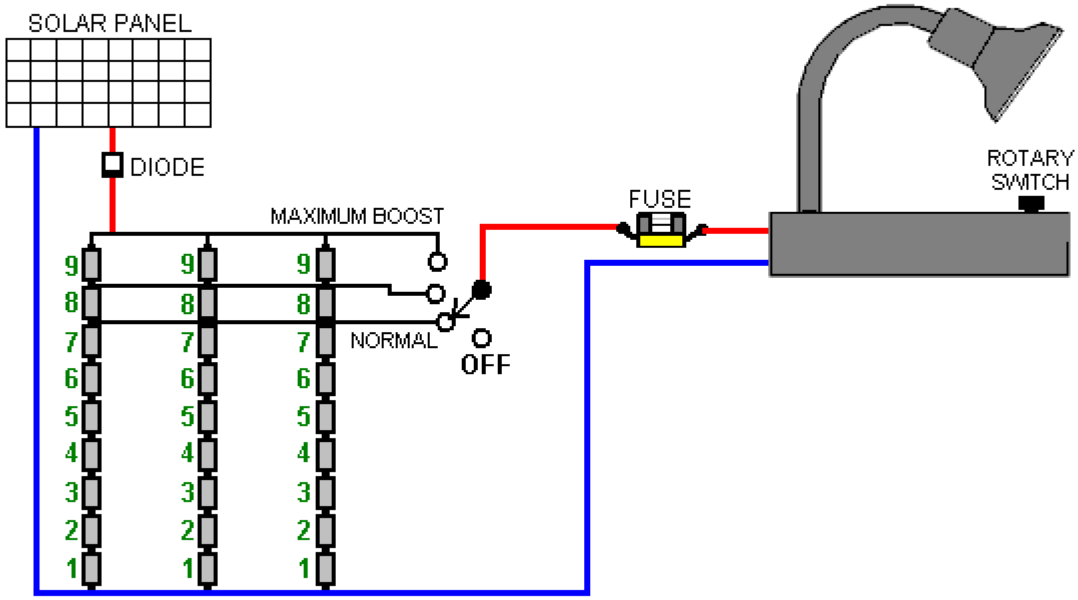
It does not matter whether it is the Plus end of the battery chain, or the Minus end which is switched. The way that the battery boxes are constructed, actually make it more convenient to make the two extra connections at the Minus end of the stack:



Medical usage

The applications of the solar desk lamp shown above are intended for home or office use. There is one other serious lighting requirement and that is for doctors working in isolated rural areas, far from any electrical grid but also, very far from fuel supplies for running a conventional generator which is the only known option for most of them. For example, it can take a doctor two days of travelling to get some more generator fuel. If we apply a slight alteration to the desk lamp and sacrifice the long period of lighting, we could boost the light output from 1000 lux right up to 2,700 lux for an hour or two of very brightly lighting. I can see no reason why two or three of those would not give more than adequate light for night time emergency surgery when placed on stands or suspended from the ceiling. Being self-contained and mobile, an assistant could hold and aim one to illuminate exactly where the light is needed.

The basic solar desk lamp operates off seven 1.2V batteries in series. Eight batteries in series would boost the light level to 1730 lux at the cost of much higher current draw and reduced period of lighting. Increasing the batteries to nine would raise the light level to a massive 2,700 lux with a current draw so high that there might only be lighting for perhaps one hour, but that doesn't matter in an emergency where a life could be saved. To achieve this emergency level of lighting all that is needed is an ordinary 4-way rotary switch which replaces the On/Off switch as it can do that job as well, otherwise the construction remains identical. The arrangement could be like this:



360 Degree Lighting for Africa

The desktop lighting unit described above is very effective for lighting in cold areas where houses have windows with glass in them and where the roof does not project much beyond the house wall. However, housing style is very different in places like Africa where strong sunlight is experienced all year round and so a house roof is likely to project well beyond the wall in order to give improved shade for outside seating.

Anna Brüderle's "*Solar Lamps – Africa*" marketing research published by GIZ GmbH Uganda, has raised many previously unknown facts which should result in physical design changes. To date, I have produced three solar prototype lighting units, but these have been based on recharging using light coming through a glass window. That is not really possible in the African environment surveyed, as it shows:

1. Using a solar panel indoors is not possible due to lack of windows and major roof overhang.
2. Using a solar panel light being recharged outdoors is liable to have it stolen.
3. Using an outside solar panel connected by a wire is liable to damage and/or child injury when at play.

The survey-area lifestyle has the following characteristics:

1. Seven people living in one building is not unusual and so 360-degree lighting is preferred.
2. The kitchen is normally separate and has no windows and yet needs meal-preparation lighting.
3. Burning a fuel for lighting is liable to cause poor health from the fumes produced.
4. Child education is hindered by lack of lighting.
5. Light usage is usually 3 or 4 hours at night plus 2 hours in the morning.
6. Tests with 100 lumen lighting level have been considered to be satisfactory.
7. Lamps are normally placed on the dining table during meals and hung from the ceiling at other times.
8. When carried outside, a narrow forward lighting arc of say, 90-degrees is preferred for safety.
9. Units with variable lighting levels are preferred but why is not specified – probably light duration.

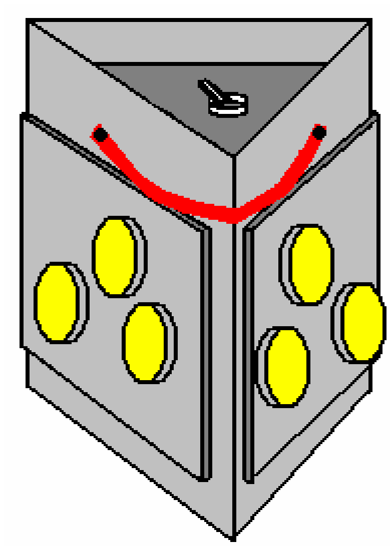
In these houses, there can be internal walls which do not reach the ceiling so that light in the central room spills over into the additional rooms.

These features call for a lighting unit which is:

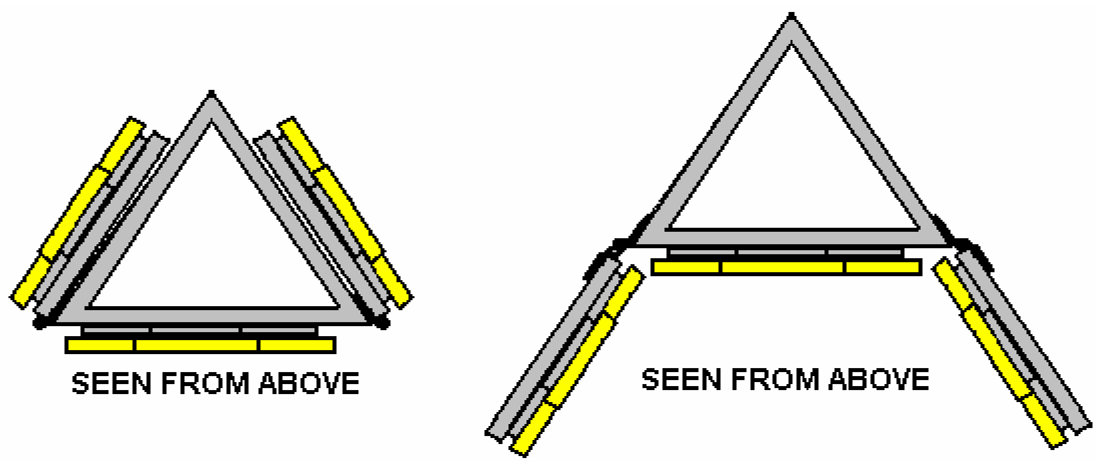
1. Able to provide 360-degree illumination.
2. Able to give a restricted 90-degree lighting arc when used outside.
3. Stable when standing on a horizontal surface.
4. Able to be carried comfortably.
5. Able to be suspended from a ceiling.
6. Able to provide considerably more than 100 lumens for the lighting periods used.
7. Is cheap enough to be bought.

8. Is very robust.
9. Is free of any glass components as hurricane lamp accidents are mainly cuts from broken glass.

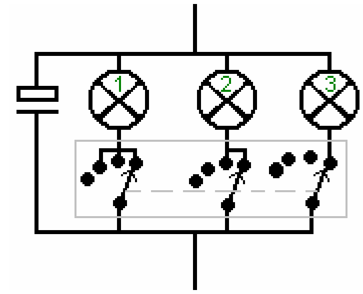
It is possible to design a lamp which meets all of these requirements although low cost is the most challenging requirement. To meet the user's needs, it might be possible to use a housing like this:



The triangular shape makes for easy construction and is very robust from an engineering point of view. It also cuts down the number of faces needed for 360-degree lighting to just three. The versatility is increased greatly if two faces are hinged:

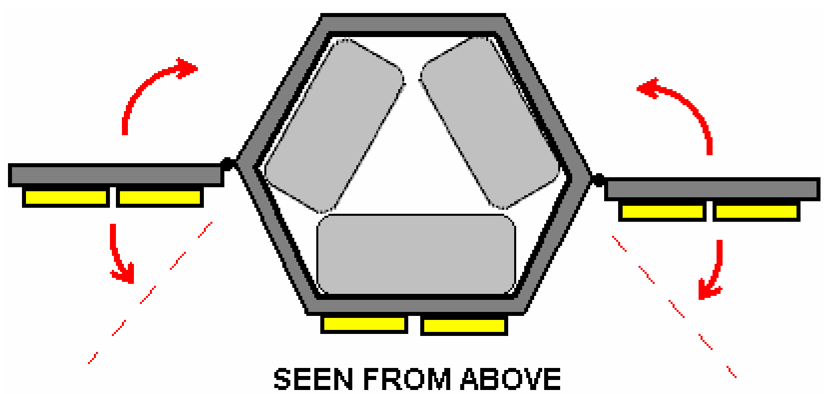


This arrangement allows two faces to be aligned with the fixed front face, giving all horizontal lighting in one direction which is a very, very bright arrangement. The two faces can be moved further around to give the wanted narrow forward beam for walking outdoors. If desired, the lighting level can be controlled by making the On/Off switch a three-pole four-way rotary switch:

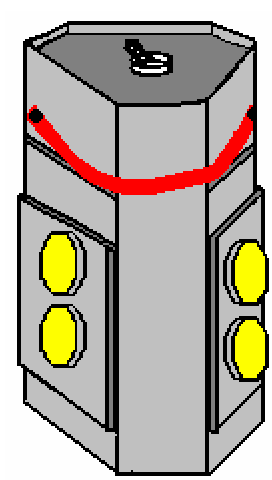


This arrangement gives Off, One panel, Two panels and Three panels of illumination, but it could also be that instead of switching off an entire panel that the switching illuminates one LED array per panel, two LED arrays per panel and three LED arrays per panel.

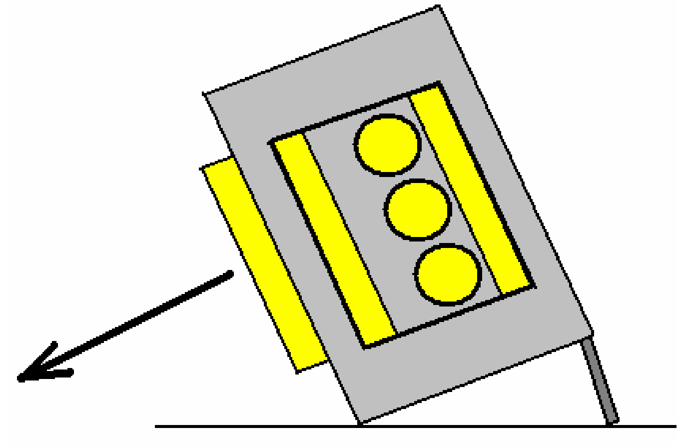
If ordinary 10-battery holders are used, then the lamp housing can be made more compact as the corners of the triangle are not needed. The battery packs fit in like this:



Giving a compact hexagonal shape which is strong and has the same lighting capability. The sides extend above the top and below the base so that the unit can stand on a flat surface either way up. The hinges need to be stiff so that they hold their position when set to the desired angle.



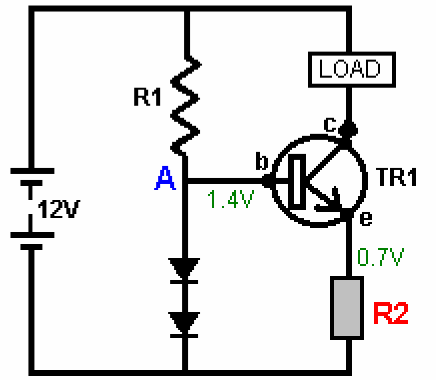
The addition of a simple hinged flap to the base allows a tilted option which imitates the downward lighting style of a desk lamp:



The Chinese LM2587 DC-DC converter from [h-quality_electronic]() selling on eBay in October 2015 for £3.17 including postage, has COP>1 performance:

Ten LED arrays are brightly lit by it with just a 2.88 volt input. Measurements using three NiMh batteries connected in series, indicate an input of 800 mA at 3.33 volts (2.664W) driving the 10-LED array displays with 389 mA at 10.3 volts (4.01W) which is COP=1.5 and has the advantage of reducing the number of batteries needed for good LED array lighting. In practice, four batteries in series are used. This converter also charges ten NiMh batteries from 10.5V to 13V (falling eventually to 12.5V) in just 30 minutes at 50 mA current draw. Please note that there is a wide range of performance from DC-Dc converters and not every converter will give COP>1 performance.

A very useful addition to this sort of lighting system is using a simple constant-current circuit to control the current draw and give a steady, unchanging lighting level throughout the entire period of illumination. I have found that zener diodes do not perform well when supplied by batteries with gradually falling voltage. A much better method of getting a reference voltage is to use ordinary diodes and use their normal voltage drop as a reference.



As the transistor TR1 has a voltage drop across it's Base - Emitter junction equivalent to the voltage drop across one diode, we use two diodes to create a voltage reference level and so maintain a 0.7 volt voltage drop across resistor R2. R1 is chosen to give about 3 milliamps of current flowing through point "A" and the diodes can be any silicon type, perhaps 1N4148 diodes. The transistor needs to have a high gain and be able to handle the desired current flow through the load. A 2N2222 transistor appears to work well in this circuit. Resistor R2 is chosen to give the desired current flow, forcing that current flow through the load (provided that the battery can supply that current). The load can be the DC-DC converter shown above and the battery voltage can quite easily be 5 volts. If there is concern about the power handling ability of a 2N2222 transistor, then two or more can be used in parallel with the Bases connected together, the Collectors connected together and the Emitters connected together.

It may well be possible to charge a second battery pack when the lights are on and then, when the lights are switched off, to use that second battery to recharge the main battery pack. Alternatively, a 10 watt solar panel, as used with the desk light, can be used to recharge the battery pack through a length of low-resistance cable and a plug and socket. There is also the possibility of providing a USB socket for recharging mobile phones. It should be able to supply 5 volts at 500 milliamps and draw no current when not in use. The user should be alerted to the fact that extensive use of the USB socket may reduce the power in the battery pack used for powering the lighting.

The prototype worked very well indeed when carried out of doors in a totally unlit and unfamiliar place. If the suspension cord is made longer and an additional hook is provided near the base, then the unit can be suspended indoors with all of the LED arrays facing downwards, which with their 160 degree angle of illumination gives excellent 360 degree lighting.

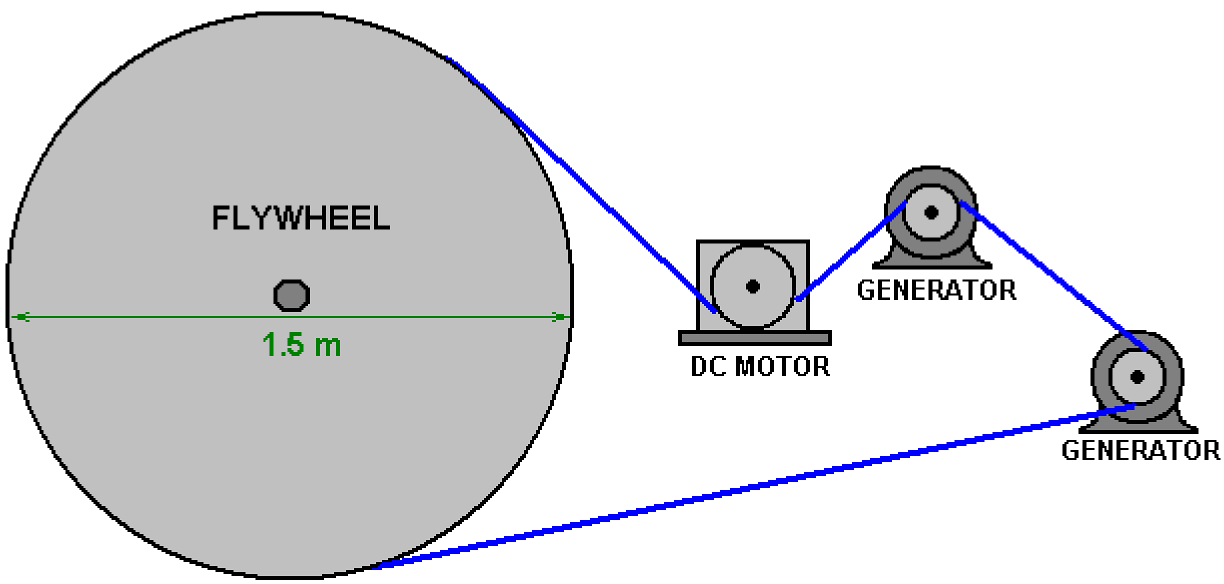
Chapter 11 - Motor-Generators

It often occurs to people to use a motor to drive an alternator and then take some of the output power to feed the motor. That works if you have a flywheel as part of the mechanism as explained in the Chas Campbell generator information. In theory, it can't work without a flywheel. Sometimes, the flywheel is hidden or the flywheel effect is accidentally produced in the normal gearing.

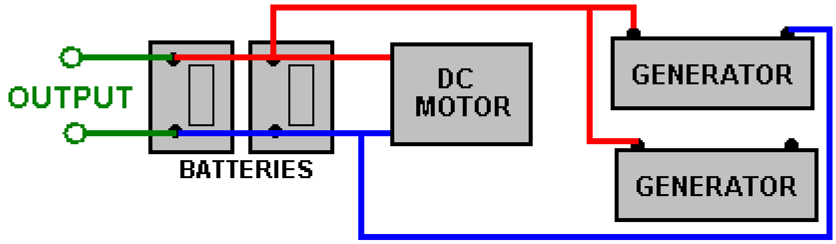
The Wilson Self-Powered DC Generator

Mr. Wilson of Texas built a self-powered generator system using an old table and some car parts. His construction was shaky, but in spite of that, it powered itself and other equipment. The table which he used was five feet (1.5 m) in diameter and 2-inches (50 mm) thick which means that it will have weighed at least 130 pounds or 60 Kilograms which is a substantial amount, well in excess of that used by Chas Campbell with his AC self-powered system. In this DC construction the system was driven by a standard, unmodified, off-the-shelf DC motor powered by two car batteries wired in parallel to give a larger current capacity. These batteries were kept charged up by two ‘generators’ from pre-1964 American cars (the closest available today are permanent magnet alternators). These generators also powered additional equipment and Mr Wilson pointed out that three or more generators could be run by the system, giving a substantial level of excess electrical power.

The machine has to be described as ‘shaky’ because he chose to convert the table top into a V-pulley belt drive flywheel by driving a series of nails into the edge of the wooden disc, with those nails angled to form a V shaped gap through which he ran a pulley belt. After three days of continuous running, those nails started to come out, causing him to power the system down. This unit was built around 1990, and if anyone decides to attempt a replication, then I suggest that the rim of the wooden disc is grooved to take the belt rather than relying on nails. The arrangement was like this:



There was also a belt-tensioning roller which is not shown in the diagram above which assumes that the flywheel has been grooved to take the drive belt. Schematically, the arrangement was like this:



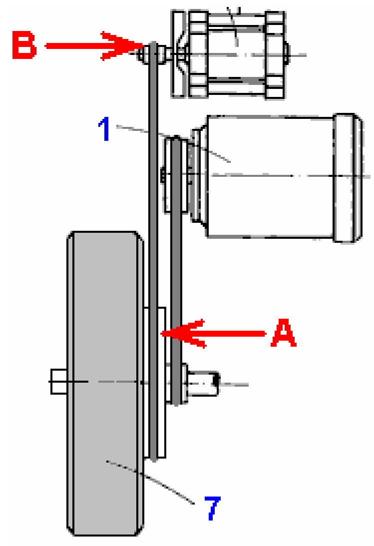
Here, the additional output can be used directly for powering 12-volt equipment or an inverter can be used to provide mains voltage and frequency. A typical inverter looks like this:

The battery power is connected to one end using thick cables to carry the heavy current, and one or more mains sockets are provided at the other end of the case, along with an On/Off switch and power indicators. Inverters come in many sizes and power ratings, generally ranging from 150 watts to 3,000 watts (3 kW). The more expensive ones are specified as "True Sine-Wave Output" but very few present day items of equipment will not run well on the cheaper versions which do not produce a true sine-wave output.

Mr Wilson decided not to patent his design and instead wanted it to be open-source information for anybody to use freely. However, the Jesse McQueen patent shown in chapter 13 looks to be Mr Wilson's design although the flywheel does not appear to be mentioned there. It should be stressed that the generator output needs to be high and so permanent magnet types are considered to be essential for this application. The specialised motor (and consequently, generator) winding methods of 'UFOpolitics' shown in chapter 2, raise efficiencies by a factor of typically 300% or more, and so would raise the output of this system very substantially if they were applied to the motor, or the generators, or both.

The Self-powered Generator of José Luis García del Castillo

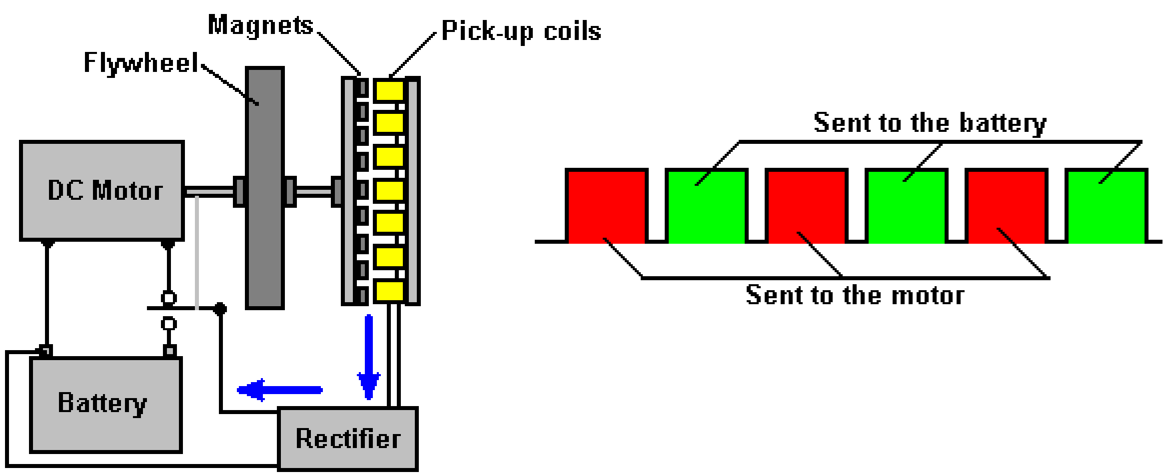
In 1998, Spanish patent ES 2,119,690 was granted to José Luis García del Castillo. I suspect that the auxiliary generators shown in the patent are only there to get the patent accepted by the patent examiner, rather than because they are actually needed. If that is correct, then the design is almost the same as Chas Campbell's design, although built in a more compact form:



As Jacob Byzehr points out, an energy gain is achieved through inertial acceleration caused by having the pulley wheel "A" attached to the flywheel shaft, larger than the pulley wheel "B" attached to the shaft of the generator. As drawn, there is a major difference in those diameters.

Jim Watson

However, let us now consider a device built by John Bedini, another talented man in America. He built a battery-powered motor with a flywheel on the shaft of the motor. This, of course, does not sound like startling stuff, but the crunch is that this motor ran in his workshop for more than three years, keeping it's battery fully charged during that time - now that **is** startling. The arrangement is like this:

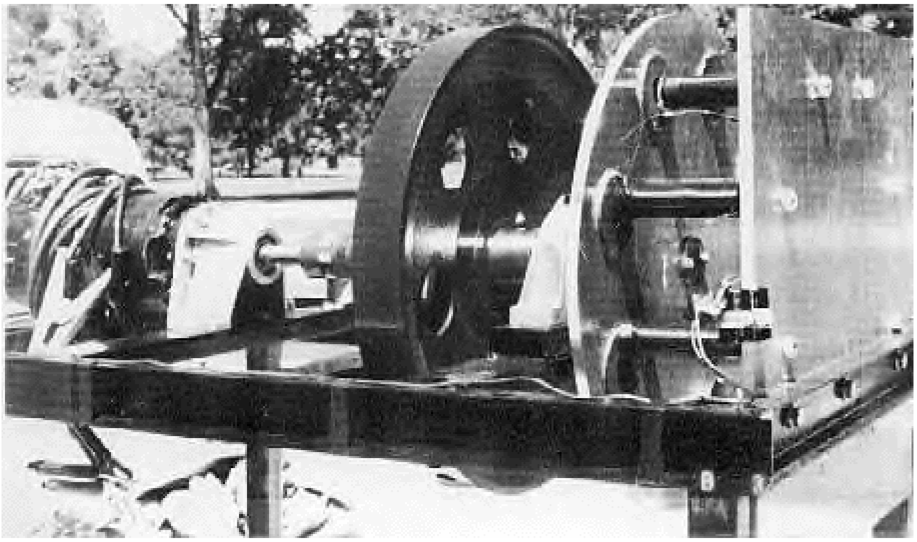


What makes this arrangement different from a standard set-up is that the battery powered motor is not connected directly to the battery but instead is fed with a rapid series of DC pulses. This has two effects. Firstly, that method of driving a motor is very efficient electrically speaking and secondly, when a flywheel is driven with a series of pulses, it picks up additional energy from the local environment.

One other unusual feature is the way that the motor shaft spins a disc with permanent magnets mounted on it. These sweep past a matching set of coils attached to a stationary board, forming an ordinary electrical generator and the resulting electrical power which is generated is converted to DC current and fed back to the driving battery, charging it and maintaining its voltage.

Standard theory says that a system like this has to be less than 100% efficient because the DC motor is less than 100% efficient (true) and the battery is only about 50% efficient (true). Therefore, the conclusion is that the system cannot possibly work (false). What is not understood by conventional science is that the pulsed flywheel draws in additional energy from the local environment, showing that conventional science theory is inadequate and out of date and needs to be upgraded, after all, this is not a 'closed system'.

An American called Jim Watson built a much larger version of John's system, a version which was twenty feet (6 meters) long. Jim's version not only powered itself, but generated 12 kilowatts of excess electrical power. That extra 12 kilowatts of power must be a considerable embarrassment for conventional science and so they will either ignore it, or deny that it ever existed, in spite of the fact that it was demonstrated at a public seminar. This is what Jim's device looked like:



Each of these machines are definitely flywheel assisted, but some others are not:

Direct Coupled Motors

Rob Ellis shows a very strongly built arrangement which has a 100-watt motor driving a 500-watt generator and the output of the generator powers the drive motor and has 400-watts spare for driving other things. However, this notion may be due to the common misconception that a generator will give its full output power if you can spin the drive shaft. That is true, but only if you can spin the shaft at its full required speed when the generator is fully loaded. If you can spin the generator at low loads well and good, but the generator is wound symmetrically and because of that, the resistance of the drive shaft depends directly on the output load and the greater the output, the harder it is to spin the shaft, and certainly in theory, the motor which is also wound symmetrically and so is inefficient, needs to have a wattage at least as high as that of the generator.

This is shown at https://www.youtube.com/watch?v=kaDDAFu269s&feature=youtu.be and nowadays is a popular style of free-energy device.. However, two points need to be mentioned here. First, I suspect that the quoted 400 watts is a calculated figure and as the motor is probably an ordinary commercial unit, it will be wound symmetrically which forces any output drawn from it to oppose the input power, making it so inefficient that its efficiency will never, ever, exceed 100%. If that is the case, then the 100-watt motor may not be able to drive the generator (which is probably also wound in the very ineffective symmetrical style) to its full output power.

Second, there appear to be a flywheel on each of the intermediate gearing shafts, and if that is so, then the inertial effects of those flywheels will draw in energy from the surrounding gravity field, enhancing the overall performance and making it a replication of Chas Campbell's design in chapter 4.

Chapter 12 - Other Devices

There are many other devices which give an energy gain. This book only skims through a few of the better known devices. For more information on these designs and for information on many other designs, you should download the free PJKbook.pdf file from any of these sites:

www.free-energy-info.com
www.free-energy-info.co.uk
www.free-energy-info.tuks.nl
www.free-energy-devices.com

Those four web sites are mirror images of each other and the 3000-page, somewhat technical ebook can be downloaded from any of them.

The Optical Generator of Pavel Imris

Pavel was awarded a US patent in the 1970's. The patent is most interesting in that it describes a device which can have an output power which is more than nine times greater than the input power. He achieves this with a device which has two pointed electrodes enclosed in a quartz glass envelope which contains xenon gas under pressure (the higher the pressure, the greater the gain of the device) and a dielectric material.

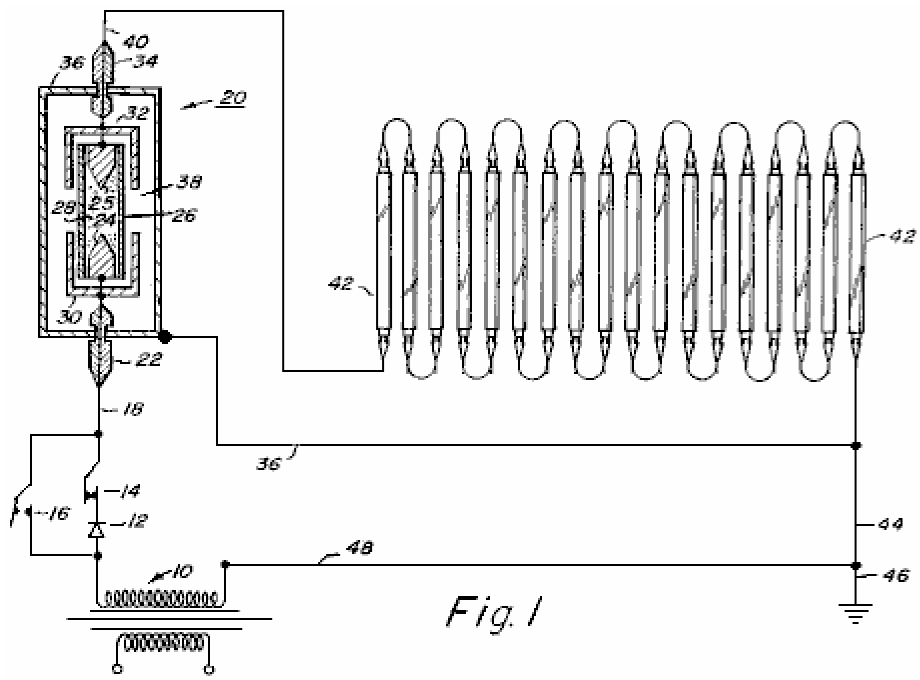


Fig. 1

Here, the power supply to one or more standard fluorescent lamps is passed through the device. This produces a power gain which can be spectacular when the gas pressure in the area marked '24' and '25' in the above diagram is high. The patent is included in this set of documents and it contains the following table of experimental measurements:

Table 1 shows the data to be obtained relating to the optical electrostatic generator. **Table 2** shows the lamp performance and efficiency for each of the tests shown in **Table 1**. The following is a description of the data in each of the columns of **Tables 1 and 2**.

Column	Description
B	**Gas used in discharge tube**
C	**Gas pressure in tube** (in torrs)
D	**Field strength across the tube** (measured in volts per cm. of length between the electrodes)
E	**Current density** (measured in microamps per sq. mm. of tube cross-sectional area)
F	**Current** (measured in amps)
G	**Power across the tube** (calculated in watts per cm. of length between the electrodes)
H	**Voltage per lamp** (measured in volts)
K	**Current** (measured in amps)
L	**Resistance** (calculated in ohms)
M	**Input power per lamp** (calculated in watts)
N	**Light output** (measured in lumens)

Table 1

		Optical	Generator	Section		
A	**B**	**C**	**D**	**E**	**F**	**G**
Test No.	**Type of discharge lamp**	**Pressure of Xenon**	**Field strength across lamp**	**Current density**	**Current**	**Power str. across lamp**
		(Torr)	**(V/cm)**	**(A/sq.mm)**	**(A)**	**(W/cm.)**
1	Mo elec	-	-	-	-	-
2	Xe	0.01	11.8	353	0.1818	2.14
3	Xe	0.10	19.6	353	0.1818	3.57
4	Xe	1.00	31.4	353	0.1818	5.72
5	Xe	10.00	47.2	353	0.1818	8.58
6	Xe	20.00	55.1	353	0.1818	10.02
7	Xe	30.00	62.9	353	0.1818	11.45
8	Xe	40.00	66.9	353	0.1818	12.16
9	Xe	60.00	70.8	353	0.1818	12.88
10	Xe	80.00	76.7	353	0.1818	13.95
11	Xe	100.00	78.7	353	0.1818	14.31
12	Xe	200.00	90.5	353	0.1818	16.46
13	Xe	300.00	100.4	353	0.1818	18.25
14	Xe	400.00	106.3	353	0.1818	19.32
15	Xe	500.00	110.2	353	0.1818	20.04
16	Xe	600.00	118.1	353	0.1818	21.47
17	Xe	700.00	120.0	353	0.1818	21.83
18	Xe	800.00	122.8	353	0.1818	22.33
19	Xe	900.00	125.9	353	0.1818	22.90
20	Xe	1,000.00	127.9	353	0.1818	23.26
21	Xe	2,000.00	149.6	353	0.1818	27.19
22	Xe	3,000.00	161.4	353	0.1818	29.35
23	Xe	4,000.00	173.2	353	0.1818	31.49
24	Xe	5,000.00	179.1	353	0.1818	32.56

Table 2

		Fluorescent	Lamp	Section	
A	**H**	**K**	**L**	**M**	**N**
Test No.	**Voltage**	**Current**	**Resistance**	**Input Energy**	**Light Output**
	(Volts)	**(Amps)**	**(Ohms)**	**(Watts)**	**(Lumen)**
1	220	0.1818	1,210	40.00	3,200
2	218	0.1818	1,199	39.63	3,200
3	215	0.1818	1,182	39.08	3,200
4	210	0.1818	1,155	38.17	3,200
5	200	0.1818	1,100	36.36	3,200
6	195	0.1818	1,072	35.45	3,200
7	190	0.1818	1,045	34.54	3,200
8	182	0.1818	1,001	33.08	3,200
9	175	0.1818	962	31.81	3,200
10	162	0.1818	891	29.45	3,200
11	155	0.1818	852	28.17	3,200
12	130	0.1818	715	23.63	3,200
13	112	0.1818	616	20.36	3,200
14	100	0.1818	550	18.18	3,200
15	85	0.1818	467	15.45	3,200
16	75	0.1818	412	13.63	3,200
17	67	0.1818	368	12.18	3,200
18	60	0.1818	330	10.90	3,200
19	53	0.1818	291	9.63	3,200
20	50	0.1818	275	9.09	3,200
21	23	0.1818	126	4.18	3,200
22	13	0.1818	71	2.35	3,200
23	8	0.1818	44	1.45	3,200
24	5	0.1818	27	0.90	3,200

The results from Test No. 24 where the gas pressure is a very high 5,000 Torr, show that the input power for each 40-watt standard fluorescent tubes is 0.9 watts for full lamp output. In other words, each lamp is working to its full specification on less than one fortieth of its rated input power. However, the power taken by the device in that test was 333.4 watts which with the 90 watts needed to run the 100 lamps, gives a total input electrical power of 423.4 watts instead of the 4,000 watts which would have been needed without the device. That is an output power of more than nine times the input power.

From the point of view of any individual lamp, without using this device, it requires 40 watts of electrical input power to give 8.8 watts of light output which is an efficiency of about 22% (the rest of the input power being converted to heat). In test 24, the input power per lamp is 0.9 watts for the 8.8 watts of light produced, which is a lamp efficiency of more than 900%. The lamp used to need 40 watts of input power to perform correctly. With this device in the circuit, each lamp only needs 0.9 watts of input power which is only 2.25% of the original power. Quite an impressive performance for so simple a device!

The Michel Meyer and Yves Mace Isotopic Generator

There is a French patent application number FR 2,680,613 dated 19th August 1991 entitled “Activateur pour Mutation Isotopique” which provides some very interesting information. The system described is a self-contained solid-state energy converter which abstracts large amounts of energy from an ordinary iron bar. This is also shown in Michel’s Czechoslovakia Patent No.284,333

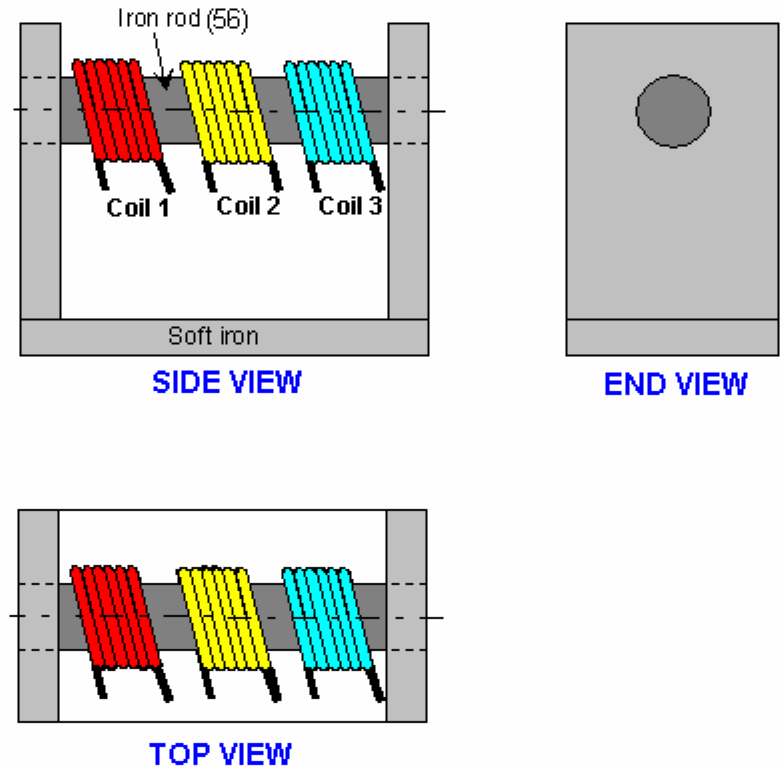
The inventors describes the technique as an “isotopic mutation effect” as it converts ordinary iron (isotope 56) to isotope 54 iron, releasing large amounts of electrical energy in the process. This excess energy can, they say, be used to drive inverters, motors or generators.

The description of the mechanism which is being used by the device is: “the present invention uses a physical phenomenon to which we draw attention and which we will call 'Isotopic Change'. The physical principle applies to isotope 56 iron which contains 26 protons, 26 electrons and 30 neutrons, giving a total mass of 56.52 Mev, although its actual mass is 55.80 Mev. The difference between the total mass and the actual mass is therefore 0.72 Mev this which corresponds to an energy of cohesion per nucleon of 0.012857 Mev.

So, If one introduces an additional 105 ev of energy to the iron core isotope 56, that core isotope will have a cohesion energy level of 0.012962 Mev per nucleon corresponding to iron isotope 54. The instability created by this contribution of energy will transfer the isotope 56 iron to isotope 54 causing a release of 2 neutrons.

This process generates an excess energy of 20,000 ev since the iron isotope 54 is only 0.70 Mev while isotope 56 has 0.72 Mev. To bring about this iron isotope 56 conversion, we use the principle of Nuclear Magnetic Resonance."

The practical method for doing this is by using three coils of wire and a magnetic-path-closing support frame of iron as shown in this diagram:



In this arrangement,

Coil 1: Produces 0.5 Tesla when fed with DC, converting the iron bar into an electromagnet
Coil 2: Produces 10 milli-Tesla when fed with a 21 MHz AC sinewave signal
Coil 3: Is the output coil, providing 110, 220 or 380 volts AC at about 400 Hz depending on the number of turns in the coil

This simple and cheap system has the potential for producing substantial energy output for a very long time. The inventors claim that this device can be wired to be self-powered, while still powering external devices. Coil 1 turns the iron rod into an electromagnet with it's flux channelled in a loop by the iron yoke. Coil 2 then oscillates that magnetic field in resonance with the isotope 56 iron atoms in the rod, and this produces the isotope conversion and release of excess energy. Coil 3 is wound to produce a convenient output voltage.

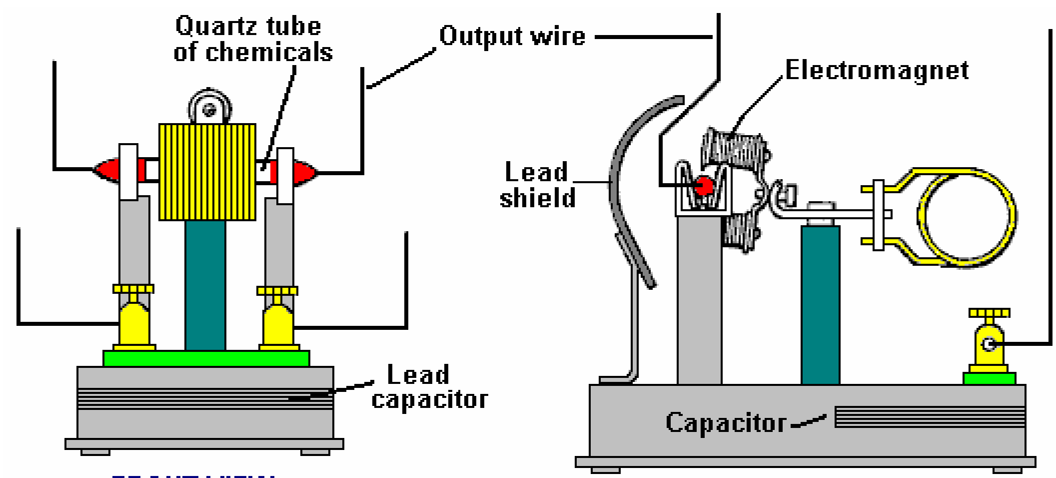
The Colman / Seddon-Gilliespie Generator

This device, patented by Harold Colman and Ronald Seddon-Gillespie on 5th December 1956, is quite remarkable. It is a tiny lightweight device which can produce electricity using a self-powered electromagnet and chemical salts. The working life of the device before needing refurbishment is estimated at some seventy years with an output of about one kilowatt.

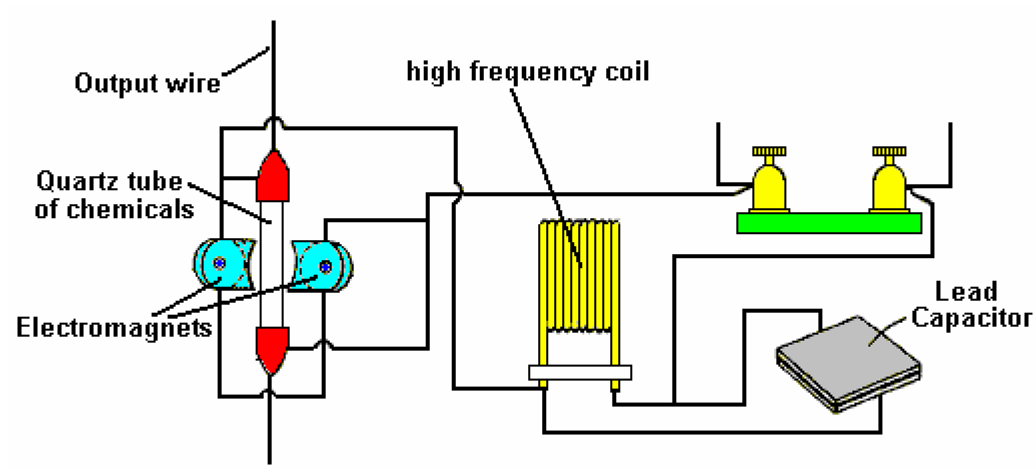
The operation is controlled by a transmitter which bombards the chemical sample with 300 MHz radio waves. This produces radioactive emissions from the chemical mixture for a period of one hour maximum, so the transmitter needs to be run for fifteen to thirty seconds once every hour. The chemical mixture is shielded by a lead screen to prevent harmful radiation reaching the user. The patent, GB 763,062 is included in the Appendix.

This generator unit includes a magnet, a tube containing a chemical mixture of elements whose nuclei becomes unstable as a result of bombardment by short waves so that the elements become radio-active and release electrical energy, the mixture being mounted between, and in contact with, a pair of different metals such as copper and zinc, and a capacitor mounted between those metals.

The mixture is preferably composed of the elements Cadmium, Phosphorus and Cobalt having Atomic Weights of 112, 31 and 59 respectively. The mixture, which may be of powdered form, is mounted in a tube of non-conducting, high heat resistivity material and is compressed between granulated zinc at one end of the tube and granulated copper at the other end, the ends of the tube being closed by brass caps and the tube being carried in a suitable cradle so that it is located between the poles of a magnet. The magnet is preferably an electro-magnet and is energised by the current produced by the unit. The transmitter unit which is used for activating the generator unit may be of any conventional type operating on ultra-shortwave and is preferably crystal controlled at the desired frequency.

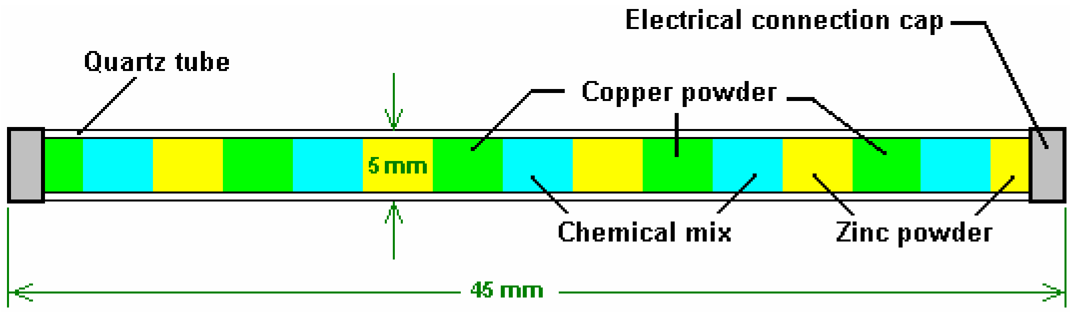


FRONT VIEW SIDE VIEW



SCHEMATIC LAYOUT

The transmitter unit is of any suitable conventional type for producing ultra shortwaves and may be crystal controlled to ensure that it operates at the desired frequency without needing tuning. The quartz tube containing the chemical mixture, works best if made up of a number of small cells in series. In other words, considering the cartridge from one end to the other, at one end and in contact with the brass cap, there would be a layer of powdered copper, then a layer of the chemical mixture, then a layer of powdered zinc, a layer of powdered copper, etc. with a layer of powdered zinc in contact with the brass cap at the other end of the cartridge. With a cartridge some forty five millimetres long and five millimetres diameter, some fourteen cells may be included.



Dr Oleg Gritskevitch's 1.5 Megawatt Self-Powered Generator.

Dr Oleg V. Gritskevitch of Vladivostok in Russia, the holder of some seventy patents, designed and fully tested an electrical generator along the same lines as Joseph Cater's device mentioned above. It uses no fuel and has given a DC output of 220 volts at 6,800 amps (1.5 megawatts) for more than two years. As built by Dr Gritskevitch, this is not a home-builder's ideal project as massive electrical input is needed to get the device started, and his prototype weighs 900 kilograms (nearly 2,000 lbs). Details are given on the very good RexResearch web site: http://www.rexresearch.com/gritskevich/gritskevich.htm but in broad outline, the device is a toroidal pipe some two metres (6'-6") in diameter, coated on the inside with barium titinate and filled with ultra-pure distilled water mixed with 'heavy water'. Inside the toroid are electromagnetic coils and surrounding it, copper pipes carrying cooling water to keep the temperature down to 50 degrees Centigrade. Also inserted into the toroid at intervals around the circumference are electrical contacts.

The device is started by giving the water a massive high-voltage discharge of some 100,000 volts at 50 mA for three to five minutes. This power input gets the water ionised and circulating. The circulation is maintained by the electromagnetic coils and the power output is around COP=100.

Oleg died without ever getting funding for his design (a typical method of blocking free-energy devices from reaching the market). A more detailed description of the device and it's operation comes direct from Oleg:

This is a description of the construction and operation of Oleg V. Gritskevitch's hydro-magnetic dynamo, which is an example of a very powerful new energy system. The prototype in Armenia has averaged some 1,500 kilowatts of power over a period of several years.

Oleg was born on 14 August 1936 and grew up in Vladivostok, Russia. He married and has a son Boris. Gritskevitch was a physicist by education. He worked in the Far-East branch of the USSR Academy of Sciences. Since 1985 he worked independently as an inventor. He has more than 70 patents on inventions ranging from household engineering up to high technologies, which he has been trying to apply in our country although he encountered major difficulties in this. After numerous attempts to obtain the patents, he became convinced that the information had become widely known. Therefore he received the state certificates of know-how (a French way of patenting), for all his inventions.

Introduction

During the 1999 Symposium of the Institute for New Energy, he lectured on his hydro-magnetic dynamo. This paper is his attempt to explain the construction and operation of his dynamo. To protect his secrets from investigators, he, on occasion, provided misleading information. For example, the drawing accompanying the Russian patent mentioned below, shows a cylinder across the toroid to mislead readers. The real dynamo has the toroid alone, without the cylinder. Even its name "hydro-magnetic dynamo" is somewhat deliberately misleading.

Oleg stated that he had some familiarity with the new energy field. Nearly all purported new energy devices are fairly small electrical generators. The dynamo may be the only new electrical generator which most nearly meets all the requirements of an ideal large-scale electrical generator. Oleg claimed that his dynamo really is the single most valuable invention the world has ever known.

Alexander V. Frolov of St. Petersburg recommended Oleg to contact Dr. Patrick Bailey of the Institute for New Energy since Patrick has lots of contacts who could possibly help with patenting his invention of a new source of energy in USA.

Oleg worked on the theory and creation of the electrostatic generator-converter the "Hydro-Magnetic Dynamo" for about 20 years. The first primitive equipment was created when Oleg worked in the Academy of Sciences. During that time, various changes were introduced in the generator and in the theory of how it works. As a result, it is now ready for manufacture, installation, and applications in industry.

Oleg made the first public report on his work in 1991 at a symposium in Volgodonsk city. His report received positive reactions and reviews from the experts in the nuclear industry in USSR. That same year, he was accepted into the International Nuclear Society. During those years he offered development of this technology to different state bodies and private enterprises. But the answer from everybody was "It is a very interesting and important project, but we cannot fund it.

Eventually, Oleg tried to transfer this technology to the USA through the embassy in Moscow. The former ambassador to the USSR, Dr. J. Matlock knows about it. He wanted to meet Oleg, but at that time there were forces opposed to the carrying out of his plans. So he started to look for other possible investors. He was ready to consider any offers of co-operation, joint patenting, sale of technological information, creation of a joint venture, etc. etc. Oleg was awarded some 70 Russian patents covering a wide range of important technical topics.

History

This project was the result of one article in the August 1972 issue of a popular Russian magazine *Tehnika Molodiozhi.* The article written by A. Kaldamasov was entitled *Ball Lightning in a Liquid*. The article came to the attention of Michail Razovsky and Oleg in 1974. Oleg's group of volunteers and enthusiasts was looking for a new source of energy and so this article served as a starting point for the understanding of chemical-physical processes occurring in water. During the period 1976 to 1978 one year was spent in the radiological lab of the Vladivostok city hospital, including Vladilen Bulgakov, radiology physician, and Michail Razovsky, theoretician in the plasma physics field and others, assembling a device, which was supposed to separate water into oxygen and hydrogen more efficiently. During the experiments, instead of the expected results, it produced electricity very efficiently! The input power during the experiment was one 800-watt water pump. The output was 1,400 watts (COP=1.75). This device was assembled using plastic pipes connected with hoses, where the water was circulating in a loop. This then led to the idea of creating the second device as a generator-toroid.

The second generator was assembled in the workshop of the Ocean Research Institute in Vladivostok (Director Academician Viktor Ilichov), and in the summer of 1990 it was transported to the testing station of the Ministry of Electronics Industry in Vladivostok. This lab was well equipped with all necessary sets of instruments. At the same time, patent papers were filed in the USSR State Committee of Inventions. In the spring of 1991 the State Commission, led by Yurii Lebedev, chairman of the Innovation Council and Chairman of the Russian Federation Council of Ministers, arrived in Vladivostok. This commission arrived to the town for two reasons: to recommend a financial request for manufacturing the dynamo; and to classify this energy source as a "Discovery". (document #14-451).

After the next change in Russian government the financing for the project was terminated. The first article on the dynamo was published in the Russian magazine (*Tehnika Molodyozhi* 1990, #3, March issue, Page 17, entitled

"*Innovator's Ideas*".

Several Armenian physicists, after reading that article, sent Oleg a letter asking to meet with him in Vladivostok for negotiations about the dynamo. They arrived in March 1991 and ran tests on the second generator, which was operational at that time. Oleg flew to Armenia, and work on the third generator started at the end of 1991. It was completed at the end of 1992. It was operating and producing energy until January 1997, when it was destroyed during the war. Some people were also killed and other people moved to the USA. This version of dynamo created an output which averaged 6,800 amperes at 220 volts DC (1.496 megawatts). It's input power was only approximately 1% of the output power.

Oleg was an invited speaker of the Meeting of the Alternative Energy Institute (Dr. Hal Fox) in Salt Lake City in August 1999. The official announcement about his speech had several mistakes (for example, the name of Armenia was changed to Romania).

Dynamo Theory

The **H**ydro-**M**agnetic **D**ynamo is a large-scale, emission-free electrical generator, which does not require external fuelling. The dynamo is capable of powering large transportation vehicles such as buses, trucks, ships, locomotives, and aeroplanes. Doubt remains about making dynamos compact enough to power cars.

While three experimental prototypes have been built with Russian and Armenian expertise and equipment, a fourth demonstration prototype needs to be built with more modern Western engineering expertise and equipment to verify the dynamo's performance claims and to further explore the dynamo's potential capabilities.

The claimed performance is as follows:

> Dynamos are scaleable from 100 kilowatts to 1,000 megawatts. One 1000-megawatt dynamo is about the size of a two-car garage. For comparison, Hoover Dam's 17 generators have a total capacity of 2,000 megawatts. A dynamo can reliably run continuously for 25 years or more with little or no maintenance, no external fuel source, and no pollution. If a dynamo's output is 1,000,000 watts, its total input power is approximately 10,000 watts and so the dynamo's energy efficiency is about 10,000%.

The source of the dynamo's huge electrical output is a nuclear reaction, which is not generally known to mainstream science. However, it is known that the dynamo produces alpha particles, which are helium nuclei, made from fused deuterium, an isotope of hydrogen with one proton and one neutron. The electrons missing from the helium nuclei are what seem to provide a copious 'sink' of electricity, and that is the secret of the dynamo's ability to generate an exceptionally large amount of electricity. It is also known that the dynamo uses high-density charge clusters. High-density charge clusters are thought by some theorists, to be the basis of plasma-injected transmutation of elements and the neutralisation of radioactive materials. Unlike hot fusion and fission reactors, the dynamo does not accumulate any radioactive components.

The result of the dynamo's processes is conversion of electrostatic fields to direct current. It should be noted that a clear understanding of terms like "Coulomb's conversion" and "liquid Van de Graff generator" is very important.

Schematically, the dynamo is an electrostatic transformer, or in other words an electrostatic voltage multiplier. One version of the dynamo uses lasers to start up. There were three dynamo prototypes built. The first two small experimental prototypes were built in Vladivostok, Russia. The third and last prototype generated electricity continuously, (except when turned off to incorporate improvements), from 1992 to January 1997 in Armenia.

As mentioned above, the Armenian prototype generated a direct current of 6,800 amperes at 220 volts which is about 1.5 megawatts. Minimum power output has been 500,000 watts, and maximum power output has been 2,500,000 watts during winter experiments due to better cooling. The Armenian prototype dynamo's toroid weighed 900 kilograms and had a diameter of approximately 2 meters. Cooling water is circulated through copper pipes wrapped around the toroid. The heat is expelled from the cooling water with a heat exchanger. The working temperature was typically 36 degrees Centigrade.

After a dynamo is assembled, the water is literally 'jump-started' (by discharging a large bank of capacitors) to get it circulating inside the toroid. The starting impulse pressure is as high as 400 atmospheres. The dynamo's controls are temporarily set to generating a modest amount of electricity sufficient to sustain itself, possibly even while being transported from the factory to the place of its future operation. The control circuits are simple as only sensors and a control computer are used. We do not need any technical-maintenance personnel.

For the Armenian prototype dynamo, two 10-Farad capacitor-batteries were used to provide the initial water motion (acceleration and excitation of water). The capacitors were 20 kilograms each, with diameters of 50 centimetres, and were borrowed from Russian military radar stations. Using a total of 20,000 Joules, 100,000 Volts at 0.05 Amperes of current were applied to the Armenian dynamo for 3 to 5 minutes to ionise and polarise the water, which then started the generation of electricity.

The reason for the very high voltage provided by the large Russian radar capacitors, when starting the generator, appears to be to polarise the crystals of barium titanate. One comparison is with the electronic ignition on a gas stove. Once the barium titanate crystals are polarised, the generator is running.

After these capacitors had been used to 'jump-start' the Armenian prototype dynamo, a bank of buffer batteries sustained continuous operation when water motion and ionising began. This battery bank contained 8 powerful 12-volt, 150-ampere lead batteries. The Armenian dynamo's sustaining input power was 14,400 watts. The nominal maximum output power was about 1,500,000 watts. On one occasion, the output current was accidentally increased to 40,000 amperes for almost a minute. Fortunately, the power was reduced to a safe level before the water started to boil. Internal coils (windings) provide the control of water velocity and therefore control dynamo power. The faster the water is moving, the more electricity the dynamo generates. Once the water stops circulating around the toroid, the dynamo must be 'jump-started' again to a minimum power level before it can sustain its electricity generation using it's own output power.

The following is a condensed summary, with some editing and additional commentary, of the "Description" of the dynamo's Russian patent IPC H 02 K 44/00 "*Method of Deriving Electrical Energy and Realisation of Gritskevich's MHD-Generator*":

The dynamo is a sealed polystyrene toroid filled with ultra-pure distilled water with heavy water (deuterium oxide) added. The movement of water inside the closed loop and the use of the unique properties of water as a polar liquid, cause a release of electrical energy as an outcome of a rupture of the hydrogen bonds. Additional electrical energy is drawn from nuclear reactions and micro-cavity processes. The liquid is ionised, polarised, and moving around the toroid at start-up time by a running magnetic field with the help of stimulating electromagnetic windings.

Electrostatic generator-transformer "Hydro-magnetic dynamo". ("GT HMD") works due to the process of amplification and maintenance of a stationary (oscillating in particular) electromagnetic field by hydrodynamic movements of the conductive medium. The stator (i.e. the toroid) is made of materials with a high dielectric permittivity. Liquid rotor is a recombined water ('pure' water with high-molecular compounds), which moves due to the high-voltage discharges and running electromagnetic field.

The main processes in GT HMD are:

A principle of Van-der-Graff's electrostatic generator, where the solid insulating tape was changed to the liquid one.

A perpetual washout of the surface electrons from the spacer layer takes place;

The Coulomb's transformations take place;

A single-turn low-frequency generator works as a coaxial turn with 4 resonance points and energy carrying substance inside it that has very high resonance properties;

The electrostatic breakdowns of cavitation-vacuum structures in water take place.

The polar liquid (pure water) consists of dipoles only, i.e. strictly oriented charged molecules. During the interaction of ionized pure water with the layer $BaTiO_3$ the electrostatic field of above 10 million volts/cm is formed. During this process the breakdown of physical vacuum takes place.

The electrostatic field, coupled with the action of the $BaTiO_3$ layer (if we apply electrical filed to $BaTiO_3$, then this layer creates the sound vibrations of about 25,000 Hz, this vibration helps to break down the water molecules) and facilitates the further break down of the molecular-atomic structures of water. Also, due to the perpetual electrostatic discharges, the breakdown of the cavitation-vacuum structures occurs and the cold fusion nuclear reaction continues. With this fusion the energy of 500 kJ/mole is liberated in a vacuum and an energy of 6 kJ/mole is liberated in water. Thus, new hydrogen bonds form in vacuum with the energy liberation of about 20 kJ/ mole. Due to this process the acceleration of ionisation of polar liquid takes place. In addition, the constant 'washing out' of the incomplete electron bindings from the layer of barium titanate occurs and free electrons form. Due to this process, the polar liquid transforms into an ordered flow of electrons and negative ions, which can be described very simply, as an ionic-electric current.

Work on construction of the experimental generator started in September 1991 in Armenia and came to an end in March 1992. The active working weight of the prototype of dynamo (torus + water) was about 900 Kg. The diameter of the torus was about 2 meters. The torus was made from impact-resistant optic polysterol. This torus consisted of two halves, which were turned on the merry-go-round machine.

The monocrystallic barium titanate $BaTiO_3$ was sprayed on the internal surface of torus, its dielectric permittivity was 6000. The thickness of the layer was about 1 micron. The water was purified to the specific resistance of 18,000,000 Ohm/cm.

As we mentioned above, to start the dynamo two condenser jars of 10 Farad each were used. The energy of a starting battery constituted 20,000 Joules, the voltage was 100,000 Volts and the current was 0.05 Ampere to provide the initial movement of water (acceleration and disturbance).

The electrodes were made of metal tubes with diameter of about 5 mm. The dynamo is started using these electrodes. A total of 32 of these electrodes were installed evenly spaced around the circumference of the toroid. The toroid's cooling system formed a closed circuit of copper piping with purified water circulated through it. The copper tubes used in this system were covered with glass insulation. They also were the turns of load winding. The temperature of toroid was maintained not higher than 50 Celsius degrees.

An average output power was 220 volts x 6,800 ampere = 1,490 kilowatts. The current was DC. Periodically the power could be increased to 2,500 Kw when sufficient cooling of the generator could be provided. The additional power was drawn from four resonant windings. This alternating current, after rectification, was used to charge the back-up battery. Thus, the total output power constituted more than 1,500,000 watts. The low-frequency voltage was obtained from the load windings and the direct current was obtained from the stabilisation chamber.

It should be noted that the high-voltage discharges of the 32 electrodes, ionise the partially pre-ionised water further. By means of the stimulation windings, a circulating magnetic field is created which moves the water in one direction inside the toroid. An electromotive force is created by the electromagnetic induction in a separate set of windings. As we already mentioned, during the movement of the water stream, free electrons are created, and an additional energy gets emitted because of the water's friction against the coating layer on the inside surface of the toroid, because of electrostatic breakdowns of cavity-vacuum structures, and because of the ongoing nuclear reaction.

If the dynamo's output is 1,000,000 watts, it's total input power is approximately 10,000 watts. So therefore the dynamo's energy efficiency is about 10,000%.

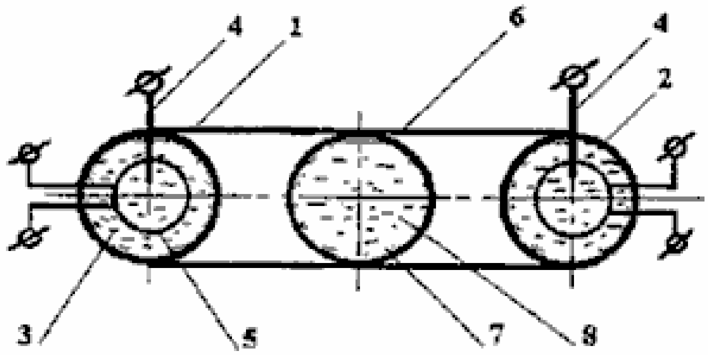
In addition to the barium titanate deposited on the teflon-coated inner surface of the polystyrene toroid, the water itself also contains tiny barium titanate crystals which are suspended in the water. Ultrasound at 25,000 cycles per second is propagated through the water to form micro-bubbles on the surfaces of the suspended barium titanate crystals. Again due to the barium titanate's piezoelectric action, very high electrostatic fields are also developed within the micro-bubbles at the surface of the crystals. The electrons from the nuclear reaction are added to the electrons generated at the toroid's interior surface. The total amount of mono-crystalline barium titanate in the Armenian dynamo was nearly 1000 grams. Satellites, locomotives, heavy trucks, airplanes, and ships are obvious transportation applications.

Dynamo Economics

The dynamo's production cost is estimated at $500 per kilowatt which is very competitive when compared to nuclear power's capital costs of $5,000 per kilowatt, windmill capital costs of $4,000 per kilowatt, etc. A well-run nuclear power plant can generate power for 1.5 cents per kilowatt-hour, coal 1.8 cents, natural gas 3.4 cents, and oil 4.1 cents, on average. The dynamo's operating cost would be approximately 0.1 cent per kilowatt-hour with no external fuel needed and without any pollution being created.

These dynamos could replace all nuclear power plants, solar installations, wood-burning furnaces, hydro-electric generation, etc. A recent IEEE *Spectrum* article stated that the world's demand for electricity increases by approximately 500 megawatts every day. To put this in perspective, that is the equivalent of building another Hoover Dam every four days to keep up with the world's increasing electricity demand. Or, a dynamo manufacturing company would have to build another 500-megawatt dynamo every single day to keep up with world electricity increased demand (in addition to replace all existing generators fuelled by hydro, nuclear, and fossil fuels.)

The text of the patent application mentioned above is not in English although the abstract of the patent number WO 01/15305 A1 has been translated into English:



WO 01/15305 A1

(57) **Abstract:** The invention is directed at increasing output, reliability and environmental safety of MHD generators as well as at simplifying the design of said generators. The inventive method for the production of energy comprises the following steps: a polar liquid (8) is circulated in a predetermined direction along a hermetically sealed toroidal channel (1) by means of a travelling magnetic field, and electric power is collected by means of electromagnetic winding. The liquid is ionized at least at the stage of launching, by means of electrodes (4), for example. The internal walls (2) of the channel have a dielectric constant which is higher than the dielectric constant of said liquid.

Josef Papp's Inert Gas Engine Conversion.

The Hungarian, Josef Papp, invented an unusual engine system which genuinely appears to be very nearly "fuel-less". His design modifies an existing vehicle engine to operate on a fixed amount of gas. That is to say, the engine has no air intake and no exhaust and consequently, no inlet or exhaust valves. The engine cylinders contain a mixture of gases which have an Atomic Number below 19, specifically, 36% helium, 26% neon, 17% argon, 13% krypton, and 8% xenon by volume. The control system causes the contained gas to expand to drive the pistons down the cylinders and then contract to suck the pistons back up the cylinders. This effectively converts the engine into a one-stroke version where there are two power strokes per revolution from every cylinder.

A small amount of radioactive material is used in the engine, and I have seen it suggested that the engine should be screened to protect the user from radiation. I'm not sure that this is correct, but if it is, then it suggests that a matter to energy conversion is indeed taking place. It seems most unlikely that the minor amount of radioactive material in the engine itself could cause any significant radiation. The patent describes the material as "low-level" which suggests to me, material no more dangerous that the luminous paint that used to be used on the hands of clocks and watches.

Suitable engines must have an even number of cylinders as they operate in pairs. Josef's first prototype was a four-cylinder, 90 horsepower Volvo engine. He removed the intake and exhaust components and replaced the engine head with his own design. During a thirty-five minute test in a closed room, the engine generated a constant 300 horsepower output at 4,000 rpm. The electrical power needed to run the engine was produced by the standard engine alternator, which was also able to charge the car battery at the same time. Interestingly, an engine of this type, quite apart from having zero pollution emissions (other than heat), is quite capable of operating under water.

Josef, a draftsman and ex-pilot, emigrated from Hungary to Canada in 1957 where he lived until his death in April 1989. There is solid evidence that Josef built an engine of over 100 horsepower (75 kilowatts) that was "fuelled" by a mixture of inert (or "noble") gases. With no exhaust or cooling system, it had huge torque even at low rpm (776 foot-pounds at only 726 rpm in one certified test). Dozens of engineers, scientists, investors and a Federal judge with an engineering background saw the engine working in closed rooms for hours. This would not have been possible if the engine had been using fossil fuel. There was absolutely no exhaust and no visible provision for any exhaust. The engine ran cool at about 60°C (140°F) on its surface, as witnessed by several reliable observers. All these people became convinced of the engine's performance. They all failed to discover a hoax. Ongoing research in the United States (totally independent of Papp) has proved conclusively that inert gases, electrically triggered in various ways, can indeed explode with fantastic violence and energy release, melting metal parts and pushing pistons with large pressure pulses. Some of the people performing this work, or who have evaluated it, are experienced plasma physicists. Contemporary laboratory work has established that inert gases can be made to explode

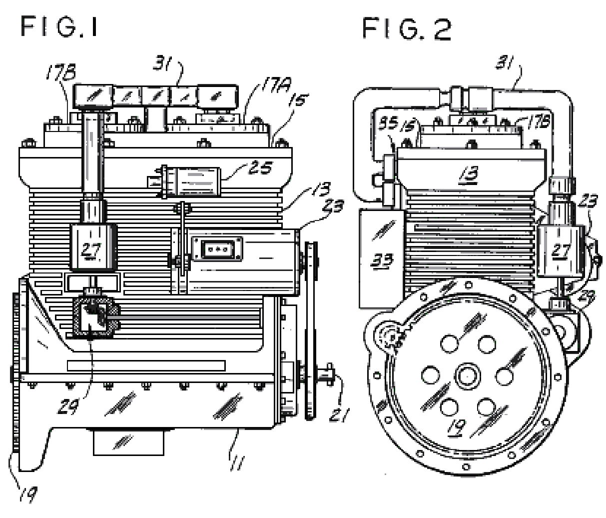
In a demonstration on 27th October 1968 in the Californian desert, Cecil Baumgartner, representing the top management of the TRW aerospace corporation and others witnessed the detonation of one of the engine cylinders. In full public view, just a few cubic centimetres of the inert gas mixture was injected into the cylinder using a hypodermic needle. When the gas was electrically triggered, the thick steel walls of the cylinder were burst open in a dramatic way. William White, Edmund Karig, and James Green, observers from the Naval Underseas Warfare Laboratory had earlier sealed the chamber so that Papp or others could not insert explosives as part of a hoax. In 1983, an independent certification test was carried out on one of the Papp engines. Joseph Papp was issued three United States patents for his process and engines:

US 3,680,431 on 1st August 1972 "Method and Means for Generating Explosive Forces" in which he states the general nature of the inert gas mixture necessary to produce explosive release of energy. He also suggests several of the triggering sources that may be involved. It appears that Papp is not offering full disclosure here, but there is no doubt that others who have examined this patent and followed its outline have already been able to obtain explosive detonations in inert gases.

US 3,670,494 on 20th June 1972 "Method and Means of Converting Atomic Energy into Utilisable Kinetic Energy" and

US 4,428,193 on 31st January 1984 "Inert Gas Fuel, Fuel Preparation Apparatus and System for Extracting Useful Work from the Fuel". This patent shown here, is very detailed and provides information on building and operating engines of this type. It also gives considerable detail on apparatus for producing the optimum mixture of the necessary gasses.

At the time of writing, a web-based video of one of the Papp prototype engines running on a test bed, can be found at http://www.youtube.com/watch?v=N4li_z4Jpso although it must be said that a good deal of the footage is of very poor quality, having been taken many years ago. The video is particularly interesting in that some of the demonstrations include instances where a transparent cylinder is used to show the energy explosion. Frame-by-frame operation on the original video shows energy being developed outside the cylinder as well as inside the cylinder, which does seem to suggest that the zero-point energy field is involved. I have recently been contacted by one man who attended some of the engine demonstrations run by Papp and he vouches for the fact that the engine performed exactly as described.



Josef never managed to get his engine design into commercial production before his death, primarily due to the opposition of vested interests. However, his design principles have been picked up and advanced by John Rohner and Haik Biglari.

The "Plasmic Transition Process" is the subject of various patents pending by PlasmERG Inc. of Iowa. John Rohner founded this company in 2008 to be the means to disseminate, develop and license this technology to other motor manufacturers for their own use. This process originally called the "Papp Engine" did run in 1982 and was then lost until John, and his partner Haik Biglari rediscovered it and applied modern science to the system to explain the process and filed their patents, presently pending. The original process was based on information originally patented by the late Joseph Papp, whose patents have now expired. John Rohner, a well known new-product design engineer, was originally contacted in 1979 by his brother Robert, with a schematic for the controller which Papp had designed. Unfortunately, John was busy with several other projects so he turned it over to his brother Tom.

PlasmERG has designed two motors for Own-Equipment-Manufacturers to use. One is an opposed, 2-cylinder, 120 cubic inch engine which produces some 300 horsepower. The second is a 6-cylinder 360 cubic inch engine which can produce around 1,500 horsepower. These motors are being co-developed with a sister company in Canada. John Rohner has personally provided the total investment for this development. As the company moves toward manufacturing, they are seeking investment partners by trading stock for investment. Their first commercial manufacturing plant will cost about 10 million dollars.

An alternative strategy is to create licenses for existing car and truck motor manufacturers until they can fund their own production. The current plan is to provide 500 to 1,000 test sites in underdeveloped nations for water pumping and power generation as "humanitarian" test sites. This should allow the time needed to get production understood and patents completed.

The expected run time of a motor from a single inert gas charge is over 3 months of continuous operation and gas re-charge should cost less than US $50. John stresses that the PlasmERG motor is **not**, (just as the original Papp engine was **not**), a "Pulsed Plasma motor". Plasma is not retained and "pulsed" as some people have supposed. What actually happens is that the plasma is recreated with each power stroke and then returns to a steady state gas on each return stroke, from which the name “Plasmic Transition” is derived.

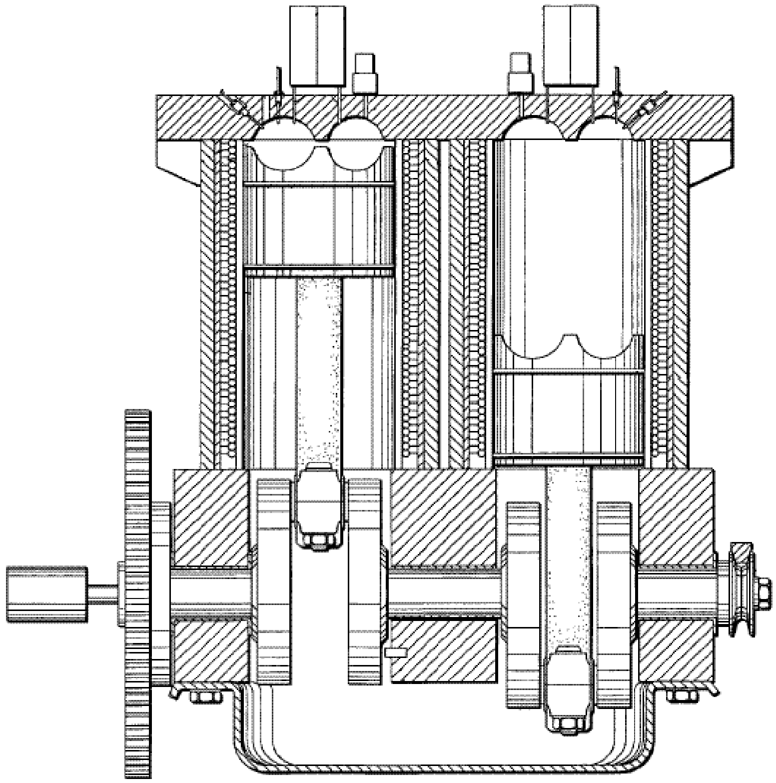
The initial power and creation of plasma for expansion, is produced by a fusion event with a side-effect of a limited "chaotic" fission event causing a “plasmic transition” which is contained in a sealed 2-cycle rotating crankshaft motor.

There are two parallels to Plasmic Transition and power production of this motor. The first is natural lightning, which uses an almost identically similar Plasmic Transition process; and the second is steam which provides the same torque over rotational speed event characteristics. There is nothing in the ordinary internal combustion motor's operation that is comparable to either of these processes. The most crucial part of PlasmERG's motor operation is the Electronic Control System (ECS), comprising the following elements:

1. Programmable micro computers;
2. Radio frequency power generator;
3. HV spark coil initiation driver;
4. Various electromagnetic coil voltage switches providing base (resting) or variable (engine speed) voltages for all cylinder or reaction chamber electromagnetic coils;
5. On-controller DC to 12 volt DC converter;
6. Engine speed DC voltage (accelerator) to programmed variable voltage DC converter,
7. Inter controller communications port;
8. Instrument support for user panel and action port which receives commands from the user comprising by not limited to things like Run, Start, Throttle position, Hold speed, Brake application, Brake hard, various motor inputs and fuel container information.

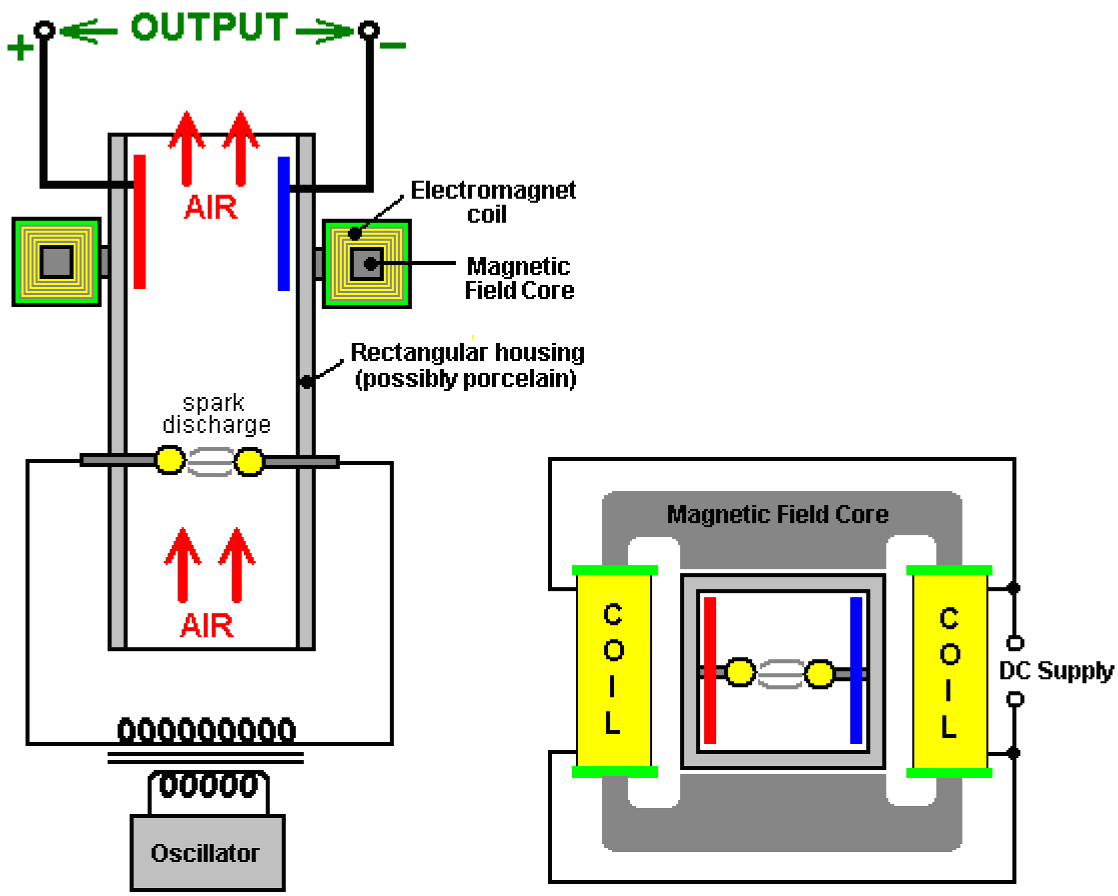
The PlasmaERG’s website is at http://plasmerg.com/ but it needs Internet Explorer to display properly as it has major display problems when Firefox is used.

John Rohner’s Patent Application US 2011/0113772 A1 entitled “Plasmic Transition Process Motor” can be downloaded from www.freepatentsonline.com or from www.free-energy-info.com. It shows a 2-cylinder motor as an example of the operation:



Nikola Tesla's Ionised-Air Electrical Generator.

Tesla also designed a device for picking up energy from the air. As far as I am aware, it was never patented and I have never seen a specification of its output. Perhaps it was one of Tesla's failures but personally, I doubt that. It might make a very interesting experiment so see what level of output can be achieved using it. The construction is shown here:



SIDE VIEW

TOP VIEW

It is essentially, a rectangular cylinder which contains two spherical electrodes like a Wimshurst machine. The cylinder is positioned vertically, so that when the electrodes are powered up with high voltage to create spark discharges, the air inside the cylinder is heated which causes it to rise up the cylinder. The heated air is ionised, so a magnetic field generated by a surrounding electromagnet, causes the charged ions to move to opposite sides of the cylinder. Electrode plates positioned inside the cylinder, provide an electrical path for the excess positive and negative charges to flow together through the load - lighting, heating or motor circuits typically.

On the surface, this system would appear to be less than 100% efficient, in that the amount of power applied to the device to make it operate should be less that the amount of power drawn from it to drive useful loads. I am not sure that this is necessarily so. Firstly, the air already contains charged ions before this device starts to generate more. These naturally occurring ions gain in number when a thunderstorm is likely, even to the extent of giving many people a headache by their presence. These naturally occurring ions will be picked up by this device and without any input power needed to create them, they are capable of providing output power.

Also, the whole earth is immersed in the zero-point energy field. This is seething energy at the quantum level whose effects can be seen even at 'absolute zero'. This field is made of small random effects which makes it hard to obtain useful energy directly from it. The field needs to be structured before energy can be drawn from it. One way to do this is to align the field with an event which causes coherent waves of energy to radiate outwards as a 'radiant energy' wave - something like the ripples caused on the surface of a pond of still water when a large stone is dropped vertically into the water. The ripple 'waves' move outwards from the 'event' until they reach the bank of the pond. If there was a generator attached to a float in the pond, it would be possible to pick up some energy from the ripples. The same can be done with 'radiant energy' waves if you can create them and know how to pick up energy from them.

Radiant energy waves can be formed by very short sharp uni-directional electrical pulses. Pulses less than one hundredth of a second are suitable for this. One way of creating pulses of that type is using a spark gap. In Tesla's device shown above, sparks are generated continuously. These sparks will generate radiant energy waves radiating out at right angles to the spark. Without a doubt, the vertical cylinder will have a mass of radiant energy shooting up it when it is being operated. This is in addition to the air ions which are being picked up. The only question is whether or not the electrode plate arrangement shown is capable of picking up any of this excess energy. Considering the metallic pickup device used by Edwin Gray to capture radiant energy as described below, it seems highly likely that some of that additional energy is, in fact, picked up and used to power the loads.

It should be noted that Tesla's device shown above, will generate UV radiation in the same way as any MIG or stick welder does, so care should be exercised to avoid looking at the arc or allowing the UV to shine on your skin, even if the skin is covered by clothing. You can get serious sunburn through thin clothing if it is subjected to strong UV radiation. Also, radio interference is likely to be generated by the arc, so screening should be provided during any tests. **WARNING**: Tesla accidentally discovered that electric spark discharges in air, ignite and burn atmospheric oxygen and nitrogen, producing 12,000,000 volt waves. The oxygen and nitrogen, both below atomic number 19 are thereby transmuted into alpha and beta charges (stripped helium nuclei with +2 charge each, and electrons with -1 charges each) by the powerful radiation produced, having a voltage potential of 12 Mev. This is almost three times the Mev level of gamma radiation emitted by radium, it may well be the reason why Tesla did not publicise the device shown above, and should you decide to experiment with it, please be aware of the potential hazard of this radiation.

A variation on the above device of Tesla's is given in the book "Physical Chemistry" by E. A. Moelwyn-Hughes, Pergamon Press, Oxford 1965, page 224. Rutherford and Geiger determined the fact that radium puts out alpha particles at the rate of 34,000,000,000 per second, each having two units of positive charge at 4.5 million electron-volts. This is a staggering amount of energy which ionises the air inside the housing and produces enough power to be capable of replacing the entire Four Corners power complex indefinitely.

Chapter 13 - Where Can I Buy These Generators?

The short answer is that you can't (unless you are very rich and operating through a company). That may change in the near future courtesy of the internet spreading information. The problem is a small group of psychopaths called the "New World Order". Their aim is to literally rule the world and have everybody else as slaves. They have been working on this for the last 150 years or so and they have achieved a great deal in that time.

Let me guess: you pay Income Tax. Yes? Did anybody ever tell you that it was optional and ask you to agree to pay it? No? Then why do you pay it?

I suggest that you pay it either because you mistakenly think that "it is the right thing to do" or more likely, because you will be attacked if you don't, your goods seized, maybe you will be put in prison, destroying your chances of employment in the future. In other words, through intimidation and/or violence. So, just to clarify, you pay large amounts of money (amounts set by somebody else at their whim) under the threat of violence against you. That is a clear description of an unlawful Protection Racket.

You live in a violent society and probably don't realise that, so let me fill you in. In the last 150 years the New World Order people have achieved a great deal. Just to give you some idea as to who we are talking about, their leading members include the Rockefellers, the Rothschilds, the European 'royal' families, and the Vatican. They have managed to get governments to allow their private companies to print cash, have set up private 'central' banks, have funded key politicians, have suborned military organisations in many countries, have suborned many police forces and have set up fake "de facto" courts. They have introduced Taxes, Licences, Charges etc., which combine to steal 80% or more of your money on a permanent basis and they use your stolen money against you. They are clever people and have managed to persuade you that what they do is good for everybody. They are adept liars.

For example, take America as an example. The US government needs $100,000,000 for some project, but instead of printing it which they are fully entitled to do, they get the printing done by the private, New World Order-owned private Federal Reserve (which is not Federal nor is it a Reserve). If, for example, the Federal Reserve charges 17% for doing the work, then it is "owed" $17,000,000 for doing the job. Now instead of retaining that 17%, most of it is left as an outstanding "National Debt". The next year, that unpaid amount is still outstanding and it attracts additional 'interest' which is paid by the American taxpayers. That process is repeated over and over again and now silly amounts of money are supposedly owed by the American taxpayer to the New World Order. That original $100,000,000 is spent by the government in such a way that excessive amounts of it go to the New World Order people anyway. To be polite, that is a racket and personally, I can see no reason why the American "National Debt" should not be scrapped without being paid.

But there is more, much more. The New World Order people, using the strange notion of 'copyright' have set up Patent Offices around the world. That is a money-spinner but its real purpose is to identify and suppress seriously talented inventors. One method used frequently is to designate any seriously good patent as being "Of National Security Importance" which means that the inventor may not use his own invention and he may not speak of it to others. If he does, he goes straight to prison without trial. This is a clever technique as inventors are almost never have marketing skills nor are they familiar with the opposition which they face. The Patent Office staff are instructed specifically to reject any free-energy patents on the basis that free-energy is "impossible" as it contradicts the (incorrect) Laws of Physics.

The New World Order people are determined to keep free-energy from the general public, because if you have free energy, then you can do almost anything you want. For example, if you have a cold drink in a glass on a hot day, the outside of the glass gets drops of water on it due to the air touching the glass getting cooled down and losing some of its moisture. With free energy, you can make that happen on a large scale by using refrigeration as described in the 1961 US patent 2,996,897 of Elmer Grimes which shows a neat way of gaining enough water to run a farm in a drought area:

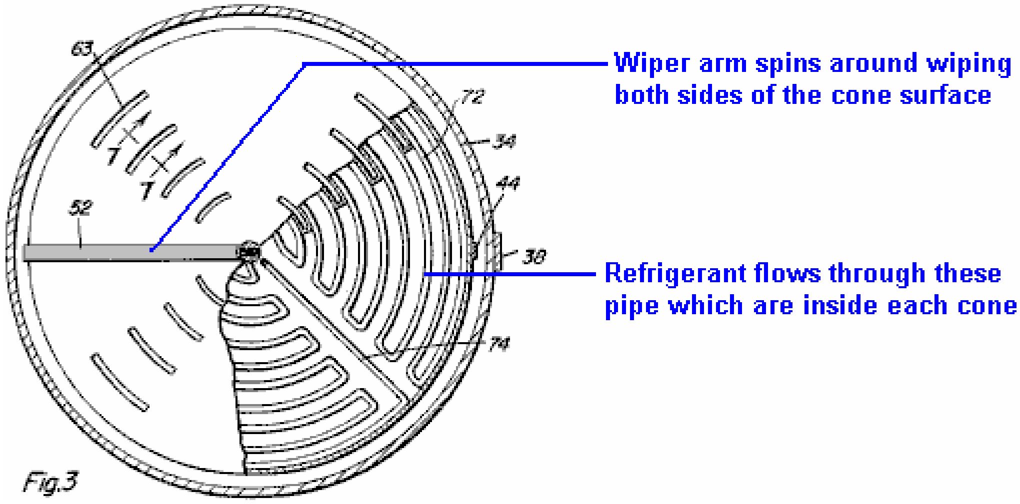


Fig.3

A smooth conical surface is cooled and the water forming on that surface is wiped off to become part of a continuous outflow of water.

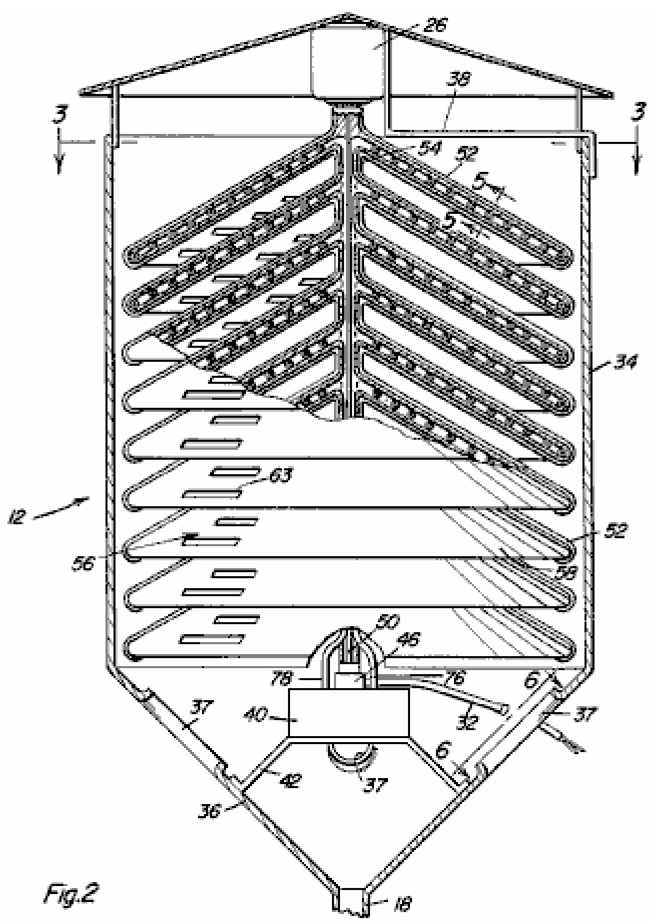


Fig.2

The conical plates are stacked one on top of the other and the resulting system is very effective. So, with free energy, anyone can set up a farm anywhere and have heating, cooling, lighting, water supply without a local water source and almost-free transport.

The New World Order people are keenest to have control over others. One of their biggest influences is oil, which they cornered early on. When Henry Ford was producing his first cars, it was his intention to have them run using a modified magneto designed by Nikola Tesla. The oil industry had a problem waste material called "petroleum" so they persuaded Ford to make his cars run on that material. That worked out well until motorists discovered that making a long journey was very difficult as there were so few petrol filling stations. They got around the difficulty by buying alcohol from one of the 50,000 farms making alcohol. That worked until extra petrol filling stations were built. Then those petrol filling stations found themselves in direct competition with farms. So, to put the farms out of business, Prohibition was introduced and maintained until the petrol monopoly was established securely. Prohibition never had anything to do with humans drinking alcohol. Free-energy must be suppressed, otherwise people would just run vehicles without burning any fuel and the oil revenue stream which benefits governments as well as the New World Order people would be lost.

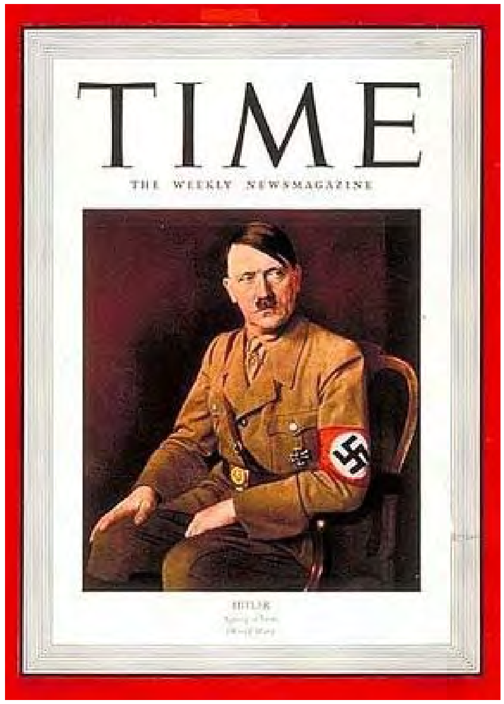
Waging war is a major source of income for the New World Order people as they own the "Defence Contractor companies". Wars are almost never waged for the reasons given. For example, WW1 was staged because Germany was outperforming Britain in the marketplace and the objective was to cripple Germany and her production. The New World Order people generally fund both sides of any major war. Here is a little background detail:

It is important to remember that prior to the creation of the Federal Reserve, there was no such thing as a world war. The First World War started between Austria-Hungary and Serbia, but quickly shifted to focus to Germany, whose industrial capacity was seen as an economic threat to Great Britain, who saw the decline of the British Pound as a result of too much emphasis on financial activity to the neglect of agriculture, industrial development, and infrastructure (not unlike the present day United States).

Although pre-war Germany had a private central bank, that bank was heavily restricted, and inflation kept to reasonable levels. Under government control, investment was guaranteed to internal economic development, and Germany was seen as a major power. So, in the media of the day, Germany was portrayed as the prime instigator of World War One, and subsequently, not just defeated, but had its industrial base flattened.

Following the Treaty of Versailles, Germany was ordered to pay the war costs of all of the participating nations, even though Germany had not actually started the war. This amounted to three times the value of all of Germany itself. Germany's private central bank, to whom Germany had gone deeply into debt to pay the costs of the war, broke free of government control, and massive inflation followed (mostly triggered by currency speculators), permanently trapping the German people in endless debt.

When the Weimar Republic collapsed economically, it opened the door for the National Socialists to take power. Their first financial move was to issue their own state currency which was not borrowed from private central bankers. Freed from having to pay interest on the money in circulation, Germany blossomed and quickly began to rebuild its industry. The media called it "The German Miracle". TIME magazine lionized Hitler for the amazing improvement in life for the German people and the explosion of German industry, and even named him TIME Magazine's “Man Of The Year” in 1938.



Once again, Germany's industrial output became a threat to Great Britain, resulting in these comments:

"Should Germany merchandise (do business) again in the next 50 years, we have led this war (WW1) in vain". **- Winston Churchill in The Times (1919)**

"We will force this war upon Hitler, if he wants it or not". **- Winston Churchill (1936 broadcast**)

"Germany becomes too powerful. We have to crush it". **- Winston Churchill** (November 1936 speaking to US - General Robert E. Wood).

"This war is an English war and its goal is the destruction of Germany". **- Winston Churchill (- Autumn 1939 broadcast) .**

Germany's state-issued value-based currency was also a direct threat to the wealth and power of the private central banks, and as early as 1933 they started to organise a global boycott against Germany to strangle this upstart ruler who thought he could break free of private central bankers!


Daily Express

NO. 10,258. FRIDAY, MARCH 24, 1933. ONE PENNY.

To-day's Weather: Fair. Mild.

JUDEA DECLARES WAR ON GERMANY

Jews Of All The World Unite In Action

BOYCOTT OF GERMAN GOODS

MASS DEMONSTRATIONS IN MANY DISTRICTS

DRAMATIC ACTION

"Daily Express" Special Political Correspondent.

ALL Israel is uniting in wrath against the Nazi onslaught on the Jews in Germany.

Adolf Hitler, swept into power by an appeal to elemental patriotism, is making history of a kind he least expected. Thinking to unite only the German nation to race consciousness he has roused the whole Jewish people to a national renaissance.

The appearance of the swastika symbol of a new Germany has called forth the Lion of Judah, the old battle symbol of Jewish defiance.

Fourteen million Jews dispersed throughout the world have banded together as one man to declare war on the German persecutors of their co-religionists. Sectional differences and antagonisms have been submerged in one common aim—to stand by the 600,000 Jews of Germany who are terrorised by Hitlerist anti-semitism, and to compel Fascist Germany to end its campaign of violence and suppression directed against its Jewish minority.

SPECIAL SESSION

HIGHER WAGES FOR STEEL WORKERS

AN INCREASE OF THREE SHILLINGS A WEEK

BRIGHT SPOT IN A BLACK TOWN

THE BIRTH OF AN IDEA

OFFICER'S DAYS OF LOVE

CUTS THAT KILL

New "Sweep" Bill In The Dail

MR. DE VALERA AND STATE CONTROL

SECRET MEASURE

NO CLUE

MR. MacDONALD EXPLAINS HIS TOUR

"PEACE CAN BE KEPT IN EUROPE"

MR. RAMSAY MACDONALD faced a crowded House of Commons yesterday afternoon when he spoke about his visits to Paris, Geneva, and Rome, and his talks with Signor Mussolini.

LATE NEWS

LABOUR LEADER BEREAVED

As had been the case in World War One, Great Britain and other nations threatened by Germany's economic power looked for an excuse to go to war, and as public anger in Germany grew over the boycott, Hitler foolishly gave them that excuse. Years later, in a spirit of candour, the real reasons for that war were made clear:

"The war wasn't only about abolishing fascism, but to conquer sales markets. We could have, if we had intended to, prevented this war from breaking out without firing one shot, but we didn't want to". **- Winston Churchill to Truman (Fultun, USA March 1946).**

"Germany's unforgivable crime before WW2 was its attempt to loosen its economy out of the world trade system and to build up an independent exchange system from which the world-finance couldn't profit any more. ...We butchered the wrong pig". **- Winston Churchill (The Second World War - Bern, 1960).**

As a side note, we need to step back before WW2 and recall Marine Major General Smedley Butler. In 1933, Wall Street bankers and financiers had bankrolled the successful coups by both Hitler and Mussolini. Brown Brothers Harriman in New York was financing Hitler right up to the day war was declared with Germany. And they decided that a fascist dictatorship in the United States based on the one on Italy would be far better for their business interests than Roosevelt's "New Deal" which threatened massive wealth re-distribution to recapitalise the working and middle class of America. So the Wall Street tycoons recruited General Butler to lead the overthrow of the US Government and install a "Secretary of General Affairs" who would be answerable to Wall Street and not the people, would crush social unrest and shut down all labour unions.

General Butler pretended to go along with the scheme but then exposed the plot to Congress. Congress, then as now in the pocket of the Wall Street bankers, refused to act. When Roosevelt learned of the planned coup he demanded the arrest of the plotters, but the plotters simply reminded Roosevelt that if any one of them were sent to prison, their friends on Wall Street would deliberately collapse the still-fragile economy and blame Roosevelt for it. Roosevelt was thus unable to act until the start of WW2, at which time he prosecuted many of the plotters under the Trading With The Enemy Act. The Congressional minutes into the coup were finally released in 1967 and became the inspiration for the movie, "Seven Days in May" but with the true financial villains erased from the script.

"I spent 33 years and four months in active military service as a member of our country's most agile military force -- the Marine Corps. I served in all commissioned ranks from second lieutenant to Major General. During that period I spent more of my time being a high-class muscle man for Big Business, for Wall Street and for the bankers. In short, I

was a racketeer, a gangster for capitalism. I suspected that I was just a part of a racket at the time. Now I am sure of it. Like all members of the military profession I never had an original thought until I left the service. My mental faculties remained in suspended animation while I obeyed the orders of the higher-ups. This is typical with everyone in the military service. Thus I helped make Mexico and especially Tampico safe for American oil interests in 1914. I helped make Haiti and Cuba a decent place for the National City Bank boys to collect revenues in. I helped in the raping of half a dozen Central American republics for the benefit of Wall Street. The record of racketeering is long. I helped purify Nicaragua for the international banking house of Brown Brothers in 1909-12. I brought light to the Dominican Republic for American sugar interests in 1916. In China in 1927 I helped see to it that Standard Oil went on its way unmolested. During those years, I had, as the boys in the back room would say, a swell racket. I was rewarded with honours, medals and promotion. Looking back on it, I feel I might have given Al Capone a few hints. The best he could do was to operate his racket in three city districts. I operated on three continents". -- General Smedley Butler, former US Marine Corps Commandant,1935

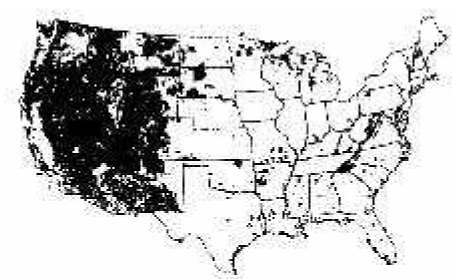
As President, John F. Kennedy understood the predatory nature of private central banking, he understood why Andrew Jackson fought so hard to end the Second Bank of the United States. So Kennedy wrote and signed Executive Order 11110 which ordered the US Treasury to issue a new public currency, the United States Note.

Kennedy's United States Notes were not borrowed from the Federal Reserve but created by the US Government and backed by the silver stockpiles held by the US Government. It represented a return to the system of economics on which the United States had been founded, and this was perfectly legal for Kennedy to do. All told, some four and a half billion dollars went into public circulation, eroding interest payments to the Federal Reserve and loosening their control over the nation. Five months later John F. Kennedy was assassinated in Dallas Texas, and the United States Notes pulled from circulation and destroyed (except for samples held by collectors). John J. McCloy, President of the Chase Manhattan Bank, and President of the World Bank, was named as part of the Warren Commission, presumably to make certain that the banking dimensions behind the assassination were concealed from the public.

As we enter the eleventh year of what future history will most certainly describe as World War Three, we need to examine the financial dimensions behind the wars. Towards the end of World War Two, when it became obvious that the allies were going to win and dictate the post war environment, the major world economic powers met at Bretton Woods, a luxury resort in New Hampshire in July 1944, and hammered out the Bretton Woods agreement for international finance. The British Pound lost its position as the global trade and reserve currency and its place was taken by the US dollar (part of the price demanded by Roosevelt in exchange for the US entry into the war). Without the economic advantages of being the world's central currency, Britain was forced to nationalise the Bank of England in 1946. The Bretton Woods agreement, was ratified in 1945, and in addition to making the US dollar the global reserve and trade currency, obliged the signatory nations to tie their currencies to the dollar. The nations which ratified Bretton Woods did so on two conditions. The first was that the Federal Reserve would refrain from over-printing the dollar as a means to loot real products and produce from other nations in exchange for ink and paper; basically an imperial tax. That assurance was backed up by the second requirement, which was that the US dollar would always be convertible to gold at $35 per ounce.

Of course, the Federal Reserve, being a private bank and not answerable to the US Government, did start overprinting paper dollars, and much of the perceived prosperity of the 1950s and 1960s was the result of foreign nations' obligations to accept the paper notes as being worth gold at the rate of $35 an ounce. Then in 1970, France looked at the huge pile of paper notes sitting in their vaults, for which real French products like wine and cheese had been traded, and notified the United States government that they would exercise their option under Bretton Woods to return the paper notes for gold at the $35 per ounce exchange rate. Of course, the United States had nowhere near the gold to redeem the paper notes, so on August 15th, 1971, Richard Nixon "temporarily" suspended the gold convertibility of the US Federal Reserve Notes.

This "Nixon shock" effectively ended Bretton Woods and many global currencies started to disengage from the US dollar. Worse still, since the United States had collateralised their loans with the nation's gold reserves, it quickly became apparent that the US Government did not in fact have enough gold to cover the outstanding debts. Foreign nations began to get very nervous about their loans to the US and understandably were reluctant to lend any additional money to the United States without some form of collateral. So Richard Nixon started the environmental movement, with the EPA and its various programs such as "wilderness zones", Road-less areas", Heritage rivers", "Wetlands", all of which took vast areas of public lands and made them off limits to the American people who were technically the owners of those lands. But Nixon had little concern for the environment and the real purpose of this land grab under the guise of the environment was to pledge those pristine lands and their vast mineral resources as collateral on the national debt. The plethora of different programs was simply to conceal the true scale of how much American land was being pledged to foreign lenders as collateral on the government's debts; eventually almost 25% of the nation itself.



With open lands for collateral already in short supply, the US Government embarked on a new program to shore up sagging international demand for the dollar. The United States approached the world's oil producing nations, mostly in the Middle East, and offered them a deal. In exchange for only selling their oil for dollars, the United States would guarantee the military safety of those oil-rich nations. The oil rich nations would agree to spend and invest their US paper dollars inside the United States, in particular in US Treasury Bonds, redeemable through future generations of US taxpayers. The concept was labelled the "petrodollar". In effect, the US, no longer able to back the dollar with gold, was now backing it with oil. Other peoples' oil, and the necessity to keep control over those oil nations in order to prop up the dollar has shaped America's foreign policy in the region ever since.

But as America's manufacturing and agriculture has declined, the oil producing nations faced a dilemma. Those piles of US Federal Reserve notes were not able to purchase much from the United States because the United States had little (other than real estate) which anyone wanted to buy. Europe's cars and aircraft were superior and less costly, while experiments with GMO food crops led to nations refusing to buy US food exports. Israel's constant belligerence against its neighbours caused them to wonder if the US could actually keep their end of the petrodollar arrangement. Oil-producing nations started to talk of selling their oil for whatever currency the purchasers chose to use. Iraq, already hostile to the United States following Desert Storm, demanded the right to sell their oil for Euros in 2000 and in 2002, the United Nations agreed to allow it under the "Oil for food" program instituted following Desert Storm. One year later the United States re-invaded Iraq, lynched Saddam Hussein, and placed Iraq's oil back on the world market only for US dollars.

Following 9-11, the clear US policy shift away from being an impartial broker of peace in the Middle East to one of unquestioned support for Israel's aggressions, only further eroded confidence in the Petrodollar deal and even more oil-producing nations started openly talking of oil trade for other global currencies.

Over in Libya, Muammar Gaddafi had instituted a state-owned central bank and a value-based trade currency, the Gold Dinar. Gaddafi announced that Libya's oil was for sale, but only for the Gold Dinar. Other African nations, seeing the rise of the Gold Dinar and the Euro, even as the US dollar continued its inflation-driven decline, flocked to the new Libyan currency for trade. This move had the potential to seriously undermine the global hegemony of the dollar. French President Nicolas Sarkozy reportedly went so far as to call Libya a “threat” to the financial security of the world.

So, the United States invaded Libya, brutally murdered Gaddafi (the object lesson of Saddam's lynching not being enough of a message, apparently), imposed a private central bank, and returned Libya's oil output to dollars only. The gold that was to have been made into the Gold Dinars is, as of last report, unaccounted for.

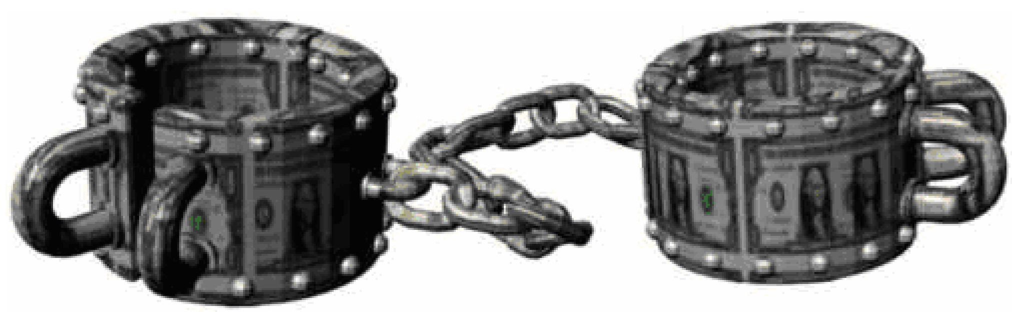
According to General Wesley Clark, the master plan for the "dollarification" of the world's oil nations included seven targets, Iraq, Syria, Lebanon, Libya, Somalia, Sudan, and Iran (Venezuela, which dared to sell their oil to China for the Yuan, is a late addition). What is notable about the original seven nations originally targeted by the US is that none of them are members of the Bank for International Settlements, the private central bankers private central bank, located in Switzerland. This meant that these nations were deciding for themselves how to run their nations' economies, rather than submit to the international private banks.

Now the gun sights of the bankers are on Iran, which dares to have a government central bank and sell their oil for whatever currency they choose. The war agenda is, as always, to force Iran's oil to be sold only for dollars and to force them to accept a privately owned central bank.

The German government recently asked for the return of some of their gold bullion from the Bank of France and the New York Federal Reserve. France has said it will take 5 years to return Germany's gold. The United States has said they will need 8 years to return Germany's gold. This suggests strongly that the Bank of France and the NY Federal Reserve have used the deposited gold for other purposes, and they are scrambling to find new gold to cover the shortfall and prevent a gold run. So it is inevitable that suddenly France invades Mali, ostensibly to combat Al Qaeda, with the US joining in. Mali just happens to be one of the world's largest gold producers with gold accounting for 80% of Mali exports. War for the bankers does not get more obvious than that!

Americans have been raised by a public school system and media that constantly assures them that the reasons for all these wars and assassinations are many and varied. The US claims to bring democracy to the conquered lands (they haven't; the usual result of a US overthrow is the imposition of a dictatorship, such as the 1953 CIA overthrow of Iran's democratically elected government of Mohammad Mosaddegh and the imposition of the Shah, or the 1973 CIA overthrow of Chile's democratically elected government of President Salvador Allende, and the imposition of Agusto Pinochet), or to save a people from a cruel oppressor, revenge for 9-11, or that tired worn-out catch all excuse for invasion: “weapons of mass destruction”. Assassinations are always passed off as "crazed lone nuts" to obscure the real agenda.

The real agenda is simple. It is enslavement of the people by the creation of a false sense of obligation. That obligation is false because the Private Central Banking system, by design, always creates more debt than money with which to pay that debt. Private Central Banking is not science, it is a religion; a set of arbitrary rules created to benefit the priesthood, meaning the owners of the Private Central Bank. The fraud persists, with often lethal results, because the people are tricked into believing that this is the way life is supposed to be and no alternative exists or should be dreamt of. The same was true of two earlier systems of enslavement, ‘Rule by Divine Right’ and ‘Slavery’, both of which are systems designed to trick people into obedience, and both of which are now recognised by modern civilization as illegitimate. Now we are entering a time in human history where we will recognise that ‘rule by debt’, or rule by Private Central Bankers issuing the public currency as a loan at interest, is equally illegitimate. It only works as long as people allow themselves to believe that this is the way life is supposed to be.



But understand this above all else, Private Central Banks do not exist to serve the people, the community, or the nation. Private Central Banks exist to serve their owners, to make them rich beyond the dreams of Midas and all for the cost of ink, paper, and the right bribe to the right official.

Behind all these wars, all these assassinations, the hundred million horrible deaths from all the wars lies a single policy of dictatorship. The private central bankers allow rulers to rule only on the condition that the people of a nation remain enslaved to the private central banks. Failing that, any ruler will be killed, and their nation invaded by those other nations which are already enslaved to private central banks.

The so-called "clash of civilizations" we read about on the corporate media is really a war between banking systems, with the private central bankers forcing themselves on to the rest of the world, no matter how many millions must die for it. Indeed the constant hatemongering against Muslims lies in a simple fact. Like the ancient Christians (prior to the Knights Templar's private banking system), Muslims forbid usury (the lending of money at interest), and that is the reason why the American government and media insist that Muslims must be killed or converted. They refuse to submit to currencies issued at interest. They refuse to be debt slaves. So off to war American children must go, to spill their blood for the gold of the money-junkies. We barely survived the last two world wars. In the nuclear/bio weapon age, are the private central bankers willing to risk incinerating the whole planet just to feed their greed? Apparently so.

Flag waving and propaganda aside, all modern wars are wars by and for the private bankers, fought and bled for by third parties unaware of the true reason why they are expected to be killed and crippled. The process is quite simple. As soon as the Private Central Bank issues its currency as a loan at interest, the public is forced deeper and deeper into debt. When the people are reluctant to borrow any more, that is when the Keynesian economists demand the government borrow more to keep the pyramid scheme working. When both the people and government refuse to borrow any more, that is when wars are started, to plunge everyone even deeper into debt to pay for the war, then after the war to borrow more to rebuild. When the war is over, the people have about the same as they did before the war, except the graveyards are far larger and everyone is in debt to the private bankers for the next century. This is why Brown Brothers Harriman in New York was funding the rise of Adolph Hitler.

As long as Private Central Banks are allowed to exist, inevitably, as night follows day, there will be poverty, hopelessness, and millions of deaths in endless World Wars, until the Earth itself is sacrificed in flames to Mammon. The path to true peace on Earth lies in the abolishment of all private central banking everywhere, and a return to the state-issued value-based currencies that allow nations and people to become prosperous.

Michael Rivero

The Economic Hit-Men

It is one of the most ingenious scams for social manipulation ever invented, and at it’s core, it is an invisible war waged against the population, and you will remember that the Emergency Banking Relief Act of 9th March 1933, **defined** the American people as “the **enemy”** of the United States Government. Debt is the weapon used to conquer and enslave societies and interest is its prime ammunition. While the majority of people are not aware of this reality, banks in collusion with governments and corporations continue to expand and perfect their tactics of economic warfare, spawning new bases such as the World Bank and the International Monetary Fund and introducing a new kind of soldier - the economic hit-man.

Here is the testimony of one of those American economic hit-men, John Perkins:

We, the economic hit men, are the ones really responsible for creating the first really global empire, and we work many different ways. Perhaps the most common is that we will identify a country which has resources which our corporations covet, such as oil, and then arrange a huge loan to that country from the World Bank or one of it's sister organisations. But the money never actually goes to the country, instead, it goes to our big construction corporations to build infrastructure projects in that country, like industrial power plants, things which benefit a few rich people in that country (in addition to our corporations), but really don't help the people involved, however those people and the whole country are left holding a huge debt so big that they can't repay it, which is the whole plan - that they can't repay it. So we economic hit men go back to them and say "listen, you owe us a lot of money, you can't repay it, so sell your oil real cheap to our oil companies, allow us to build a military base in your country or send troops to some place in the world to support our troops in somewhere like Iraq, or vote with us in the UN to have their electric utility company privatised, or their sewage system privatised and sold to US corporations or other multinational corporations, so there is a whole mushrooming thing and it's the way that the World Bank and the International Monetary Fund operate to put a whole country in debt with such a big debt that it can't pay it, so you then offer to refinance that debt and get them to pay even more interest and you demand this 'quid pro quo' or 'conditionality' or 'good governance' which means basically that they have to sell off their resources, including their social services and utility companies, their school systems sometimes, their penal systems, their insurance systems to foreign corporations. So, it's a double, triple, quadruple whammy.

Examples:

Iran 1953: The precedent for economic hit men began back in the early 1950s when the democratically elected Prime Minister of Iran, Dr Mohammed Mossadegh, was considered to be a hope for democracy - Time Magazine's Man of the Year. One of the policies which he ran on was the idea that the oil companies needed to pay the Iranian people a lot more for the oil which they were taking out of Iran. We didn't like that, of course, but we were afraid to do what we would normally do, which is to send in the military. Instead, we sent in one CIA agent, a relative of President Roosevelt. He went in with a few million dollars and was very efficient and effective and in a short amount of time he managed to get Mossadegh overthrown and brought in the Shah of Iran to replace him. It was extremely effective. So back here in the United States, people in Washington looked around and said "wow - that was easy and cheap !" So this established the whole new way of manipulating countries and creating empire. The only problem with Roosevelt was that he was a card-carrying CIA agent and if he had been caught, the ramifications would have been pretty serious. So, very quickly at that point a decision was made to use private 'consultants', to channel the money through the World Bank, the IMF or one of the other such agencies, bring in people like me who worked for private companies, so that if we got caught, there would be no government ramifications.

Guatemala 1954: When Arbenz (Jacobo Arbenz Guzman) became President of Guatemala, the country was very much under the thumb of the United Fruit Company, the big international corporation and Guzman ran under the strategy of giving the land back to the people. When he was elected he started implementing those policies of giving the land back to the people. United Fruit didn't like that so much, so they hired a Public Relations company in the United States mounted a huge campaign to convince the people of the US, the press of the US and the Congress of the US that Arbenz was a Soviet puppet and if we allowed him to stay in power the Soviets would have a foothold in this hemisphere, which, at that time, was a huge fear on everybody's minds, so to make a long story short, out of this public relations campaign came a commitment on the part of the CIA and the military to take this man out, and in fact, we did. We sent in planes, we sent in soldiers, we sent in jackals, we sent in everything to take him out, and we did take him out. And as soon as he was removed, his successor reinstated the links to the big corporations including United Fruit.

Ecuador 1981: Ecuador for many, many years was ruled by pro-US dictators, often relatively brutal. Then it was decided that they were going to have a truly democratic election Jaime Roldos (Aguilera) ran for office and his main goal, he said, as President was to make sure that Ecuador's resources were used to help the people. And he won, overwhelmingly, by more votes than anyone has ever won anything in Ecuador and he began to implement these policies to make sure that the profits from oil went to help the people. Well, we didn't like that in the United States. I was sent down as one of several economic hit men to change Roldos, to corrupt him, to bring him around, to let him know "you know, you and your family can get very rich if you play our game but if you but if you continue to try and keep these policies you promised, then you are going to go". He wouldn't listen. He was assassinated "Ecuadorian

Leader Dies in Plane Crash". As soon as the plane crashed, the whole area was cordoned off. The only people allowed in were the US military from a nearby base and some of the Ecuadorian military. When an investigation was launched, two of the key witnesses died in car accidents before they had a chance to testify. A lot of very, very strange things went on around the assassination of Roldos. I, like most of the people who really looked at this case had absolutely no doubt that it was an assassination and of course, in my position of an economic hit man, I was expecting something to happen to Jaime, whether a coup or an assassination I was sure that he would be taken down as he was not being corrupted, he would not allow himself to be corrupted the way we wanted to corrupt him.

Panama 1981: Omar Tarrijas President of Panama was one of my favourite people. I really, really liked him, he was very charismatic and he really wanted to help his country. When I tried to bribe him, to corrupt him, he said "look, John, he called me Juanita, look Juanita, you know, I don't need the money, what I really need is for my country to be treated fairly. I need the United States to replay the debts which you owe my people for all the destruction you have done here. I need to be in a position to help other Latin American countries with their independence and be free of this terrible presence from the North. You people are exploiting us so badly. I need to have the Panama Canal back in the hands of the Panamanian people. That's what I want. So leave me alone, don't try to bribe me". It was in 1981 and in May Jaime Roldos was assassinated and Omar was very aware of this. He got his family together and said "I'm probably next, but it is ok because I've done what I came here to do, I've renegotiated the Canal, the Canal will now be in our hands". He had been renegotiating the treaty with Jimmy Carter:

In June of that same year, just a couple of months later, he also went down in an aeroplane crash which there is no question was executed by CIA jackals. There is a tremendous amount of evidence, one of Tarrijas' security guards handed him, at the last moment as he was getting on the plane, a small tape recorder which contained a bomb.

Venezuela 2002: It is interesting to me how this system has continued pretty much the same way for years and years and years except the economic hit men get better and better and better. Then we come up with, very recently, what happened in Venezuela in 1998 when (Hugo Rafael) Chavez gets elected, following a long line of Presidents who were very corrupt and who basically destroyed the economy of the country, and Chavez was elected following all of that. Chavez stood up to the United States demanding that Venezuela oil be used to help the Venezuelan people. Well we didn't like that in the United States, so in 2002, a coup was staged, and there is no question in my mind or in most other people's minds, that the CIA was behind that coup. The way that coup was fermented was very effective, like Colonel Roosevelt had done in Iran - paying people to go out into the streets to riot, to protest and say that Chavez is very unpopular. You know, if you can get a few thousand people to do that, television can make it look like the whole country and things start to mushroom, except in the case of Chavez, he was smart enough and the people were so strongly behind him that they overcame it, which was a phenomenal moment in the life of Latin America.

Iraq 2003: Iraq, actually, is a perfect example of the way the whole system works. We economic hit men are the first line of defence. We go in and try to corrupt governments and get them to accept these huge loans which we then use as leverage to basically own them. If we fail, as I failed in Panama with Omar Tarrijas, and in Ecuador with Jaime Roldos, men who refused to be corrupted, then the second line of defence is we send in the jackals and the jackals either overthrow governments or they assassinate and when that happens and a new government comes in, boy, it's going to toe the line as the new President knows what will happen if he doesn't. And in the case of Iraq, both of those things failed and the economic hit men were not able to get through to Saddam Hussein although they tried very hard. We tried very hard to get him to accept a deal but he wouldn't accept it and so the jackals went in to take him out but they couldn't do it as his security was very good. After all, he had at one time worked for the CIA and been hired to assassinate a former President of Iraq and failed, but he knew the system. So, in 1991 we send in the troops and we take out the Iraqi military, assuming that at that point that Saddam is going to come around. We could, of course, have taken him out at that time, but we didn't want to as he is the kind of strong man that we like, able to control his people and keep pumping oil for us. But when we took out his military he didn't come around so the economic hit men go back in the 90s without success. If they had had success, he'd still be running the country - we'd be selling him all the fighter jets he'd want, but they didn't have success. The jackals couldn't take him out again, so we sent the military in once again and took him out, and created for ourselves very lucrative reconstruction deals to rebuild a country which we had essentially destroyed - which is a very good deal if you own a construction company - a really big one. So, Iraq shows the three stages: the economic hit men - failed there, the jackals failed there, so as the final measure, the military goes in.

And in that way, we have really created an empire, but we have done it very, very subtly, it's clandestine. All the empires in the past were built by the military and everybody knew they were building them. The British knew they were building it, the French, the Germans, the Romans, the Greeks - they were all proud of it and they always had some excuse like "spreading civilisation", or spreading some religion, something like that, but they knew they were doing it. We don't. The majority of the people in the United States have no idea that we are living off the benefits of a clandestine empire, that today there is more slavery in the world than ever before.

You may have to ask yourself if it's an empire, then who's the Emperor? Obviously, our Presidents in the United States are not Emperors. An Emperor is someone who is not elected, does not serve a limited term, and who doesn't report to anyone. So you can't classify Presidents that way. But we do have what I consider to be the equivalent of the Emperor in what I call the "Corporatocracy". The Corporatocracy is this group of individuals who run our biggest corporations and they really act as the Emperor of this empire. They control our media (either by direct ownership or by advertising), they control most of our politicians because they finance their campaigns, either through corporations or through personal donations. They are not elected, they don't serve a limited term, they don't report to anybody, and at the very top of the Corporatocracy, we can't tell if the person is working for a corporation or for the government as they are always moving back and forth, so you get a guy who is one moment the president of a big company like Halliburton and the next moment he's the Vice President of the United States, or the President who is in the oil business and this is true whether you get Democrats or Republicans in the office, you have them moving back and forth through the revolving door, and in a way, our government is invisible a lot of the time as it's policies are carried out by a corporation on one level or another, and then again, the policies of the government are basically forged by the Corporatocracy and then presented to the government and become government policies. So, it is an incredibly cosy relationship. This isn't a "conspiracy theory" kind of thing, these people don't have to get together and plot to do things, they all basically work under one primary assumption, and that is that they must maximise profits regardless of the social and environmental costs.

This process of manipulation by the Corporatocracy, through the use of debt, bribery and political overthrow, is called "Globalisation". Just as the Federal Reserve keeps the American people in a position of indentured servitude, through perpetual debt, inflation and interest, the World Bank and International Monetary Fund fulfil this role on a global scale.

Oh, and by the way, the lame excuse for going to war with Iraq which was never believable beforehand, is laid out in fair detail here by a high-ranking US Major General expert in gathering and interpreting military and terrorist intelligence: http://www.youtube.com/watch?v=W0xzsbSbVUE&feature=player_embedded.

Libya 2011: If the ruler of a country refuses to become the servant of the New World Order people, he is subjected to character assassination and physically attacked with troops. I don't for a moment suggest that Col. Gaddafi was a saint, but as the Bible so aptly remarks, you can tell a man's character by the things which he does, so what did Col. Gaddafi do? Well, here is some information passed to me and I leave you to decide for yourself:

1. In Libya, electricity is free for all of it's citizens.

2. There is no interest on loans, banks in Libya are state-owned and loans are given to all its citizens at 0% interest which is requirement of Libyan law.

3. Owning a home is considered a human right in Libya – Gaddafi vowed that his parents would not get a house until everyone else in Libya had a home. Gaddafi's father has died while he, his wife and his mother were still living in a tent.

4. All newlyweds in Libya receive $60,000 Dinar (US $50,000) from the government, to buy their first apartment to help them start a family.

5. Education and medical treatments are free in Libya. Before Gaddafi only 25% of Libyans were literate. Today the figure is 83%.

6. If any Libyan wants to take up farming, he receives farming land, a farm house, equipment, seeds and livestock to kick- start their farms – all for free.

7. If Libyans cannot find the education or medical facilities they need in Libya, the government funds them to go abroad for it – not just free, but they get US $2,300 per month for accommodation and running a car.

8. If a Libyan buys a car, the government pays 50% of the price.

9. The price of petrol in Libya is US $0.14 per litre (in the UK, it is $2.17 per litre at this time, which is more than 15 times as much).

10. Libya has no external debt and its reserves amount to US $150 billion – now frozen globally.

11. If a Libyan is unable to get employment after graduation, the state pays the average salary of the profession as if he or she is employed, until employment is found.

12. A portion of Libyan oil sale revenues is credited directly to the bank accounts of all Libyan citizens.

13. A mother who gives birth to a child receives US $5,000.

14. 40 loaves of bread in Libya costs just US $0.15 (in the UK, it is 200 times more expensive).

15. 25% of Libyans have a university degree, while in the UK, Sir Clive Woodhead, former Chief Inspector of Schools, has recently recommended that children should leave school at age 14 and become apprentices.

16. Col. Gaddafi carried out the world's largest irrigation project, known as the Great Man-Made River project, to make water readily available throughout his desert country.

So, I will leave it up to you to decide if the attacks on Libya and the killing of Col. Gaddafi was an honest action designed to make the world a safer and better place, or if those actions were motivated by some other agenda.

The Petro Dollar

To discover more, perhaps you should consider the following video at http://www.safeshare.tv/w/gQnBDHTCDs which states:

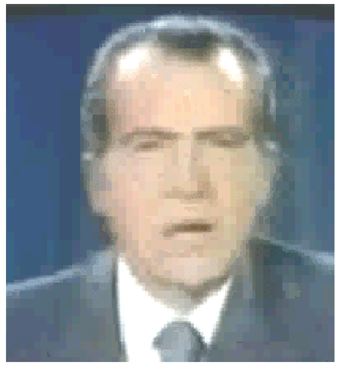
Why did the United States attack Libya, Iraq, Afghanistan and Yemen? Why are US operatives helping to de-stabilise Syria? And why is the United States government so intent in taking down Iran, in spite of the fact that Iran has not attacked any country since 1798?

And, what's next? What are we headed for? When you look at the current trajectory that we are on, it doesn't make any sense at all if you evaluate it on what we are taught in school. And it doesn't make any sense if you base your world view on the propaganda that the mainstream media tries to pass off as news. But it makes perfect sense once you know the real motives of the powers that be. In order to understand those motives, we first have to take a look at history:

In 1945, Britain, with agreement, established the dollar as the world's Reserve Currency, which meant that international commodities were priced in dollars. The agreement, which gave the United States a distinct financial advantage was made under the condition that those dollars would remain redeemable for gold at a consistent rate of $35 per ounce.

The United States *promised* not to print very much money but this was on the honour system because the Federal reserve refused to allow any audit or supervision of it's printing presses.

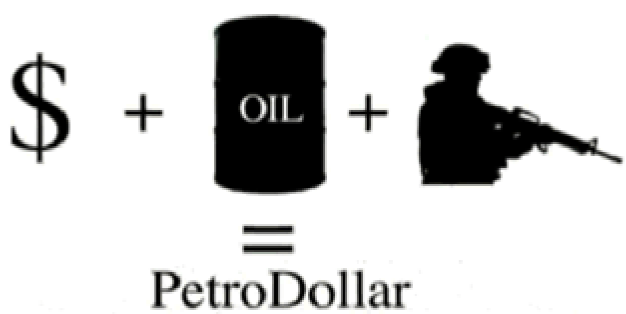
In the years leading up to 1970, expenditures in the Vietnam War made it clear to many countries that the US was printing far more money than it had in gold, and in response, they began to ask for their gold back. This, of course, set off a rapid decline in the value of the dollar. The situation climaxed in 1971, when France attempted to withdraw it's gold and Nixon refused. On 15th August, he made the following announcement:



“I have directed the Secretary of the Treasury to take the action necessary to defend the dollar against the speculators. I directed Secretary Connolly to suspend temporarily, the convertibility of the dollar into gold or other reserve assets except in amounts and in conditions determined to be in the interests of monetary stability and in the best interests of the Unites States”.

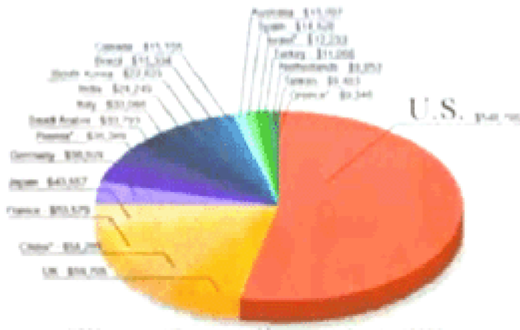
This was obviously not a temporary suspension as he claimed, but rather a permanent default, and for the rest of the world who had entrusted the United States with their gold, it was outright theft. In 1973, President Nixon asked King Faisal of Saudi Arabia to accept only US dollars in payment for oil, and to invest any excess profits in

US Treasury Bonds, Notes and Bills. In return, Nixon offered military protection for Saudi oil fields. The same offer was extended to each of the key oil-producing countries, and by 1975, every member of OPEC had agreed to only sell their oil in US dollars.



The act of moving the dollar off gold and tying it to foreign oil, instantly forced every oil-importing country in the world to maintain a constant supply of Federal Reserve paper, and in order to get that paper, they would have to send real physical goods to America. This, was the birth of the Petro Dollar. Paper went out, everything America needed came in, and the United States got very, very rich as a result. It was the largest financial con in recorded history.

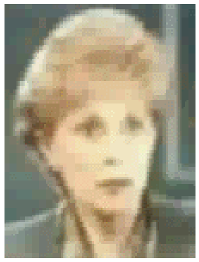
The Arms Race of the Cold War was a game of poker. Military Expenditures were the chips, and the US had an endless supply of chips. With the Petro Dollar under it's belt, it was able to raise the stakes higher and higher, outspending every other country on the planet, until eventually, US military expenditure surpassed that of all of the other nations in the world combined – the Soviet Union never had a chance.



Military Expenditures in Millions

The collapse of the communist bloc in 1991, removed the last counterbalance to American military might. The United States was now an undisputed Super-power with no rival. Many hoped that this would mark the start of a new era of peace and stability. Unfortunately, there were those in high places who had other ideas. Within that same year, the US invaded Iraq in the first Gulf War, and after crushing the Iraqi military, and destroying their infrastructure, including water-purification plants and hospitals, crippling sanctions were imposed which prevented that infrastructure from being rebuilt.

These sanctions which were initiated by Bush Senior, and sustained throughout the entire Clinton administration, lasted for over a decade and were estimated to have killed over five hundred thousand children. The Clinton administration was fully aware of these figures.

A TV interviewer speaking to Madeleine Albright, Secretary of State for Clinton, asked: "We have heard that half a million children have died, I mean, that's more children that died than in Hiroshima, and, and is the price worth it?". To which Madeleine Albright replied: "I think that this is a very hard choice. We think that the price is worth it".

Miss Albright, what exactly was worth killing 500,000 kids for? In November of 2000, Iraq began selling it's oil exclusively in Euros. This was a direct attack on the dollar and on US financial dominance, and it wasn't going to be tolerated. In response, the US government with the assistance of the mainstream media, began to build up a mass propaganda campaign claiming that Iraq had weapons of mass destruction and was planning to use them. In 2003, the US invaded and once they had control of the country, oil sales were immediately switched back to dollars. This is particularly noticeable as switching back to the dollar meant a 15% to 20% loss in revenue due to the Euro's higher value. It doesn't make any sense at all unless you take the Petro Dollar into account.

On 2nd March 2007, US General Wesley Clark said: "So I came back to see him a few weeks later and by that time we were bombing in Afghanistan. I said: 'Are we still going to war with Iraq?' and he said 'Oh it's worse than that'. He said as he reached over on his desk and picked up a piece of paper and he said 'I just got this down from upstairs (meaning from the Secretary of Defence's Office) today, this is a memo which describes how we are going to take out seven countries in five years, starting off with Iraq and Syria, Lebanon, Libya, Somalia, Sudan and finishing off Iran".

Let's take a look at the events of the past decade and see if you see a pattern. In Libya, Gadaffi was in a process of organising a block of African countries to create a gold-based currency called the "Dinar" which they intended to use to replace the dollar in that region. US and NATO forces helped to destabilise and topple the government in 2011 and after taking control of the region, US armed rebels executed Gadaffi in cold blood and immediately set up the Libyan Central Bank. Iran has been actively campaigning to pull oil sales off the dollar for some time now, and it has recently secured agreements to trade it's oil in exchange for gold. In response, the US government with mainstream media assistance has been attempting to build international support for military strikes on the pretext of preventing Iran from building a nuclear weapon. In the mean time they established sanctions which they openly admit are aimed at causing a collapse of the Iranian economy.

Syria is Iran's closest ally and they are bound by mutual defence agreements. The country is currently in the process of being destabilised with covert assistance from NATO and although Russia and China have warned the United States not to get involved, the White House has made statements in the past month indicating that they are considering military intervention. It should be clear that military intervention in Syria and Iran isn't being considered – it is a foregone conclusion. Just as it was in Iraq and Libya, the US is actively working to create the context which gives them the diplomatic cover to do what they have already planned. The motive for these invasions and covert actions becomes clear when we look at them in their full context and 'connect the dots'. Those who control the United States understand that if even a few countries begin to sell their oil in another currency, it will set off a chain reaction and the dollar will collapse. They understand that there is absolutely nothing else holding up the value of the dollar at this point and so does the rest of the world. But instead of accepting the fact that the dollar is nearing the end of it's lifespan, the powers that be have made a calculated gambit. They have decided to use the brute force of the US military to crush each and every resistant State in the Middle East and Africa.

That in itself would be bad enough, but what you need to understand is that this is not going to end with Iran. China and Russia stated publicly and in no uncertain terms that they will not tolerate an attack on Iran or Syria. Iran is one of their key allies, one of the last independent oil-producers in the region, and they understand that if Iran falls, then they will have no way to escape the dollar without going to war. And yet, the United States is pushing forward in spite of the warnings. What we are witnessing here is a trajectory which leads straight to the unthinkable. It is a trajectory which was mapped out years ago in full awareness of the human consequences. But who was it that put us on this course? What kind of psychopath is willing to intentionally set off a global conflict which will lead to millions of deaths, just to protect the value of a paper currency? It obviously isn't the President. The decision to invade Syria, Libya and Iran was made long before Obama had risen to the national spotlight, and yet, he is carrying out his duties just like the puppets who preceded him. So who is it that pulls the strings?

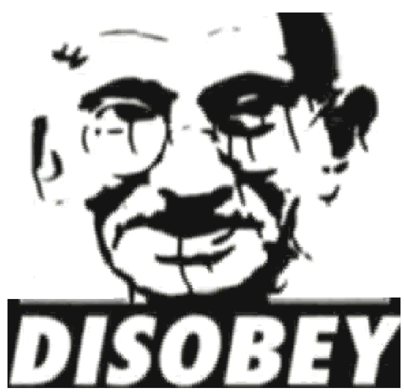
Often, the best answers to questions like this are found by asking another question "Cui Bono?" - "Who Benefits?" Obviously, those who have the power to print the dollar out of thin air have the most to lose if the dollar were to fall, and since 1913, that power has been held by the Federal Reserve. The Federal reserve is a private entity owned by a conglomerate of the most powerful banks in the world and the men who control those banks are the ones who pull those strings. To them, this is just a game. Your life, and the lives of those you love are just pawns on their chessboard. And like a spoiled four-year-old who tips the board on to the floor when he starts to lose, the powers that be are willing to start World War Three to keep control of the global financial system.

Remember that when these wars extend and accelerate. Remember that when your son, or your neighbour's son comes back in a flag-draped coffin. Remember that when they point the finger at the new 'bogeymen' because the madmen who are running this show, will take this as far as you allow them to.

So, how much time do we have left? It's a question which I hear constantly. But it is the wrong question. Asking how much time we have left is a passive posture. It is the attitude of a prisoner who is waiting to be taken out to a ditch and shot in the back of the head.

What are our chances? Can we change course?   Also, the wrong question. The odds don't matter any more. If you understand what we are facing, then you have a moral responsibility to do everything in your power to alter the course we are on, regardless of the odds. It is only when you stop basing your involvement on the chances of your success, that success actually becomes possible. To strip the ill-begotten power from the financial elites and bring these criminal cartels to justice, will require nothing less than a revolution. The government is not going to save us. The government is completely infiltrated and corrupt to the core. Looking to them for a solution at this point is utterly naive.

There are three stages of revolution and they are sequential.   Stage One is already underway Stage One is the ideological resistance. In this stage we have to actively work to wake up as many people as possible about what is happening and the direction we are headed. All revolutions originate from a shift in the mind-set of the population and no other meaningful resistance is possible without it. Success in this stage of the game can be measured by the contagion of ideas. When idea reaches critical mass, it begins to spread on its own and seeps into all levels of society. In order to achieve that contagion, we need more people in this fight. We need more people speaking up, making videos, writing articles, getting this information on to the national and international stage, and we especially need to reach the police and the military.



Stage Two is civil disobedience, also known as Non-violent Resistance. In this Stage, you put your money where your mouth is, or more accurately, you withhold your money and your obedience from the government and you do everything in your power to bring the gears of the State to a halt. Practiced in mass, this method alone is often enough to bring a regime to it's knees. However, if it fails at this stage, Stage Three is inevitable.

Stage Three is direct physical resistance.   Direct physical resistance is the last resort and it should be avoided and delayed as long as possible and only invoked when all other options have been thoroughly exhausted. There are those who ‘talk tough’ and claim that they will resist when the time comes, but what they fail to realise is that if you are inactive during the first two Stages and save your efforts for the last resistance, then you will fail.

When the Nazis were moving from door to door, dragging people out of their homes in Germany, that was the time to fight back physically, but due to the lack of ideological resistance and civil disobedience leading up to that moment, even an armed uprising would have likely failed at that point. An armed uprising can only succeed if the people have established an attitude of active resistance. And active resistance is only possible after their minds have broken free from the mainstream propaganda. If you want to fight back, then it’s now or never – you’re not going to get another chance, and the stakes are far higher than they were in Nazi Germany.

If you want to know more about the present situation, then watch the very informative web video at http://www.youtube.com/user/ThriveMovement, which also shows what you can do to improve things.

Chapter 14 - How Are You?

The New World Order people mentioned in the previous chapter own the pharmaceutical companies. In 2016, if the mainstream news services are to be believed (and that is definitely not something that we can be sure of), then we have a major health problem which they describe as us entering a "post antibiotic era". Before the discovery of antibiotics, a simple illness such as influenza could kill you. This was a major factor in the very slow growth of human population in those times. Then, antibiotics were discovered, and previously fatal diseases became treatable. The result was that people who would have died now survived and lived to much greater ages. That strengthened the family unit as survival has always been the goal of families.

The pharmaceutical companies jumped on the band wagon, but their major aim is to make money from sick people. They want to sell drugs, potions and salves - nothing wrong with that. But unfortunately, they realise that keeping a patient from dying but not curing the patient makes the most money. So, for example, cancer treatment is very expensive and very prolonged. The cancer is poisoned along with the patient and it is common for conventionally treated patients to die within five years of their poisoning (err, "treatment"). The care staff who treat these patients are excellent, well-meaning people who have been told that this is the best that anyone can do for the patient. This lack of knowledge is very painful to see as are reports on the news that somebody has been abandoned to die as their cancer is "untreatable" (which, of course, it isn't as there are several effective ways of dealing with cancer - the snag is that those ways are simple and cheap and therefore highly unpopular with pill manufacturers).

However, the problem now is that antibiotics have been used too freely on humans and on farm animals, and that has resulted in infections which are immune to every antibiotic available to the pill-pushers, who now consider that we are going to return to simple diseases becoming fatal again. An article in the Lancet which is a specialist publication for doctors, states that by 2050 a person will die every three seconds if things continue as they are now. They propose action costing "billions" of dollars to try to deal with the situation. That does **not** have to happen.

I am not a medical expert, but let me explain some of the simple treatments which you can use yourself. Let's start with colloidal silver. This is a very basic and wholly safe liquid which is distilled water which has very tiny particles of pure silver in it. Each particle of silver is given an electrical charge and the particles are so tiny that they never settle out of the water. The treatment is to take a teaspoonful of the water in your mouth four or five times per day. It is tasteless and safe. You can buy it made up (and labelled 'not for consumption' by the supplier for fear of the pill manufacturers) or you can make it very easily yourself in just a few minutes. What happens is that the charged particles are so small that they migrate from your mouth into your bloodstream within one minute. There they circulate around your body and when they encounter an infecting microbe, they enter the microbe and kill it. Cancer is those microbes hijacking the essential replication mechanism of your own cells making them multiply when they shouldn't. Due to their very small size, the silver particles destroy the hijacker and restore the cells to full health again. That happens anywhere that blood goes in your body and I have not yet heard of any disease which colloidal silver does not deal with, including diseases which the medical profession honestly believe are incurable.

Instead of using charged silver particles, it is also possible to kill off the invaders in your bloodstream by passing a very tiny pulsing current through your bloodstream. This can be done using electrodes strapped to your wrists. It is not a painful process and if you wish, you can make the equipment yourself. Several different designs are put forward by different doctors.

Perhaps I should mention that the drive to sell you pills and potions is so strong that the pharmaceutical companies will cheerfully poison you and sell you things which they know perfectly well are useless. For example, "remedies" for colds and flu are commonplace although they do not deal with the infection at all - colloidal silver does. You are also sold toothpaste with fluoride in it, under the ridiculous claim that it whitens your teeth. They might as well claim that it will grow you a third leg. Fluoride is a serious poison which gives your teeth brown patches. If a child swallowed a piece of fluoride toothpaste the size of a pea, it would die. Fluoride is put in toothpaste to get rid of an unwanted industrial poison, and getting people to pay for disposing of it will be found amusing by the manufacturers.

Jane Burgermeister, MA. Jane, who is an experienced science writer for prestige publications such as Nature, the British Medical Journal, The Scientist, Reuters Health, and The Guardian, with exceptional bravery, in April 2009, filed a series of criminal charges against Baxter, the World Health Organisation and others alleging attempted bio-terrorism with the intent to commit mass murder.

Although her case is based on solid fact, it is most unlikely that it will have much effect because the main media sources are heavily controlled by the people who are instigating this attack on the peoples of the world (and that includes you, personally). Her interview http://www.youtube.com/watch?v=PelTWCUmTsU gives you the full background details and allows you to assess her honesty and personality. You may not be aware of it, but it is planned to have mandatory, forced "inoculation" (actually, injection with the virus) for everybody, with no exceptions. This has already been arranged with the World Health Organisation taking direct charge of medical and police organisations in every country. Jane's website is https://www.youtube.com/watch?v=x3_xZCL-ipY.

However, to specifics:

Making Colloidal Silver
There is a method of protection against many infections which is not expensive and which can be very effective. The method involves the use of colloidal silver, which is a suspension of very, very tiny charged particles of pure silver suspended in distilled water. I have had e-mails from people who have had very satisfactory results, working from the information in this document, and I myself, have found it to be most helpful.

Due to legal considerations, please understand that just because the following information is presented here, it must not be considered to be a recommendation from me that you should follow the procedure or inhale, drink or in any other way use the resulting liquid. Nor are any representations made to the effectiveness or otherwise of this or any other related procedure. The following material must be considered to be presented here solely for information purposes and not a recommendation that you or anyone else should make or use this substance.

Having said that, let me explain that my friend Ravi Raju in India has made and used colloidal silver very successfully for more than two years and both he and the members of his family have experienced highly positive effects from it.

Making Colloidal Silver.
In broad outline, all that is necessary is to apply a DC voltage to two electrodes made from 99.99% pure silver, placed in distilled water for about ten minutes. The lower the current flowing through the water, the smaller the size of the silver particles suspended in the water, and the smaller the particle size, the more effective the colloidal silver becomes. Here are some additional facts about colloidal silver, prepared electrically as described here:

1. In July 2009, one of the members in a Yahoo forum reported that he had been infected with the swine 'flu virus via a relative. Using colloidal silver and one or two similar treatments (while avoiding anti-oxidants such as Vitamin C and Vitamin E) he cleared the infection in just eighteen hours while the relative was still ill five days later.

2. According to the US Environmental protection Agency Poison Control Centre, colloidal silver is considered harmless and a daily intake of 14 teaspoons of 5 parts per million colloidal silver is quite safe for the first 70 years. So, treating an infection with one teaspoon of colloidal silver per hour is perfectly safe. A normal treatment rate for an infection is a teaspoon dose three times per day, but clearly, a greater rate of intake is perfectly safe if you wish to raise the dosage. If that is the case, then stick to one teaspoon at a time and take it more often.

3. Colloidal silver does more than just kill disease-causing organisms, it also promotes major bone growth and accelerates the healing of injured tissues by over 50%. It promotes healing in skin and other soft tissues in a way which is unlike any other known natural process. An example of this is the case of Glen Roundtree, a 32 year old man, who was clearing brush and trees in his parent's yard when some petrol left on his hands after filling the chain saw ignited. He burned for over 30 seconds as he tried to get the fire out. Glen suffered third degree burns on his hands and face. His mother's friend brought him some colloidal silver. He drank it and sprayed it on his face often. He was able to stop taking morphine immediately. Within three and a half weeks his recovery was so advanced that his hospital attendant did not believe he was the same burns patient. In less than three months his face was completely healed with absolutely no scarring. The planned re-constructive surgery for his melted nose and ear was cancelled.

4. In the presence of colloidal silver, cancer cells change back to normal cells regardless of their location in the body. The presence of silver ions regenerates tissues and eliminates cancer cells and other abnormal cells. For many years, Dr Bjorn Nordstrom of Sweden's Karolinska Institute has used silver in his cancer treatment methods. He reports that he has successfully cured patients who had been diagnosed as "terminally ill" by other doctors. He also discovered that the silver was promoting the growth of a new kind of cell which looked like the cells only found in children. These cells grew fast, producing a diverse and surprising assortment of primitive cell forms able to multiply at great rate and then change into the specific cells of an organ or tissue which had been injured, even in patients over 50 years old. In no case were there any undesirable side effects. He also discovered that previously untreatable osteomyelitis and bones which refused to knit, could be healed quickly by applying a silver-impregnated nylon dressing attached to a small battery. This worked so well that it has become standard practice today when dealing with bones which refuse to knit.

5. Dr Paul Farber suffered a tick bite which overnight, gave him the crippling Lyme's Disease. There was no satisfactory treatment so he searched medical literature to see if he could find anything to help. He finally found the comments of Dr Crookes about colloidal silver killing a microbe in six minutes or less. He also found the research and development work done on colloidal silver by Dr Moyer, Dr Bretano and Dr Margraf. Dr Farber started taking colloidal silver with spectacular results, clearing the bacteria out of his body in a short time - colloidal silver kills the Lyme's Disease bacteria.

6. When Czechoslovakia was under communist occupation, Soviet intelligence came across a domestic disinfectant which was capable of neutralising not only their existing biological weapons, but also those under development. The Soviets quickly dismantled the factory which was producing this product and moved the equipment, documentation and even the staff to the Soviet Union. Following this, no one heard of the disinfectant again. In a study of infected wells, it completely destroyed typhus, malaria, cholera, and amoebic dysentery. This domestic disinfectant is a variety of colloidal silver.

7. Antibiotics have no impact whatsoever on viruses. This means that taking any antibiotic will have no effect on a viral infection. Worse still, many forms of bacteria are now resistant to most antibiotics. Colloidal silver will kill both and boost your natural immune system at the same time.

It should be noted that colloidal silver offered for sale is seldom of adequate quality, so it is highly recommended that you make your own if you want to use it. Any types of batteries can be used and the equipment is very cheap.

Please note that you don't drink out of the glass container with the colloidal silver in it as your lips will pass additional materials into the remaining colloidal silver, wasting much of the charge and quite possibly causing a brownish colour in the remaining colloidal silver. Instead, you pour the amount of colloidal silver that you want, into another non-metal container before using it. If taking it orally, then some should be held under the tongue for at least one minute as the silver particles enter the bloodstream easily through the skin beneath the tongue and they do not have to contend with the acid in the stomach. If you are applying it externally (which is very effective for skin complaints) then just tip a little into the cupped palm of one hand and apply it from there. It is highly likely that colloidal silver will enter your bloodstream through your skin and be beneficial throughout all of your body as well as improving your skin. Either way, the important thing is that the colloidal silver is kept in a dim place and does not come into contact with sunlight which will affect the charged silver particles in the water and ensure that it only touches the glass container until it is being used.

Making colloidal silver

To keep the current low, I use a 5-volt battery comprising four 1.2V Ni-Mh AA-size rechargeable batteries in a battery holder box. These, bought through eBay were very low-cost and should last for many years.

Thick silver wire is recommended, but I have never been able to find a supplier and so, I bought thin silver wire from Cricklewood Electronics, bending the wire in a zig-zag fashion backwards and forwards in order to give a good deal of under water surface area on each electrode.

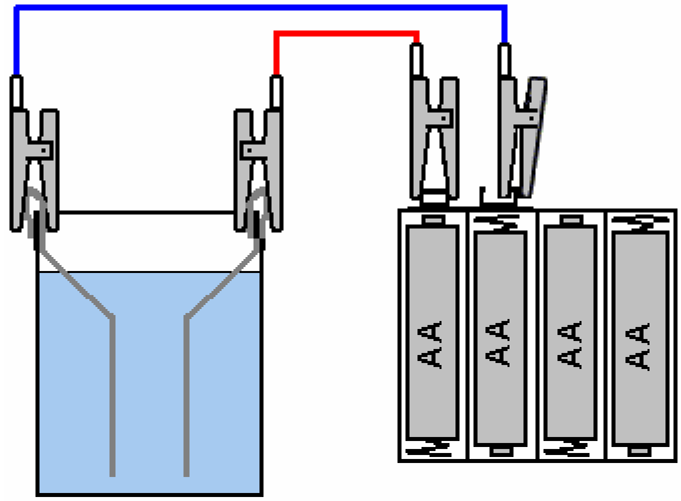
As the process continues, the water is stirred with a glass rod although plastic or wood can be used, but not metal as that will react with the charged silver particles. After a few minutes, the silver wire which is connected to the minus terminal of the battery, will become coated with a black substance. This needs to be cleaned off. Ravi uses sterile cotton wool for this while I use a clean tissue for the cleaning. As time goes by, the rate at which the black coating develops increases as the water becomes much more able to carry current from the battery. Do **not** use any kind of chemicals to clean the silver – the purity of the water, silver is vital and glassware needs to be used. The silver wire connected to the positive terminal of the battery develops a dull grey coating which needs to be cleaned off occasionally.

I generally continue the process until I have cleaned off the negative electrode four or five times using a clean tissue. Most people have a slightly different method for producing and using colloidal silver. In passing, “colloidal” just means that the silver particles are too small to drop out of the water under gravity and so, stay dispersed throughout the water indefinitely. The end product should be clear and look exactly like water (which it mainly is). If you shine a laser light such as a lecture pointer into the colloidal silver, it looks very pretty, lighting up with thousands of little sparkles as the light is reflected off the silver particles.

If you want to be very ‘scientific’ about the process, then you can determine the actual concentration of silver particles in the water using a cheap (£5) TDS PPM meter which gives a readout in Parts Per Million. Dorron Shapir uses one of those as a monitor for his production of colloidal silver. He starts with a voltage of 17 volts from a mains DC unit, stirring periodically. When his PPM meter shows a concentration of 4 ppm, he lowers the voltage to 9V and continues until 8 ppm is reached. Finally, he lowers the voltage to 6V until the finishing point of 10 ppm is reached. The continual reduction of the voltage is to produce silver particles of small size as they are the most effective. The concentration needs to be anywhere from 5 ppm to 10 ppm and higher concentrations are no more effective than a 10 ppm concentration.

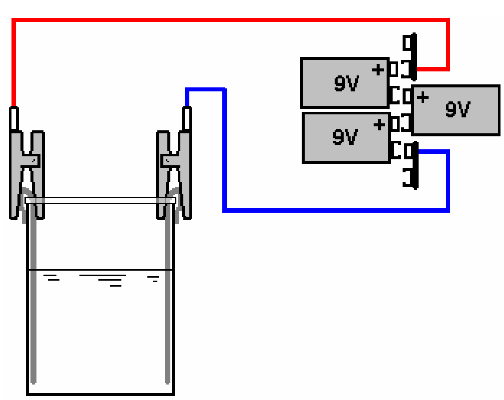
Ravi uses 27 volts continuously. The current flow through the distilled water depends very much on the spacing between the electrodes. The further apart the electrodes are, the smaller the current for any given voltage. Ravi’s electrodes are spaced far apart, which accounts for the high voltage which he uses. As I do, he bends the ends of the silver wire over the lip of the glass container holding the distilled water, and clips a wire over the top of the loop so as to make an electrical connection as well as clamping the silver wire to the glass container.

I use a small glass tumbler of about 50 mm (2-inches) inside diameter and some 65 mm (2.5 inches) tall and position the electrodes so that they are about 12 mm (half an inch) apart. This method looks like this:



Dorron uses a lid to support the silver wires and to keep the electrodes at his chosen spacing, as shown here:

And Ravi uses much wider electrode spacing as shown here:



This is quite enough and you can skip the following material on colloidal silver as it is for electronics experts.

A more advanced method

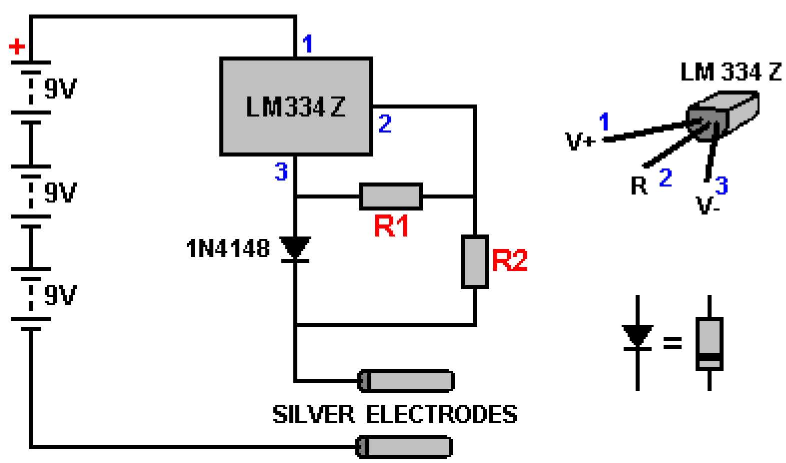
Mike Lexa presents an improved technique here. He says:

First of all, colloidal silver produced in the above process is not good for internal use. It will not cause any harm, but silver particles released from silver wires are too big to penetrate bacteria or virus cells. Silver particles must by only few nanometers in size if they are to be able to penetrate cell membranes. The smaller a silver particle is, the more effective it is. The technique for making more effective colloidal silver is:

The operating current must not exceed 0.155 milliamps per square centimetre of one submerged electrode. So, for example, if each electrode has 3 square centimetres of submerged surface area, then the maximum current should be three times the 0.155 mA figure which is 0.465 milliamps. If you were to supply more than that, then the resulting particles of silver will be too large to be fully effective.

As the current is so low, using three 9-volt batteries is a perfectly good idea, although, a small mains unit could be used instead, if its output voltage is sufficiently high (say, 40 volts).

An easy way to arrange the controlled power supply is to use a current regulator as shown here:

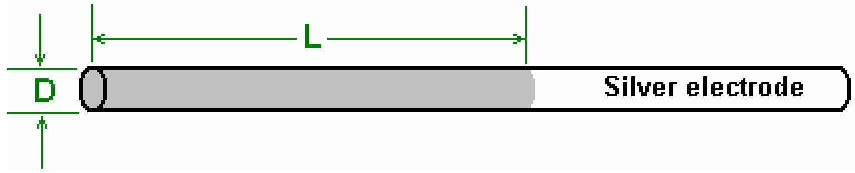


If you are not familiar with electronic components or how to put them together, then the free download electronics beginner's tutorial http://www.free-energy-info.tuks.nl/Chapter12.pdf should be helpful as it describes electronic components and shows how to assemble them into circuits.

In this circuit, the resistor **R1** controls how much current will flow in the circuit and the resistor **R2** needs to be ten times higher in value than **R1**. For example, if the desired current were 3 milliamps (0.003 amps) then the resistor **R1** would have a value of 0.134 divided by our desired 0.003 amps, giving us an **R1** resistor value of 44.7 ohms. This is not a standard resistor size, so the next higher value is picked (as we do not want to exceed our chosen current) and that would be a 47 ohm resistor and as **R2** is ten times bigger, we would use a 470 ohm resistor. Using 5% tolerance resistors is recommended. As the power in the circuit is trivial, any wattage of resistors can be used, and the 1N4148 diode shown can in fact be any silicon, small-signal diode.

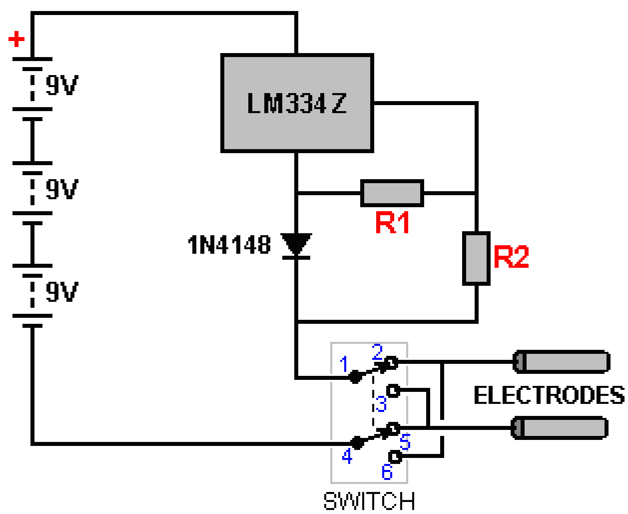
Some example results are:
R1 = 1K, R2 = 10K, current = 0.13 milliamps.
R1 = 100 ohms, R2 = 1K, current = 1.38 milliamps.
R1 = 47 ohms, R2 = 470 ohms, current = 3.02 milliamps.

The wetted surface area of an electrode is worked out like this:

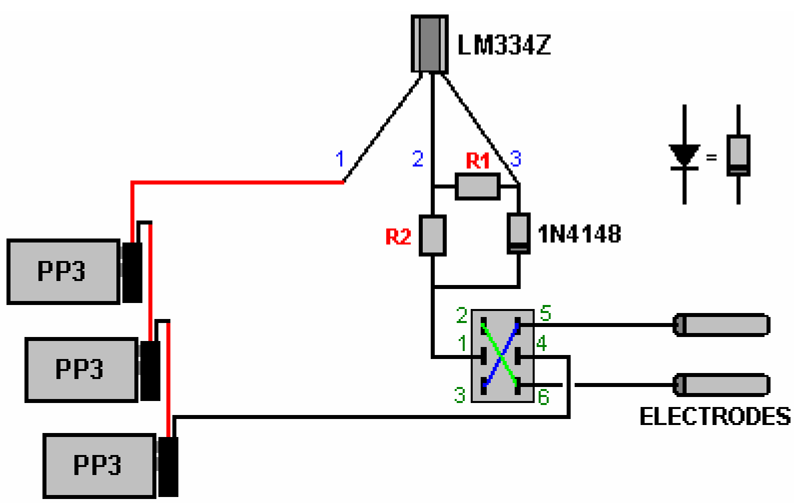


If the wetted length is **L** and the wire diameter is **D**, then the surface area is 3.14159 x D x L. For example, if the wire diameter is 3 mm and the wetted length is 70 mm, then, as there are ten millimeters in one centimetre, the area would be 3.14159 x 0.3 x 7 which is 6.6 square centimetres and so the maximum current for that situation would be 0.155 x 6.6 = 1.0 milliamps, giving resistor values of 134 ohms and 1340 ohms, which could be 150 and 1500 ohms, or two resistors could be used to get a very close value, say 120 + 15 and 1200 + 150. The wetted area of just one of the two electrodes is used for calculating the current.

However, a second suggestion in ensuring small silver particle size is to keep swapping over the electrical supply to the silver electrodes every 20 seconds. As you will be supervising the production of the colloidal silver during the period of time when it is being produced, in order to stir the water on a regular basis, a simple two-pole changeover switch can be used to manually swap the electrical supply to the electrodes. That addition to the circuit looks like this:



The physical interconnections are not difficult to do and could be arranged like this:



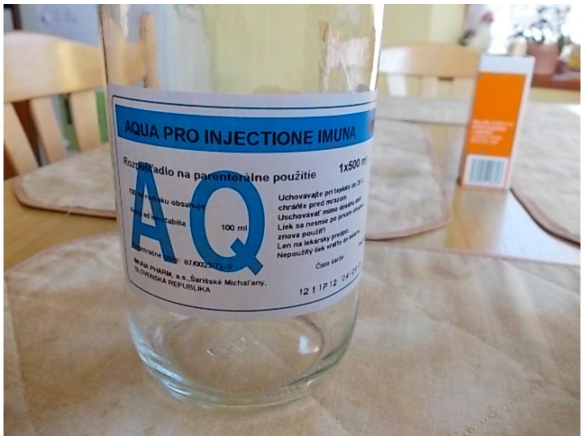
Using a switch is, of course, purely optional as it is not essential by any means. It is not even important to swap the electrodes around. An important thing is to stir the solution frequently, to prevent the silver particles clustering together. Personally, I gently stir the water continuously as I only make a small amount at any one time, and this takes only twelve minutes or so. With this system, it takes about 110 minutes to make 200 ccs of colloidal silver, but that solution will keep for about two weeks if stored properly. It needs to be made in low lighting and then stored in a dark bottle in a dark place (**not** the fridge) as light will discharge the small silver particles which are held in the water by their charge. If that charge is lost, then the particles are said to sink to the bottom and cluster there, although I have never seen this happen. **The colloidal silver solution produced should be completely clear and not a light milky colour.** The particles are so small, that the silver wire never looks any different even after weeks of use.

The water itself is very important as it needs to be top quality distilled water, or the water used for medical injections, or water from a distiller or dehumidifier. Tap water is unsuitable because it contains minerals which contaminate the solution and are highly undesirable, negating most of the benefits of the colloidal silver. If you are monitoring the current, then when first switched on, the current reading should be very low and it should rise gradually as silver particles are released into the water. The current should stop rising at the chosen level if a constant-current circuit is being used. After stirring, the current should go down for while for first few times.

Mike Lexa says: the electrodes should be 20mm to 25 mm apart. For cleaning I use a new kitchen sponge with an abrasive back. Steel wool is not suitable as it will contaminate the electrodes, while sandpaper is too abrasive. The most important factors are the current level and frequent stirring. My home-made apparatus looks like this:

All of the equipment


Current meter (optional)

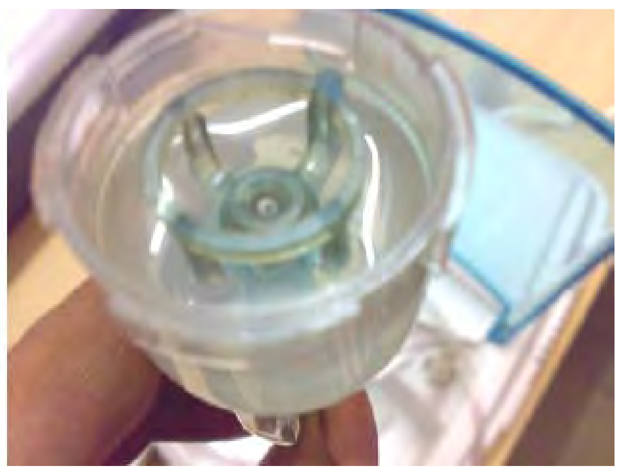


water

Electrodes after use – both the same colour

Using colloidal silver

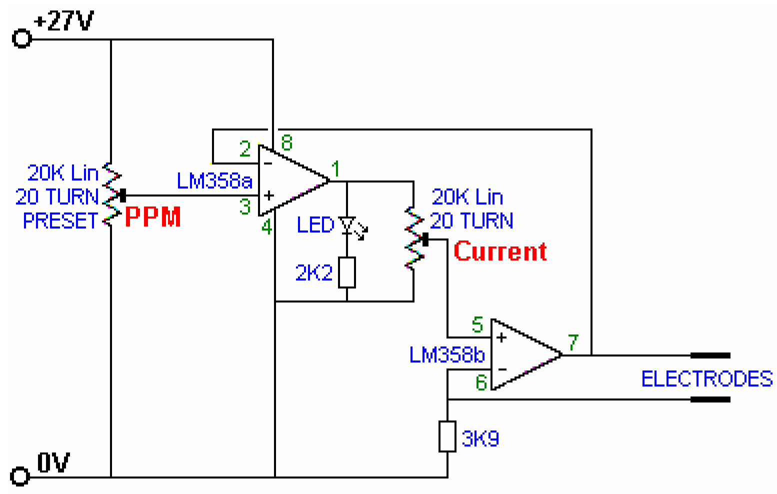
It is possible to use colloidal silver by taking two teaspoonfuls (with a plastic spoon), holding it under the tongue for at least one minute and then swallowing it - that is the complete dosage. Holding it in the mouth is effective as the silver particles pass quickly through the thin skin covering the inside of the mouth, and doing this fully sterilises the whole of the mouth. However, another good way is to use an ordinary nebuliser as that makes sure that only the tiniest particles are absorbed. For this, the water is placed in the reservoir of an standard nebuliser as shown here:



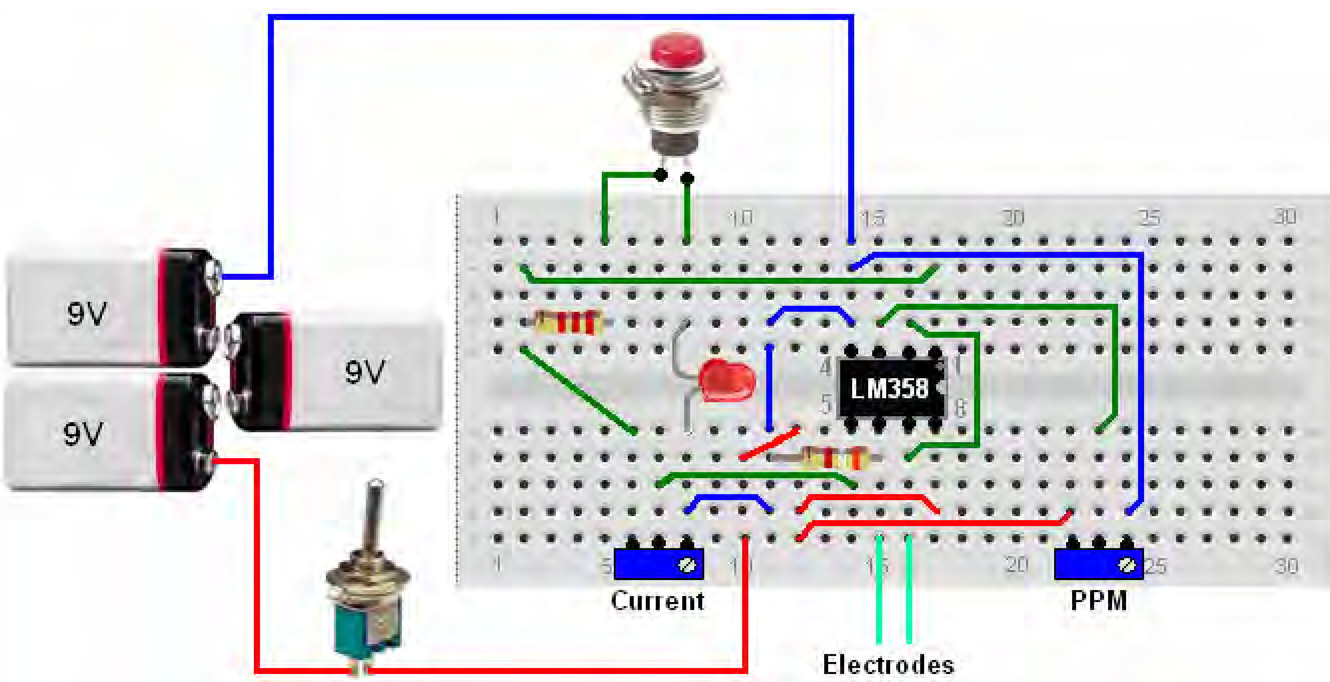
The nebuliser is then assembled and switched on. The lungs are filled completely by breathing in through the nebuliser using the mouth. The next full breath is then taken through the nose. Doing this for 6 to 7 minutes is quite sufficient. This would normally be done once per day, just before going to bed at night, but if there is a really severe infection, then twice per day is recommended. While it is possible to store the colloidal silver solution in a brown glass bottle placed in a cool dark cupboard, most people prefer to make up a new solution each day as this is quick to do. To be sure that the water is fully charged, it is definitely worth while to make up a new batch each time and if that is done, then only a small amount of distilled water need be used and the process is quick.

When stirring the water, be sure not to brush the silver wire which gets the black coating as that can dislodge black particles which contaminate the water, turning it dark and making it unusable. If you are using a nebuliser which only takes a few millilitres, then a small glass container can be used, although more care is needed when stirring to avoid brushing against the wires.

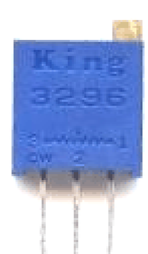
Pasi Mäkilä has made a simple, automated circuit for making colloidal silver. His circuit uses the very cheap and versatile LM358 integrated circuit and is shown here:



This circuit can be laid out on any ordinary plug-in board, perhaps like this:

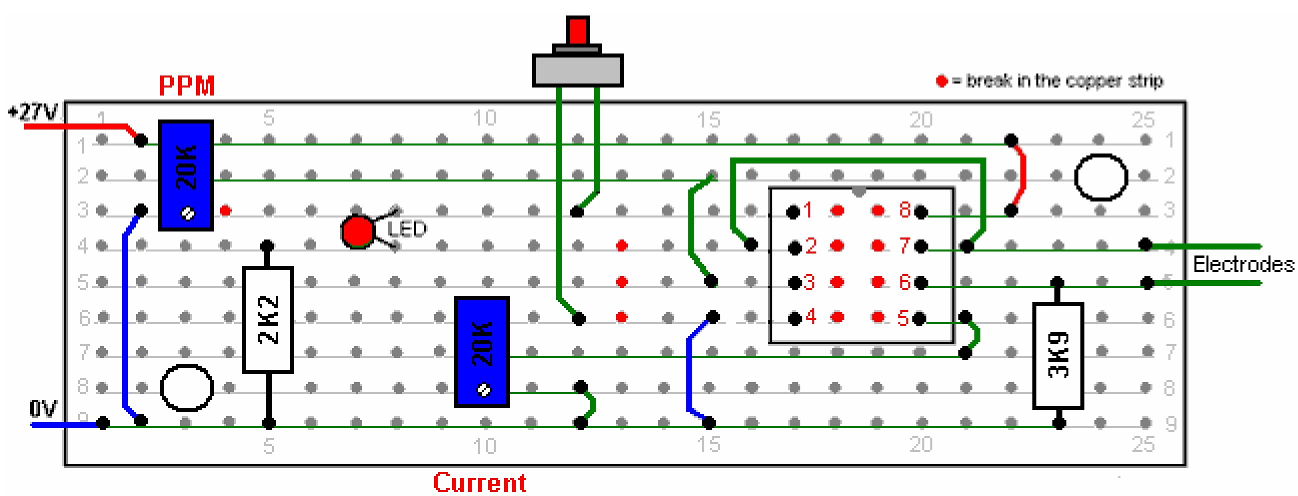


While this board layout may look a little complicated, there are actually only a few components on it. Two of the components are preset variable resistors each with a resistance of 20K ohms. There are several different versions of these preset resistors, the ones used here are adjusted with a small screwdriver. It takes twenty full turns of the adjusting screw to move the slider all the way across the restive track inside the unit. A common type looks like this:



To use this circuit, the battery is switched on and the "Current" preset resistor is adjusted to give the same current flow as recommended by Mike Lexa (described earlier in this document). The current is displayed during adjustment by placing an ordinary multimeter switched to a milliamp range, between the battery and the circuit while the current adjustment is being made. The LED lights while the colloidal silver is being made and turns off when the required level is reached – usually 10 Parts Per Million. If the unit is being powered by a mains unit, then the press-button switch can be omitted and the LED left lighting continuously. With batteries, however, the LED current draw is too great to have it on all the time and so the press-button switch allows occasional checking to see if the process has completed. Please remember that the silver wire electrodes need to be cleaned at intervals during the production process in order to keep the water completely transparent. The adjustment of the PPM preset resistor is done initially by successive trials, the PPM level is assessed using one of the very low cost (about £5) commercial meters like this:

Please bear in mind that the resulting liquid should be completely transparent when the process is completed. A possible construction layout for the smallest standard size of stripboard might be:

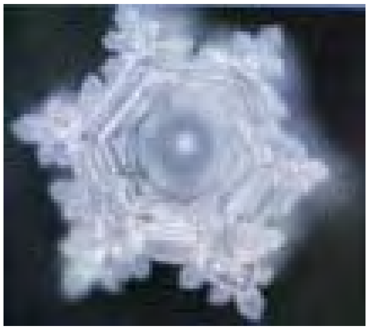


While I am highly reluctant to make spectacular claims for this process - claims which will sound like a "snake oil" pitch, it is only reasonable that you should be informed of what the effects have been in past cases. As this information comes from a highly reliable and experienced source, it should be considered carefully no matter what your final opinion is.

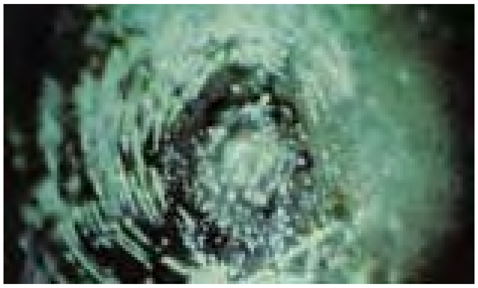
1. This process has cured cancer patients who have been diagnosed as being terminally ill.
2. It has neutralised all known viruses and harmful bacteria, including AIDS.
3. It has overcome chronic pain from arthritis.
4. There is direct experience of six different people being cured of serious lung conditions.
5. One person has had severe diabetes reduced to just a very mild form.

I do apologise for presenting a list like this, especially since some of these actual cases sound so improbable, but as these are genuine, bona fide results of treatment attested to by a most reliable source, it is difficult not to present the facts, no matter how hard readers may find it to accept them.

Unfortunately, it gets worse, much worse. You are probably not aware of it, but the structure of water is affected by thoughts, and not just the thoughts of some special, gifted mentalist, but the thoughts of ordinary people such as you and me. Hard to believe, isn't it? However, it has been proved over and over again. One well-known demonstrator of this effect is Mr Masaru Emoto http://www.masaru-emoto.net/english/water-crystal.html who has shown that the thoughts of ordinary members of the public can alter the structure of water without there being any actual physical contact with the water. If the water receives positive thoughts and is then frozen, the resulting crystal structure will be like this:



While on the other hand, if negative thoughts are aimed at the water, whether just by looking at it and thinking, or by writing those thoughts down on paper, the resulting crystal shape is quite different when the water is frozen, as shown here:



I can personally vouch for the fact that thought can have a powerful effect over a distance of some miles and while that fact may seem completely alien to your present view of the world around you, you do need to become aware of facts which affect you personally.

This does relate to the production of colloidal silver as stressed by Dorron Shapir who is experienced in this field, having used colloidal silver for six years now. He says: a friend of mine had prostate cancer. I made him 10 litres of 10 ppm colloidal silver and his cancer was completely gone within a month. When making colloidal silver, do it in dim light or darkness. Use a dark glass container to store the colloidal silver and keep it well away from sunlight. You can then structure the colloidal silver further by one of several methods: you could stick a label on the jar, saying LOVE AND GRATITUDE, or you could place the jar in a home-made metal pyramid (aligned North-South) for half an hour, or you could place the jar on top of a Karl Welz Orgone generator water structuriser (http://www.chi-tec.com/). Please understand that for the process to be successful, the person making the colloidal silver must **NOT** be feeling anger or hatred as those thoughts completely destroy the structure of the water.

Two very experienced Italian people who have been using colloidal silver for some years now, have a slightly different method. They use silver plates about 10 mm wide and 60 mm to 80 mm long. They also recommend that silver deposited by electrolysis is used, and that kind of silver can be obtained from the people who supply goldsmiths.

Current is controlled by starting with a 15 mm gap between the electrodes and as time passes, increasing the gap gradually until it reaches 50 mm. They take the concentration up to between 13 and 15 ppm as after some time, the concentration drops back down to 8 to 10 ppm.

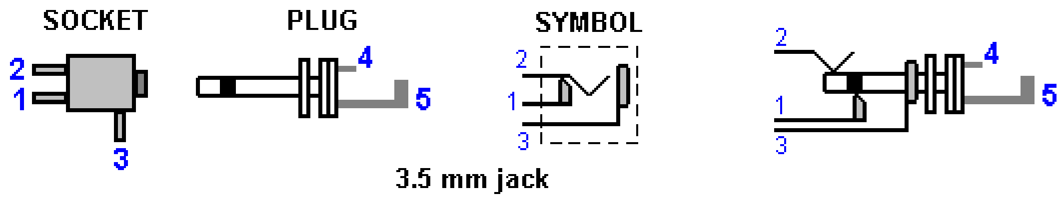
To exclude light as well as to block off stray electromagnetic radiation from TV sets, wi-fi and mobile phone transmissions and the like, they wrap metal foil around the container used to hold the colloidal silver.

Colloidal copper and colloidal gold are also very beneficial and taking colloidal silver and colloidal gold together has a synergic effect where the effect is greater than taking them separately.

The Bob Beck Pulser

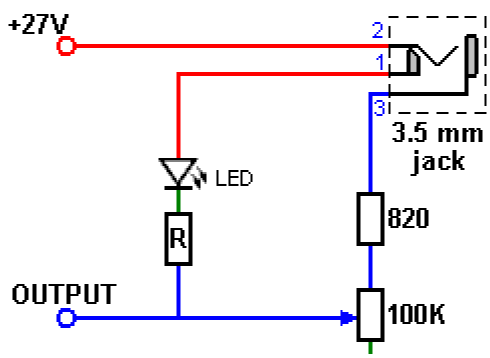
Bob Beck has cured many people whom the medical profession has written off as "incurable". He has written one document describing his work; http://www.free-energy-info.tuks.nl/Beck.pdf but it is not a document which I would rate highly. In addition to the use of colloidal silver, Bob's main device is an electronic pulsing circuit which can be built into a small box and has electrodes which are attached to each wrist. It is recommended that the pulser is used for two hours each day, and for that, the circuit board is clipped to one forearm so that normal activities can be carried out without too much disruption.

Bob Beck's design calls for the LED display to be running when the unit is switched on and then be disconnected when the electrodes are plugged into a 3.5 mm socket mounted on the case containing the circuit. The switched socket looks like this:

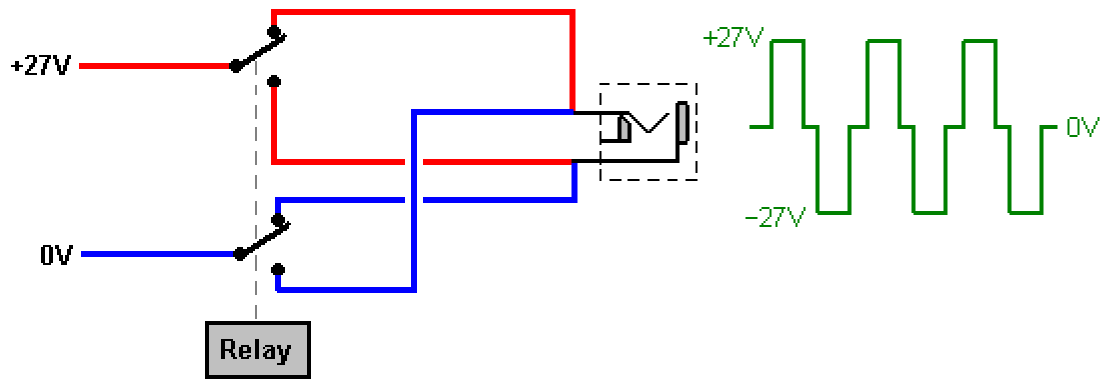


When the plug is not inserted into the socket, pin 1 connects to pin 2 and pin 3 is not connected to anything. When the plug is inserted, then pin 1 is isolated, pin 2 is connected to plug pin 4 and pin 3 is connected to plug pin 5.

The Beck circuit is connected to the output socket like this:

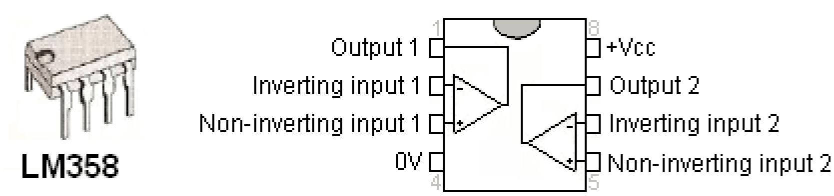


This arrangement will give a 27V 4Hz square wave output through the jack socket. But, Bob Beck's original circuit did not do that. Instead, it was like this:



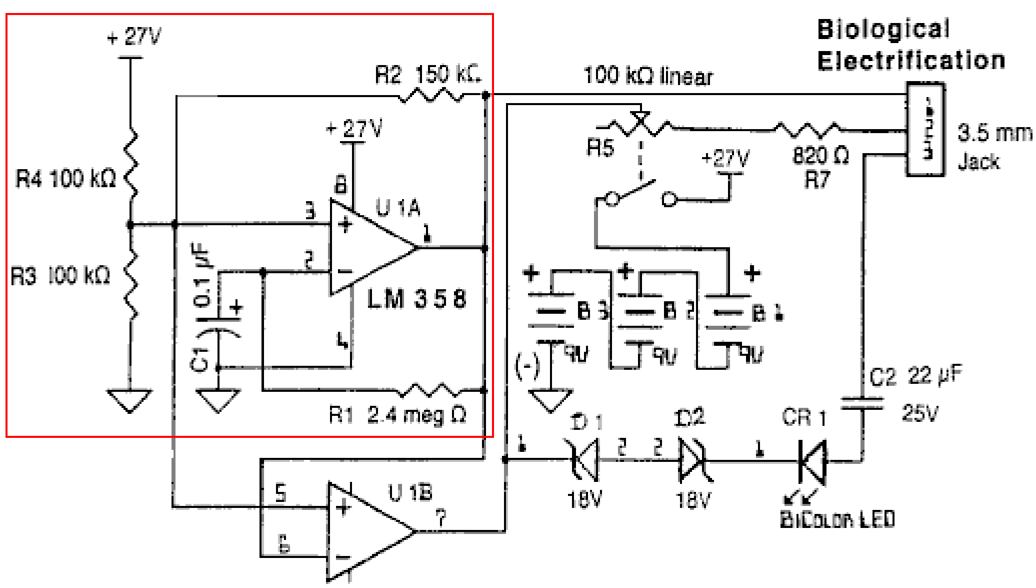
Here, a relay operates two change-over switch contacts which are used to reverse the battery bank contacts four times per second. That is different from just producing a positive-going square wave voltage between the two output terminals. If you were to consider a resistor connected across the output socket, then with the relay switching, the direction of the current reverses four times per second, but with the square wave, while it starts and stops four times per second, the direction of the current is always the same and there is no reversal of direction.

As Bob wanted to avoid using a relay which clicks four times per second all the way through the two-hour treatment described in chapter 11 and in the "Take Back Your Power" pdf on the http://www.free-energy-info.tuks.nl/ web site, he redesigned the circuit using the very impressive LM358/A integrated circuit:



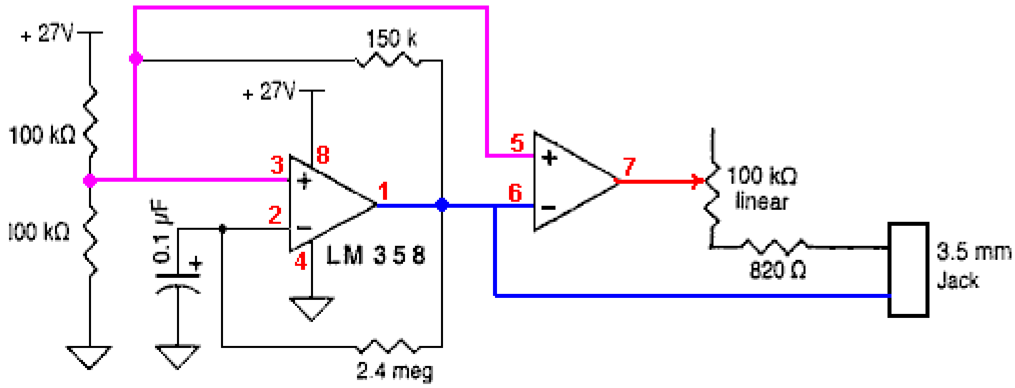
This chip draws only half of one milliamp, has two very high-gain operational amplifiers and can operate with a wide range of supply voltages. It is also inexpensive.

Bob displays the circuit as:



Bob states that the first section acts as a 4Hz square-wave signal generator, the frequency being controlled by the 2.4M resistor "R1" and the 100nF capacitor "C1". The data sheet for the LM358 states that the output voltage swing is between zero volts and 1.5V less than the supply voltage "Vcc" (which is +27V in this case). That implies that, as would be expected, the pin 1 output voltage from the first stage will switch sharply from 0V to +25.5V and sharply back again, four times per second.

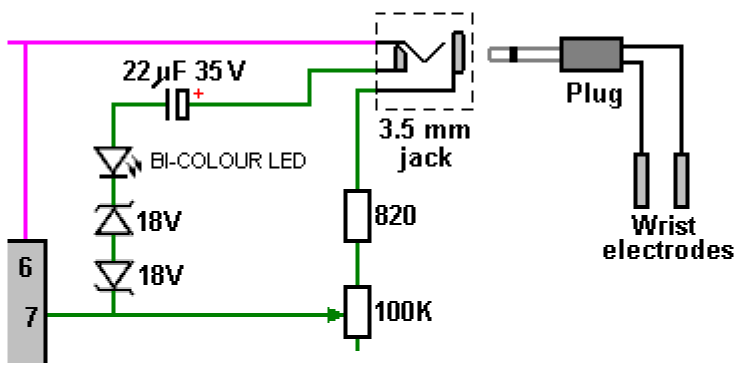
It is difficult to follow the circuit as it is drawn, so it might be a little easier to follow when drawn like this:



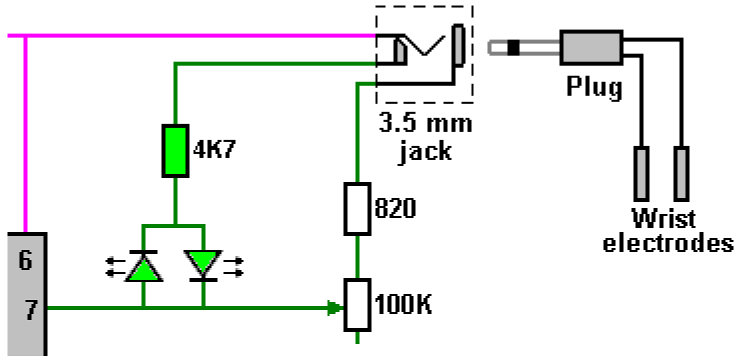
The output from the first amplifier inside the LM358 package is on pin 1 and it can supply a large amount of current (if a large current is ever needed). That output goes straight to one of the jack socket connections. It also goes the pin 6 input of the second amplifier inside the chip and that causes the high-power output of that amplifier on pin 7 to be the opposite of the pin 1 voltage. When pin 1 goes high to +25.5 volts, then pin 7 goes low, to about zero volts. That output is also fed to the other jack socket connection, placing 25.5 volts across the electrodes when they are plugged in to the jack socket.

When the oscillator circuitry connected to the first amplifier causes the voltage on pin 1 to go low, then the output on pin 7 inverts it and so it goes to +25.5 volts. You will notice that while the overall voltage of 25.5 volts is applied again to the jack socket, the polarity is now reversed, achieving what the relay circuit does (although 1.5 volts is lost in the process). This is a neat solution.

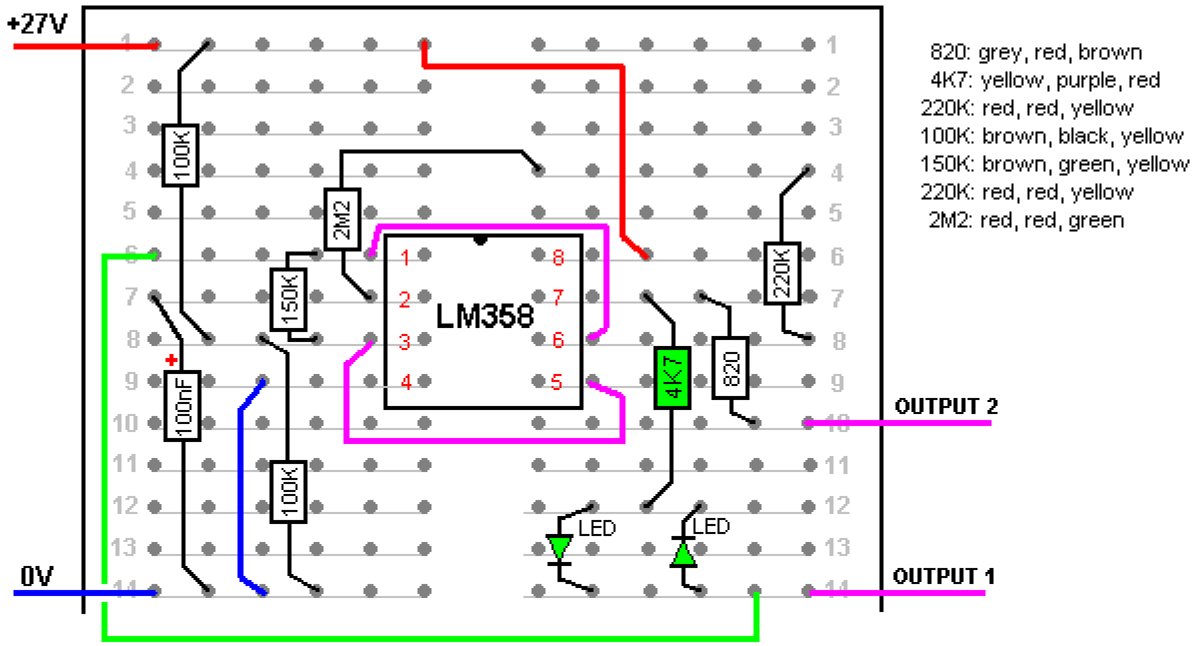
Bob uses a two-colour LED to confirm that the circuit is working correctly before the electrodes are plugged in. He chooses to do it this way:



The two 18V zener diodes drop off 18.7 of the 25.5 volts as one will be forward biased dropping 0.7 volts and the other reversed biased, dropping off 18 volts. That leaves a 7V drop for the LED, which is a bit excessive, so Bob says that he uses a capacitor to limit the current. As there is already an 820 ohm resistor in the LED current path through the socket, the capacitor is not needed. The variable resistor need to be set to it's minimum resistance by rotating it's shaft fully clockwise so that it does not affect the LED brightness as the zeners also show when the battery voltage has dropped as there will no longer be sufficient voltage to light the LED brightly, indicating that the batteries need to be replaced (or recharged if they are rechargeable batteries). When testing the circuit, an alternative to the two zeners is to use a 4.7K resistor and if a bi-colour LED is not to hand, then two ordinary LEDs can be used back to back like this:

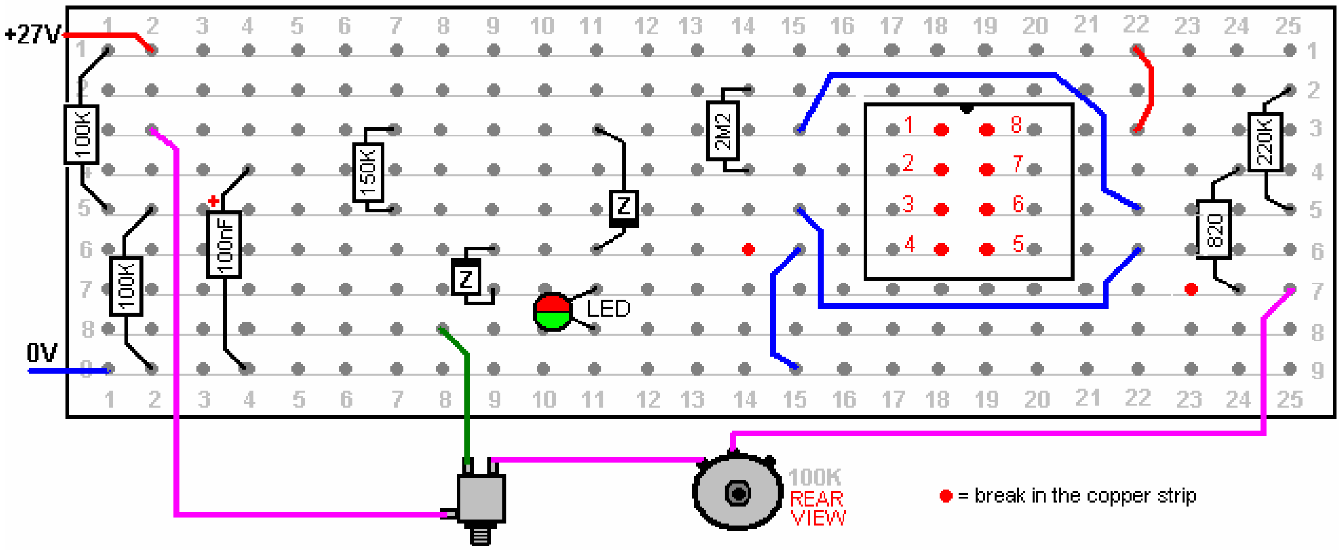


With this arrangement, the two LEDs flash alternately. In any circuit, a capacitor with a higher voltage rating can always be used if the capacitance values are the same. The Beck external circuit is completed through the body of the user, so there is just one electrode connected to each side of the output jack socket. A possible plug-board layout is:



The 4.7K resistor and LEDs are only on the board for testing purposes and when the circuit is built in permanent form, then the LED chain connects to pin 1 of the jack socket so that the LEDs are disconnected during the two hours of daily treatment recommended when using the device.

One stripboard layout using the standard 9-strip 25-hole board and incorporating the two 18V zener diodes for voltage sensing is:



When using a Beck device, it is very important to pay attention to the precautions which Bob sets out. These are in his “Take Back Your Power” pdf document: http://www.free-energy-info.tuks.nl/Beck.pdf which includes the following, which, while it refers to treatment to deal with HIV, presumably applies to all treatments with his device:

EXPANDED INSTRUCTIONS FOR EXPERIMENTAL / THEORETICAL HIV BLOOD NEUTRALIZATION

HYPOTHETICAL PROTOCOLS FOR EXPERIMENTAL SESSIONS

Revision March 20, 1997. Copyright 8 1991/1997 Robert C. Beck

PRECAUTIONS: Do NOT use wrist to wrist current flow with subjects who have cardiac pacemakers. Any applied electrical signals may Interfere with 'demand' type heart pacers and cause malfunction. Single wrist locations should be acceptable. Do NOT use on pregnant women, while driving or using hazardous machinery.

Users MUST avoid Ingesting anything containing medicinal herbs, foreign or domestic, or potentially toxic medication. nicotine, alcohol, recreational drugs. laxatives, tonics. and certain vitamins etc., for one week before starting because blood electrification can cause electroporation which makes cell membranes pervious to small quantities of normally harmless-chemicals in plasma. The effect Is the same as extreme overdosing which might be lethal. See *Electroporation: a General Phenomenon for Manipulating Cells and Tissues;* J.C. Weaver, Journal of Cellular Biochemistry 51:426-435 (1993). Effects can mimic increasing dosages many fold. Both the magnetic pulsar and blood purifier cause electroporation.

Do NOT place electrode pads over skin lesions, abrasions, new scars, cuts, eruptions, or sunburn. Do NOT advance output amplitude to uncomfortable levels. All subjects will vary. Do NOT fall asleep while using. The magnetic pulser should be safe to use anywhere on body or head.

Avoid ingesting alcohol 24 hours before using. Drink an 8 oz. glass of distilled water 15 minutes before and immediately following each session end drink at least four additional glasses daily for flushing during 'neutralization' and for one week thereafter. This Is imperative. Ignoring this can cause systemic damage from unflushed toxic wastes. When absolutely essential drugs *must* be ingested, do so a few minutes *after* electrification then wait 24 hours before next session.

If subject feels sluggish, faint, dizzy, headachy, light-headed or giddy, nauseous. bloated or has flu-like symptoms or rashes after exposures, reduce pulsing per session and/or shorten applications of electrification. Drink more water-preferably ionized -to speed waste oxidation and disposal. Use extreme caution when treating patients with impaired kidney or liver function. Start slowly at first like about 20 minutes per day to reduce detoxification problems.

To avoid shock liability, use batteries only. Do NOT use any line-connected power supply, transformer, charger, battery eliminator, etc. with blood clearing device. However line supplies are OK with well-insulated magnetic pulse generators (strobe lights).

Health professionals: Avoid nicotine addicts, vegans, and other unconsciously motivated death-wishers and their covert agendas of 'defeat the healer'. Tobacco, the most addictive (42 times more addictive than heroin) and deadly substance of abuse known, disrupts normal cardiovascular function. True vegetarian diets are missing essential amino acids absolutely necessary for the successful rebuilding of AIDS-ravaged tissues. Secondary gains (sympathy / martyrdom, work avoidance, free benefits, financial assistance, etc.) play large roles with many AIDS patients. “Recovery guilt” as friends are dying has even precipitated suicide attempts masked as 'accidents'. Avoid such entanglements, since many have unconscious death wishes.

SUPERIOR ELECTRODES: Excellent, convenient and vastly superior electrodes, reusable indefinitely can be made by butt-soldering lead wires to ends of 1” long by 3/32” dia. blanks cut from type 316 stainless steel rods available from welding supply stores (Cameron Welding Supply. 11061 Dale Ave., Stanton, CA 90680). Use 'Stay Clean' flux before soldering (zinc chloride/hydrochloric acid). Shrink-insulate TWO tight layers of tubing over soldered joints to prevent flexing/breaking and lead/copper ions from migrating. Wrap three or four turns of 100% cotton flannel around rods. Spiral-wrap with strong thread starting from wire side to end, tightly pinch cloth over the rod’s end so as to leave no metal exposed by wrapping 6 or 7 turns of thread TIGHTLY just off end of rod, then spiral wrap back to start and tie tightly with four knots then cut off excess cloth at end close to pinch -wraps. Treat end windings and knots with clear fingernail polish or Fray Check®(fabric & sewing supply stores) to prevent ravelling. Soak in a strong solution of sea salt (not table salt) containing a little wetting agent like Kodak Photo Flow, ethylene glycol, or 409 kitchen cleaner. Add a few drops of household bleach, sliver colloid, etc., for disinfectant. Store solution for reuse. Tape soaking-wet electrodes tightly over pulse sites with paper masking or Transpore™ tape or with 1 inch wide stretch elastic bands with tabs of Velcro ® at ends to fasten. Electrodes should closely conform *precisely* along blood vessels, not skewing ever so slightly over adjacent flesh. This insures better electrical conductivity paths to circulating blood and insures very low internal impedance. (~2000W). Rinse and blot-dry electrodes and skin after each use. NEVER allow bare metal to touch skin as this will cause burns manifested as small red craters that heal slowly. The objective is to get maximum current into blood vessels, not leak it over to adjacent tissue. Therefore never use any electrode wider that about 1/8 inch (3 mm).

ELECTRODE PLACEMENTS: Locate *maximum* pulse position *(NOT* to be confused with acupuncture, reflexology, Chapman, etc. points) on feet or wrists by feeling for maximum pulse on inside of ankle about 1 inch below and to rear of ankle bone, then test along top centre of instep. Place electrode on whichever pulse site on that foot that feels strongest. Scrub skin over chosen sites with mild soap and water or alcohol swab. Wipe dry. Position the electrodes lengthwise along each left and right wrists blood vessel. Note: with subjects having perfectly healthy hearts and not wearing pacers, it is convenient to use left wrist to right wrist exactly over ulnar arterial pulse paths instead of on feet. Recent (Dec. 1995) research suggests that placing both electrodes over different arteries on the same wrist works very well (see pg. 7), avoids any current through heart, and is much more convenient and just as effective. An 8” long, 1” wide elastic stretch-band with two 1.5” lengths of 3/4” wide Velcro ® sewn to ends of opposite sides makes an excellent wrist band for holding electrodes snugly in place. With electrode cable unplugged, turn switch ON and advance amplitude control to *maximum*. Push momentary SW. 2 'Test' switch and see that the red and green light emitting diodes flash alternately. This verifies that polarity is reversing about 4 times per second (frequency is *NOT* critical) and that batteries are still good. When LED's don't light replace all three 9V batteries. Zener diodes will extinguish the LEDs when the three 9V battery’s initial 27V drops below 18V after extended use. Never use any electrode larger than 1.125” (28 mm) long by 1/8” wide to avoid wasting current through surrounding tissue. Confine exactly over blood vessels only. Apply drops of salt water to each electrode’s cotton cover ~every 20 minutes to combat evaporation and insure optimum current flow. Later devices are solid-state, use only three batteries and no relays, and are much smaller.

Now rotate amplitude control to *minimum* (counter-clockwise) and plug In electrode cable. Subject now advances dial slowly until he feels a “thumping” and tingling. Turn as high as tolerable but don’t advance amplitude to where It is ever uncomfortable. Adjust voltage periodically as he adapts or acclimates to current level after several minutes. If subject perspires, skin resistance may decrease because of moisture, so setting to a lower voltage for comfort is indicated. Otherwise it is normal to feel progressively less sensation with time. You may notice little or no sensation at full amplitude immediately, but feeling will begin building up to maximum after several minutes at which time amplitude must be decreased. Typical adapted electrode-to-electrode impedance is on the order of 2000W. Typical comfortable input (to skin) is about 3 mA, and maximum tolerable input (full amplitude) is about 7 mA but this 'reserve' margin although harmless is unnecessary and can be uncomfortable. Current flowing through blood Is very much lower than this *external* input because of series resistance through skin, tissue and blood vessel walls, but 50 to 100 µA through blood is essential.

Apply blood neutralizer for about 2 hours daily for ~2 months. Use judgment here. The limiting factor is detoxification. Carefully monitor subject’s reactions (discomfort, catarrh, skin eruptions, weeping exudates, rashes, boils, carbuncles, coated tongue, etc.). With very heavy infections, go slower so as not to overload body’s toxic disposal capability. With circulation-impaired diabetics, etc., you may wish to *extend* session times. Again, ***have subject drink lots of water***. Recent changes in theoretical protocol being currently tested suggest following up the three weeks of treatments with a 24 hours per day (around the clock) continuous electrification of blood for two days to deal a knockout blow to the remaining HIV's 1.2 day life cycle. (A. Perelson; Los Alamos Biophysics Group, Mar. 16, 1996 "Science" Journal.) Remember to remoisten electrodes regularly. If you absolutely ***must*** ingest prescription drugs, do so immediately ***after*** turning off instrument and allow 24 hours before next treatment to let concentrations in blood plasma decay to lower levels.

Remember, if subjects ever feel sleepy, sluggish, listless. nauseous, faint, bloated, or headachy, or have flu-like reactions they may be neglecting sufficient water intake for flushing toxins. We interpret this as detoxification plus endorphin release due to electrification. Let them rest and stabilize for about 45 minutes before driving if indicated. If this detoxing becomes oppressive, treat every *second* day. Treating at least 21 times should 'fractionate' both juvenile and maturing HIV to overlap maximum neutralization sensitivity windows and interrupt 'budding' occurring during HIV cells' development cycles. Treatments are claimed to safely neutralize many other viruses, fungi, bacteria, parasites, and microbes in blood. See patents US 5,091,152 US 5,139,684 US 5,188,738 US 5,328,451 and others as well as numerous valid medical studies which are presently little known or suppressed. Also. ingesting a few oz. of about 5 parts per million of silver colloid solution daily can give subjects a 'second intact immune system' and minimise or eliminate opportunistic infections during recovery phase. This miracle substance Is pre-1938 technology, and unlike ozone is considered immune from FDA harassment. Silver colloid can *easily* be made at home electrolytically in minutes and in any desired quantities and parts per million strength for under 14 cents per gallon plus cost of water. It is ridiculous to purchase it for high prices. Colloid has no side effects, and is known to rapidly eliminate or prevent hundreds of diseases. Sliver colloids won't produce drug resistant strains as will all other known antibiotics. No reasonable amount can overdose or injure users either topically, by ingestion, or medical professional injection.

Conclusion

The objective of this composition has been to make you aware of some of the many designs which can provide you with electricity without you having to pay a utility company every month. It has also been an objective to make you aware of how much harm is being done to you by psychopaths who are opposed to you remaining alive.

At the time of writing - May 2016 - it looks as if the psychopaths are losing their stranglehold on science and as a result, some free-energy devices may well reach the marketplace. However, please be aware that most of the mainstream media: TV, radio, newspapers, etc. are owned by the New World Order people and so they ignore the important news items and they lie outrageously about many of the statements which they make. For example, the false-flag attack on the Twin Towers in New York on 11th September 2001 is stated to be that at least one airliner was flown into one building causing it to collapse in a period of nine seconds. That is so ridiculous that it would be funny if it were not for the many people murdered during the attack. No aircraft flew into any building. The building did not collapse. If it had, then the whole area would have been flooded. The seismic record shows clearly that no significant rubble fell to the ground. There was no impact and no rubble. Instead, the building was destroyed by a beam weapon.

The video shown on TV was just artwork and the fact that it was a set-up is demonstrated by the BBC reporter Jane Standley who reported that WTC Building 7 had collapsed most unexpectedly, and the actual building could still be seen standing intact behind her: http://www.youtube.com/watch?v=ltP2t9nq9fI.

Reporting an unexpected building collapse before it occurred, takes some explaining as to how prior knowledge of the event was in the hands of the BBC. The BBC operates a protection racket called the "TV Licence" scam, where people are threatened and coerced into paying an arbitrarily chosen amount of money to this private commercial company. There is actually, not the slightest doubt about this, a fact which was highlighted by the court case of Mr Rooke who was charged with the "crime" of withholding his TV licence fees, and in February 2013, in Surrey in England, the BBC took Mr Rooke to court. However, once the judge saw the evidence presented by Mr Rooke and his team of experts against the BBC, he had no option but to discharge the conviction. Mr Rooke felt that the BBC's cover up of this evidence was supporting the true terrorists of 9/11 to get away with their crime. He refused to pay his TV licence fee on the basis of Section 15, Article 3 of the UK Terrorism Act.

This states that it is a crime to provide monetary support to any organisation that engages in or supports terrorist activity. In the opinion of Mr Rooke, by the BBC covering up the evidence about 9/11, they have been aiding and supporting the true perpetrators of 9/11, allowing them to escape justice, and that this is allowing a false version of 9/11 to continue to be used to justify further terrorist activity which is still continuing today. Therefore, in Mr Rooke's opinion, to provide funds to the BBC through his TV licence fees would in effect be funding an organisation which is supporting terrorist activity, and under Section 15, Article 3 of the Terrorism Act, he would be committing a serious crime if he did this.

So, unfortunately, the main news media lies to you without a moments hesitation. At this moment in time, the so-called "9-11" attack is being twisted around to be used against the Saudi Arabia government and American people are being told that it is a criminal offence not to believe the official story of 9-11 (no matter how ludicrous that story actually is).

Let me close by wishing you a long and prosperous life in spite of the wicked people around you who are trying to steal from you and eventually kill you.

In closing, let me remind you that you can get additional constructional details as well as additional information on other devices in the free download documents at http://www.free-energy-info.com.

Patrick Kelly

May 2016

Chapter 15 - Electronics Tutorial

Introduction
This document is not an in-depth presentation of the subject of electronics. Instead, it is intended to give you sufficient (empirical) knowledge of the subject to be able to understand, design and build simple circuits such as the control circuits used with the 'Free Energy' devices described in the later parts of this book.

Disclaimer
This material is provided for information purposes only. Should you decide to attempt construction of some device based on information presented here and injure yourself or any other person, I am not liable in any way. To clarify this; should you construct something in a heavy box and drop it on your toe, I am not liable for any injury you may sustain (you should learn to be more careful). If you attempt to construct some electronic circuit and burn yourself with the soldering iron, I am not liable. Also, I strongly recommend that unless you are expert in electronics, you do not construct any device using, or producing more than 30 Volts - high voltage circuits are extremely dangerous and should be avoided until you gain experience or can obtain the help and supervision of a person experienced in constructing high voltage circuits.

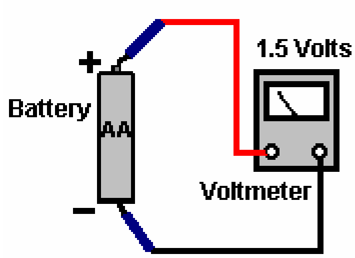
Voltage.
Voltage is the key to understanding electronics. Without voltage, nothing happens in electronics. What is it? Nobody knows. We know how to generate it. We know what it does. We know how to measure it, but nobody knows what it actually is.

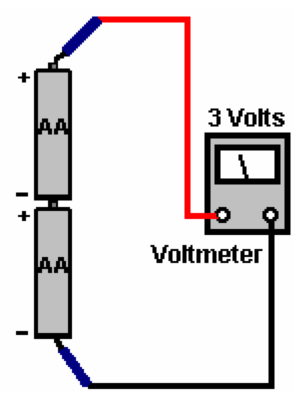
It is also called "Electro Motive Force" or "EMF" which is no help whatsoever in knowing ***what*** it is. That, is roughly equivalent to saying "the thing that pushes is the thing that pushes" - very true but absolutely no help whatsoever. OK, having admitted that we really don't know *what* it is, we can start to say the things we do know about it:

A new battery has a voltage between its terminals. This voltage is said to cause a current to flow through any complete electrical circuit placed across it. The current flowing through the circuit can cause various things to happen such as creating light, creating sound, creating heat, creating magnetism, creating movement, creating sparks, etc., etc.

By using the current caused by a voltage, a device called a 'Voltmeter' can indicate how big the voltage is. The bigger the voltage, the bigger the current and the bigger the display on the voltmeter. The voltmeter can have a numerical display where you read the voltage directly from the display, or it can be an 'analogue' voltmeter where the voltage is shown by the position of a needle on a scale. The size of the voltage is stated in 'Volts' which is a unit of measurement named after the man Volta who introduced voltage to the world (it was always there, we just did not know about it).

Voltages add up if they are connected the same way round, i.e. with the + terminals all facing the same way:





The physical size of the battery usually determines the length of time it can supply any given current - the bigger the battery, the longer it can provide any given current. A battery is constructed from a number of 'cells'. The number of cells in the battery controls the voltage of the battery. For example, an 'AA' size battery (what used to be called a 'penlight' battery) has a single 'cell' and so produces 1.5 Volts when new. The very much larger and heavier 'D' battery also has just one cell and so it also produces 1.5 Volts when new. The difference (apart from the higher cost of the 'D' cell) is that the larger cell can provide a much higher current if both batteries are discharged over the same period of time.

There are several different types of battery construction. A rechargeable NiCad battery has a single cell but its construction method means that it produces about 1.35 Volts when fully charged. In passing, NiCad batteries have a 'memory' characteristic which means that if they are recharged before they are fully discharged, then the next time they are discharged they run out of power at the voltage level it had when the last charging was started. Consequently, it is a good idea to fully discharge a NiCad battery before charging it again.

Car and motorcycle batteries are described as Lead/Acid batteries. This type of construction is not very convenient being large, heavy and potentially corrosive. The big advantages are the ability to provide very high currents and giving 2.0 Volts per cell. These batteries are normally produced as 6 Volt or 12 Volt units. The Amp-Hours for lead/acid car batteries is usually quoted for a 20 hour discharge period, so a fully charged, new, 20 AHr battery can provide 1 Amp for 20 hours of continuous use. That battery loaded to give 5 Amps, will **not** provide that current for 4 hours but might only last 2 hours, or perhaps a little better. The manufacturers literature should give an indication of the performance, but if it is important, run your own test to see how the battery actually works in practice.

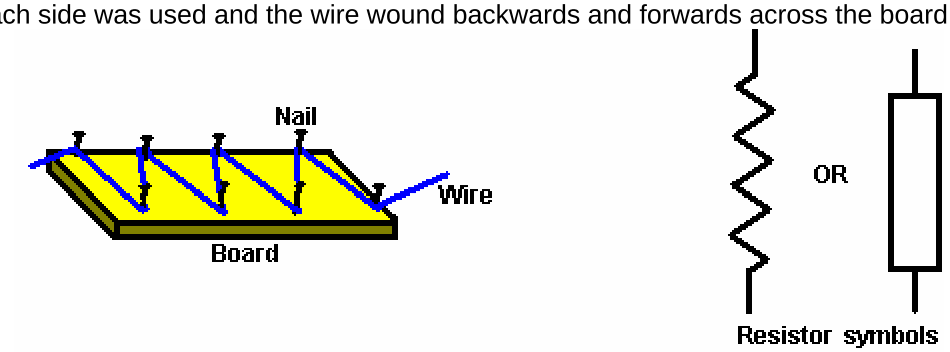
"Mains units" are known in the electronics world as "Power Supply Units" or "PSUs" for short. These convert the mains voltage (220 Volts in UK, 110 Volts in USA) to some convenient low voltage; 12 Volts, 9 Volts, 6 Volts, or whatever is needed. A mains unit can provide several different voltages simultaneously.

Resistance.

Being familiar with Voltage and Resistance is the key to understanding electronic circuitry. Resistance is a measure of how difficult it is for current to flow through something. Some materials such as glass, ceramics, wood and most plastics do not easily carry a current and so are considered to be 'insulators'. That is why you will see power lines hung from their pylons by a series of ceramic discs. Current flows easily through metals, especially along the surface of the metal, so cables are made from metal wires surrounded by a layer of plastic insulation. The higher grade cables have wire cores made up of many small-diameter strands as this increases the surface area of the metal for any given cross-sectional area of the metal core (it also makes the cable more flexible, and generally, more expensive).

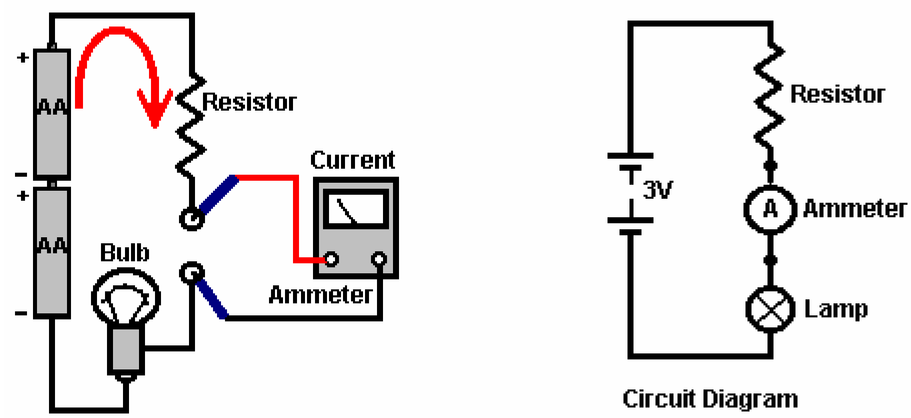
There is a very important, third group of materials, silicon and germanium in particular, which fall between conductors and insulators. Not surprisingly, these are called 'semi-conductors' and the amount of current they can carry depends on the electrical conditions in which they are placed. Much, much more about this later on.

While a metal wire carries current very well, it is not perfect at the job and so has some 'resistance' to current flowing through it. The thicker the wire, the lower the resistance. The shorter the wire, the lower the resistance. The first researchers used this characteristic to control the way circuits operated. Sometimes, as higher resistances were needed, the researcher used to need long lengths of wire which would get tangled up. To control the wire, a board with nails along each side was used and the wire wound backwards and forwards across the board like this:



When drawing a circuit diagram, the researcher would sketch the wire on the board giving a zig-zag line which is still used today to represent a 'resistor' although different methods of construction are now used. An alternative symbol for a resistor is a plain rectangle as shown above.

If a resistor is connected across a battery, a circuit is formed and a current flows around the circuit. The current cannot be seen but that does not mean that it is not there. Current is measured in 'Amps' and the instrument used to display it is an 'ammeter'. If we place an ammeter in the circuit, it will show the current flowing around the circuit. In passing, the ammeter itself, has a small resistance and so putting it in the circuit does reduce the current flow around the circuit very slightly. Also shown is a bulb. If the current flowing around the circuit is sufficiently high and the bulb chosen correctly, then the bulb will light up, showing that current is flowing, while the ammeter will indicate exactly how much current is flowing:



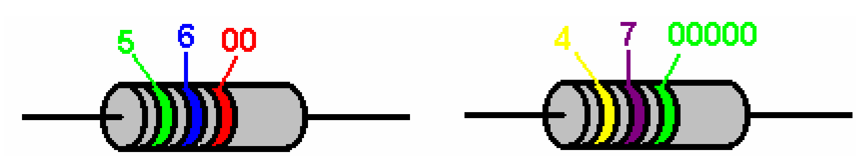
Shown on the right, is the way that this circuit would be shown by an electronics expert (the 'Resistor', 'Ammeter' and 'Lamp' labels would almost certainly not be shown). There are several different styles of drawing circuit diagrams, but they are the same in the basic essentials. One important common feature is that unless there is some very unusual and powerful reason not to do so, every standard style circuit diagram will have the positive voltage line horizontally at the top of the diagram and the negative as a horizontal line at the bottom. These are often referred to as the positive and negative 'rails'. Where possible, the circuit is drawn so that its operation takes place from left to right, i.e. the first action taken by the circuit is on the left and the last action is placed on the right.

Resistors are manufactured in several sizes and varieties. They come in 'fixed' and 'variable' versions. The most commonly used are the 'fixed' carbon 'E12' range. This is a range of values which has 12 resistor values which repeat: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and then: 100, 120, 150, 180, 220, 270, 330, 390, 470, 560, 680, 820 and then: 1000, 1200, 1500, 1800, 2200, 2700, 3300, 3900, 4700, 5600, 6800, 8200, etc. etc. Nowadays, circuits often carry very little power and so the resistors can, and are, made in very small physical sizes. The higher the resistance value of a resistor, the less current will flow through it when a voltage is placed across it. As it can be difficult to see printing on small resistors clustered together on a circuit board and surrounded by other larger components, the resistor values are not written on the resistors, instead, the resistors are colour-coded. The unit of measurement for resistors is the 'ohm' which has a very small size. Most resistors which you encounter will be in the range 100 ohms to 1,000,000 ohms. The higher the resistance of any resistor, the smaller the current which will flow through it.

The colour code used on resistors is:

0 Black
1 Brown
2 Red
3 Orange
4 Yellow
5 Green
6 Blue
7 Purple (Violet if your colour vision is very good)
8 Grey
9 White

Each resistor has typically, three colour bands to indicate its value. The first two bands are the numbers and the third band is the number of noughts:



Green: 5
Blue: 6
Red: 2 noughts
Value: 5,600 ohms or 5.6K or 5K6

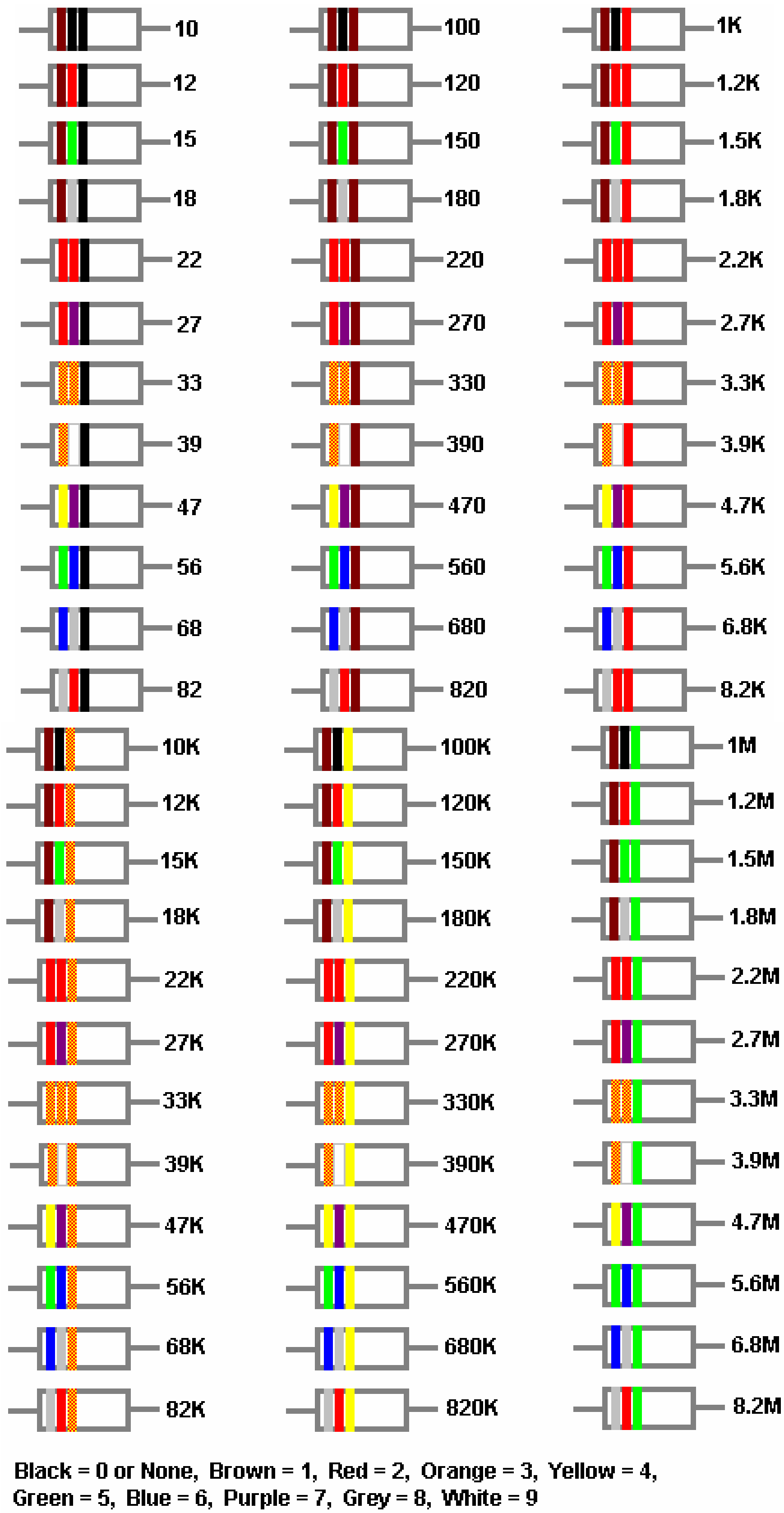
Yellow: 4
Purple: 7
Green: 5 noughts
Value: 4,700,000 ohms or 4.7M or 4M7

The colour bands are read from left to right and the first band is close to one end of the body of the resistor. There is often a fourth band which indicates the manufacturing tolerance: you can ignore that band.

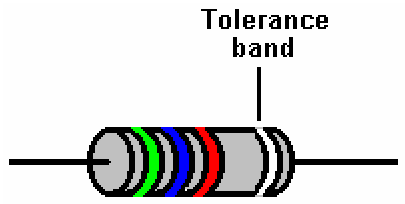
Examples:

Red, Red, Red: 2 2 00 ohms or 2K2
Yellow, Purple, Orange: 4 7 000 ohms or 47K
Brown, Black, Brown: 1 0 0 ohms or 100R
Orange, Orange, Orange: 3 3 000 ohms or 33K
Brown, Green, Red: 1 5 00 ohms or 1K5
Brown, Green, Black: 1 5 no noughts, or 15 ohms
Blue, Grey, Orange: 6 8 000 ohms or 68K
Brown, Green, Green: 1 5 00000 ohms or 1,500,000 ohms or 1M5
Yellow, Purple, Brown: 4 7 0 ohms

As there are only 12 standard resistor values per decade, there are only 12 sets of the first two colour bands:
10: Brown/Black,
12: Brown/Red,
15: Brown/Green,
18: Brown/Grey
22: Red/Red,
27: Red/Purple
33: Orange/Orange,
39: Orange/White
47: Yellow/Purple
56: Green/Blue
68: Blue/Grey
82: Grey/Red



The details above give you all the basic information on resistor colour codes but there are a few additional refinements. There is an extra colour band further down the body of the resistor as shown here:

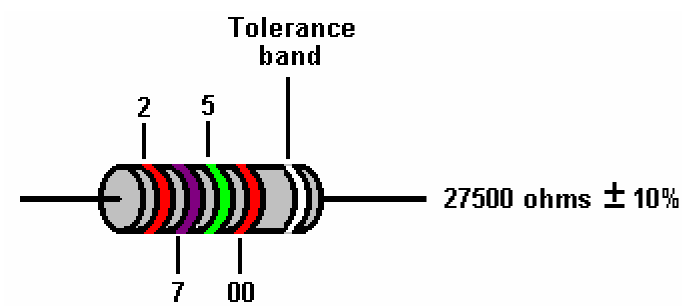


This extra band is used to indicate the manufacturing tolerance of the construction of the resistor. Resistor values are never exact and this rarely has any significant effect on their use in circuits. If some circuit needs very accurate resistor values in it, then buy several resistors of the same nominal value and use an ohm-meter to measure that actual value of each particular resistor and if none are perfect, then use two or more resistors to give the exact value wanted.

The tolerance band has the following codes:

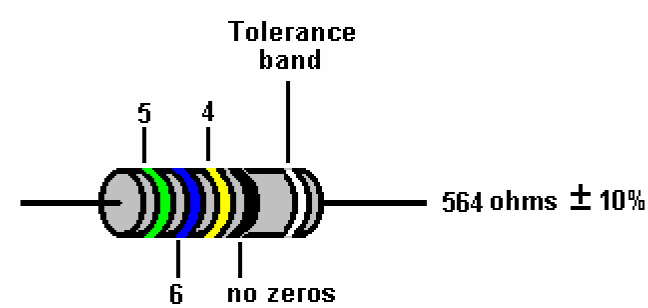
Silver is ± 10% (i.e. a 10K resistor of this type should be between 9K and 11K)
Gold ± 5% (i.e. a 10K resistor of this type should be between 9.5K and 10.5K)
Red ± 2% (i.e. a 10K resistor of this type should be between 9.8K and 10.2K)
Brown ± 1% (i.e. a 10K resistor of this type should be between 9.9K and 10.1K)
Green ± 0.5% (i.e. a 10K resistor of this type should be between 9.95K and 10.05K)
Blue ± 0.25% (i.e. a 10K resistor of this type should be between 9.975K and 10.025K)
Purple ± 0.1% (i.e. a 10K resistor of this type should be between 9.99K and 10.01K)

This type of resistor in the 10% and 5% ranges are the most common as they are the cheapest to buy and so tend to be the most popular. Recently, however, two additions to the coding have been introduced in order to allow for very high specification resistors which the average constructor may never come across. Each of these additions involves one additional colour band. The first additional colour band allows an extra digit in the resistor value, and looks like this:



As before, the colour coding is exactly the same, with the fourth colour band specifying the number of zeros after the digits indicated by the colour bands in front of it. So, in the example shown above, the first band being Red indicates a "2". The second colour band being Purple indicates a "7". The third colour band being Green indicates a "5" and the fourth colour band being Red indicates "2 zeros", so putting those together it produces the value of 27,500 ohms, which can also be written as 27.5 K or more briefly as 27K5.

Another example of this is:

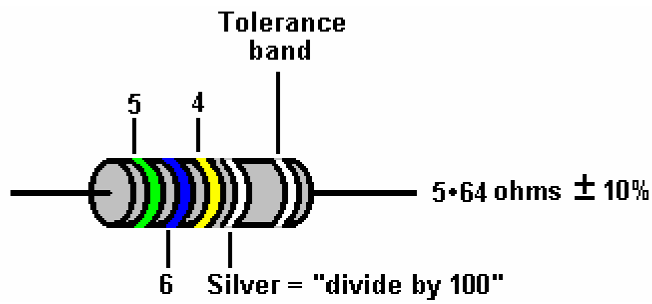


The fourth colour band coding has also been extended to include two other colours:

Gold: meaning "no zeros and divided by 10" so if the band in the example above had been gold, then the value would be 56.4 ohms.

Silver: meaning "no zeros and divided by 100" and if the example band had been silver then the value would have been 5.64 ohms.

So, for example, if the resistor had a fourth colour band which was silver, then the value would be:

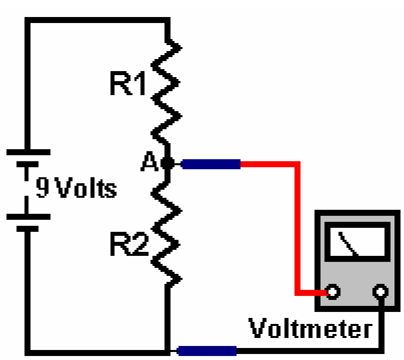


Finally, for very high-quality applications (typically military applications), there can be a sixth colour band positioned outside the tolerance band, and that final colour band states how much the resistance value can be expected to alter with changes in temperature. This is not something which is likely to be of any interest to you, but the codes for that final colour band are:

Brown: 0.01% of the resistor value for each degree Centigrade change in temperature.
Red: 0.005% of the resistor value for each degree Centigrade change in temperature.
Yellow: 0.0025% of the resistor value for each degree Centigrade change in temperature.
Orange: 0.0015% of the resistor value for each degree Centigrade change in temperature.

To put this in context, the worst of these represents a change of 1% in the resistor value when moving from the temperature of ice to the temperature of boiling water. Is this something which you really care about? I don't.

Leaving the details of identifying individual resistors, we now come to the interesting part: what happens when there are several resistors in a circuit. The important thing is to keep track of the voltages generated within the circuit. These define the currents flowing, the power used and the way in which the circuit will respond to external events. Take this circuit:



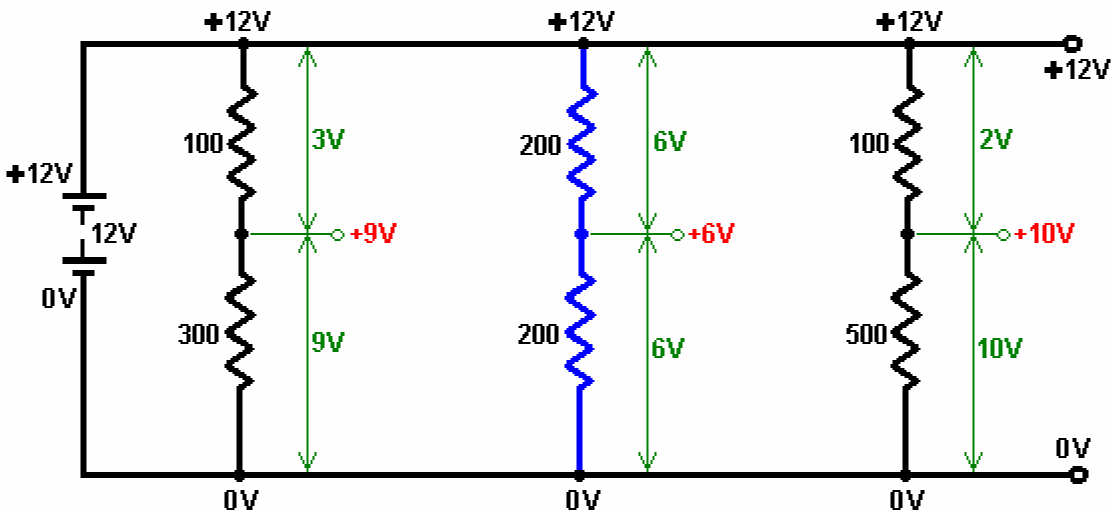
What is the voltage at point ‘A’? If you feel like saying “Who cares?” then the answer is “you” if you want to understand how circuits work, because the voltage at point ‘A’ is vital. For the moment, ignore the effect of the voltmeter used to measure the voltage.

If R1 has the same resistance as R2, then the voltage at ‘A’ is half the battery voltage, i.e. 4.5 Volts. Half the battery voltage is dropped across R1 and half across R2. It does not matter what the actual resistance of R1 or R2 is, as long as they have exactly the same resistance. The higher the resistance, the less current flows, the longer the battery lasts and the more difficult it is to measure the voltage accurately.

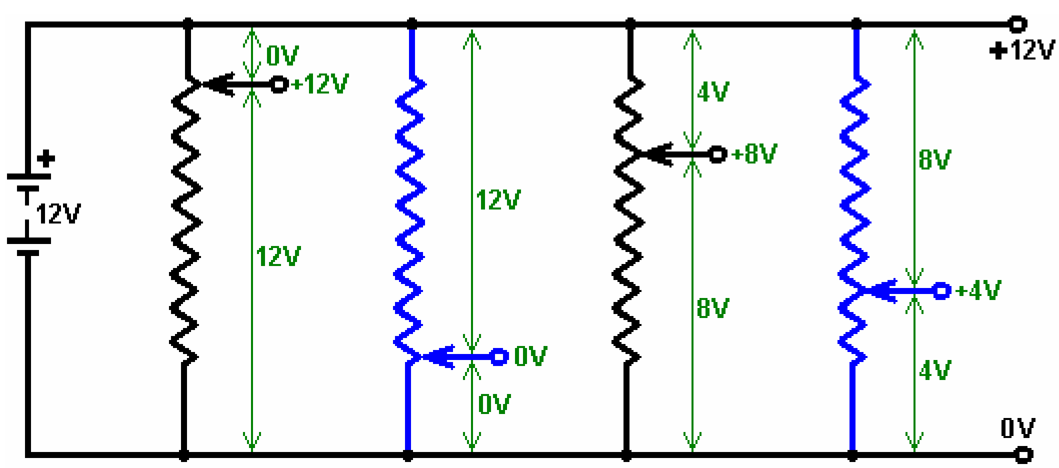
There is no need to do any calculations to determine the voltage at point “A” as it is the ratio of the resistor values which determines the voltage. If you really want to, you can calculate the voltage although it is not necessary. The method for doing this will be shown you shortly. For example, if R1 and R2 each have a value of 50 ohms, then the current flowing through them will be 9 volts / 100 ohms = 0.09 Amps (or 90 milliamps). The voltage drop across R1 will be 50 ohms = Volts / 0.09 amps or Volts = 4.5 volts. Exactly the same calculation shows that the voltage across R2 is exactly 4.5 volts as well. However, the point to be stressed here is that it is the **ratio** of R1 to R2 which controls the voltage at point "A".

If R1 has half as much resistance as R2, then half as much voltage is dropped across it as is dropped across R2, i.e. 3 Volts is dropped across R1, giving point 'A' a voltage of 6 Volts and that is what the voltmeter will show. Again, it does not matter what the actual value of R1 is in ohms, so long as R2 has exactly twice the resistance (shown by a higher number on the resistor).

If R1 has twice as much resistance as R2, then twice as much voltage is dropped across it as is dropped across R2, i.e. 6 Volts is dropped across R1, giving point 'A' a voltage of 3 Volts. Here are some examples with different resistors:

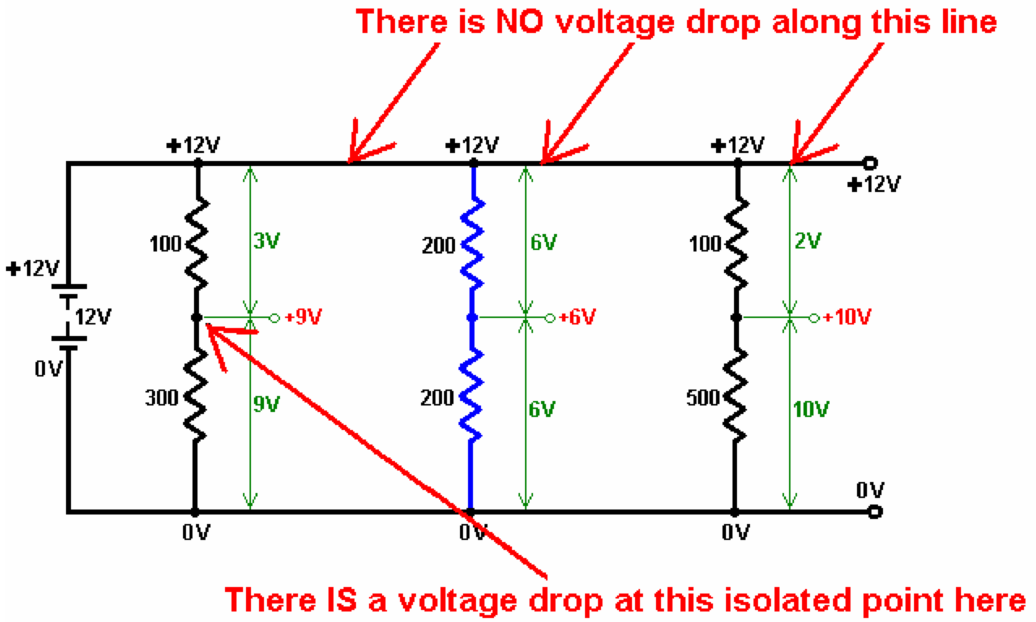


The same division of the supply voltage can be produced by positioning the slider of a variable resistor at different points by rotating the shaft of the device:



This determination of the voltage levels is the key factor to understanding electronic circuitry. The voltage levels control what currents flow and how every circuit will perform, so it is essential to understand what is happening. Stick with this section until you understand it, and if necessary, ask questions about what you find difficult.

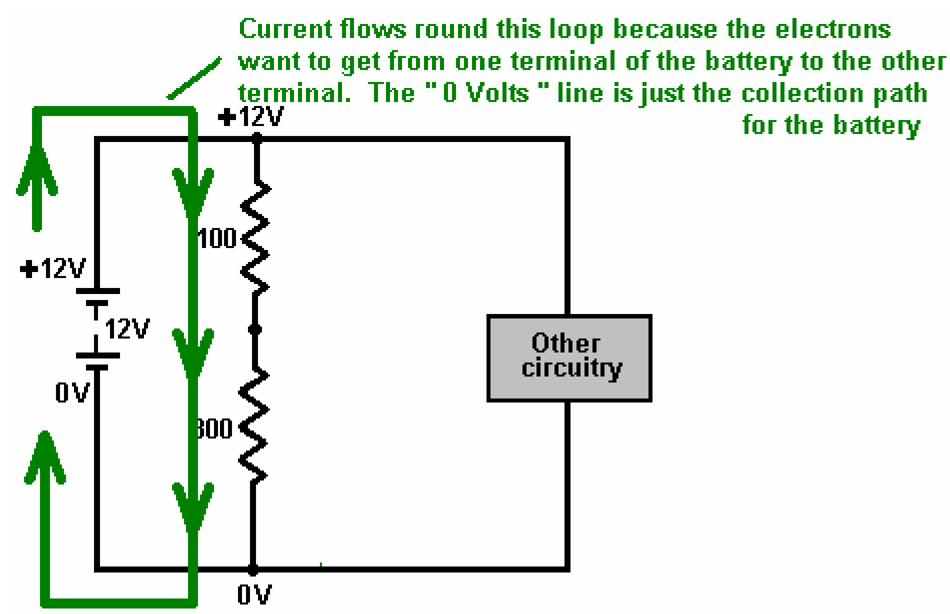
First, please understand that a good battery is an unlimited source of voltage and that voltage does not get "used up" when a resistor or whatever is connected across it:



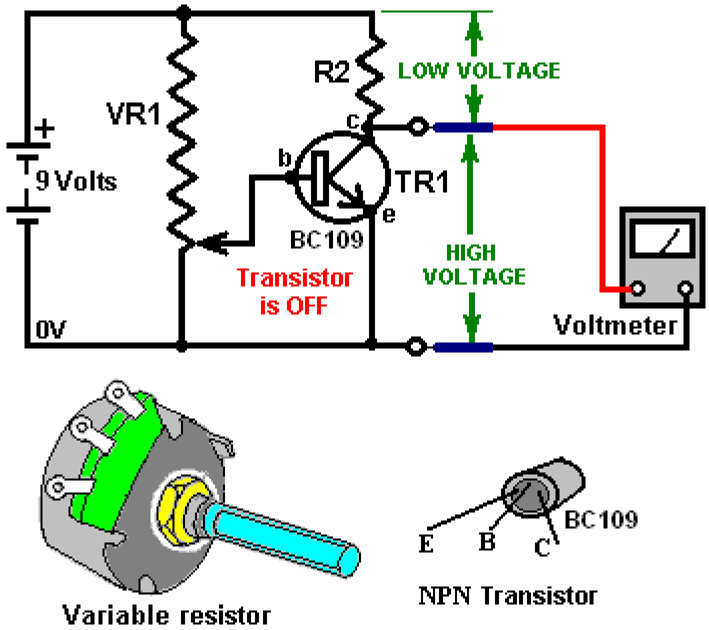
There can be some difficulty in understanding the "0-volt" connection in a circuit. All this means is that it is the return line for current flowing from the battery. Most conventional circuits are connected to both sides of the battery and that allows a current to flow around a closed "circuit" from one terminal of the battery to the other terminal.

It is normal practice to draw a circuit diagram so that the Plus terminal of the battery is at the top and the minus terminal is at the bottom. Many circuit diagrams show the negative line at the bottom connected to the ground or an "earth" connection, which is literally a metal rod driven into the ground to make a good electrical connection to the ground. This is done because the Earth is literally a vast reservoir of negative electricity. However, in reality, most circuits are not connected directly to the Earth in any way. The standard circuit diagram can be visualised as being like a graph of voltage, the higher up the diagram, the higher the voltage.

Anyway, when there is a circuit connected across the battery, the negative or "0V" line just indicates the return path to the battery for the current flow:



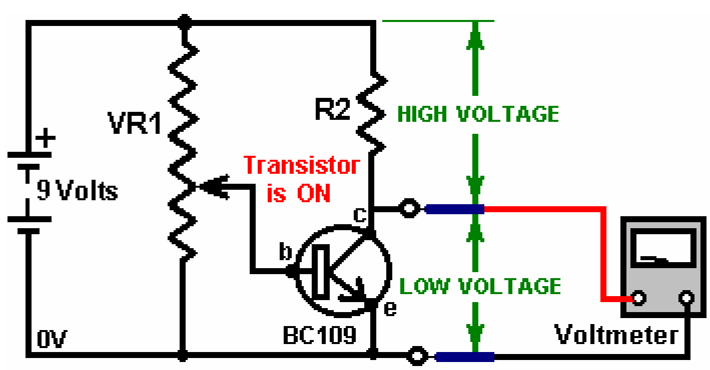
This principle applies immediately to the following circuit:



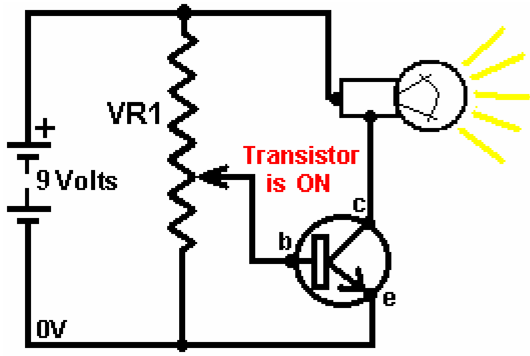
Here we encounter two new components. The first is 'VR1' which is a variable resistor. This device is a resistor which has a slider which can be moved from one end of the resistor to the other. In the circuit above, the variable resistor is connected across the 9 Volt battery so the top of the resistor is at +9 Volts (relative to the battery Minus terminal) and the bottom is at 0 Volts. The voltage on the slider can be adjusted from 0 Volts to 9 Volts by moving it along the resistor by turning the shaft of the component (which normally has a knob attached to it).

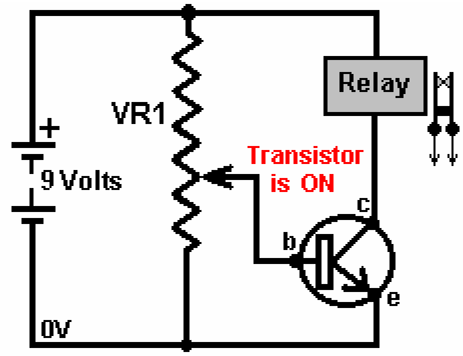
The second new device is 'TR1' a transistor. This semiconductor has three connections: a **C**ollector, a **B**ase and an **E**mitter. If the voltage on the base is below 0.7 volts, then the transistor is said to be "OFF" and in that state it has a very high resistance between the collector and the emitter, much higher than the resistance of resistor "R2". The voltage dividing mechanism just discussed means that the voltage at the collector will therefore, be very near to 9 Volts - caused by the **ratio** of the transistor's **C**ollector/**E**mitter resistance compared to the resistor "R2".

If the voltage on the base of the transistor is raised to 0.7 volts by moving the slider of the variable resistor slowly upwards, then this will feed a small current to the base which then flows out through the emitter, switching the transistor ON causing the resistance between the collector and the emitter to drop instantly to a very low value, much, much lower than the resistance of resistor 'R2'. This means that the voltage at the collector will be very close to 0 Volts. The transistor can therefore be switched on and off just by rotating the shaft of the variable resistor:



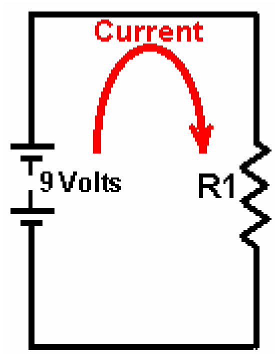
If a bulb is used instead of R2, then it will light when the transistor switches on. If a relay or opto-isolator is used, then a second circuit can be operated:





If a buzzer is substituted for R2, then an audible warning will be sounded when the transistor switches on. If a light-dependent resistor is substituted for VR1, then the transistor will switch on when the light level increases or decreases, depending on how the sensor is connected. If a thermistor is used instead of VR1, then the transistor can be switched on by a rise or fall in temperature. The same goes for sound, wind speed, water speed, vibration level, etc. etc. - more of this later.

We need to examine the resistor circuit in more detail:



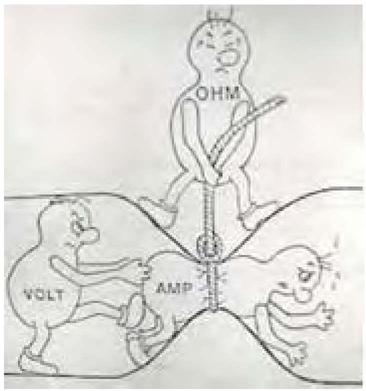
We need to be able to calculate what current is flowing around the circuit. If the circuit contains only resistors, then this can be done using "Ohms Law" which states that "Resistance equals Voltage divided by Current" or, if you prefer:

Ohm's Law (resistive Circuits only).

"**Ohms = Volts / Amps**" which indicates the units of measurement.

In the circuit above, if the voltage is 9 Volts and the resistor is 100 ohms, then by using Ohm's Law we can calculate the current flowing around the circuit as 100 Ohms = 9 Volts / Amps, or Amps = 9 / 100 which equals 0.09 Amps. To avoid decimal places, the unit of 1 milliamp is used. There are 1000 milliamps in 1 Amp. The current just calculated would commonly be expressed as 90 milliamps which is written as 90 mA.

In the circuit above, if the voltage is 9 Volts and the resistor is 330 ohms, then by using Ohm's Law we can calculate the current flowing around the circuit as 330 = 9 / Amps. Multiplying both sides of the equation by "Amps" gives:
Amps x 330 ohms = 9 volts. Dividing both sides of the equation by 330 gives:
Amps = 9 volts / 330 ohms which works out as 0.027 Amps, written as 27 mA.



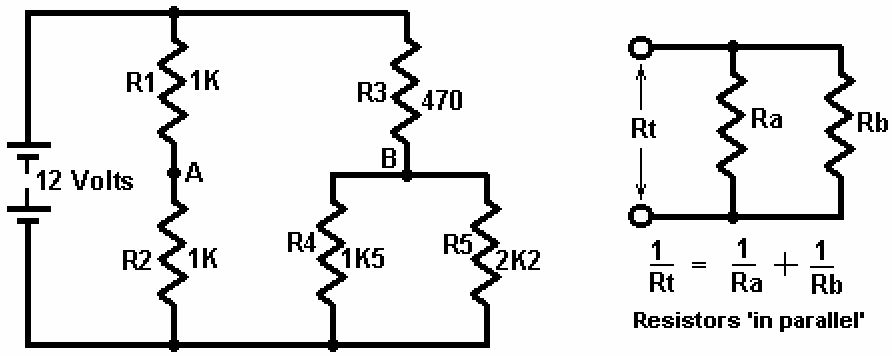
Using Ohm's Law we can calculate what resistor to use to give any required current flow. If the voltage is 12 Volts and the required current is 250 mA then as Ohms = Volts / Amps, the resistor needed is given by: Ohms = 12 / 0.25 Amps which equals 48 ohms. The closest standard resistor is 47 ohms (Yellow / Purple / Black).

The final thing to do is to check the wattage of the resistor to make sure that the resistor will not burn out when connected in the proposed circuit. The power calculation is given by:

Watts = Volts x Amps. In the last example, this gives Watts = 12 x 0.25, which is 3 Watts. This is much larger than most resistors used in circuitry nowadays.

Taking the earlier example, Watts = Volts x Amps, so Watts = 9 x 0.027 which gives 0.234 Watts. Again, to avoid decimals, a unit of 1 milliwatt is used, where 1000 milliwatts = 1 Watt. So instead of writing 0.234 Watts, it is common to write it as 234 mW.

This method of working out voltages, resistances and wattages applies to any circuit, no matter how awkward they may appear. For example, take the following circuit containing five resistors:



As the current flowing through resistor 'R1' has then to pass through resistor 'R2', they are said to be 'in series' and their resistances are added together when calculating current flows. In the example above, both R1 and R2 are 1K resistors, so together they have a resistance to current flow of 2K (that is, 2,000 ohms).

If two, or more, resistors are connected across each other as shown on the right hand side of the diagram above, they are said to be 'in parallel' and their resistances combine differently. If you want to work out the equation above, for yourself, then choose a voltage across Rt, use Ohm's Law to work out the current through Ra and the current through Rb. Add the currents together (as they are both being drawn from the voltage source) and use Ohm's Law again to work out the value of Rt to confirm that the 1/Rt = 1/Ra + 1/Rb + ... equation is correct. A spreadsheet is included which can do this calculation for you.

In the example above, R4 is 1K5 (1,500 ohms) and R5 is 2K2 (2,200 ohms) so their combined resistance is given by 1/Rt = 1/1500 + 1/2200 or Rt = 892 ohms (using a simple calculator). Apply a common-sense check to this result: If they had been two 1500 ohm resistors then the combined value would have been 750 ohms. If they had been two 2200 ohm resistors then the combined value would have been 1100 ohms. Our answer must therefore lie between 750 and 1100 ohms. If you came up with an answer of, say, 1620 ohms, then you know straight off that it is wrong and the arithmetic needs to be done again.

So, how about the voltages at points 'A' and 'B' in the circuit? As R1 and R2 are equal in value, they will have equal voltage drops across them for any given current. So the voltage at point 'A' will be half the battery voltage, i.e. 6 Volts.

Now, point 'B'. Resistors R4 and R5 act the same as a single resistor of 892 ohms, so we can just imagine two resistors in series: R3 at 470 ohms and R4+R5 at 892 ohms. Common-sense rough check: as R3 is only about half the resistance of R4+R5, it will have about half as much voltage drop across it as the voltage drop across R4+R5, i.e. about 4 Volts across R3 and about 8 Volts across R4+R5, so the voltage at point 'B' should work out at about 8 Volts.

We can use **Ohm's Law** to calculate the current flowing through point 'B':

Ohms = Volts / Amps, (or **Amps = Volts / Ohms** or **Volts = Ohms x Amps**)

(470 + 892) = 12 / Amps, so

Amps = 12 / (470 + 892)

Amps = 12 / 1362 or

Amps = 0.00881 Amps (8.81 milliamps).

Now that we know the current passing through (R4+R5) we can calculate the exact voltage across them:

Resistance = Volts / Amps so

892 = Volts / 0.00881 or

Volts = 892 x 0.00881

Volts = 7.859 Volts.

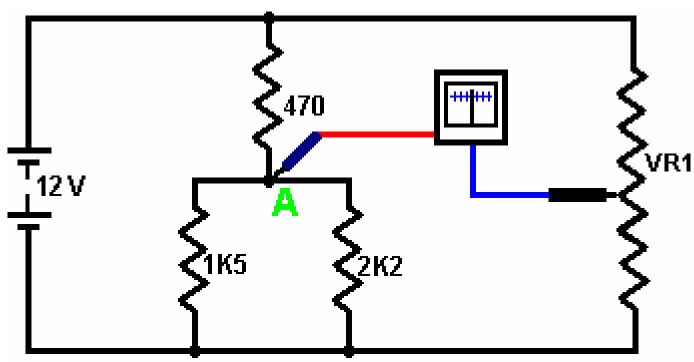
As our common-sense estimate was 8 Volts, we can accept 7.86 Volts as being the accurate voltage at point 'B'.

The Potentiometer.

Just before we leave the subject of resistors and move on to more interesting subjects, we come across the term 'potentiometer'. This term is often shortened to 'pot' and many people use it to describe a variable resistor. I only mention this so that you can understand what they are talking about. A variable resistor is not a potentiometer and really should not be called one. You can skip the rest of this part as it is not at all important, but here is what a potentiometer is:

A fancy name for voltage is 'potential', so a circuit powered by a 12 Volt battery can be described as having a 'potential' of zero volts at the negative side of the battery and a 'potential' of plus twelve volts at the positive side of the battery. Ordinary folks like me would just say 'voltage' instead of 'potential'.

When a voltmeter is used to measure the voltage at any point in a circuit, it alters the circuit by drawing a small amount of current from the circuit. The voltmeter usually has a high internal resistance and so the current is very small, **but** even though it is a small current, it **does** alter the circuit. Consequently, the measurement made is not quite correct. Scientists, in years gone by, overcame the problem with a very neat solution - they measured the voltage without taking **any** current from the circuit - neat huh? They also did it with a very simple arrangement:



They used a sensitive meter to measure the current. This meter is built so that the needle is in a central position if no current is flowing. With a positive current flowing, the needle deflects to the right. With a negative current flowing, the needle moves to the left. They then connected a variable resistor 'VR1' across the same battery which was powering the circuit. The top end of VR1 is at +12 Volts (they called that 'a potential of +12 Volts') and the bottom end of VR1 is at zero volts or 'a potential of zero volts'.

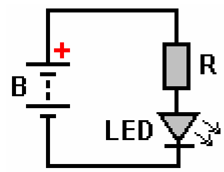
By moving the slider of VR1, any voltage or 'potential' from zero volts to +12 Volts could be selected. To measure the voltage at point 'A' without drawing any current from the circuit, they would connect the meter as shown and adjust the variable resistor until the meter reading was exactly zero.

Since the meter reading is zero, the current flowing through it is also zero and the current taken from the circuit is zero. As no current is being taken from the circuit, the measurement is not affecting the circuit in any way - very clever. The voltage on the slider of VR1 exactly matches the voltage at point 'A', so with a calibrated scale on the variable resistor, the voltage can be read off.

The slick piece of equipment made up from the battery, the variable resistor and the meter was used to measure the 'potential' (voltage) at any point and so was called a 'potentiometer'. So, please humour me by calling a variable resistor a 'variable resistor' and not a 'potentiometer'. As I said before, this is not at all important, and if you want to, you can call a variable resistor a 'heffalump' so long as you know how it works.

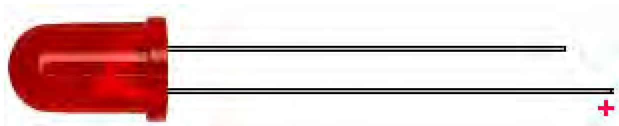
Understanding what circuit diagrams mean.

Many people look at a circuit diagram and have no idea what it means, so let's see if can make the mystery go away. Take this circuit for example:

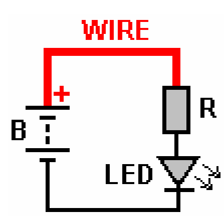


This circuit has three components plus some wire. The symbol "B" represents a battery, or more strictly speaking, a battery made up of a number of cells. Batteries come in many different shapes and sizes. Here are some of them:

The symbol "R" represents a resistor as described above, and the "LED" is a Light-Emitting Diode which probably looks like this:



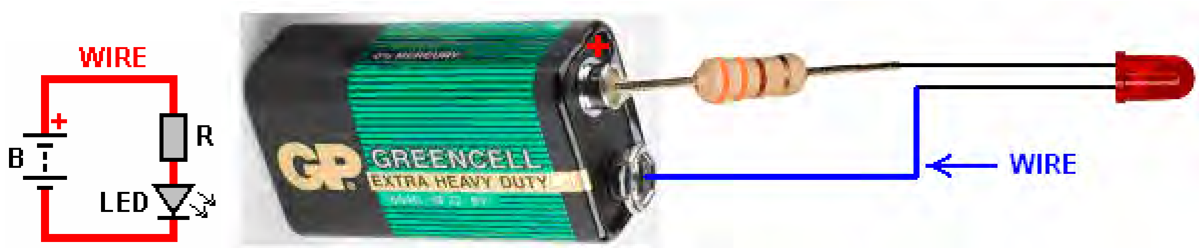
The longer lead is the Plus. Many LEDs need more than 1.5 volts to light up, and while it is very easy to think of a single AA-size battery as being 1.5 volts, the very common AA-size NiMh batteries are only 1.2 volts. So, let us set up the circuit using a 9V battery and a 330 ohm resistor (Orange, Orange, Brown) to limit the current flowing through the LED. The circuit is:



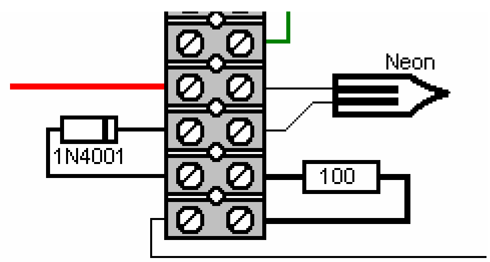
And this indicates that the Plus of the battery gets connected to the resistor. This can be done using some wire, or the resistor can be connected directly to the battery:

Then the LED gets connected to the other end of the resistor:

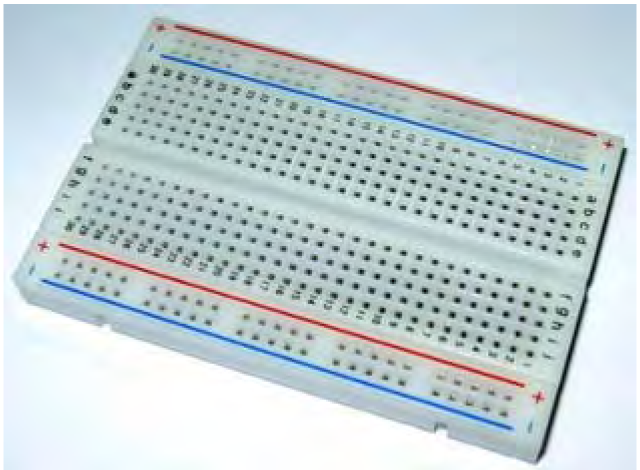
And finally, the other side of the LED is connected to the Minus of the battery:



If the LED is connected the wrong way round, it will not damage anything but the LED will not light up. Poor quality connections can be made by twisting wires together. Better quality connections can be made using screw connectors:



The spacing of the connectors on the strip varies with the power rating of the connectors and there are four or five sizes commonly available, and so it is sometimes necessary to cut the strip and use individual connectors at times. Another option is to use a plug-in board although they are far from perfect. They used to be very good but then integrated circuits came along with their tiny pin spacing and the boards adapted to them by making the holes and the spacing between the holes small enough to suit the integrated circuits. Now, it is no longer possible to plug in quite ordinary components such as the fast UF5408 diode as the diode wires are too large to plug into the tiny holes:

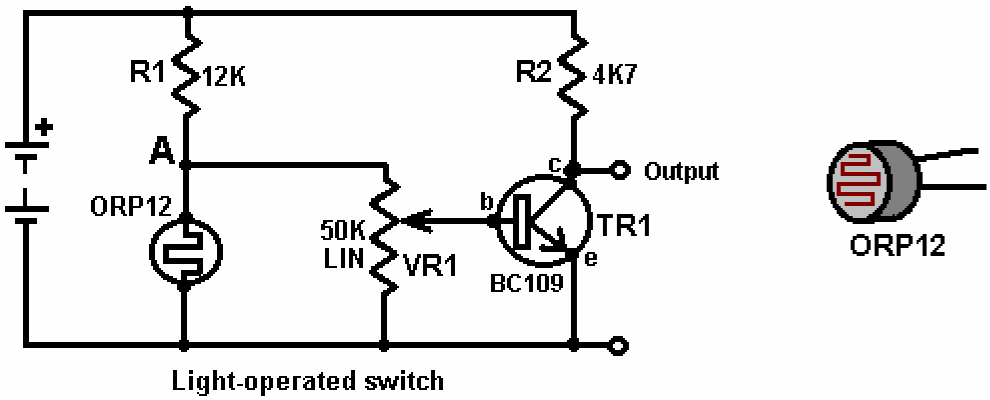


The most effective method of connection is to solder the components together and that is not particularly difficult to do. Veroboard (stripboard) is convenient and there are several other board styles which can be used. When I was very young and almost no components were available, I used drawing pins and soldered components to them, killing the excessive heat using a wet cloth which is very effective in dropping temperature vary rapidly. However, no matter what method of connection is used, you just follow along the connecting lines in any diagram to see what components are connected together.

Semiconductors.

This section deals with discrete semiconductors. A later section deals with 'Integrated Circuits' which are large-scale semiconductor devices.

ORP12 Light-dependent resistor. This device has a high resistance in the dark and a low resistance in bright light. It can be placed in a circuit to create a switch which operates with an increase in light level or a decrease in light level:



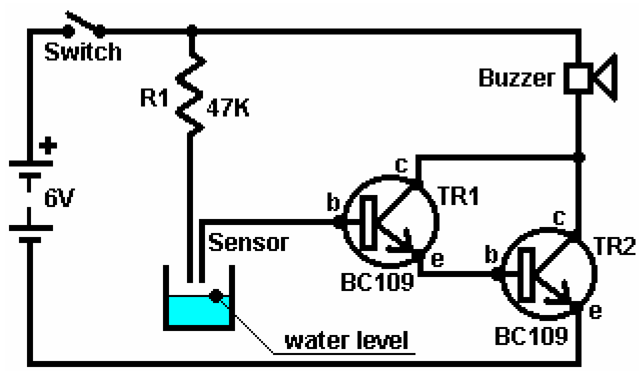
In this version, the voltage at point 'A' controls the circuit. In darkness, the ORP12 has a resistance ten times greater than that of R1 which is 12,000 ohms. Consequently, the voltage at point 'A' will be high. As the light level increases, the resistance of the ORP12 falls, dragging the voltage at point 'A' downwards. As the variable resistor 'VR1' is connected from point 'A' to the ground rail (the -ve of the battery), its slider can be moved to select any voltage between 0 Volts and the voltage of 'A'. A slider point can be chosen to make the transistor switch off in daylight and on at night. To make the circuit trigger when the light level increases, just swap the positions of R1 and the ORP12.

The transistor shown is a BC109 although most transistors will work in this circuit. The BC109 is a cheap, silicon, NPN transistor. It can handle 100mA and 30V and can switch on and off more than a million times per second. It has three connections: the Collector, marked '**c**' in the diagram, the Base, marked '**b**' in the diagram and the Emitter, marked '**e**' in the diagram.

As mentioned before, it has a very high resistance between the collector and the emitter when no current flows into the base. If a small current is fed into the base, the collector/emitter resistance drops to a very low value. The collector current divided by the base current is called the 'gain' of the transistor and is often called 'hfe'. A transistor such as a BC109 or a BC108 has a gain of about 200, though this varies from actual transistor to actual transistor. A gain of 200 means that a current of 200mA passing through the collector requires a current of 1mA through the base to sustain it. Specific information on the characteristics and connections of semiconductors of all kinds can be obtained free from the excellent website www.alldatasheet.co.kr which provides .pdf information files.

The BC109 transistor shown above is an NPN type. This is indicated by the arrow of the symbol pointing outwards. You can also tell by the collector pointing to the positive rail. There are similar silicon transistors constructed as PNP devices. These have the arrow in the transistor symbol pointing inwards and their collectors get connected, directly or indirectly, to the negative rail. This family of transistors are the earliest transistor designs and are called 'bi-polar' transistors.

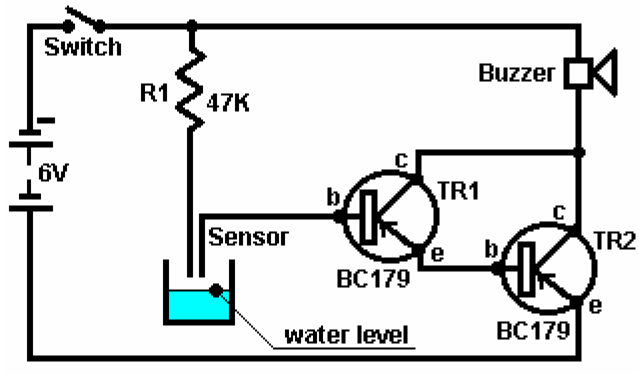
These silicon transistors are so efficiently constructed that they can be connected directly together to give greatly increased gain. This arrangement is called a 'Darlington pair'. If each transistor has a gain of 200, then the pair give a gain of 200 x 200 = 40,000. This has the effect that a very, very small current can be used to power a load. The following diagram shows a Darlington pair used in a water-level detector. This type of alarm could be very useful if you are asleep on a boat which starts taking on water.



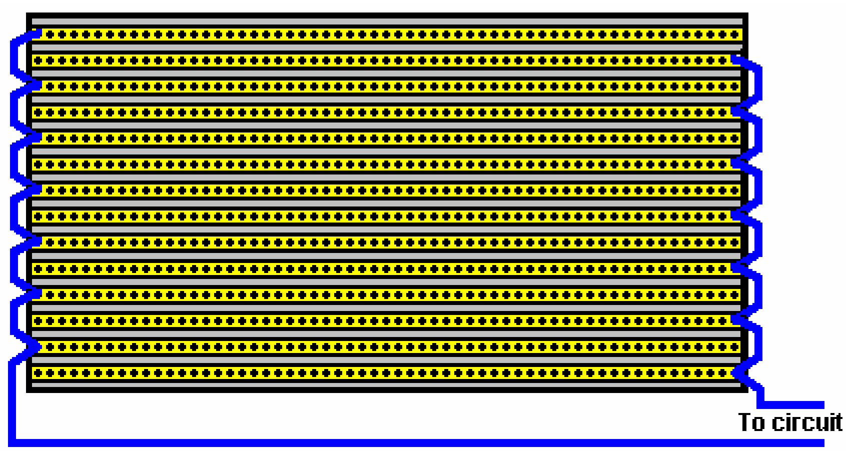
Here, (when the circuit is switched on), transistor TR1 has so little leakage current that TR2 is starved of base current and is hard off, giving it a high resistance across its collector/emitter junction. This starves the buzzer of voltage and keeps it powered off. The sensor is just two probes fixed in place above the acceptable water level. If the water level rises, the probes get connected via the water. Pure water has a high electrical resistance but this circuit will still work with pure water.

The odds are that in a practical situation, the water will not be particularly clean. The resistor R1 is included to limit the base current of TR1 should the sensor probes be short-circuited. Silicon bi-polar transistors have a base/emitter voltage of about 0.7V when fully switched on. The Darlington pair will have about 1.4V between the base of TR1 and the emitter of TR2, so if the sensor probes are short-circuited together, resistor R1 will have 6 - 1.4 = 4.6V across it. Ohms Law gives us the current through it as R = V / A or 47,000 = 4.6 / A or A = 4.6 / 47,000 amps. This works out at 0.098mA which with a transistor gain of 40,000 would allow up to 3.9A through the buzzer. As the buzzer takes only 30mA or so, it limits the current passing through it, and TR2 can be considered to be switched hard on with the whole battery voltage across it.

NPN transistors are more common than PNP types but there is almost no practical difference between them. Here is the previous circuit using PNP transistors:



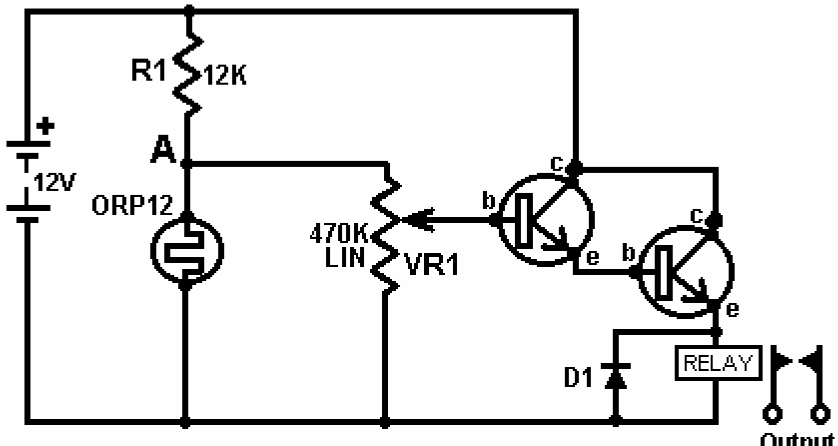
Not a lot of difference. Most of the circuit diagrams shown here use NPN types but not only are these not critical, but there are several ways to design any particular circuit. In general, the semiconductors shown in any circuit are seldom critical. If you can determine the characteristics of any semiconductor shown, any reasonably similar device can generally be substituted, especially if you have a general understanding of how the circuit works. Either of the two previous circuits can operate as a rain detector. A suitable sensor can easily be made from a piece of strip board with alternate strips connected together to form an interlacing grid:



Rain Sensor

Here, if a raindrop bridges between any two adjacent strips, the circuit will trigger and sound a warning.

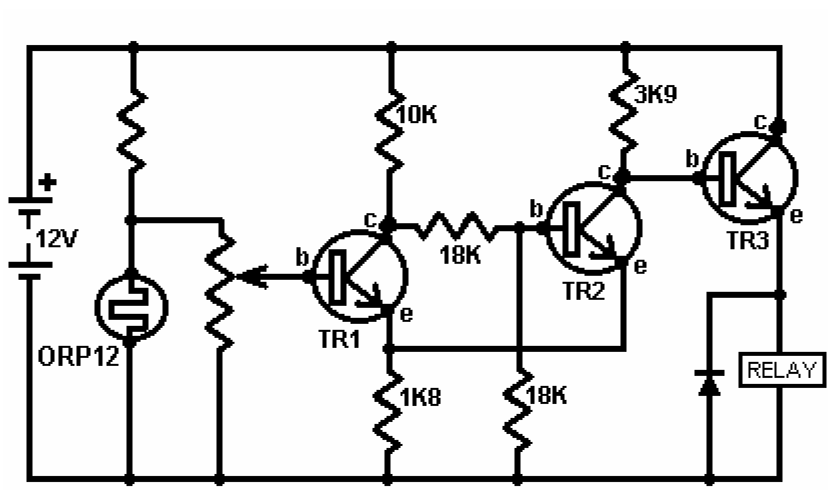
The transistors in the circuit above are connected with their emitter(s) connected to the ground rail (the lower battery line shown in any circuit is considered to be "ground" unless it is specifically shown elsewhere). This connection method is called 'common emitter'. The following circuit uses the transistor connected in 'emitter follower' mode. This is where the emitter is left to *follow* the base voltage - it is always 0.7V below it unless the base itself is driven below 0.7V:



Light-operated switch

This is almost the same as the light-operated circuit shown earlier. In this variation, the transistors are wired so that they work as an 'emitter-follower' which follows the voltage at point 'A' which rises as the light level drops and the resistance of the ORP12 increases. This causes the voltage across the relay to increase until the relay operates and closes its contacts. A relay is a voltage-operated mechanical switch which will be described in more detail later on.

The disadvantage of the above circuit is that as the light level decreases, the current through the relay increases and it may be a significant amount of current for some considerable time. If it was intended to power the unit with a battery then the battery life would be far shorter than it need be. What we would like, is a circuit which switched rapidly from the Off state to the On state even though the triggering input varied only slowly. There are several ways to achieve this, one of them being to modify the circuit to become a 'Schmitt Trigger':



Here, an additional transistor ('TR2') has changed the circuit operation significantly, with transistor TR3 switching fully on and fully off, rapidly. This results in the current through the relay being very low until the circuit triggers.

The circuit operates as follows. When the voltage at the base of TR1 is high enough, TR1 switches on, which causes the resistance between its collector and emitter to be so low that we can treat it as a short circuit (which is a nearly-zero resistance connection). This effectively connects the 10K and 1K8 resistors in series across the battery. The voltage at their connecting point (both the collector and emitter of TR1) will then be about 1.8 Volts. The two 18K resistors are in series across that voltage so the voltage at their junction will be half that; 0.9 Volts.

This puts the Base of TR2 at about 0.9 Volts and its emitter at 1.8 Volts. The base of TR2 is therefore not 0.7 Volts above its emitter, so no base/emitter current will flow in TR2, which means that TR2 is switched hard off. This means that the TR2 collector/emitter resistance will be very high. The voltage at the base of TR3 is controlled by the 1K8 resistor, the TR2 collector/emitter resistance (very high) and the 3K9 resistor. This pushes the base voltage of TR3 up to near the full battery voltage and as it is wired as an emitter-follower, its emitter voltage will be about 0.7 Volts below that. This means that the relay will have most of the battery voltage across it and so will switch hard on.

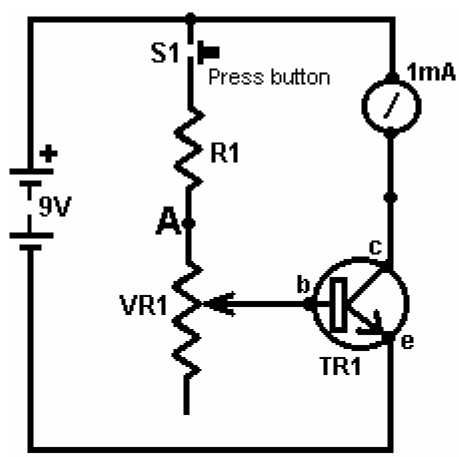
Some practical points: The current flowing into the base of TR3 comes via the 3K9 resistor. A 3K9 resistor needs 3.9 Volts across it for every 1 mA which flows through it. If the relay needs 150 mA to operate and TR3 has a gain of 300, then TR3 will need a base current of 0.5 mA to provide 150 mA of current through its collector/emitter junction. If 0.5 mA flows through the 3K9 resistor, there will be a voltage drop across it of some 2 Volts. The TR3 base/emitter voltage will be a further 0.7 Volts, so the voltage across the relay will be about 12.0 - 2.0 - 0.7 = 9.3 Volts, so you need to be sure that the relay will work reliably at 9 Volts.

If you used a Darlington pair of transistors, each with a gain of 300, instead of TR3, then their combined base/emitter voltage drop would be 1.4 Volts, but they would only need a base current of 150 mA / (300 x 300) = 1/600 mA. That current would only drop 0.007 Volts across the 3K9 resistor, so the relay would receive 10.6 Volts.

So, how do you work out the gain of any particular transistor? The main working tool for electronics is a multimeter. This is a digital or analogue meter which can measure a wide range of things: voltage, current, resistance, ... The more expensive the meter, generally, the greater the number of ranges provided. The more expensive meters offer transistor testing. Personally, I prefer the older, passive multimeters. These are looked down on because they draw current from the circuit to which they are attached, but, because they do, they give reliable readings all the time. The more modern battery-operated digital multimeters will happily give incorrect readings as their battery runs down. I wasted two whole days, testing rechargeable batteries which appeared to be giving impossible performances. Eventually, I discovered that it was a failing multimeter battery which was causing false multimeter readings.

Transistor Testers.

For the moment, let us assume that no commercial transistor tester is to hand and we will build our own (or at least, discover how to build our own). The gain of a transistor is defined as the collector/emitter current divided by the base/emitter current. For example, if 1mA is flowing through the collector and 0.01mA is flowing into the base to sustain that collector flow, then the transistor has a gain of 100 times at 1mA. The transistor gain may vary when it is carrying different current loads. For the circuits we have been looking at so far, 1mA is a reasonable current at which to measure the transistor gain. So let's build a circuit to measure the gain:



Transistor Tester

With the circuit shown here, the variable resistor is adjusted until a collector current of 1mA is shown on the millimetre and the gain of the transistor is then read off the scale on the variable resistor knob. The circuit is built into a small box containing the battery and with a socket into which the transistor can be plugged. The question then is, what values should be chosen for the resistor R1 and the variable resistor VR1?

Well, we might choose that the minimum gain to be displayed is 10. This would correspond to where the variable resistor slider is taken all the way up to point 'A' in the circuit diagram, effectively taking the variable resistor out of the circuit. If the transistor gain is 10 and the collector current is 1mA, then the base current will be 0.1mA. This current has to flow through the resistor R1 and it has a voltage of (9.0 - 0.7) Volts across it as the base/emitter voltage is 0.7 Volts when the transistor is on. Ohms Law gives us Ohms = Volts / Amps, which for the resistor R1 means Ohms = 8.3 / 0.0001 or 83,000 ohms, or 83K.

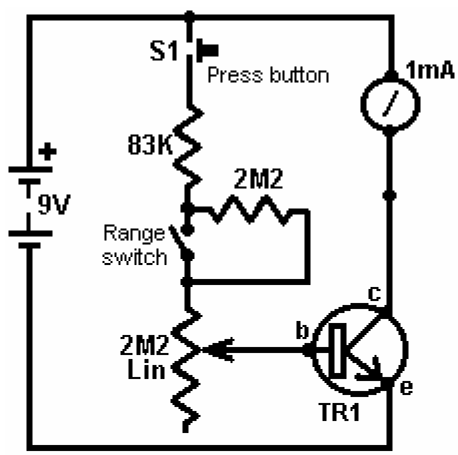
Rule of thumb: 1K provides 1mA if it has 1V across it, so 10K will give 0.1mA if it has 1 Volt across it. With 8.3 Volts across it, it needs to be 8.3 times larger to hold the current down to the required 0.1mA so the resistor should be 83K in size.

As 83K is not a standard size, we need to use two or more standard resistors to give that resistance. Nearest standard size below 83K is 82K, so we can used one 82K resistor and one 1K resistor in series to give the required 83K.

Suppose that we say that we would like to have 500 as the highest gain shown on our tester, then when VR1 is at its maximum value, it and R1 should provide 1/500 of the collector current of 1mA, i.e. 0.002mA or 0.000002 Amps. From Ohms Law again we get VR1 + R1 = 4,150,000 ohms or 4M15. Unfortunately, the largest value variable resistor available is 2M2 so the circuit as it stands, will not be able to cope.

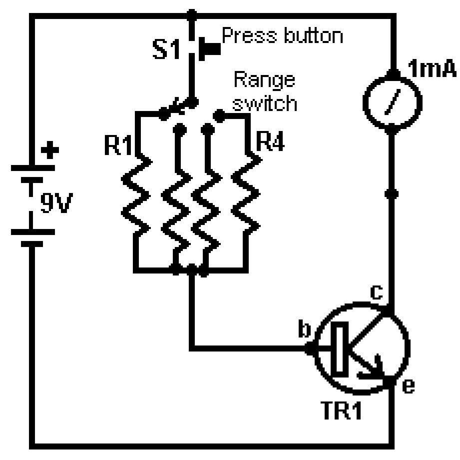
Suppose we were to just use a 2M2 variable resistor for VR1, what transistor gain range could we display? Well Ohms Law ... lets us calculate the base current with 8.3 Volts across (83,000 + 2,200,000) ohms and from that the maximum transistor gain which would be 277.77 (at 1mA). You would buy a 'linear' standard carbon track variable resistor so that the change in resistance is steady as the shaft is rotated. The scale which you would make up would be in even steps and it would run from 10 at the minimum setting, to 278 at the highest setting.

But that is not what we wanted. We wanted to measure up to 500. But they don't make variable resistors big enough, so what can we do? Well, if we wanted, we could lower the battery voltage, which in turn would lower the resistor values. As a 9V battery is very convenient for this kind of circuit, lets not go down that route. We could add extra circuitry to drop the 9V battery voltage down to a lower value. The most simple solution is to add an extra resistor and switch to give two ranges. If we switched in an extra 2M2 resistor above VR1 then the circuit would measure transistor gains from 278 to just over 500 and all we would need to do would be to add a second scale for the VR1 pointer knob to move over. We could, provide extra ranges which overlap and which have more convenient scales to mark. The design is up to you.



Transistor Tester 2

The design covered above is not the only way to measure the transistor gain. A second way, which accepts that it is not so accurate, picks a set base current and measures the collector current as a guide to the gain. In this simple method, one or more resistor values are chosen to give gain ranges, and the milliammeter used to read the corresponding gain:



Transistor Tester 3

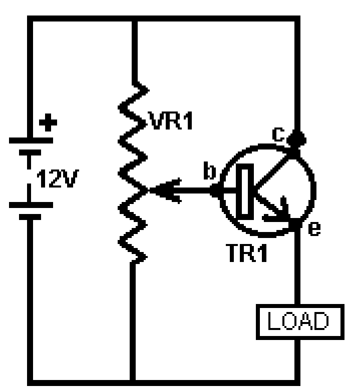
Here, resistor R1 might be chosen to give a collector current of 1mA (which is a full-scale deflection on the meter) when the transistor gain is 100. Resistor R2 might be picked to give a full-scale deflection for a gain of 200, R3 for a gain of 400, R4 for a gain of 600, and so on. Generally speaking, it is not essential to know the exact gain but any reasonable approximation to it is sufficient. You are normally selecting a transistor where you need a gain of 180, so it is not important if the transistor you pick has a gain of 210 or 215 - you are only avoiding transistors with gains below 180.

How do you work out the values of the resistors R1 to R4? Well, you probably won't expect this, but you use Ohms Law. Voltage drop is 8.3 Volts and the base current is given by the full-scale deflection's 1mA divided by the transistor gain for each range, i.e. 1/100 mA for R1, 1/200 mA for R2,... 1/600 mA for R4,...

Emitter Followers

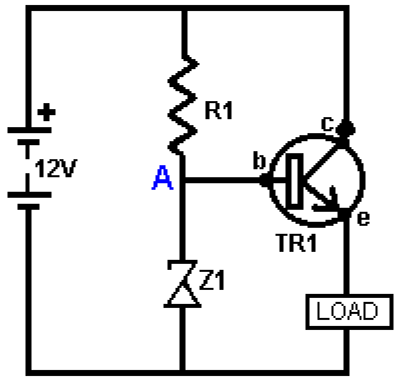
The transistor circuits show so far are known by the technical term "Common Emitter" because the emitters are generally connected to the 'Negative rail' or battery minus line. This method of use is very popular because when the transistor is switched on, all of the supply voltage is supplied to the load. Another common and very useful method is known as the 'Emitter-Follower' circuit where the load is connected to the negative rail instead of the emitter of the transistor. With this arrangement, the voltage at the emitter remains at 0.7 volts below the voltage of the transistor base and 'follows' that voltage no matter how it changes. Generally speaking, the transistor is being used to amplify the current which could be drawn from the point in the circuit where the transistor base is connected.

The circuit arrangement is like this:



If the battery is genuinely 12-volts, then the slider of the variable resistor VR1 can be moved from a voltage of zero volts to a voltage of +12 volts, or any desired value between those two values. That means that the voltage on the base of transistor TR1 can be any of those values. If the voltage on the transistor base is 0.7 volts or higher, then the transistor will conduct current and the voltage across the load will increase until the emitter is 0.7 volts below the base voltage. This means that the voltage across the load can be adjusted to any value from 0 volts to +11.3 volts. This circuit is known as an "Emitter-Follower" circuit.

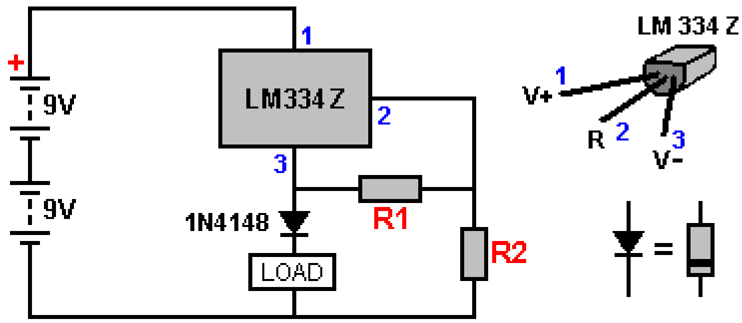
The actual values encountered in 'real life' are that a battery marked as 12-volts is very seldom actually at that voltage and a common value is 12.8 volts. I have called the Base-to-Emitter voltage 0.7 volts but in reality, it may be anything from 0.6 volts to 0.75 volts. A common use for this type of circuit is to pass a constant voltage to a circuit, using a zener diode. The circuit is like this:



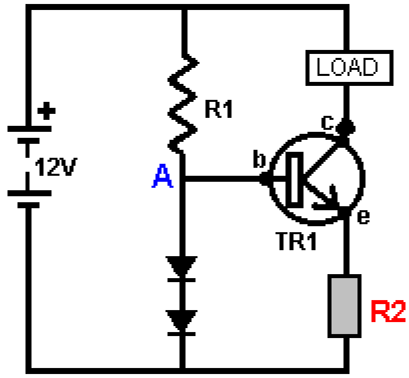
This circuit is supposed to have a fixed voltage at point "A" as the zener diode Z1 is supposed to produce a fixed voltage. That can work reasonably well if the battery voltage is fixed, but if the battery voltage alters either upwards or downwards, the voltage at "A" drifts, which means that the voltage across the load also alters. You will sometimes see this in constant-current circuits.

Constant-Current circuits

The generally recommended way to arrange a constant current flow through some load or other is to use an integrated circuit designed for the job. The arrangement is generally like this:



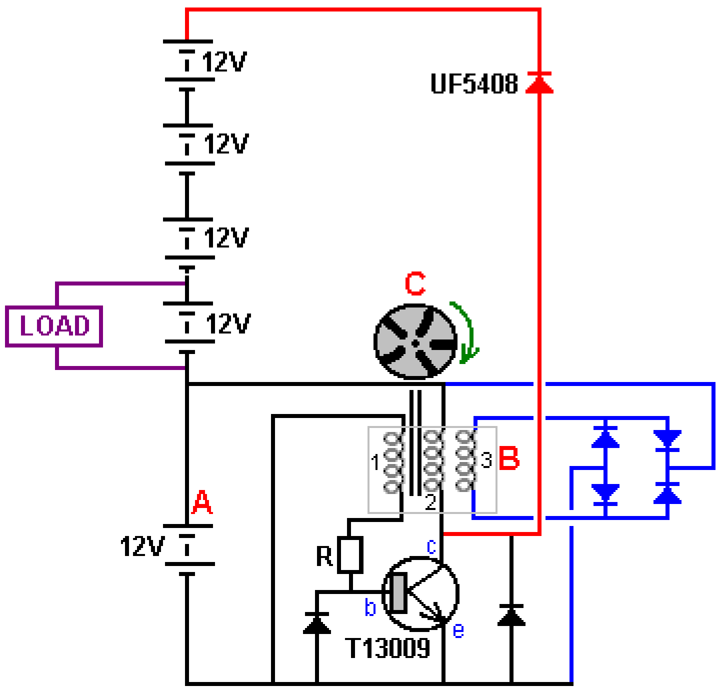
Here, the resistor **R1** controls how much current will flow in the circuit and the resistor **R2** needs to be ten times higher in value than **R1**. One snag is that the LM334Z drops about 4-volts when stabilising the current through the load. That is a lot of voltage sacrificed. An alternative arrangement is:



With this circuit, two ordinary diodes such as the 1N4007, are used to give a steady voltage due to the current flowing through them, supplied by resistor R1. Each diode has a voltage drop across it roughly equal to the voltage drop across the Base/Emitter junction of the transistor TR1. That means that the resistor **R2** will have about the same voltage across it as one of the diodes. It is my experience that the voltage drop across the diodes is not affected much if the battery voltage changes as time goes by. The value of the resistor **R2** is chosen to give the desired current flow through the load. The voltage drop across the transistor Collector/Emitter connections adjusts automatically to keep the current through the load at the constant required value.

Substitute Transistors

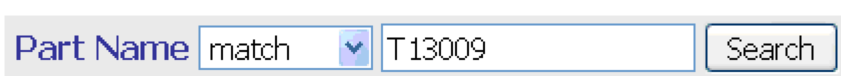
A recent question was how to find a substitute transistor for the T13009 transistor in this chapter 21 circuit, as there seemed to be no local supplier for it, and would a 2N2222 transistor do as a substitute?



That is a very reasonable question. So to answer it, we look at the circuit and we see that the Collector of the transistor is going to be pulled upwards until it exceeds the voltage of the battery chain. There are five 12-volt batteries in a chain going upwards from the transistor Emitter and while those batteries have "12 Volts" written on them, they can charge up to nearly 14 volts each. That means that the transistor collector may be dragged up to a voltage of 5 x 14 = 70 volts or more if the batteries are going to be charged. So, common sense says that any successful substitute transistor will have to have a voltage rating of at least 70 volts.

If we want to find out the characteristics of a transistor or diode, we can go to the http://www.alldatasheet.com/ web site, although just Googling the transistor name often gets the needed information very quickly. Anyway, on the web site, the top of the page has an entry section like this:

And if you type in T13009 as the part name:



and click on the Search button, then it comes up with this:

T13009 Datasheet, PDF

Shortcut	T13009(1) recommended result.
Match, Like	ST13009(1)

So you click on the blue ST13009 link and it then comes up with a slightly confusing advertisement display which offers information on some totally unrelated component. However, if you scroll down the page a little you reach a link to the datasheet for the transistor:

Electronic Manufacturer	Part no	Datasheet
STMicroelectronics	ST13009	PDF

If you then click on the PDF symbol, you get another screen offering the actual link to the pdf file:

Part No.	ST13009
Download	ST13009 Click to view

Clicking on the link actually provides you with the datasheet which you can store locally to save ever having to go through all that lot again.

ST13009

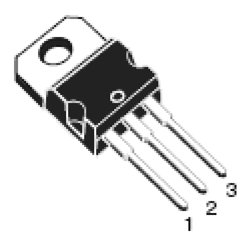
High voltage fast-switching
NPN power transistor

Features

- Low spread of dynamic parameters
- High voltage capability
- Minimum lot-to-lot spread for reliable operation
- Very high switching speed

Applications

- Switch mode power supplies



TO-220

This is not an FET transistor and so our main interest is in the voltage it can withstand, the continuous current which it can carry, the peak current it can manage when fed sudden pulses, how much power overall it can handle, what DC-current gain (that is amplification) you can expect from it and how fast it can operate.

That sounds a lot but it really is quite simple. However, there is a manufacturing spread on transistors and most other electronic components, and so we are looking for just a ball-park number for these things. That is, you can have five identical-looking transistors in your hand but it is most unlikely that any two of them will actually be identical. However, let's look at this data sheet and see what we find out:

First, the maximum voltage that the transistor can withstand with the base unconnected is 400 volts which is a good deal more that is likely to be reached in our circuit.

Next, the current. The continuous current is stated to be 12 amps and 24 amps if in pulses. That is likely to be more than the circuit needs, as a sustained output of 40 watts from a 12-volt connection is a current of under 4-amps.

Next, the wattage is stated as being 100 watts (a heat sink is definitely needed for that – imagine holding a lit 100 watt light bulb in your hand and think how comfortable that would be). However, in our circuit, the transistor will be off for most of the time and so, wattage is not likely to be a problem.

Next, the switching speed, which is likely to be important in this circuit. The data sheet suggests that about 60 nanoseconds is likely for any T13009 transistor.

And finally, the DC current gain will probably be between 15 and 39 at a current of 5 amps. It is likely to be much better than that at lower currents.

Some people have difficulty visualising how a bipolar transistor works, so let me explain it in a bit more detail. When current is flowing through a bipolar transistor, then the base voltage of that transistor is pretty much fixed. It is a bit like having a large lake with a long horizontal dam wall holding the water in the lake. When the lake water level is below that of the dam, then no water flows over the dam. If the lake level rises, then water spills over the dam. The amount of that water flow is VERY much affected by the depth of water over the dam with even a small increase in depth causing a massive increase in water flow. The same goes for the transistor base and that is why the base current flow is limited by a resistor. Without a resistor, the current flow would very quickly become many amps and burn the transistor out through sheer heating of the base/emitter junction.

The base current flow is like the setting of a valve between the collector and the emitter. If the transistor gain is 200, then 1 mA flowing into the base allows 200 mA to flow between the collector and the emitter, unless there is a load between the collector and the battery – a load which chokes off that current flow, and that is the normal case. For example, if 0.5 mA flows into the base, then a maximum of 100 mA can pass between the collector and emitter. The gain of any transistor depends on the amount of current flowing through the transistor and it varies so much that the only way to specify it properly is to draw a graph of it. Because of that, printed gain figures are given for just one or two currents. Generally, the lower the current, the higher the actual gain, so if a gain is given as 20 at 1 amp and you are only intending to have 100 mA flowing through it, then you can expect a gain much higher than 20. The voltage on the base of a single transistor which is conducting will always be 0.7 volts (or something very close to that depending on how that particular transistor was actually manufactured). That 0.7 volts stays fixed even if the current flowing into the base increases from 0.1 milliamps to 100 milliamps. So back to our T13009 transistor.

Okay, we now know a bit about the T13009 transistor, and the question asked about the 2N2222 transistor, so we look it up on the All Data Sheet web site and we find that the maximum voltage is 40-volts. That rules it out of our circuit where the voltage goes to at least 70-volts and a 2N2222 transistor would die instantly. We then look at the current and see that it has a maximum of 0.8 of an amp which means that it is really not in the ball-park for this circuit.

We know that the TIP3055 (originally packaged as the 2N3055) is very popular with free-energy builders, so we look it up and find out that it can handle voltages up to 60 volts, 90 watts of power and 15 amps of current. While it is a powerful transistor, it looks as if its voltage rating is too low for this circuit.

So, what do we do now? One way is to ask an electronics expert to suggest a suitable alternative. Another way is to look up the transistors offered by your local supplier, which for me is www.esr.co.uk which leads to this table which is one of many and which has far more entries:

Device	Type	VCB VMAX	IC mA Max	PTOT mW Max	HFE MIN IC mA Max
MJ2501	PNP	80	10A	150W	100@5A
MJ2955	PNP	100	15A	150W	5@10A
MJ11015	PNP	120	30A	200W	1k@20A
MJ11016	NPN	120	30A	200W	1k@20A
MJE340	NPN	300	500	20W	30@50
MJE350	PNP	300	500	20W	30@50
MPSA05	NPN	60	500	625	50@100
MPSA13	NPN	30	500	625	5k@10
MPSA42	NPN	300	500	625	40@30

We want an NPN transistor and so the MJ11016 looks possible with a 100 volt capacity, 30 amp current and 200 watt dissipation. It is a Darlington pair in a single case and so will switch on around 1.4 volts as opposed to 0.7 volts on the base, but that should not make any difference in our circuit. With a gain of 1000 a simple carbon variable resistor could be used to control the base current. There are many other transistors to choose from.

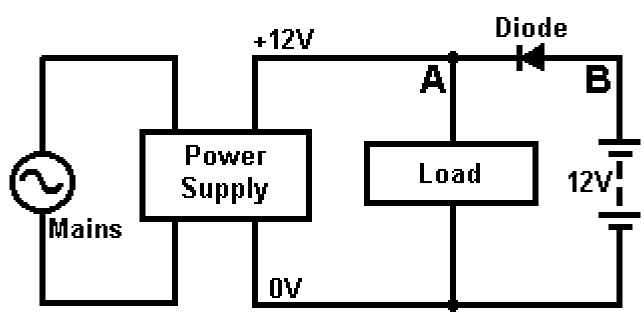
Another way to find a suitable transistor might be to go on eBay and search on "transistor" and see what transistors are popular and how much they cost. An alternative might be to try the circuit with a FET transistor such as the IRF740 which is high voltage, very powerful and not expensive. However, FET transistors trigger on voltage and draw almost no current through their "grid" connection which is the equivalent to a bipolar "base" connection and so some experimentation with the circuit may be needed.

It might also be worthwhile looking to see what transistors were chosen by Alexkor in his 5-battery circuits in chapter 6. If we do that we find the MJE13009 which has an identical specification and so is almost certainly the same as a T13009 transistor and the MJE version is readily available on eBay. Another of his transistors is the 2SC3552 transistor with 500V capability and 150 watt capacity and described as "fast acting".

The Diode

One component which has been shown but not described is the diode or 'rectifier'. This is a device which has a very high resistance to current flowing in one direction and a very low resistance to current flowing in the opposite direction. The base/emitter junction of a transistor is effectively a diode and, at a push, can be used as such. A proper diode is cheap to buy and has far greater voltage and current handling capacities than the base/emitter junction of a transistor.

Diodes are mainly made from one of two materials: germanium and silicon. Germanium diodes are used with very small alternating currents such as radio signals coming from an aerial. This is because a germanium diode needs only 0.2 Volts or so to carry a current while silicon needs 0.6 to 0.7 Volts (same as a silicon transistor base/emitter junction). Germanium diodes (and transistors) are very sensitive to temperature change and so are normally restricted to low power circuits. One very neat application for a silicon diode is as an 'un-interruptible power supply' where mains failure is caught instantly:



Mains Unit Back-up Circuit

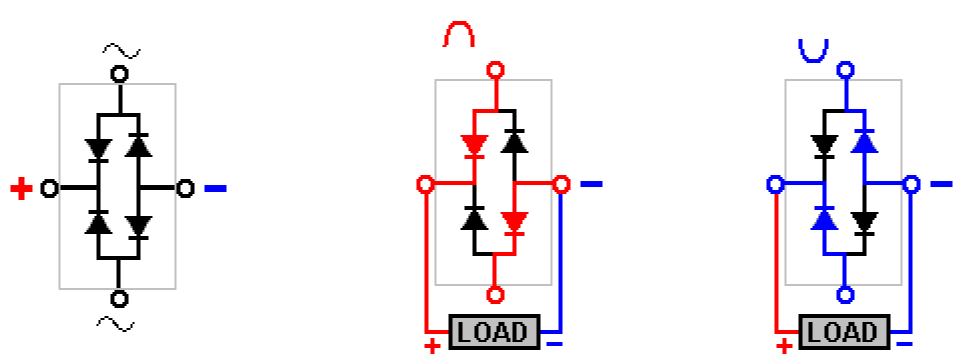
In this circuit, the mains voltage drives the Power Supply Unit which generates 12 Volts at point 'A'. This provides current to the Load. The diode has +12 Volts at 'A' and +12 Volts at point 'B' so there is no voltage drop across it and it will not carry current in either direction. This means that the battery is effectively isolated when the mains is functioning. If the Power Supply Unit output were to rise above its design level of +12 Volts, then the diode would block it from feeding current into the battery.

If the mains fails, the Power Supply Unit ('PSU') output will fall to zero. If the battery and diode were not there, the voltage at point 'A' would fall to zero, which would power-down the Load and possibly cause serious problems. For example, if the load were your computer, a mains failure could cause you to lose important data. With a battery back-up of this type, you would have time to save your data and shut your computer down before the battery ran out.

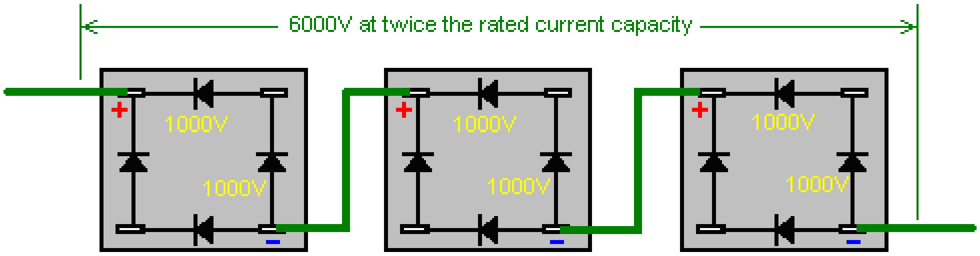
The circuit operates in a very simple fashion. As soon as the voltage at point 'A' drops to 0.7 Volts below the +12 Volts at point 'B", the diode starts feeding current from the battery to the Load. This happens in less than a millionth of a second, so the Load does not lose current. It would be worth adding a warning light and/or a buzzer to show that the mains has failed.

Diodes are also supplied packaged as a diode bridge, with four diodes enclosed inside. Usually intended for power supply rectification, they are not particularly fast-acting diodes, but are cheap and can carry a good deal of current. A common size is with the diodes rated at 1000 volts and able to carry 35 amps. Although there are many package types, a very common package looks like this:

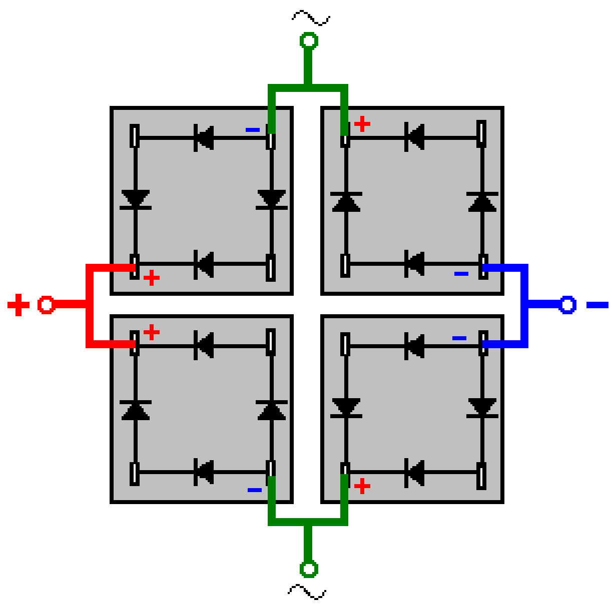
The alternating signal is connected between two opposite corners and the pulsating DC is taken off from the other two terminals. The symbols shown above are normally marked on the flat face which is not seen in this picture. The package has a hole in the centre so that the metal case can be bolted to a heat-sink in order to keep the device reasonably cool when carrying large currents. The connections inside the package are like this:



It is possible to connect the bridge in a different way and use it as a higher voltage double diode arrangement as shown here:



By skipping the alternating current ability and connecting to just the Plus and the Minus terminals, the package provides two pairs if diodes in connected in series. This gives twice the voltage handling in both current paths and the rated current handling capacity in both of those two paths which are now connected across each other, which doubles the current handling capacity. The diagram shows how three ordinary, cheap 1000V 35 amp bridges can be connected to give one 70 amp 6000V composite diode. You could, if you wish, raise the specification of a 1000V 35A diode bridge to 2000V 70A by using four of them like this:



Diodes are specified by their voltage handling capacity and their current-carrying capacity and the speed at which they can switch on and off. For power supplies where the frequency is very low, any diode will do, but there are circuits where the switching is needed hundreds of thousand times per second and so the diode specification sheets need to be checked to see what frequency can be handled by any particular diode. Those data sheets can be downloaded free from http://www.alldatasheet.co.kr/.

One other thing which needs to be checked for some circuits is the voltage needed to get the diode to switch on. Two common materials used when making diodes are silicon and germanium. Germanium types have a low forward voltage of around 0.2 volts typically which silicon has about a 0.6 volt threshold generally. These voltage figures vary enormously as the current through the diode increases. Circuits which use very low voltages need germanium diodes such as the 1N34.

LED SCR Triac Opto-isolator

Light-Emitting Diodes.
There is a widely used variation of the diode which is extremely useful, and that is the Light Emitting Diode or 'LED'. This is a diode which emits light when carrying current. They are available in red, green, blue, yellow or white light versions. Some versions can display more than one colour of light if current is fed through their different electrical connections.

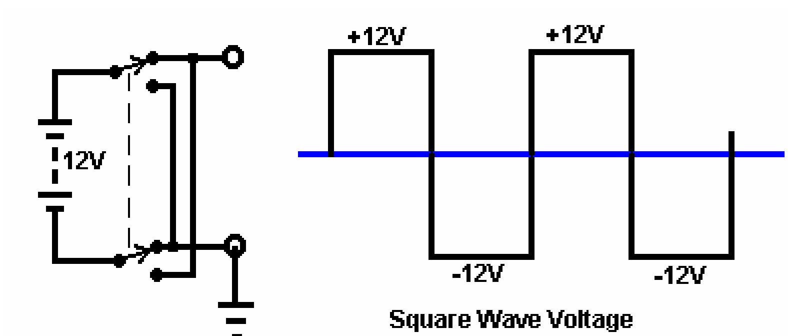
LEDs give a low light level at a current of about 8 or 10 mA and a bright light for currents of 20 to 30 mA. If they are being used with a 12 Volt system, then a series resistor of 1K to 330 ohms is necessary. LEDs are robust devices, immune to shock and vibration. They come in various diameters and the larger sizes are very much more visible than the tiny ones.

Thyristors ("SCR"s) and Triacs.
Another version of the diode is the Silicon Controlled Rectifier or 'Thyristor'. This device carries no current until its gate receives an input current. This is just like the operation of a transistor but the SCR once switched on, stays on even though the gate signal is removed. It stays on until the current through the SCR is forced to zero, usually by the voltage across it being removed. SCRs are often used with alternating voltages (described below) and this causes the SCR to switch off if the gate input is removed. SCRs only operate on positive voltages so they miss half of the power available from alternating power supplies. A more advanced version of the SCR is the 'Triac' which operates in the same way as an SCR but handles both positive and negative voltages.

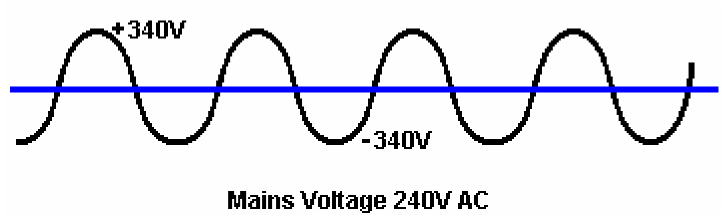
Opto-Isolators.
Another very useful variation on the LED is the Opto-Isolator. This device is a fully enclosed LED and light-sensitive transistor. When the LED is powered up, it switches the transistor on. The big advantage of this device is that the LED can be in a low voltage, low power sensing circuit, while the transistor can be in a completely separate, high voltage, high power circuit. The opto-isolator isolates the two circuits completely from each other. It is a very useful, and very popular, low-cost device.

Alternating Current.
A battery provides a constant voltage. This is called a Direct Current or 'DC' source of power. When a circuit is connected to a battery, the positive rail is always positive and the negative rail is always negative.

If you connect a battery to a circuit through a double-pole changeover switch as shown here:



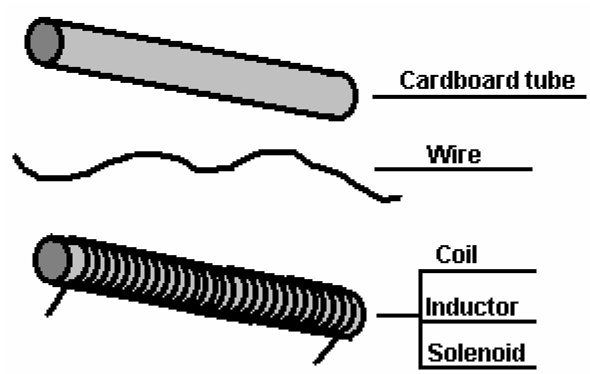
When the changeover switch is operated, the battery is effectively turned over or inverted. This circuit is called an 'inverter' because it repeatedly inverts the supply voltage. If the switch is operated on a regular, rapid basis, the graph of the output voltage is as shown on the right. This is a 'square wave' voltage and is used extensively in electronic equipment. It is called alternating current or 'AC' for short. SCRs and Triacs can be used conveniently with supply voltages of this type. Mains voltage is also AC but is rather different:



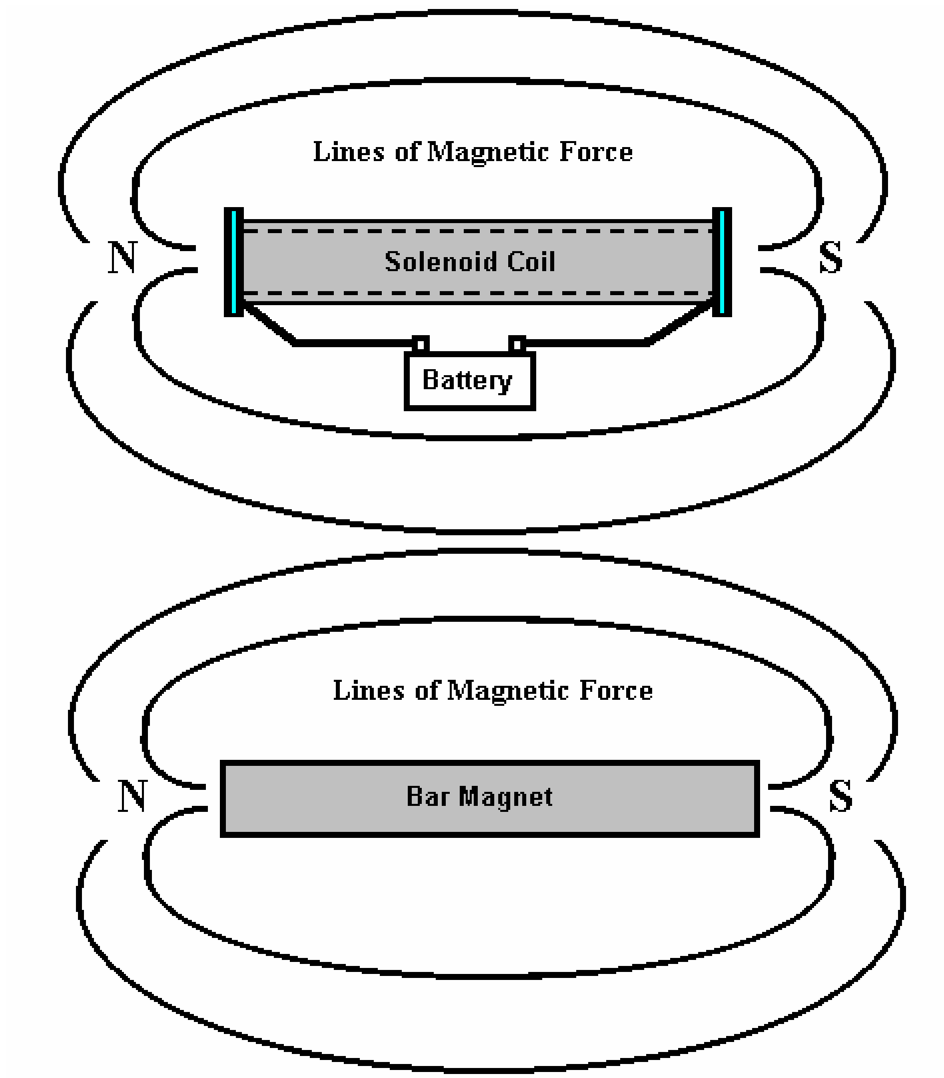
Mains voltage varies continuously in the form of a sine wave. In Britain, the mains voltage is described as ‘240 Volts AC’ and it cycles up and down 50 times per second, i.e. 50 positive peaks and 50 negative peaks in one second. It would be reasonable to assume that each voltage peak would be 240 Volts but this is not the case. Even though the supply is described as 240 Volts, it peaks at the square root of 2 times greater than that, i.e. 339.4 Volts. The actual supply voltage is not particularly accurate, so any device intended for mains use should be rated to 360 Volts. In America, the supply voltage is 110 Volts AC and it cycles 60 times per second, peaking at plus and minus 155 Volts. Later on, you will see how one or more diodes can be used to convert AC to DC in a unit which is sold as a ‘mains adapter’ intended to allow battery operated equipment be operated from the local mains supply.

Coils (“Inductors”) and Solenoids.

If you take a cardboard tube, any size, any length, and wind a length of wire around it, you create a very interesting device. It goes by the name of a ‘coil’ or an ‘inductor’ or a ‘solenoid’.

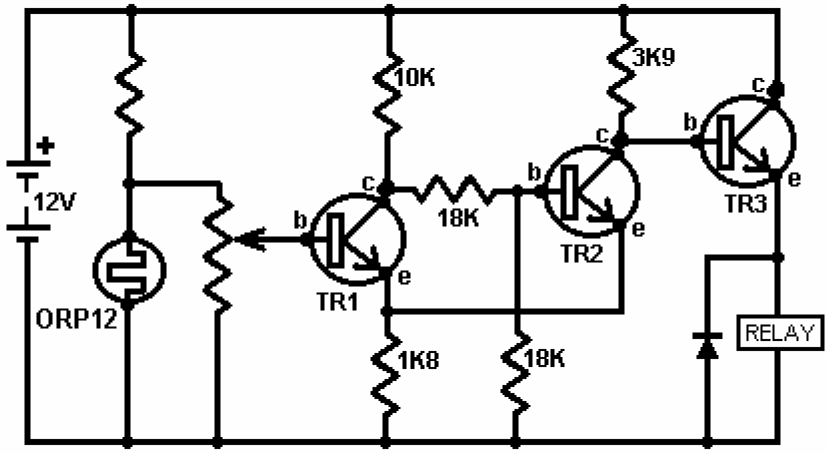


This is a very interesting device with many uses. It forms the heart of a radio receiver, it used to be the main component of telephone exchanges, and most electric motors use several of them. The reason for this is if a current is passed through the wire, the coil acts in exactly the same way as a bar magnet:



The main difference being that when the current is interrupted, the coil stops acting like a magnet, and that can be very useful indeed. If an iron rod is placed inside the coil and the current switched on, the rod gets pushed to one side. Many doorbells use this mechanism to produce a two-note chime. A 'relay' uses this method to close an electrical switch and many circuits use this to switch heavy loads (a thyristor can also be used for this and it has no moving parts).

A coil of wire has one of the most peculiar features of almost any electronic component. When the current through it is altered in any way, the coil opposes the change. Remember the circuit for a light-operated switch using a relay?:

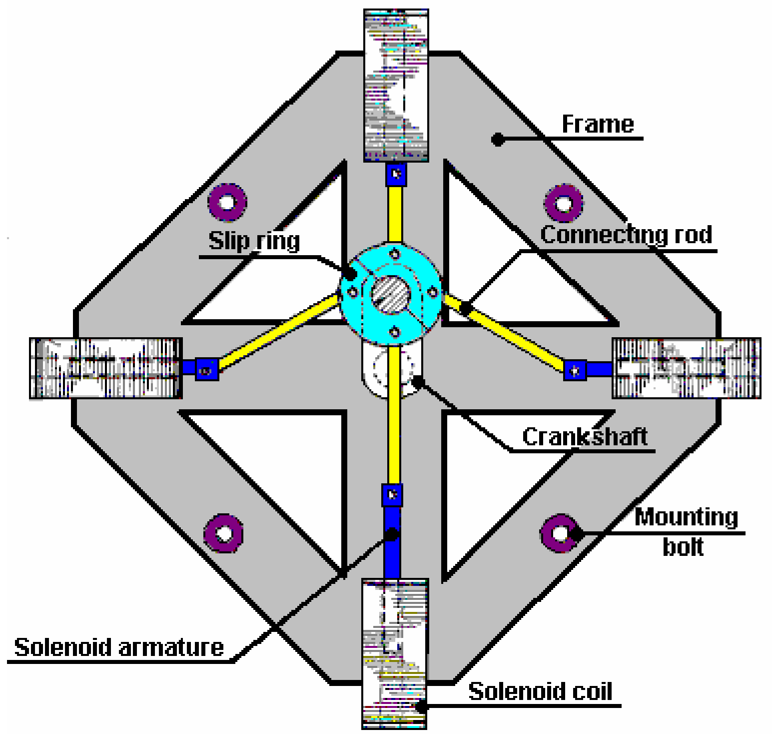


You will notice that the relay (which is mainly a coil of wire), has a diode across it. Neither the relay nor the diode were mentioned in any great detail at that time as they were not that relevant to the circuit being described. The diode is connected so that no current flows through it from the battery positive to the 'ground' line (the battery negative). On the surface, it looks as if it has no use in this circuit. In fact, it is a very important component which protects transistor TR3 from damage.

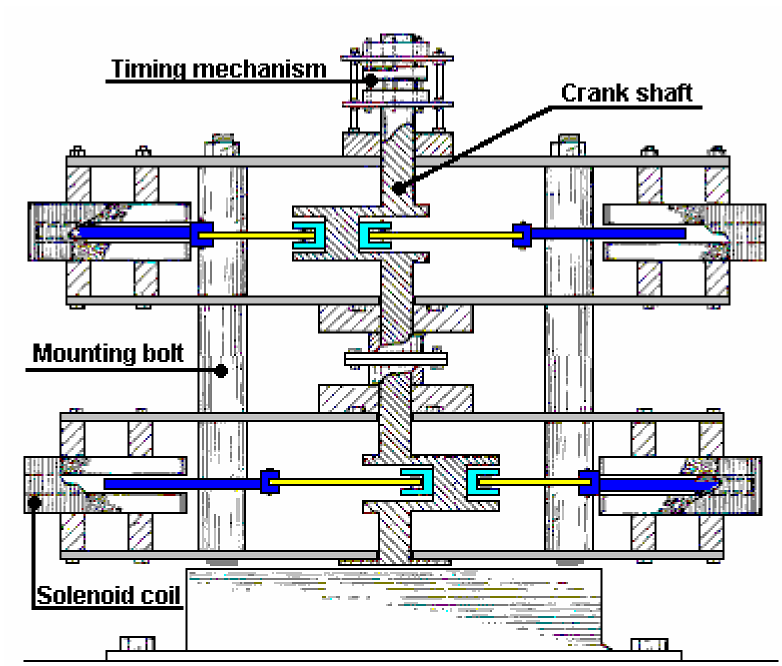
The relay coil carries current when transistor TR3 is on. The emitter of transistor TR3 is up at about +10 Volts. When TR3 switches off, it does so rapidly, pushing the relay connection from +10 Volts to 0 Volts. The relay coil reacts in a most peculiar way when this happens, and instead of the current through the relay coil just stopping, the voltage on the end of the coil connected to the emitter of TR3 keeps moving downwards. If there is no diode across the relay, the emitter voltage is forced to briefly overshoot the negative line of the circuit and gets dragged down many volts below the battery negative line. The collector of TR3 is wired to +12 Volts, so if the emitter gets dragged down to, say, -30 Volts, TR3 gets 42 Volts placed across it. If the transistor can only handle, say, 30 Volts, then it will be damaged by the 42 Volt peak.

The way in which coils operate is weird. But, knowing what is going to happen at the moment of switch-off, we deal with it by putting a diode across the coil of the relay. At switch-on, and when the relay is powered, the diode has no effect, displaying a very high resistance to current flow. At switch-off, when the relay voltage starts to plummet below the battery line, the diode effectively gets turned over into its conducting mode. When the voltage reaches 0.7 Volts below the battery negative line, the diode starts conducting and pins the voltage to that level until the voltage spike generated by the relay coil has dissipated. The more the coil tries to drag the voltage down, the harder the diode conducts, stifling the downward plunge. This restricts the voltage across transistor TR3 to 0.7 Volts more than the battery voltage and so protects it.

Solenoid coils can be very useful. Here is a design for a powerful electric motor patented by the American, Ben Teal, in June 1978 (US patent number 4,093,880). This is a very simple design which you can build for yourself if you want. Ben's original motor was built from wood and almost any convenient material can be used. This is the top view:



And this is the side view:



Ben has used eight solenoids to imitate the way that a car engine works. There is a crankshaft and connecting rods, as in any car engine. The connecting rods are connected to a slip-ring on the crankshaft and the solenoids are given a pulse of current at the appropriate moment to pull the crankshaft round. The crankshaft receives four pulls on every revolution. In the arrangement shown here, two solenoids pull at the same moment.

In the side view above, each layer has four solenoids and you can extend the crankshaft to have as many layers of four solenoids as you wish. The engine power increases with every layer added. Two layers should be quite adequate as it is a powerful motor with just two layers.

An interesting point is that as a solenoid pulse is terminated, its pull is briefly changed to a push due to the weird nature of coils. If the timing of the pulses is just right on this motor, that brief push can be used to increase the power of the motor instead of opposing the motor rotation. This feature is also used in the Adams motor described in the 'Free-Energy' section of this document.

The strength of the magnetic field produced by the solenoid is affected by the number of turns in the coil, the current flowing through the coil and the nature of what is inside the coil 'former' (the tube on which the coil is wound). In passing, there are several fancy ways of winding coils which can also have an effect, but here we will only talk about coils where the turns are wound side by side at right angles to the former.

1. Every turn wound on the coil, increases the magnetic field. The thicker the wire used, the greater the current which will flow in the coil for any voltage placed across the coil. Unfortunately, the thicker the wire, the more space each turn takes up, so the choice of wire is somewhat of a compromise.

2. The power supplied to the coil depends on the voltage placed across it. Watts = Volts x Amps so the greater the Volts, the greater the power supplied. But we also know from Ohm's Law that Ohms = Volts / Amps which can also be written as Ohms x Amps = Volts. The Ohms in this instance is fixed by the wire chosen and the number of turns, so if we double the Voltage then we double the current.

For example: Suppose the coil resistance is 1 ohm, the Voltage 1 Volt and the Current 1 Amp. Then the power in Watts is Volts x Amps or 1 x 1 which is 1 Watt.

Now, double the voltage to 2 Volts. The coil resistance is still 1 ohm so the Current is now 2 Amps. The power in Watts is Volts x Amps or 2 x 2 which is **4** Watts. Doubling the voltage has quadrupled the power.

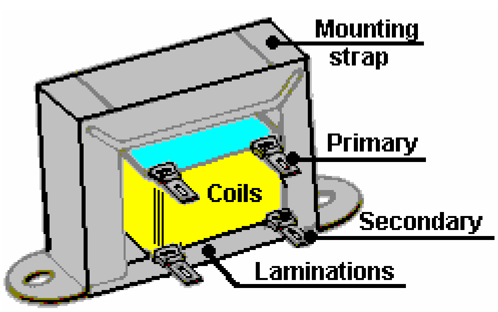
If the voltage is increased to 3 Volts. The coil resistance is still 1 ohm so the Current is now 3 Amps. The power in Watts is Volts x Amps or 3 x 3 which is **9** Watts. The power is Ohms x Amps squared, or Watts = Ohms x Amps x Amps. From this we see that the voltage applied to any coil or solenoid is critical to the power developed by the coil.

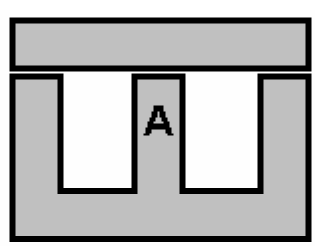
3. What the coil is wound on is also of considerable importance. If the coil is wound on a rod of soft iron covered with a layer of paper, then the magnetic effect is increased dramatically. If the rod ends are tapered like a flat screwdriver or filed down to a sharp point, then the magnetic lines of force cluster together when they leave the iron and the magnetic effect is increased further.

If the soft iron core is solid, some energy is lost by currents flowing round in the iron. These currents can be minimised by using thin slivers of metal (called 'laminations') which are insulated from each other. You see this most often in the construction of transformers, where you have two coils wound on a single core. As it is convenient for mass production, transformers are usually wound as two separate coils which are then placed on a figure-of-eight laminated core.

Transformers.

Transformers are used to alter the voltage of any alternating current power source. If the alteration increases the output voltage, then the transformer is called a 'step-up' transformer. If the output voltage is lower than the input voltage then it is called a 'step-down' transformer. If the voltages are the same, it is called an 'isolation' transformer. A common construction looks like this:





Laminations

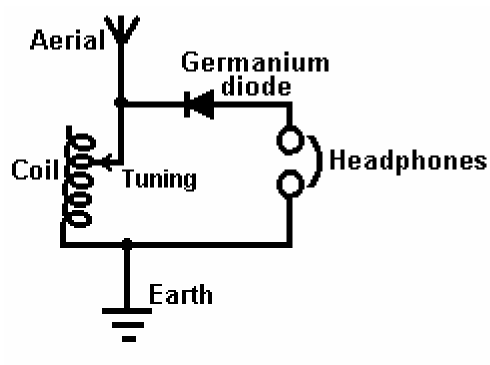
The Coil bobbin sits on the section of the laminations marked 'A' above. The coil is wound on its bobbin former, first one winding and then the second winding. The bobbin is then placed on the central part of the 'E' shaped laminations and then completely surrounded by the laminations when the crossbar is placed on the top. The mounting strap is used to hold the two sets of laminations together and provide mounting lugs for attaching the transformer to a chassis. There are typically, twenty laminations in each set and every lamination is insulated from the adjoining laminations.

If you want to change the voltage of a battery supply, it is possible to build an electronic circuit to generate an alternating voltage and then use a transformer to change that alternating voltage to whatever voltage you want. The most common form of this, is for generating mains voltage from a 12 Volt car battery, so that mains equipment can be run in remote locations, such as boats, caravans, etc. These circuits are called ‘inverters’ and they are very popular pieces of equipment. The voltage in the secondary coil of any transformer is determined by the ratio of the turns in the primary and secondary windings.

For example; if there is a 10 Volt alternating voltage available and you have a transformer which has 100 turns in the primary coil and 1000 turns in the secondary coil. If you connect the 10 Volts across the primary, there will be 100 Volts generated across the secondary coil.

Instead, if you connect the 10 Volts across the secondary coil, a voltage of 1 Volts will be generated across the primary winding. This is because there is a 10:1 ratio between the two windings. The Law of Conservation of Energy applies to transformers as it does to everything else. The power input to the primary winding will be the same as the power in the secondary winding minus the losses. The losses, in this case, will be a temperature rise of the whole transformer. If the current passed through the transformer is well below its rated capacity, then the losses will be small. The important point is that 10 Volts at 1 Amp into the primary winding will generate 100 Volts in the secondary, but at somewhat less than 0.1 Amps: Power Input is 10 Watts and Power Output is almost 10 Watts. The voltage has been raised to 100 Volts but the potential current draw has been reduced from 1 Amp to 0.1 Amps (100 mA).

In practice, the thickness of the wire used in the windings is very important. If the voltage to be placed across the winding is high, then the wire diameter will be small. Coil windings have fairly low resistances but this is not critical in circuits as coils operate in a peculiar way. Coils have AC ‘impedance’ in addition to their DC ‘resistance’. While Direct Current (from a battery, say) can flow quite easily through a coil with low resistance, Alternating Current may have a hard job getting through the coil due to its high ‘impedance’. Sometimes, coils are used to choke off any AC ripple (interference) coming along a DC power cable. When a coil is used for this purpose it is called a ‘choke’. Each coil has its own resonant frequency and at that frequency it is very difficult for AC to get through the coil. Crystal set radios work on that principle:



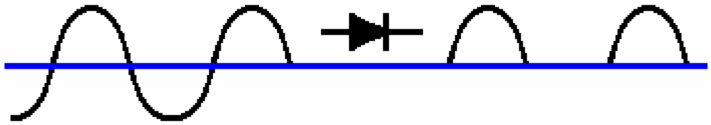
Crystal Set Radio

Here, the aerial picks up every radio station broadcasting in the area. These are all at different frequencies and they all head down the aerial wire, looking for the easiest path to the earth connection. Most of them run through the coil with no problem whatsoever. If the resonant frequency of the coil matches the frequency of one of the radio stations, then that radio signal (and **only** that signal) finds it very hard to get through the coil and looks for an easier path to earth. The next easiest path is through the diode and the headphones, so the signal goes that way. The diode blocks part of the signal which generates the sound of the radio broadcast in the headphones.

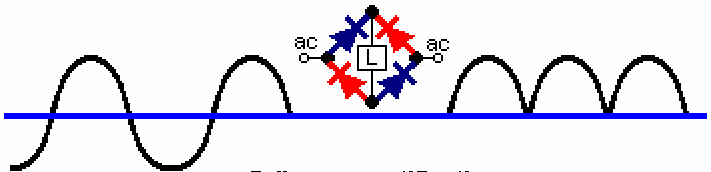
This system works very well indeed if there is a good radio signal. A germanium diode is used as the radio signal voltage is very small and a germanium diode operates on 0.2 Volts while a silicon diode needs 0.7 Volts to operate. That difference is significant at these very low voltages. The resonant frequency of the coil depends on the number of turns in the coil. In this design, the coil has a slider which allows the number of turns to be altered and so, different radio stations to be tuned in.

Rectification and Power Supplies.

We now have the question of how do we turn an alternating voltage into a constant 'direct' voltage. The crystal radio set operates by chopping off half of the alternating radio signal. If we were to do this to the output from a mains transformer with an output of say, 12 Volts AC, the result is not very satisfactory:



Half-wave rectification

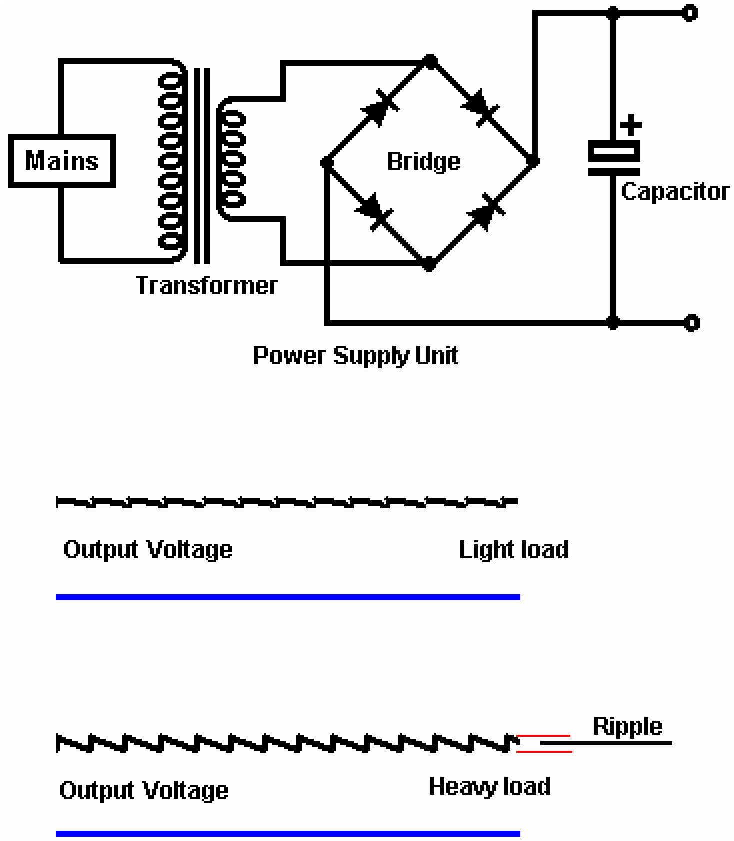


Full-wave rectification

Here, we have the situation shown in the upper diagram. The output consists of isolated pulses at 50 per second. You will notice that there is **no** output power for half of the time. The negative part of the waveform is blocked by the high resistance of the diode while the positive part of the waveform is allowed through by the low resistance of the 'forward-biased' diode. It should be remembered that the diode drops 0.7 Volts when conducting so the output of the half-wave rectified transformer will be 0.7 Volts lower than the transformer's actual output voltage.

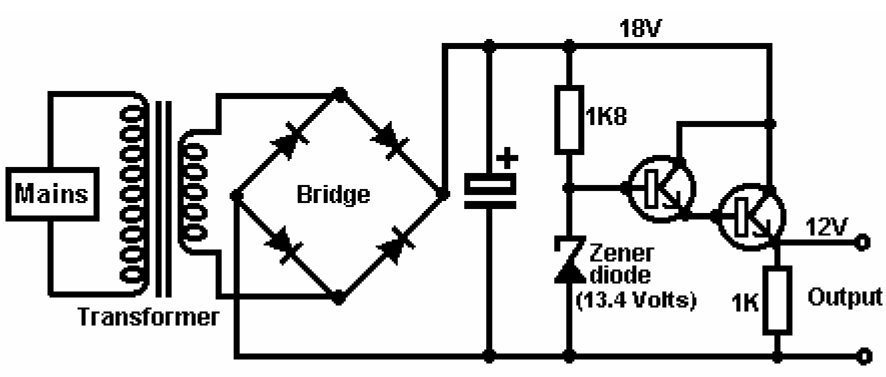
If four diodes are used instead of one, they can be arranged as shown in the lower diagram. This arrangement of diodes is called a 'bridge'. Here the positive part of the waveform flows through the upper blue diode, the load 'L' and on through the lower blue diode. The negative part flows through the left hand red diode, the load and then the right hand red diode. This gives a much better output waveform with twice the power available. The output voltage will be 1.4 Volts less than the transformer output voltage as there are two silicon diodes in the supply chain.

The output from even the full-wave rectifier is still unsatisfactory as there is a voltage drop to zero volts 100 times per second. Only a few devices operate well with a power supply like that, an incandescent bulb as used in a car can use this output, but then, it could use the original AC supply without any rectification. We need to improve the output by using a reservoir device to supply current during those moments when the voltage drops to zero. The device we need is a **Capacitor** which used to be called a 'condenser'. The circuit of a mains unit using a capacitor is shown here:



This produces a much better result as the capacitor stores some of the peak energy and gives it out when the voltage drops. If the load on the unit is light with not very much current taken from it, the output voltage is quite good. However, if the current drain is increased, the output voltage gets dragged down 100 times per second. This voltage variation is called 'ripple' and if the unit is supplying an audio system or a radio, the ripple may well be heard as an annoying hum. The larger the capacitor for any given current draw, the smaller the ripple.

To improve the situation, it is normal to insert an electronic control circuit to oppose the ripple:

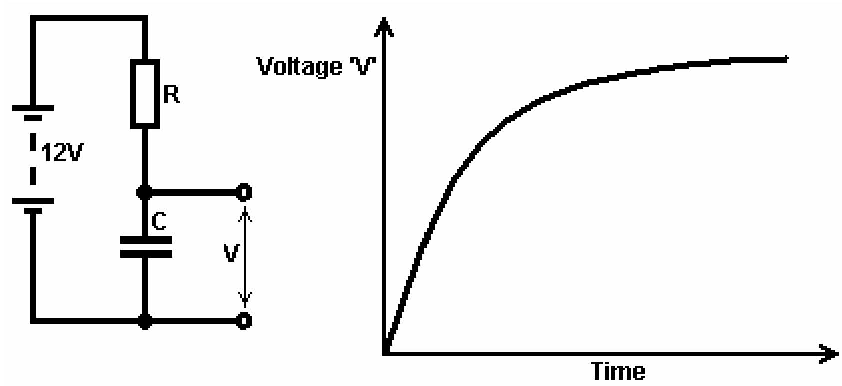


This circuit uses one new component, a new variety of diode called a 'Zener' diode. This device has an almost constant voltage drop across it when its current-blocking direction breaks down. The diode is designed to operate in this state to provide a reference voltage. The circuit merely uses a tiny current from the top of the zener diode to drive the Darlington pair emitter-follower transistors used to provide the output current.

With this circuit, when the output current is increased, the resistance of the transistor pair automatically reduces to provide more current without varying the output voltage. The 1K resistor is included to give the transistors a completed circuit if no external equipment is connected across the output terminals. The zener diode is chosen to give 1.4 Volts more than the required output voltage as the two transistors drop 1.4 Volts when conducting.

You should note that the output transistor is dropping 6 Volts at the full supply current. Watts = Volts x Amps so the power dissipated by the transistor may be quite high. It may well be necessary to mount the transistor on an aluminium plate called a ‘heat sink’ to keep it from overheating. Some power transistors, such as the 2N3055, do not have the case isolated from the active parts of the transistor. It is good practice to use a mica gasket between the transistor and the heat-sink as it conducts then heat without making an electrical connection to the metal heat-sink.

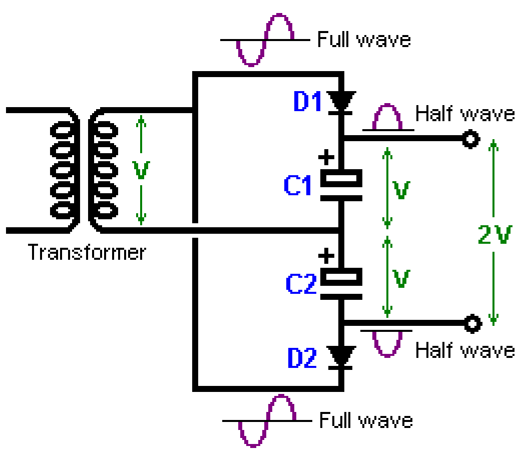
A capacitor, being an electrical reservoir, can be used as part of a timer circuit. If the current flow into it is restricted by passing it through a resistor. The length of time between starting the flow on an empty capacitor, and the voltage across the capacitor reaching some chosen level, will be constant for a high-quality capacitor.



As the voltage increase tails off, it becomes more difficult to measure the difference accurately, so if the capacitor is to be used for generating a time interval, it is normal to use the early part of the graph area where the line is fairly straight and rising fast.

The Voltage Doubler.

It is possible to increase the output voltage of a transformer although this does reduce its ability to supply current at that voltage. The way that this is done is to feed the positive cycles into one storage capacitor and the negative cycles into a second reservoir capacitor. This may sound a little complicated, but in reality, it isn't. A circuit for doing this is shown here:

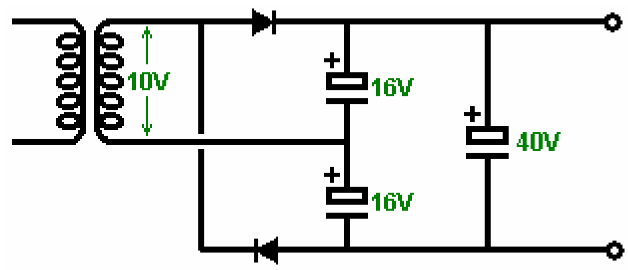


With this circuit, the transformer output is some voltage, say "V" volts of AC current. This output waveform is fed to capacitor "**C1**" through diode "**D1**" which lops off the negative part of the cycle. This produces a series of positive half-cycles which charge up capacitor "**C1**" with a positive voltage of "V".

The other half of the output is fed to capacitor "**C2**" through diode "**D2**" which cuts off the positive part of the cycle, causing capacitor "**C2**" to develop a voltage of -V across it. As the two capacitors are 'in series' and not placed across each other, their voltages add up and produce twice the transformer output voltage.

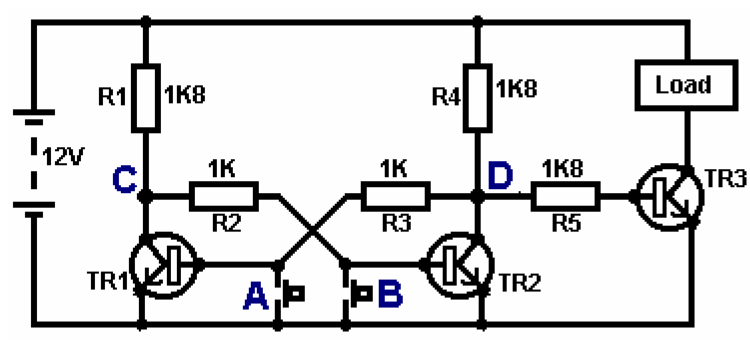
A word of warning here. The transformer is producing an AC waveform and these are marked with the **average** voltage of the waveform, which is usually a sine wave. The peak voltage of a sinewave is 41% greater than this, so if your transformer has an AC output of 10 volts, then the peaks fed to the capacitors will be about 14.1 volts. If there is no current draw from the capacitors (that is, with the load switched off), then each capacitor will charge to this 14.1 volts and the overall output voltage will be 28.2 volts and **not** the 20 volts which you might expect. You need to understand that as this is only a half-wave supply, there will be considerable ripple on the output voltage if the current draw is high.

Using one additional smoothing capacitor and paying attention to the voltage ratings of the capacitors, the 28 volts supply circuit might be like this:



Multivibrators: The Bistable.

The number of electronic circuits which can be built with basic components such as resistors, capacitors, transistors, coils, etc. is limited only by your imagination and needs. Here is a circuit where two transistors operate as a pair:



Bistable multivibrator

This circuit has two stable states and so it is called a “bi” “stable” or “bistable” circuit. It is important to understand the operation of this simple and useful circuit.

If press-button switch ‘**A**’ is pressed, it short-circuits the base/emitter junction of transistor TR1. This prevents any current flowing in the base/emitter junction and so switches TR1 hard off. This makes the voltage at point ‘**C**’ rise as high as it can. This leaves transistor TR2 powered by R1 and R2 which have 11.3 Volts across them and switches TR2 hard on.

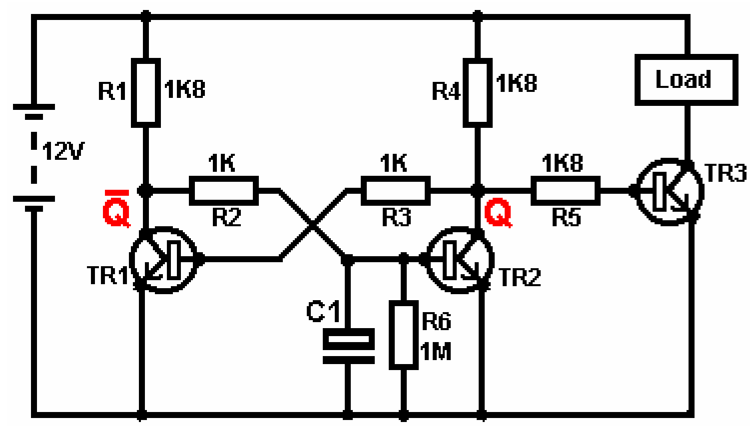
This pulls point ‘**D**’ down to about 0.1 Volts. This happens in less than a millionth of a second. When the press-button switch ‘**A**’ is released, transistor TR1 does not switch on again because its base current flows through resistor R3 which is connected to point ‘**D**’ which is far, far below the 0.7 Volts needed to make TR1 start conducting.

The result is that when press-button ‘**A**’ is pressed, transistor TR2 switches on and stays on even when press-button ‘**A**’ is released. This switches transistor TR3 off and starves the Load of current. This is the first ‘stable state’.

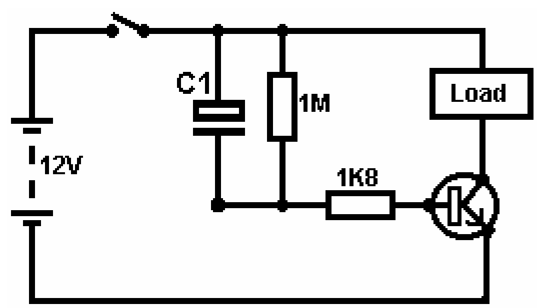
The same thing happens when press-button ‘**B**’ is pressed. This forces transistor TR2 into its ‘off’ state, raising point ‘**D**’ to a high voltage, switching transistor TR3 hard on, powering the Load and holding transistor TR1 hard off. This is the second of the two ‘stable states’.

In effect, this circuit ‘remembers’ which press-button was pressed last, so millions of these circuits are used in computers as Random Access Memory (‘RAM’). The voltage at point ‘**C**’ is the inverse of the voltage at point ‘**D**’, so if ‘**D**’ goes high then ‘**C**’ goes low and if ‘**D**’ goes low, then ‘**C**’ goes high. In passing, the output at ‘**D**’ is often called ‘**Q**’ and the output at '**C**' is called '**Q-bar**' which is shown as the letter Q with a horizontal line drawn above it. This is shown on the next circuit diagram.

A minor variation of this circuit allows a load to be energised when the circuit is powered up:



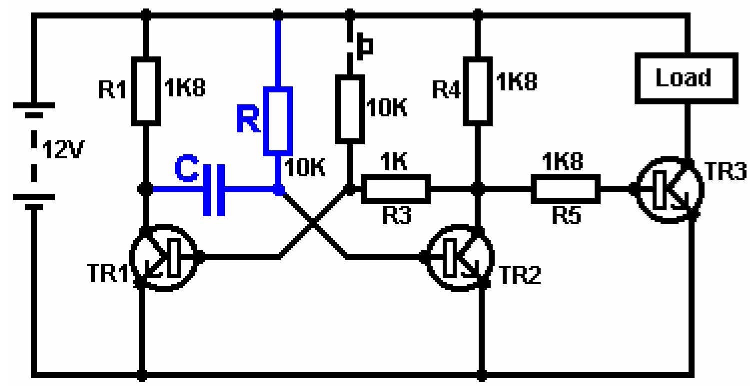
When powered down, the capacitor 'C1' in this circuit is fully discharged through resistor 'R6'. When the 12 Volts supply is connected to the circuit, capacitor C1 does not charge instantly and so holds the base of TR2 down below 0.7 Volts for much longer than it takes for transistor TR1 to switch on (which, in turn, holds TR2 hard off). Mind you, if it is not necessary to have the Load held powered on indefinitely, then an even more simple circuit can do this:



Here, when the switch is closed, both sides of the capacitor C1 are at +12 Volts and this causes the 1K8 resistor to conduct heavily, driving the transistor and powering the load. The capacitor charges rapidly through the transistor and reaches the point at which it can no longer keep the transistor switched on. When the battery is switched off, the 1M resistor discharges the capacitor, ready for the next time the battery is connected.

the Monostable Multivibrator.

The monostable has one stable state and one unstable state. It can be flipped out of its stable state but it will 'flop' back into its stable state. For that reason, it is also known as a 'flip-flop' circuit. It is similar to a bistable circuit, but one of the cross-link resistors has been replaced by a capacitor which can pass current like a resistor, but only for a limited amount of time, after which, the capacitor becomes fully charged and the current flow stops, causing the 'flop' back to the stable state once more.



In this circuit, the '**R**' resistor and the '**C**' capacitor values determine how long the monostable will be in its unstable state. The circuit operates like this:

1. In the stable state, transistor TR1 is off. Its collector voltage is high, pushing the left hand side of capacitor '**C**' to near +12 Volts. As the right hand side of capacitor '**C**' is connected to the base of TR2 which is at 0.7 Volts, the capacitor gets charged to about 11.3 Volts.

2. The press-button switch is operated briefly. This feeds current through its 10K resistor to the base of transistor TR1, switching it hard on. This drops the collector voltage of TR1 to near 0 Volts, taking the left hand side of the capacitor with it.

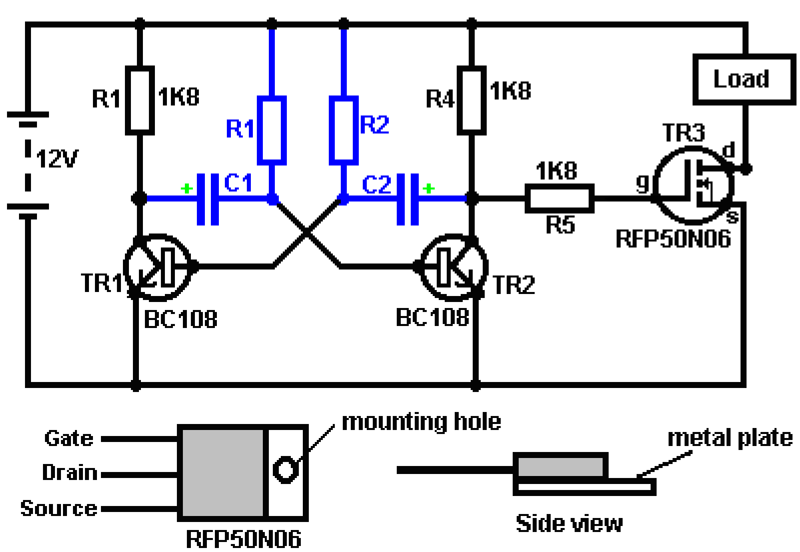
3. As the voltage across a capacitor can't change instantly, the right hand side of the capacitor drives the base of transistor TR2 down below 0.7 Volts, causing TR2 to switch off.

4. The circuit can't hold TR2 in its 'off' state for ever. The resistor '**R**' feeds current into the capacitor, forcing the voltage at the base of TR2 steadily upwards until the voltage reaches 0.7 Volts and transistor TR2 switches on again, forcing TR1 off again (provided that the press-button switch has been released). This is the stable state again. If the press-button switch is held on, then both transistors will be on and the output voltage will still be low. Another output pulse will not be generated until the press-button is let up and pressed again.

This circuit could be used to switch a microwave oven on for any chosen number of seconds, create a delay on your home-built burglar alarm, to give you time to switch it off after walking through your front door, operate a solenoid valve to feed a pre-determined quantity of beverage into a bottle on a production line, or whatever...

The Astable Multivibrator.

The astable circuit is the monostable with a second capacitor added so that neither state is stable. This results in the circuit flopping backwards and forwards continuously:



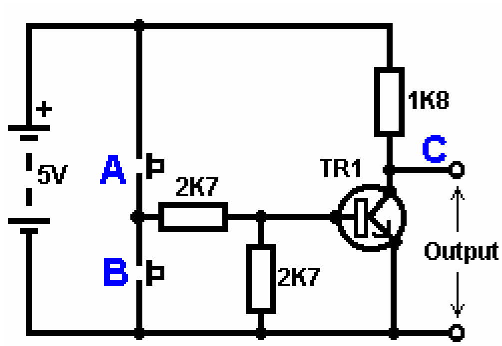
The rate of switching is controlled by the R1/C1 and R2/C2 combinations. The load's ON time to its OFF time is called the 'mark-space' ratio, where the ON period is the 'mark' and the OFF period is the 'space'. If you choose to use electrolytic capacitors which have their own polarity, then the +ve end of each capacitor is connected to the transistor collector.

While it is good to understand how these multivibrator circuits operate and can be built, nowadays there are pre-built circuits encased in a single package which you are much more likely to choose to use. These are called Integrated Circuits or 'ICs' for short. We will be discussing these shortly. Before we do, notice that in the circuit above, transistor TR3 has been changed to a new variety called a **F**ield **E**ffect **T**ransistor ('FET'). This type of transistor is newer than the 'bipolar' transistors shown in the earlier circuits. FETs come in two varieties: 'n-channel' which are like NPN transistors and 'p-channel' which are like PNP transistors.

FETs are more difficult to make but have now reached a level of cost and reliability which makes them very useful indeed. They require almost no base current (called 'gate' current with this type of transistor) which means that they have almost no effect on any circuit to which they are attached. Also, many of them can handle large currents and boast major power handling capabilities. Because of this, it is usual to see them packaged with a metal plate mounting, ready to be bolted to an aluminium heat-sink plate to help dissipate the heat generated by the large amount of power flowing through them. The 'RFP50N06' shown above can handle up to 50 Volts and carry up to 60 Amps, which is serious power handling.

Inverters and Truth Tables.

Consider the following circuit:

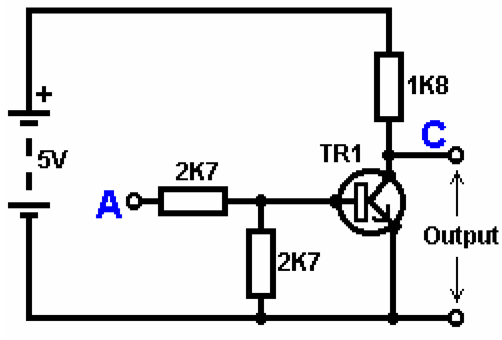


If neither of the press-button switches are operated, the transistor has no base/emitter current flow and so it is off. This places the collector voltage at '**C**' near the positive rail (+5 Volts).

If press-button switch '**A**' is operated, the base voltage tries to rise to half of the battery voltage but doesn't make it because the transistor base pins it down to 0.7 Volts. This feeds base current to the transistor, switching it hard on and causing the output at '**C**' to drop to nearly 0 Volts.

If press-button switch '**B**' is operated (don't do this when switch '**A**' is closed or you will get a very high 'short-circuit' current flowing directly through the two switches) it has no effect on the output voltage which will stay high.

If we re-draw the circuit like this:



TRUTH TABLE	
Input A	**Output C**
0	1
1	0

Key:
0 = Less than 0.5 Volts
1 = More than 3.5 Volts

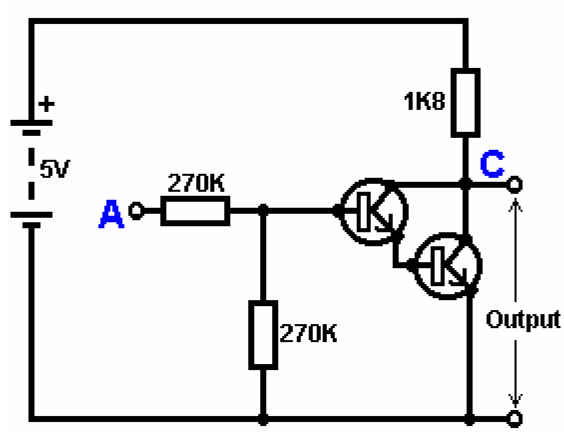
We can see that if the voltage at the input 'A' is taken high, then the output voltage at 'C' will be low. If the voltage at the input 'A' is taken low, then the output voltage at 'C' will be high. A circuit which does this is called an 'Inverter' because it 'inverts' (or 'turns upside down') the input voltage.

We can summarise this operation in a table. Personally, I would call the table an 'Input/Output' table, but for no obvious reason, the standard name is a 'Truth' table. The purpose of this table is to list all of the possible inputs and show the corresponding output for each input.

Another standard, is to substitute '1' for 'High Voltage' and '0' for 'Low Voltage'. You will notice that many items of electrical and electronic equipment have these symbols on the ON / OFF switch. In computer circuitry (hah! you didn't notice that we had moved to computer circuits, did you?), the '0' represents any voltage below 0.5 Volts and the '1' represents any voltage above 3.5 Volts. Many, if not most, computers operate their logic circuits on 5 Volts. This Inverter circuit is a 'logic' circuit.

A criticism of the above circuit is that its input resistance or 'impedance' is not particularly high, and its output impedance is not particularly low. We would like our logic circuits to be able to operate the inputs of eight other logic circuits. The jargon for this is that our circuit should have a 'fan-out' of eight.

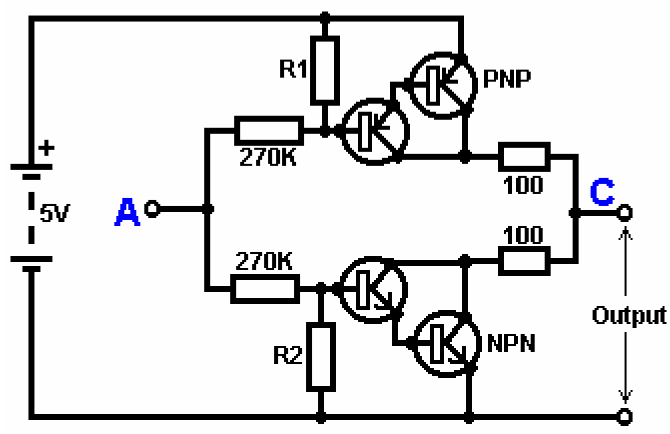
Let's go for a simple modification which will improve the situation:

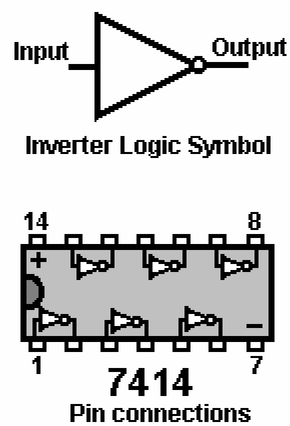


Here, The input impedance has been increased by a factor of 100 by using a Darlington pair of transistors which need far less base current, and so can have a much higher input resistor.

Unfortunately, the output impedance is still rather high when the transistors are in their OFF state as any current taken from the positive line has to flow through the 1K8 (1800 ohm) resistor. But we need this resistor for when the transistors are in their ON state. We really need to change the 1K8 resistor for some device which has a high resistance at some times and a low resistance at other times. You probably have not heard of these devices, but they are called 'transistors'.

There are several ways to do this. We might choose to use PNP transistors (we normally use NPN types) and connect these in place of the 1K8 resistor. Perhaps we might use a circuit like this:



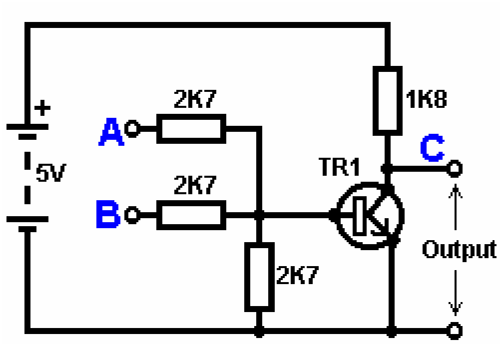


This circuit is starting to look complicated and I don't like complicated circuits. It is not as bad as it looks. The NPN transistors at the bottom are almost the same as the previous circuit. The only difference is that the collector load is now two 100 ohm resistors plus the resistance of the two transistors. If the PNP transistors are OFF when the NPN transistors are ON, then the circuit loading on the NPN transistors will be negligible and the whole of the NPN transistors output will be available for driving external circuits through the lower 100 ohm resistor (a large 'fan-out' for the '0' logic state). To make sure that the PNP transistors are hard off before the NPN transistors start to switch on, the resistor 'R1' needs to be selected carefully.

The PNP transistors are an exact mirror image of the NPN side, so resistor R2 needs to be selected carefully to ensure that the NPN transistors are switched hard OFF before the PNP transistors start to switch ON.

You need not concern yourself unduly with that circuit, because you will almost certainly use an **I**ntegrated **C**ircuit rather than building your own circuit from 'discrete' components. An Integrated Circuit containing six complete inverters is the 7414 which is shown above. This comes in a small black case with two rows of 7 pins which make it look a bit like a caterpillar. Because there are two row of pins, the packaging is called "Dual In-Line" or "DIL" for short.

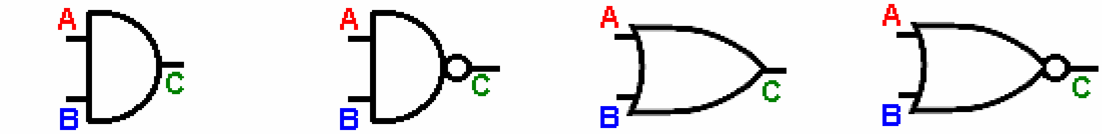
Now, consider the following circuit:



TRUTH TABLE		
Input A	Input B	Output C
0	0	1
0	1	0
1	0	0
1	1	0

0 = Low voltage 1 = High Voltage

This circuit operates the same way as the Inverter circuit, except that it has two inputs ('**A**' and '**B**'). The output voltage at '**C**' will be low if either, '**A**' **OR** '**B**' or both, of the inputs is high. The only time that the output is high, is when both Input '**A**' and Input '**B**' are low. Consequently, the circuit is called an "**OR**" gate. Strictly speaking, because the output voltage goes Down when the input voltage goes Up, it is called a "**Not OR**" gate, which gets shortened to a "**NOR**" gate. In this context, the word "not" means "inverted". If you fed the output '**C**' into an inverter circuit, the resulting circuit would be a genuine "**OR**" gate. The digital circuit symbols for an **AND** gate, a **NAND** gate, an **OR** gate and a **NOR** gate are:



AND Gate

A	0	1	0	1
B	0	0	1	1
C	0	0	0	1

NAND Gate

A	0	1	0	1
B	0	0	1	1
C	1	1	1	0

OR Gate

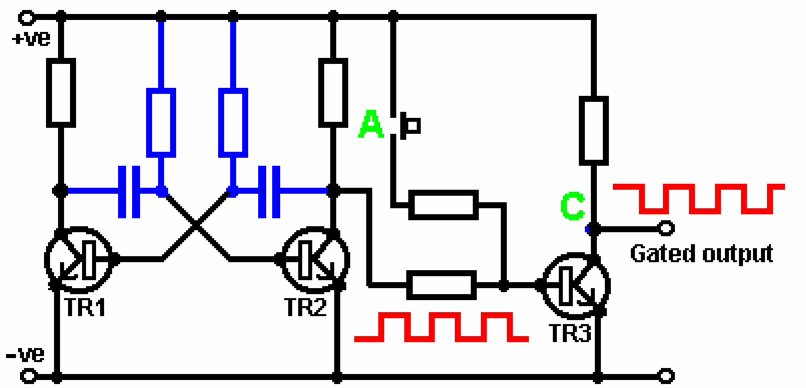
A	0	1	0	1
B	0	0	1	1
C	0	1	1	1

NOR Gate

A	0	1	0	1
B	0	0	1	1
C	1	0	0	0

Gating.

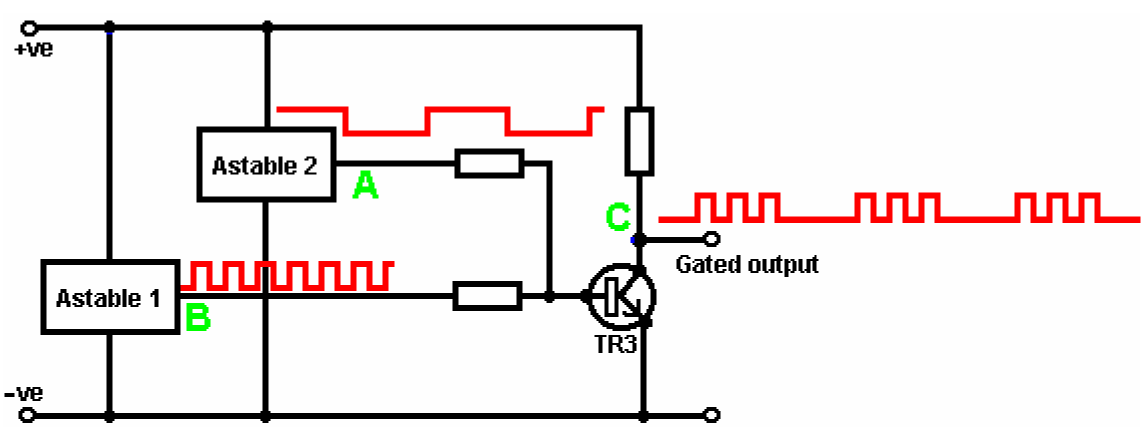
These common chips are usually supplied with 2, 4 or 8 inputs. So, why is it called a "Gate" - isn't it just a double inverter? Well, yes, it **is** a double inverter, but a double inverter acts as a gate which can pass or block an electronic signal. Consider this circuit:



Here, transistors 'TR1' and 'TR2' are connected to form an astable (multivibrator). The astable runs freely, producing the square wave voltage pattern shown in red. Transistor 'TR3' passes this voltage signal on. TR3 inverts the square wave, but this has no practical effect, the output being the same frequency square wave as the signal taken from the collector of TR2.

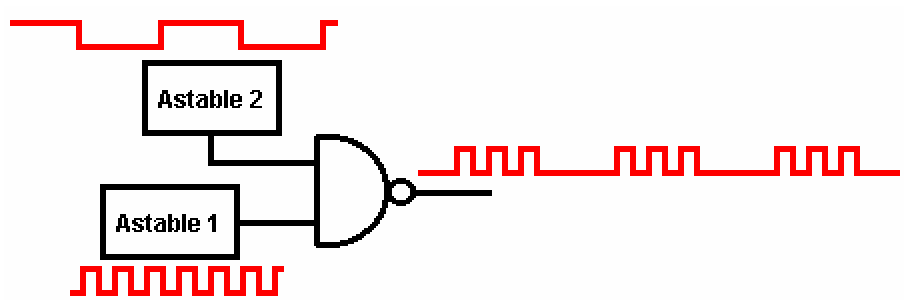
If the press-button switch at point '**A**' is operated, a current is fed to the base of TR3 which holds it hard on. The voltage at point '**C**' drops to zero and stays there. The square wave signal coming from the collector of TR2 is blocked and does not reach the output point '**C**'. It is as if a physical 'gate' has been closed, blocking the signal from reaching point '**C**'. As long as the voltage at point '**A**' is low, the gate is open. If the voltage at point '**A**' goes high, the gate is closed and the output is blocked.

There is no need for a manual switch at point '**A**'. Any electronic switching circuit will do:



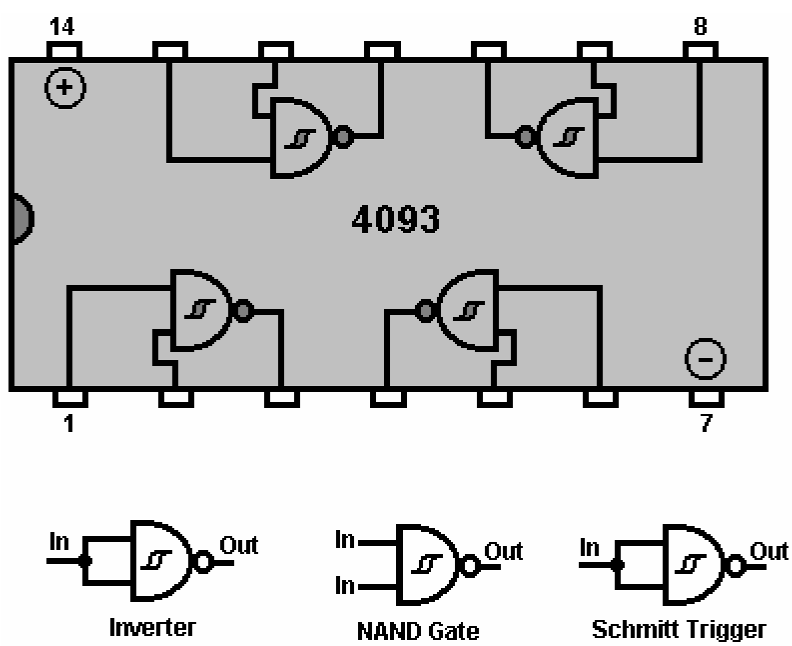
Here, a slow-running astable is substituted for the manual switch. When the output voltage of 'Astable 2' goes high, it switches the gate transistor 'TR3', holding it hard on and blocking the square-wave signal from 'Astable 1'. When the output voltage of 'Astable 2' goes low, it frees transistor 'TR3' and it then passes the 'Astable 1' signal through again. The resulting gated waveform is shown in red at point '**C**' and it is bursts of signal, controlled by the running rate of 'Astable 2'. This is the sort of waveform which Stan Meyer found very effective in splitting water into Hydrogen and Oxygen (see Chapter 10).

This circuit could also be drawn as:



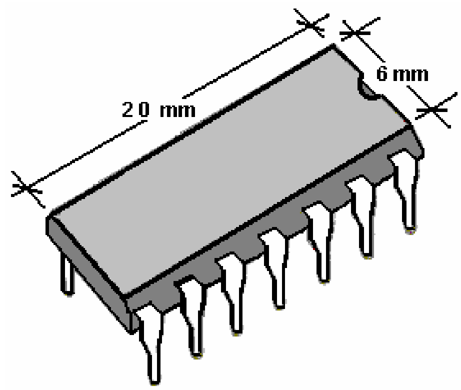
The small circle on the output side of logic devices is to show that they are inverting circuits, in other words, when the input goes up, the output goes down. The two logic devices we have encountered so far have had this circle: the Inverter and the NAND gate.

If you wish, you can use a NAND gate chip which has the circuitry also built as a Schmitt trigger, which as you will recall, has a fast-switching output even with a slowly moving input. With a chip like that, you can get three different functions from the one device:

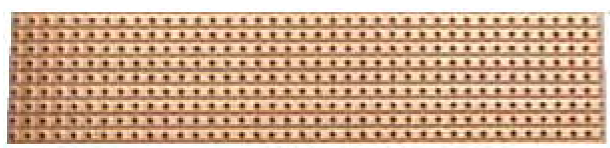


If the two inputs of a NAND gate are connected together, then the output will always be the opposite of the input, i.e. the gate acts as an inverter. This arrangement also works as a Schmitt Trigger due to the way the NAND gate circuitry is built. There are several packages built with this type of circuitry, the one shown here is the "74132" chip which contains four "dual-input" NAND gates. Gates can have almost any number of inputs but it is rare to need more than two in any given circuit. Another chip with identical pin connections is the **4011** chip (which is not a Schmitt circuit). This 'quad dual-input' NAND gate package uses a construction method called "CMOS" which is very easily damaged by static electricity until actually connected into a circuit. CMOS chips can use a wide range of voltages and take very little current. They are cheap and very popular

The number of devices built into an Integrated Circuit is usually limited by the number of pins in the package and one pin is needed for one connection to 'the outside world'. Packages are made with 6 pins (typically for opto-isolators), 8 pins (many general circuits), 14 pins (many general circuits, mostly computer logic circuits), 16 pins (ditto, but not as common) and then a jump to large numbers of pins for Large Scale devices such as microprocessors, memory chips, etc. The standard IC package is small:



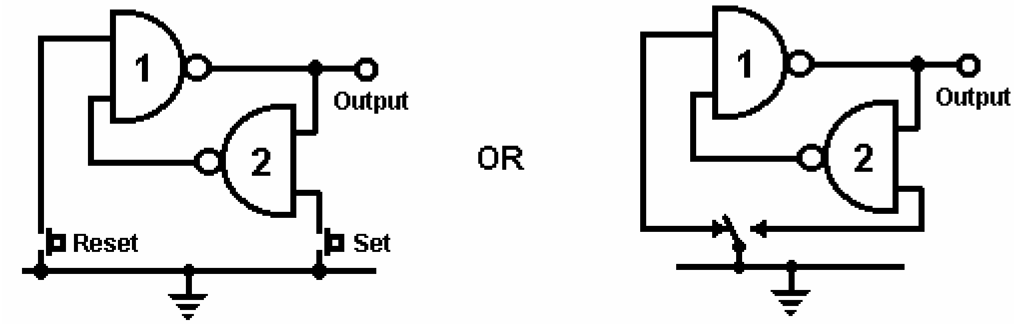
Prototype circuits are often built on 'strip board' which is a stiff board with strips of copper running along one face, and punched with a matrix of holes. The strips are used to make the electrical connections and are broken where necessary. This strip board is usually called "Veroboard":



Nowadays, the strip board holes are spaced 2.5 mm (1/10") apart which means that the gaps between the copper strips is very small indeed. I personally, find it quite difficult to make good solder joints on the strips without the solder bridging between two adjacent strips. Probably, a smaller soldering iron is needed. I need to use an 8x magnifying glass to be sure that no solder bridging remains in place before a new circuit is powered up for the first time. Small fingers and good eyesight are a decided advantage for circuit board construction. The narrow spacing of the holes is so that the standard IC DIL package will fit directly on the board.

Circuits built using computer circuitry, can experience problems with mechanical switches. An ordinary light switch turns the light on and off. You switch it on and the light comes on. You switch it off and the light goes off. The reason it works so well is that the light bulb takes maybe, a tenth of a second to come on. Computer circuits can switch on and off 100,000 times in that tenth of a second, so some circuits will not work reliably with a mechanical switch. This is because the switch contact bounces when it closes. It may bounce once, twice or several times depending on how the switch is operated. If the switch is being used as an input to a counting circuit, the circuit may count 1, 2 or several switch inputs for one operation of the switch. It is normal to "de-bounce" any mechanical switch. This could be done using a couple of NAND gates connected like this:

The NAND Latch.



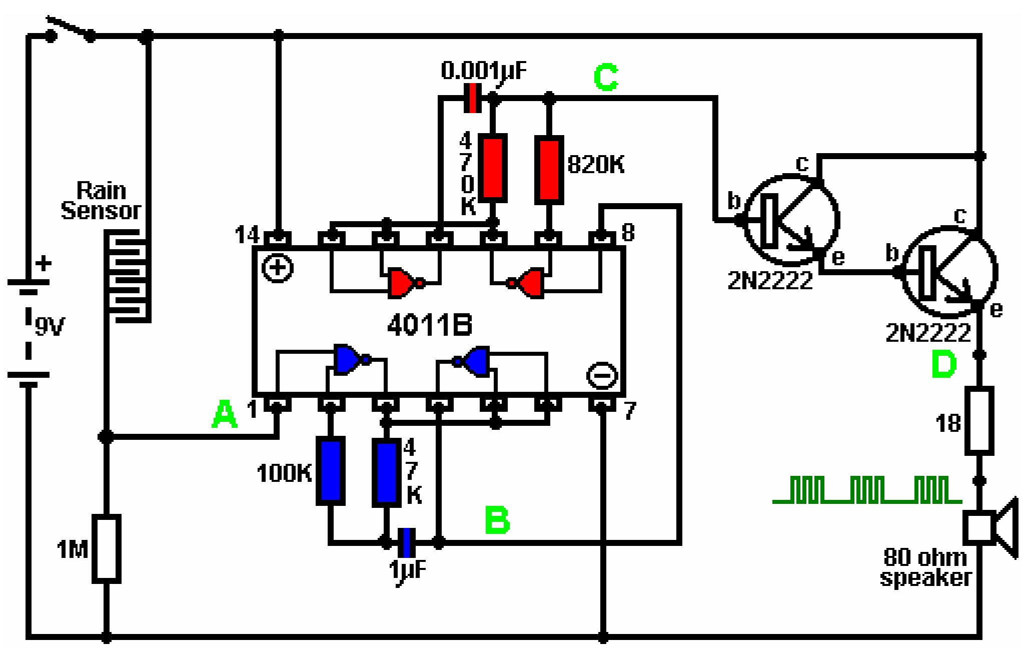
Here, the mechanical switch is buffered by a ‘latch’. When the ‘Set’ switch is operated, the output goes low. The unconnected input of gate ‘1’ acts as if it has a High voltage on it (due to the way the NAND gate circuit was built). The other input is held low by the output of gate ‘2’. This pushes the output of gate ‘1’ high, which in turn, holds the output of gate ‘2’ low. This is the first stable state.

When the ‘Set’ switch is operated, the output of gate ‘2’ is driven high. Now, both inputs of gate ‘1’ are high which causes its output to go low. This in turn, drives one input of gate ‘2’ low, which holds the output of gate ‘2’ high. This is the second stable state.

To summarise: pressing the ‘Set’ switch any number of times, causes the output to go low, once and only once. The output will stay low until the ‘Reset’ switch is operated once, twice or any number of times, at which point the output will go high and stay there.

This circuit uses just half of one cheap NAND gate chip to create a bistable multivibrator which is physically very small and light.

Gate Circuits.
NAND Gates can be used as the heart of many electronic circuits apart from the logic circuits for which the package was designed. Here is a NAND gate version of the rain alarm described earlier. The ‘4011B’ chip is a CMOS device which has a very high input impedance and can operate at convenient battery voltages (3 to 15 Volts):



This circuit is comprised of a rain sensor, two astable multivibrators and a power-driver feeding a loudspeaker:

1. The rain sensor is a wired-up strip board or similar grid of interlaced conductors, forming a voltage-divider across the battery rails.

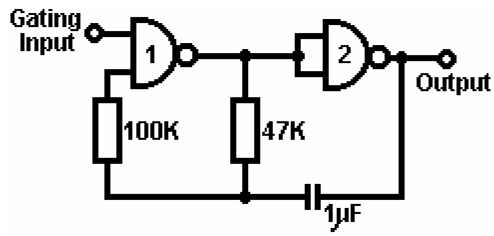
2. The output voltage from this, at point '**A**' in the circuit diagram, is normally low as the strip board is open-circuit when dry. This holds the first NAND gate locked in the OFF state, preventing the first astable from oscillating. This first astable is colour-coded blue in the diagram. Its frequency (the pitch of the note it produces) is governed by the values of the 47K resistor and the 1 microfarad capacitor. Reducing the value of either of these will raise the frequency (note pitch). If rain falls on the sensor, the voltage at point '**A**' goes high letting the astable run freely. If the voltage at '**A**' does not rise sufficiently when it rains, increase the value of the 1M resistor.

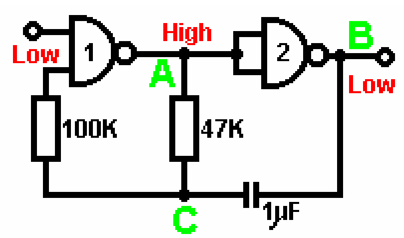
3. The output of the first astable is a low voltage when the sensor is dry. It is taken from point '**B**' and passed to the gating input of the second astable, holding it in its OFF state. The speed of the second astable is controlled by the value of the 470K resistor and the 0.001 microfarad capacitor. Reducing the value of either of these will raise the pitch of the note produced by the astable. The rate at which this astable operates is very much higher than the first astable.

When it rains, the voltage at point '**A**' rises, letting the first astable oscillate. As it does so, it turns the second astable on and off in a steady rhythmic pattern. This feeds repeated bursts of high speed oscillations from the second astable to point '**C**' in the diagram.

4. The Darlington-pair emitter-follower transistors cause the voltage at point '**D**' to follow the voltage pattern at point '**C**' (but 1.4 Volts lower voltage due to the 0.7 Volts base/emitter voltage drop for each transistor). The high gain of the two transistors ensures that the output of the second oscillator is not loaded unduly. These power-driver transistors place the output voltage across an eighty ohm loudspeaker, padded with a resistor to raise the overall resistance of the combination. The voltage pattern produced is shown at point '**D**' and is an attention-grabbing sound.

So, why does this circuit oscillate?:

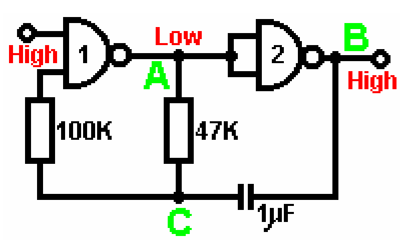




The circuit will not oscillate if the gating input is low, so assume it to be high. Take the moment when the output of gate 2 is low. For this to happen, the inputs of gate 2 have to be high. As the output of gate 1 is wired directly to the inputs of gate 2, it must be high, and for that to be true, at least one of its inputs must be low. This situation is shown on the right.

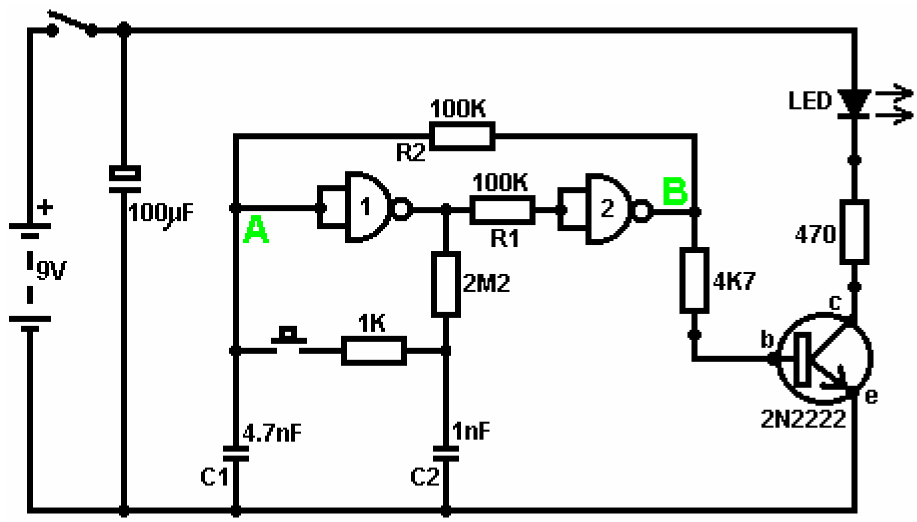
There is now a full voltage drop between point '**A**' and point '**B**'. The 47K resistor and the capacitor are in series across this voltage drop, so the capacitor starts to charge up, progressively raising the voltage at point '**C**'. The lower the value of the resistor, the faster the voltage rises. The larger the value of the capacitor, the slower the voltage rises.

When the voltage at point '**C**' rises sufficiently, the 100K resistor raises the input voltage of gate 1 far enough to cause it to change state. This creates the following situation:



Now, the voltage across '**A**' to '**B**' is reversed and the voltage at point '**C**' starts to fall, its rate governed by the size of the 47K resistor and the 1 microfarad capacitor. When the voltage at point '**C**' falls low enough, it takes the input of gate 1 low enough (via the 100K resistor) to cause gate 1 to switch state again. This takes the circuit to the initial state discussed. This is why the circuit oscillates continuously until the gating input of gate 1 is taken low to block the oscillation.

Now, here is a NAND gate circuit for a sequential on/off switch:

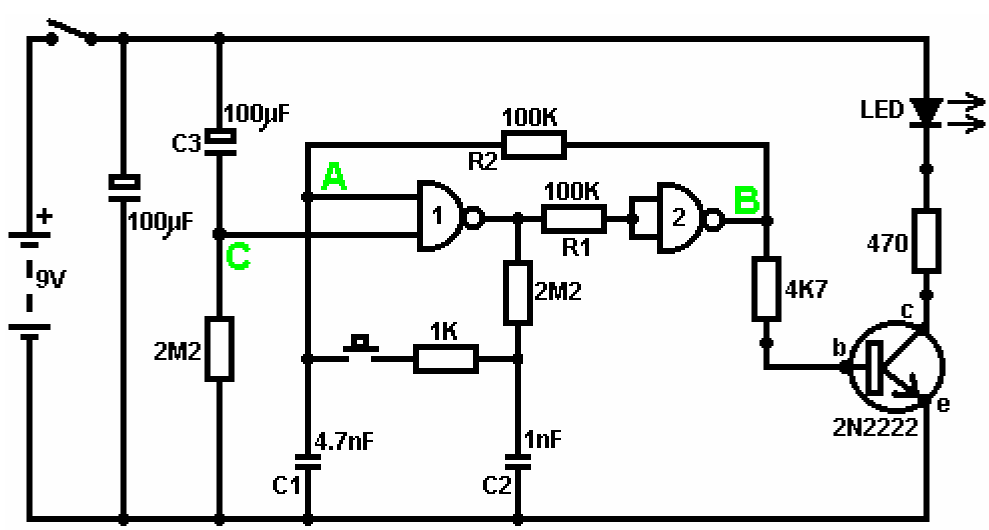


This circuit turns the Light Emitting Diode on and off repeatedly with each operation of the press-button switch. When the on/off switch is closed, capacitor 'C1' holds the voltage at point '**A**' low. This drives the output of gate 1 high, which moves the inputs of gate 2 high via the 100K resistor 'R1'. This drives the voltage at point '**B**' low, turning the transistor off, which makes the LED stay in its off state. The low voltage at point '**B**' is fed back via the 100K resistor 'R2' to point '**A**', keeping it low. This is the first stable state.

As the output of gate 1 is high, capacitor 'C2' charges up to that voltage via the 2M2 resistor. If the press-button switch is operated briefly, the high voltage of 'C2' raises the voltage of point '**A**', causing gate 1 to change state, and consequently, gate 2 to change state also. Again, the high voltage at point '**B**' is fed back to point '**A**' via the 100K resistor 'R2', keeping it high, maintaining the situation. This is the second stable state. In this state, point '**B**' has a high voltage and this feeds the base of the transistor via the 4.7K resistor, turning it on and lighting the LED.

In this second state, the output of gate 1 is low, so capacitor 'C2' discharges rapidly to a low voltage. If the press-button switch is operated again, the low voltage of 'C2' drives point '**A**' low again, causing the circuit to revert to its original stable state.

We could, if we wished, modify the circuit so that it would operate for three or four minutes after switch-on but then stop operating until the circuit was turned off and on again. This is accomplished by gating one of the gates instead of just using both as inverters. If we gated the second gate, then the LED would be left permanently on, so we will modify the first gate circuit:



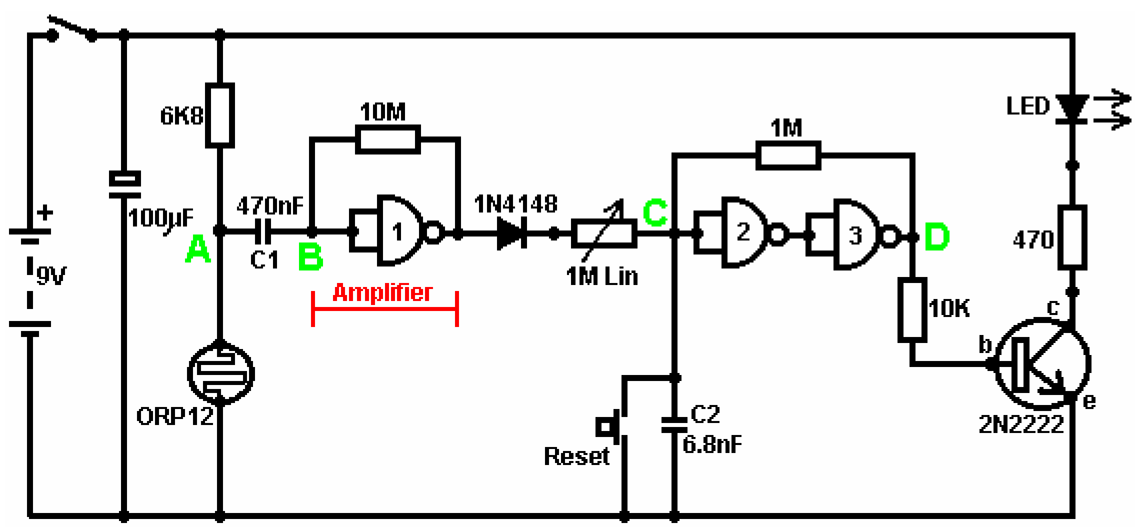
This circuit operates exactly the same way as the previous circuit if, and only if, the voltage at point ‘**C**’ is high. With the voltage at point ‘**C**’ high, gate 1 is free to react to the voltage at point ‘**A**’ as before. If the voltage at point ‘**C**’ is low, it locks the output of gate 1 at the high level, forcing the output of gate 2 to the low level and holding the LED off.

When the circuit is first powered up, the new 100 microfarad capacitor ‘C3’ is fully discharged, which pulls the voltage at point ‘**C**’ to nearly + 9 Volts. This allows gate 1 to operate freely, and the LED can be toggled on and off as before. As time passes, the charge on capacitor ‘C3’ builds up, fed by the 2M2 resistor. This causes the voltage at point ‘**C**’ to fall steadily. The rate of fall is governed by the size of the capacitor and the size of the resistor. The larger the resistor, the slower the fall. The larger the capacitor, the slower the fall. The values shown are about as large as are practical, due to the current ‘leakage’ of ‘C3’.

After three or four minutes, the voltage at point ‘**C**’ gets driven low enough to operate gate 1 and prevent further operation of the circuit. This type of circuit could be part of a competitive game where the contestants have a limited time to complete some task.

The NAND Gate as an Amplifier.

Gates can also be used as amplifiers although they are not intended to be used that way and there are far better integrated circuits from which to build amplifiers. The following circuit shows how this can be done:



This circuit operates when there is a sudden change in light level. The previous light-level switching circuit was designed to trigger at some particular level of increasing or decreasing level of lighting. This is a shadow-detecting circuit which could be used to detect somebody walking past a light in a corridor or some similar situation.

The voltage level at point ‘**A**’ takes up some value depending on the light level. We are not particularly interested in this voltage level since it is blocked from the following circuitry by capacitor ‘C1’. Point ‘**B**’ does not get a voltage pulse unless there is a sudden change of voltage at point ‘**A**’, i.e. there is a sudden change in light level reaching the light-dependent resistor ORP12.

The first gate amplifies this pulse by some fifty times. The gate is effectively abused, and forced to operate as an amplifier by the 10M resistor connecting its output to its input. At switch-on, the output of gate 1 tries to go low. As its voltage drops, it starts to take its own inputs down via the resistor. Pushing the voltage on the inputs down, starts to raise the output voltage, which starts to raise the input voltage, which starts to lower the output voltage, which ...... The result is that both the inputs and the output take up some intermediate voltage (which the chip designers did not intend). This intermediate voltage level is easily upset by an external pulse such as that produced by the ORP12 through capacitor ‘C1’. When this pulse arrives, an amplified version of the pulse causes a voltage fluctuation at the output of gate 1.

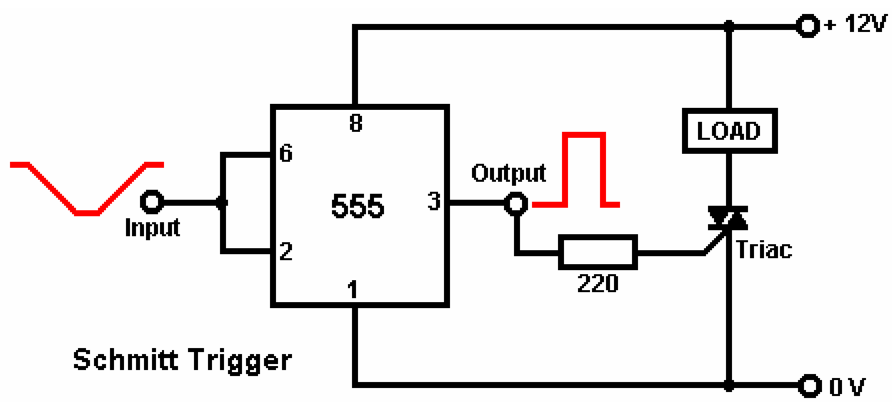
This voltage change is passed through the diode and variable resistor to the input of gate 2. Gates 2 and 3 are wired together as a makeshift Schmitt trigger in that the output voltage at point ‘**D**’ is fed back to point ‘**C**’ via a high value resistor. This helps to make their change of state more rapid and decisive. These two gates are used to pass a full change of state to the output stage transistor. The variable resistor is adjusted so that gate 2 is just about to change state and is easily triggered by the pulse from amplifier gate 1. The output is shown as an LED but it can be anything you choose. It could be a relay used to switch on some electrical device, a solenoid used to open a door, a counter to keep track of the number of people using a passageway, etc. etc. Please note that an operational amplifier chip (which will be described later) is a far better choice of IC for a circuit of this type. A gate amplifier is shown here only to show another way that a gate can be utilised.

The NE555 Timer Chip.

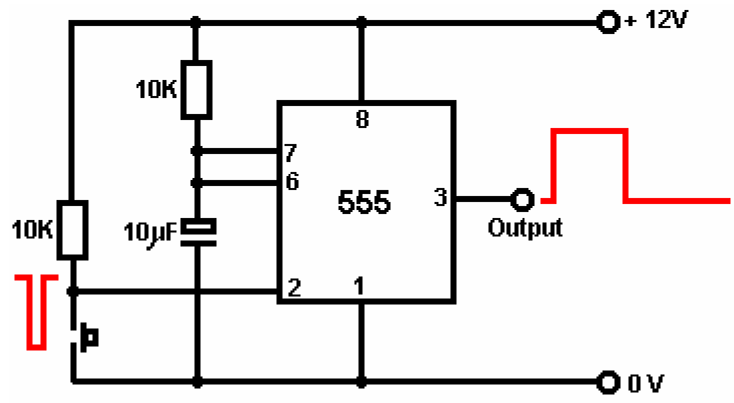
There is an exceptionally useful chip designated by the number 555. This chip is designed to be used in oscillator and timer circuits. Its use is so widespread that the chip price is very low for its capability. It can operate with voltages from 5 Volts to 18 Volts and its output can handle 200 mA. It takes 1 mA when its output is low and 10 mA when its output is high. It comes in an 8-pin **D**ual-**I**n-**L**ine package and there is a 14-pin package version which contains two separate 555 circuits. The pin connections are:

This device can operate as a monostable or astable multivibrator, a Schmitt trigger or an inverting buffer (low current input, high current output).

Here it is wired as a Schmitt trigger, and for variation, it is shown triggering a triac which will then stay on until the circuit is powered down (an SCR could be used just as well with this DC circuit):

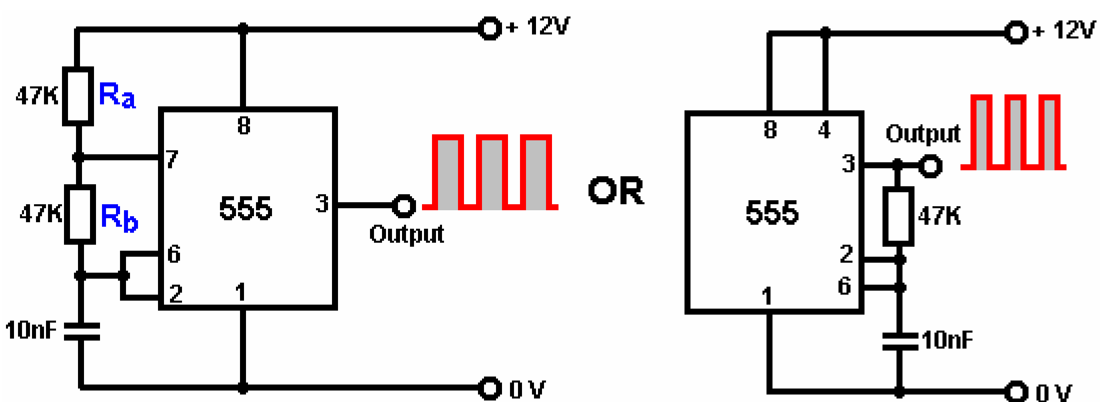


And here, a monostable:

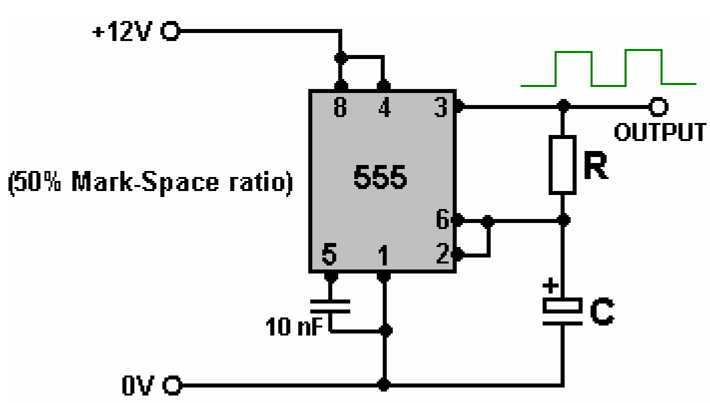


Monostable multivibrator

And here are two astables, the second of which has fixed, equal mark/space ratio and the first a high output voltage time determined by Ra + Rb and a low voltage output time determined by Rb (2:1 in this case):



Astable multivibrators



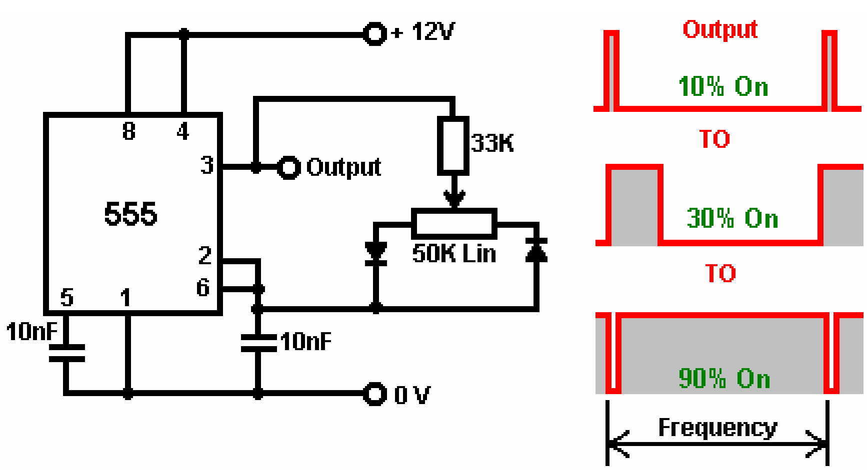
Frequency = $\frac{0.72}{C \times R}$

Astable Frequencies

	100	470	1K	4.7K	10K	47K	100K	470K	1M
0.1 µF	72,000 Hz	15,319 Hz	7,200 Hz	1,532 Hz	720 Hz	153 Hz	72 Hz	15 Hz	7.2 Hz
0.47 µF	15,319 Hz	3,259 Hz	1,532 Hz	326 Hz	153 Hz	33 Hz	15 Hz	3.3 Hz	1.5 Hz
1.0 µF	7,200 Hz	1,532 Hz	720 Hz	153 Hz	72 Hz	15 Hz	7.2 Hz	1.5 Hz	1.4 secs
2.2 µF	3,272 Hz	696 Hz	327 Hz	70 Hz	33 Hz	7 Hz	3.3 Hz	1.4 secs	3 secs
4.7 µF	1,532 Hz	326 Hz	153 Hz	33 Hz	15 Hz	3.3 Hz	1.5 Hz	3 secs	6.7 secs
10 µF	720 Hz	153 Hz	72 Hz	15 Hz	7.2 Hz	1.5 Hz	1.4 secs	6.7 secs	14 secs
22 µF	327 Hz	70 Hz	33 Hz	7 Hz	3.3 Hz	1.4 secs	3 secs	14 secs	30 secs
47 µF	153 Hz	33 Hz	15 Hz	3.3 Hz	1.5 Hz	3 secs	6.7 secs	30 secs	65 secs
100 µF	72 Hz	15 Hz	7.2 Hz	1.5 Hz	1.4 secs	6.7 secs	14 secs	65 secs	139 secs
220 µF	33 Hz	7 Hz	3.3 Hz	1.4 secs	3 secs	14 secs	30 secs	139 secs	307 secs
470 µF	15 Hz	3.3 Hz	1.5 Hz	3 secs	6.7 secs	30 secs	65 secs	307 secs	614 secs
1,000 µF	7.2 Hz	1.5 Hz	1.4 secs	6.7 secs	14 secs	65 secs	139 secs	614 secs	
2,200 µF	3.3 Hz	1.4 secs	3 secs	14 secs	30 secs	139 secs	307 secs		
4,700 µF	1.5 Hz	3.3 secs	6.7 secs	30 secs	65 secs	307 secs	614 secs		
10,000 µF	1.4 secs	6.7 secs	14 secs	65 secs	139 secs	614 secs			

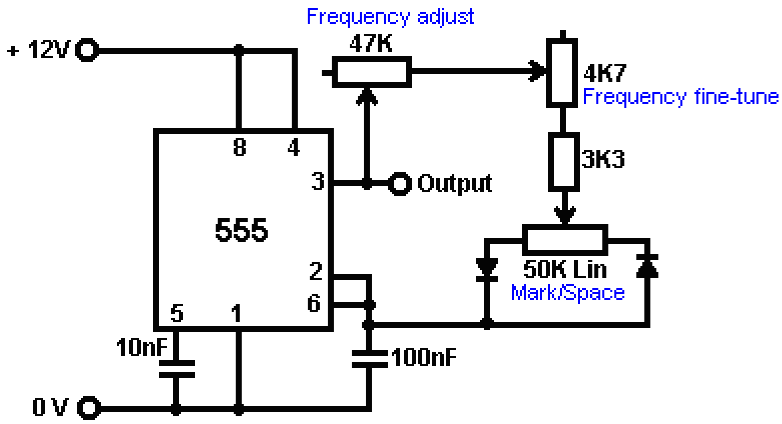
Note: The high leakage of large value electrolytic capacitors prevents them being used with high value resistors in timing circuits. Instead, use a smaller capacitor and follow the timing circuit with a "divide-by-N" chip to give accurately timed long periods. Not all 555 chips have a manufacturing quality sufficient for them to operate reliably above 20,000 Hz, so for the higher frequencies the chip needs to be selected after testing its actual performance.

We can also wire the 555 to give a variable mark/space ratio while holding the frequency of the oscillation fixed:



The output waveform changes drastically as the variable resistor is adjusted, but the frequency (or pitch of the note) of the output stays unaltered.

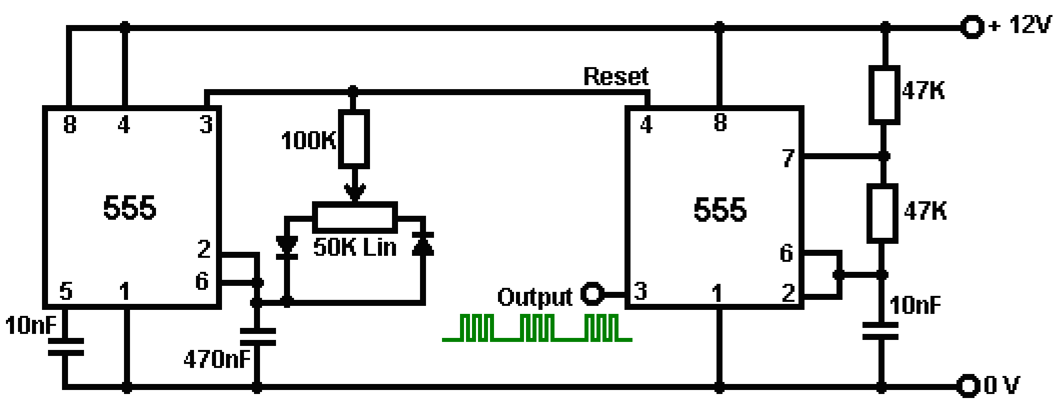
A variable-frequency version of this circuit can be produced by changing the 33K resistor to a variable resistor as shown here:



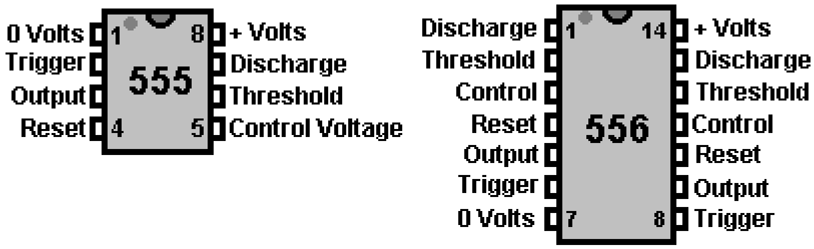
Here, the 33K resistor has been replaced by two variable resistors and one fixed resistor. The main variable resistor is 47K in size (an almost arbitrary choice) and it feeds to a second variable resistor of 4.7K in size. The advantage of this second variable resistor is that it can be set to it's mid point and the frequency tuning done with the 47K variable. When the frequency is approximately correct, the 4.7K variable can be used to fine tune the frequency. This is convenient as the small variable will have ten times more knob movement compared to the main variable (being just 10% of its value).

Obviously, it is not necessary to have the fine-tuning variable resistor, and it can be omitted without changing the operation of the circuit. As the 47K variable resistor can be set to zero resistance and the 4.7K variable resistor can also be set to zero resistance, to avoid a complete short-circuit between output pin 3 and the 50K Mark/Space variable resistor, a 3.3K fixed resistor is included. In this circuit, the frequency is set by your choice of the resistor chain 47K + 4.7K + 3.3K (adjustable from 55K to 3.3K) and the 100nF (0.1 microfarad) capacitor between pin 6 and the zero volt rail. Making the capacitor larger, lowers the frequency range. Making the resistors larger, also lowers the frequency range. Naturally, reducing the size of the capacitor and/or reducing the size of the resistor chain, raises the frequency.

One 555 chip can be used to gate a second 555 chip via its pin 4 'Reset' option. You will recall that we have already developed a circuit to do this using two astables and a transistor. We also generated the same effect using four NAND gates. Here, we will create the same output waveform using the more conventional circuitry of two 555 chips:



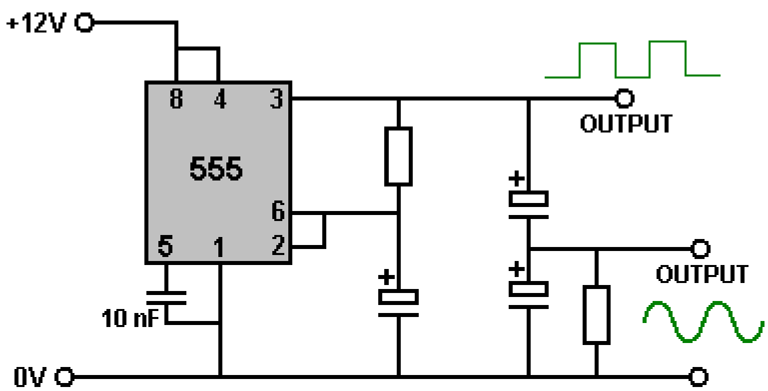
Both of the NE555 circuits can be bought in a single 14-pin DIL package which is designated 'NE556':



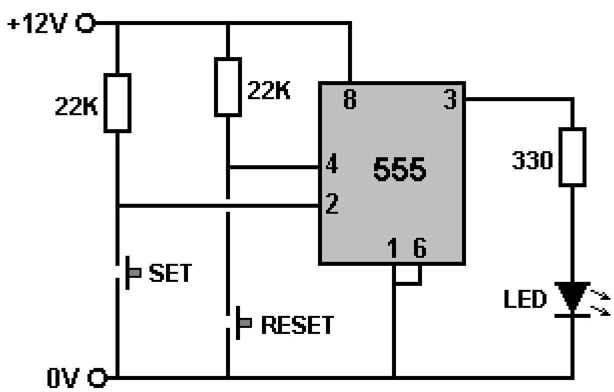
555 8-pin	555 No.1	555 No.2
2	6	8
3	5	9
4	4	10
5	3	11
6	2	12
7	1	13

There are many additional circuit types which can be created with the 555 chip. If you wish to explore the possibilities, I suggest that you download the free pdf "50 555 Projects" from the web site: http://www.talkingelectronics.com/projects/50%20-%20555%20Circuits/50%20-%20555%20Circuits.html.

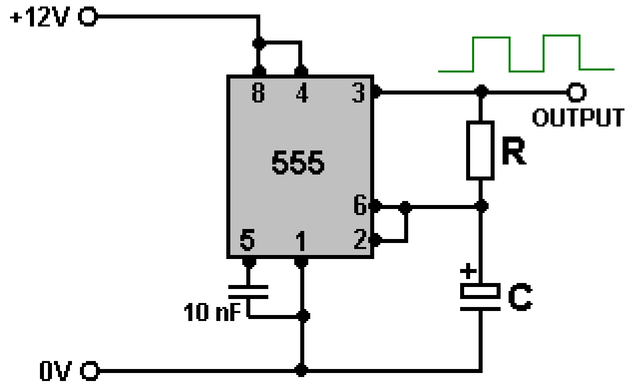
The 555 chip can also produce a sine wave output:



Or, if you wish, a bi-stable multivibrator:



All right, suppose that we want to design and build a circuit to do the same as Bob Beck's pulser circuit mentioned in chapter 11. The requirements are to produce a square wave output pulsing four times per second using a 27 volt power supply, the circuit being powered by three small PP3 size batteries. An obvious choice for the circuit seems to be a 555 timer chip which is small, robust and cheap and a suitable circuit would appear to be:



This leaves us with choosing a value for the capacitor and the resistor. We need to pay attention to the fact that the circuit will be running on 27 volts and while the capacitor will not charge up to anything like that voltage, we still will pick one which will survive 27V. Looking on the local eBay shows that a pack of ten capacitors of 1 microfarad rated at 50V can be bought for just £1 including postage, so take that as the value for "C". Looking at the 555 table of frequencies above shows:

Astable Frequencies

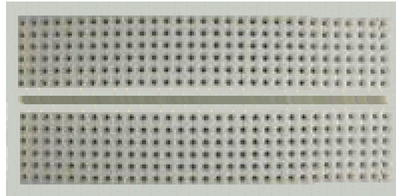
	100	470	1K	4.7K	10K	47K	100K	470K	1M
0.1 μF	72,000 Hz	15,319 Hz	7,200 Hz	1,532 Hz	720 Hz	153 Hz	72 Hz	15 Hz	7.2 Hz
0.47 μF	15,319 Hz	3,259 Hz	1,532 Hz	326 Hz	153 Hz	33 Hz	15 Hz	3.3 Hz	1.5 Hz
1.0 μF	7,200 Hz	1,532 Hz	720 Hz	153 Hz	72 Hz	15 Hz	7.2 Hz	1.5 Hz	1.4 secs

Which indicates that to get the circuit switching four times per second (4 Hz) the resistor "R" will need to be somewhere between 100K and 470K. With my capacitor, 120K is about right.

While the switching frequency does not have to be exact, let's aim at getting it correct. Most reasonably priced components have a tolerance of around 10% so we need to select our resistor/capacitor combination for the exact values of the actual components which we will use. For this, it is worth building the circuit on a solder-less 'breadboard', so looking on eBay again we find that a suitable small plug-in board can be bought and delivered for £3. It looks like this :

These type of boards allow ICs to be plugged in spanning the central divide, leaving up to five extra connections on every pin. Short lengths of solid-core wire can be used to connect between any two socket holes. This will allow us to plug in one of our capacitors and find what resistor (or what two resistors) make the circuit switch forty times in ten seconds.

However, if we go to http://www.alldatasheet.co.kr/ and download the data pdf for the NE555 chip, we find that the maximum 555 chip voltage is quite limited:



DC AND AC ELECTRICAL CHARACTERISTICS

T_A = 25°C, V_{CC} = +5V to +15 unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	SE555			NE555/SE555C			UNIT
			Min	Typ	Max	Min	Typ	Max	
V_{CC}	Supply voltage		4.5		18	4.5		16	V
I_{CC}	Supply current (low state)[1]	V_{CC}=5V, $R_L=\infty$		3	5		3	6	mA
		V_{CC}=15V, $R_L=\infty$		10	12		10	15	mA

This means that the chip is liable to burn out instantly if it is fed more than 16 volts. As we need to run our circuit on 27V this is a problem. As the 27V is being provided by three separate batteries, we could supply the 555 chip from just one of the batteries and run it on 9V which would be ok from the point of view of the chip as the table above shows that it can operate correctly with a supply voltage as low as 4.5 volts. The disadvantage of that arrangement is that one of the batteries will run down more quickly than the others and it would be nice to avoid that.

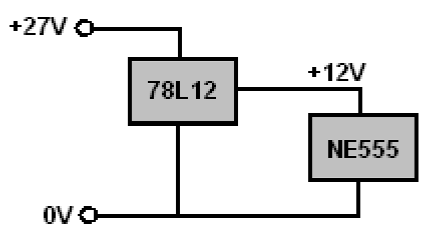
The table also shows that the current draw just to keep the 555 running can be anything from 6 to 15 milliamps. That is not a large current but the PP3 batteries have been chosen for their small size, allowing the whole circuit to be strapped to a person's wrist. A quick search on the internet shows that cheap PP3 batteries have a capacity of 400 milliamp-hours and the very expensive alkaline types 565 milliamp-hours. These ratings are the "C20" values, based on the battery being discharged at a constant current over a period of twenty hours, which would be ten days of use if Bob Beck's two hours per day protocol is followed.

This means that the 'cheap' batteries should not be discharged at more than one twentieth of their 400 mAHr rating, which is 20 mA. The expensive alkaline batteries should be able to be discharged at 28 mA for twenty hours.

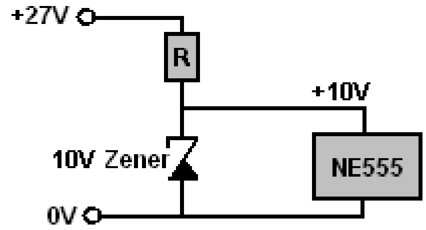
Our current draw is made up of two parts. The first part is supplying the circuit with the current which it needs to run. The second part is the current flowing through the body of the user. This second part is limited by the 820 ohm resistor in the output line which limits that part of the current to a maximum of 33 milliamps (Ohm's Law: Amps = Volts /Resistance). This neglects the body resistance and assumes that the output control variable resistor is set to minimum resistance, which is unlikely.

Checking these values shows that the 555 chip is liable to draw as much current as the circuit supplies through the output electrodes. However, let's go ahead with the circuit, after all, we might decide to use rechargeable PP3 batteries which would overcome the need to buy new batteries every few days.

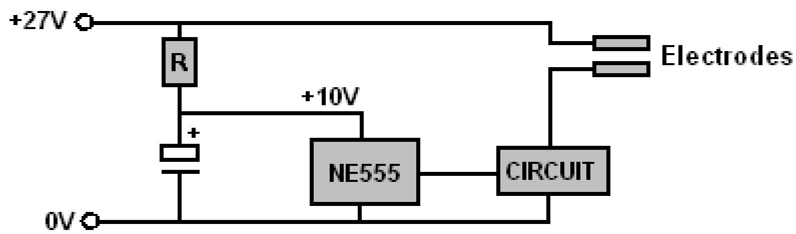
The first essential requirement is to provide the 555 chip with a voltage of, say, 10 volts when it is running in the completed circuit. That could be done with one of the voltage-stabiliser integrated circuits:



That is not a particularly expensive option, but those chips draw a current in order to provide the voltage stabilisation and an absolutely steady voltage is not needed by the 555 chip. Alternatively, we could use a resistor and a 10V zener diode:



But that method does waste some current flowing through the zener in order to provide the wanted voltage. The most simple method is to use a resistor and a capacitor:



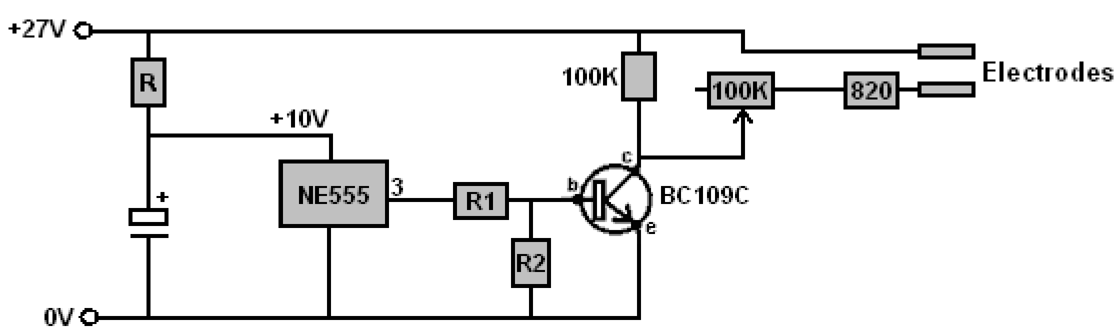
Considerable care is needed when selecting the resistor value "**R**". If the value is too low, then the voltage passed to the 555 chip will be too high and the chip will burn out. When selecting the resistor "**R**", start with a higher value than expected and then substitute slightly lower value resistors while monitoring the voltage across the capacitor to make sure that it stays low enough. The resistor value can be assessed using Ohm's Law. Assuming a current of about 6 mA, the voltage drop across the resistor being (27 – 10) = 17 volts, then a resistor of about 2.83K (as Ohms = Volts / Amps) which suggests that starting with a 4.7K resistor is likely to be ok, and then picking each lower standard resistor in turn until a satisfactory voltage across the capacitor is reached.

The capacitor could be 12V or 15V rated, but if one rated at a higher voltage is used, then if it is accidentally connected across the full 27V it will not be harmed in any way. The larger the capacitance, the better, say 220 microfarads which can be got for a few pence on eBay. If you want to play safe, you could connect a 12V zener diode across the capacitor. It will not draw any current under normal working conditions, but if anything should cause the voltage on the capacitor to rise, then it will fire up and hold the voltage down to a safe 12V level. I would be inclined to see the zener as being unnecessary, but the choice is always yours.

So what resistor power rating is needed? Well, if the resistor turns out to be a 2.7K and the capacitor voltage ends up as 9.5 volts, then the average voltage across the resistor is 17.5V which makes the current through it 6.48 mA and as Watts = Volts x Amps, the power rating needs to be 113 milliwatts, so the typical quarter-watt (250 mW) resistor should be perfectly ok. If two (nearly equal value) resistors in parallel are used to get some intermediate value of "**R**" then that increases the overall resistor wattage.

The output of the 555 chip is then used to drive the remainder of the circuit which operates at 27V. A BC109C transistor costs only a few pence, can handle the voltage and has a minimum gain of 200 although the gain can be anything up to 800 and a BC109 can handle the current quite easily. If you need to find out any of these things, then download a datasheet for the transistor from the internet.

The output of the 555 timer is on pin 3 and it can easily supply 200 mA which is far, far more current than we would ever need for this circuit. We can feed the 555 square-wave output to the 27V electrodes using a transistor:

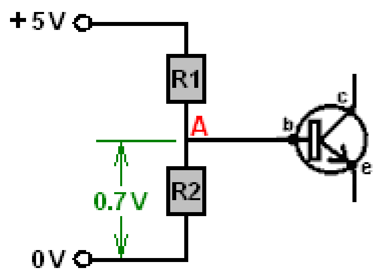


As the transistor is made of silicon, the switch-on voltage is when the base voltage is about 0.7 volts above the emitter voltage. That means that when the transistor is switched on, the top of resistor "**R1**" will be at around 10 volts and the bottom of "**R1**" will be at about 0.7 volts, which means that the voltage across "**R1**" will be (10 – 0.7) = 9.3 Volts. When that voltage is present across "**R1**" we want it to feed sufficient current to the transistor to switch it on fully. The transistor supplies a 100K resistor (which will carry 0.27 mA when 27 volts is across it) and the electrodes which will have a minimum resistance of 820 ohms across them (causing a current of 33 mA through them). So, the transistor might have to supply about 33 mA maximum. The BC109C transistor has a minimum gain of 200 so the current flowing into the base needs to be 33 / 200 = 0.165 mA and the resistor which will carry that current when it has 9.3 volts across it is 56.3K. A somewhat smaller resistor will suit.

A commonsense check that the resistor calculation is correct is:
A 1K resistor carries 1 mA per volt and so will carry 9.3 mA with 9.3 volts across it.
A 10K resistor will carry one tenth of that amount, or 0.93 mA with 9.3 volts across it.
A 100K resistor will carry one tenth of that again, or 0.093 mA with 9.3 volts across it.
This indicates that for a current of 0.165 mA which is about twice the 100K current, a resistor of about half of 100K should be about the right value, so 56.3K looks correct.

Considering that the gain of 200 is the minimum and three or four times that is typical, we could perhaps choose to use a 47K resistor for "**R1**"

As the electrode current is likely to be considerably less than 33 mA and as the BC109C gain is likely to be very high, it could be quite difficult to get the transistor to switch off as it can operate on very tiny amounts of input current. To get it to switch on and off cleanly when the 555 output voltage is say, about 5 volts, (at which point the NE555 voltage will be changing very rapidly), "**R2**" is included. With it in place, the output voltage of the NE555 is divided between "**R1**" and "**R2**" in the ratio of their resistances. The situation we want is:

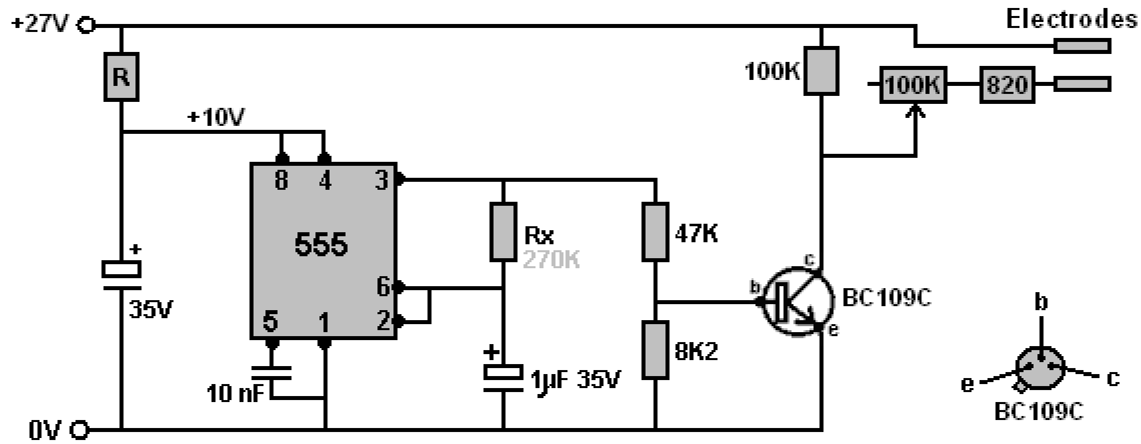


When The transistor is not switched on, it draws almost no current and so looks like a very high value resistor to the circuit. This allows the "**R1**" and "**R2**" resistors to act as a voltage-divider pair. This causes the voltage at point "**A**" to be determined by the ratio of "**R1**" to "**R2**" and the transistor can be ignored provided that the voltage at point "**A**" is below 0.7 volts. If the voltage at that point rises to 0.7 volts then the situation changes dramatically and Ohm's Law no longer holds as the transistor is not a passive resistor but instead, is an active semi-conductor device. If the voltage at point "**A**" tries to rise further it can't because the transistor base clamps it solidly there by appearing to be an ever lower resistor between the base and the emitter of the transistor. So for higher input voltages, resistor "**R2**" might as well not be there for all the difference it makes.

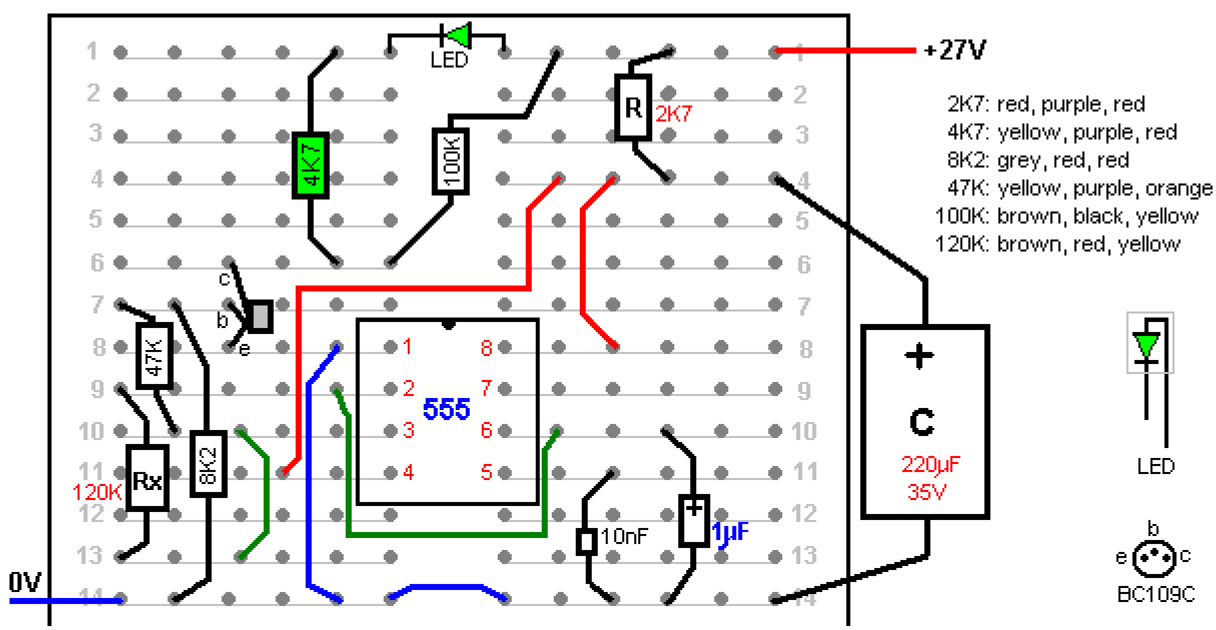
So, what value do we need for "**R2**" in order for the voltage at point "**A**" to be 0.7V when pin 3 of the NE555 reaches 5V? Well, that part of the circuit is acting in a resistive fashion and so Ohm's Law can be used. The resistor "**R1**" is 47K and has 4.3 volts across it, which means that the current through it must be 0.915 mA. That means that "**R2**" has 0.7V across it and 0.915 mA flowing through it which means that it has a value of 7.65K. A standard 8.2K or 6.8K resistor could be used as there is nothing dramatically important about the 5V switching point. If you were fussed about getting exactly 7.65K (and you shouldn't be), then you can get that value by combining two standard resistors, either in series or in parallel.

A common sense method of working out the value of "**R2**" is to use the fact that as the same current flows through them (no matter what that current happens to be), then the ratio of the voltage will be the same as the ratio of the resistors. That is: 0.7V / 4.3V = "**R2**" / 47K or "**R2**" = 47K x 0.7 / 4.3 which is 7.65K.

We have now reached the point where we can determine the resistor value needed to provide a reasonable voltage for the NE555 timer chip, the circuit being:



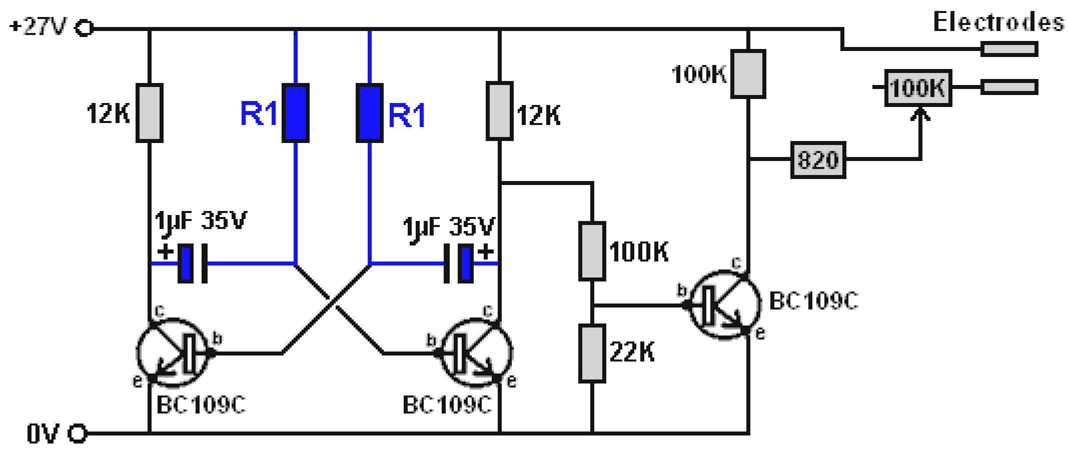
The “**Rx**” value is going to be fairly close to 270K so you can use that value when testing to find a suitable value for “**R**” (2.2K in my case). The capacitor across the NE555 chip should be as large a capacitance as is convenient, bearing in mind that the entire circuit, batteries, etc. is to fit into a small case to be strapped to a wrist. One way that the components could be positioned on the plug-board is:



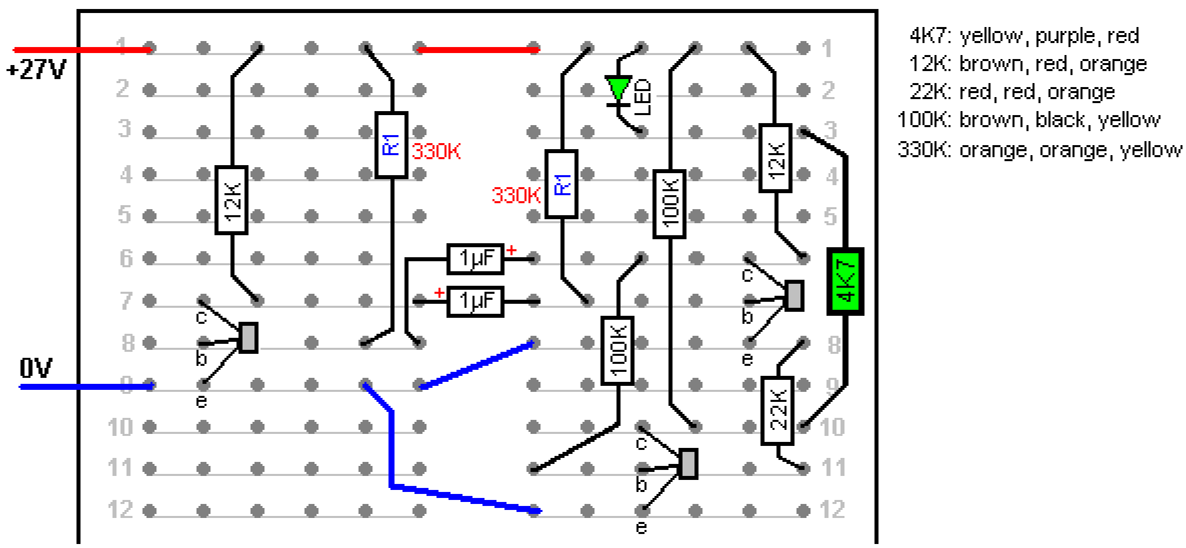
Remember that when trying various resistors for “**R**” you need to start high at about 4.7K and the resulting voltage on the capacitor shows the voltage drop across your first resistor choice and so, the actual current being drawn by your particular NE555 chip. That calculated current will allow you to calculate the resistor value needed to give 10 volts or so, allowing your next resistor to be tested to be almost exact in value.

For checking the frequency produced by the circuit, any ordinary LED can be used as a temporary measure. It can be connected across the 100K ‘load’ resistor between the transistor collector and the +27V positive supply line. A current-limiting resistor is essential to stop the LED burning out instantly. If we allow a current of 5 mA to flow through the LED then since the current-limiting resistor has some 26.3 volts across it, then it’s value will be about 5.4K (1K would give 26 mA, 2K would give 13 mA, 3K would give 9 mA, 4K would give 6.5 mA) and so a 4.7K resistor works well. This LED and resistor are shown in the layout above. Please remember that if your BC109C transistor has a metal case, then that case is normally connected internally to the collector and so, care must be taken that the case does not short-circuit to anything else.

If it is considered important to maximise battery life by reducing the current draw to a minimum, then perhaps using an astable circuit might be a good choice. In common with most electronic circuits, there are many different ways to design a suitable circuit to do the required job. The BC109C transistor can handle the 27V and so we might aim at a current draw for the circuit of just 3 mA. If 2 mA were to flow through the astable transistors when they are switched on, then with 27V across them, the resistors would be 13.5K which is not a standard value. We might select 12K to give a 2.25 mA current, or 15K to give 1.8 mA. Either should be satisfactory. The circuit might then be:

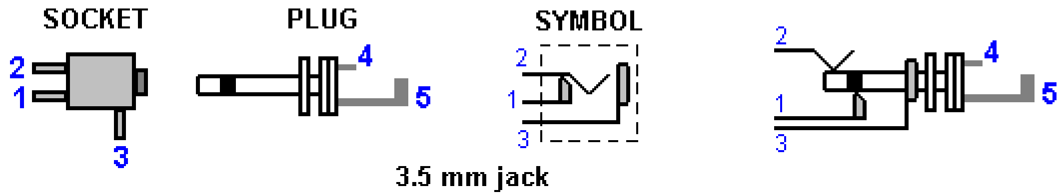


As the voltage swing feeding the output transistor has now risen from 10V to 27V the voltage-divider resistors can now increase in value by 2.7 times, giving around 127K and 22.1K for these resistors. However, the situation is not the same as for the NE555 chip which can supply at least 200 mA at the voltage-high output level. Instead, the transistor becomes such a high resistance that it can be ignored, but the 12K remains in the path which supplies the base current for the output transistor and it will in fact, add to the upper resistor of the voltage-divider pair. So while a 100K resistor is shown, it is effectively 112K due to that extra 12K resistor between it and the +27V supply line. The astable transistors will be switching fast at the point where the output transistor changes state, so the output square wave should be good quality. The BC109C transistor can switch on and off a hundred million times per second, so it's performance in this circuit should be very good. A test breadboard layout might be:



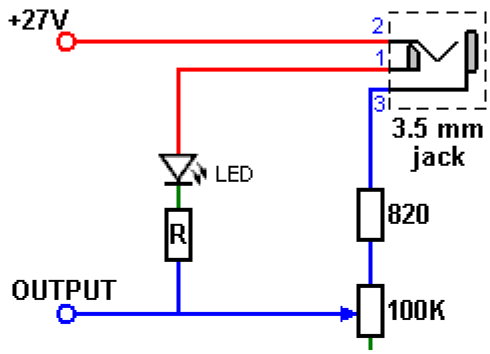
We now need to choose the timing components. For an even 50% duty cycle where each transistor is ON for half the time and OFF for half the time, the two timing capacitors can be the same size and then the two timing resistors will have the same value, in my case, 330K but it depends on the actual capacitors used.

Bob Beck's design calls for the LED display to be running when the unit is switched on and then be disconnected when the electrodes are plugged into a 3.5 mm socket mounted on the case containing the circuit. The switched socket looks like this:

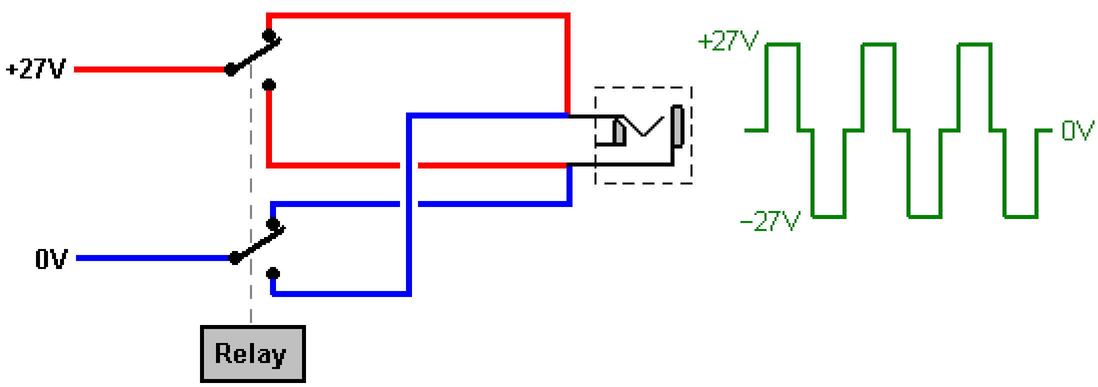


When the plug is not inserted into the socket, pin 1 connects to pin 2 and pin 3 is not connected to anything. When the plug is inserted, then pin 1 is isolated, pin 2 is connected to plug pin 4 and pin 3 is connected to plug pin 5.

The Beck circuit is connected to the output socket like this:

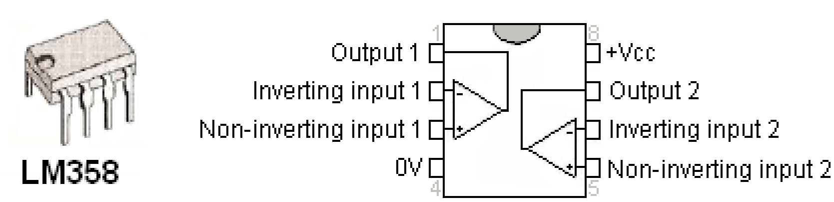


This arrangement will give a 27V 4Hz square wave output through the jack socket. But, Bob Beck's original circuit did not do that. Instead, it was like this:



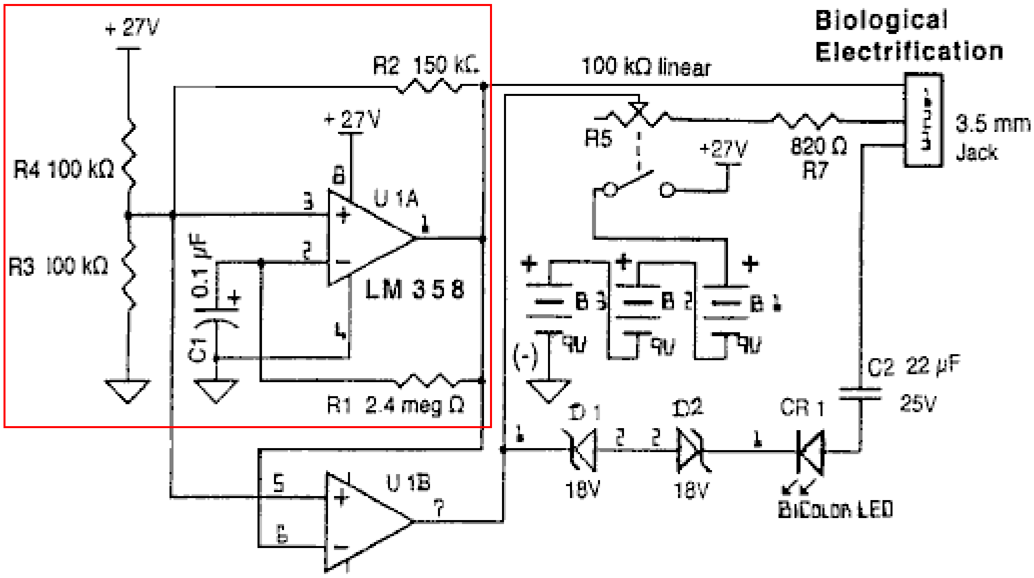
Here, a relay operates two change-over switch contacts which are used to reverse the battery bank contacts four times per second. That is different from just producing a positive-going square wave voltage between the two output terminals. If you were to consider a resistor connected across the output socket, then with the relay switching, the direction of the current reverses four times per second, but with the square wave, while it starts and stops four times per second, the direction of the current is always the same and there is no reversal of direction.

As Bob wanted to avoid using a relay which clicks four times per second all the way through the two-hour treatment described in chapter 11 and in the "Take Back Your Power" pdf on the http://www.free-energy-info.tuks.nl/ web site, he redesigned the circuit using the very impressive LM358/A integrated circuit:



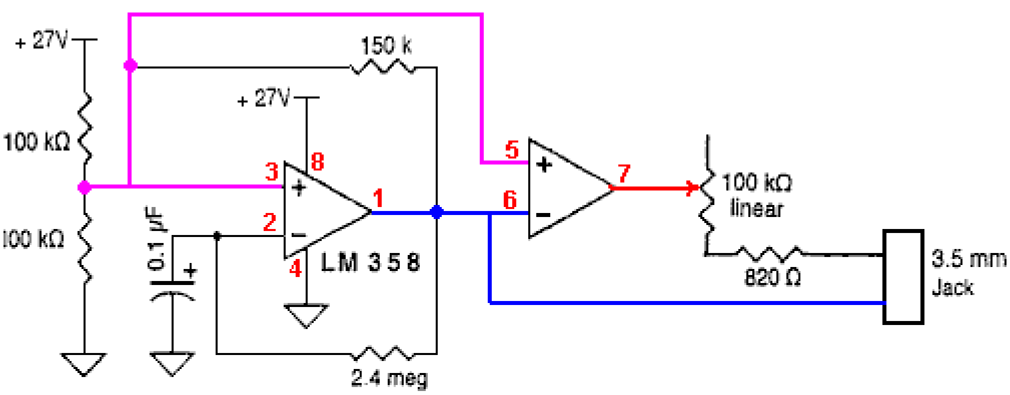
This chip draws only half of one milliamp, has two very high-gain operational amplifiers and can operate with a wide range of supply voltages. It is also inexpensive.

Bob displays the circuit as:



Bob states that the first section acts as a 4Hz square-wave signal generator, the frequency being controlled by the 2.4M resistor "R1" and the 100nF capacitor "C1". The data sheet for the LM358 states that the output voltage swing is between zero volts and 1.5V less than the supply voltage "Vcc" (which is +27V in this case). That implies that, as would be expected, the pin 1 output voltage from the first stage will switch sharply from 0V to +25.5V and sharply back again, four times per second.

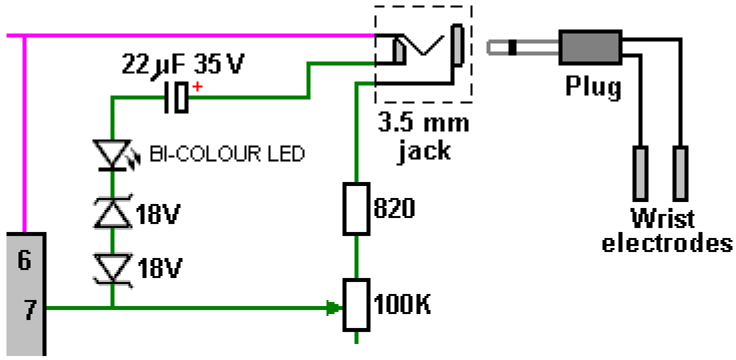
It is difficult to follow the circuit as it is drawn, so it might be a little easier to follow when drawn like this:



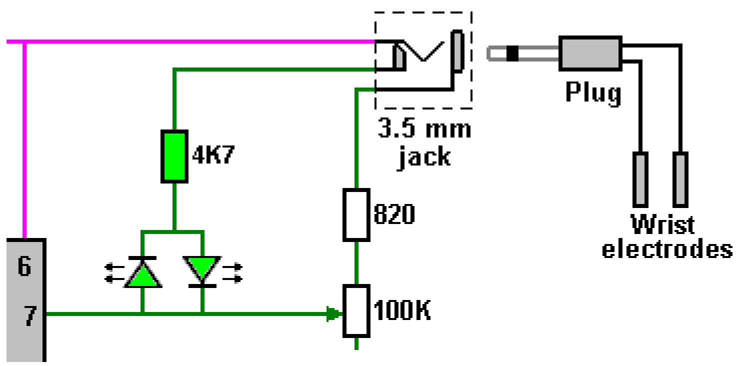
The output from the first amplifier inside the LM358 package is on pin 1 and it can supply a large amount of current (if a large current is ever needed). That output goes straight to one of the jack socket connections. It also goes the pin 6 input of the second amplifier inside the chip and that causes the high-power output of that amplifier on pin 7 to be the opposite of the pin 1 voltage. When pin 1 goes high to +25.5 volts, then pin 7 goes low, to about zero volts. That output is also fed to the other jack socket connection, placing 25.5 volts across the electrodes when they are plugged in to the jack socket.

When the oscillator circuitry connected to the first amplifier causes the voltage on pin 1 to go low, then the output on pin 7 inverts it and so it goes to +25.5 volts. You will notice that while the overall voltage of 25.5 volts is applied again to the jack socket, the polarity is now reversed, achieving what the relay circuit does (although 1.5 volts is lost in the process). This is a neat solution.

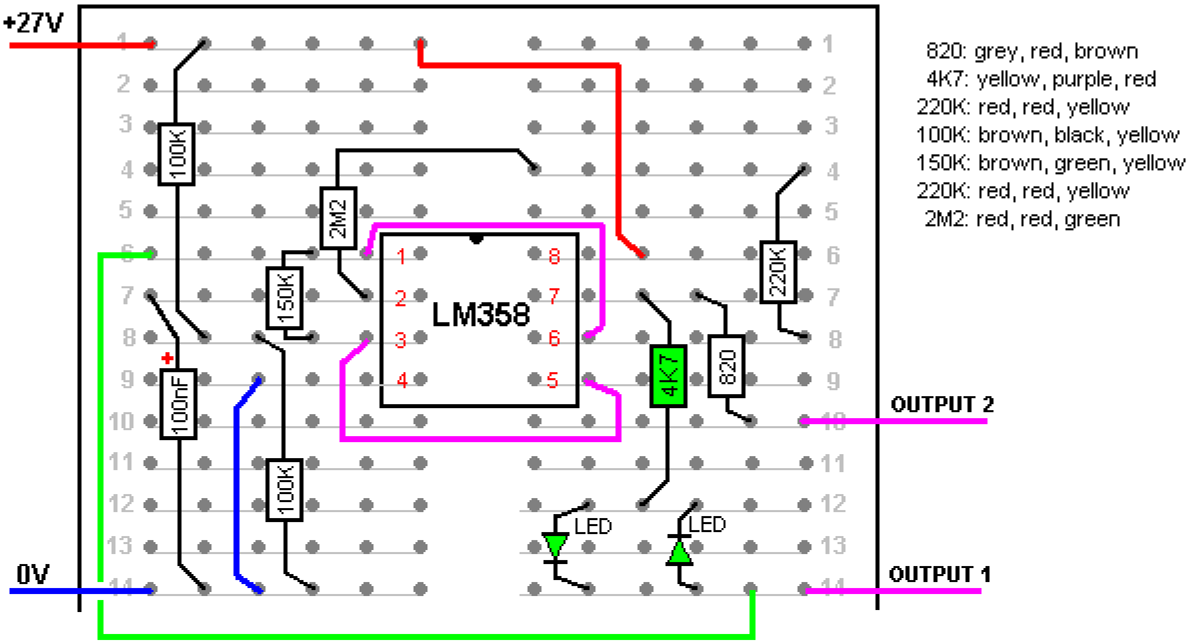
Bob uses a two-colour LED to confirm that the circuit is working correctly before the electrodes are plugged in. He chooses to do it this way:



The two 18V zener diodes drop off 18.7 of the 25.5 volts as one will be forward biased dropping 0.7 volts and the other reversed biased, dropping off 18 volts. That leaves a 7V drop for the LED, which is a bit excessive, so Bob says that he uses a capacitor to limit the current. As there is already an 820 ohm resistor in the LED current path through the socket, the capacitor is not needed. The variable resistor need to be set to it's minimum resistance by rotating it's shaft fully clockwise so that it does not affect the LED brightness as the zeners also show when the battery voltage has dropped as there will no longer be sufficient voltage to light the LED brightly, indicating that the batteries need to be replaced (or recharged if they are rechargeable batteries). When testing the circuit, an alternative to the two zeners is to use a 4.7K resistor and if a bi-colour LED is not to hand, then two ordinary LEDs can be used back to back like this:

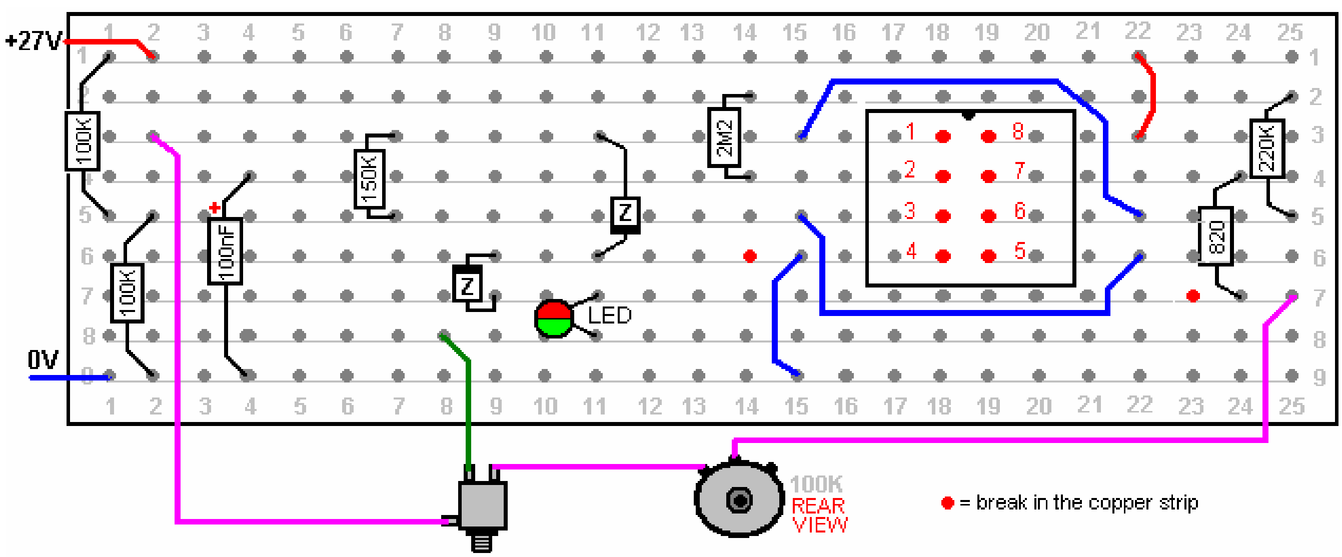


With this arrangement, the two LEDs flash alternately. In any circuit, a capacitor with a higher voltage rating can always be used if the capacitance values are the same. The Beck external circuit is completed through the body of the user, so there is just one electrode connected to each side of the output jack socket. A possible plug-board layout is:



The 4.7K resistor and LEDs are only on the board for testing purposes and when the circuit is built in permanent form, then the LED chain connects to pin 1 of the jack socket so that the LEDs are disconnected during the two hours of daily treatment recommended when using the device.

One stripboard layout using the standard 9-strip 25-hole board and incorporating the two 18V zener diodes for voltage sensing is:



When using a Beck device, it is very important to pay attention to the precautions which Bob sets out. These are in his "Take Back Your Power" pdf document: http://www.free-energy-info.tuks.nl/Beck.pdf which includes the following, which, while it refers to treatment to deal with HIV, presumably applies to all treatments with his device:

EXPANDED INSTRUCTIONS FOR EXPERIMENTAL / THEORETICAL HIV BLOOD NEUTRALIZATION

HYPOTHETICAL PROTOCOLS FOR EXPERIMENTAL SESSIONS

Revision March 20, 1997. Copyright 8 1991/1997 Robert C. Beck

PRECAUTIONS: Do NOT use wrist to wrist current flow with subjects who have cardiac pacemakers. Any applied electrical signals may Interfere with 'demand' type heart pacers and cause malfunction. Single wrist locations should be acceptable. Do NOT use on pregnant women, while driving or using hazardous machinery.

Users MUST avoid Ingesting anything containing medicinal herbs, foreign or domestic, or potentially toxic medication. nicotine, alcohol, recreational drugs. laxatives, tonics. and certain vitamins etc., for one week before starting because blood electrification can cause electroporation which makes cell membranes pervious to small quantities of normally harmless-chemicals in plasma. The effect Is the same as extreme overdosing which might be lethal. See *Electroporation: a General Phenomenon for Manipulating Cells and Tissues;* J.C. Weaver, Journal of Cellular Biochemistry 51:426-435 (1993). Effects can mimic increasing dosages many fold. Both the magnetic pulsar and blood purifier cause electroporation.

Do NOT place electrode pads over skin lesions, abrasions, new scars, cuts, eruptions, or sunburn. Do NOT advance output amplitude to uncomfortable levels. All subjects will vary. Do NOT fall asleep while using. The magnetic pulser should be safe to use anywhere on body or head.

Avoid ingesting alcohol 24 hours before using. Drink an 8 oz. glass of distilled water 15 minutes before and immediately following each session end drink at least four additional glasses daily for flushing during 'neutralization' and for one week thereafter. This Is imperative. Ignoring this can cause systemic damage from unflushed toxic wastes. When absolutely essential drugs *must* be ingested, do so a few minutes *after* electrification then wait 24 hours before next session.

If subject feels sluggish, faint, dizzy, headachy, light-headed or giddy, nauseous. bloated or has flu-like symptoms or rashes after exposures, reduce pulsing per session and/or shorten applications of electrification. Drink more water-preferably ozonized -to speed waste oxidation and disposal. Use extreme caution when treating patients with impaired kidney or liver function. Start slowly at first like about 20 minutes per day to reduce detoxification problems.

To avoid shock liability, use batteries only. Do NOT use any line-connected power supply, transformer, charger, battery eliminator, etc. with blood clearing device. However line supplies are OK with well-insulated magnetic pulse generators (strobe lights).

Health professionals: Avoid nicotine addicts, vegans, and other unconsciously motivated death-wishers and their covert agendas of 'defeat the healer'. Tobacco, the most addictive (42 times more addictive than heroin) and deadly substance of abuse known, disrupts normal cardiovascular function. True vegetarian diets are missing essential amino acids absolutely necessary for the successful rebuilding of AIDS-ravaged tissues. Secondary gains (sympathy / martyrdom, work avoidance, free benefits, financial assistance, etc.) play large roles with many AIDS patients. “Recovery guilt” as friends are dying has even precipitated suicide attempts masked as 'accidents'. Avoid such entanglements, since many have unconscious death wishes.

SUPERIOR ELECTRODES: Excellent, convenient and vastly superior electrodes, reusable indefinitely can be made by butt-soldering lead wires to ends of 1” long by 3/32” dia. blanks cut from type 316 stainless steel rods available from welding supply stores (Cameron Welding Supply. 11061 Dale Ave., Stanton, CA 90680). Use 'Stay Clean' flux before soldering (zinc chloride/hydrochloric acid). Shrink-insulate TWO tight layers of tubing over soldered joints to prevent flexing/breaking and lead/copper ions from migrating. Wrap three or four turns of 100% cotton flannel around rods. Spiral-wrap with strong thread starting from wire side to end, tightly pinch cloth over the rod’s end so as to leave no metal exposed by wrapping 6 or 7 turns of thread TIGHTLY just off end of rod, then spiral wrap back to start and tie tightly with four knots then cut off excess cloth at end close to pinch -wraps. Treat end windings and knots with clear fingernail polish or Fray Check®(fabric & sewing supply stores) to prevent ravelling. Soak in a strong solution of sea salt (not table salt) containing a little wetting agent like Kodak Photo Flow, ethylene glycol, or 409 kitchen cleaner. Add a few drops of household bleach, sliver colloid, etc., for disinfectant. Store solution for reuse. Tape soaking-wet electrodes tightly over pulse sites with paper masking or Transpore™ tape or with 1 inch wide stretch elastic bands with tabs of Velcro ® at ends to fasten. Electrodes should closely conform *precisely* along blood vessels, not skewing ever so slightly over adjacent flesh. This insures better electrical conductivity paths to circulating blood and insures very low internal impedance. (~2000W). Rinse and blot-dry electrodes and skin after each use. NEVER allow bare metal to touch skin as this will cause burns manifested as small red craters that heal slowly. The objective is to get maximum current into blood vessels, not leak it over to adjacent tissue. Therefore never use any electrode wider that about 1/8 inch (3 mm).

ELECTRODE PLACEMENTS: Locate *maximum* pulse position *(NOT* to be confused with acupuncture, reflexology, Chapman, etc. points) on feet or wrists by feeling for maximum pulse on inside of ankle about 1 inch below and to rear of ankle bone, then test along top centre of instep. Place electrode on whichever pulse site on that foot that feels strongest. Scrub skin over chosen sites with mild soap and water or alcohol swab. Wipe dry. Position the electrodes lengthwise along each left and right wrists blood vessel. Note: with subjects having perfectly healthy hearts and not wearing pacers, it is convenient to use left wrist to right wrist exactly over ulnar arterial pulse paths instead of on feet.

Recent (Dec. 1995) research suggests that placing both electrodes over different arteries on the same wrist works very well (see pg. 7), avoids any current through heart, and is much more convenient and just as effective. An 8" long, 1" wide elastic stretch-band with two 1.5" lengths of 3/4" wide Velcro ® sewn to ends of opposite sides makes an excellent wrist band for holding electrodes snugly in place. With electrode cable unplugged, turn switch ON and advance amplitude control to *maximum*. Push momentary SW. 2 'Test' switch and see that the red and green light emitting diodes flash alternately. This verifies that polarity is reversing about 4 times per second (frequency is *NOT* critical) and that batteries are still good. When LED's don't light replace all three 9V batteries. Zener diodes will extinguish the LEDs when the three 9V battery's initial 27V drops below 18V after extended use. Never use any electrode larger than 1.125" (28 mm) long by 1/8" wide to avoid wasting current through surrounding tissue. Confine exactly over blood vessels only. Apply drops of salt water to each electrode's cotton cover ~every 20 minutes to combat evaporation and insure optimum current flow. Later devices are solid-state, use only three batteries and no relays, and are much smaller.

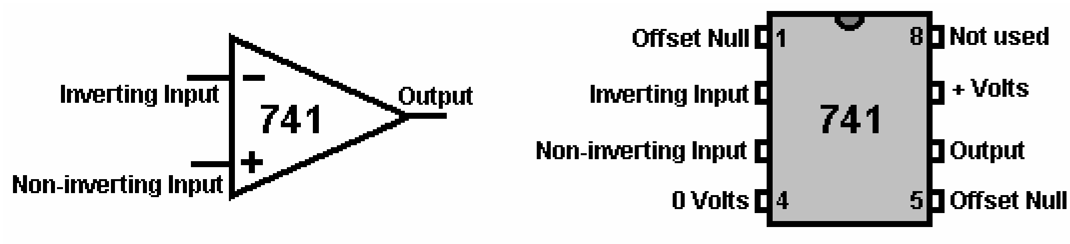
Now rotate amplitude control to *minimum* (counter-clockwise) and plug In electrode cable. Subject now advances dial slowly until he feels a "thumping" and tingling. Turn as high as tolerable but don't advance amplitude to where It is ever uncomfortable. Adjust voltage periodically as he adapts or acclimates to current level after several minutes. If subject perspires, skin resistance may decrease because of moisture, so setting to a lower voltage for comfort is indicated. Otherwise it is normal to feel progressively less sensation with time. You may notice little or no sensation at full amplitude immediately, but feeling will begin building up to maximum after several minutes at which time amplitude must be decreased. Typical adapted electrode-to-electrode impedance is on the order of 2000W. Typical comfortable input (to skin) is about 3 mA, and maximum tolerable input (full amplitude) is about 7 mA but this 'reserve' margin although harmless is unnecessary and can be uncomfortable. Current flowing through blood Is very much lower than this *external* input because of series resistance through skin, tissue and blood vessel walls, but 50 to 100 µA through blood is essential.

Apply blood neutralizer for about 2 hours daily for ~2 months. Use judgment here. The limiting factor is detoxification. Carefully monitor subject's reactions (discomfort, catarrh, skin eruptions, weeping exudates, rashes, boils, carbuncles, coated tongue, etc.). With very heavy infections, go slower so as not to overload body's toxic disposal capability. With circulation-impaired diabetics, etc., you may wish to *extend* session times. Again, ***have subject drink lots of water***. Recent changes in theoretical protocol being currently tested suggest following up the three weeks of treatments with a 24 hours per day (around the clock) continuous electrification of blood for two days to deal a knockout blow to the remaining HIV's 1.2 day life cycle. (A. Perelson; Los Alamos Biophysics Group, Mar. 16, 1996 "Science" Journal.) Remember to remoisten electrodes regularly. If you absolutely ***must*** ingest prescription drugs, do so immediately ***after*** turning off instrument and allow 24 hours before next treatment to let concentrations in blood plasma decay to lower levels.

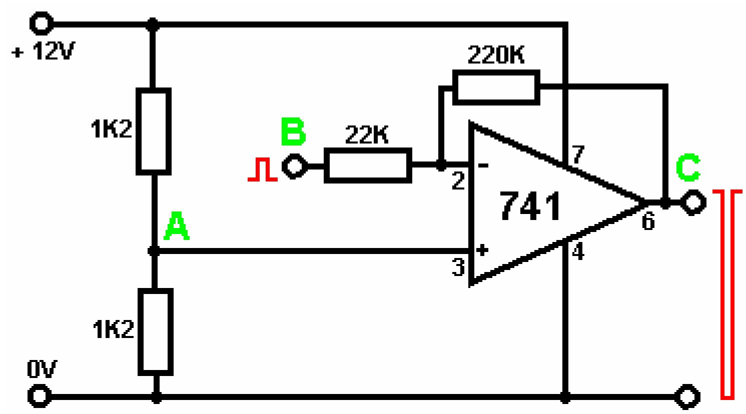
Remember, if subjects ever feel sleepy, sluggish, listless. nauseous, faint, bloated, or headachy, or have flu-like reactions they may be neglecting sufficient water intake for flushing toxins. We interpret this as detoxification plus endorphin release due to electrification. Let them rest and stabilize for about 45 minutes before driving if indicated. If this detoxing becomes oppressive, treat every *second* day. Treating at least 21 times should 'fractionate' both juvenile and maturing HIV to overlap maximum neutralization sensitivity windows and interrupt 'budding' occurring during HIV cells' development cycles. Treatments are claimed to safely neutralize many other viruses, fungi, bacteria, parasites, and microbes in blood. See patents US 5,091,152 US 5,139,684 US 5,188,738 US 5,328,451 and others as well as numerous valid medical studies which are presently little known or suppressed. Also. ingesting a few oz. of about 5 parts per million of silver colloid solution daily can give subjects a 'second intact immune system' and minimise or eliminate opportunistic infections during recovery phase. This miracle substance Is pre-1938 technology, and unlike ozone is considered immune from FDA harassment. Silver colloid can *easily* be made at home electrolytically in minutes and in any desired quantities and parts per million strength for under 14 cents per gallon plus cost of water. It is ridiculous to purchase it for high prices. Colloid has no side effects, and is known to rapidly eliminate or prevent hundreds of diseases. Sliver colloids won't produce drug resistant strains as will all other known antibiotics. No reasonable amount can overdose or injure users either topically, by ingestion, or medical professional injection.

The 741 Operational Amplifier.

An important and very useful group of Integrated Circuits is the "Operational Amplifier" or "op-amp" group. These devices have a very high gain, an 'inverting' input and a 'non-inverting' input. There are many op-amps but we will look at just one popular type called the "741" which has an 'open-loop' gain of 100,000 times. All operational amplifiers work in the same way in theory. The way they operate in a circuit is controlled by the external components attached to them. They can operate as inverting amplifier, a non-inverting amplifier (i.e. a 'buffer'), a comparator, an astable multivibrator, and various other things. The symbol and connections for a 741 op-amp are:



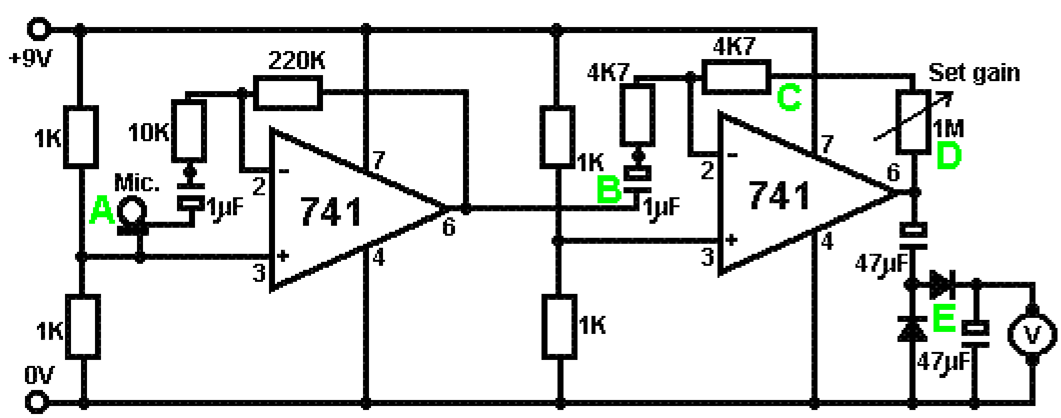
We can connect the 741 chip to act as an amplifier with any set gain level that we choose:



Here, the gain is set by the ratio of the 220K resistor to the 22K resistor. This circuit has a gain of 10 times, so the input signal at point 'B' will generate an output signal at point 'C' which is ten times larger, **provided** that the output signal does not approach the battery voltage. If it does, then clipping will occur with the top and the bottom of the output waveform chopped off at about a volt away from the battery voltage levels, approximately 1 Volt and +11 Volts in this example.

Operational amplifiers are generally designed to operate from a dual power supply. In the above example, the supply would be created by using two 6 Volts batteries instead of one 12 Volt battery. To avoid the inconvenience of this, a mid-point voltage is generated at point 'A' by using two equal resistors in series across the battery. This gives a central voltage of +6 Volts which is fed to the IC.

This circuit can be used in many applications. Here is a circuit for a meter to measure sound intensity:



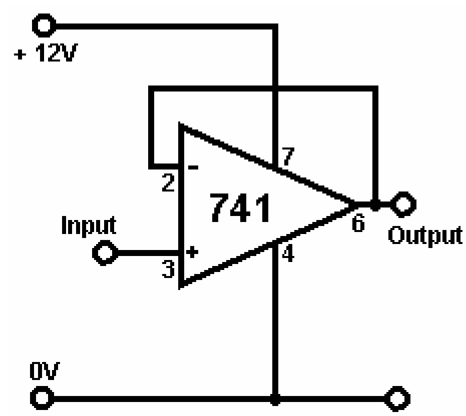
This circuit is two copies of the previous circuit. Each 741 chip has a reference voltage of half the supply voltage created by a voltage-divider pair of 1K resistors. This voltage is fed to pin 3 of the chip, which is the non-inverting input.

At point ‘A’, a microphone or small loudspeaker is used to generate a signal voltage when sound reaches it. This voltage is fed to the 741 op-amp via a 1 microfarad blocking capacitor. This passes the audio signal through while blocking the +4.5 Volts DC on pin 3. The first 741 has a gain of 22, set by the 10K and 220K resistors (220/10 = 22).

Point ‘B’ then receives an audio signal 22 times larger than the signal produced by the microphone. This signal is still quite small, so the second 741 boosts it further. The gain of the second 741 is variable and depends on the resistance set on the 1M variable resistor. If the variable resistor is set to zero ohms, then the gain of the second 741 will be controlled by the 4K7 resistor at point ‘C’ alone and so will be 1 (4.7/4.7 = 1). If the variable resistor is set to its maximum value, then the gain of the second 741 will be some 214 (1,004,700/4,700 = 213.8).

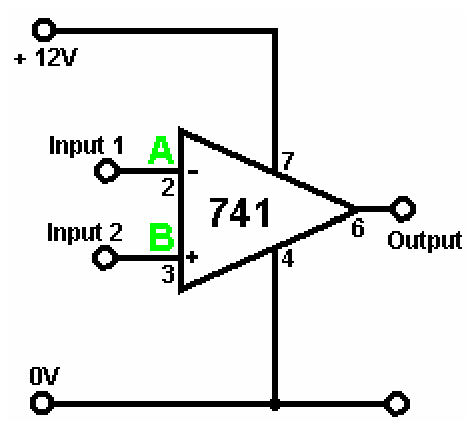
The two op-amps together have a combined gain which ranges from 22 to 4702. The amplified audio signal arrives at point ‘D’ and it can be adjusted to a respectable value. This alternating voltage is now rectified via the diodes at point ‘E’ and it builds up a DC voltage across the 47 microfarad capacitor there. This voltage is displayed on a voltmeter. The result is that the voltmeter shows a reading directly proportional to the sound level reaching the microphone.

The 741 can be wired as a **buffer**. This is the equivalent of an emitter-follower circuit when using transistors. The set up for the 741 is:



Difficult circuit - huh! Are you sure you can afford all the extra components? This circuit utilises the full gain of the 741 chip. The output follows the input waveform exactly. The input requires almost no current, so the circuit is described as having a ‘high input impedance’. The output can drive a serious load such as a relay, so the circuit is described as having a ‘low output impedance’.

The 741 chip can be wired to act as a comparator. This is the circuit:



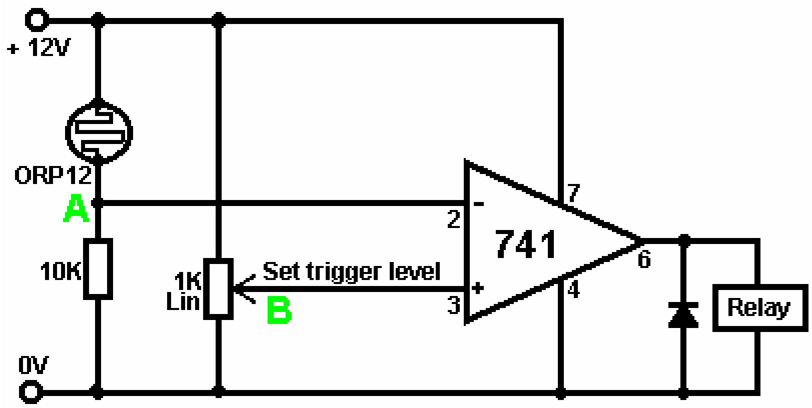
Are you sure you are up to such a difficult circuit? Bit complicated - huh! This is the basic operational form for an operational amplifier.

If the voltage at point 'A' is higher than the voltage at point 'B' then the output goes as low as it can go, say 1 or 2 volts.

If the voltage at point 'A' is lower than the voltage at point 'B' then the output goes as high as it can go, say 10 volts or so.

Having seen how transistor circuits work, you should be able to understand why the 741 chip circuitry (which is a transistor circuit inside the 741 package) needs some voltage inside the supply rails to provide an efficient high-current output drive.

Here is a 741 version of the light-operated switch:

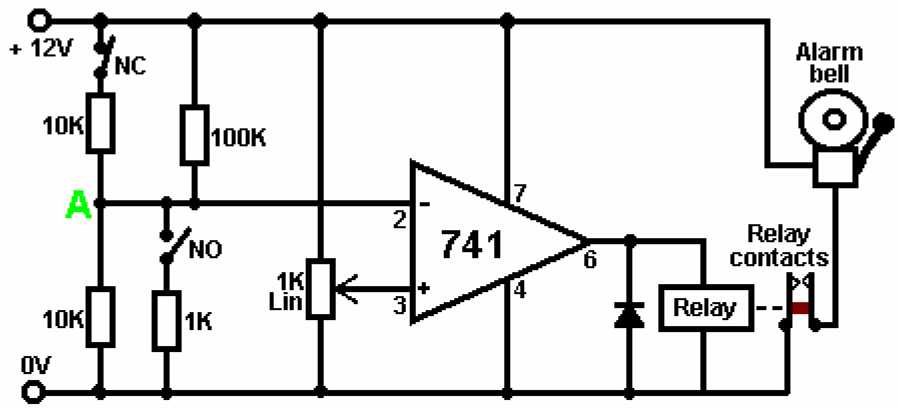


This circuit is set up as evening falls. We want the relay to have minimum voltage across it in daylight, so the voltage at point 'A' needs to be higher than the voltage at point 'B'. As the 1K variable resistor is across the supply voltage, its slider can be set to any voltage between 0 Volts and +12 Volts. To make this easy to do, we choose a 'linear' variable resistor as the logarithmic variety would be hard to adjust in this application. With the 'linear' version, each 1 degree of rotation of the resistor shaft causes the same change in resistance, anywhere along the range. This is not the case for the logarithmic variety.

Anyhow, we adjust the variable resistor downwards until the relay voltage drops to a minimum. When the light level has fallen to the level at which we wish the circuit to trigger, we adjust the variable resistor to make the relay click on. The 741 chip has a very rapid output voltage swing when the input voltages swap over, so the relay switching will be decisive. The switching can be made even more positive by adding a resistor between the output and point 'B'. This acts like a Schmitt trigger when switching occurs by providing some additional positive feedback, lifting the voltage at point 'B'.

If you wish the circuit to trigger on a rising light level, just swap the positions of the 10K resistor and the ORP12 light-dependent resistor. The same circuit will operate as a temperature sensing circuit by substituting a 'thermistor' (which is a temperature-dependent resistor) for the ORP12.

If we would like the circuit to act as a burglar alarm, we could use the same circuit like this:



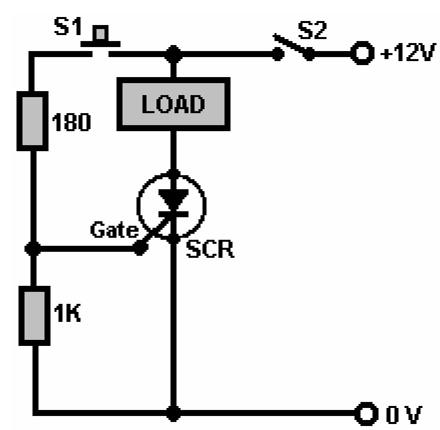
The circuit is still controlled by the voltage at point 'A'. Under normal circumstances, this voltage will be near +6 Volts (produced by the two 10K resistors and the 100K resistor). The upper switch marked 'NC' for 'Normally Closed', represents a chain of, say, magnetic switches attached to doors and windows. If any of these are opened, then the voltage at point 'A' will be dictated by the lower 10K resistor in series with the 100K resistor. This will cause the voltage at 'A' to fall instantly to a low value, triggering the circuit.

The 'NO' switch ('Normally Open') represents one or more pressure-operated switches under carpets or rugs and/or switches which get brushed when doors are swung open, etc. These switches are wired in parallel across each other and if any of them is closed for even a millionth of a second, the voltage at point 'A' will be pulled down by the 1K resistor and the circuit will be triggered.

The circuit can be latched on in any one of a variety of ways. One relay contact can be used to hold the relay on or hold the voltage at 'A' low. A transistor can be wired across the relay to hold the circuit on, etc. etc. If this is done, the circuit will remain in its triggered state until the supply voltage is interrupted. You might prefer to use a 555 chip to limit the length of time the alarm sounds to three minutes or so.

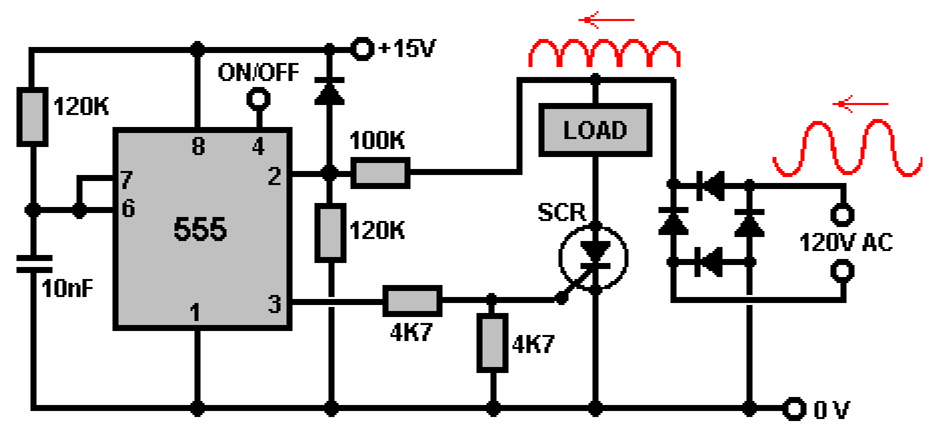
The SCR and Triac.

An alternative to using a relay or semiconductor latch is to use a **S**ilicon **C**ontrolled **R**ectifier usually referred to as an 'SCR' or 'Thyristor'. This device is normally "off" with a very high resistance to current flow. If it is switched on by applying a voltage to its Gate connection, it stays continuously on until some external device stops current flowing through it. The following circuit shows how it operates:



When the voltage is first applied to the circuit by closing switch S2, the SCR is in its OFF state so no current is supplied to the load. If the press-button switch S1 is pressed, a current is fed into the Gate of the SCR, turning it ON. When switch S1 is allowed to open, the SCR remains in its ON state and it will stay that way until the current through it is cut off. Opening switch S2 cuts off the current to the load and the SCR returns to its OFF state. A very valid question would be: "Why have an SCR at all and just turn the load on and off with switch S2?". The answer is that switch S1 might be the under-carpet pressure pad of a burglar-alarm and it might be operated some hours after switch S2 was closed to activate the alarm system. Stepping off the pressure pad does not stop the alarm sounding.

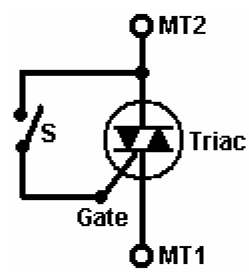
While this sort of DC latching action is useful, it is more common for an SCR to be used in an AC circuit. For example, take the circuit shown here:



The 120 volt AC supply coming in from the right hand side, is converted to positive-going sine-wave pulses by the diode bridge. This pulsing voltage is applied to the Load/SCR path. If the voltage at pin 3 of the 555 chip is low, then the SCR will remain OFF and no current will be fed to the load device. If the voltage on pin 3 goes high **and** the voltage applied to the Load/SCR chain is high, then the SCR will be switched ON, powering the load until the pulsing voltage drops to its zero level again some 1/120 of a second later.

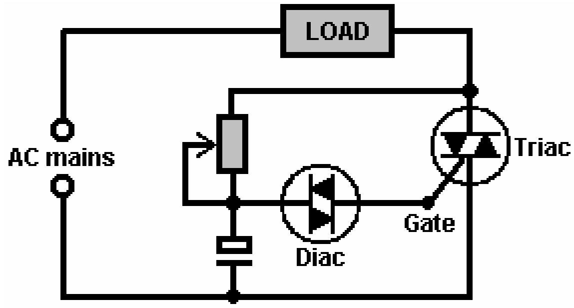
The 555 chip is connected to form a monostable multivibrator and the timing components (the 120K resistor and the 10nF capacitor) cause it to output a 1 millisecond pulse which is long enough to trigger the SCR into its ON state, but short enough to have finished before the mains pulse reaches its zero-voltage level again. The 555 chip is triggered by the rising mains voltage being passed to its pin 2 through the voltage-divider 100K and 120K pair of resistors, and that synchronises it with the AC waveform. Pin 4 of the 555 chip can be used to switch the load power on and off.

In the circuit shown above, the diode bridge is needed to convert the incoming AC waveform to pulsing DC as shown in red in the diagram, as the SCR can only handle current flowing in one direction. The AC load equipment works just as well with the pulsing DC as with a full blown AC waveform. A better semiconductor construction is the 'Triac' which acts like two SCR devices back-to-back in a single package. It is shown like this in circuit diagrams:



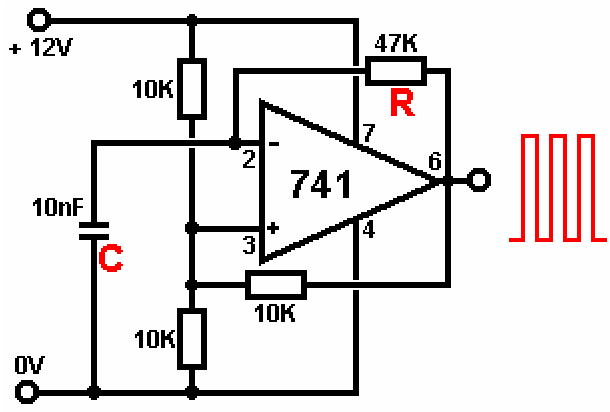
There are three connections to the device: Main Terminal 1, Main Terminal 2 and the Gate. When switch 'S' shown in the diagram is closed, the triac conducts on both positive and negative voltages applied to its MT1 and MT2 terminals. When the switch is open, the device does not conduct at all.

If the external circuit containing switch 'S' is placed inside the device as a permanently closed circuit, then the device becomes a 'Diac' which can be used to trigger a Triac and give a very neat circuit for controlling the power to an item of AC mains equipment as shown here:



Here, the variable resistor/capacitor pair controls the point on the AC waveform that the Triac is triggered and so controls how much of each sinewave cycle is passed to the mains equipment, and so it controls the average power passed to the equipment. A very common use for a circuit of this type is the 'dimmer-switch' used with household lighting.

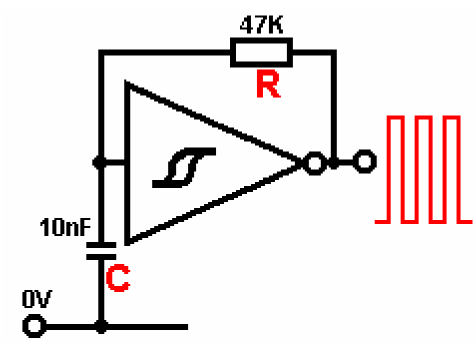
To return now to the 741 chip. The 741 can also be used as an **astable multivibrator**. The circuit is:



The rate of oscillation of this circuit is governed by the Resistor marked '**R**' in the diagram and the capacitor marked '**C**'. The larger the resistor, the lower the rate of oscillation, the larger the capacitor, the lower the rate of oscillation.

When the output goes high, capacitor '**C**' charges up until the voltage on it exceeds the mid-rail voltage on pin 3, at which time the 741 output goes low. The capacitor now discharges through resistor '**R**' until the voltage on it drops below the voltage on pin 3, at which time the output goes high again. The 10K resistor connecting the output to pin 3 provides some positive feedback which makes the 741 act quite like a Schmitt trigger, sharpening up the switching.

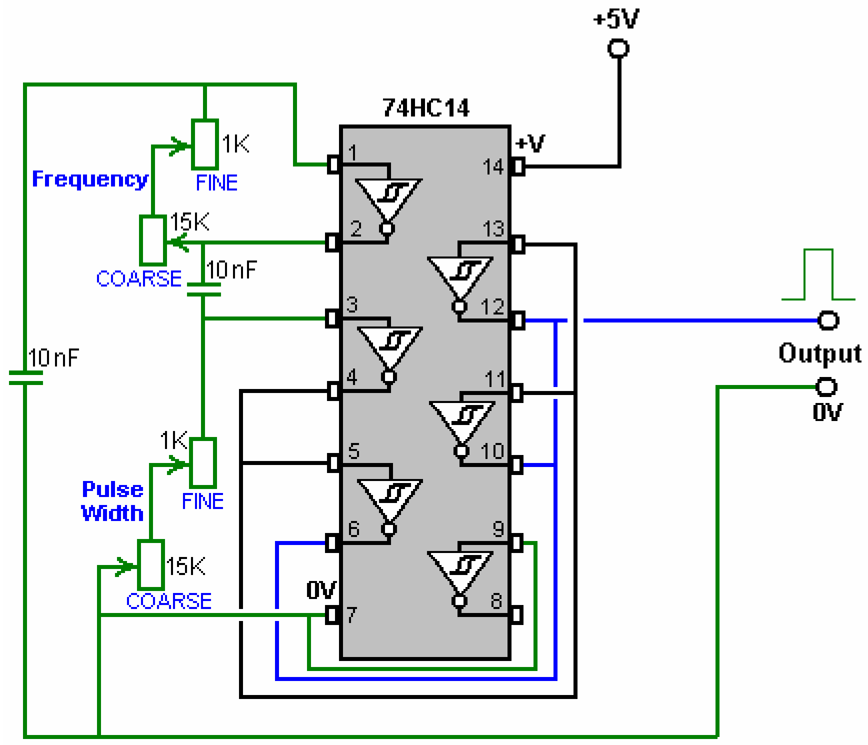
The same arrangement of resistor and capacitor applied to a Schmitt inverter or Schmitt NAND gate causes exactly the same oscillation:



If you would like to see additional ways of using 741 and 555 chips, I can recommend the excellent book "Elementary Electronics" by Mel Sladdin and Alan Johnson ISBN 0 340 51373 X.

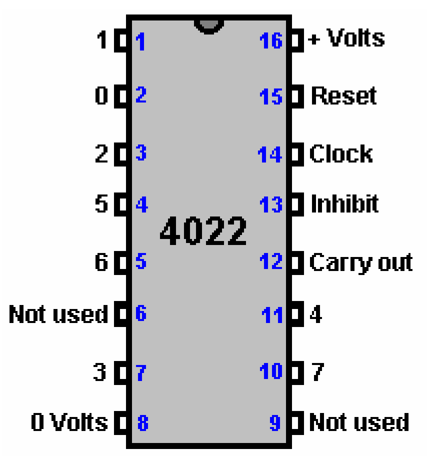
A Hex Inverter Signal Generator.

Here is a very well tested and highly thought of, low-cost oscillator circuit, using a 74HC14 Schmitt inverter chip (or the 40106B higher voltage CMOS chip). It allows fine tuning control of the frequency and the pulse width produced. Three of the inverters are connected together to give a more powerful output current drive:



The 4022 Divide-by-Eight Chip.

One very useful CMOS integrated circuit is the '4022' chip which is a 16-pin 'divide by 8' chip with built-in decoding. The connections are:



If pin 14 is provided with the output from some variety of astable multivibrator, on the first pulse, this chip sets the "0" output on pin 2 to High while the other outputs are Low. On the next pulse, the "0" output goes Low and the "1" output on pin 1 goes High. On the next pulse, output "1" goes Low and the "2" output on pin 3, goes High. And so on until on the eighth pulse, output "7" on pin 10 goes Low and output "0" goes high again.

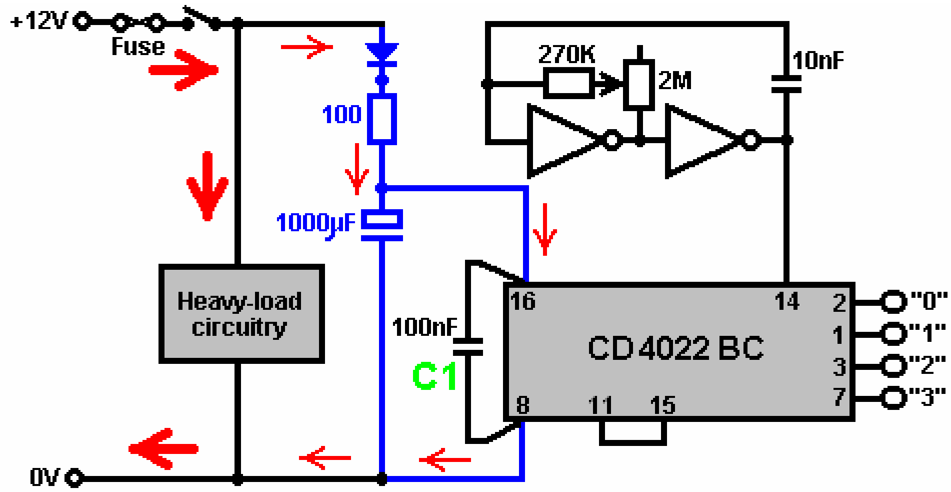
The chip can also divide by lower numbers:

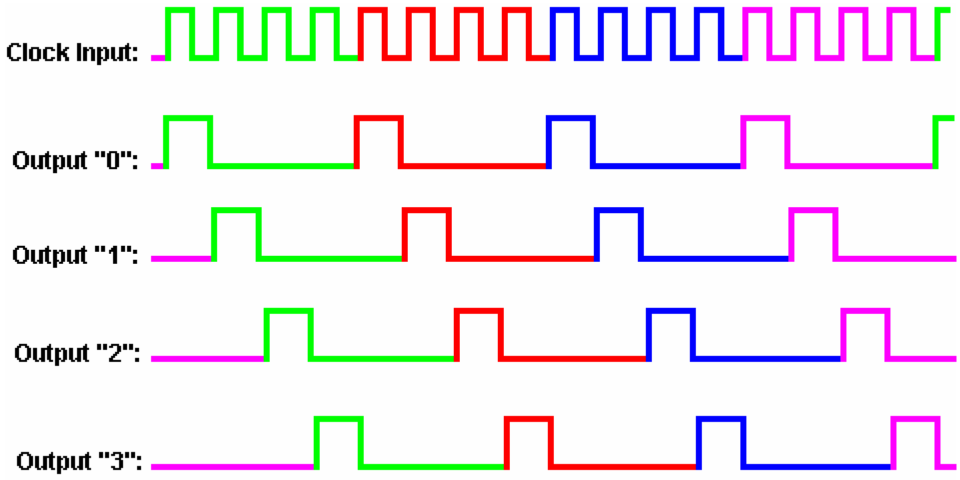
For 'Divide by 7' operation, connect pin 10 to pin 15 (this resets the output to '0')
For 'Divide by 6' operation, connect pin 5 to pin 15
For 'Divide by 5' operation, connect pin 4 to pin 15

For ‘Divide by 4’ operation, connect pin 11 to pin 15
For ‘Divide by 3’ operation, connect pin 7 to pin 15
For ‘Divide by 2’ operation, connect pin 3 to pin 15

If you want a ‘Divide by 1’ circuit, I suggest you cut down on the amount of alcohol you drink.

Here is an illustration of a ‘Divide by 4’ setup:





There are a number of things to notice in the above diagram. Firstly, the practical arrangements for circuitry have not been stressed before. If the circuitry has a pulsing circuit drawing heavy current, as shown by the thick red arrows, then it should be physically connected to the battery and any low-current circuitry should be further away from the battery. The supply from the battery should have a fuse or circuit breaker and a switch in the line before anything else is connected, so that if any component develops a fault and goes short-circuit, the fuse will blow and prevent any significant problems.

Secondly, it is a good idea to provide the other circuitry with a smoothed power supply as shown by the blue components in the diagram. This minimises the effect if the battery voltage gets pulled down by the pulsing of the high-current circuitry. The diode (silicon, 1 Amp, 50 V) stops the heavy current circuit drawing current from the large smoothing capacitor. The 100 ohm resistor limits the current into the large capacitor on switch-on and provides a little more smoothing. This circuitry is called “de-coupling” as it de-couples the low current circuitry from the high current circuitry.

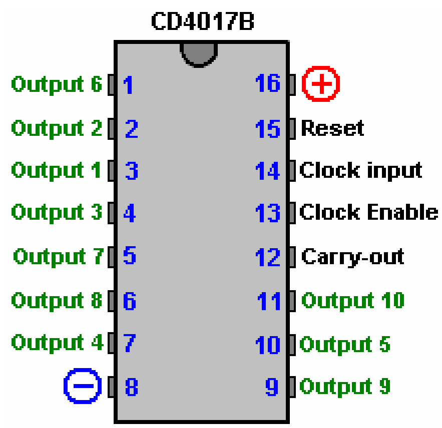
Thirdly, notice capacitor “C1” which is wired physically as close to the power supply pins of the integrated circuit as is possible. If a spike is superimposed on the battery supply, then this capacitor soaks it up and prevents it damaging or triggering the integrated circuit. A spike could be caused by a very strong magnetic pulse nearby as that can induce an extra voltage in the battery wires.

The lower part of the diagram shows the output voltages produced as the clock pulses reach pin 14 of the chip. The positive-going part of the clock signal triggers the change in state of the outputs. If necessary, a positive-going pulse on the reset pin, pin 15, causes output “0” to go high and the other outputs to go low.

The 4017 Divide-by-Ten Chip.

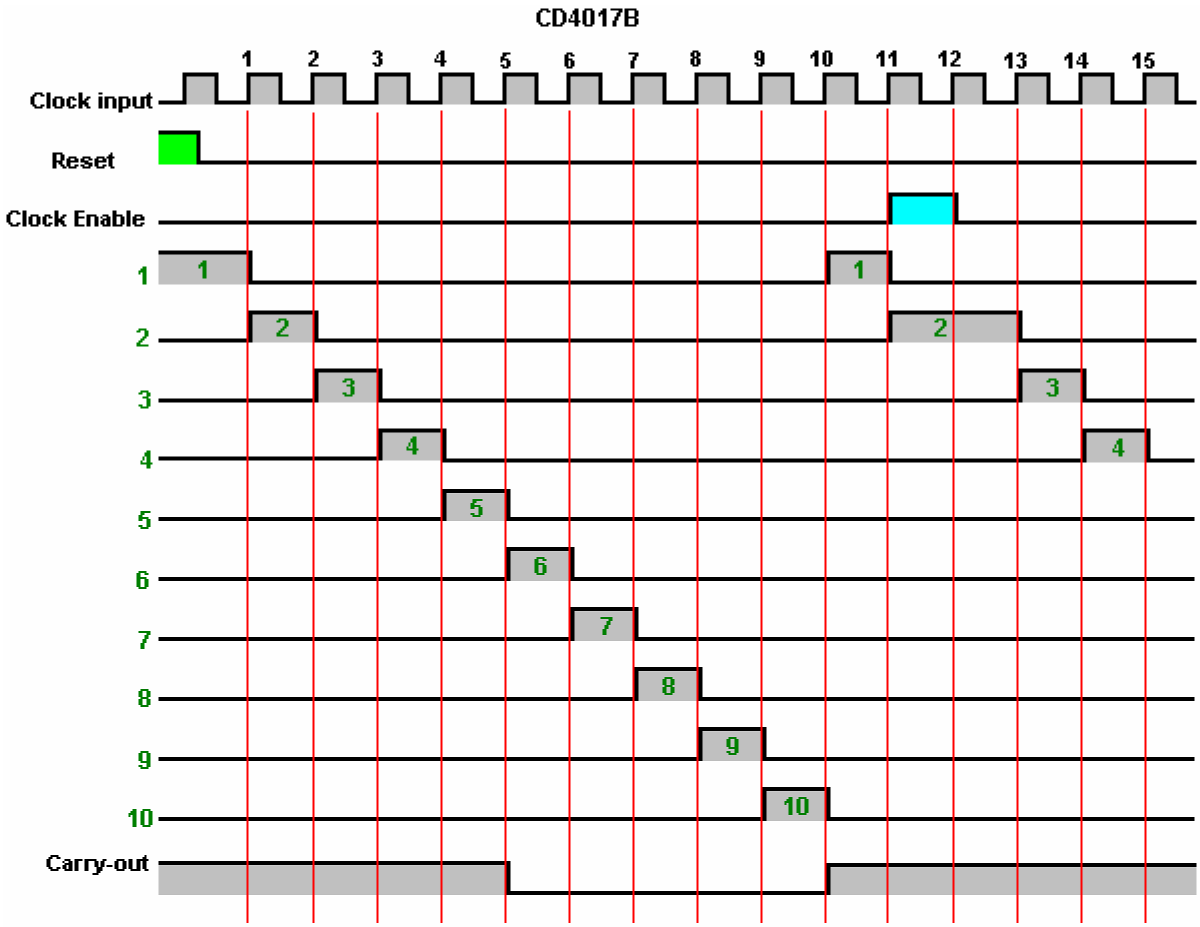
Now, to take this output sequencing a little further. For example, the Charles Flynn magnet motor shown in Chapter 1 needs coils to be powered up, one after the other and only one should be on at any one time. This calls for a circuit which has a large number of outputs. The CD4022BC chip gives up to eight outputs one after the other. The CD4017B chip gives up to ten outputs one after the other but there is no need to be limited by these numbers as more than one chip can be used. If you find this section difficult to understand, then just skip past to the next section as it is not important for you to understand these larger circuits.

The pin connections for the divide-by-ten CD4017B chip is shown here:



While this shows outputs 1 to 10, the manufacturers and some people who draw circuits, prefer to label the outputs as “0 to 9” which correspond to digital displays. In our style of operation, it is easier to think of the ten outputs as being from 1 to 10.

You will notice that there are two pin labels which we have not come across before, namely, the “Carry-out” pin and the “Clock Enable” pin. These allow us to use several of these chips in a row to give a much larger “divide-by” number. The “Clock Enable” pin can be used to block the clock input. The operation is like this:



In this example, the sequence is started by the Reset pin being given a high voltage as shown by the green shading. This pushes the output pin 1 to a high voltage and all of the other outputs to a low voltage and holds those voltages as long as the reset voltage is high.

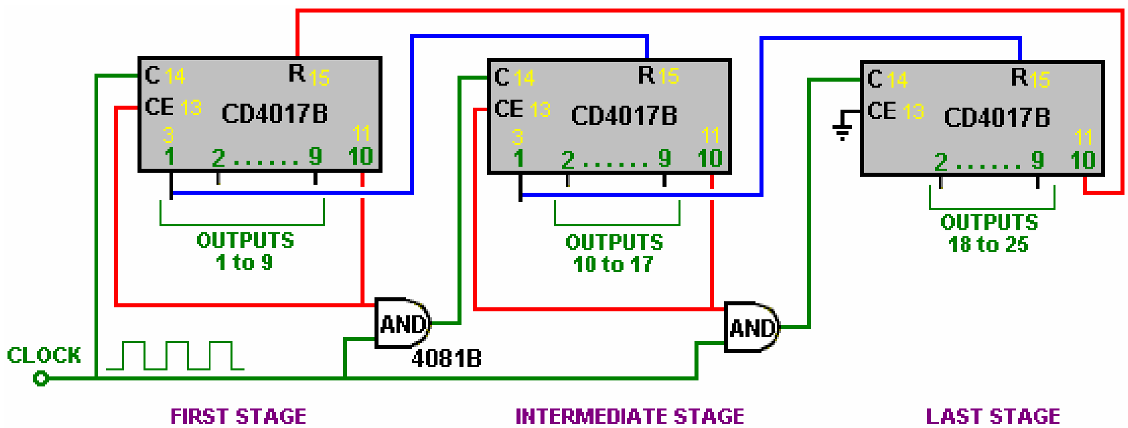
When the Reset voltage drops, the next rising edge of the clock pulse (marked “1” in the diagram) causes the output 1 to go low and output 2 to go high. Each of the successive clock pulses “2” to “9” moves the high voltage steadily along the outputs until output pin 10 is high.

The next clock pulse rising edge (marked “10” in the diagram) starts the sequence again with output 10 going low and output 1 going high again. If nothing changes, then that sequence of output voltage changes will continue indefinitely.

However, in the diagram above, the Clock Enable pin voltage is driven high on clock pulse “11”. Output 2 has just gone high and would have gone low when the rising edge of clock pulse “12” occurred, but in this case, the Clock Enable feature blocks the clock pulse and prevents it reaching the rest of the circuitry. This causes the output 2 voltage to stay high as long as the Clock Enable remains high. In this example, the Clock Enable voltage stays high for just one clock pulse, causing the output 2 voltage to be high for twice it’s usual length, and then the sequence continues as before.

A Divide-by-Twenty-five Circuit.

Here is one way to get a large “divide-by” number. This example is divide-by-25 because there is only one ‘intermediate stage’ but there can be any number and each additional one adds another eight outputs to the total:



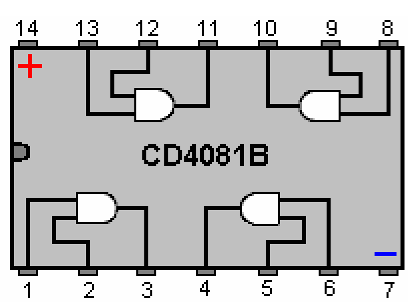
At startup, output 10 of the first stage (which is physical pin 11 of the chip) is at a low voltage. This holds the Clock Enable (pin 13) low, allowing the clock pulses to enter the first stage. Because the output 10 voltage is low, one input to the first AND gate is held low, preventing it from letting the clock pulse flow through it, i.e. the "gate" is closed to through traffic.

The first stage chip then operates as normal, producing outputs 1 to 9 in order as you would expect. The next clock pulse sets the first stage output 10 high, allowing the clock pulses through the first AND gate and holding the Clock Enable (pin 13) high, which in turn locks the output 10 high, dropping the first stage chip out of the operation.

As the output 1 of the first stage is connected to the Reset (pin 15) of the second chip, it will have been cleared and it's output 1 set high, which in turn Resets the third chip and closes the second AND gate. So, when the first pulse gets through to the second chip, it pushes it from state 1 to state 2 where the output 2 goes high. For that reason, output 1 of the second chip is not one of the outputs which can be used by whatever following circuitry you choose to connect to this system. Consequently, only eight of the ten outputs of the second chip are available as counter outputs. That is, outputs 1 and 10 are taken up in passing the switching sequence between the various chips in the chain.

The same applies to all following chips in the chain, each extra chip adding up to eight extra sequential outputs. On the final stage chip, if you connect the red Reset wire (which goes back to fire up the first chip again) to output 9 instead of output 10 of the final chip, then you get a divide-by-24 result.

If the Reset is taken from output 8 of the final chip, then you get a divide-by-23 result, and so on. Using this method, you can have a divide-by circuit for any number you want. These chips are very popular and so their cost is low, making the entire circuit cheap to make. The pin connections for the AND gates is shown here:

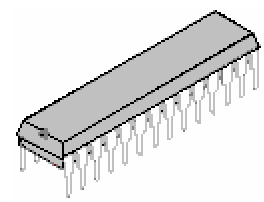


The PIC Revolution.
Over the years, there have been advances in the way that circuitry can be put together, prototypes built and tested. Initially, "valves" or "vacuum tubes" were used and circuits required a good deal of electrical power in order to operate. Mechanical vibrators or "reeds" were used to generate the switching needed to convert DC into AC. Then the transistor became widely available and the transistor replaced the mechanical vibrator reed, the circuit being called an "astable multivibrator" and comprising of two transistors wired back to back (as described in chapter 12). Then came the digital integrated circuit with it's "NOR gates" which could also be wired back to back to make a multivibrator. This was done so often that a special integrated circuit called the "555 chip" was designed to do the job

all on its own. That chip has been a tremendous success and is now found in all sorts of different circuits, being very easy to use, very robust and very cheap. Surprisingly, the dominant position of the "555" chip is being challenged by a completely different type of chip, one which is essentially, a computer on a single chip, and which is called a "PIC controller".

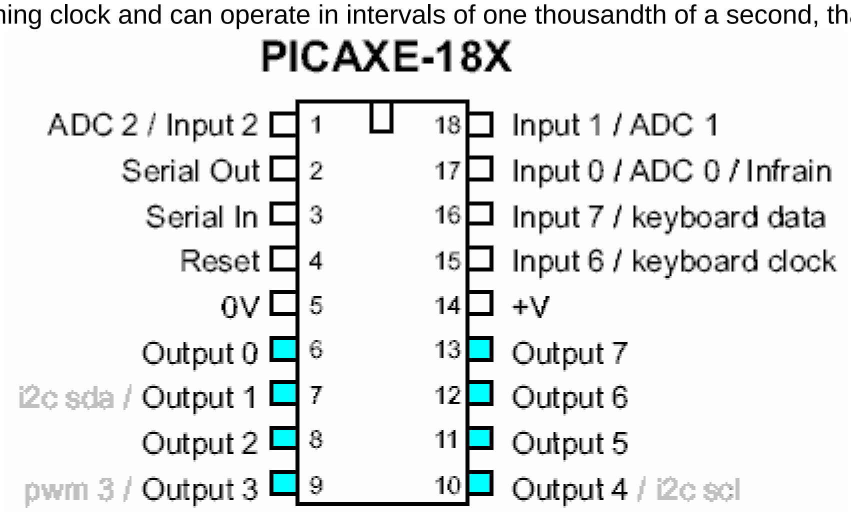
This new type of chip is not expensive, is easy to use, and can be changed to perform a different task in just a few seconds. It can perform timing tasks. It can act as a multivibrator. It can act as a "Divide-by-N" chip. It is a very impressive chip which is very useful. The reason that I mention it here is because it is at the heart of the fastest working Tesla Switch research forum around (the "energetic forum" group). The chip is something you need to know about as it will certainly take over more and more circuit applications in the coming years.

There is a whole family of these processor chips, but I will select just one for this description, and that will be the one being used by the "energetic forum" members, and I have to thank Jeff Wilson for his help in describing this circuitry, the programming and the methods which he uses.



First, however, some information on this new design of chip and the methods used with it. The one used by Jeff is called the "PICAXE-18X" and it looks like the chip shown here. From which you can see, it looks just like any other chip, although with eighteen pins. The powerful performance comes from the way that it operates. You are probably familiar with the "555" chip and understand that it operates by changing the voltage on just one of it's pins (pin 3) the output pin, from a low voltage to a high voltage. The PIC chip can do that as well, but even better still, it has more than one output pin and it can alter the voltage on any of those pins to either a high or a low voltage and it can do that in any order and with any timing that you choose. This makes it a very versatile chip indeed and one which is very well suited to be the central controller for a Tesla Switch test environment.

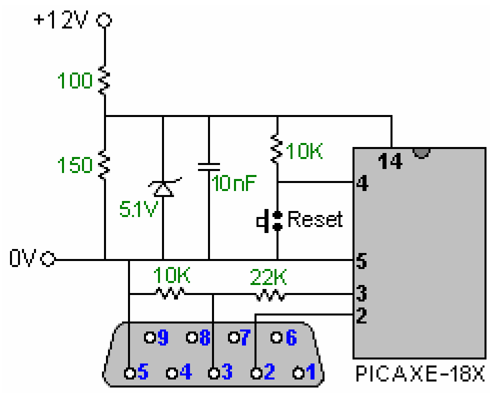
The chip is used by wiring it into a circuit in the same sort of way that a 555 chip would be used, except that the PIC has it's own internal timing clock and can operate in intervals of one thousandth of a second, that is, one millisecond.



The top eight pins are for making the chip work. The next two are for providing the chip with electrical power. The bottom eight pins are separate outputs, any one of which can operate switches, timers, etc., just as the output from a 555 chip can. Having been named by computer people, instead of the eight output pins being numbered from 1 to 8 as any rational person would do, they have numbered them from 0 to 7.

The voltage on those output pins will be either High or Low. PIC switching can be used with a wide range of different free-energy designs. The PIC chip is generally supplied with a socket, a connecting cable and a program for feeding instructions into the chip. The feed is generally from an ordinary PC. The programming instructions are very simple and anyone can learn how to use them in just a few minutes.

So let's look at a circuit which has been used by Jeff when he tests prototype circuitry. The first part of the circuit is for connecting the standard PC socket to the PIC chip and it looks like this:



A standard 9-pin computer socket has it's pin 2 connected to the PIC's pin 2, pin 3 connected to the PIC's pin 3 via a 10K / 22K voltage divider resistor pair (which lowers the incoming signal voltage), and pin 5 is connected to the PIC's pin 5. That is all that's needed to feed information into the PIC chip.

The chip is supplied from a 12-volt battery but as it needs a 5-volt supply, the 100 / 150 ohm (2 watt) resistor pair is used to drop the 12 volts down to about 7 volts and then the 5.1-volt zener diode clamps the voltage at 5.1 volts, which is just what the chip needs. The tiny 10 nF (0.01 microfarad) capacitor is there to trap any voltage spikes should any be picked up from some outside influence. Finally, the press-button switch used to short between pins 4 and 5 is used to wipe out the program inside the PIC, ready for a new program to be loaded.

The actual programming is not difficult and the feed into the chip is handled by the program supplied with the chip and which is run on your home computer. Let's take an example. Suppose we want the output on pin 10 to act as a clock signal. The people who made the chip expect that pin to be called "Output 4" in the program. Please don't ask me why it isn't called "10" in the program as I have no answer for you other than "it takes all sorts of people to make a world".

All right, suppose we want to produce an output signal like a 555 chip running at 50 Hz. We choose one of our output pins, say, the physical pin 10, that being the bottom right hand pin on the chip. As you can see from the pin diagram of the chip shown above, pin 10 is called "Output 4" in a set of commands, or just "4" to save typing. The program might be:

```
Main:
  high 4
  pause 10
  low 4
  pause 10
goto Main
```

Wow - really difficult stuff !! Only a genius could manage to program! Well, we'll see if we can struggle along with this "difficult" stuff.

The "Main:" at the start is a "label" which can be jumped to and that is done by the "goto Main" command which sends the chip back to repeat the commands in the loop indefinitely (or until the chip is powered down).

The second line "high 4" tells the chip to put the maximum possible voltage on the "Output 4" which is the physical pin 10 of the chip. The chip does this immediately, with no time delay.

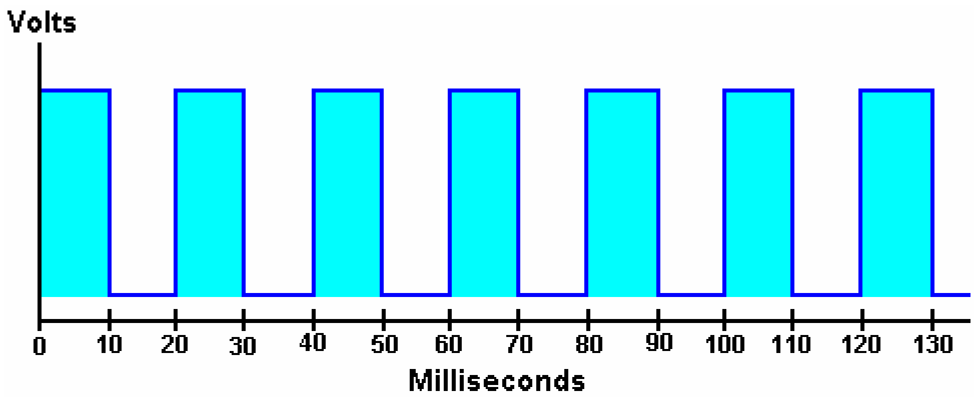
If we want the output to give a 50 Hz output signal, then the voltage on our chosen output pin will have to go high, pause, go low, pause and go high again, 50 times each second. As there are 1,000 milliseconds in one second, and the chip's clock runs with 1 millisecond ticks, then we need our complete cycle of "up, pause, down, pause" to happen 50 times in those 1,000 clock ticks. That is, once every 20 ticks, so each delay will be 10 clock ticks long.

The third line "pause 10" tells the chip to sit on it's hands and do nothing for the next 10 ticks of it's internal clock (which ticks 1,000 times per second).

The fourth line "low 4" tells the chip to lower the output voltage on it's "Output 4" (pin 10 in real life) to it's minimum value.

The fifth line "pause 10" tells the chip to wait for 10 milliseconds before doing anything else.

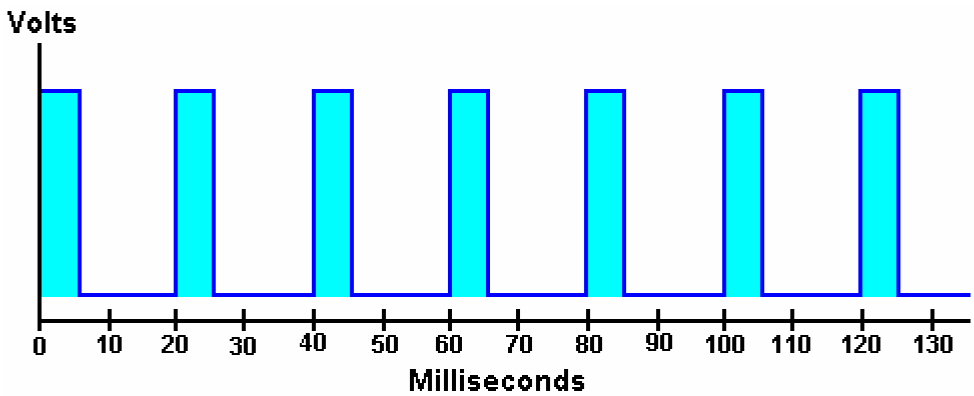
The last line "goto Main" tells the computer to go back to the label "Main:" and continue with whatever instructions follow that label. This puts the chip into an 'infinite loop' which will make it generate that output waveform continuously. The output will look like this:



This gives an even waveform, that is, one with a Mark/Space ratio of 50:50 or a Duty Cycle of 50%. If we want the same rate of pulsing but a Duty Cycle of just 25% then the program would be:

```
Main:
  high 4
  pause 5
  low 4
  pause 15
goto Main
```

which produces this waveform:

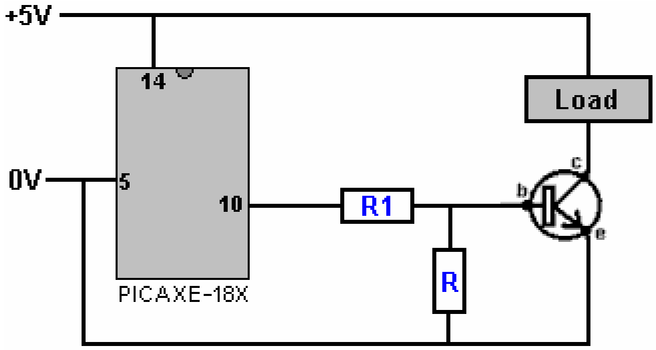


If you wanted "Output 7" (physical pin 13) to do the reverse of this at the same time - that is, when Output 4 goes high we want Output 7 to go low, and vice versa, then, for a 20% Duty Cycle the program would be:

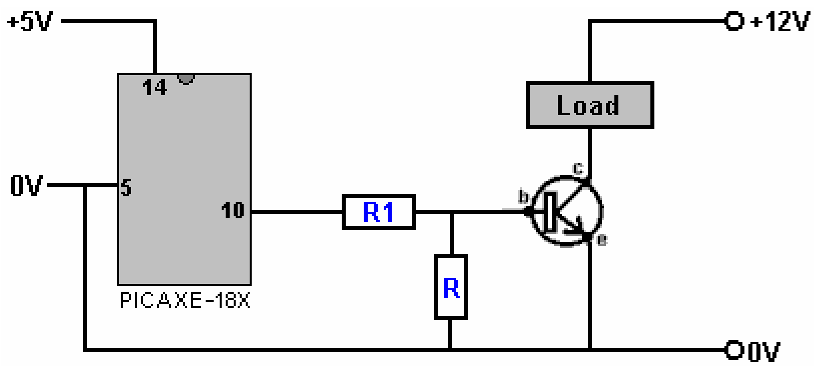
```
Main:
  high 4
  low 7
  pause 4
  low 4
  high 7
  pause 16
goto Main
```

These output voltages are then used in exactly the same way as the output voltages on pin 3 of a 555 chip, or any of the outputs of NAND gates, Hall-effect sensor chips, Schmitt triggers, or whatever. If the device to be powered requires very little current, then the easiest method is to connect the load directly to the output pin.

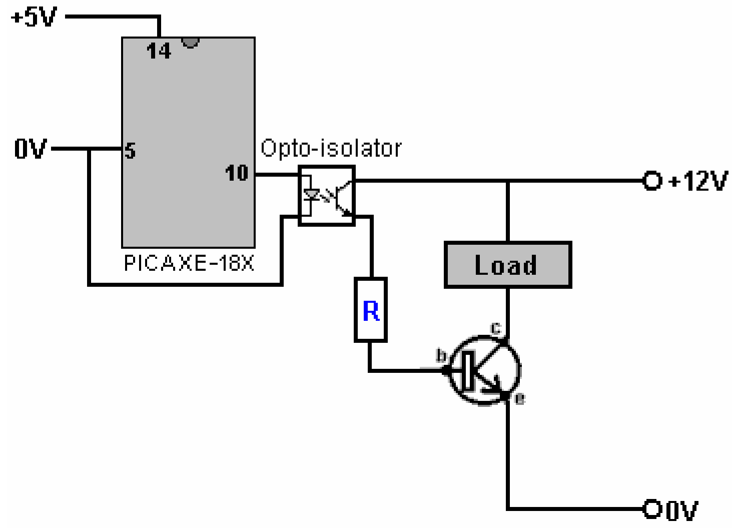
If, as is most often the case, the device to be powered needs a large current to make it work, then the output voltage is used to power a transistor, perhaps like this:



Here, the resistor "R1" limits the current fed into the base of the transistor when pin 10 goes high, but allowing enough current for the transistor to switch on fully, powering the load. The resistor "R" makes sure that the transistor switches off fully when the output on pin 10 goes low. The circuit as shown restricts the load to some piece of equipment which can operate on just five volts, so an alternative circuit could be:

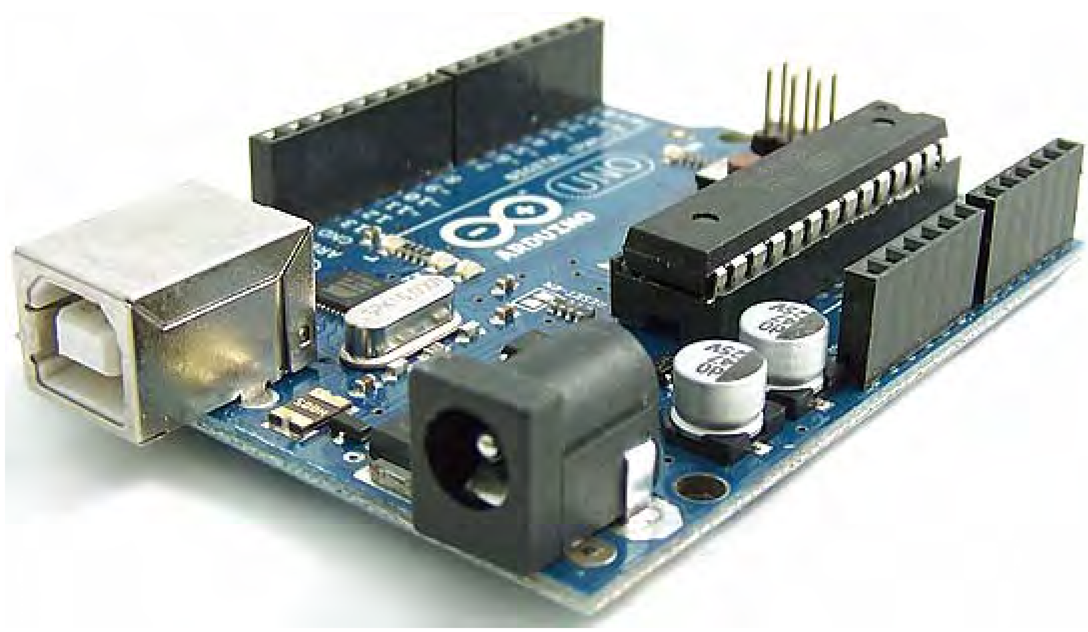


This allows whatever voltage the load needs to be applied to the load, while the PIC chip remains running on it's normal 5-volt supply. However, the equipment to be powered may not be able to have a common zero voltage connection with the PIC. To deal with this, an optical isolation chip can be used like this:



Here a high output voltage on pin 10 of the PIC chip lights up the LED inside the opto-isolator chip, causing a major drop in the resistance between the other two pins. This causes a current controlled by the resistor "R" to be fed into the base of the transistor, switching it on and powering the load.

Recently, a very popular programmable chip has been introduced. It is called the "Arduino" and it is fast and versatile and very popular with experimenters. There is an extensive set of English-language Video tutorials on the Arduino chip, the first in the series by Jeremy Blum is http://www.youtube.com/watch?v=fCxzA9_kg6s. The board looks like this:



Capacitors.
We have avoided mentioning capacitors in any detail as it has not been necessary for understanding the circuitry covered so far. Capacitors come in many sizes, types and makes. Their size is stated in 'Farads' but as the Farad is a very large unit, you are unlikely to encounter a capacitor marked in anything larger than a microfarad, which is a millionth of a Farad. The symbol for a microfarad is mu-F where 'mu' is the letter of the Greek alphabet. This is a pain for normal text production as Greek letters do not occur in your average font. Some circuit diagrams give up on 'mu' and just write it as uF which looks like mu-F slightly mis-printed where the descender of the mu has not printed.

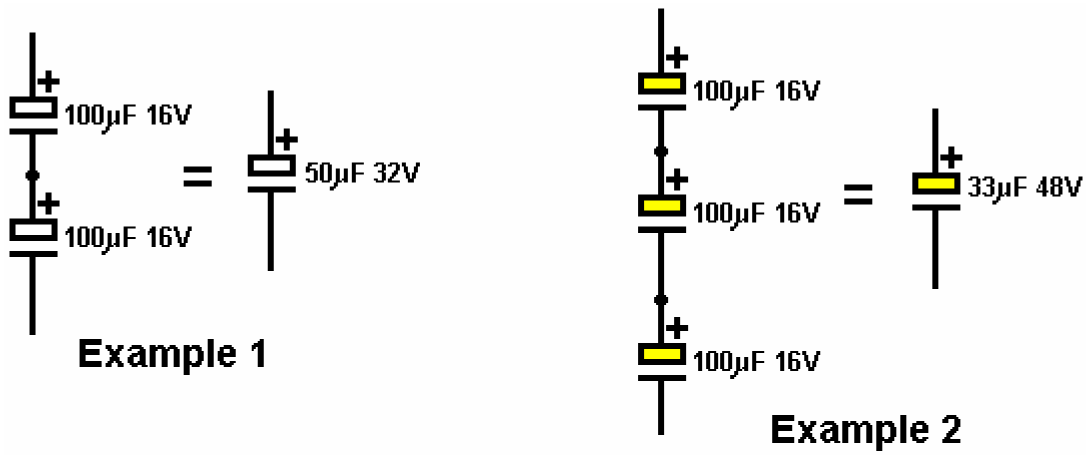
Anyway, very large capacitors which you may encounter range from 5,000 microfarads to maybe as much as 20,000 microfarads. Large capacitors range from 10 microfarads to 5000 microfarads. Medium sized capacitors run from 0.1 microfarad to about 5 microfarads and small capacitors are those below 0.1 microfarad.

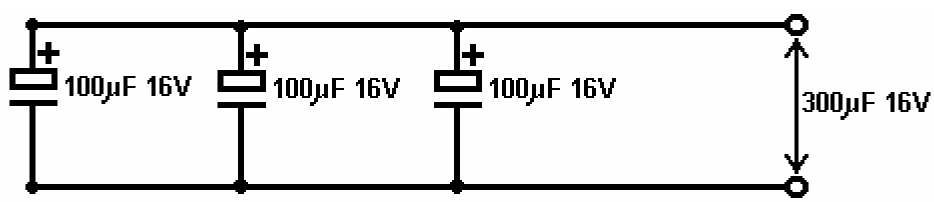
1000 nanofarads (‘nF’) = 1 microfarad.
1000 picofarads (‘pF’) = 1 nanofarad

So:

0.01 microfarad can be written as 10nF
0.1 microfarad can be written as 100nF
0.1nF can be written as 100pF

Capacitors larger than 1 microfarad tend to be ‘polarised’. In other words, the capacitor has a ‘+’ connector and a ‘-’ connector, and it does matter which way round you connect it. The larger capacitors have a voltage rating and this should **not** be exceeded as the capacitor can be damaged and possibly even totally destroyed. Capacitors can be added together, but surprisingly, they add in the reverse way to resistors:





Example 3

If two capacitors are wired in series, as shown in Example 1 above, the overall capacity is reduced while the voltage rating increases. The reduction in capacitance is given by:

1/Ct = 1/C1 + 1/C2 + 1/C3 + ...

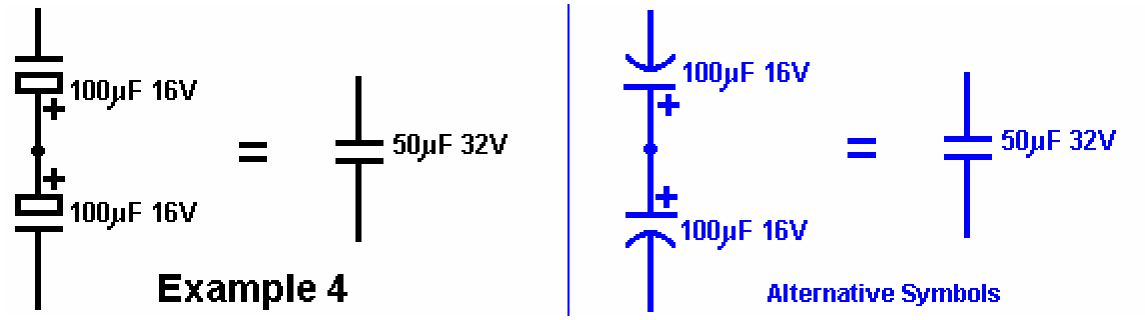
In Example 1, then, 1/total capacitance = 1/100 + 1/100 or 1/Ct = 2/100 or 1/Ct = 1/50
so the overall capacitance reduces from 100 microfarads to 50 microfarads. The advantage in wiring the capacitors like this is that the voltage rating has now increased to 32V (16V across each of the capacitors).

In Example 2, the overall capacitance has reduced to a third of 100 microfarads but the voltage rating has tripled.

In Example 3, the capacitors are wired in parallel. The voltage rating is unchanged but the overall capacitance is now the sum of the three capacitors, namely 300 microfarads.

There is no need for the capacitors to have similar values, there are merely shown that way in the examples to make the arithmetic easier and not distract you from the ways in which the capacitors interact together.

Occasionally, a circuit needs a large capacitor which is not polarised. This can be provided by placing two polarised capacitors back-to back like this:



When the capacitors are connected this way, it does not matter which end of the pair is connected to the positive side of the circuit and which to the negative side.

Large capacitors usually have their capacitance and voltage printed on the outside of the capacitor, but small capacitors are usually far too tiny for that to be an option. So, a code very much like that used for resistors id used for small capacitors. The code is a 2-digit code for capacitors up to 100 picofarads and for higher values it is a 3-digit code where the first two digits are the numerical value of the capacitor in picofarads and the third digit is the number of zeros following the two digits. One thousand picofarads (pF) is one nanofarad (nF) and one thousand nanofarads is one microfarad. These are some common values:

Value	Code	Value	Code
10 pF	10	2.2 nF	222
22 pF	22	4.7 nF	472
47 pF	47	10 nF	103
100 pF	101	22 nF	223
220 pF	221	47 nF	473
470 pF	471	100 nF	104
1 nF	102	220 nF	224

The time has come for a serious warning: High voltages are very, very dangerous. Do not become so familiar with them that you treat them casually. **High voltages can kill you.** Capacitors are capable of building up high voltages and some good makes can hold the charge for several days.

In particular, do **not** try to make adjustments to, or take parts from, the inside of a TV set. A black and white TV set uses 18,000 Volts on the magnetic coils used to create the moving picture on the tube. A capacitor inside the set may well have that voltage on it three days after the set was last used. Don't fool around inside a TV set, it could kill you quick, or if you are really unlucky, it could injure you for life. A colour TV set uses 27,000 Volts to operate the coils inside it and that will fry you in jig time if you touch it.

Also, please don't think that you are safe if you don't quite touch it; 27,000 volts can jump across a gap to your hand. If you try to discharge a TV capacitor using a metal screwdriver with a wooden handle, please ensure that you medical insurance is up to date before you do it. You can receive a hefty shock through the screwdriver handle.

Voltages up to 24 Volts should be quite safe. **However**, some circuits will generate very high voltages even though the battery driving the circuit is low voltage. A standard off-the-shelf inverter circuit produces 240 Volts AC from a 12 Volt battery. Just because the battery is only 12 Volts does **not** mean that the circuit is not dangerous. Circuits which have inductors in them can produce high voltages, especially if they contain large capacitors. The voltage which produces the spark in your car engine is very high and it comes from the 12-volt car battery. You know enough about this by now, so **pay attention**!

The more advanced stuff:

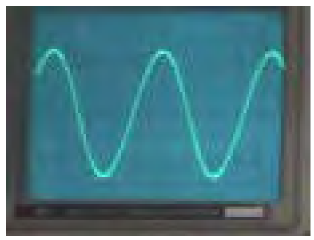
You do not need to bother with this section if you are just starting out with some basic switching circuits of the type already described in this tutorial, so please feel free to skip this section and move on to the "Prototype Construction" section which you will find immediately useful.

This section is a lightweight introduction to Alternating Current circuits and pulsed DC circuits. Let me stress again that I am mainly self-taught and so this is just a general introduction based on my present understanding.

AC Power Factors.

Alternating Current, generally called "AC" is called that because the voltage of this type of power supply is not a constant value. A car battery, for instance, is DC and has a fairly constant voltage usually about 12.8 volts when in it's fully charged state. If you connect a voltmeter across a car battery and watch it, the voltage reading will not change. Minute after minute it says exactly the same because it is a DC source.

If you connect an AC voltmeter across an AC power supply, it too will give a steady reading, but it is telling a lie. The voltage is changing all the time in spite of that steady meter reading. What the meter is doing is **assuming** that the AC waveform is a sine wave like this:



and based on that assumption, it displays a voltage reading which is called the "Root Mean Square" or "RMS" value. The main difficulty with a sine wave is that the voltage is below zero volts for exactly the same length of time as it is above zero volts, so if you average it, the result is zero volts, which is not a satisfactory result because you can get a shock from it and so it can't be zero volts, no matter what the arithmetical average is.

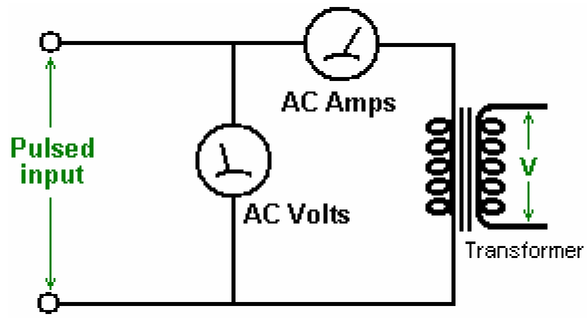
To get over this problem, the voltage is measured thousands of times per second and the results squared (that is, the value is multiplied by itself) and then those values are averaged. This has the advantage that when the voltage is say, minus 10 volts and you square it, the answer is plus 100 volts. In fact, all of the answers will be positive, which means that you can add them together, average them and get a sensible result. However, you end up with a value which is far too high because you squared every measurement, and so you need to take the square root of that average (or "mean") value, and that is where the fancy sounding "Root Mean Square" name comes from – you are taking the (square) root of the (average or) mean value of the squared measurements.

With a sine wave like this, the voltage peaks are 41.4% higher than the RMS value which everyone talks about. This means that if you feed 100 volts AC through a rectifier bridge of four diodes and feed it into a capacitor the capacitor voltage will **not** be 100 volts DC but instead it will be 141.4 volts DC and you need to remember that when choosing the voltage rating of the capacitor. In that instance I would suggest a capacitor which is made to operate with voltages up to 200 volts.

You probably already knew all of that, but it may not have occurred to you that if you use a standard AC voltmeter on a waveform which is **not** a sine wave, that the reading on the meter is most unlikely to be correct or anywhere near correct. So, please don't merrily connect an AC voltmeter across a circuit which is producing sharp voltage spikes like, for instance, one of John Bedini's battery pulsing circuits, and think that the meter reading means anything (other than meaning that you don't understand what you are doing).

You will, hopefully, have learned that power in watts is determined by multiplying the current in amps by the voltage in volts. For example, 10 amps of current flowing out of a 12 volt power supply, represents 120 watts of power. Unfortunately, that only holds true for circuits which are operating on DC, or AC circuits which have only resistors in them. The situation changes for AC circuits which have non-resistive components in them.

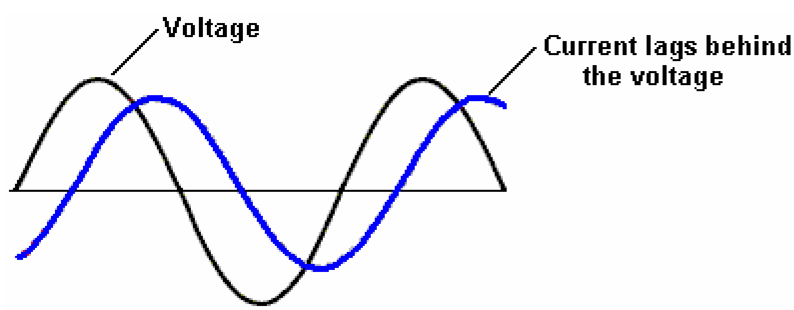
The circuits of this type which you are likely to come across are circuits which have coils in them, and you need to think about what you are doing when you deal with these types of circuit. For example, consider this circuit:



This is the output section of a prototype which you have just built. The input to the prototype is DC and measures at 12 volts, 2 amps (which is 24 watts). Your AC voltmeter on the output reads 15 volts and your AC ammeter reads 2.5 amps and you are delighted because 15 x 2.5 = 37.5 which looks much bigger than the 24 watts of input power. **But**, just before you go rushing off to announce on YouTube that you have made a prototype with COP = 1.56 or 156% efficient, you need to consider the real facts.

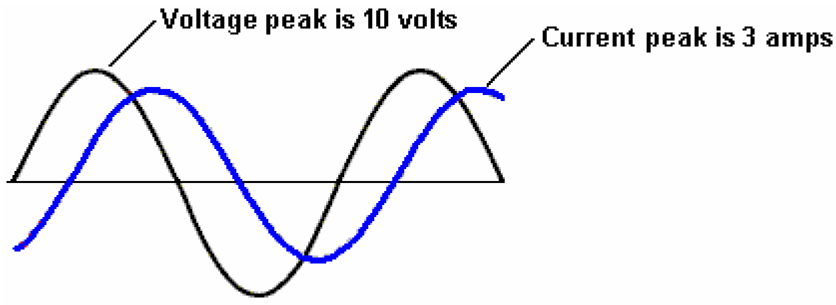
This is an AC circuit and unless your prototype is producing a perfect sine wave, then the AC voltmeter reading will be meaningless. It is just possible that your AC ammeter is one of the few types that can accurately measure the current no matter what sort of waveform is fed to it, but it is distinctly possible that it will be a digital meter which assesses current by measuring the AC voltage across a resistor in series with the output, and if that is the case, it will probably be assuming a sine wave. The odds are that both readings are wrong, but let's take the case where we have great meters which are reading the values perfectly correctly. Then the output will be 37.5 watts, won't it? Well, actually, no it won't. The reason for this is that the circuit is feeding the transformer winding which is a coil and coils don't work like that.

The problem is that, unlike a resistor, when you apply a voltage across a coil the coil starts absorbing energy and feeding it into the magnetic field around the coil, so there is a delay before the current reaches it's maximum value. With DC, this generally doesn't matter very much, but with AC where the voltage is changing continuously, it matters a great deal. The situation can be as shown in this graph of both voltage and current:

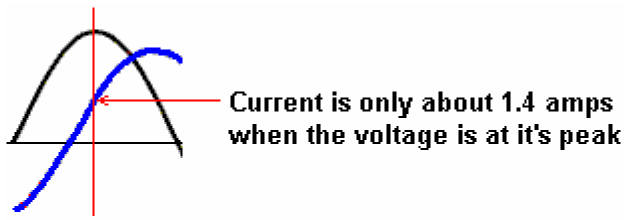


At first, this does not look like any great problem, but it has a very significant effect on the actual power in watts. To get the 37.5 watts output which we were talking about earlier, we multiplied the average voltage level by the average current level. But these two values do not occur at the same time and that has a major effect.

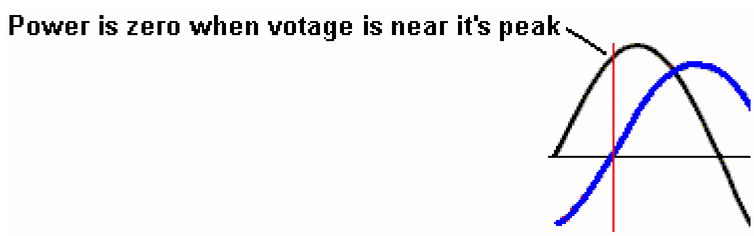
As this can be a little difficult to see, let's take the peak values rather than the averages as they are easier to see. Let's say that in our example graph that the voltage peak is 10 volts and the current peak is 3 amps. If this were DC we would multiply them together and say that the power was 30 watts. But with AC, this does not work due to the timing difference:



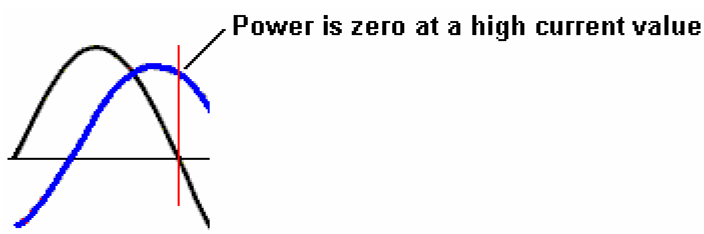
When the voltage is peaking, the current is nowhere near it's peak value of 3 amps:



As a result of this, instead of getting our expected peak power at the top of the voltage peak, the actual power in watts is very much lower – less than half of what we were expecting. Not so good, but it gets worse when you look at the situation more closely. Take a look at what the voltage is when the current crosses the zero line, that is, when the current is zero. The output power is zero when the current is zero but this occurs when the voltage is at a very high value:

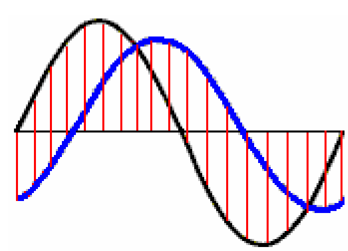


The same goes for when the voltage is zero. When the voltage is zero, then the power is also zero, and you will notice that this occurs when the current is at a high value:



The power is **not** the average current multiplied by the average voltage if there is a coil involved in the circuit – it will be less than that by an amount known as the "power factor" and I'll leave you to work out why it is called that.

So, how do you determine what the power is? It is done by sampling the voltage and current many times per second and averaging those combined results:



Both the voltage and the current are sampled at the times indicated by the vertical red lines and those figures are used to calculate the actual power level. In this example, only a few samplings are shown, but in practice, a very large number of samples will be taken. The piece of equipment which does this is known as a wattmeter as it measures watts of power. The sampling can be done by windings inside the instrument, resulting in an instrument which can be damaged by overloading without the needle being anywhere near full deflection, or it can be done by digital sampling and mathematical integration. Most digital sampling versions of these meters only operate at high frequencies, typically over 400,000 cycles per second. Both varieties of wattmeter can handle any waveform and not just sine waves.

The power company supplying your home measures the current and assumes that the full voltage is present all of the time that the current is being drawn. If you are powering a powerful electric motor from the mains, then this current lag will cost you money as the power company does not take it into account. It is possible to correct the situation by connecting one or more suitable capacitors across the motor to minimise the power loss.

With a coil (fancy name “inductor” symbol “L”), AC operation is very different to DC operation. The coil has a DC resistance which can be measured with the ohms range of a multimeter, but that resistance does not apply when AC is being used as the AC current flow is **not** determined by the DC resistance of the coil alone. Because of this, a second term has to be used for the current-controlling factor of the coil, and the term chosen is “impedance” **.** The wire in any coil has a resistance and that opposes current flow through the coil irrespective of whether the voltage applied to the coil is DC or AC. The capacitance between the neighbouring turns of wire in a coil, introduces a feature of the coil which “impedes” AC current flow through the coil and the amount of that impedance depends on the frequency of the AC voltage being applied to the coil.

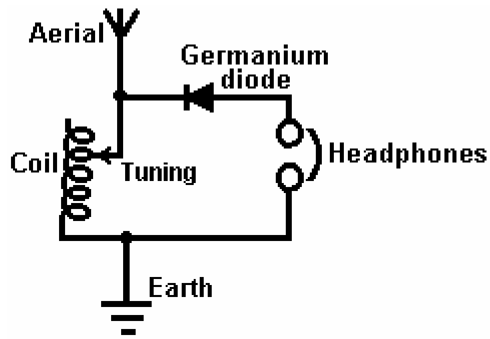
The impedance of a coil depends on it’s size, shape, method of winding, number of turns and core material. If the core is made up of iron or steel, (usually thin layers of iron which are insulated from each other), then it can only handle low frequencies. You can forget about trying to pass 10,000 cycles per second (“Hz”) through the coil as the core just can’t change it’s magnetisation fast enough to cope with that frequency. A core of that type is ok for the very low 50 Hz or 60 Hz frequencies used for mains power, which are kept that low so that electric motors can use it directly.

For higher frequencies, ferrite can be used for a core and that is why some portable radios use ferrite-rod aerials, which are a bar of ferrite with a coil wound on it. For higher frequencies (or higher efficiencies) iron dust encapsulated in epoxy resin is used. An alternative is to not use any core material and that is referred to as an air-core coil. These are not limited in frequency by the core but they have a very much lower inductance for any given number of turns. The efficiency of the coil is called it’s “Q” (for “Quality”) and the higher the Q factor, the better. The resistance of the wire lowers the Q factor.

A coil has inductance, and resistance caused by the wire, and capacitance caused by the turns being near each other. However, having said that, the inductance is normally so much bigger than the other two components that we tend to ignore the other two. Something which may not be immediately obvious is that the impedance to AC current flow through the coil depends on how fast the voltage is changing. If the AC voltage applied to a coil completes one cycle every ten seconds, then the impedance will be much lower than if the voltage cycles a million times per second.

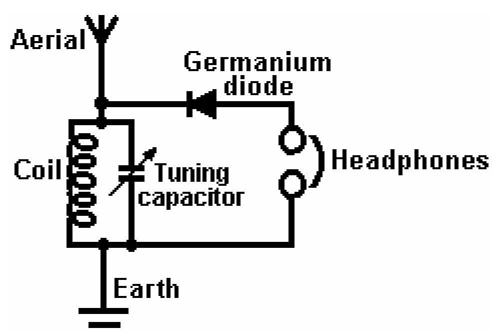
If you had to guess, you would think that the impedance would increase steadily as the AC frequency increased. In other words, a straight-line graph type of change. That is not the case. Due to a feature called resonance, there is one particular frequency at which the impedance of the coil increases massively. This is used in the tuning method for AM radio receivers. In the very early days when electronic components were hard to come by, variable coils were sometimes used for tuning. We still have variable coils today, generally for handling large currents rather than radio signals, and we call them “rheostats” and some look like this:

These have a coil of wire wound around a hollow former and a slider can be pushed along a bar, connecting the slider to different winds in the coil depending on it's position along the supporting bar. The coil connections are then to the slider and to one end of the coil. The position of the slider effectively changes the number of turns of wire in the part of the coil which is in the circuit. Changing the number of turns in the coil, changes the resonant frequency of that coil. AC current finds it very, very hard to get through a coil which has the same resonant frequency as the AC current frequency. Because of this, it can be used as a radio signal tuner:



If the coil's resonant frequency is changed to match that of a local radio station by sliding the contact along the coil, then that particular AC signal frequency from the radio transmitter finds it almost impossible to get through the coil and so it (and only it) diverts through the diode and headphones as it flows from the aerial wire to the earth wire and the radio station is heard in the headphones. If there are other radio signals coming down the aerial wire, then, because they are not at the resonant frequency of the coil, they flow freely through the coil and don't go through the headphones.

This system was soon changed when variable capacitors became available as they are cheaper and more compact. So, instead of using a variable coil for tuning the radio signal, a variable capacitor connected across the tuning coil did the same job:

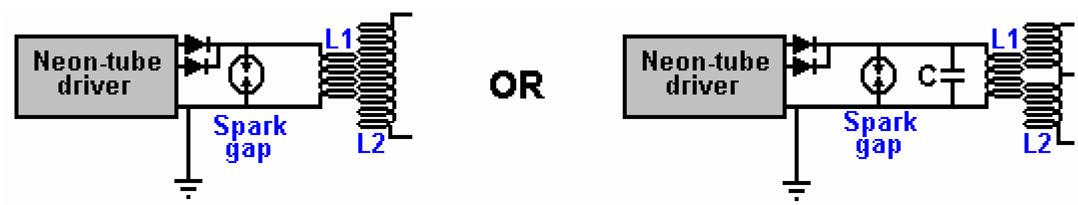


Resonance.

While the circuit diagram above is marked "Tuning capacitor" that is actually quite misleading. Yes, you tune the radio receiver by adjusting the setting of the variable capacitor, **but**, what the capacitor is doing is altering the resonant frequency of the coil/capacitor combination and it is the resonant frequency of that combination which is doing exactly the same job as the variable coil did on it's own.

This draws attention to two very important facts concerning coil/capacitor combinations. When a capacitor is placed across a coil "in parallel" as shown in this radio receiver circuit, then the combination has a very high impedance (resistance to AC current flow) at the resonant frequency. But if the capacitor is placed "in series" with the coil, then there is nearly zero impedance at the resonant frequency of the combination:

This may seem like something which practical people would not bother with, after all, who really cares? However, it is a very practical point indeed. In Chapter 3, some of the very high-power devices produced by Don Smith are described. Typically, he uses an off-the-shelf neon-tube driver module as an easy way to provide a high-voltage, high-frequency AC current source, typically, 6,000 volts at 30,000 Hz. He then feeds that power into a Tesla Coil which is itself, a power amplifier. The arrangement is like this:



People who try to replicate Don's designs tend to say "I get great sparks at the spark gap until I connect the **L1** coil and then the sparks stop. This circuit can never work because the resistance of the coil is too low".

If the resonant frequency of the **L1** coil does not match the frequency being produced by the neon-tube driver circuit, then the low impedance of the **L1** coil will definitely pull the voltage of the neon-tube driver down to a very low value. But if the **L1** coil has the same resonant frequency as the driver circuit, then the **L1** coil (or the **L1** coil/capacitor combination shown on the right, will have a very high resistance to current flow through it and it will work well with the driver circuit. So, no sparks, means that the coil tuning is off. It is the same as tuning a radio receiver, get the tuning wrong and you don't hear the radio station.

Choosing components which are not specified.

Some people find it difficult to select a suitable component where the exact component is not specified or where an alternative has to be selected, so perhaps a few general pointers might be helpful. The reason why component values are omitted may well be because a very wide range of alternative values can be used and if one particular is specified, the newcomers to electronics feel that they **have** to use that one value or the circuit will not work, (which is almost never the case). For example, I have been asked if a capacitor rated at 25V could be used instead of the same value capacitor rated at 16V shown in the circuit, to which the answer is 'yes, most definitely'. The lower voltage rating is adequate and the component cheaper to buy, but if one of a higher voltage rating is available, then it can be used.

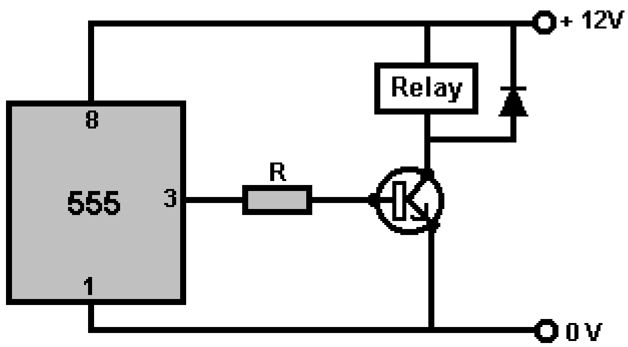
With **capacitors**, you need to consider the physical size and wire connections, the capacitance, the voltage rating, and the leakage. The cost and size of a capacitor is directly related to it's voltage rating, and once the voltage rating exceeds that normally used, the price shoots up rapidly as the sales volume reduces rapidly, which in turn, discourages further sales. This sometimes causes circuit builders to connect chains of cheaper capacitors together to make a smaller-capacity high-voltage capacitor. In the case of Tesla Coil builders, they then may connect several of these chains in parallel to boost the capacitance.

If the voltage rating is exceeded (usually by a very large amount), the capacitor will be damaged and become either a short-circuit, or more likely, an open circuit. Either way, it will never work as a capacitor again. In a household circuit, where the capacitor is being used as part of the power supply to the circuit, the voltage rating does not need to be much higher than the supply voltage, with say, 16V being used for a 12V circuit. You could use a capacitor rated at 25V, 40V, 63V, 100V or 400V and it would work perfectly well, but it will be much larger and have cost much more. But, if you have one sitting around and not being used, there is no reason why you should not use it rather than paying to buy another one.

If the capacitor is being used in a timing circuit where a high-value resistor is feeding current to it, then the leakage current of the capacitor becomes very important. Electrolytic capacitors are seldom suitable for such an application as they have a small, unpredictable leakage current which will vary with the age of the capacitor. For accurate timing with a capacitor, ceramic, polypropylene, mylar or tantalum should be used.

The voltage rating for an electrolytic capacitor is for DC, so if you use it for limiting current in an AC power supply, that is, where the current flows through the capacitor rather than the capacitor being placed across the supply and is acting to combat ripple, then great care is needed. The capacitor will heat up due to the power flowing through it, and it is possible for an electrolytic capacitor used in that way to rupture or 'explode' due to the electrolyte boiling. Instead, you need to use the very much more expensive oil-filled can capacitors (as shown near the end of chapter 10). That style of usage is unusual for home constructors.

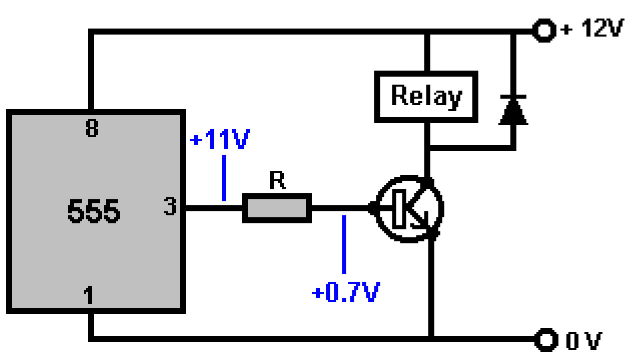
With bi-polar **transistors**, you need to use commonsense. Suppose a 555 timer chip is required to power a transistor which controls a relay:



For the moment, we will ignore the fact that the 555 could drive the relay directly without the need for a transistor. let's say that the relay draws a current of 30 mA when connected to a 12V supply. Therefore, the transistor needs to be able to handle a current of 30 mA. Any small switching transistor such as the BC109 or 2N2222 can easily handle that current. The transistor also needs to be able to handle 12 volts. If in doubt, look up the characteristics of your choice of transistor at http://www.alldatasheet.co.kr/ by entering the transistor name 'BC109' or whatever in the entry box at the top of the screen and clicking on the button to the right of it. Eventually, it will let you download a pdf document specifying the transistor, and that will show you the voltages which the transistor can handle. Both of the above transistors can handle far more than 12V.

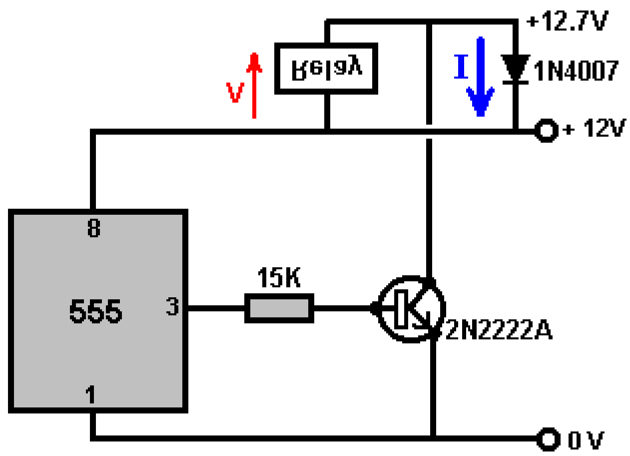
The next question is, 'can the transistor switch fast enough to work in this circuit?' and the data sheet will show that they can switch on and off a million times per second. As the relay can only switch on and off a few times per second, the transistor can easily operate fast enough to handle the switching.

Next, we need to know what size of resistor would be suitable. The data sheet will also show the DC current gain of the transistor. This is usually marked as "hfe" and for these transistors is likely to be a minimum of, say, 200. This means that the current flowing into the base of the transistor needs to be one two-hundredth of the relay's 30 mA which is 0.15 mA. The resistor will have about +11 volts at pin 3 of the 555 timer and around +0.7 volts at the base of the transistor when it is switched fully on. That means that the resistor will have about 10.3 volts across it when the relay is switched on:



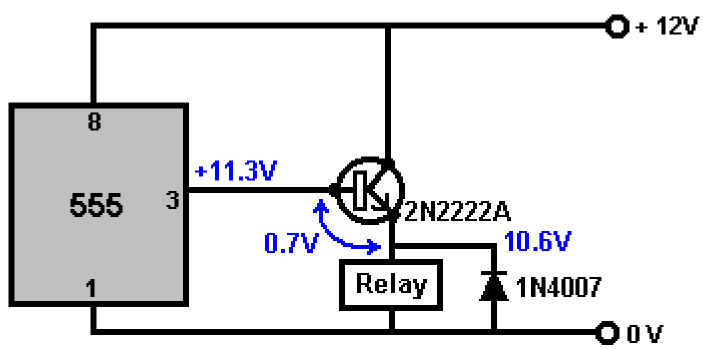
So, what size of resistor will have 0.15 mA flowing through it when there is a 10.3-volt drop across it? We know that a 1K resistor passes 1mA per volt and so would pass 10.3 mA with 10.3 volts across it. That is far more than we need. A 10K resistor would pass 1.03 mA which is still far too much but certainly could be used. As it is a resistor, we can use Ohm's Law: R = V / A (Ohms equals Volts over Amps), or R = 10.3 / 0.00015 which is 68K. So, any resistor between 68K and perhaps 15K should work well.

The diode is there to protect the transistor from excessive voltage caused by the coil of the relay. When a coil is switched off suddenly, it generates a reverse voltage which can be hundreds of volts, pulling the collector of the transistor far above the +12V power supply line. When that starts to happen, it effectively reverses the diode direction, allowing it to conduct and short-circuit that big voltage spike:



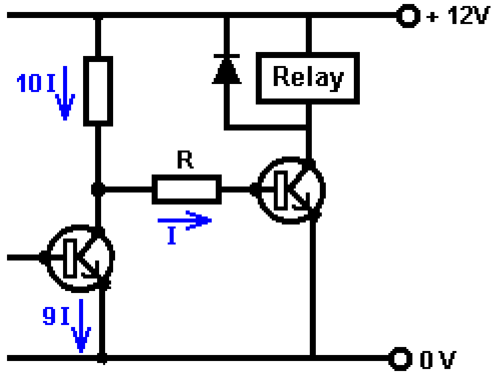
Due to the short-circuiting, the voltage can't get any higher and the current through the diode is not large, so most diodes such as the popular and cheap 1N4001 or 1N4007 types can be used.

When a transistor is connected like that and switched on, it is effectively a short-circuit between it's collector and emitter, and that places the full 12 volts across the relay, powering it very solidly. This connection method is called a "common-emitter" circuit because all of the transistors used have their emitters all wired in common to the 0V line. An alternative arrangement is the "emitter-follower" circuit:



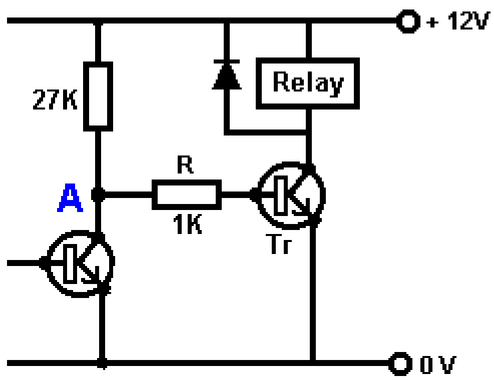
With this circuit arrangement, the emitter of the transistor "follows" the voltage on pin 3 of the 555 timer. It is always a constant voltage below it, typically about 0.7 volts. The output of the 555 timer has a maximum of about 0.7V below the supply voltage, and so it's maximum value is about 11.3V in this circuit. The transistor drops that by a further 0.7V, which means that the relay only gets about 10.6V across it instead of the full 12V of the supply, which means that it should be a 10-volt relay rather than a 12-volts relay.

Those are the easy cases because the 555 timer can supply at least 200 mA through it's output pin, while keeping the output voltage steady. That is not the case with simple transistor circuits. Take a situation like this:



For audio work - microphone pre-amplifiers and the like – the rule of thumb is that the current flowing through the first transistor should be at least ten times the current required by the base of the second transistor in order not to drag down and distort the audio waveform.

Relay switching is not so critical but the same general principle applies and attention needs to paid to the collector resistor of the preceding transistor. For example, if the current flowing through the preceding transistor is small, say, 0.5 mA and the output transistor needs 1.5 mA flowing into it's base, then there can be a problem. In this circuit, for example:



Here, the voltage at point "A" goes high because the first transistor switches off and so becomes the same as a resistor of 1Meg or more. Normally, that resistance is so much greater than the 27K of it's resistor, that the voltage at point "A" would be nearly +12V, but if you were to connect the resistor "R" of just 1K in value, then the situation is changed completely. the base of "Tr" can't rise above 0.7V. The first transistor can be ignore due to its very high resistance. That leaves a voltage-divider pair of resistors, the 27K and the 1K, with 11.3 volts across them, stopping the voltage at point "A" from rising above 1.13V instead of the original 12V and transistor "Tr" will only get 0.43 mA instead of the 1.5 mA which was wanted. The transistor "Tr" has effectively a 28K resistor feeding it current from the +12V rail.

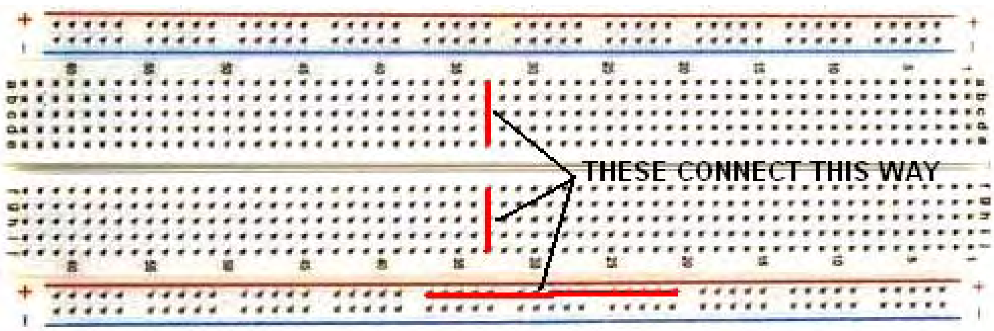
One solution would be to raise the current through the first transistor by using a resistor a good deal smaller than the present 27K. Another option is to lower the input current requirement of transistor "Tr" by making it a Darlington pair or by using a transistor with a much higher gain.

Constructing Prototypes.

The main options for building a prototype circuit are:

1. A (plug-in) breadboard
2. Electrical screw connector strips.
3. Stripboard
4. A printed circuit board.

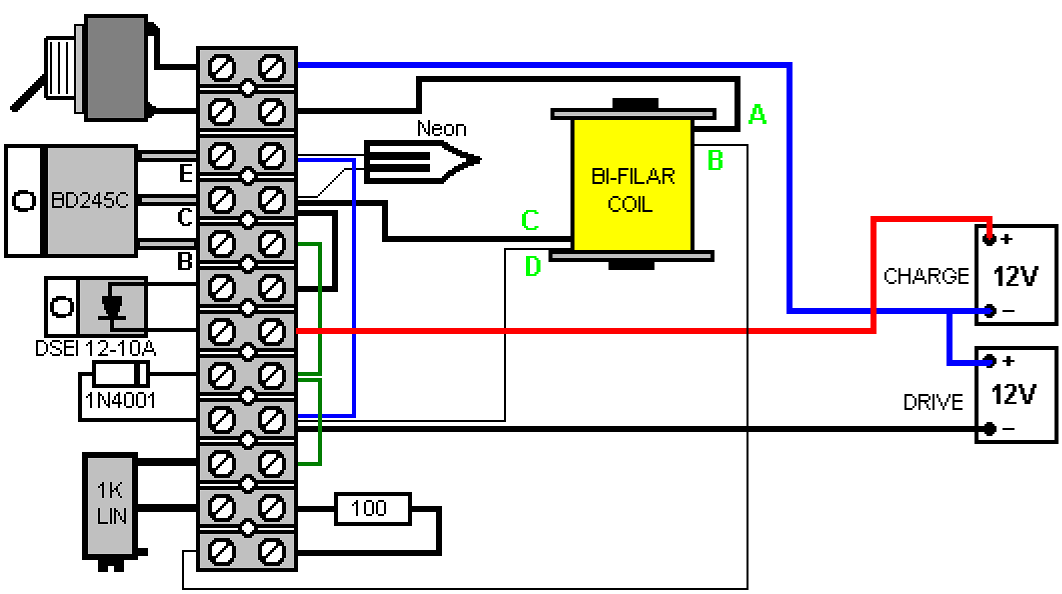
1. The typical breadboard unit consists of a matrix of clip holes wired in strips, into which component leads can be pushed to make a circuit. In my opinion, they are best avoided as it takes quite some effort to implement any significant circuit using them, some components do not fit well in the sockets which are small enough to take DIL IC packages, and when you do get a circuit working well on the breadboard, there is no guarantee that it will work well when you attempt to move it to a permanent soldered board:



While a plastic board of this type looks as if it should be quick and easy to use, I have never found it to be so ever since the boards were scaled down in size to take the closely-spaced pins of integrated circuits ("chips"). It is generally difficult to lay the components out in the same pattern as the circuit diagram, and if they are not, then it becomes slow to follow the circuit through on the breadboard layout.

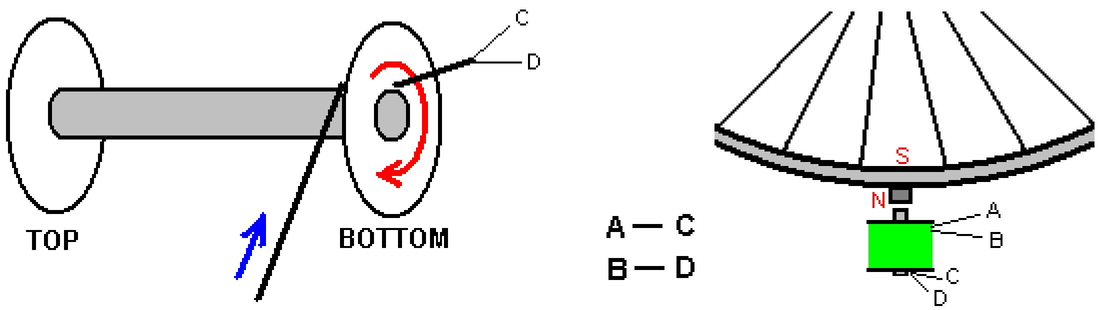
2. The local hardware shop has cheap screw connectors which can be very effective. These come in several sizes and the smaller ones are very convenient for constructing transistor circuitry. They look like this:

Circuits can be assembled very easily, using these connectors and an example might be one of the John Bedini battery pulsing circuits which might have a layout like this:



I have built this circuit using this style of construction and it was very successful indeed, being very quick and easy to construct and it proved to be very tough and effective over a long period of use. The plastic strip has a hole between each connector strip and that allows you to bolt the strip to a base board on which you mount other components, in this case, the pulsing coil and the rotor with the magnets attached. Each connection block can take two or three wires. The wires need to have the insulation removed and the wires scraped clean and shiny if they are not already in that state. If more than one multi-strand wire is being put into one side of a connector, then it is usually best to twist the wires together before tightening the clamping screw. If you want, you can give the twisted wires a thin coat of solder, but this has to be done neatly to avoid producing a joint which is too large to fit into the connector. One connector can be cut out of the strip quite easily, using a pair of scissors or a craft knife. Single connectors can join two wires very effectively without the need to solder them.

While the wire trigger switch is shown as a thin line in the diagram above, it is suggested that it is more convenient to use wires of identical diameter, and if it is not clear which is the beginning and end of a single wire, then, an ohmmeter may be used to identify the ends. It is suggested that the cables are stretched oput in a long length and then twisted together using an electric drill. I have found that doing that is not very good because the cable near the drill is twisted much more strongly than the rest of the wire. Also, it needs a considerable distance outside to lay out a sufficient length of wire. If you really want to twist the wires together (it is not immediately obvious why you would want to do that), then use two coils of wire and twist them together for a short length by turning the reels over as a pair, then wind the twisted length on to a third spool or temporary holder. This method does not need for you to set long cables (which tangle and catch on things very easily) and it gives uniformly twisted wires which can be prepared when sitting in a small workspace. The coil of 850 turns is wound like this:



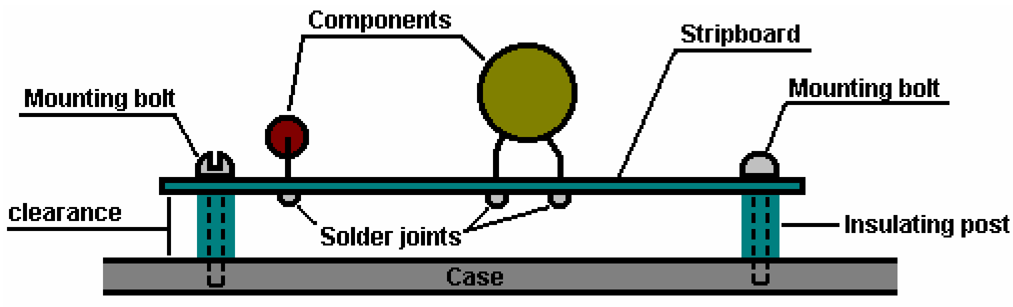
The first strand of the coil starts at point “C” at the base of the coil and finishes at point “A” at the top of the coil. This is the coil which drives the motor with point “A” connected to the Plus of the drive battery. The second strand starts at point “D” at the base of the coil and finishes at point “B” with point “B” connected to the transistor’s base resistor. This arrangement generates a magnetic North field at the top of the coil and that pushes against the rotor’s permanent magnet’s North pole which is the one facing the coil. With the implementation which I used to charge a car battery, the wheel rotation was gentle, giving perhaps 200 to 300 pulses per minute to the battery. The speed of the wheel reduced as the battery charge increased and so a glance at the wheel showed the charge state of the battery. It is recommended that the coil core be made up from lengths of 1.5 millimetre diameter copper coated welding rod, but as copper is highly conductive electrically, I prefer to coat each rod with enamel paint to block sideways eddy currents which waste power.

3. Stripboard, usually called ‘Veroboard’ even if it is not made by Vero, is a quick and satisfactory method, although you have to make very tiny solder joints. Please be aware that the fumes from the burning resin when soldering are most definitely not good for your health and should be avoided by making sure that the ventilation is adequate.

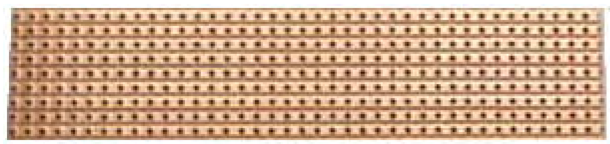
4. A printed circuit board is feasible for a one-off prototype and making one will increase your production skills, so it is also a reasonable option if you have the etching and drilling equipment to hand. Buying all of the necessary equipment if you do not have any, can cost a fair amount, but the skills gained are significant and the finished boards looks very professional.

There are several other methods of construction, and many varieties of construction board and stripboard. Simple stripboard will be used in the following descriptions, although the method does apply to many different styles of construction.

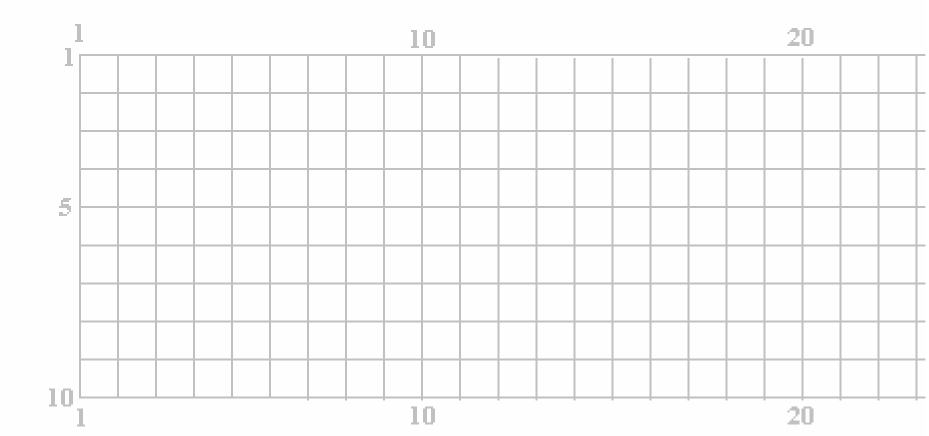
The first step is to produce a layout for the components on the board. When designing the layout provision should be made for drilling holes to allow the completed board to be bolted to its case using bolts and insulating pillars to keep the soldered joints clear of all other surfaces.



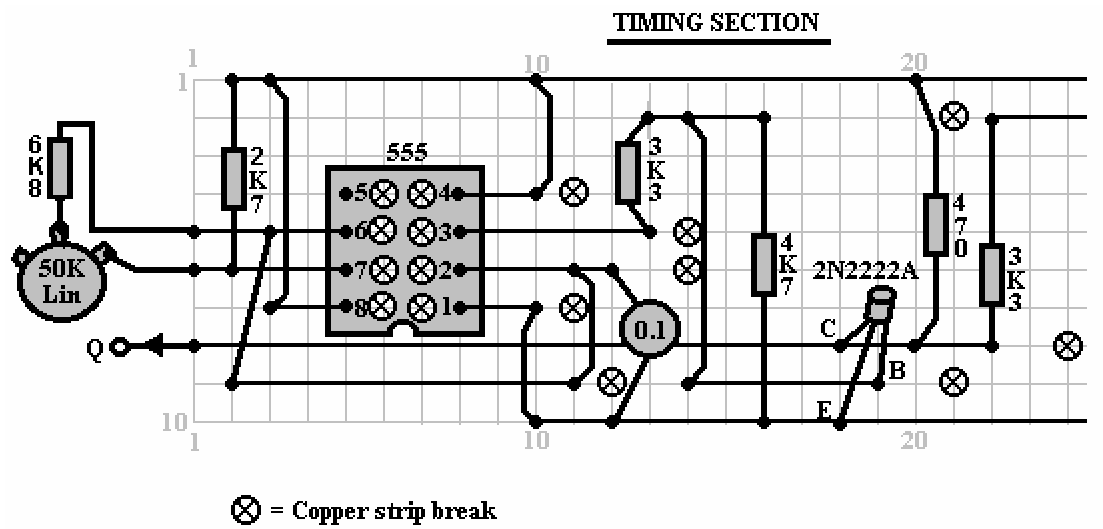
The circuit diagram of the circuit to be built is the starting point. You might wish to draw a light grid of lines to represent the matrix of holes in the strip board. This helps to visualise the run of the copper strips and the sketch can be made to show the exact number of holes available on the piece of strip board to be used. The strip board looks like this:



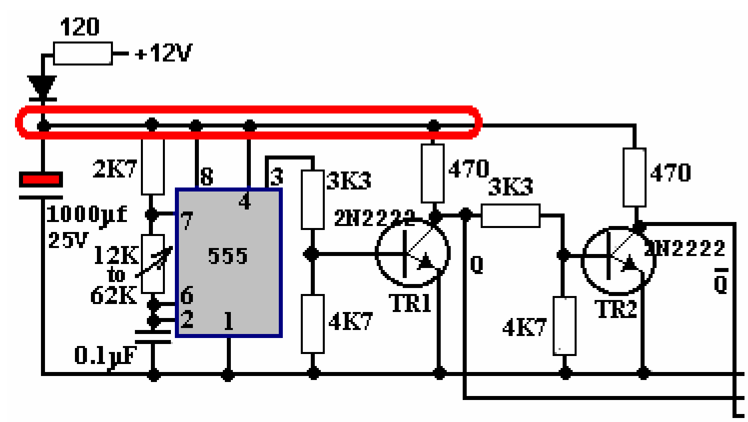
So you might wish to produce a layout sketch re-usable drawing like this:



where the horizontal strips are numbered and the vertical lines of holes are also numbered. In this sketch, where the lines cross, represents a hole in the board. The sketch of a possible physical layout can then be prepared and it might look like this when seen from the top although the copper strips on the underside of the board are shown in the sketch:



It is very important when producing a sketch like this, that the copper strips making up the circuit are not accidentally used to connect components further along the board, without breaking the copper strip between the two sections of the board. It helps to mark a copy of the circuit diagram when you are sketching a possible physical layout on the strip board. It might be done like this:

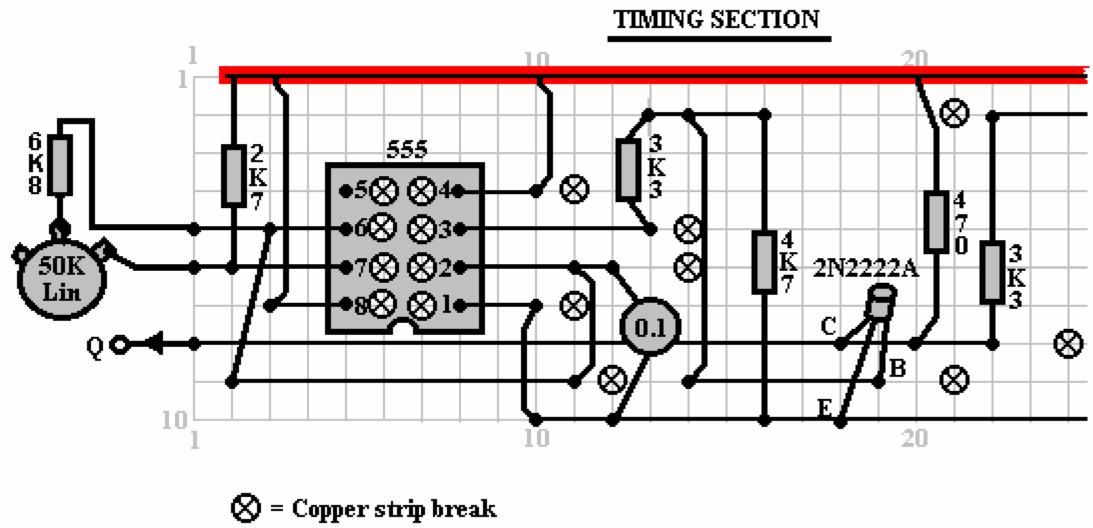


Here, the components just below the diode are ringed to show that they have been marked on the layout sketch and, if necessary, the copper strip broken to isolate the components. A component worth mentioning in passing, is the capacitor marked with red in the circuit diagram. This is a decoupling capacitor, fed from the 12V battery via a resistor and a diode (a diode is not normally used in this part of the circuit).

The decoupling is to provide the 555 chip and drivers with a supply which is reasonably isolated from the heavy current-draw circuit not shown in this small section of the circuit diagram. The pulsating heavy current draw of the rest of the circuit is capable of pulling the battery voltage down slightly many times per second. This creates a voltage ripple on the positive supply line from the battery and to smother the ripple, the resistor and diode are used to feed a large reservoir capacitor which smoothes out the ripple.

The circuit itself is not beyond criticism. Transistor 'TR2' and its associated components are redundant since pin 3 of the 555 chip already supplies the required signal (and with higher drive capacity) so the second output line should be taken directly from pin 3 of the 555 chip. This snippet of circuit is only shown here as an example of marking up a circuit diagram when making a components layout sketch.

As the layout sketch is produced, the circuit diagram should be marked off with a highlighting pen to make sure that every part of the circuit diagram has been successfully copied to the sketch. In the example below, not all of the highlighted strip is shown, since it runs off the small section of the board being shown here:



Many electronic components can be damaged by the high temperatures they are subjected to when being soldered in place. I personally prefer to use a pair of long-nosed pliers to grip the component leads on the upper side of the board while making the solder joint on the underside of the board. The heat running up the component lead then gets diverted into the large volume of metal in the pair of pliers and the component is protected from excessive heat. On the same principle, I always use a DIL socket when soldering a circuit board, that way, the heat has dissipated fully before the IC is plugged into the socket. It also has the advantage that the IC can be replaced without any difficulty should it become damaged.

If you are using CMOS integrated circuits in any construction, you need to avoid static electricity. Very high levels of voltage build up on your clothes through brushing against objects. This voltage is in the thousands of volts range. It can supply so little current that it does not bother you and you probably do not notice it. CMOS devices operate on such low amounts of current that they can very easily be damaged by your static electricity. Computer hardware professionals wear an earthing lead strapped to their wrists when handling CMOS circuitry. There is no need for you to go that far. CMOS devices are supplied with their leads embedded in a conducting material. Leave them in the material until you are ready to plug them into the circuit and then only hold the plastic body of the case and do not touch any of the pins. Once in place in the circuit, the circuit components will prevent the build up of static charges on the chip.

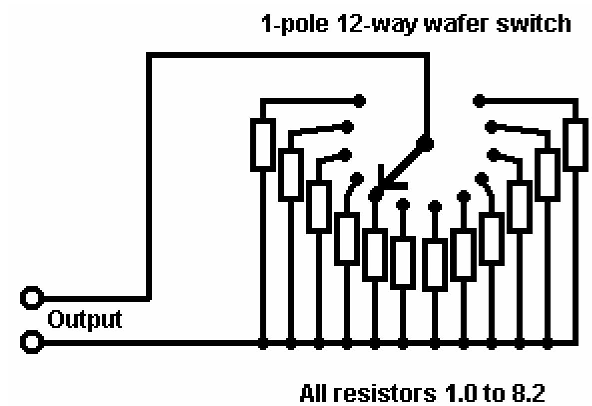
Soldering is an easily-acquired skill. Multi-cored solder is used for electronic circuit soldering. This solder wire has flux resin contained within it and when melted on a metal surface, the flux removes the oxide layer on the metal, allowing a proper electrical joint to be made. Consequently, it is important that the solder is placed on the joint area and the soldering iron placed on it when it is already in position. If this is done, the flux can clean the joint area and the joint will be good. If the solder is placed on the soldering iron and then the iron moved to the joint, the flux will have burnt away before the joint area is reached and the resulting joint will not be good.

A good solder joint will have a smooth shiny surface and pulling any wire going into the joint will have no effect as the wire is now solidly incorporated into the joint. Making a good solder joint takes about half a second and certainly not more than one second. You want to remove the soldering iron from the joint before an excessive amount of heat is run into the joint. It is recommended that a good mechanical joint be made before soldering when connecting a wire to some form of terminal (this is often not possible).

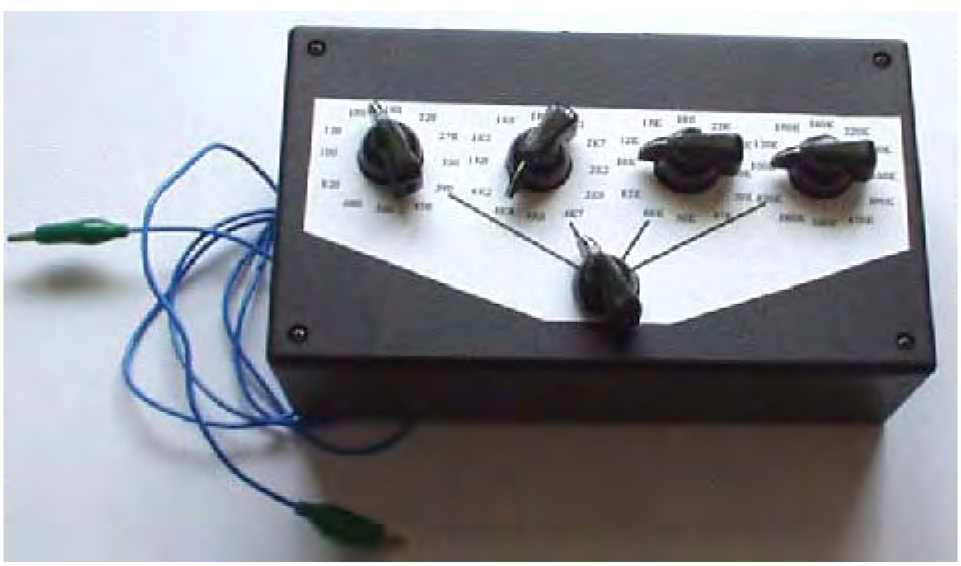
The technique which I use is to stand the solder up on the workbench and bend the end so that it is sloping downwards towards me. The lead of the component to be soldered is placed in the hole in the strip board and gripped just above the board with long-nosed pliers. The board is turned upside down and the left thumb used to clamp the board against the pliers. The board and pliers are then moved underneath the solder and positioned so that the solder lies on the copper strip, touching the component lead. The right hand is now used to place the soldering iron briefly on the solder. This melts the solder on the joint, allowing the flux to clean the area and producing a good joint. After the joint is made, the board is still held with the pliers until the joint has cooled down.

Test Equipment.
When developing new circuitry, it may be convenient to try different values of resistor in some position in the circuit (the resistor value may be dependent on the gain of a transistor or the actual resistance of an ORP12, or some such other situation). For this, it is very convenient to have a resistor-substitution box which allows you to select any standard resistor at the turn of a switch.

These are not readily available on the market. In years gone by, it was possible to buy custom wafer switches, where the number of wafers could be built up to whatever switch size was required, but these do not seem to be available any more. A slightly less convenient method of construction is to use four of these, selected by a second wafer switch:



In the above diagram, all of the resistors in one range (100 ohms to 820 ohms, 1K to 8K2, 10K to 82K or 100K to 820K) are wired to a single 12-way switch. The output wires then have any of these standard resistors across them, depending on the setting of the switch. A second switch can then be used to select several of these groups, while still using the same output wires. When boxed, it might look like this:



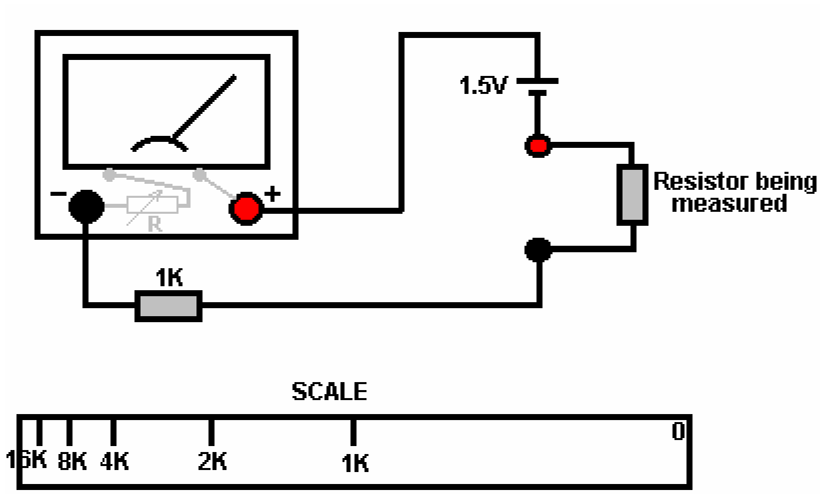
It can also be useful to have a versatile signal generator. You can easily construct your own with variable frequency, variable mark/space ratio and optional variable gating. If you do, you might as well make it with a low output impedance so that it can drive devices under test directly rather than having to provide additional buffering. It might look like this:

The really essential item of equipment is a multimeter. These come in many shapes, sizes and varieties and the cost varies enormously. The reliability also varies a great deal. The most reliable and the cheapest is the analogue type which does not use a battery (other than for the occasional measurement of resistance). Although these types are looked down upon nowadays, they are 100% reliable:

The meter shown above is rated at 2,000 ohms per volt, so connecting it to a circuit to make a measurement on the 10V range is the same as connecting a 20K resistor to the circuit. The big brother of this style of equipment is about five times larger and has 30,000 ohms per volt performance, so connecting it on a 10V range is the same as connecting a 300K resistor to the circuit being measured. This one is battery driven, so if you get one of these, may I suggest that you check its accuracy on a regular basis:

The really excellent non-battery (ex-professional) Avo meter multimeters are still available through eBay at affordable prices. These have 30,000 ohms per volt performance and are robust and accurate, having been built to very high standards.

A multimeter uses a 1.5V battery to measure resistance. Ohm's Law is used as the working principle and the operation is:



The meter shown in the diagram has a small resistance of its own. This has a small variable resistor added to it. This variable resistor will have a small knob mounted on the face of the multimeter, or it will be a thumbwheel knob projecting slightly from the right hand side of the multimeter case. The 1.5V battery will be positioned inside the multimeter case as is the 1K resistor. To use the resistance ranges, the multimeter probes are touched firmly together to form a short-circuit and the variable resistor adjusted so that the meter points to zero.

For the purpose of this discussion, let us assume that the internal resistance of the meter, when correctly adjusted, is exactly 1K. If the resistor under test is exactly 1K in value, then the current through the meter will be halved and the meter will show a needle deflection half way across the scale. If the resistor under test is 2K, then the current will be one third and the scale marking will be at the 1/3 position from the left. If the resistor is 4K, then there will be one fifth (1K + 4K = 5K) of the full-scale current and the 4K mark will be 20% from the left hand side of the scale.

Two things to notice: firstly, the scale has to read from right to left which can take some getting used to, and secondly, the scale is not linear, with the markings getting closer and closer together and consequently, more difficult to mark and read, the higher the value of the resistor being measured. The bunching up of the scale markings is why the more expensive multimeters tend to have more than one range.

A mains-operated oscilloscope is an excellent piece of equipment to own but they are expensive when new. It is possible to pick one up at a reasonable price second-hand via eBay. An oscilloscope is by no means an essential item of equipment. One of its most useful features is the ability to measure the frequency, and display the shape of a waveform. Most waveforms are of known shape so the frequency is the major unknown. The following meter is not expensive and it displays the frequency of a signal on a digital readout:

So, when you are deciding what multimeter to buy, consider the following points:

1. How reliable is it? If you are opting for a battery driven unit, what happens to the accuracy if the battery starts to run down. Does it display a warning that the battery needs to be replaced? Mains-operated digital multimeters are brilliant but are a problem if you want to make measurements away from the mains.

2. What DC voltage ranges does it have? If you are intending to work mainly with 12V circuits, it is inconvenient for the ranges to be 9V and 30V as successive ranges. Digital meters do not have this problem but the question then is, how accurate are they going to be in day to day use?

3. Transistor testing options you can ignore - you are better off making your own dedicated unit to check transistors if you think you will ever need to do this - you probably won't.

4. Measuring current can be very useful so see what ranges are offered.

5. Measuring capacitance is very useful, especially since many capacitors are not well marked to indicate their value.

6. Measuring the frequency of a waveform could be a significant bonus but the question is; are you every likely to need it?

7. Measuring resistance is very useful. Every meter has it. There is no need to be over fancy on measurement ranges as you usually only need to know the approximate answer - is it a 1K resistor or a 10K resistor?

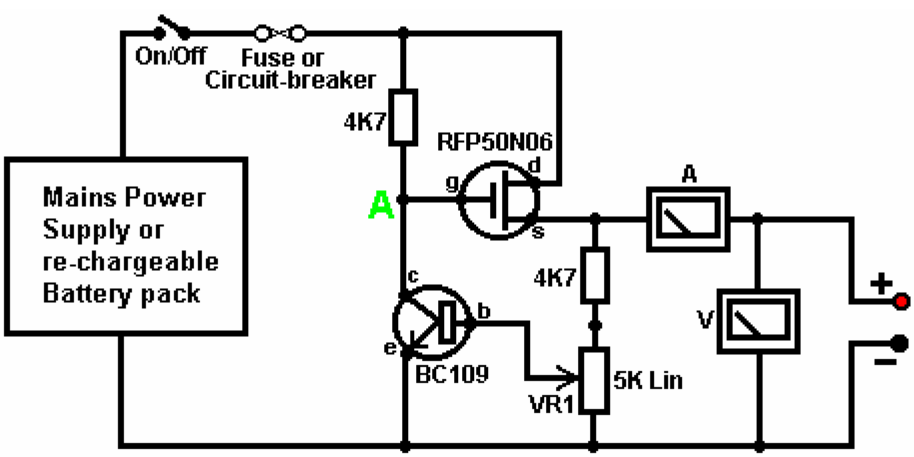
Look around and see what is available, how much it costs and what appeals to you. It might not be a bad idea to buy a really cheap multimeter and use it for a while to see if it has any shortcomings which are a nuisance, and if so, what improvements you personally want from a more expensive meter.

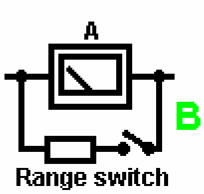
The 'Bench' Power Supply.

It might be worth getting a fancy bench power supply which allows you to set any voltage you want and which displays the current being drawn by your development circuit:

However, there is no need to spend money on a fancy unit when you can build an excellent unit of your own with voltage stabilisation, adjustable output, metered current, etc. etc. Personally, if developing a circuit to be used with a battery, I believe you are better off powering the development from a battery, that way the characteristics of the battery are included in any tests which you carry out.

If you wish, you can construct a very convenient development test bed power supply system. This has the advantage that you can make it in the most convenient style for your own use. You can also make the protection ultra-sensitive and build in additional circuitry such as transistor tester and resistor substitution box to produce an integrated test bed. You could perhaps use a circuit like this:





Here, the power is supplied by a pack of re-chargeable Ni-Cad batteries or possibly, a mains unit with voltage stabilisation. As in all actual circuits, the next thing in the circuit is **always** an on/off switch so that the power source can be disconnected immediately should any problem arise. Next, as always, comes a fuse or circuit breaker, so that should the problem be serious, it can disconnect the circuit faster than you can react. If you wish, you can build your own super-accurate adjustable circuit breaker to use in this position.

The two transistors and three resistors form an adjustable, stabilised output. The FET transistor has a high output power handling capacity and a very low input power requirement and so is good for controlling the output voltage. Resistor 'VR1' is padded with the 4K7 resistor solely to reduce the voltage across the variable resistor. VR1 is adjusted to control the output voltage. If the current draw is increased and the output voltage is pulled down slightly, then the voltage on the base of the BC109 transistor is reduced. This starts to turn the transistor off, raising the voltage at point 'A', which in turn, raises the output voltage, opposing the variation caused by the load.

The output is monitored, firstly by a large milliammeter to show the current draw and secondly, on the output side of the milliammeter, a voltmeter. This allows very close monitoring of the power supplied to the prototype, especially if the milliammeter is placed alongside the prototype. You can build this circuit into a wide flat box which provides a working surface beside the milliammeter.

At point 'B' in the above diagram, a method for altering the current range of the milliammeter by placing a 'shunt' resistor across it. When the switch is closed, some current flows through the resistor and some through the milliammeter. This resistor has a very low value, so you are better off making it yourself. Let's say we wish to double the range of the meter. Solder the switch across the meter and for the resistor use a length of enamelled copper wire wound around a small former. Put a load on the output so that the meter shows a full-scale deflection. Close the switch. If the current displayed is exactly half of what it was, if not, switch off, remove some wire to lower the reading or add some wire to raise the reading and repeat the test until exactly half the current is displayed. The lower the value of the shunt resistor, the more current flows through it and the less through the meter, which then gives a lower reading.

Please note: it is very important to have a fuse or circuit breaker in the power being delivered to your test circuit. Any error in building the prototype can cause a major current to be drawn from the supply and **this can be dangerous**. Remember, you can't see the current. Even if you have a meter on the current being delivered, you may not notice the high reading. The first sign of trouble may be smoke! You can easily fry the circuit you are building if you do not have a safety cut-off, so use a fuse or other device which limits the current to twice what you are expecting the circuit to draw.

So, after all that, what equipment do you really need? You need a small soldering iron and multicore solder, a pair of long-nosed pliers and a multimeter. One other thing is some tool to cut wires and remove the insulation prior to soldering. Personal preferences vary. Some people prefer one of the many custom tools, some people use a knife, I personally use a pair of straight nail scissors. You pick whatever you are comfortable with.

Not exactly a vast array of essential equipment. The other items mentioned are not by any means essential so I suggest that you start by keeping things simple and use a minimum of gear.

If you are not familiar with electronics, I suggest that you get a copy of the Maplin catalogue, either from one of their shops or via the http://www.maplin.co.uk web site. Go through it carefully as it will show you what components are available, how much they cost and often, how they are used. The specifications of almost any semiconductor can be found free at http://www.alldatasheet.co.kr in the form of an Adobe Acrobat document.

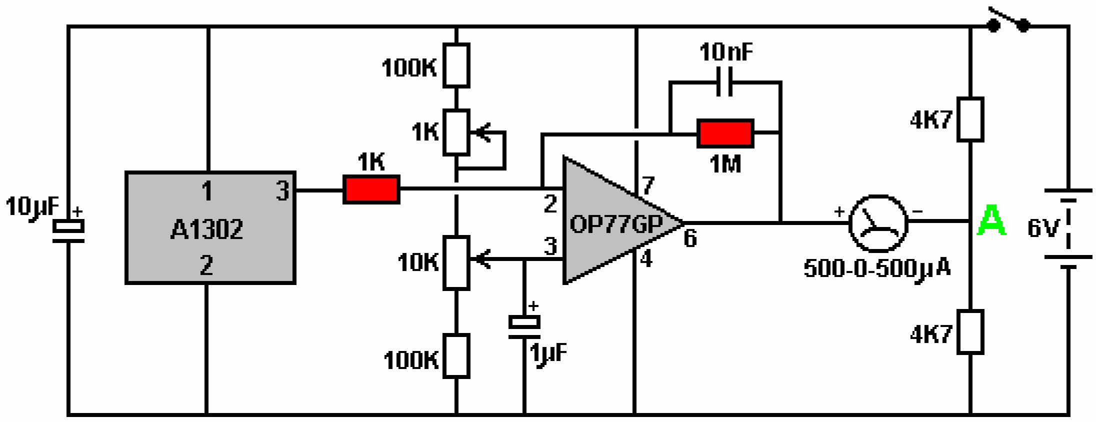
Finally, because it is not important, all of the circuitry shown so far has indicated current flowing from the + of a battery to the - terminal. The discovery of voltage was made by Volta but he had no way of knowing which way the current was flowing, so he guessed. He had a 50 - 50 chance of getting it right but he was not lucky and got it wrong. Electrical current is actually a flow of electrons, and these flow from the battery minus to the battery plus. So, who cares? Almost nobody, as it has no practical effect on any of the circuitry. Some useful websites:

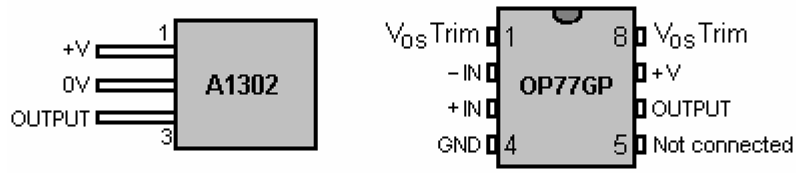
http//:www.esr.co.uk for components
http//:www.maplin.co.uk for components
http//:www.alldatasheet.co.kr for semiconductor specifications
http//:www.cricklewoodelectronics.com for components
http//:www.greenweld.co.uk for components

The Oscilloscope.
If you do decide that you are going to research new equipment, design and possibly invent new devices, then an oscilloscope is useful. Let me stress again that this is not an essential item of equipment and most certainly is not needed until you are quite familiar with constructing prototypes. It is quite easy to misread the settings of an oscilloscope and the methods of operation take some getting used to. The low-cost book "How to Use Oscilloscopes and Other Test Equipment" by R.A. Penfold, ISBN 0 85934 212 3 might well be helpful when starting to use a 'scope.

It is possible to get an oscilloscope at reasonable cost by buying second-hand through eBay. The best scopes are 'dual trace' which means that they can display the input waveform and the output waveform on screen at the same time. This is a very useful feature, but because it is, the scope which have that facility sell at higher prices. The higher the frequency which the scope can handle, the more useful it is, but again, the higher the selling price. Not all scopes are supplied with (the essential) 'test probes', so it might be necessary to buy them separately if the seller wants to keep his. Getting the manual for the scope is also a decided plus. A low cost scope might look like this:

Measuring Magnetic Field Strength.
People who experiment with permanent magnets, can make use of an instrument which displays the strength of a magnetic field. Professionally made devices to do this tend to be well outside the purchasing power of the average experimenter who will already have spent money on materials for his prototypes. Here is a design for a simple and cheap circuit, powered by four AA dry cell batteries, and utilising a Hall-effect semiconductor as the sensor:





This design uses an OP77GP operational amplifier chip to boost the output signal from the A1302 chip which is a Hall-effect device. The gain of the DC-connected operational amplifier is set by the ratio of the 1K and 1M fixed resistors shown shaded in the circuit diagram, giving a gain of 1,000.

The circuit operation is simple. The six-volt battery charges the 10 microfarad capacitor which helps iron out any supply line fluctuations caused by varying current draw by the circuit. The 10K variable resistor is used to set the output meter display to zero when the Hall-effect device is not near any magnet. The 1K variable resistor is there to make fine tuning adjustments easier.

When the A1302 chip encounters a magnetic field, the voltage on it's output pin 3 changes. This change is magnified a thousand times by the OP77GP amplifier. It's output on pin 6 is connected to one side of the display meter and the other side of the meter is connected to point "**A**". The voltage on point "**A**" is about half the battery voltage. It would be exactly half the voltage if the two 4.7K resistors were exactly the same value. This is rather unlikely as there is a manufacturing tolerance, typically around 10% of the nominal value of the resistor. The exact value of the voltage on point "**A**" is matched by the OP77GP tuning and so the meter reads zero until a magnetic field is encountered. When that happens, the meter deflection is directly proportional to the strength of the magnetic field.

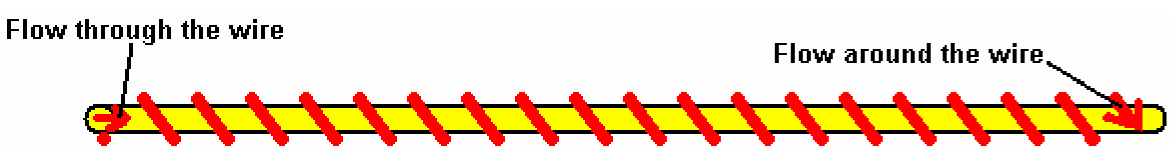
The Weird Stuff.

You don't need to know the following information, so please feel free to skip it and move on to something else.

The presentation shown above is based on the conventional view of electronics and electrical power as taught in schools and colleges. This information and concepts works well for designing and building circuits, but that does not mean that it is wholly correct. Unfortunately, the world is not as simple as is generally made out.

For example, it is said that current is a flow of electrons passing through the wires of a circuit at the speed of light. While it is true that some electrons do actually flow through the metal of the wires, the small percentage of electrons which actually do that, do it quite slowly as they have to negotiate their way through the lattice of the molecules of metal making up the body of the wires.

In spite of this, when the On/Off switch of a circuit is flipped on, the circuit powers up immediately, no matter how long the wires are. The reason for this is that electrical current flows along the wires at very high speed indeed, but it flows rapidly **along** the outside of the wires, not rapidly **through** the wires. One thousandth of a second after switching on a circuit, the electrons flowing through the wires have hardly got started, while the current flowing along the outside of the wires has gone all around the circuit and back:



The above sketch does not show the proportions correctly, as the current flow spiralling along the outside of the wire should be hundreds of thousands of times longer than shown, which is not practical in a diagram.

The actual path taken by current flow makes the surface of the wire of particular importance, and the insulation material is also of great importance. In years gone by, wire manufacturers used to anneal (cool down) copper wires in air. This created a layer of cupric oxide on the outer surface of copper wires, and that layer gave the wire different characteristics than copper wire has today. William Barbat in his patent application claims that the cupric oxide layer can be utilised in making devices with greater power output than the power input from the user.

Unfortunately, the world is not quite as simple as that, as power flowing in a circuit has at least two components. The electrical current which we measure with ammeters is as described above and is sometimes referred to as "hot" electricity as when it flows through components, it tends to heat them up. But there is another component referred to as "cold" electricity, so named because it tends to cool components down when it flows through them. For example, if the output wires of Floyd Sweet's VTA device were short circuited together, frost would form on the device due to the heavy flow of "cold" electricity, and getting a "shock" from it could give you frostbite instead of a burn.

"Cold" electricity is not something new, it has always been there as it is just one aspect of "electricity". It has not been investigated much by conventional science because none of the instruments used to measure "hot" electricity, react to "cold" electricity at all. (Actually, "hot" electricity, "cold" electricity and magnetism are all features of a single entity which should really be called "electromagnetism").

Now the spooky bit: "cold" electricity does not flow along or through the wire at all. Instead, it flows in the space around the wire, possibly riding on the magnetic field caused by the "hot" current. Thomas Henry Moray is famous for building a device which captured "cold" electricity and produced a massive power output capable of powering a whole host of ordinary electrical pieces of equipment. In his many public demonstrations before he was intimidated into silence and his equipment smashed, he invited members of the audience to bring a piece of ordinary glass with them. Then, when his circuit was powering a row of lights, he would cut one of the wires and insert the piece of glass between the cut ends of the wires. This had no noticeable effect on his circuit, with the power flowing happily through the glass and on through his circuit, powering the lights just as before. That does not happen with "hot" electricity, but as the "cold" electricity is not flowing through or along the surface of the wire, a break in the wire is not a major obstacle to it.

We still do not know very much about "cold" electricity. Edwin Gray snr. demonstrated light bulbs powered by "cold" electricity being submerged in water. Not only did the bulbs continue to operate unaffected by the water, but Edwin often put his hand in the water along with the lit bulb, suffering no ill effects from doing so. Neither of those two effects are possible with conventional electricity, so please **don't** try them to check it out.

Another interesting item is the water-powered car system produced by an American man Nathren Armour. His system, (among other things) involves feeding extra electrical power to the spark plugs. One thing which has always puzzled him is that the engine will not run with just one wire going to the spark plug cap. He has to have a second wire running from his extra power supply to the body of the plug where it screws into the engine block. Take that wire away and the engine stops. Put it back again and the engine runs. But according to conventional electrics, that wire cannot possibly be needed, because the engine block is grounded and the power supply output is grounded, so in theory, there is no voltage difference between the ends of the wire, therefore no current can flow along the wire, hence the wire is not needed and has no function. Well, that is true for "hot" electricity, but it seems possible that the Nathren Armour system is using "cold" electricity as well as "hot" electricity and the "cold" electricity needs the extra wire as a flow guide to the spark plug.

Enough about that for now. Let's go one step further into the "weirdness" of the actual world. If, three hundred years ago, you had described X-rays, gamma rays, nuclear energy and TV signals to the average well-educated person, you would have run a considerable risk of being locked up as being mad. If you do it today, your listener would probably just be bored as he already knows all this and accepts it as a matter of fact (which it is). Please bear that in mind when you read the following information. If it seems strange and far-fetched, that is only because conventional science today is lagging badly behind and still teaching things which have been conclusively proven to be wrong decades ago.

If you lived in a desert and every day a company drove in with a lorry-load of sand and sold it to you for a large amount of money, what would you think about that? Not a very good deal for you, is it? What's that you say, you would never do that? But you already do, because you don't realise that the sand is all around you ready for the taking at next to no cost at all. Several people have tried to publicise the fact, but the sand company has immediately silenced them by one means or another. The company does not want to lose the business of selling you the sand and definitely doesn't want you to start picking it up for yourself for free.

Well... to be perfectly fair, it is not actually sand, it is energy, and it is all around us, free for the taking. Sound a bit like X-rays did three hundred years ago? Doesn't mean that it is not true. It is perfectly true. The design of all computers made today is based on the equations of Quantum Mechanics, and while those equations are not yet perfect, they are easily good enough for practical purposes. The snag is that the world seen at the level of the quantum is not much like the world we think that we see around us and which we think that we understand fully. Examining the world at the quantum level shows that we live in a seething mass of incredible energy. Einstein is famous for stating that Mass equals a very large amount of Energy, a fact that is shown clearly when an atomic bomb is detonated. Put in different words, a small amount of matter is the equivalent of a very large amount of energy.

Actually, Energy and Matter are two different aspects of a single thing (which could reasonably be called "Mass-Energy").

At the quantum level, it can be seen that particles of matter pop into existence and drop out again into energy on a continuous basis, everywhere in the whole of the universe. The whole universe is seething with energy. That energy doesn't bother us any more than water bothers a fish, as we evolved in this sea of energy and we just don't notice it. It doesn't harm us, but if we wanted, and knew how, we could use as much of that energy as we wanted for ever and ever. The amount of that energy is unbelievable. It has been calculated that one cubic centimetre anywhere in the universe contains enough energy to create all of the matter we can see in the whole of the universe. Think how many cubic centimetres there are in the Earth ... the Solar System ... our Galaxy ... If every person on Earth were to run their vehicles, power their homes, fly their planes, etc. etc. for the next million years, it would not make the slightest dent in the energy contained in one cubic millimetre of the universe. This is not a theory, it is a fact. (Would you like to buy a big pile of sand? - I've got a load just over here...). This big energy field has gone under different names over the years. A popular name at the present time is the "Zero-Point Energy Field" and it is responsible for everything that happens in the universe. It powers life itself. It balances out in equilibrium everywhere, which is one reason which makes it hard to realise that it is all around us.

Tom Bearden is an American man with very considerable abilities and considerable in-depth knowledge of how the world actually operates. His statements are generally based on laboratory-proven criteria backed up by his high level of mathematical skills which give him an additional grasp of things. He explains how electricity actually works in circuits, and it is nothing like the system taught in schools and colleges. We think that when we attach a battery to an electrical circuit, the battery forces a current through the wires of the circuit. Sorry Chief - it is actually nothing like that at all. The power in the circuit comes directly from the Zero-Point Energy Field and has very little to do with the battery at all. We tend to think of "using up" power, but that is just not possible. Energy cannot be destroyed or "used up" the most you can do to it is to change it from one form to another. It will perform "work" (power equipment, generate heat, generate cold...) when it changes from one form to another, but if you reverse the process and convert it back to it's original form, it will perform another lot of "work" during the conversion and end up back in exactly the same state as it started out from, in spite of having performed two lots of "work" during the operation.

A battery does **not** provide energy to power a circuit. Instead, what happens is that the chemical action inside the battery causes negative charges to gather at the "minus" terminal of the battery and positive charges to gather together at the "plus" terminal of the battery. These two close-together "poles" of the battery are called a "dipole" (two opposite poles near each other) and they have an effect on the Zero-Point Energy Field which is everywhere. The "Plus" pole of the battery causes a massive cluster of Zero-Point Energy Field negative charges to cluster around it. In the same way, the "Minus" pole of the battery causes a massive gathering of ZPE ("Zero-Point Energy") positive charges to gather around it. Not only do these charges gather around the poles of the battery, but an imbalance in the energy field is created and the ZPE charges continue to arrive at the poles and they radiate out in every direction in a continuous stream of incredible energy.

So, there is your shiny new battery sitting there, not connected to anything and yet it causes massive energy streams to radiate out from its terminals in every direction. We don't notice it, because the energy flows freely through us and we can't feel it and none of our conventional instruments, such as voltmeters, ammeters, oscilloscopes, etc. react to it at all.

The situation changes immediately if we connect a circuit to the battery. The circuit provides a flow path for the ZPE energy to flow along, and a significant amount of energy flows near the wires of the circuit, actually powering the circuit for a split second until it reaches the battery "pole" at the far end of the circuit. When it gets there it promptly wipes out the pole, destroying it completely. The ZPE field calms down and the energy flow ceases. But our trusty battery immediately does it all again, using it's chemical energy to create the "dipole" once more, and the imbalance of the ZPE field starts again. It is because the battery has to use it's chemical energy all the time, creating and re-creating, and re-creating it's "dipole" that it runs down and eventually ceases to be able to create the dipole any more - result: no more power in the circuit.

Sorry to spoil the illusion, but the battery never did power the circuit itself, it merely acted as channelling device for the Zero-Point Energy Field. In passing, Direct Current ("DC") is actually not a continuous current at all, but instead it is a stream of DC pulses at an incredibly high frequency - way higher than we can measure at present. The speed of the pulses is so great that it looks continuous to us, a bit like the individual still pictures which are the frames of a movie, appear to be a moving image to us if they are played one after the other at a rate of 25 per second - it looks like continuous movement to us, but in reality, it is a rapid series of still pictures.

The way that a battery “dipole” works on the Zero-Point Energy Field is rather like the way that a magnifying glass acts on sunlight. The rays of the sun get concentrated into a point, focused by the lens. You can start a fire with the lens, and it would be easy to think that the lens started the fire, when in actual fact, it is the rays of the sun that started the fire and the lens just influenced a local area of the large “field” of sunlight, raising the temperature at just one point.

While we tend to think of a “dipole” being generated by a battery, the same effect is also created by a magnet, whether an electromagnet or a permanent magnet - remember that electricity and magnetism are two faces of the same entity. It is possible, but not easy, to capture the energy streaming out from the interference with the ZPE field caused by the poles of a magnet. For example, Hans Coler managed to do this with a completely passive device which, when set up correctly, could produce electrical power, hour after hour from apparently “nothing” (well, actually, the ZPE field). Roy Meyers also did it with his patented array of magnets and zinc plates - completely passive, with no moving parts at all, no battery and no circuitry.