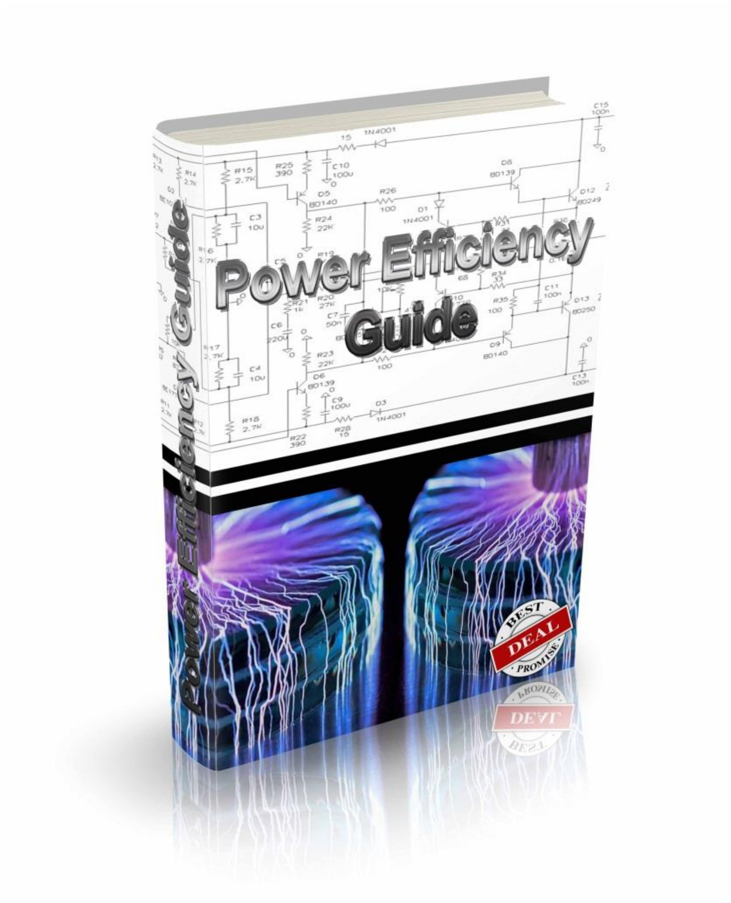
Power Efficiency Guide



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Additional information

We are not professional writers or photographers and didn't always have the opportunity to document or photograph every step of development. Therefore, please take the level of engineer/electrical experience required to build a Power Efficiency Generator very seriously as we are giving these to you under this premise. You will discover the advanced level of knowledge of mechanical/electrical processes needed quickly enough. The correct construction of the Power Efficiency Generator requires patience and careful thought. We made several mistakes in development and had given here the steps that were successful. You will probably still make mistakes – and these will be your most significant learning opportunities as you gain more knowledge about this type of energy.

Before beginning to build, consider how much you would like to outsource to one of the cottage industry community units (CICUs) near you! In the US we recommend Polaris for the steel stator/rotor construction, and Torelco for toroidal winding. As FTW continues to roll out the distribution plan, and more connections across the world are made, we think CICUs will be commonplace and hence, Power Efficiency Generator parts accessible (many people will be making them!)

When website URLs were available, we provided links for the person reading this online. You may certainly use your sources for materials, but it is imperative you do not alter the instructions/parts herein if you are building a Power Efficiency Generator. (We know with the increased knowledge you will discover many applications for this technology.) When photographs can be shown to help you visualize a process, they will be provided. Please remember, we are not professional manual writers. What we offer you here is our gift to humanity – but it comes with great responsibility. Learn as much as you can, use discernment and wisdom, share freely, and you will be privileged to know the secrets of energy created from the quantum field.

WARNING! We are not responsible for anything in these plans; you build at your own risk.

Introduction

Human civilization has started realizing how much harm they have already caused to the environment, not to mention the costs involved; and when it comes to taking a stand against these environmental problems, the focus shifts to the use of alternative energy sources. Have you ever wondered what Alternative Energy Sources are? And why are they supposed to help us sustain? Alternative sources of energy are the ones which do not cause any undesirable consequences to the environment, are renewable and are free!

Alternative energy sources can be implemented for houses, for cars, factories and any other facility you can imagine. Scientists around the world are researching developing and discovering new *Alternative Energy Sources* so that the growing energy needs of the human population can be met more efficiently, safely and efficiently.

The Power Efficiency Guide does precisely that. It uses one of the necessary materials in nature to convert its power into clean, usable energy. It has been around for thousands of years, and its properties haven't changed. It's the magnet.

What are Alternative Energy Sources?

Alternative energy encompasses all those things that do not consume fossil fuel. They are widely available and environmentally friendly. They cause little or almost no pollution. There have been several alternative energy projects running in various countries to reduce our dependence on traditional fossil fuels. There are many impressive options that you can take into consideration. Here in you will learn more about alternative energy sources that you can take into account.

Solar energy

Solar is the first energy source in the world. It was in use much earlier before humans even learn how to light a fire. Many living things are dependent on solar energy from plants, aquatic life, and animals. The solar is mostly used in generating light and heat. The solar power coming down to the planet is affected by the orbital path of the sun and its variations within the galaxy. Also, it is affected by activity taking place in space and on the sun. It was this energy that is believed to have been responsible for the breaking of ice during the ice age, which creates the separation of lands and sea.

Solar energy is one the alternative energy source that is used most widely across the globe. About 70% of the sunlight gets reflected into space, and we have only 30% of the sun to meet up our energy demands. While solar energy is used for producing solar power, it is also used for drying clothes, used by plants during the process of photosynthesis and also used by human beings during winter seasons to make their body temperature warm. Solar energy can be extracted either by Solar Thermal or using Photovoltaic (PV) Cells. Learn more about these methods here.

There are two kinds of solar energy the active solar energy and passive solar energy. Passive solar energy primarily uses duration, position and sun's rays intensity to its advantage in heating a particular area. It also uses it to induce airflow from an area to the next. Active solar energy uses electrical technology and mechanical technology like collection panels in capturing, converting and storing energy for future use.

Solar energy does not create any pollution and is widely used by many countries. It is a renewable source of power since the sun will continue to produce sunlight all the years. Solar panels, which are required to harness this energy can be used for a long time and require little or no maintenance. Solar energy proves to be ineffective in colder regions which don't receive good sunlight. It cannot be used during the night, and solar panels can trap not all the light from the sun. Solar energy advantages are much more than its disadvantages which make it a viable source of producing alternative energy.

Wind Energy

This is one of the energy sources that have been in use for a very long time and centuries. It was used in powering sailing ships, which made it possible for explorers to navigate around their trade routes in distant lands. A single windmill can power the crop irrigation, and the family energy needs, water pumping and electric lights. However, in the present time, several mills are used to generate the required energy mostly for industrial uses. Many of the wind turbines can capture much power all at once before feeding it to the power grid. This is commonly known as wind farms and has been in use for many years all around the world. It is only the United States that is going slow regarding accepting this alternative energy source.

Wind power is a renewable source of energy and reduces our alliance on foreign countries for the supply of oil and gas. It does not cause any air pollution and has created several jobs in the last few decades. Advancement in technologies has brought down the cost of setting up wind power plant. Wind energy can only be used in areas which experience high winds which mean that it cannot be used as a source to extract energy anywhere on earth. They sometimes create noise disturbances and cannot be used near residential areas. These disadvantages have made the use of wind energy in particular regions only.

Geothermal Energy

'Geo' means Earth and 'thermal' means energy. Geothermal energy means energy drawn or harnessed from beneath the earth. It is immaculate and renewable. Geothermal energy has been in use since last several years. The universe contains a molten rock called magma. Heat is continuously produced from there. The temperature increases about 3 degrees Celsius, for every 100 meters you go below ground. Below, 10,000 meters the temperature is so high, that it can be used to boil water. Water makes its way deep inside the earth, and hot rock boils that water. The boiling water then produces steam which is captured by geothermal heat pumps. The steam turns the turbines which in turn activates generators.

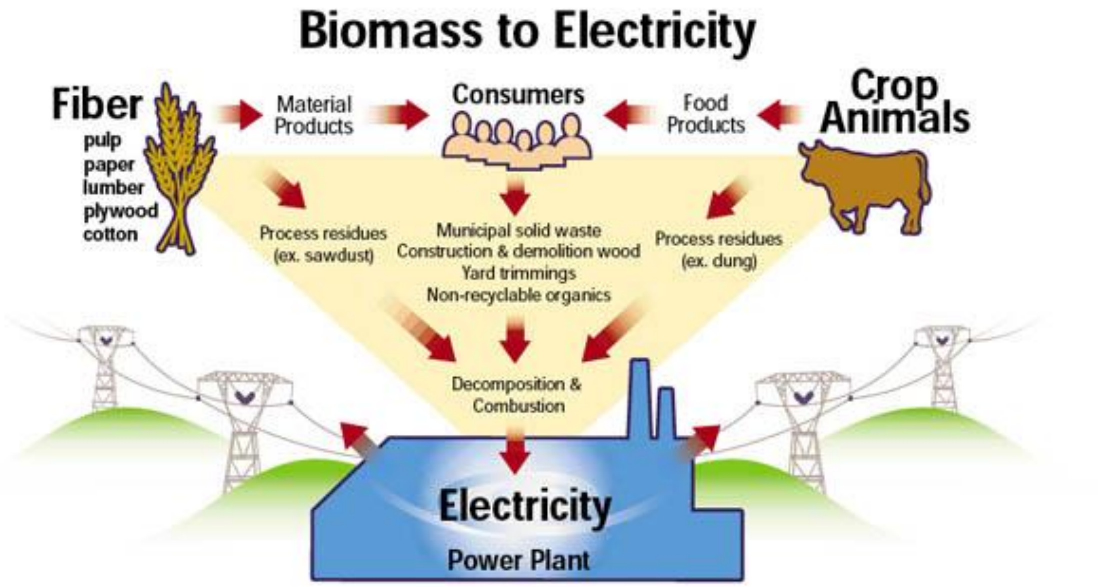
Geothermal energy can be found anywhere on the earth. Most countries tap this energy to generate electricity, using thermal mass flow meters and power millions of homes. The areas which have high underground temperatures are the ones which are the ones which are prone to earthquakes and volcanoes. The United States produces more Geothermal electricity than any other country in the world. Most hot water geothermal reservoirs are located in the western states, Alaska, and Hawaii. Geothermal energy is renewable as earth will continue to produce heat as long as we are all are here. If these resources are tapped and are utilized effectively, they can provide a solution to the world's power problems.

Geothermal energy produces no pollution, reduces our alliance on fossil fuels. It also results in significant cost savings as no fuel is required to harness power from beneath the earth. These advantages make geothermal energy as one the best alternative energy source. But, geothermal has its downsides too. It is suitable for a particular region and cannot be harnessed everywhere. The earth may release some harmful gases while releasing the heat which may prove adverse from humanity. Also, the areas where this energy is harnessed are prone to earthquakes and volcanoes. Apart from that, setting up geothermal power stations requires huge installation cost. Here are some pros and cons of geothermal energy.

Biomass Energy

This is the process by which alternative energy is generated through the conversion of biological materials and wastes into forms that can be used as energy sources for heating, power generation, and transportation. Those carbon-based substances or materials converted over a long period to fossil fuels are not regarded as biomass. However, in their original state, they are considered as biomass. This is because of the separation of the carbon they previously contained from the carbon cycle. This makes them figure differently affecting carbon dioxide levels in the air.

Biomass energy has been around since ancient times when people use to burn wood or coal to heat their homes or prepare food. Wood remains the most common source to produce biomass energy. Apart from wood, the other products that are used to create biomass energy include crops, plants, landfills, municipal and industrial waste, trees and agricultural waste.



Biomass is a renewable source of energy as we would be able to produce it as long as crops, plants, and waste exists. It does not create any greenhouse gases and can be easily extracted through the process of combustion.

Furthermore, another advantage of biomass is that it helps to reduce landfills. Biomass is comparatively ineffective as compared to fossil fuels. They release methane gases which can be harmful to the environment. Read more about the advantages and disadvantages of biomass here.

Ocean Energy

The earth promises many power sources. Just like the geothermal and solar energy, which have long been used in heating homes and lighting as well when harnessed. Even in the last century, these forms of power was in use. Due to the massive size of oceans, this energy can be used on a much broader scale than other alternative sources of energy. The waves produced by the sea and tides that hit the seashore has enormous potential in them. If they are harnessed with the full capacity, they can go a long way in reducing the world's energy problems. There are three ways, i.e., Tidal energy, Wave energy and Ocean thermal energy conversion (OTEC) via which ocean energy can be harnessed.

Tidal power involves using kinetic energy from the incoming and outgoing tides. Thus, the difference in high tides and low tides are also crucial in this respect. There are lots of energy that can be harnessed from waves for use. It is another form of hydropower. Tidal energy generators which turn turbines capture the rise and fall of ocean tides. The movement of the turbines is responsible for producing electricity. In short, the tidal energy generator captures the kinetic motion of the tides and converts them into electrical energy. The primary advantage of tidal power is that it is entirely renewable and are thus much more predictable than wave energy. Learn more about the tidal energy here.

Hydrogen Energy

Hydrogen is the most abundant element available on earth, but it is rarely alone. Even water contains two third of hydrogen. It is usually possible with other items and has to separate before we can make use of it. Hydrogen has tremendous potential and can be used to power up homes, vehicles and even space rockets. However, it takes a lot of energy to separate hydrogen from other elements, and therefore it proves to quite expensive to extract it. Take a close look at hydrogen energy and see how it works.

The main benefit of hydrogen energy is that it is a clean source of fuel and does not leave any waste elements behind except water. There are no harmful emissions and is environment-friendly. It is entirely renewable and can be produced over and over again on demand. Hydrogen can also be used to make bombs like the ones used by America on Hiroshima and Nagasaki which makes it highly flammable. Dependency on fossil fuels remains as we need them to extract hydrogen from other elements. Also, it is quite expensive to produce and store.

Hydro-Energy

Solar energy is produced by the sun, and wind energy is generated by moving of winds. The heat caused by the sun drives the wind. Wind turbines then capture the movement of winds. Both wind and sun cause water to evaporate. The water vapor then turns into rain or snow and flows down to sea or oceans through rivers or streams. The energy of the moving water can then be captured and called as hydroelectric power. Hydroelectric power stations capture the kinetic energy of moving water and give mechanical strength to turbines. The moving turbines then convert mechanical energy into electrical energy through generators. Dams around the world have been built for this purpose only. Hydropower is the largest producer of alternative energy in the world.

There are different types of hydropower plants. The selection of a hydropower plant depends on many volume and flow of water. Hydropower is a renewable, constant, predictable and controllable source of energy. They emit no greenhouse gases and are environment-friendly. On the negative side, they may cause an adverse effect on aquatic life, reduce the flow of water which may affect agriculture, require considerable costs to build and may cause havoc if they broke down.

These are some of the alternative energy sources that can be taken into consideration when planning your energy production and usage. However, they are either too expensive, too complicated to build, too dangerous to use, or your geographical position does not favor one or more of them.

However, one of the most overlooked solutions to generate energy is magnets. Other sources of energy have been used but, with the inevitable increase in the demand on the world's natural resources, humankind may turn to this unique source of power.

What is a Magnet?

The general definition of a magnet is "An object made of certain materials which create a magnetic field."

However, the word “magnet” was first used by the Greeks as early as 600 B.C. for describing a mysterious stone that attracted iron and other pieces of the same material? According to one Greek legend, the name magnet was taken from the shepherd Magnets who discovered the magnetic stone by accident when his stuff was mysteriously attracted to the force of the stone. Another, and perhaps more believable, theory says that the word magnet came from a city in Asia Minor, called Magnesia, where many of these mysterious magnetic stones were found.

During the Middle Ages, this stone became known as lodestone, which is the magnetic form of magnetite. Today, magnets are available in all sorts of shapes including discs, rings, blocks, rectangles, arcs, rods, and bars. They are made out of materials such as ceramic (strontium ferrite), alnico (aluminium, nickel, and cobalt), rare earth (samarium cobalt and neodymium) and flexible, rubber-like material.

But what *is* a magnet?

A magnet is an object made of certain materials which create a magnetic field.

Magnets are objects that have a north and south pole at opposite ends. A magnet contains electrons that have both uneven orbits and uneven spins. Those magnetic atoms are aligned in nice straight rows inside each domain. And those domains are also lined up all in the same direction. And only with ALL of these conditions satisfied does this piece of metal become a magnet. Don't worry if this doesn't make sense -- we'll break it down throughout this lesson.

Every magnet has at least one the North Pole and one South Pole. By convention, we say that the magnetic field lines leave the north end of a magnet and enter the south end of a magnet. This is an example of a magnetic dipole ("di" means two, thus two poles). If you take a bar magnet and break it into two pieces, each piece will again have a north pole and a south pole. If you take one of those pieces and break it into two, each of the smaller pieces will have a north pole and a south pole. No matter how small the pieces of the magnet become, each piece will have a north pole and a south pole. It has not been shown to be possible to end up with a single north pole or a single south pole which is a monopole ("mono" means one or single, thus one pole).

All magnets are made of a group of metals called the ferromagnetic metals. These are metals such as nickel and iron. Each of these metals has the exclusive property of being able to be magnetized uniformly. When we ask how a magnet works, we are merely asking how the object we call a magnet exerts its magnetic field. The answer is quite impressive.

In every material, there are several small magnetic fields called domains. Most of the times these domains are independent of each other and face different directions. However, a strong magnetic field can arrange the domains of any ferromagnetic metal so that they align to make a more extensive and stronger magnetic field. This is how most magnets are made.

The significant difference between magnets is whether they are permanent or temporary. Temporary magnets lose their larger magnetic field over time as the domains return to their original positions. The most common way that magnets are produced is by heating them to their Curie temperature or beyond. The Curie temperature is the temperature at which a ferromagnetic metal gains magnetic properties. Heating a ferromagnetic material to its given temperature will make it magnetic for a while. While heating it beyond this point can make the magnetism permanent. Ferromagnetic materials can also be categorized into soft and hard metals. Soft metals lose their magnetic field over time after being magnetized while hard metals are likely candidates for becoming permanent magnets.

Not all magnets are human-made. Some magnets occur naturally in nature such as lodestone. This mineral was used in ancient times to make the first compasses. However, magnets have other uses. With the discovery of the relationship between magnetism and electricity, magnets are now a significant part of every electric motor and turbine in existence. Magnets have also been used in storing computer data. There is now a type of drive called a solid state drive that allows data to be still saved more efficiently on computers.

Not only do the shape and material of magnets vary, so make their applications. At many companies, magnets are used for lifting, holding, separating, retrieving, sensing, and material handling. You can find magnets in a car and around your house. Magnets are used in the home to organize tools or kitchen utensils and can be found in doorbells, loudspeakers, microwaves, and televisions. Business offices and schools use magnetic planning boards to display schedules and charts.

Magnets are also used in a compass to guide people if they are lost. The compass was probably the first crucial magnetic device discovered. Around the 12th century, someone noticed that when allowed free movement, a magnet always points in the same north/south direction. This discovery helped mariners who often had trouble navigating when the clouds covered the sun or stars.

But the use of the magnets for this device will revolutionize the entire energy industry.

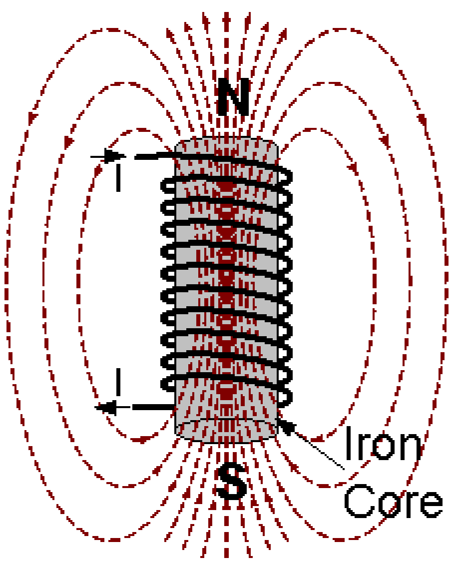
What is an electromagnet?

An electromagnet is a magnet that runs on electricity. Unlike a permanent magnet, the strength of an electromagnet can easily be changed by changing the amount of electric current that flows through it. The poles of an electromagnet can even be reversed by reversing the flow of electricity.

An electromagnet works because an electric current produces a magnetic field. The magnetic field generated by an electrical current forms circles around the electric current, as shown in the diagram below:

Mechanically, an electromagnet is simple. It consists of a length of conductive wire, usually copper, wrapped around a piece of metal. A current is introduced, either from a battery or another source of electricity and flows through the wire. This creates a magnetic field around the coiled wire, magnetizing the metal as if it were a permanent magnet. Electromagnets are useful because you can turn the magnet on and off by completing or interrupting the circuit, respectively.

Before we go too much farther, we should discuss how electromagnets differ from your run-of-the-mill "permanent" magnets. As you know, magnets have two poles, "north" and "south," and attract things made of steel, iron or some combination thereof. Like poles repel and opposites. For example, if you have two bar magnets with their ends marked "north" and "south," the north end of one magnet will attract the south end of the other. On the other hand, the north end of one magnet will repel the north end of the other (and similarly, the south will repel south). An electromagnet is the same way, except it is "temporary" - the magnetic field only exists when an electric current is flowing.



The doorbell is a good example of how electromagnets can be used in applications where permanent magnets wouldn't make any sense. When a guest pushes the button on your front door, the electronic circuitry inside the doorbell closes an electrical loop, meaning the circuit is completed and "turned on." The closed circuit allows electricity to flow, creating a magnetic field and causing the clapper to become magnetized. The hardware of most doorbells consists of a metal bell and metal clapper that, when the magnetic charges cause them to clang together, you hear the chime inside and you can answer the door. The bell rings, the guest releases the button, the circuit opens, and the doorbell stops its infernal ringing. This on-demand magnetism is what makes the electromagnet so useful.

Permanent Magnets and Electromagnets: What are the Differences?

A permanent magnet is an object made from a material that is magnetized and creates its persistent magnetic field. As the name suggests, a permanent magnet is 'permanent.' This means that it always has a magnetic field and will display a magnetic behavior at all times.

An electromagnet is made from a coil of wire which acts as a magnet when an electric current passes through it. Often an electromagnet is wrapped around a core of ferromagnetic material like steel, which enhances the magnetic field produced by the coil.

Permanent Magnet v. Electromagnet: Magnetic Properties

A permanent magnet's magnetic properties exist when the magnet is (magnetized). An electromagnetic magnet only displays magnetic properties when an electric current is applied to it. That is how you can differentiate between the two. The magnets that you have affixed to your refrigerator are permanent magnets, while electromagnets are the principle behind AC motors.

Permanent Magnet v. Electromagnet: Magnetic Strength

Permanent magnet strength depends upon the material used in its creation. The strength of an electromagnet can be adjusted by the amount of electric current allowed to flow into it. As a result, the same electromagnet can be adapted for different strength levels.

Permanent Magnet v. Electromagnet: Loss of Magnetic Properties

If a permanent magnet loses its magnetic properties, as it does by heating to a (maximum) temperature, it will be rendered useless, and its magnetic properties can be only recovered by re-magnetizing. Contrarily, an electromagnet loses its magnetic power every time an electric current is removed and becomes magnetic once again when the electric field is introduced.

Permanent Magnet v. Electromagnet: Advantages

The main advantage of a permanent magnet over an electromagnet is that a permanent magnet does not require a continuous supply of electrical energy to maintain its magnetic field. However, an electromagnet's magnetic field can be rapidly manipulated over a wide range by controlling the amount of electric current supplied to the electromagnet.

The Power Efficiency Guide uses this principle and multiplies the energy the magnets supply, eventually offering enough energy to power household appliances.

The most recent and life-changing discovery is the Neodymium Magnet

A neodymium magnet (also known as NdFeB, NIB or Neo magnet), the most widely used type of rare-earth magnet, is a permanent magnet made from an alloy of neodymium, iron, and boron to form the $Nd_2Fe_{14}B$ tetragonal crystalline structure. Developed in 1982 by General Motors and Sumitomo Special Metals, neodymium magnets are the strongest type of permanent magnet commercially available. They have replaced other types of magnets in the many applications in modern products that require strong permanent magnets, such as motors in cordless tools, hard disk drives, and magnetic fasteners.

Description

Neodymium is a metal which is ferromagnetic (more specifically it shows antiferromagnetic properties), meaning that like iron it can be magnetized to become a magnet, but its Curie temperature (the temperature above which its ferromagnetism disappears) is 19 K (−254 °C), so in pure form its magnetism only appears at extremely low temperatures.[4] However, compounds of neodymium with transition metals such as iron can have Curie temperatures well above room temperature, and these are used to make neodymium magnets.

The strength of neodymium magnets is due to several factors. The tetragonal $Nd_2Fe_{14}B$ crystal structure has exceptionally high uniaxial magnetocrystalline anisotropy (H_A ~7 T – magnetic field strength H in units of *A/m* versus magnetic moment in $A{\cdot}m^2$). This means a crystal of the material preferentially magnetizes along a specific crystal axis but is very difficult to attract in other directions. Like other magnets, the neodymium magnet alloy is composed of microcrystalline grains which are aligned in a powerful magnetic field during manufacture so their magnetic axes all point in the same direction. The resistance of the crystal lattice to turning its direction of magnetization gives the compound a very high coercivity or resistance to being demagnetized.

The neodymium atom also can have a large magnetic dipole moment because it has seven unpaired electrons in its electron structure as opposed to (on average) 3 in iron. In a magnet, it is the unpaired electrons, aligned, so they spin in the same direction, which generates the magnetic field. This gives the $Nd_2Fe_{14}B$ compound a high saturation magnetization (J_s ~1.6 T or 16 kG) and typically 1.3 teslas. Therefore, as the maximum energy density is proportional to J_s^2, this magnetic phase has the potential for storing large amounts of magnetic energy (BH_{max} ~ 512 kJ/m^3 or 64 MG·Oe). This magnetic energy value is about 18 times greater than "ordinary" magnets by volume. This property is higher in NdFeB alloys than in samarium cobalt (SmCo) magnets, which were the first type of rare-earth magnet to be commercialized. In practice, the magnetic properties of neodymium magnets depend on the alloy composition, microstructure, and manufacturing technique employed.

History

In 1982, General Motors (GM) and Sumitomo Special Metals discovered the $Nd_2Fe_{14}B$ compound. The research was initially driven by the high raw materials cost of SmCo permanent magnets, which had been developed earlier. GM focused on the development of melt-spun nanocrystalline $Nd_2Fe_{14}B$ magnets, while Sumitomo developed full-density sintered $Nd_2Fe_{14}B$ magnets.

GM commercialized its inventions of isotropic Neo powder, bonded Neo magnets, and the related production processes by founding Magnequench in 1986 (Magnequench has since become part of Neo Materials Technology, Inc., which later merged into Molycorp). The company supplied melt-spun $Nd_2Fe_{14}B$ powder to bonded magnet manufacturers.

The Sumitomo facility became part of the Hitachi Corporation, and currently manufactures and licenses other companies to produce sintered $Nd_2Fe_{14}B$ magnets. Hitachi holds more than 600 patents covering neodymium magnets.

Chinese manufacturers have become a dominant force in neodymium magnet production, based on their control of much of the world's sources of rare earth mines.

The United States Department of Energy has identified a need to find substitutes for rare earth metals in permanent magnet technology and has begun funding such research. The Advanced Research Projects Agency-Energy has sponsored a Rare Earth Alternatives in Critical Technologies (REACT) program, to develop alternative materials. In 2011, ARPA-E awarded 31.6 million dollars to fund Rare-Earth Substitute projects.

Production

There are two principal neodymium magnet manufacturing methods:

- Classical powder metallurgy or sintered magnet process
- Rapid solidification or bonded magnet process

Sintered Nd-magnets are prepared by the raw materials being melted in a furnace, cast into a mold and cooled to form ingots. The ingots are pulverized and milled; the powder is then sintered into solid blocks. The blocks are then heat-treated, cut to shape, surface treated and magnetized.

In 2015, Nitto Denko Corporation of Japan announced their development of a new method of sintering neodymium magnet material. The method exploits an "organic/inorganic hybrid technology" to form a clay-like mixture that can be fashioned into various shapes for sintering. Most importantly, it is said to be possible to control a non-uniform orientation of the magnetic field in the sintered material to concentrate the field to locally, e.g., improve the performance of electric motors. Mass production is planned for 2017.

As of 2012, 50,000 tons of neodymium magnets are produced officially each year in China, and 80,000 tons in a "company-by-company" build-up done in 2013. China produces more than 95% of rare earth elements and produces about 76% of the world's total rare-earth magnets.

Bonded Nd-magnets are prepared by melt spinning a thin ribbon of the NdFeB alloy. The ribbon contains randomly oriented $Nd_2Fe_{14}B$ nano-scale grains. This ribbon is then pulverized into particles, mixed with a polymer, and either compression- or injection-molded into bonded magnets. Bonded magnets offer less flux intensity than sintered magnets, but can be net-shape-formed into intricately shaped parts, as is typical with Halbach arrays or arcs, trapezoids and other shapes and assemblies (e.g., Pot Magnets, Separator Grids, etc.). There are approximately 5,500 tons of Neo bonded magnets produced each year. Also, it is possible to hot-press the melt spun nanocrystalline particles into fully dense isotropic magnets, and then upset-forge or back-extrude these into high-energy anisotropic magnets.

Properties

Neodymium magnets are graded according to their maximum energy product, which relates to the magnetic flux output per unit volume. Higher values indicate stronger magnets and range from N35 up to N52. Letters following the grade indicate maximum operating temperatures (often the Curie temperature), which range from M (up to 100 °C) to EH (200 °C).

Hazards

The greater forces exerted by rare-earth magnets create hazards that may not occur with other types of magnet. Neodymium magnets larger than a few cubic centimeters are strong enough to cause injuries to body parts pinched between two magnets, or a magnet and a ferrous metal surface, even creating broken bones.

Magnets that get too near each other can strike each other with enough force to chip and shatter the brittle material, and the flying chips can cause various injuries, especially eye injuries. There have even been cases where young children who have swallowed several magnets have had sections of the digestive tract pinched between two magnets, causing injury or death. The stronger magnetic fields can be hazardous to mechanical and electronic devices, as they can erase magnetic media such as floppy disks and credit cards, and magnetize watches and the shadow masks of CRT type monitors at a greater distance than other types of magnet.

That is why we recommend extra precaution when building the generator.

Working principle

Using the technology electric cars use nowadays, the Power Efficiency Guide was developed to be easier to build than any other generator plans.

Some of the steel parts can be made from wood instead of metal. But for a long lasting and a more reliable, it is best to use steel or durable materials. Please be careful!

The generator starts with a DC motor, which in the case of his prototype is a General Electric permanent magnet, one-twelfth horsepower (62 watts) 12-volt motor which runs at 1100 rpm. That motor is coupled to a gear that transfers the spins, multiplying them to another gear that is attached to a flywheel's driveshaft.

Once the driveshaft reaches the optimum RPMs, around 2000, the rotor attached to the other end of the flywheel will spin with the flywheel with the same RPMs.

One of the other rotors will start to spin along with the main rotor because of the neodymium magnets and will begin to power the DC motor.

This is the moment the battery is removed because the system will self-sustain itself. The constant RPSs of the second rotor will provide enough energy to supply the DC motor that supplies the flywheel.

The energy will not be lost due to the strength of the magnets and because there is no contact and no friction to diminish the energy.

List of components:

Dc Motor 12-volt

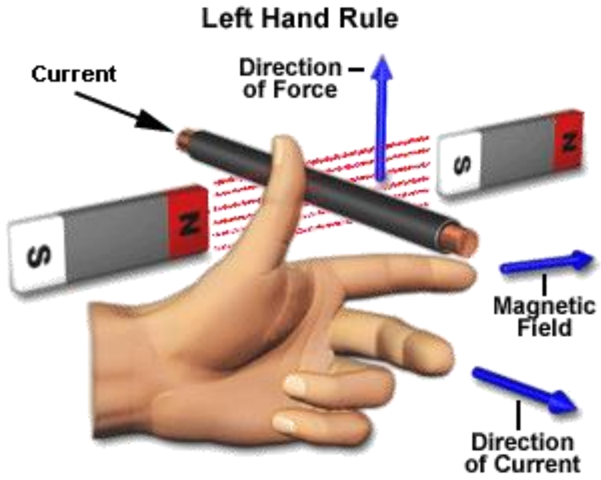
(https://www.amazon.com/AUTOTOOLHOME-Electric-Drill-Motor-Drills/dp/B01LZYWFE4/ref=sr_1_2_sspa?ie=UTF8&qid=1537381092&sr=8-2-spons&keywords=12+volt+dc+motor&psc=1)

You can find DC motor in many portable home appliances, automobiles, and types of industrial equipment. Small DC motors are used in tools, toys, and devices.

A DC motor is any of a class of rotary electrical machines that converts direct current electrical power into mechanical power. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor.

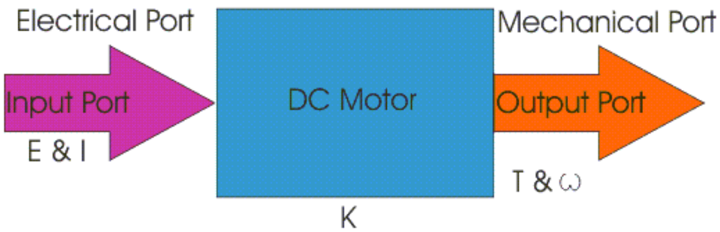
DC motors were the first type widely used since they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of the current in its field windings. The universal motor can operate on direct current but is a lightweight motor used for portable power tools and appliances.

Larger DC motors are used in the propulsion of electric vehicles, elevator, and hoists, or in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.



The direction of rotation of this motor is given by Fleming's left-hand rule, which states that if the index finger, middle finger, and thumb of your left hand are extended mutually perpendicular to each other and if the index finger represents the direction of magnetic field, middle finger indicates the direction of current, then the thumb represents the direction in which the shaft of the DC motor experiences force.

Structurally and construction wise a direct current motor is precisely similar to a DC generator, but electrically it is just the opposite. Here, unlike a generator, we supply electrical energy to the input port and derive mechanical strength from the output port. We can represent it by the block diagram shown below.



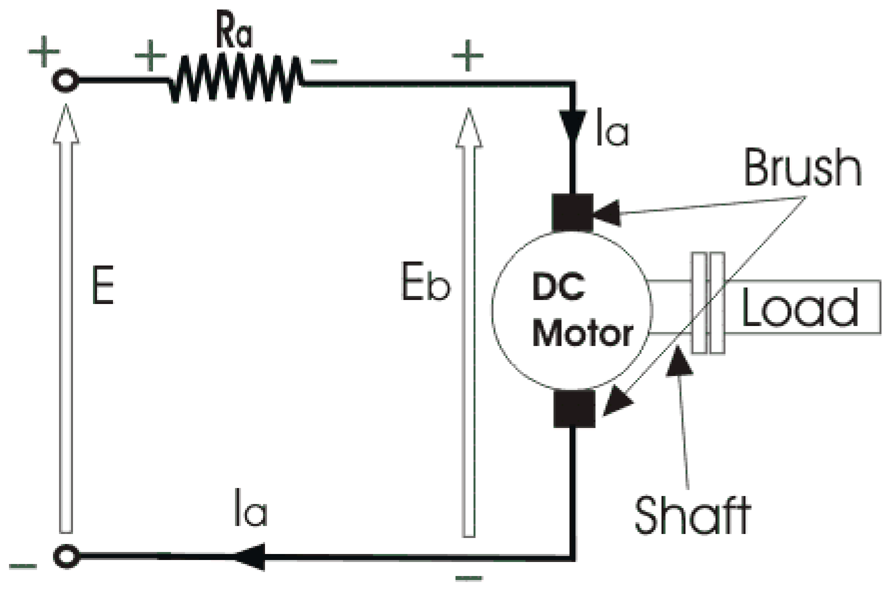
Here in a DC motor, the supply voltage E and current I is given to the electrical port or the input port, and we derive the mechanical output, i.e., torque T and speed ω from the mechanical port or output port.

The input and output port variables of the direct current motor are related by the parameter K.

$$T = KI \; and \; E = K\omega$$

So from the picture above, we can well understand that motor is just the opposite phenomena of a DC generator, and we can derive both motoring and generating operation from the same machine by merely reversing the ports.

To understand the DC motor in details let’s consider the diagram below:



The direct current motor is represented by the circle in the center, on which is mounted the brushes, where we connect the external terminals, from where the supply voltage is given. On the mechanical terminal, we have a shaft coming out of the Motor, and connected to the armature, and the armature-shaft is coupled to the mechanical load. On the supply terminals, we represent the armature resistance Ra in series.

Now, let the input voltage E, is applied across the brushes. The electric current which flows through the rotor armature via brushes, in the presence of the magnetic field, produces a torque Tg. Due to this torque Tg, the dc motor armature rotates. As the armature conductors are carrying currents and the armature rotates inside the stator magnetic field, it also produces an emf Eb in the manner very similar to that of a generator. The generated Emf Eb is directed opposite to the supplied voltage and is known as the back Emf, as it counters the forward voltage.

The back Emf like in case of a generator is represented by

$$E_b = \frac{P.\varphi.Z.N}{60.A} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where P = no of poles

φ = flux per pole

Z= No. of conductors

A = No. of parallel paths

and N is the speed of the DC Motor.

So, from the above equation, we can see Eb is proportional to speed 'N.' That is whenever a direct current motor rotates; it results in the generation of back Emf. Now let's represent the rotor speed by ω in rad/sec. So Eb is proportional to ω.

So, when the speed of the motor is reduced by the application of load, Eb decreases. Thus the voltage difference between supply voltage and back emf increases that means E − Eb increases. Due to this increased voltage difference, armature current will increase and therefore torque and hence speed increases. Thus a DC Motor is capable of maintaining the same speed under variable load.

Now armature current Ia is represented by

$$I_a = \frac{E - E_b}{R_a}$$

Now at starting,speed ω = 0 so at starting Eb = 0.

$$\therefore\ \ I_a = \frac{E}{R_a}..............................(2)$$

Now since the armature winding electrical resistance Ra is small, this motor has a very high starting current in the absence of back Emf. As a result, we need to use a starter for starting a DC Motor.

Now as the motor continues to rotate, the back Emf starts being generated and gradually the current decreases as the motor picks up speed.

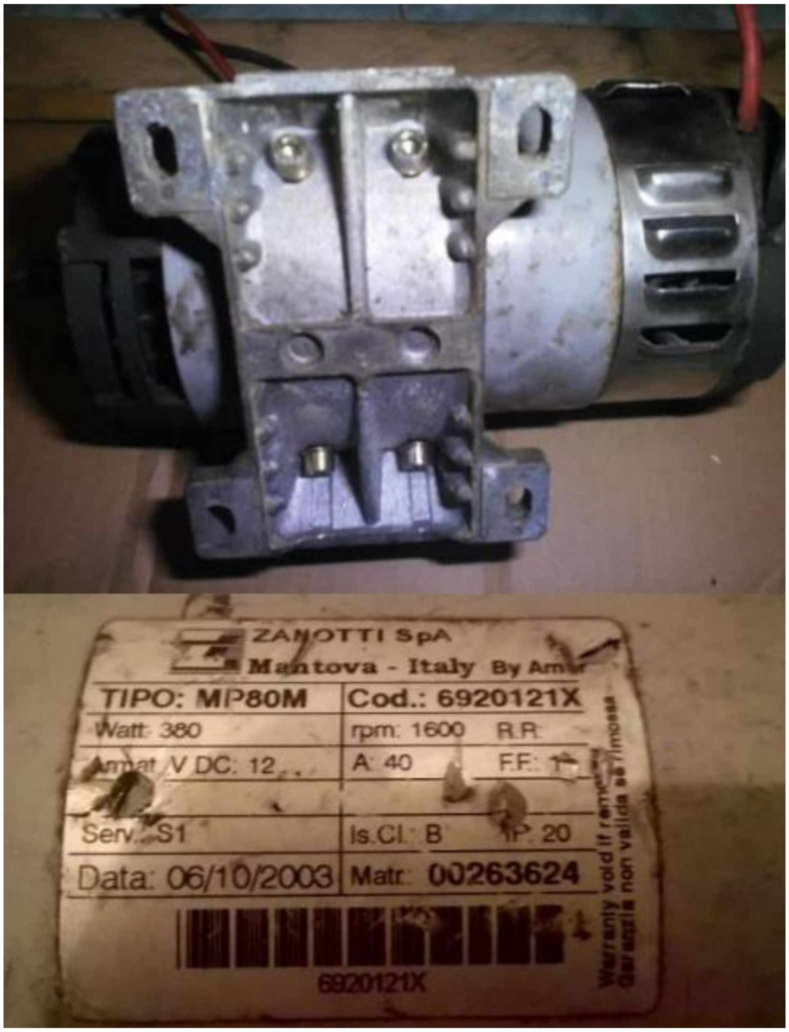
On our project, we used a one-twelfth horsepower (380 watts) 40A, 12-volt motor which runs at 1600 rpm.

You can also use other types of DC Motor, provided that they have these characteristics:

- 12V
- 60-80 Amps
- Minimum 650 RPM

The main criteria by which you need to choose the DC Motor is that it needs to be able to input to the flywheel minimum 2500 RPMs.

It's one of the most important parts because the math must be precise to reach the optimum RPMs for the device.



Gears with Sprocket Chains (you can also use rollers belts)

[(https://www.amazon.com/1989-1993-Polaris-Chains-Complete-Sprocket/dp/B077W2BK2X/ref=sr_1_1_sspa?ie=UTF8&qid=1537381205&sr=8-1-spons&keywords=sprocket+chain&psc=1)](https://www.amazon.com/1989-1993-Polaris-Chains-Complete-Sprocket/dp/B077W2BK2X/ref=sr_1_1_sspa?ie=UTF8&qid=1537381205&sr=8-1-spons&keywords=sprocket+chain&psc=1)

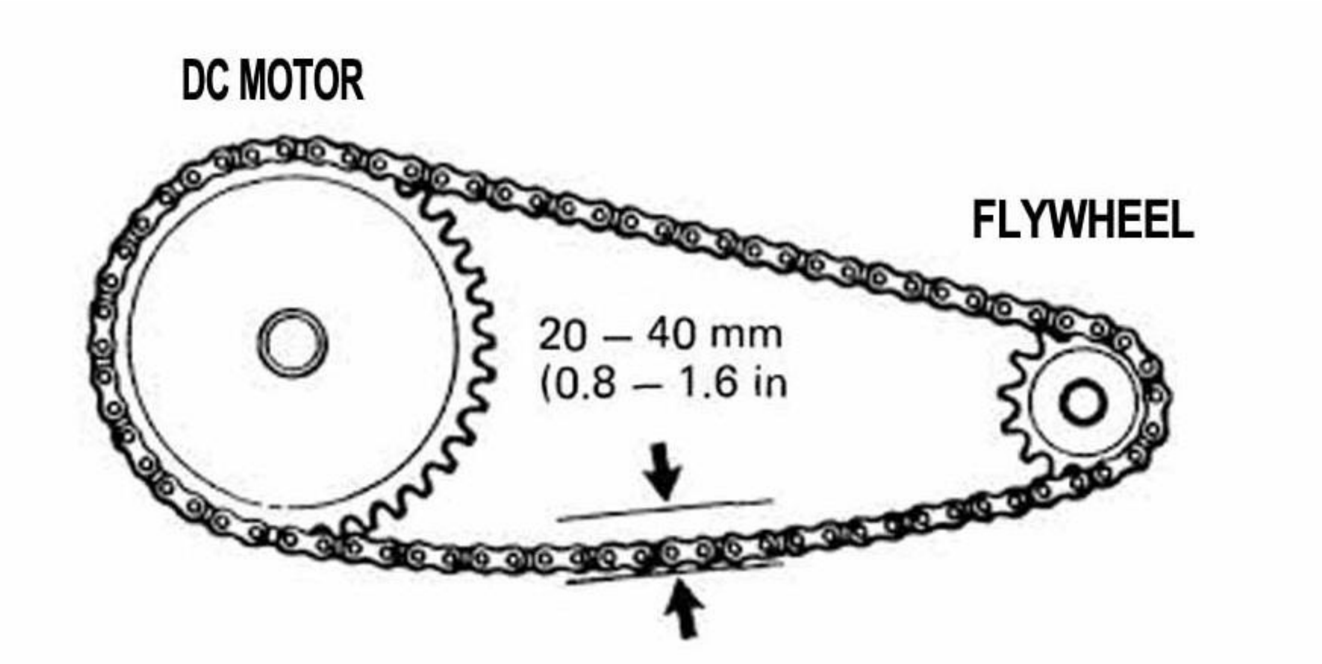
For our initial tests, as seen in the presentation, we used belts, but after a thorough investigation, we concluded that using Gears with Sprocket Chains is safer and a lot more efficient.

The means of transmitting the spin is essential. This transmission is crucial for the functionality of the generator. The connection between the DC motor's shaft and the flywheel's shaft is more efficient using Gears with Sprocket Chains because you can easily adjust it to reach the 2000 RPMs.

For the DC motor's Gear, you can use an old (or new) bicycle gear with 32 spikes or 42. You can find them with standard dimensions.

The gear that will be attached to the flywheel must be two or three times smaller than the gear used on the DC motor.

The difference between the two gears cannot be too big because the power of the DC motor would not be enough to spin the flywheel.



If the size of the gears is somehow not enough to start the spin, you may carefully help the flywheel by imprinting an initial spin (No more than two touches!). Please pay extra attention not to make contact with the flywheel more than two times because the flywheel will speed up and accidents may occur. We also advise using gloves and avoiding as much as possible this method of speeding up the flywheel.

If the first gear has 32 spikes, the small one must have 11 spikes, and if you choose to use the 42 spike gear, for the second gear, you must use a 15 spike one.

You can also use other gears, provided that the ratio between the two gears supplies the 2000 RPMs needed.

The chain (or, as used in the first devices, the belt) must not be tight and tensioned. As presented in the picture above, the chain needs to oscillate at a maximum of 1.6 inches and a minimum of 0.8 inches.

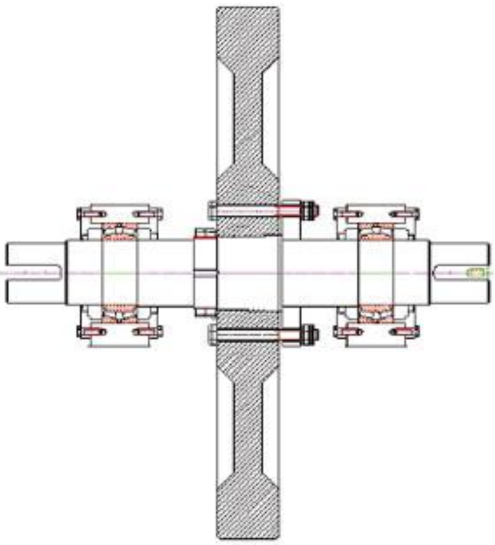
For proper functioning, the chain needs to be periodically greased

Both gears and the chain need to be firmly placed and protected with a casing (that ensures its functionality) to avoid any risks.

Flywheel:https://www.amazon.com/LuK-LFW162-Flywheel/dp/B000QQD7FS/ref=sr_1_12?ie=UTF8&qid=1537381280&sr=8-12&keywords=Flywheel

The principle of the flywheel is found in the Neolithic spindle and the potter's wheel.

A flywheel is a rotating mechanical device that is used to store rotational energy. Flywheels have inertia called the moment of inertia and thus resist changes in rotational speed. The amount of energy stored in a flywheel is proportional to the square of its rotational speed. Energy is transferred to a flywheel by the application of a torque to it, thereby increasing its rotational speed, and hence its stored energy. Conversely, a flywheel releases stored energy by applying torque to a mechanical load, thereby decreasing the flywheel's rotational speed.



The efficiency of a flywheel is determined by the amount of energy it can store per unit weight. As the flywheel’s rotational speed or angular velocity is increased, the stored energy increases; however, the centrifugal stresses also increase. If the centrifugal stresses surpass the tensile strength of the material, the flywheel will break apart. Thus, the tensile strength determines an upper limit to the amount of energy that a flywheel can store.

The inclusion of the flywheel is said to be to keep the motor running well when it is being pulsed rather than having a continuous feed of electricity from the battery.

The flywheel draws energy in from the local gravitational field.

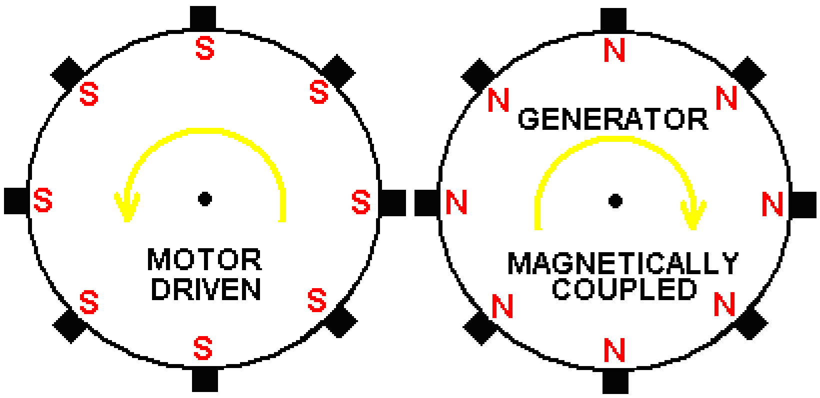
Every particle making up the rim of the flywheel is accelerating inwards towards its axle, and that happens continuously when it rotates.

Rotors

The diameter of the rotor we used for this project is 6 inch.

You can make it bigger; it is expected to produce more power when the rotor is bigger in diameter.

This is the front view about how the magnetic rotors would rotate. In series, each rotor rotates in the opposite direction of the one after or before.



All the magnets are mounted in ATTRACTION with all south or north outwards from one rotor to the other.

It is imperative to use neodymium magnets because of their properties.

https://www.amazon.com/DIYMAG-Refrigerator-Magnets-Premium-Brushed/dp/B07B3W79TP/ref=sr_1_19?ie=UTF8&qid=1537381507&sr=8-19&keywords=neodymium+magnets)

It is also advised to put a case or box around the rotors for safety reasons.

To generate even more electricity, you can make some adaptations:

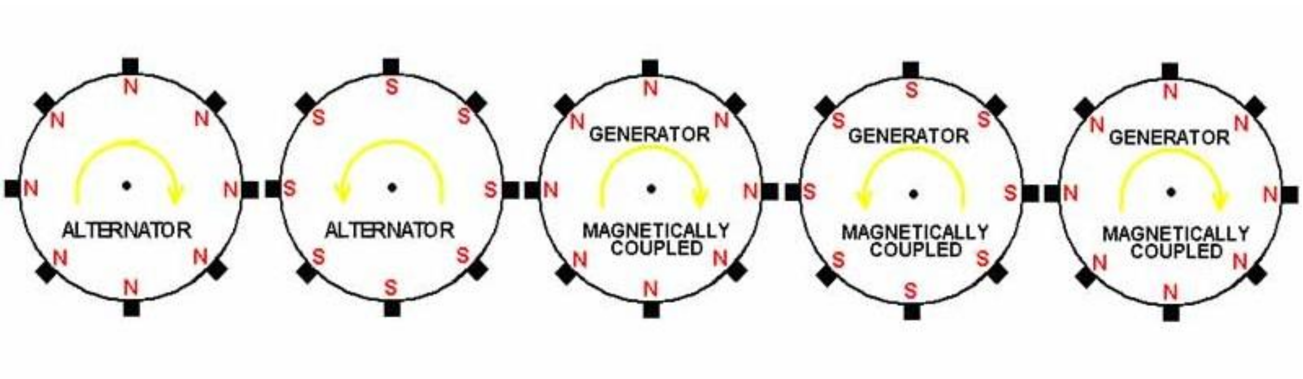
• Increase the number of magnets

• Increase the number of disks

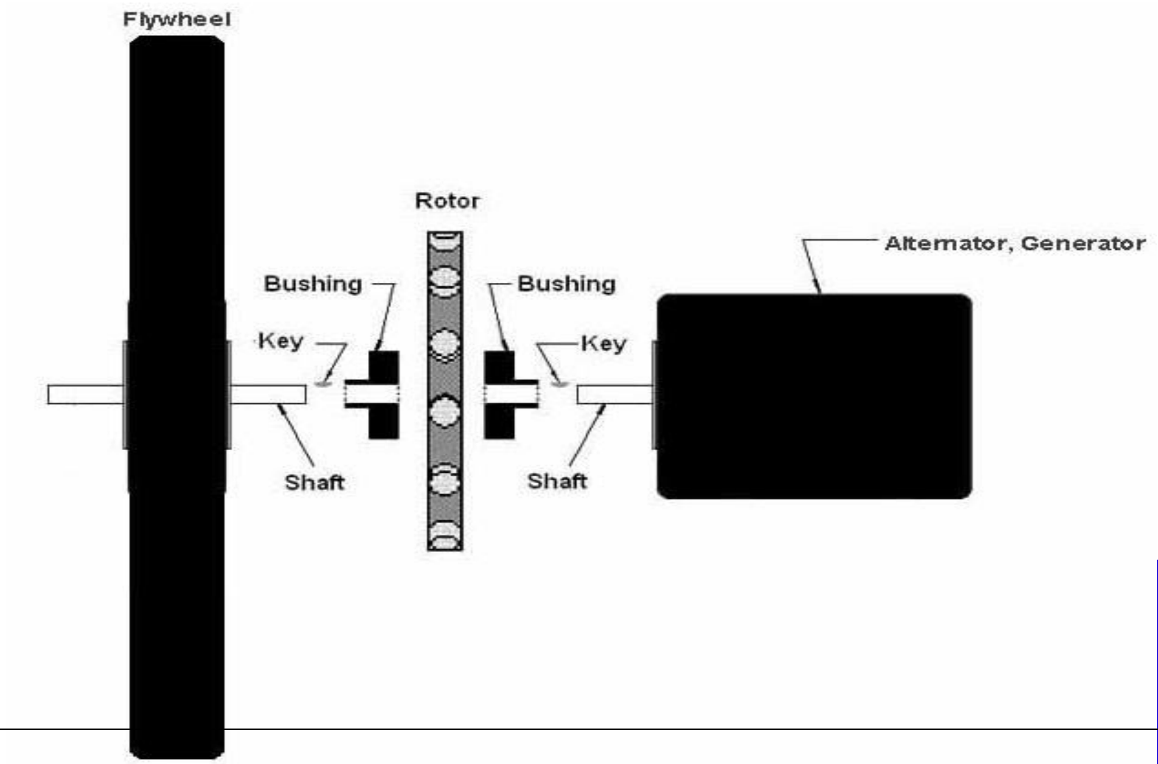
• Increase the power of the magnets

• Increase the number of rotors

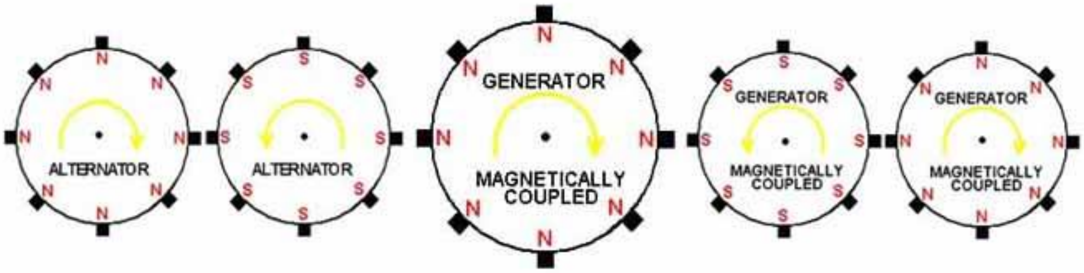
• Increase the diameter of the rotors



This is a schematic that shows how the rotor is fixed on the shaft of the generator and one of the alternators.



For higher RPMs which leads to more power, the rotors on the sides of the main rotor will need to have a smaller diameter.



Alternator - https://www.amazon.com/Value-Grade-Remanufactured-Alternator-7078V/dp/B00U1RY85A/ref=sr_1_1?s=automotive&ie=UTF8&qid=1537381577&sr=1-1&keywords=Alternator&dpID=512-PbYE4fL&preST=_SY300_QL70_&dpSrc=srch

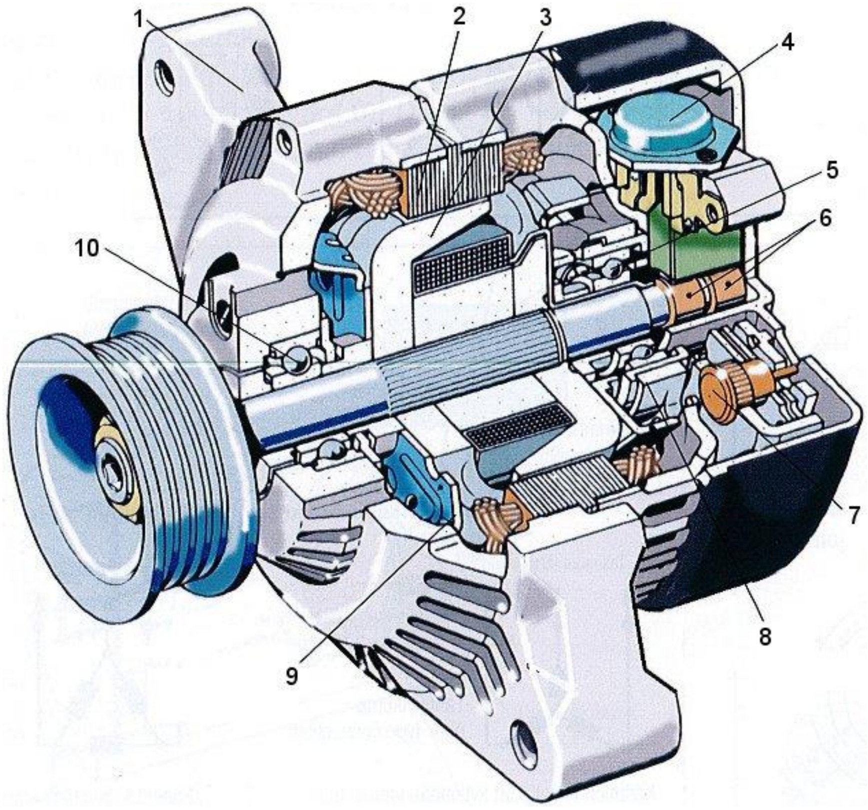
The alternator is the main component of a generator that provides electricity.

The alternator is an electric device three-phased that is driven by the combustion engine via the accessory belt.

Depending on the electronic equipment on a vehicle, electricity consumption can reach maximum values of 1.7 - 2 kW. The alternator must be able to produce this extra energy to charge the battery.

An alternator must have the following characteristics:

- It needs to produce enough energy to power all electric consumers
- It needs to produce enough energy to charge the battery, regardless of the consumption of the electrical systems that are connected to it.
- It needs to produce enough energy regardless of the RPMs required for functionality.
- It needs to have the power/mass ratio as small as possible.
- It needs to be reliable, to run as silent as possible
- No maintenance



1. Casing

2. Stator

3. Rotor

4. Voltage regulator

5. Bearing

6. Slip ring

7. Bridge rectifier

8. Back fan

9. Front fan

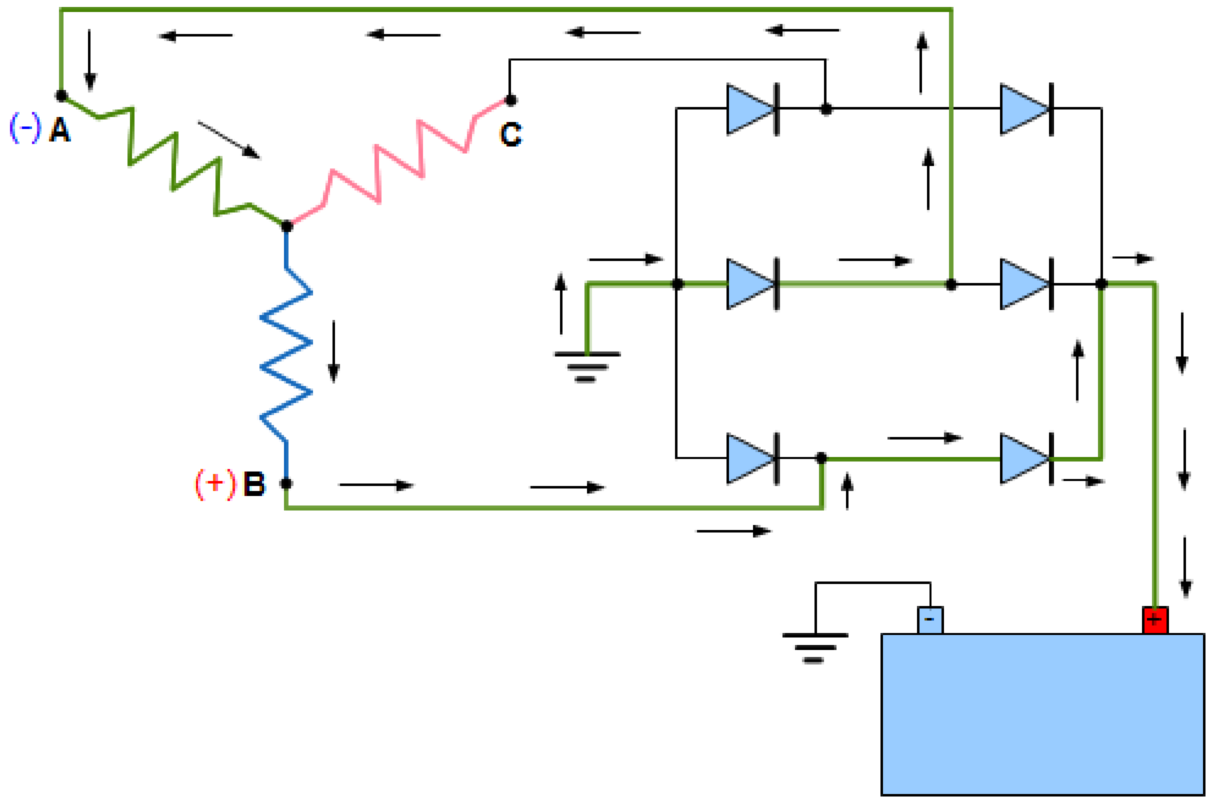
10. Bearing

The stator is made of metal plates wound with copper conductors which represent the three phases of the alternator (A, B and C). The stator windings of the three phases are connected in star, each phase having a wire connection with the bridge rectifier.

To produce more power the stator windings need a rotating magnetic field. The rotor produces the magnetic field. Positioned on the shaft, the rotor comprises a wound rotor and a pair of claw-shaped poles. Each pair of successive claws forms the two apparent magnets (N, S) which generate a magnetic field in order to have a higher efficiency of the rotor contains 12 to 16 poles.

The operating principle is relatively simple. The magnetic field generated by the rotor produces on each phase of the stator a sinusoidal electric current. All electrical components of the device are DC. Switching from AC to DC is done using a diode bridge rectifier.

The bridge rectifier contains six diodes that are integrated into an aluminum radiator. For each phase of the alternator two diodes are used to convert the alternating current into electric current.



The frequency of the electric current depends on the rotor speed and the number of magnetic poles.

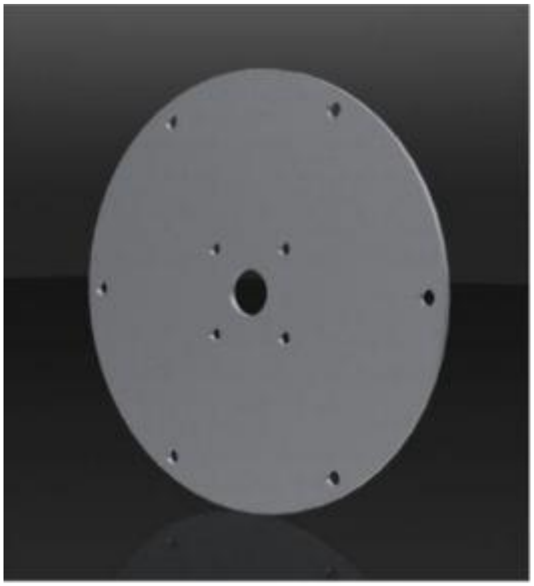
To prevent overloading the battery, the voltage from the alternator must remain constant all the time, regardless of the operating conditions of the device and the electricity consumption.

The voltage regulator is designed to control the power supply of the rotor. It controls the rotor's magnetic field, implicitly the voltage induced in the stator. The voltage generated by the alternator must be maintained around 14.2 V. The voltage regulator is integrated into the alternator casing.

The generator

1. End caps

The end caps are aluminum plates. You will need two such plates, and you will position them at each end of the generator. The flange bearings are fixed to the end caps as well as to the protective case with stator mounting bolts. The flange bearings are attached at the four bolts that are visible in the picture. You will be presented with a radius, but it can be changed, depending on the flange bearing you will use. The six outer bolts are shown in the picture if for the six bolts that will support the stator. You can build these plates from aluminum by drawing the dimension on a square sheet of aluminum. You can use a handsaw or jig saw. The overall shape of the end caps is not crucial because none of the two will rotate. However, a significant difference between them the outer casing will not fit:



2. Rotors

Each of the two rotors will be a thin steel plate (1/8 inch thick and 12 inches in diameter). As shown in the picture, a radial pattern on magnets will be placed on each rotor. The rotor is then placed into a mold, and Devcon Flexane-80 liquid will be poured on top of the rotor until the magnets will barely be seen. The Flexane-80 liquid urethane resin must be of medium consistency. This will allow the plates to expand or contract, depending on the weather condition:

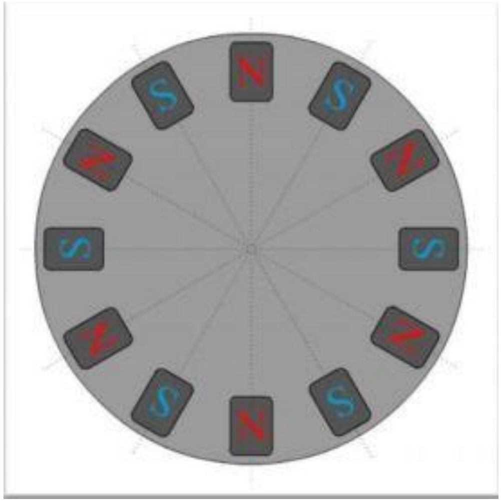
The above picture shows the rotor before the Flexane-80 liquid is added. The four bolts circling the center of the rotor plate are used to fix the plates to the flange (which will be attached to the driveshaft).

You can use the same dimension for the steel plate (1/8 inch thick).

You can use any type of magnet (the stronger, the better). We recommend using 45 neodymium-boron rare earth magnets. You will need 12 for each rotor resulting in a total of 24. You must arrange the magnets at 3.5 inches from the center of the plate. The dimensions of the magnets are 2” x 1” x 1/2” (L x W x T). Their thickness will provide the magnetic force.

As you position, the magnets to make sure you alternate the poles. This means that they must alternate N, S, N, etc. as they go around. To properly arrange the magnets, a wooden jig will be used (it will later be presented). The jig will be placed using four pins that will go through the four bolt holes presented in the picture. Then simply arrange the magnets and remove the jig.

Here is a picture of the pattern of the magnets, as they should be placed:



The jig will simplify the placing process, and it can be used for both rotor plates. You need to create the rotor plates opposite of one another and take special care in arranging the magnets. First, select a starting point on the wooden jig for the first magnet and continue with the second one, placing it with the opposite pole. Continue by alternating the poles of the magnets until the circle is complete. The second rotor plate must be built in the same manner, except the fact that the first magnet must be placed on the opposite pole as to the first magnet on the first plate. This will result in a complete opposite placement of the magnets (from the first rotor plate) - opposite poles all face one another, enhancing the magnetic flux.

Safety advice: Because the magnets are powerful, take care when handling them around the garage. Also, take care when placing the magnets of the rotor plates because they can crack/shatter and decay their magnetic potential over time.

Next, we will present the parts needed for casting the rotors. (a full plan with dimensions is included at the end of the PDF file)

3. Magnet jig and mold hardware

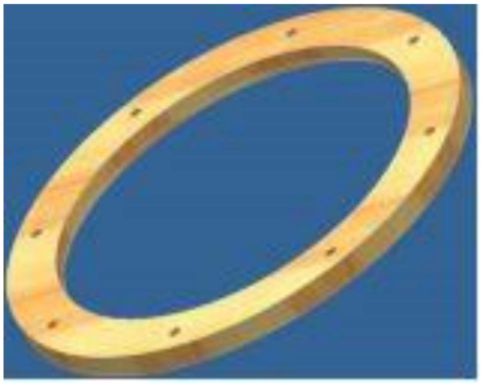
The wooden jig is a round piece of wood with slots cut into to facilitate the placement of the magnets. The inner four bold circle has a 1.375" radius - the same as the rotor plates. Because 12 magnets are used, you need to cut 12 slots into the jig at a 30-degree angle around the circumference. This way you can fix the jig with the bolts to the rotor plate and fit the magnets into the slots. Gently remove the jig after fitting all magnets.

The overall diameter of the jig is not relevant, but the distance from the center of the jig to the inner edge of the slots is crucial because the magnets must be placed equally from the center of the plate:

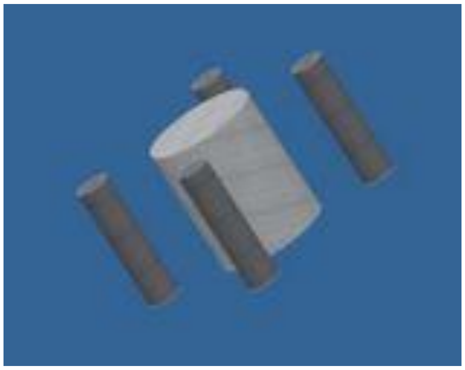
The next picture presents a second suggestion for the jig. This second idea provides an easier removal of the jig after the magnets are placed:

4. **The bolt circle** around the outside of the rotor mold base is used to bolt the entire mold together. The inner bolt circle will hold pins that will act as "dummy bolts" for the casting process and keep bushings in perfect alignment. A plug goes in the center hole which will allow the cast to mount to the flange. This part has a stepped thickness that corresponds with the top half that allows the two parts to lock together. This will prevent flexing from leaking out of the mold and keep the metal plate centered. This part is cut from MDF and stepped using a rotary table but can be left flat if the right equipment isn't present:

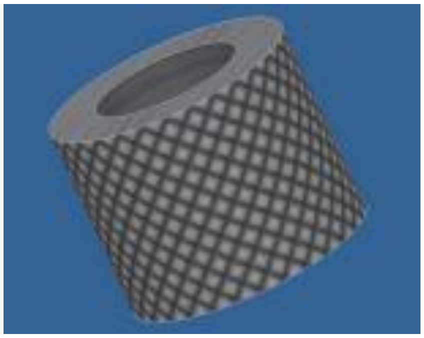
The top part of the mold can be cut from MDF. It has the same bolt circles, at the same distance as the one on the bottom. This second piece is a little thicker to lock to the one on the bottom. It is not necessary for it to be thicker. If not possible, you can make this part flat. It is important to have the same dimensions as the one on the bottom:



The material for these pins is not relevant. They must fit the bushings, and they need to be placed and removed easily from them:



The bushings you need must slide over the pins during the casting process and have knurls to be adequately bonded with the Flexane-80. You must use steel bushing to avoid corrosion:

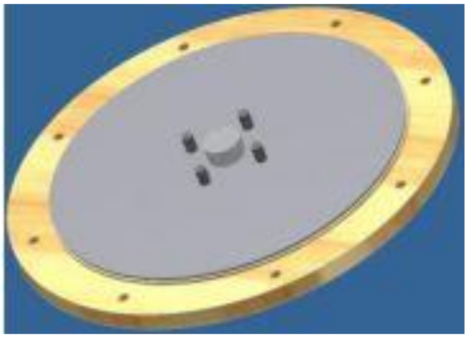


5. Mold assembly

We will present in the next section the steps to build the rotor mold.

The surface of the rotor plates must be roughened using sand paper.

A. First, place the steel rotor plate on the base of the mold and insert all four pins and the center plug through the holes until you have a plane surface on the bottom.



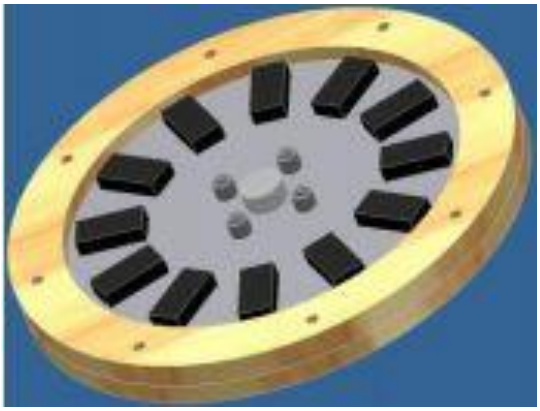
B. Next, place the wooden jig onto the rotor plate and fix it using the pins.

C. Start placing the magnets by alternating the poles. Before placing the magnets make sure to set the first magnet as the top one and remember its pole because you will need the second rotor plate to start with the opposite pole.

Place the magnets into the jig's slots by alternating the poles. You can check the polarity by hovering another magnet around the plate and checking the attraction and repulsion.

BE CAREFUL NOT TO LET THE MAGNET SLIP FROM YOUR HAND! This could damage the magnets in the jig and ruin the rotor.

D. Next, remove the wooden jig and place the knurled bushing onto the pins. Place the top of the mold and fix it using screws. You are now ready to pour the Flexane-80 liquid.



6. Casting - preparation of the mold:

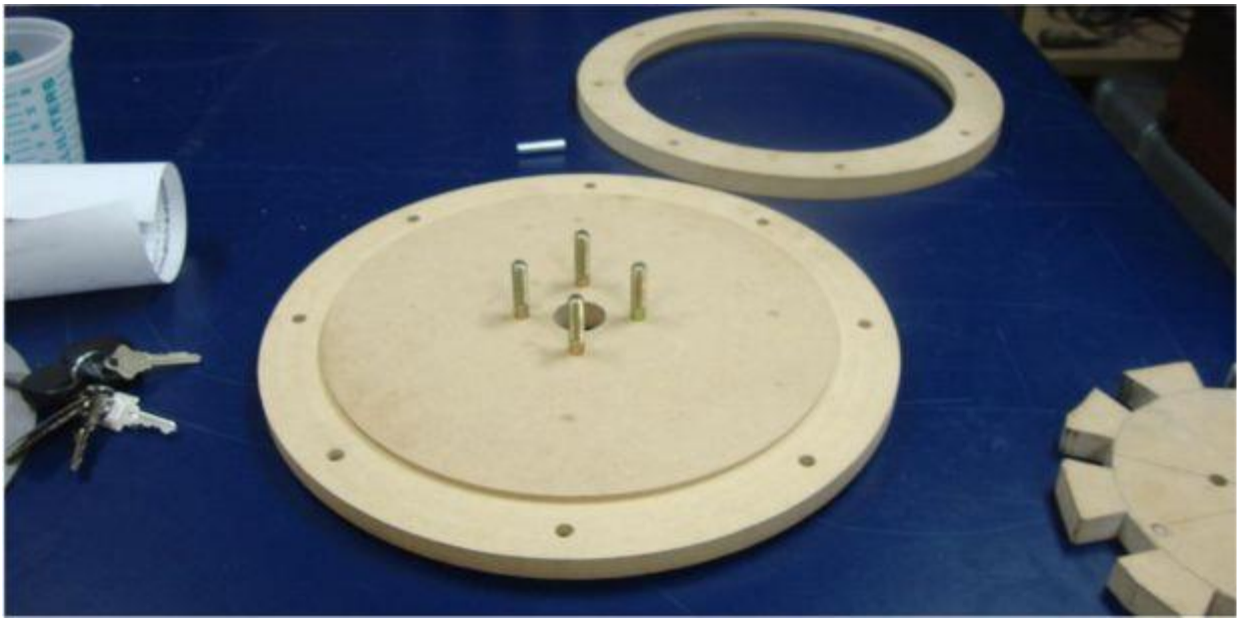
MATERIALS:

- Two brushes with wood handles
- 2 Plastic mixing buckets
- Johnson paste wax (or similar) and rags
- Liquid silicon mold release
- Hot air gun
- Flexane 80 Liquid Resin
- Devcon FL-10 Primer
- Finished metal plates
- Magnet Jig
- Metal Bushings
- Metal Pins

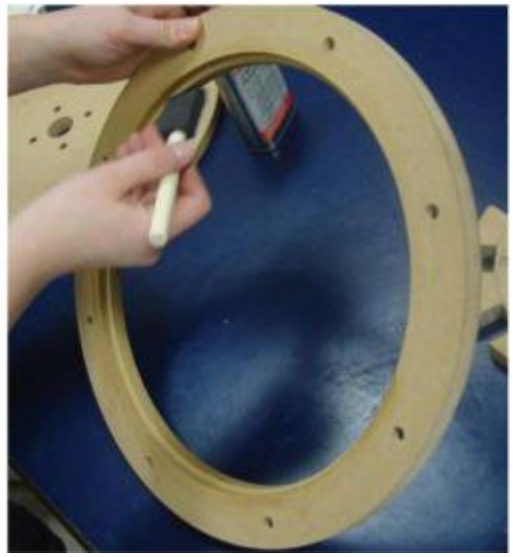
7. Preparing the mold and the surfaces

A. After preparing the MDF mold, apply Johnson paste wax on any area that the Flexane will come in contact with. Repeat this process after 10 minutes.

B. Put the mold together and rub more of the Johnson paste wax all around the mold, especially at the jointure of the two pieces of MDF. This will prevent the Flexane from leaking. Leave it for 10 minutes to dry.



C. Spread the liquid silicon onto the mold (once only).



8. Prime surfaces

Make sure again that no loose metal objects are near the magnets.

1. Place the rotor into the mold.

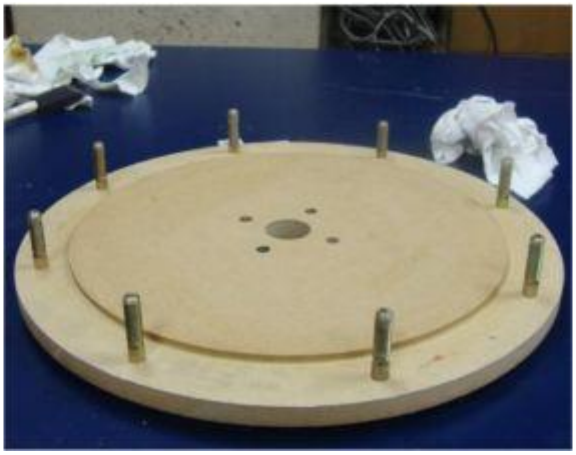
2. In a separate cup pour some Devcon FL-10 primer

3. Apply with a fresh brush some Devcon Fl-10 on the steel rotor plate and the bushings.

4. Let it dry. After 15 minutes, apply a second layer.

5. Prop up the mold on one side, so there is a slight tilt before pouring the.

6. Put the mold together. Place the bolt ring around the wooden base of the rotor. Next place the four pins into the four holes of the wooden base of the rotor. Beforehand coat them with a layer of mold release. Place the plug into the middle hole and apply a layer of mold release.



Place the second wooden ring on the first wooden ring and fix them using the nuts.

6. Cover the top of each magnet not to stain the magnets when pouring the material around them.

9. Mixing and pouring

1. In a different plate mix two bottles of Flexane and catalyst (as mentioned on the packages) for 2 minutes. You need two bottles for each rotor mold.

2. Take the mixed material to the wooden mold (that is already assembled). You will also need other brushes.

3. Apply a thin layer of Flexane on the mold - the metal and wooden part.

3. Pour the Flexane into the mold, and take extra care not to cover the magnets and leaving the top of the magnets slightly higher than the surface of the Flexane.

4. Level the Flexane.

5. You need a hot air gun to bring air bubbles out of the Flexane. Apply the hot air for 5 to 10 minutes.

6. Remove the mold after 10 hours.

7. You will need at least 16 hours before using the rotor plate.

10. STATOR

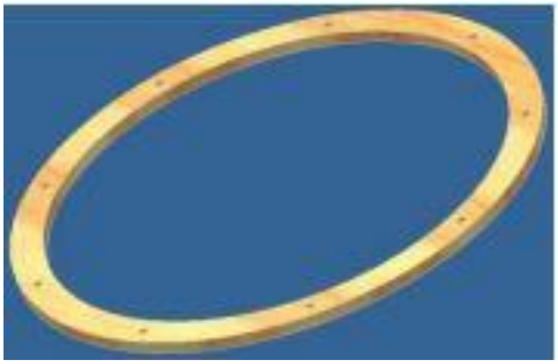
The stator is an epoxy resin casting with nine coils arranged inside. You can use as many coils as you want, provided that you use a multiple of three (because the three-phase power is produced). The casting will have six bolts towards the outside area, similar to the end caps - same diameter, same holes. You may want to add six bushings to strengthen the casting on the whole device.

You also need to place small metal pieces in the center of each coil to help concentrate the flux through the center of each coil, which will improve the performance of the generator.

11. The molds for the epoxy resin casting

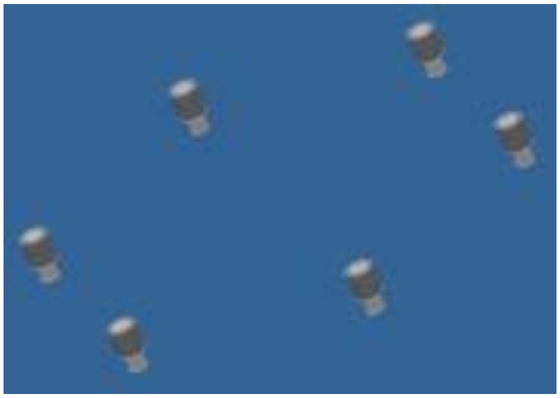
A. The mold base is made from the same material as the other mold - MDF. The outer bolt circle presented in the picture is needed to join the whole mold together and to fasten it together. The inner bolt circle (smaller holes) will hold the pins that will align the bushings. They will be removed after making the casting. The middle hole if for the center plug and it will serve for the flange.

B. This wooden circle needs to be placed in 2 layers (as presented later). It needs to go over the outer bolt holes on the base so they can be fastened together. You will need two such wooden circles.



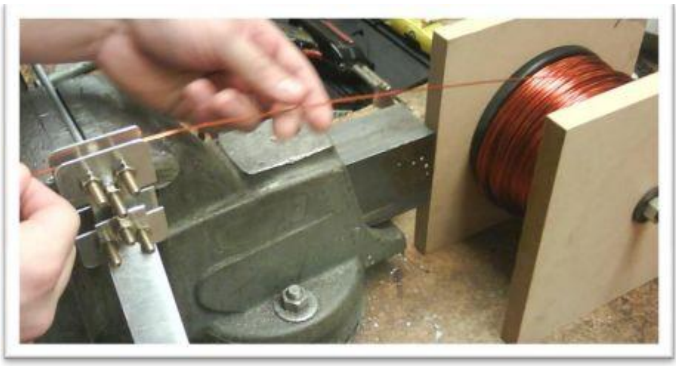
C. The central plug can be made out of any materials lying around. Take care at its dimensions because its diameter will increase after applying for the mold release.

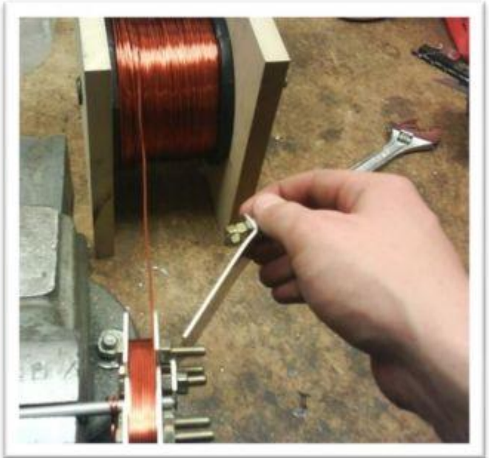
D. The outer pins can be made of any materials because they will be removed. However, the bushing must be made of steel because they will be part of the casting. You can also knurl these bushings for higher resistance into the casting.



12. Making the coils.

A. You can make the coils by winding them on a magnet jig which can be made by hand from scrap material.





B. Each coil needs 100 turns of 16 AWG enameled magnet wire. The tighter, the better.

13. The resin casting

EPOXY TERMINOLOGY

A. Open time

Open time or wet lay-up time describes the working life of the epoxy mixture. It is the portion of the cure time, after thorough mixing, that the resin/hardener mixture will remain in a liquid state and be workable or suitable for the application. The end of the open time (wet lay-up time) marks the last opportunity to apply clamping pressure to a lay-up or assembly and obtain a dependable bond.

B. Initial cure phase

The open time is over when the mixture passes into an initial or partial cure phase (sometimes called the green stage) and has reached a gel state. At this point, the epoxy will no longer feel sticky, but you will still be able to dent it with your thumbnail. It will be hard enough to be shaped with files or planes, but too soft to dry sand. Because the mixture is only partially cured, a new application of epoxy will still chemically link with it, so the surface may still be bonded to or recoated without sanding.

C. Final cure phase

In the final cure phase, the epoxy mixture will have cured to a solid state and will allow dry sanding and shaping. You should not be able to dent it with your thumbnail. At this point, the epoxy will have reached about 90% of its ultimate strength so that clamps can be removed. The epoxy will have to be left to strengthen at room temperature. A new application of epoxy will not chemically link to it, so the surface of the epoxy must be sanded before recoating to achieve a mechanical, secondary bond.

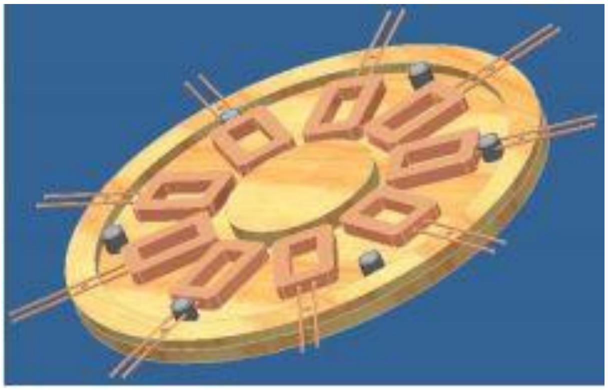
14. Mold assembly

Next, we will present the steps for fixing the mold together

A. Place the pins into the inner bolt circle until you have a plane surface on the bottom of the mold and place the bushings over them. This way, you ensure a fixed placement of the bushings.

B. Place the central plug to obtain the same plane surface on the bottom. Place the first wooden ring and fix it to the base of the mold using the bolts. Before placing the coils into the mold, pour a 1/8 inch thick layer of resin and let it harden.

C. After the resin hardens and removes the nuts from the bolts holding the stator mold together. Fix the coils on the hardened resin and place the wires as shown in the picture - around the small bolts.



D. Lastly, place the second wooden circle over the first circle. This will ensure a tight fixture. The second wooden circle goes over the wires. After the second wooden circle is tightly fixed with nuts, you can pour the rest of the resin into the mold.

15. Preparing the mold

Materials:

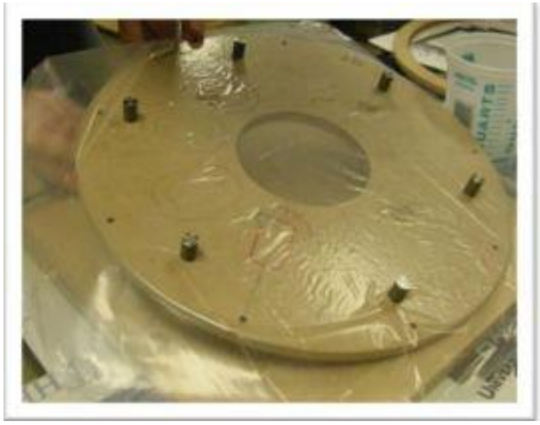
- West Systems Epoxy 105 resin
- Spray Adhesive
- West Systems 206 slow hardener
- Ruler
- West Systems pump set
- Utility Knife
- Polyethylene film, two mil
- Vaseline Mold

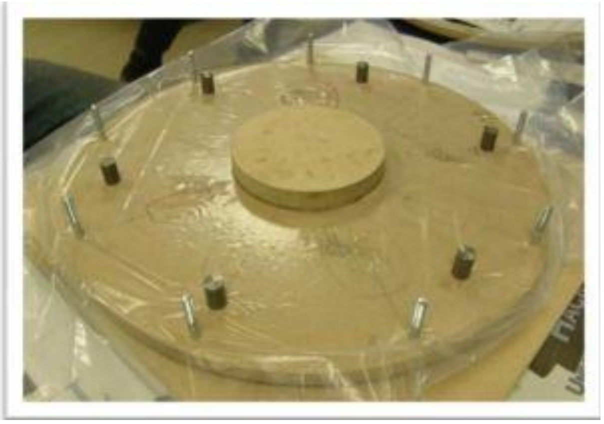
- release paste

A. Before assembling the mold, apply mold release paste onto the parts of the mold that the resin will reach. Repeat two times, after 10 minutes of soaking.

B. Clean bushings with a solvent.

C. Draw the patterns of the coils on the Polyethylene film. Apply on the other side adhesive spray then spread the film on the base of the mold. Remove any wrinkles that might have remained.





D. To prevent any leaks, pour mold release in excess on the bottom of the mold, where the outer pins are placed. Remove the extra mold release after placing and fixing the first outer wooden circles.

E. Grease the inside of the bushings with vaseline and place them together with the pins.

F. Place the center plug into the central hole after coating it with mold release paste.

G. Place all coils into the mold, as shown in the picture and place the second wooden circle on the loose wires. The center plug must be at the same level as the second wooden circle. Now, look carefully if the coils are placed 1/8" below the level of the mold. Remove the coils after removing the second wooden circle.

Pouring epoxy – dry time test

H. You need to pour this stator in 2 layers. The first layer must set up to tack-free before you pour the next level. This is to create a chemical bond between the two layers and to ensure that the coils will not sink.

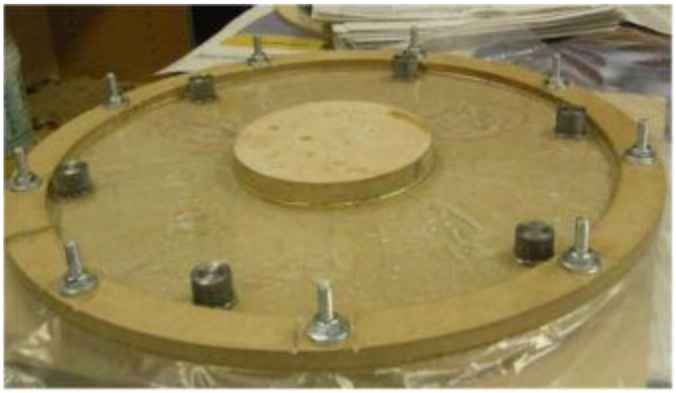
I. Following the step by step instructions, mix up a test batch to calculate the time it takes to dry. The next step is to pour a 1/8" layer of epoxy and measure the time it takes to dry. The epoxy will start from the consistency of syrup, then form peaks, then finally hold its shape with the consistency of jello. By this time the epoxy you have already poured will become tack free, and you can pour the second layer. Time will vary with temperature, humidity and time of mixing.

Pouring epoxy – first layer

J. Asses the volume and prepare the quantity. If not sure, add 10% to cover the errors.

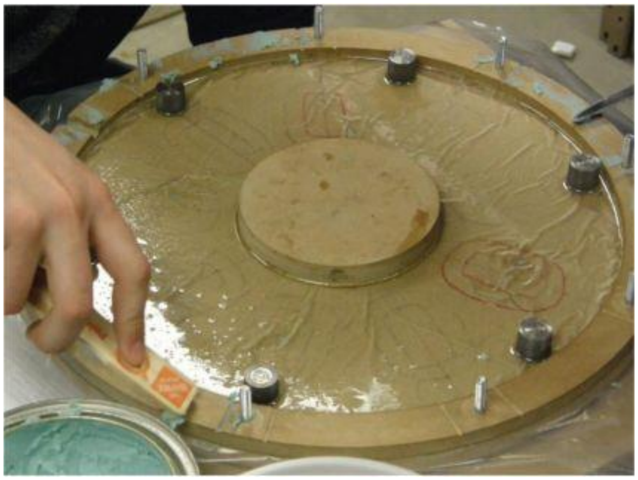
K. Using the West Systems epoxy system, take one pump from resin, then one pump from hardener. 1 pump resin + 1 pump hardener = 0.8 fl oz = 1.44 in^2 . After 3 minutes of mixing, scrape the sides. Transfer the mix to another container, then mix for 1 minute. By transferring the mix to another container alleviates the problem of unmixed resin in corners is avoided.

L. Next pour into the mold and let it sit for the test dry time to set up to tack free. Note that in the next picture, the resin is hard to see since it is clear.



Pouring epoxy – second layer

M. Place the coils into the mold. Apply excess release paste to the outer edge of the second wooden circle. Make sure not to pour excess paste on the inside of the wall of the mold. Fix the second wooden circle and clean the excess release paste.



N. Check the quantity of vaseline on the tops of the pins and bushings that are not in the cast. Add more to cover if necessary to seal these areas against epoxy spillover.

O. By mixing as shown above pour epoxy into the mold until the level reaches just below the top of the mold (the second wooden circle)

P. Place a flat board that has been prepared with mold release on top of the mold, letting it rest on the center plug and the second wooden circle. Weight the board with anything available. This layer of epoxy will set up very quickly because it is thicker and it will level the surface of the mold. The board can be removed in roughly three hours.

Demolding

Q. You can remold in 24 - 48 hours, but to be sure, let the mold dry 4/5 days.

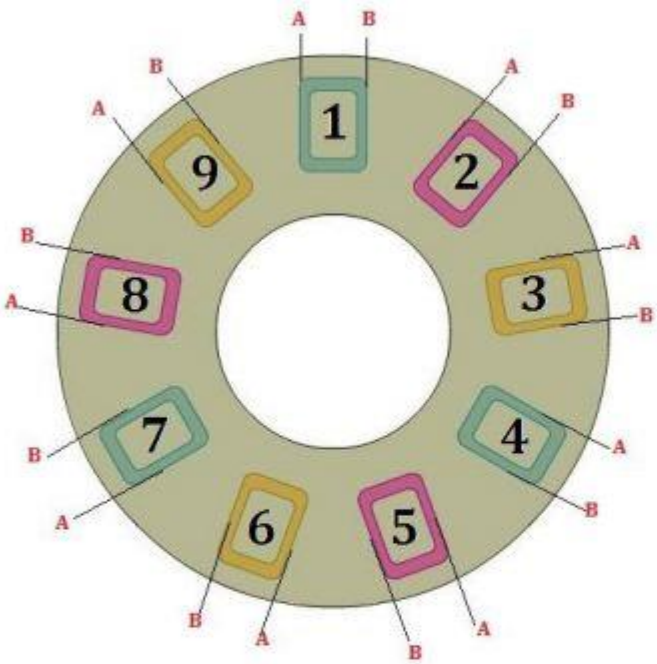
Demold in 24 - 48 hours, but let fully cure for four to five days.

R. You can polish the top side (the bottom one will be smooth because of the film) with emery until a smooth level is reached.

Note: You may obtain a slightly thicker or thinner stator. You can either adjust the thickness of the rotor flange, or the thickness of the rotor plates.

16. Stator wiring

Three-phase alternators can be wired in two configurations: Y-configuration or delta. We chose to wire our generator in the delta to produce higher voltages and attempt to keep the current in the phases down. This means that each phase is wired in series:



Phase 1			
Red Lead to 1A	1B to 4A	4B to 7A	7B to Ground
Phase 2			
Blue Lead to 2A	2B to 5A	5B to 8A	8B to Ground
Phase 3			
Green Lead to 3A	3B to 6A	6B to 9A	9B to Ground

The first column of the table (1A, 2A, 3A) should just have lengths of wire soldered onto them. Each phase is colored differently to distinguish them easily later. The next two columns show which leads to connect with pieces of wire, for example, 1B should be soldered to 4A, and then 4B should be soldered to 7A. The last column shows which lead to solder ground wires to (7B, 8B, 9B). This arrangement wires each phase in the series and brings the power out of each phase individually.

The three phases can be utilized in many ways but based on our production we are going to rectify the signal.

17. Air gap optimization

The air gap represents the space between the front of a rotor and the front of the stator, on each side. If the casting is done correctly, you have very little space to adjust. The magnetic potential will highly depend on this space as it is relatively easy to fall off across the air and the performance of the generator will vary.

When assembling the generator, you can quickly optimize the gaps. Once you establish the final position of the stator, you can cut tension spacers and in the end replace the all-thread with high strength bolts. If the gap is too small, take extra care to ensure that the rotors are not hitting the stator at any point.

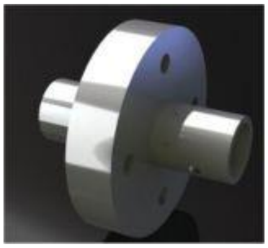
18. Rotor mount (flange)

The flange will be attached to the rotor plates. You need to mount them face to face. The flange also needs to have the same four holes drilled to align with the rotors. The tube must have the same diameter as the central hole of the rotors.

The rotor mount is built from aluminum because it is resistant to corrosion and it is light. Alternatively, it can be built from a different material.

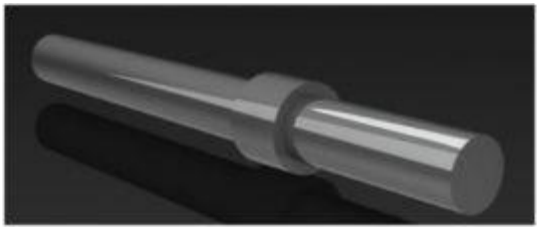
A piece of appropriately sized steel or aluminum tubing can have a steel or aluminum ring welded to it. If this is done, one must be careful to weld evenly, so that rotating balanced is maintained. The thickness of the rotor mount should match the thickness of the stator. So you need to build it after the stator is cast to determine its proper size.

To attach the flange to the shaft, two bolts can be used. Have them placed at 90 degrees to one another for a better grip.



19. The driveshaft

The driveshaft is the metal bar that holds the flange and bearings. This element will spin at a high rate so take extra care when choosing the materials. We suggest stainless steel because of its resistance. At the end of the driveshaft (the one towards the collar) place a handle. Further explanations will be presented. You can manufacture any type of handle as long as it gives you leverage to make the driveshaft spin.



You can also use carbon steel if available because it is also resistant. Regardless of the material you will use, Permatex Anti-Seize (or similar) and caution should be exercised when assembled to prevent galling and corrosion.

You need to drill holes for the support of the flange to correctly assemble and securely lock them together.

20. Bearing selection

The bearings you need to use are simple flange bearings that you may have lying in your garage. We opted to use a collar onto the driveshaft that is fixed to the back of the bearing. The bearing's role is also to set the distance between the bearings.

21. Casing

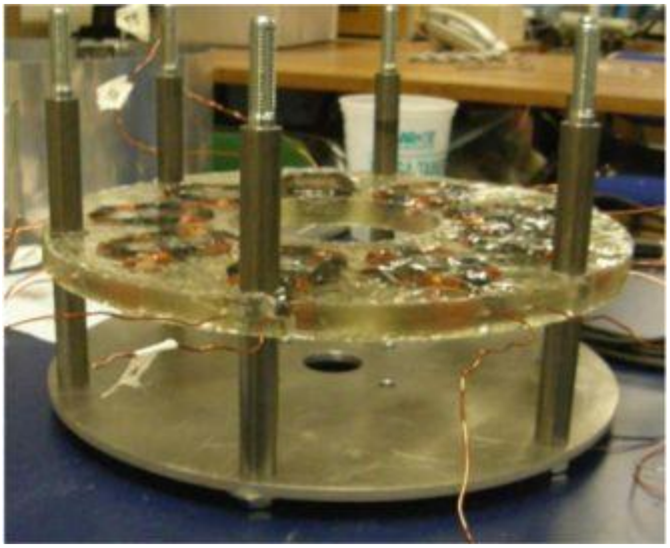
The whole generator will have a casing to protect its elements. This casing is crucial when using the generator in extreme conditions, such as snow, rain, etc. The case can help protect against everything from ice buildup to organics buildup to animal strikes. If implemented properly, it may be able to extend the life of the generator and help prevent corrosion of the assembly and wear on the bearings.

22. Implementation of the case

The case is shown here sitting with one of the end caps (before the end cap had been drilled). It is made from thin aluminum sheet and attached at the top and bottom to two aluminum boxes. They were folded out of the remaining aluminum sheet and riveted together. The box which you can see inside of in the photo is the bottom box. It has Dzus connectors which provide quarter-turn access. Also, the fasteners stay in the material, so there is no way to lose them when you open the case. The case attaches to each side of the top box via hinges. This allows each side of the case to be opened separately. The boxes will be bolted to the inside face of each end cap. The anti-chafe tape will be used on all edges that come in contact with the generator to facilitate a secure seal and prevent vibration noise and wear. To get the rounded shape of the aluminum shown here, use a roller setup or carefully hand roll it yourself around a mandrel of similar size.

Tension spacers

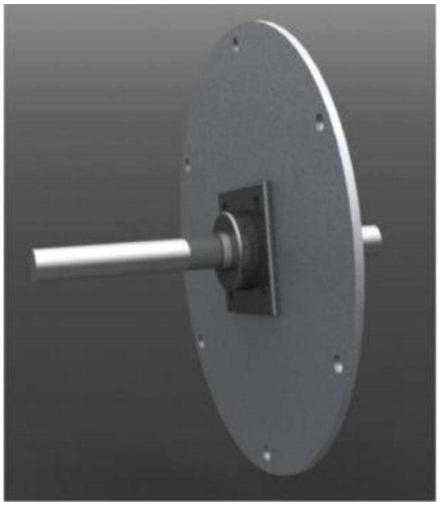
The tension spacers are the tubes wrapped around the mounting bolts. They set the distance between the stator and the rotors. They should be placed as close as possible, but be careful with the rotor and the stator not to touch. A strong but nonferrous material (brass/bronze/aluminum) should be used. This is the moment for the air gap adjustment.



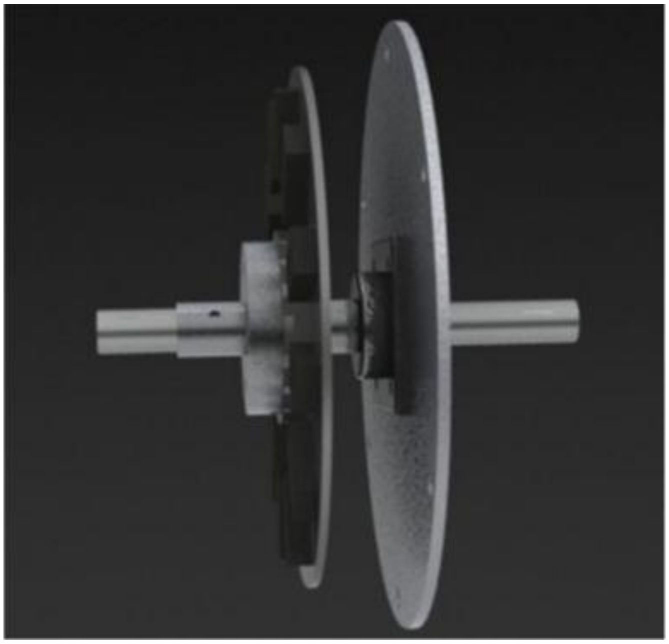
Generator assembly

Next, we will present the assembly of the generator:

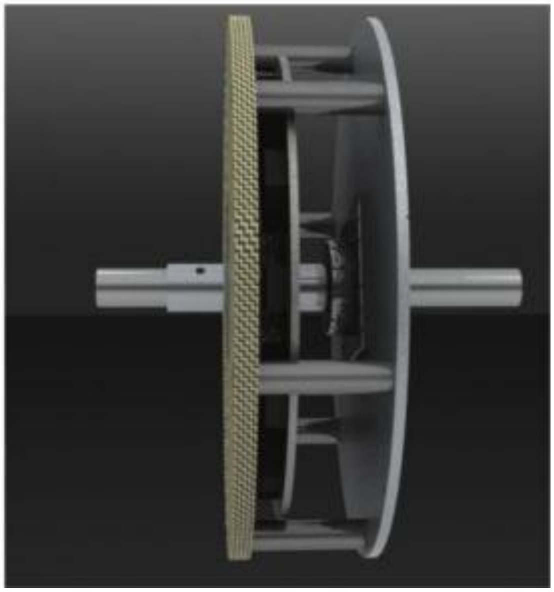
1. Fix the bearing to the end cap and slide them together through the driveshaft until it fixes onto the collar. Tightly screw the system together.



2. Next, slide the first rotor plate (on the back side) then the flange and fix them together using the four bolt pattern. Consider using anti-seize or similar to prevent galling. Insert the locking pin into the flange to attach it to the driveshaft.

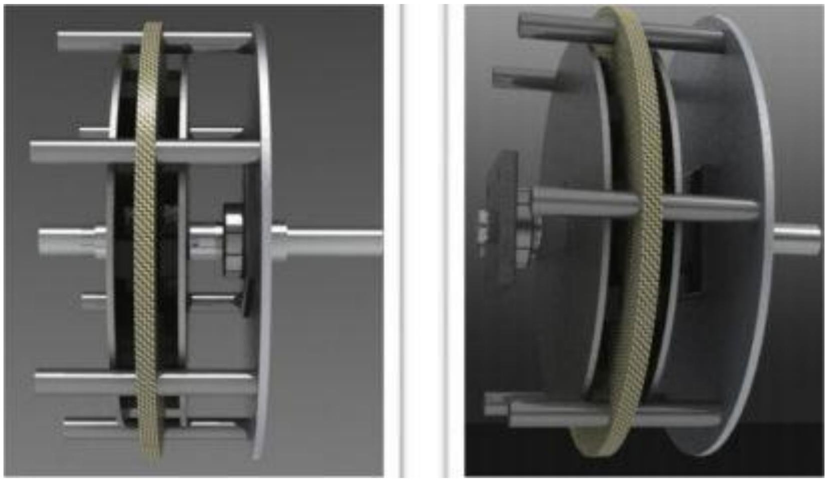


3. Place the stator onto the first rotor plate. Make sure that the rotor does not come in contact with the stator. If still not suitable, readjust the distance of the tension spacers.



4. Next, place the second rotor plate facing the stator. Make sure the position of this stator plate is accurate because it is crucial for the magnets to attract to one another. Be very careful at this step because the injury may occur. It is recommended to find a system of lowering the second plate into places, such as using wedges or small jacks. We used pieces of wood stuck in at 90 degrees and set the plate on. Then we inserted thinner pieces of wood next to them and pulled the larger ones out, thus slowly lowering the rotor. This was repeated until the rotor was in place.

5. Place the rest of the tension spacers and fix the back bearing. Fix it in place with the set screws, similar to the first bearing.



6. Place the second end cap and fix it to the bearing using the bolts.

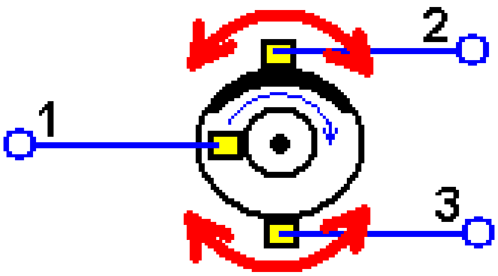
7. Place the cast over the generator.

You now have the complete generator that can be attached to the small rotor.

The switch

The best switching arrangement has been to use a mechanical switch which acts as a single pole changeover switch mounted on the shaft of the motor (and electrically insulated from the shaft).

First, the switch connects the battery Plus through to the Plus of the motor, causing it to rotate, as the battery Minus is permanently connected to the motor Minus. Current then flows from the battery, through the switch, and into the motor



Then, just before 180 degrees of rotation has occurred, the switch opens and then connects the generator output through to the motor, with current flowing in the other direction through the switch.

The inverter

A power inverter, or inverter, is an electronic device or circuitry that changes direct current (DC) to alternating current (AC).

The input voltage, output voltage and frequency, and overall power handling depend on the design of the specific device or circuitry. The inverter does not produce any power; the DC source provides the power.

An inverter converts the DC electricity from sources such as batteries or fuel cells to AC electricity. The electricity can be at any required voltage; in particular, it can operate AC equipment designed for mains operation, or rectified to produce DC at any desired voltage.

The inverter will hook up to any 12 VDC battery and step up the voltage to 115 VDC and then converts that

115 VDC to usable 115 vac x 60 Hz, some are pure sine wave just as what is running into your home and some are modified sine wave inverters. You can run lights, TV's, VCR's, DVD players, etc...

Battery

You can use a Batcap or other kind of battery with capacitors

The battery used in this project is a Batcap. It seems important to use a Batcap battery or one with capacitors and not a battery with chemical storage of the energy.

A battery made of capacitors can charge and discharge a lot faster than other types of batteries.

You can try to use standard batteries, but it seems difficult to use because of the high resistance to load.

Standard batteries need a lot of time to load.

You would also need a charge controller to control the load of the battery and to limit the power pushed into the battery otherwise the battery would not last long.

You can use standard batteries, but you would need more batteries.

Conclusion

To conclude, the best ways to reduce energy consumption is right under our noses. This device highlights how easy it is to fight against Big Energy with a simple method in a century of rapidly changing environmental and economic conditions.

If more and more methods like this one were available to the public, the energy crisis would seize to exist and we belive we would live in a better world.

List of tools

Multimeter:

A Digital multimeter is ok, but we highly recommended to use an Analogue Amp Meter, which goes up to 1 amp or more. You will also need the meter to measure your thermoelectric modules as well as your battery voltages.

Soldering Iron:

The Soldering iron will be used to solder the wires. The wires will still operate if the connections aren't soldered, though once you are sure it is wired correctly, you should solder all the connections.

Drill press:

Measuring tape: *Gripper*

And of course:

The patent, screwdriver, wrenches, knife, and cutter