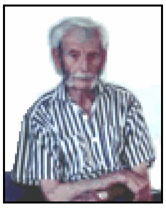
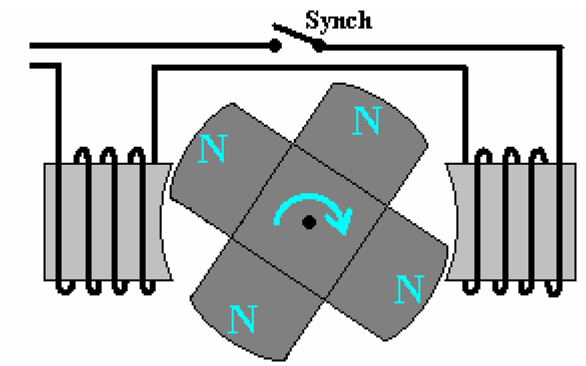
Chapter 2: Moving Pulsed Systems

There are three categories of pulsed system and we will consider each in turn. These are drive-pulsed systems, energy-tapping pulsed systems and gravity free-energy pulsing systems. Here we will look at systems where an electrical pulse is used to cause the device to operate by creating a temporary magnetic field caused by electric current flowing through a coil or "electromagnet" as it is often called. Many of these systems are rather subtle in the way that they operate. One very well-known example of this is

The Adams Motor. The late Robert Adams, an electrical engineer of New Zealand designed and built an electric motor using permanent magnets on the rotor and pulsed electromagnets on the frame of the motor. He found that the output from his motor exceeded the input power by a large margin (800%).



The diagram of his motor most frequently shown to explain the basic operation is this one:



with all of the rotor magnets presenting a North pole to the electromagnets. The motor efficiency is high because the permanent magnets of the rotor are attracted to the (laminated) soft iron cores of the electromagnets. Then, the electromagnet coils are pulsed with just enough power to cancel the attraction as the rotor magnets move away again. It is important to understand this. While it is an option to push a large amount of electrical power into the electromagnet coils and generate a very large repulsion push as soon as it is strategic to do so, that method of operation does not produce the highest efficiency.

Phil Wood received instruction direct from Robert Adams, when Phil was building his replication of the Adams motor. He stresses that there are a number of important practical details which need to be considered when building a motor of this type. Phil states that the motor operation is as follows:

All magnets are of the same polarity on the rotor. The magnets are strongly attracted to the centre cores of the electromagnets. This is not because the coils are energised, but because the rotor magnets are strongly attracted to the iron cores of the electromagnets. This causes the rotator to move around, which generates current in the coils. As the magnets get close to being aligned with the coil cores, the coils are energised by the control electronics, **but** only with just enough power to neutralise the magnet's attraction, which otherwise would then hinder the continued rotation of the rotor magnets. This strategy allows the rotor to pass by without any hindrance and the pulse is maintained until the rotor moves to a position where the next pair of magnets are strongly attracted to the cores of the electromagnets. This minimises the electrical power needed to generate rotational power. It should be noted that the driving force comes from the magnets and **not** from the electrical power fed to the electromagnets.

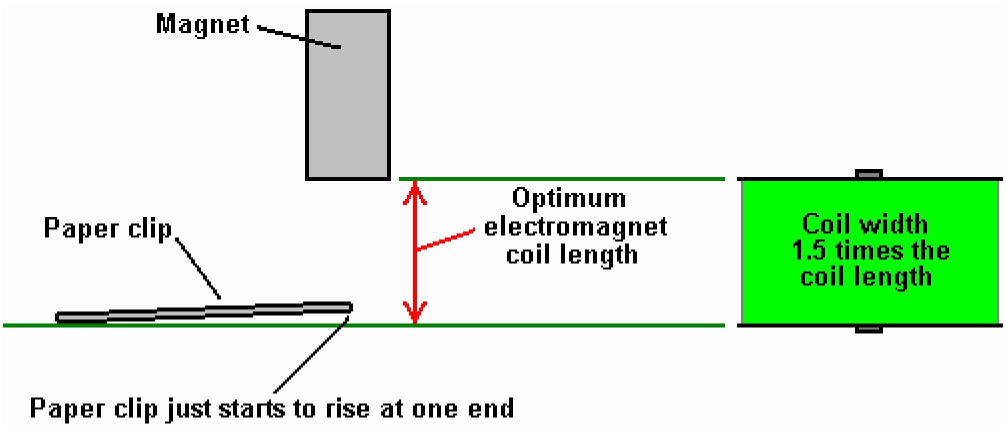
An additional bonus is the collection of the Back Electro-Motive-Force ("BEMF") from the collapsing magnetic field in the coils of the electromagnets when their power is cut off. This energy is sent back to the battery which powers the electromagnets, and this raises the overall efficiency of the motor even further.

To summarise the operation thus far: we have a temporally free rotation as the magnets pull the rotor towards the electromagnet coils, which is **Bonus 1**. As this attraction happens, current is generated in the electromagnet coils and that current is used to charge the driving battery, which is **Bonus 2**.

Please remember that the coils must only be energised just enough (of the same polarity as the rotor magnets), to allow the rotor to continue spinning freely past the electromagnets. The coils must **not** be energised to a greater level than this. Once the magnets have passed, the electromagnets are switched off. This creates a surge of electrical power, and the diode recovery circuit collects the energy from the collapsing electromagnetic fields, which is **Bonus 3**.

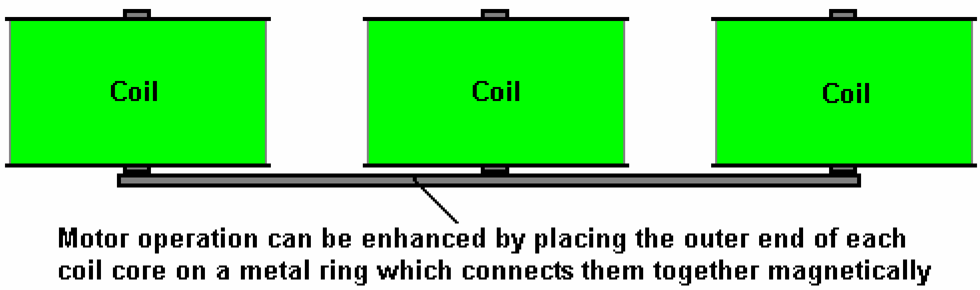
So, although this motor design looks as if it is an electrical motor driven by powerful electrical pulses fed to the electromagnets, it is actually powered by the permanent magnets attached to the rotor, and the electrical part of the operation is merely a method of overcoming the backwards drag of the magnets just after they pass the cores of the electromagnets.

Now for some practical details. The optimum physical length of the coils can determined by using the "paper clip test". This is done by taking one of the permanent magnets used in the rotor, and measuring the distance at which that magnet just begins to lift one end of a 32 mm (1.25 inch) paper clip off the table. The optimum length of each coil (and it's core) from end to end is exactly the same as the distance at which the paper clip starts to lift.



The resistance of the coils in ohms is worked out by what voltage will be used to have the coils energised just enough to equal the strength of the permanent magnets being used in the rotor (the smaller the diameter of the coil wire, the higher the final coil resistance). An Adams motor built using these techniques, has the efficiency claimed by Robert Adams. Coefficient Of Performance ("COP") values of about eight have been achieved. That is another way of saying that the motor produces eight times more output energy than the input energy needed to make it operate.

The core material used in the electromagnets can be of various different types including advanced materials and alloys such as 'Somalloy'. The coil proportions are important as an electromagnet becomes less and less effective as its length increases, and eventually, the part furthest from the active end can actually be a hindrance to the effective operation. The best coil shape is one which you would not expect, with the coil width being, perhaps 50% greater than the coil length:



As indicated in the diagram above, the overall effectiveness of a single set of coils which have only one end used for active drive, can be enhanced by placing a ring of magnetic material to connect the unused ends, forming a magnetic link between them.

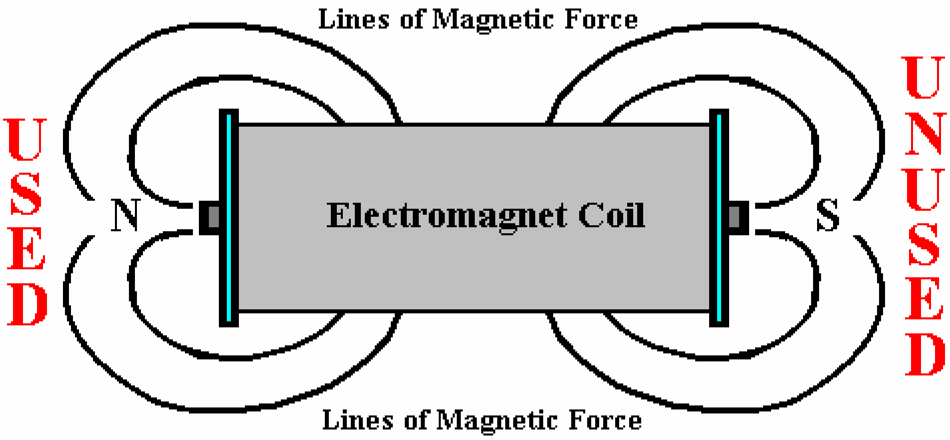
Phil also stresses that the speed at which the voltage is applied to, and removed from, the coils is very important. With very sharp voltage rises and falls, additional energy is drawn from the surrounding quantum energy field. The best switching FET which Phil has found is the IRF3205 and the best FET driver is the MC34151.

If using a Hall-effect semiconductor to synchronise the timing, say the UGN3503U which is very reliable, then the life of the Hall-effect device is much improved if it is provided with a 470 ohm resistor between it and the positive supply line, and a similar 470 ohm resistor between it and the negative line. These resistors in series with the Hall-effect device effectively "float" it and protect it from supply line spikes.

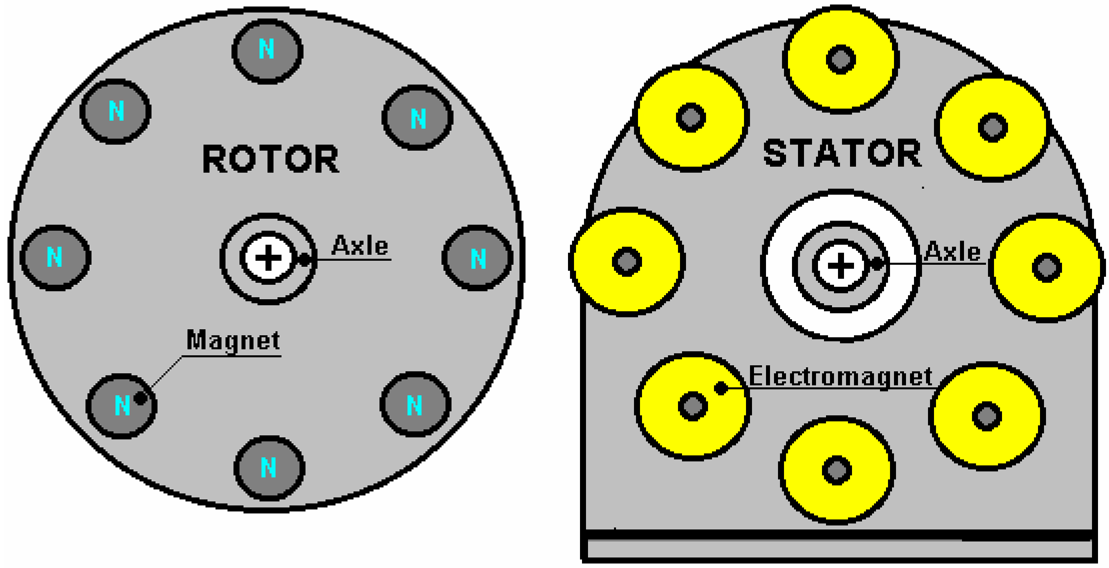
The Adams motor as described here, has a very high performance. However, Harold Aspden, a highly-respected British scientist who collaborated with Robert Adams, points out that efficient as it is, some of the energy is still being wasted.

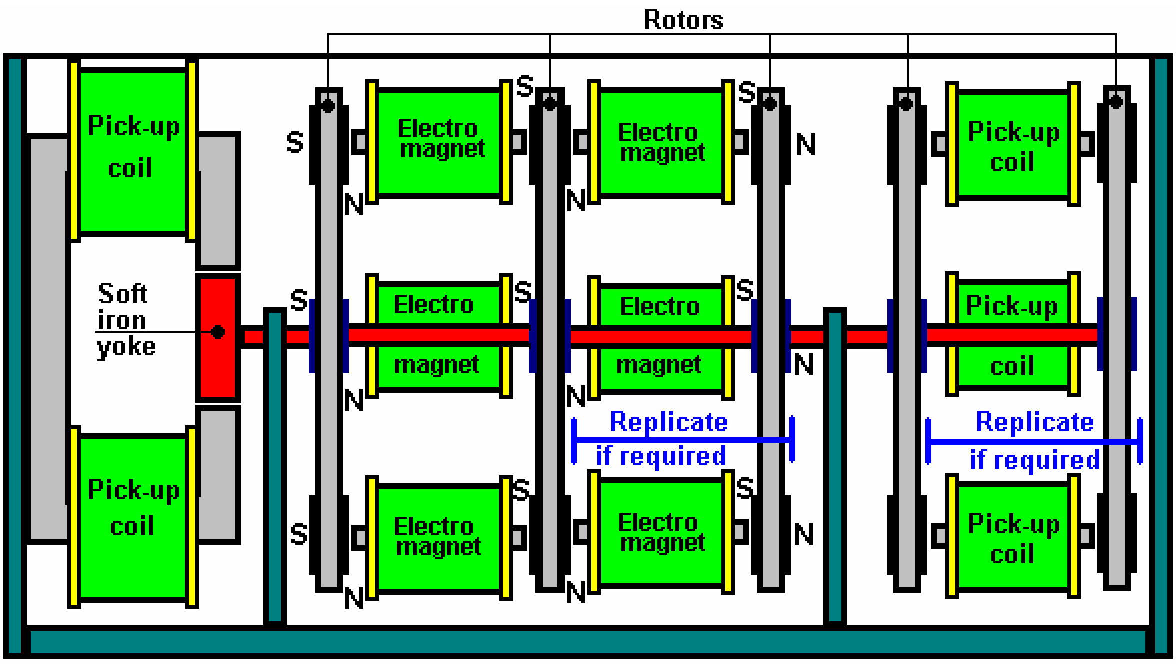
The well-known explanatory diagram shown above, gives the impression that the electromagnets must be mounted so that they radiate out around the edge of the rotor. The diagram is drawn like that to show the operation clearly, and there is actually no great need for the motor to have that particular arrangement.

Harold, points out that there is a more efficient way to construct the motor:



The Adams motor expends electrical energy when it powers the coils of the electromagnets and it uses only **one** pole of the electromagnet as part of the motor drive. The magnetic energy generated at the other end of the electromagnet is wasted. You can therefore double the turning force ("torque") of the motor for no additional use of current if you place the electromagnets parallel to the shaft of the motor and use two (or more) rotor disks holding permanent magnets:





The layout for the Adams/Aspden motor shown above, suggests two different methods of generating an electrical output from the device, though the drive shaft can be used for mechanical output in its own right. However, shown here, on the right, a bank of eight pick-up coils collect energy from the magnets passing them.

On the left, the motor shaft is used to rotate a rectangular soft iron (or mu-metal) yoke, shown in red. At one point in its rotation, this yoke almost completely bridges the gap between the ends of a powerful C-shaped magnet. When the yoke rotates a further ninety degrees, the width, rather than the length, of the yoke is presented to the magnet which creates a significant air gap between the ends of the C-shaped magnet. As this is a very much poorer magnetic path, the rotation causes a fluctuation in the magnetic flux passing through the magnetic circuit and this is collected by the pick-up coils wound on that magnet. The advantage of this arrangement is that there is almost no change in the load on the shaft, no matter how heavily the pick-up coils are loaded by current being drawn from them.

The power of an electromagnet increases with the number of turns of wire around its core. It also increases to a major degree as the current through the winding is increased. As the diameter of the winding increases, the length of wire needed for one turn increases directly in proportion to the diameter. As the resistance of the winding is proportional to the length of wire in the winding (you having already decided on the diameter of the wire), it follows that the magnetic effect for any given voltage applied to the winding, will be greater the smaller the diameter of the core.

The iron core loses power when pulsed, due to eddy currents flowing around inside the iron. The same effect applies to transformer frames, so they are constructed of thin sheets of metal, each insulated from its neighbours. It is suggested therefore, that the core of an electromagnet would be more efficient if it were not a solid piece of metal. It can be constructed from 'soft' iron wires cut to the appropriate length and insulated with lacquer which can withstand high voltages or failing that, enamel paint or nail varnish.

The number of electromagnets is a matter of personal choice. The sketch above shows eight electromagnets per stator, which gives the motor eight drive pulses per rotation. The motor works well with as few as two electromagnets. As shown, there can be as many rotors and stators in the motor as you choose. The gap between the electromagnet and the rotor magnets is of major importance and needs to be as small as it is practical to make it as magnetic force drops off very rapidly with distance from the magnet. The spacing of the rotor magnets needs to match exactly, the spacing of the electromagnets so that when an electrical pulse is applied, there is a rotor magnet opposite each electromagnet. There could be twice as many permanent magnets as electromagnets, or three times as many if you prefer.

The timing of the electrical pulses can be taken directly from the pick-up coil bank as its voltage rises as the magnets pass by. This varying voltage waveform can be sharpened up by using a Schmitt trigger circuit. The exact synchronisation can be governed by two monostables, one to set the delay before the pulse starts and one to control the exact length of the pulse.

Alternatively, a separate movable pick-up coil or Hall-effect sensor can be used and its position adjusted to give optimum operation. Another variation is to use a hole through one rotor beside each magnet and positioning an LED to shine through the holes, on to an opto device, to mark the rotation position.

There is a large amount of practical information on the construction of this type of motor at the web site http://members.fortunecity.com/freeenergy2000/adamsmotor.htm. For instance, Tim Harwood shares his experience having constructed many such motors and run many tests. A few of his observations are:

1. Ohm's Law does not apply to a correctly tuned Adams motor as the current flow is 'cold energy' rather than conventional energy being used. The greater the load on a properly set-up and tuned motor, the *colder* the stator coils and driving transistors become - the reverse of the situation for conventional energy where increased load requires increased current which produces *increased* heat. Small diameter wire can therefore be used for the electromagnet windings.

2. The cross-sectional area of each electromagnet core should be one quarter of the area of each rotor magnet.

3. The depth of the electromagnet winding should be the same as the maximum distance one rotor magnet can pull a paper-clip to itself.

4. Electromagnet wire of 24 AWG (0.511 mm dia, about 25 SWG) is a suitable size for windings.

5. The stator windings in series should have a (presumably DC) resistance of about ten ohms.

6. He uses steel nails with a 3/8" head, 100 mm shaft for the electromagnet cores. He selects these carefully from a large supply, to pick those with the best magnetic characteristics and which have a head slightly angled away from the official ninety degrees of a correctly manufactured head.

7. He finds that a electrical tape cover to both the electromagnet core before winding and outside the winding on completion, help the characteristics of the electromagnets.

8. He uses outward facing rotor magnets only and finds that having the South pole facing the electromagnets gives a slightly better result.

9. He tunes his motors using 12 Volts and then increases the voltage to 240 Volts.

10. If you use a Hall-effect semiconductor to trigger the timed pulses, he suggests buying several as they are very easy to damage.

11. The construction of the motor frame, supports, enclosure, etc. should avoid all magnetic materials as these can make the tuning difficult and they may block the tapping of 'cold' electricity.

12. It is important that the gap between the rotor magnets and the stator electromagnet cores does not exceed 1.5 mm. A gap of 1.0 to 1.5 mm works well but above that, the over-unity effect does not appear to occur. He has had outputs double that of the input for sustained periods. This he calls a "COP" of 2.0 - this web site is most definitely worth examining.

Harold Aspden and Robert Adams collaborated to develop and enhance Robert's motor design. They were awarded patent GB 2,282,708 in April 1995. This full patent forms part of this collection of documents and it is for an enhanced design which has one pole fewer in the stator than the number of poles in the rotor.

Practical details are included in the patent. For example, it is important for the width of the magnetic poles of the stator (viewed along the axle) to be only half as wide as the magnetic poles of the rotor. In fact, it can be an advantage for the stator poles to be less than half the width of the rotor poles. In the following diagrams, the magnetic poles of the stator are shown in blue and the magnetic poles of the rotor are shown in red.

With a motor of this type, it is important that the operational efficiency is as high as possible. In Fig.8 shown here, there are seven magnetic arms on the rotor, while there are eight electromagnets in the stator. This mismatch is important as this motor design operates by a stator magnet attracting a rotor magnet, and when the two line up, the stator electromagnet is pulsed to negate its magnetism. The mismatch in the number of poles causes any aligned pair of poles to have non-aligned poles 180^0 away from them. This can be seen from the following diagram:

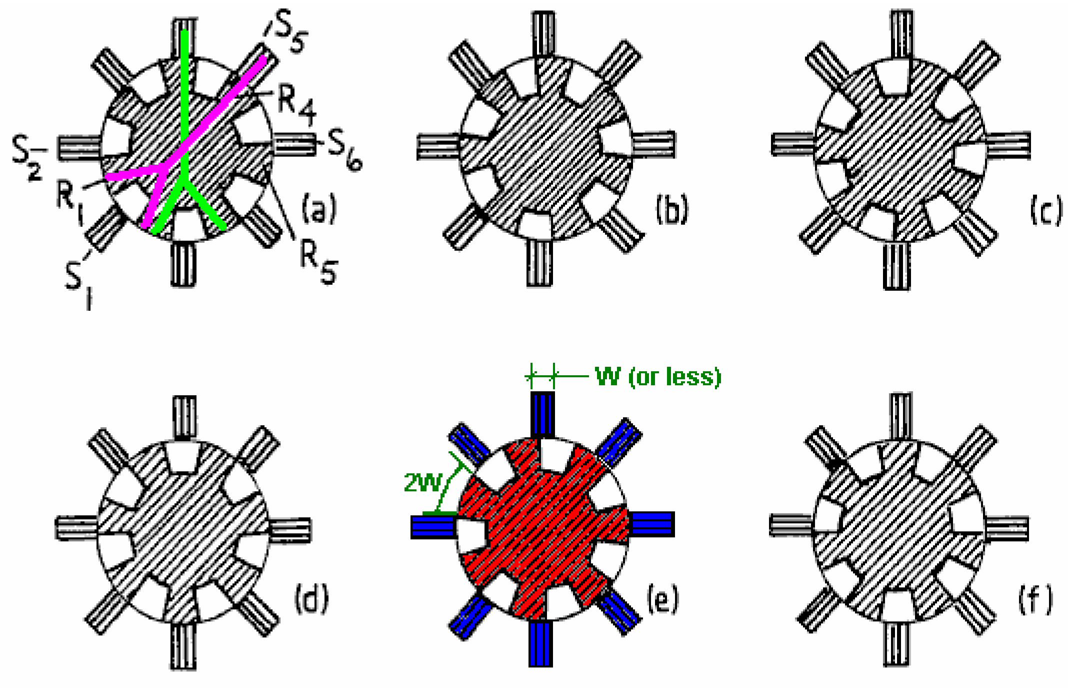


FIG.5

The suggested construction method for this motor is somewhat unusual, as shown here:

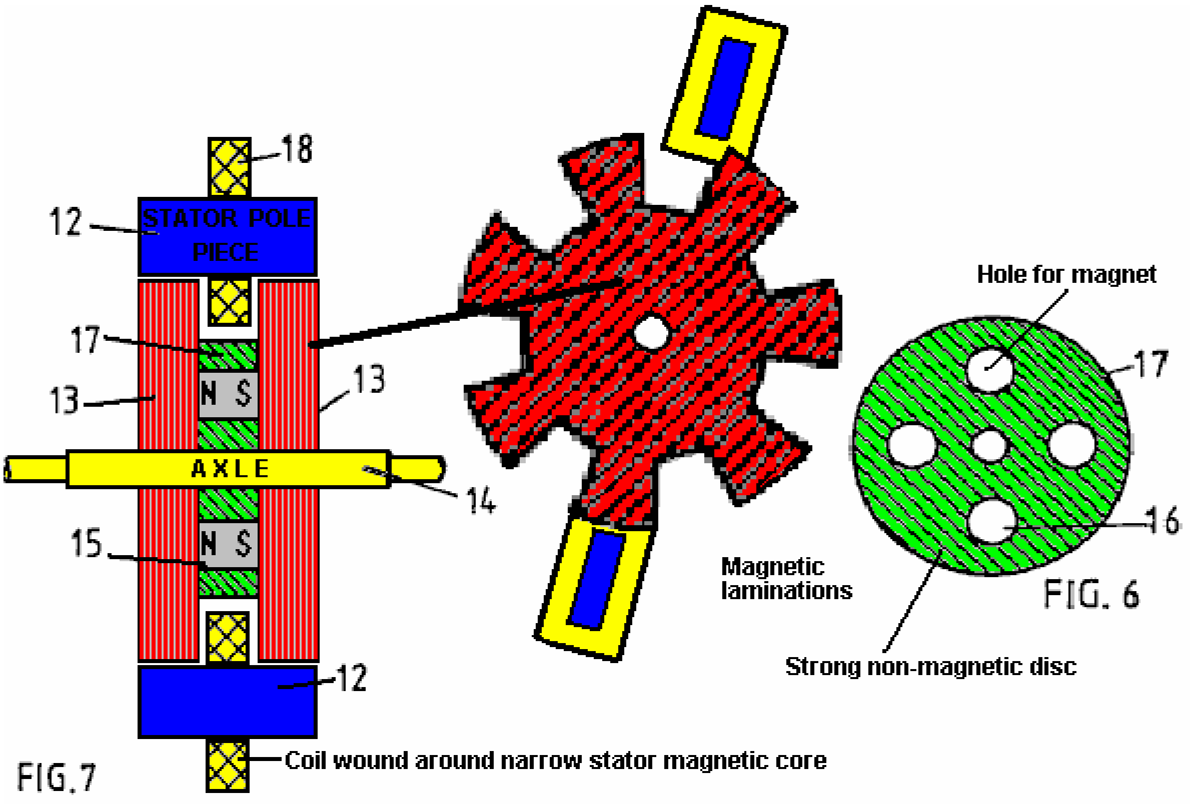


FIG.7

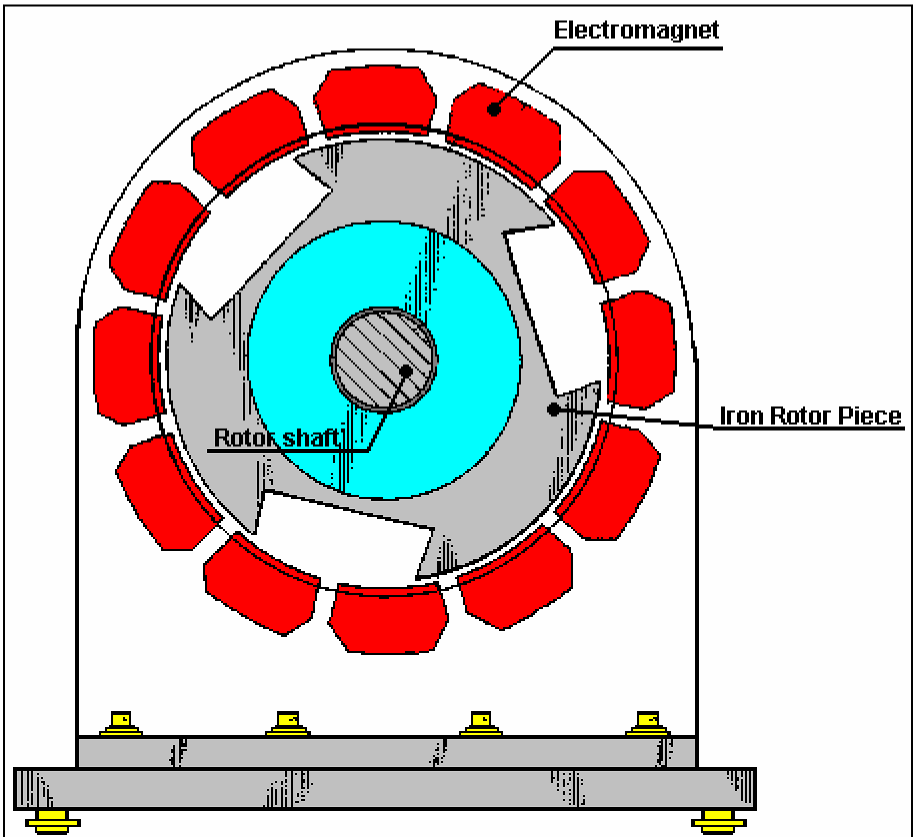
The magnetic poles of the rotor are built up from thin laminations insulated from the neighbouring laminations to prevent eddy current losses, and these laminations overlap the windings of the stator electromagnets. The diagram above only shows two of these electromagnets although there would typically be eight of them for a rotor with seven poles as shown. An interesting feature is the method of using four magnets embedded in the (green) supporting disc to provide the magnetism for the rotor laminations.

It is suggested by Harold and Robert, that this arrangement be considered to be a straight motor, used to power a conventional electrical generator, rather than using additional pick-up coils attached to the motor frame to generate electrical power as part of the device itself. Motors of this type have been recorded as producing output power which is seven times the input power. This is referred to as a "COP of 7.0" and is a clear indication of "over-unity" operation, which is supposedly impossible.

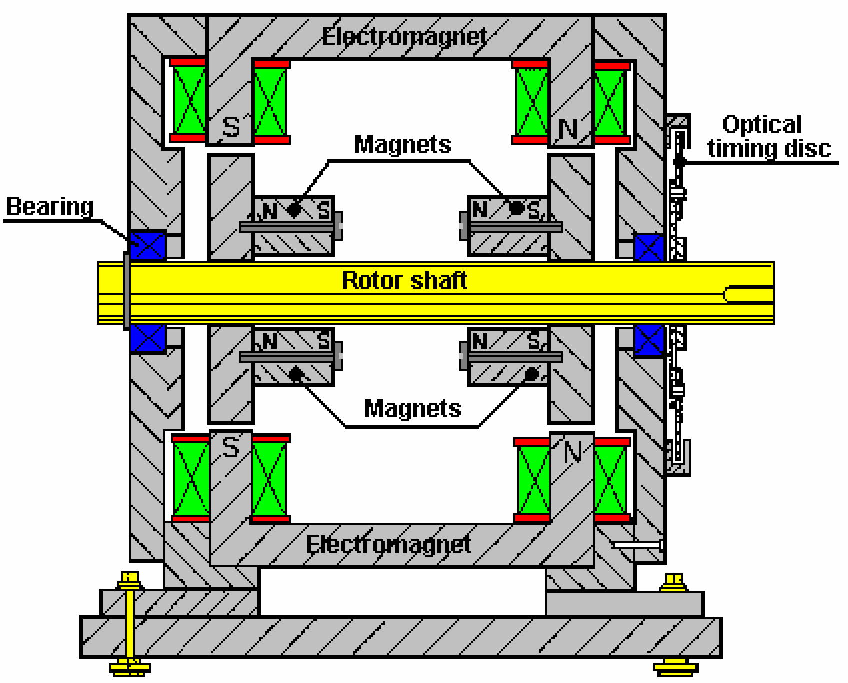
It should be remarked that having an output power greater than the input power is considered impossible, due to the "Law of Conservation of Energy". This is, of course, not true, as the "Law" (actually an expected result deduced from many measured observations) only applies to 'closed' systems and all of the 'over-unity' devices described here are not 'closed' systems. If the so-called "Law" applied to all systems, then a solar panel would be impossible, because when it is in sunlight, it produces a continuous electrical current. The power which you put in, is zero, the power coming out may well be 120 watts of electricity. If it is a 'closed' system, then it is impossible. Of course, it is not a 'closed' system as sunlight is streaming down on to the panel, and if you measure the energy reaching the panel and compare it to the energy coming out of the panel, it shows that the panel has an efficiency which is less than 20%.

The same situation applies to magnetic devices. Permanent magnets channel energy from the environment into any device which utilises them. As this is external power, a properly constructed magnetic device is capable of a performance which would be 'over-unity' if it were a 'closed' system. There are many devices which have a COP which is greater than 1.0, i.e. the output power exceeds the input power provided by the user. The objective of this set of documents is to make you aware of some of these devices, and more importantly, you alert you to the fact that it is perfectly possible to tap external energy and so provide power which appears to be completely free, in the same way that sunlight is 'free'.

Teruo Kawai. In July 1995, a patent 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. The main sections of that patent are included in the Appendix.



End View



Side View

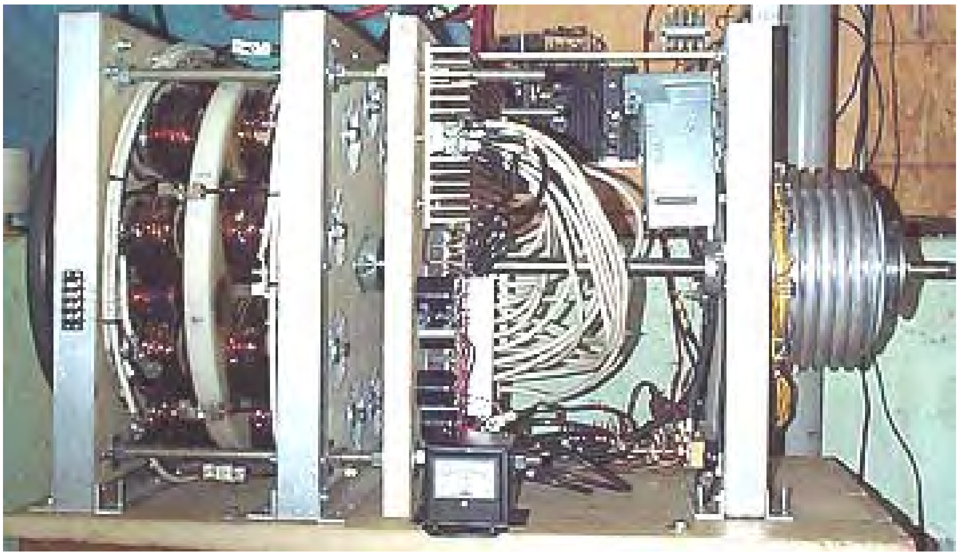
In this motor, a series of electromagnets are placed in a ring to form the active stator. The rotor shaft has two iron discs mounted on it. These discs have permanent magnets bolted to them and they have wide slots cut in them to alter their magnetic effect. The electromagnets are pulsed with the pulsing 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 in excess of its input.

Self-Powered Water-pump Generator. There is a video on Google which shows a self-powered electrical water-pump driven, electrical generator at the location: http://video.google.com.au/videoplay?docid=-3577926064917175403&ei=b1_BSO7UDILAigKA4oCuCQ&q=self-powered+generator&vt=lf

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.

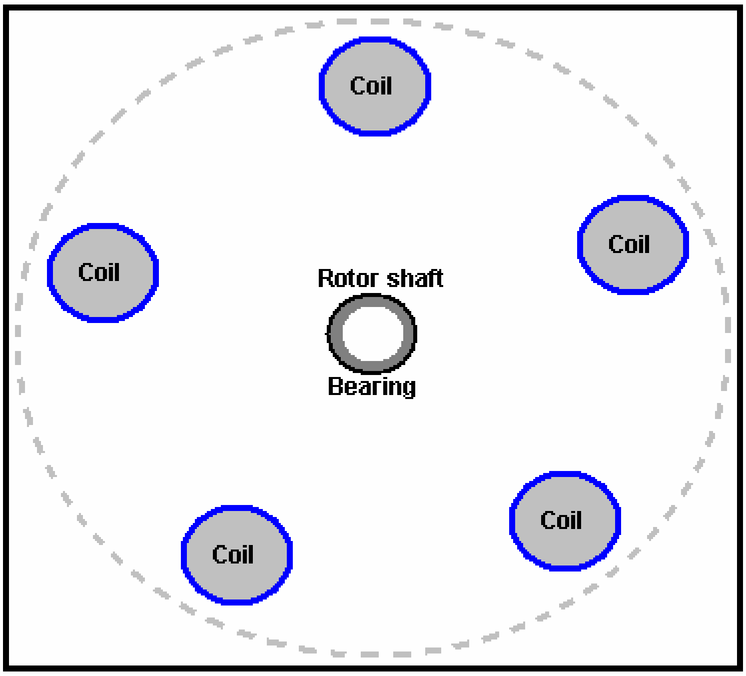
Initially, the generator is got up to speed, driven by the mains electrical supply. Then, when it is running normally, the mains connection is removed and the motor/generator sustains itself and is also able to power at least one lightbulb. The generator output is normal mains current from a standard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

The Muller Motor. Bill Muller who died in 2004, produced a series of very finely engineered devices, the latest of which he stated produced some 400 amps of output current at 170V DC for 20 amps at 2V DC drive current. The device both generates its own driving power and produces an electrical power output. Bill's device weighed some 90 kilos and it requires very strong magnets made of Neodymium-Iron-Boron which are expensive and can easily cause serious injury if not handled with considerable care. It should be noted that Ron Classen shows the details of his work in replicating this motor on his web site http://home.mchsi.com/~actt2/index.html and he reports that he spent in excess of US $3,000 in construction and so far, has already achieved an output power of about 170% of the input power. A video of his motor in action is at http://video.google.com/videoplay?docid=65862828639099378 and his development is progressing steadily. Ronald points out that decreasing the gap between the rotor and the stator by just one millimetre raises the input and output current by ten amps, so the potential of his machine is ten times greater than its present performance. Ronald has not implemented this as yet since the cost of the switching components is fairly high. His construction looks like this:

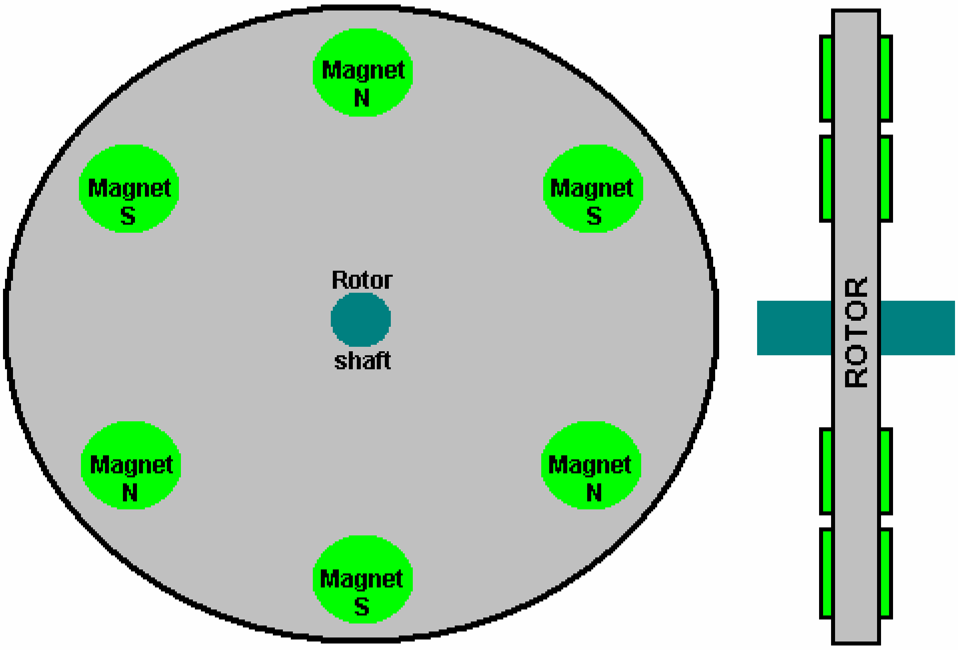


The Muller motor has a lot in common with Robert Adam's pulsed permanent-magnet motor. Both use a rotor which contains permanent magnets. Both pulse electromagnets at the precise moment to achieve maximum rotor torque. Both have pick-up coils for generating an electrical output. There are, however, considerable differences. Bill Muller's coils are wound in an unusual way as shown below. He positions his rotor magnets off-centre in relation to the stator coils. His coils are operated in pairs which are wired in series - one each side of the rotor. He has an odd number of coils and an even number of permanent magnets. His magnets are positioned with alternate polarity: N, S, N, S, ...

In order to make it easier to follow, the diagrams below show just five coil pairs and six magnets, but much larger numbers are normally used in an actual construction of the device, typically sixteen magnets.

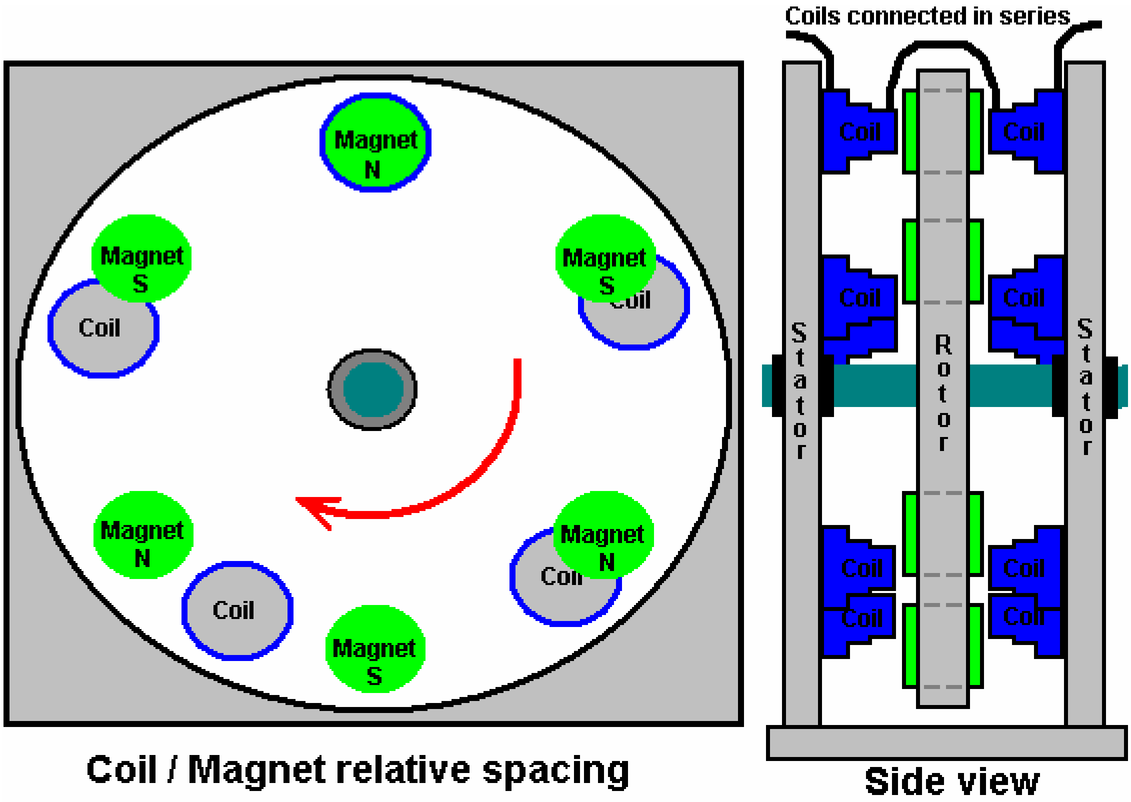


Stator (2 required)

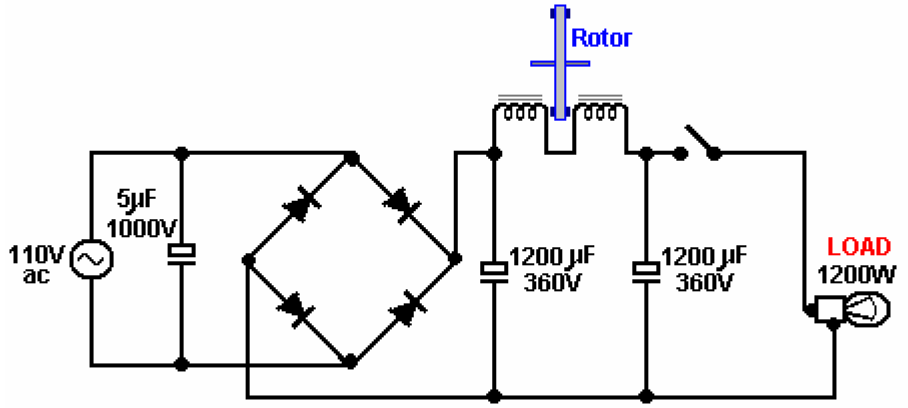


Rotor (1 required)

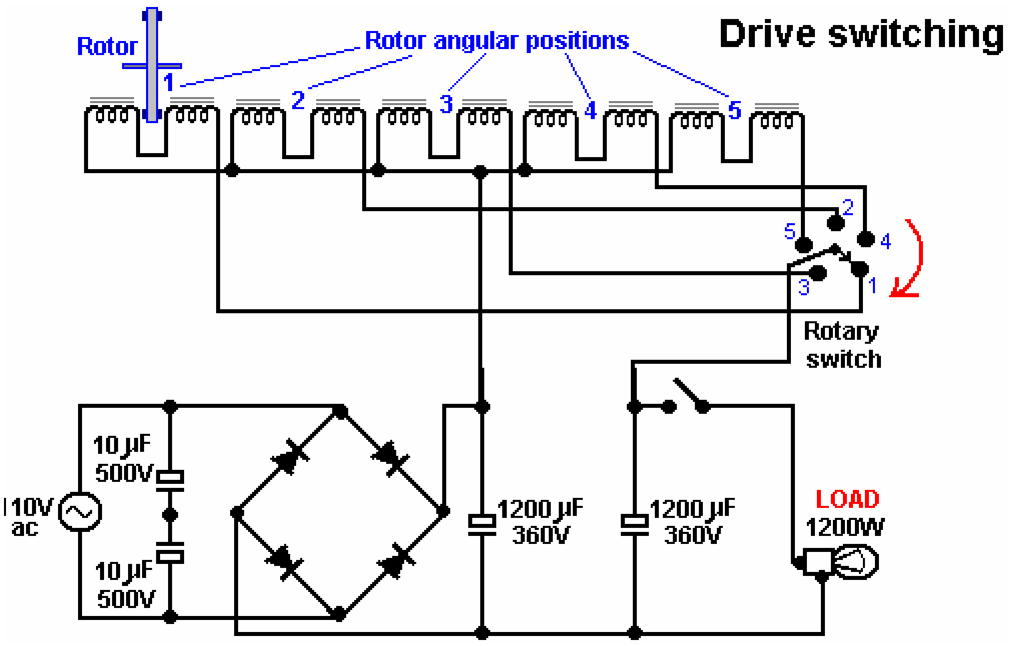
Side view



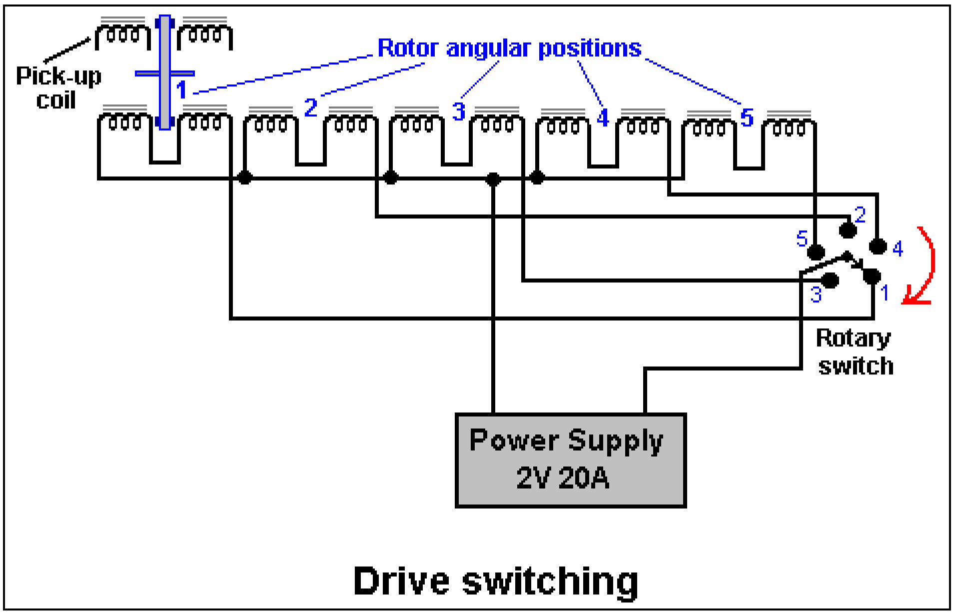
If AC mains voltage is used then the drive wiring may be as shown here:

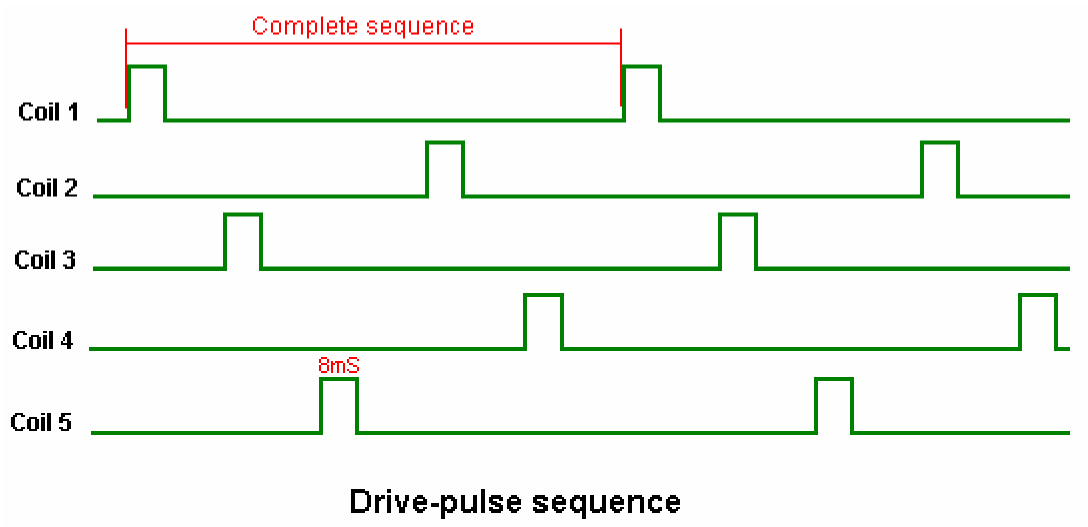


When adapted for five pairs of coils, this becomes:



If DC switching is used, then the circuit may be:



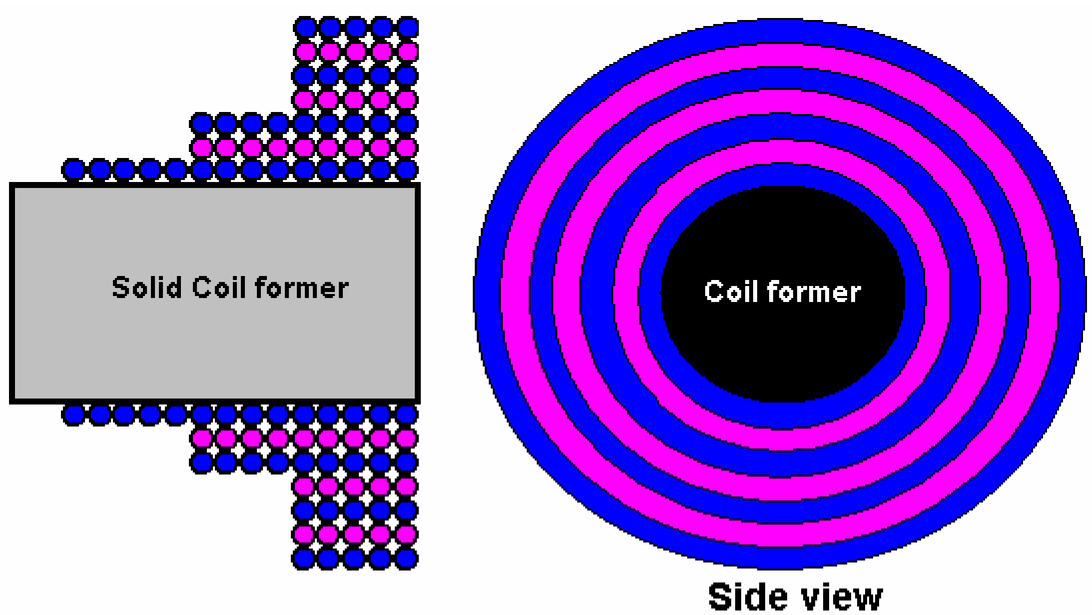


This is an unusual arrangement made all the more peculiar by the fact that the drive pulsing is carried out on the same coils which are used for power generation. The driving power pulse is applied to every successive coil which, with just five coils, makes the drive sequence 1, 3, 5, 2, 4, 1, 3, 5, 2, 4 .... For this operation, Coil 1 is disconnected from the power generation circuitry and then given a short high-power DC pulse. This boosts the rotation of the rotor. Coil 1 is then re-connected to the power generating circuitry, and coil 3 is disconnected and then given a drive pulse. This is repeated for every second coil, indefinitely, which is one of the reasons why there is an odd number of coils. The following table shows how the drive is operated.

Pulse:	1	2	3	4	5	6	7	8	9	10
Coil 1	**Pulse**	Power	Power	Power	Power	**Pulse**	Power	Power	Power	Power
Coil 2	Power	Power	Power	**Pulse**	Power	Power	Power	Power	**Pulse**	Power
Coil 3	Power	**Pulse**	Power	Power	Power	Power	**Pulse**	Power	Power	Power
Coil 4	Power	Power	Power	Power	**Pulse**	Power	Power	Power	Power	**Pulse**
Coil 5	Power	Power	**Pulse**	Power	Power	Power	Power	**Pulse**	Power	Power

It is essential that Neodymium-Iron-Boron magnets are used for this device as they are about ten times more powerful than the more common ferrite types. Bill used sixteen magnets in the 30 - 50 MegaGaussOerstedt energy density range, constructed in China, they held their magnetism unaltered for eight years of use. The air gap between the coils and the magnets is 2 mm. Bill used a computer chip to generate the switching sequence, and Ronald Classen who is expert in these systems points out that the pulsing system is adjusted when the motor speed increases. This change is not a simple one as when the speed of rotation reaches its maximum level, on a sixteen magnet rotor, only three of the magnets would be driven by coils pulses. That is, during one rotation, just three electromagnets would be energised in one simultaneous pulse, and that pulse would be of longer duration than the pulses which accelerated to rotor from its stationary position.

The output from each coil is passed through a full-wave bridge to give DC, before being added to the output from the other coils. A typical Muller motor would have 16 magnets and 15 coil pairs. The solid coil formers were made from 'amorphous metal' and are 2 inches (50 mm) in diameter and 3 inches (75 mm) long. Bill used a special mix of 'black sand' (probably magnetite granules) encased in epoxy resin, but an alternative is said to be hard steel - the harder the better. The coil core material is said to be very important and his construction was said to be free of any hysteresis eddy currents. The coils are wound from #6 AWG (SWG 8) or #8 AWG (SWG 10) wire and are formed in an unusual fashion as shown here:



The winding turns are all made in the same direction. The first layer has 14 turns, the next two layers have 9 turns each, and the remaining four layers have 5 turns each, which gives a total of 52 turns. The coils are used in pairs, being wired in series, with one of each pair being on the opposite side of the rotor to the second coil of the pair, as indicated on the drawings. The way in which the coils are connected to the stator is not certain. The thin end of the coils face the rotor magnets. The pick-up coils are not shown on the drawings, but they are placed on both of the stators, in every position where there is no drive coil.

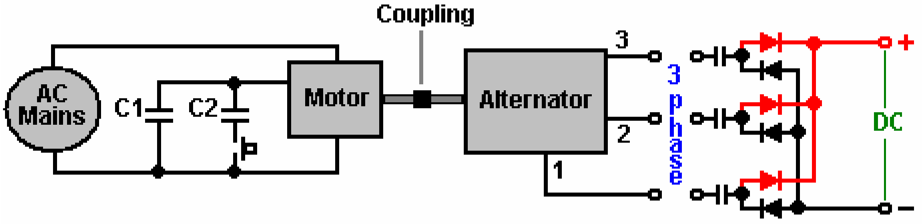
The rotor is constructed of non-magnetic material and spins at about 3,000 rpm. This device has the potential to output 35 kW of excess power when constructed in the size described, which has a rotor diameter of 660 mm with the magnets centred on a circle of 570 mm. In the demonstration which produced 35 kW of power, only five out of the intended thirty pairs of pick-up coils had been constructed. It is predicted that the output would be 400 horsepower if all thirty pairs of pick-up coils were in place. Predictions of this nature need to be borne out in a demonstration before they can be considered valid. Please be aware of the size of this item of equipment. I personally, would not be able to pick up a device of this weight, but would need mechanical lifting equipment to move it. It can, of course, be constructed in a scaled down size which will have a scaled down electrical output.

Let me stress that handling magnets of this strength has its dangers. Should you take a magnet in your hand and inadvertently move your hand near a loose steel item, then your hand is liable to become trapped between the magnet and the steel object. This may result in serious damage to your hand. Great care should be taken.

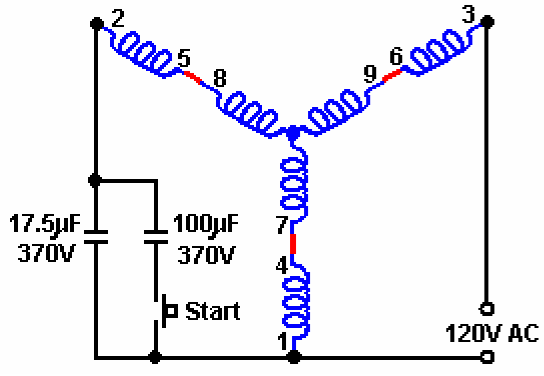
The official web site for this system is www.mullerpower.com which you may find difficult to display unless you have the MacroMedia software installed on your computer. An alternative information site on the constructional details is http://www.theverylastpageoftheinternet.com/menu/muller.htm which shows both motor details and details of a separate 'over-unity' experiment which lights four 300W light bulbs while taking 1100W directly from the AC mains supply.

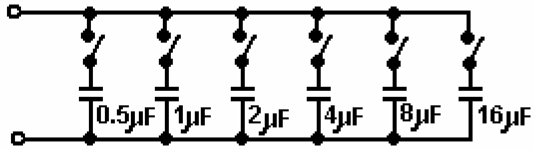
The RotoVerter. Not all pulsed-drive systems use permanent magnets as part of their drive mechanism. For example, the RotoVerter systems uses standard three-phase electric motors instead of magnets. In addition, some of the electrical driving power can be recovered for re-use.

This system has been reproduced by several independent researchers and it produces a substantial power gain when driving devices which need an electrical motor to operate. At this time, the web site: www.theverylastpageoftheinternet.com/ElectromagneticDev/arkresearch/rotoverter.htm has details on how to construct the device. The outline details are as follows:



The output device is an alternator which is driven by a three-phase mains-powered, 3 HP to 7.5 HP motor (both of these devices can be standard 'asynchronous squirrel-cage' motors). The drive motor is operated in a highly non-standard manner. It is a 240V motor with six windings as shown below. These windings are connected in series to make an arrangement which should require 480 volts to drive it, but instead, it is fed with 120 volts of single-phase AC. The input voltage for the motor, should always be a quarter of its rated operational voltage. A virtual third phase is created by using a capacitor which creates a 90-degree phase-shift between the applied voltage and the current.





Capacitor substitution box
(0.5 to 31.5μF in steps of 0.5μF)

The objective is to tune the motor windings to give resonant operation. A start-up capacitor is connected into the circuit using the press-button switch shown, to get the motor up to speed, at which point the switch is released, allowing the motor to run with a much smaller capacitor in place. Although the running capacitor is shown as a fixed value, in practice, that capacitor needs to be adjusted while the motor is running, to give resonant operation. For this, a bank of capacitors is usually constructed, each capacitor having its own ON/OFF switch, so that different combinations of switch closures give a wide range of different overall values of capacitance. With the six capacitors shown above, any value from 0.5 microfarad to 31.5 microfarad can be rapidly switched to find the correct resonant value. These values allow combined values of 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, ...by selecting the appropriate switches to be ON or OFF. Should you need a value greater than this, then wire a 32 microfarad capacitor in place and connect the substitution box across it to test higher values step by step to find the optimum value of capacitor to use. The capacitors need to be powerful, oil-filled units with a high voltage rating - in other words, large, heavy and expensive. The power being handled in one of these systems is large and setting one up is not without a certain degree of physical danger. These systems have been set to be self-powered but this is not recommended, presumably because of the possibility of runaway with the output power building up rapidly and boosting the input power until the motor burns out.

The Yahoo EVGRAY Group at http://groups.yahoo.com/group/EVGRAY has nearly 900 members many of whom are very willing to offer advice and assistance. A unique jargon has built up on this forum, where the motor is not called a motor but is referred to as a “Prime Mover” or “PM” for short, which can cause confusion as “PM” usually stands for “Permanent Magnet”. RotoVerter is abbreviated to “RV” while “DCPMRV” stands for “Direct Current Permanent Magnet RotoVerter” and “trafo” is a non-standard abbreviation for “transformer”. Some of the postings in this Group may be difficult to understand due to their highly technical nature and the extensive use of abbreviations, but help is always available there.

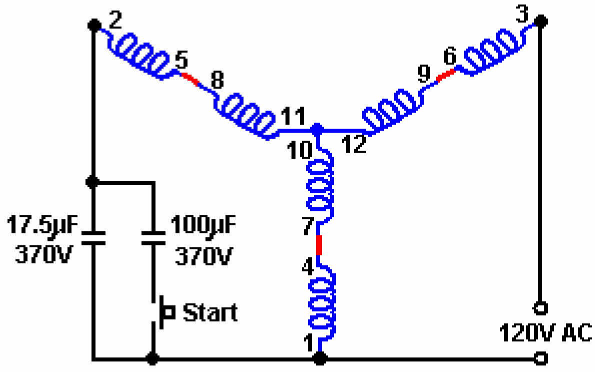
To move to some more practical construction details for this system. The motor (and alternator) considered to be the best for this application is the “Baldor EM3770T” 7.5 horsepower unit. The specification number is 07H002X790, and it is a 230/460 volts 60Hz 3-phase, 19/9.5 amp, 1770 rpm, power factor 81, device.

The Baldor web site is www.baldor.com and the following details should be considered carefully before trying any adaption of an expensive motor. The end plate of the drive motor needs to be removed and the rotor lifted out. Considerable care is needed when doing this as the rotor is heavy and it must **not** be dragged across the stator windings as doing that would damage them.

The second end-plate is then removed and placed on the opposite end of the stator housing. The fan is removed as it is not needed and just causes unnecessary drag, and the rotor is inserted the opposite way round to the way it was removed. That is, the housing is now the other way round relative to the rotor, since the rotor has been turned through 180 degrees before being replaced. The same part of the shaft of the rotor passes through the same end plate as before as the end plates have also been swapped over. The end plates are bolted in position and the rotor shaft spun to confirm that it still rotates as freely as before.

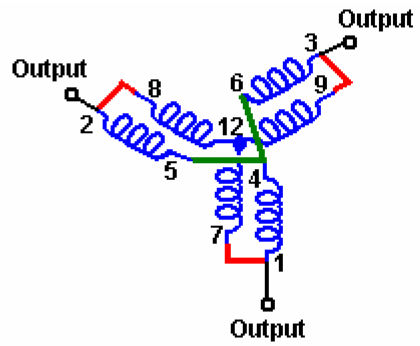
To reduce friction to an absolute minimum, the motor bearings need to be cleaned to an exceptional level. There are various ways of doing this. One of the best is to use a carburettor cleaner spray from your local car accessories shop. Spray inside the bearings to wash out all of the packed grease. The spray evaporates if left for a few minutes. Repeat this until the shaft spins perfectly, then put one (and only one) drop of light oil on each bearing and do not use WD40 as it leaves a residue film. The result should be a shaft which spins absolutely perfectly.

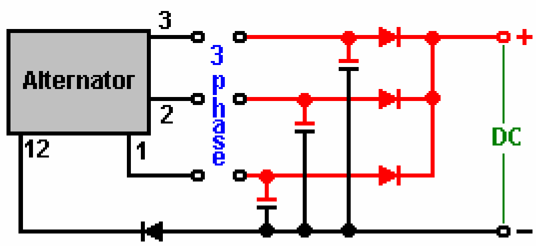
The next step is to connect the windings of the two units. The motor (the "Prime Mover") is wired for 480 volt operation. This is done by connecting winding terminals 4 to 7, 5 to 8 and 6 to 9 as shown below. The diagram shows 120 volts AC as being the power supply. This is because the RotoVerter design makes the motor operate at a much lower input than the motor designers intended. It this motor were operated in the standard way, a 480 volt 3-phase supply would be connected to terminals 1, 2 and 3 and there would be no capacitors in the circuit.



It is suggested that the jumpering of the motor windings is more neatly done by removing the junction box cover and drilling through it to carry the connections outside to external connectors, jumpered neatly to show clearly how the connections have been made for each unit, and to allow easy alterations should it be decided to change the jumpering for any reason.

The same is done for the unit which is to be used as the alternator. To increase the allowable current draw, the unit windings are connected to give the lower voltage with the windings connected in parallel as shown below with terminals 4,5 and 6 strapped together, 1 connected to 7, 2 connected to 8 and 3 connected to 9. This gives a three-phase output on terminals 1, 2 and 3. This can be used as a 3-phase AC output or as three single-phase AC outputs, or as a DC output by wiring it as shown here:



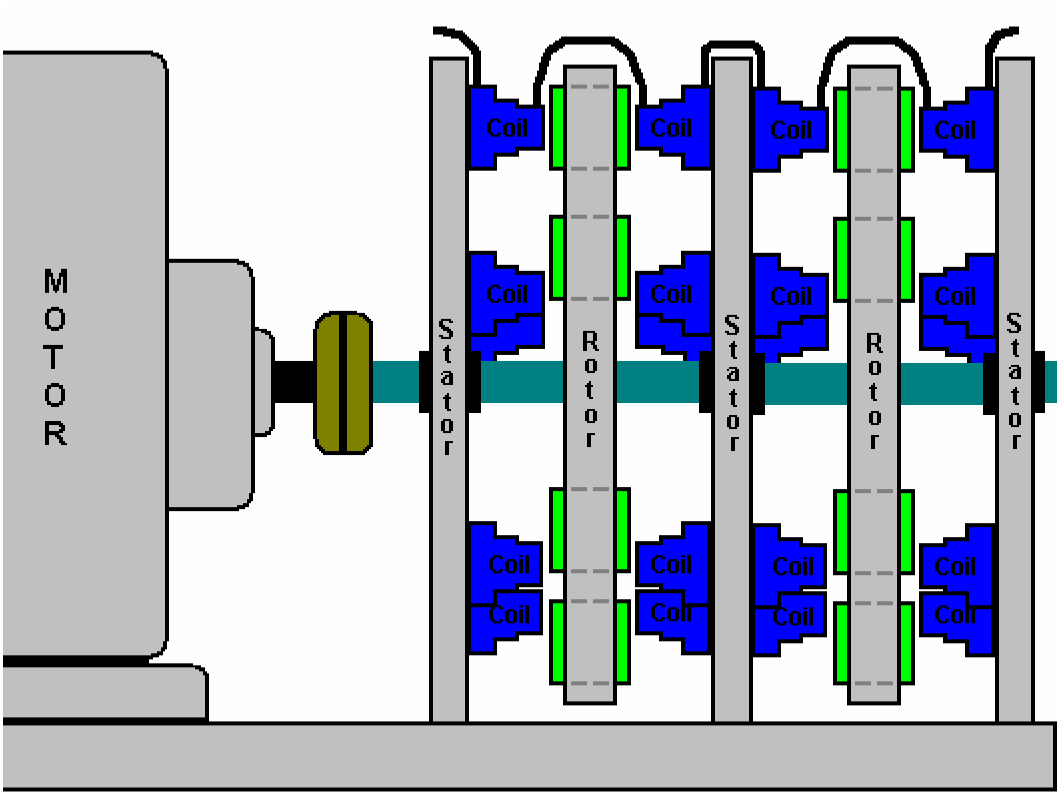


The motor and the alternator are then mounted securely in exact alignment and coupled together. The switching of the direction of the housing on the drive motor allows all of the jumpering to be on the same side of the two units when they are coupled together, facing each other:

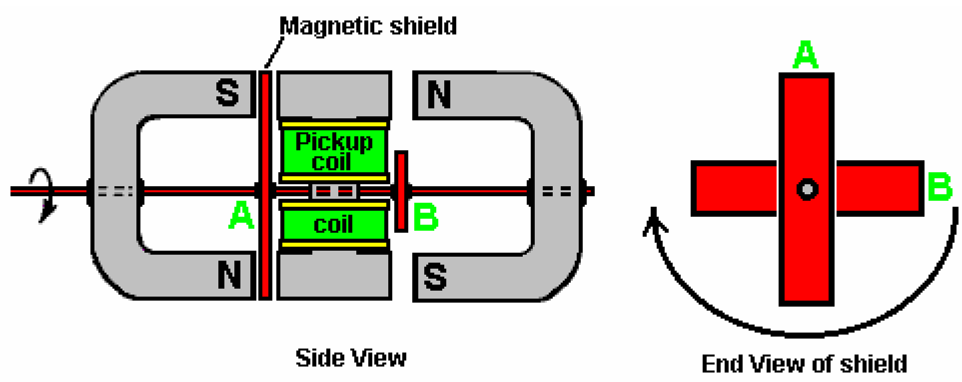
The input drive may be from an inverter driven from a battery charged via a solar panel. The system how needs to be 'tuned' and tested. This involves finding the best 'starting' capacitor which will be switched into the circuit for a few seconds at start-up, and the best 'running' capacitor.

To summarise: This device takes a low-power 110 Volt AC input and produces a much higher-power electrical output which can be used for powering much greater loads than the input could power. The output power is much higher than the input power. This is free-energy under whatever name you like to apply to it. One advantage which should be stressed, is that very little in the way of construction is needed, and off-the-shelf motors are used. Also, no knowledge of electronics is needed, which makes this one of the easiest to construct free-energy devices available at the present time. One slight disadvantage is that the tuning of the "Prime Mover" motor depends on its loading and most loads have different levels of power requirement from time to time.

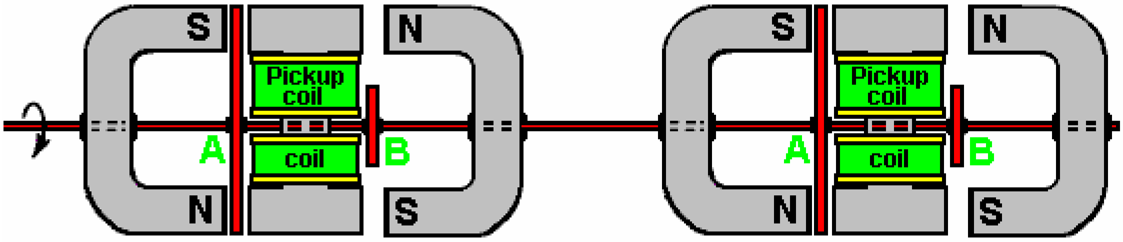
It is not essential to construct the RotorVeter exactly as shown above, although that is the most common form of construction. The Muller Motor mentioned earlier, can have a 35 kilowatt output when precision-constructed as Bill Muller did. One option therefore, is to use one Baldor motor jumpered as the "Prime Mover" drive motor and have it drive one or more Muller Motor style rotors to generate the output power:



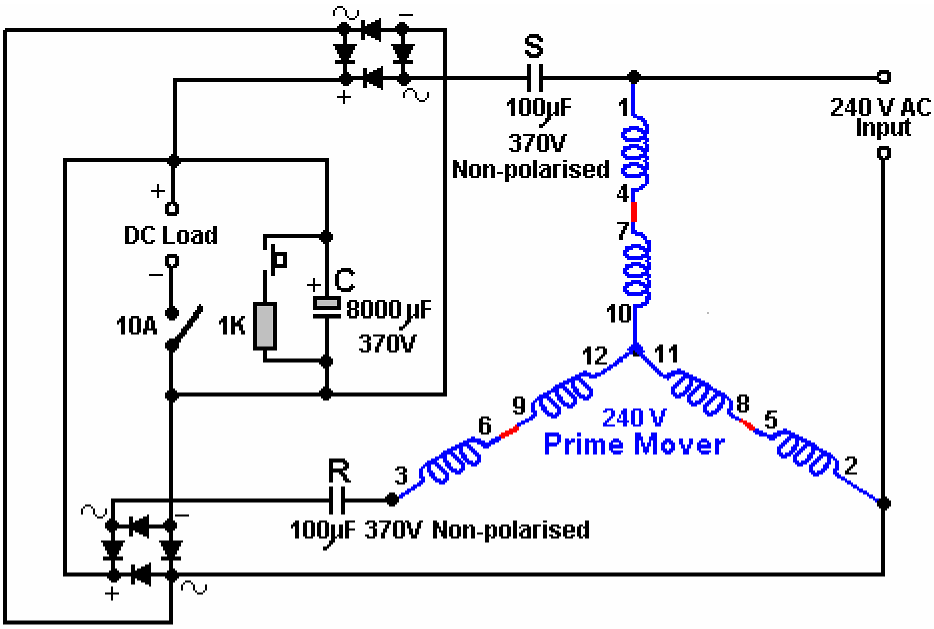
As the objective is to increase the output power and attempt to keep the motor loading as even as possible to make it possible to tune the motor power input as close to the "sweet" resonant point of its operation, another alternative springs to mind. The output power generator which has the least variation in shaft power for changes in electrical output, namely the Ecklin-Brown generator as described in Chapter 1:



The electrical power generated in the coils wound on the I-Section is substantial and the key factor is that the power needed to rotate the shaft is almost unaffected by the current draw from the pick-up coils. These generator sets could be stacked in sequence and still facilitate the tuning of the "Prime Mover" drive motor:



Phil Wood, has many years of experience working with all varieties of electric motor, has come up with a very clever circuit variation for the RotoVerter system. His design has a 240 volt Prime Mover motor driven with 240 volt AC. The revised circuit now has automated start-up and it provides an extra DC output which can be used to power additional equipment. His circuit is shown here:



Phil specifies the diode bridges as 20 amp 400 volt and the output capacitor as 4000 to 8000 microfarads 370 volt working. The ON/OFF switch on the DC output should be 10 amp 250 volt AC working. The circuit operates as follows:

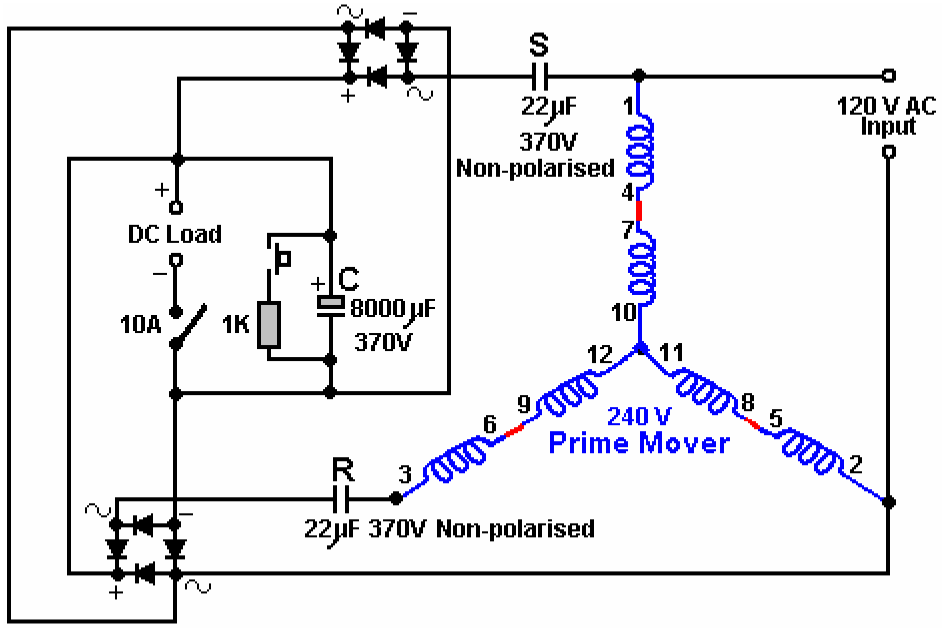
The charge capacitor “C” needs to be fully discharged before the motor is started, so the press-button switch is pressed to connect the 1K resistor across the capacitor to discharge it fully. If you prefer, the press-button switch and resistor can be omitted and the switch to the DC load closed before the AC input is applied. The switch must then be opened and the AC connected. The starting capacitor “S” and capacitor “R” both operate at full potential until capacitor “C” begins to charge. As capacitor “C” goes through its charging phase, the resistance to capacitors “R” and “S” increases and their potential capacitance becomes less, automatically following the capacitance curve required for proper AC motor operation at start-up.

After a few seconds of run time, the output switch is operated, connecting the DC load. By varying the resistance of the DC load, the correct tuning point can be found. At that point, the DC load resistance keeps both of the capacitors “R” and “S” operating at a potentially low capacitance value.

The operation of this circuit is unique, with all of the energy which is normally wasted when the AC motor is starting, being collected in the output capacitor “C”. The other bonus is where a DC load is powered for free while it keeps capacitors “R” and “S” in their optimum operating state. The DC load resistance needs to be adjusted to find the value which allows automatic operation of the circuit. When that value has been found and made a permanent part of the installation, then the switch can be left on when the motor is started (which means that it can be omitted). If the switch is left on through the starting phase, capacitor “C” can be a lower value if the DC load resistance is high enough to allow the capacitor to go through its phase shift.

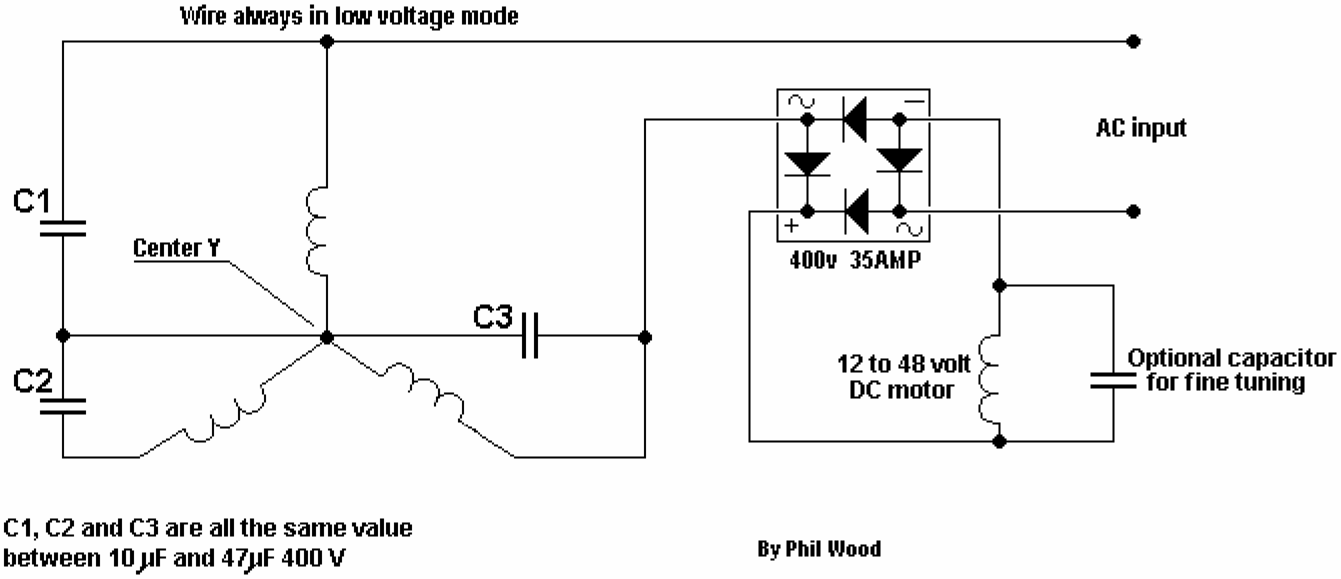
The capacitor values shown above were those found to work well with Phil's test motor which was a three-winding, 5 horsepower, 240 volt unit. Under test, driving a fan, the motor draws a maximum of 117 watts and a variable speed 600 watt drill was used for the DC load. The motor operates at its full potential with this circuit.

The circuit will need different capacitors for operation with a 120 Volt AC supply. The actual values are best determined by testing with the motor which is to be used, but the following diagram is a realistic starting point:

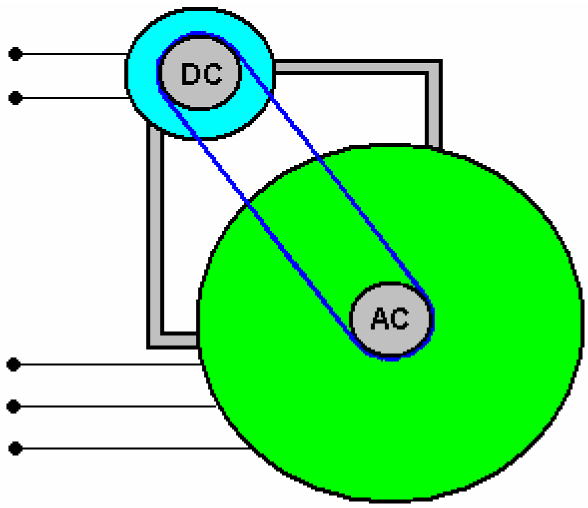


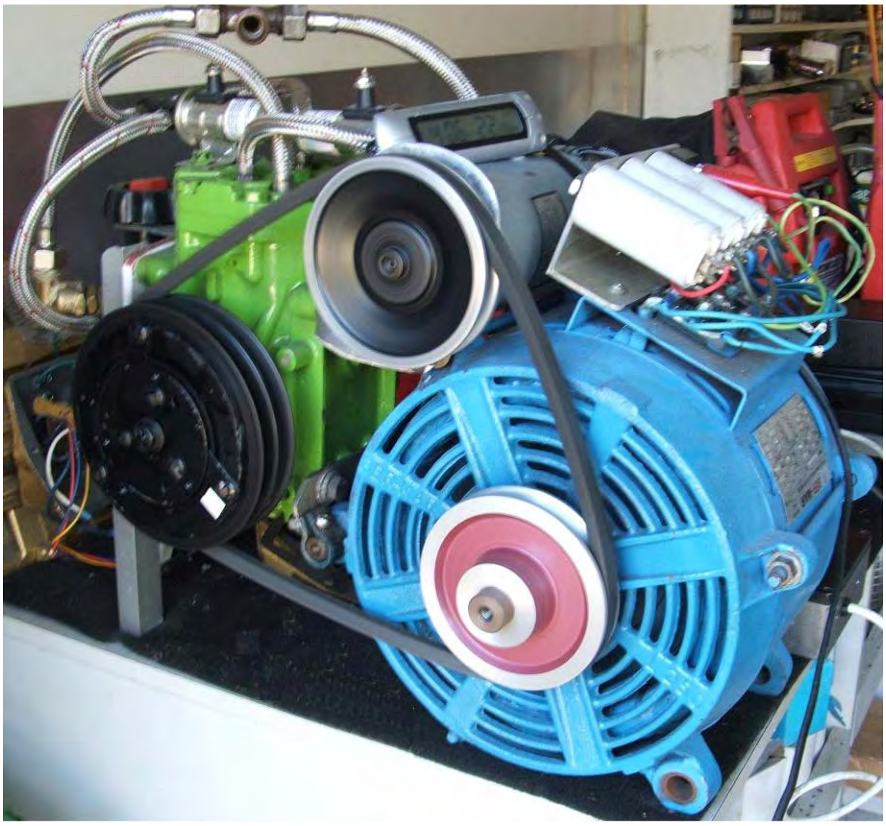
The 120 V AC motor runs very smoothly and quietly drawing only 20 watts of input power.

Advancing the design even further, Phil has now produced an extremely clever design by introducing an additional DC motor/generator coupled to the "Prime Mover" motor. The coupling is nominally mechanical with the two motors physically linked together with a belt and pulleys, but the electrical linking is such that the two motors will synchronise automatically if the mechanical linkage is omitted. I should like to express my thanks to him for sharing this information, diagrams and photographs freely.



This circuit is very clever as the DC motor/generator automatically adjusts the running of the AC motor both at startup and under varying loading. Also, the selection of the capacitors is not so critical and no manual intervention is needed at startup. In addition, the DC motor/generator can be used as an additional source of electricity.





Phil's setup

As the loading on the Prime Mover motor is quite low due to the very, very high efficiency of the RotoVerter arrangement, it is perfectly feasible to drive the whole system with a low-power inverter run from a battery. If that is done, then it is possible to use two batteries. One is charged by the DC generator while the other is driving the inverter. A timer circuit then switches the batteries over on a regular basis using relay switching.

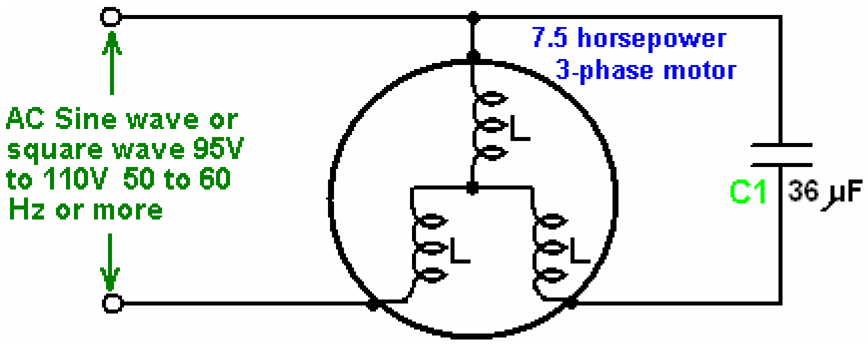
Extra Energy Collection

A very effective additional circuit has been developed by David Kousoulides. This circuit allows extra current to be drawn off a RotoVerter while it is running, without increasing the input power needed to drive the RotoVerter. David's circuit can be used with a wide range of systems, but here it is being shown as an addition to the RotoVerter system, raising it's efficiency even higher than before.

As is common with many effective circuits, it is basically very simple looking, and it's apparent operation is easily explained. The objective is to draw additional current from the RotoVerter and use that current to charge one or more batteries, without loading the RotoVerter at all. The current take off is in the form of a rapid series of current pulses which can be heard as a series of faint clicks when fed into the battery.

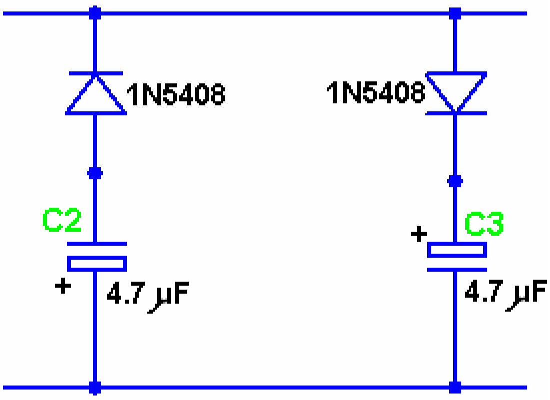
Let us examine the circuit section by section:

First, we start with a standard "off the shelf" 3-phase motor. In this example, the motor is a 7.5 horsepower motor, which when wired in RotoVerter mode, using just a single-phase supply as shown here, only draws a very low amount of power when running, especially if the single-phase supply is about 25% of the voltage rating of the motor:



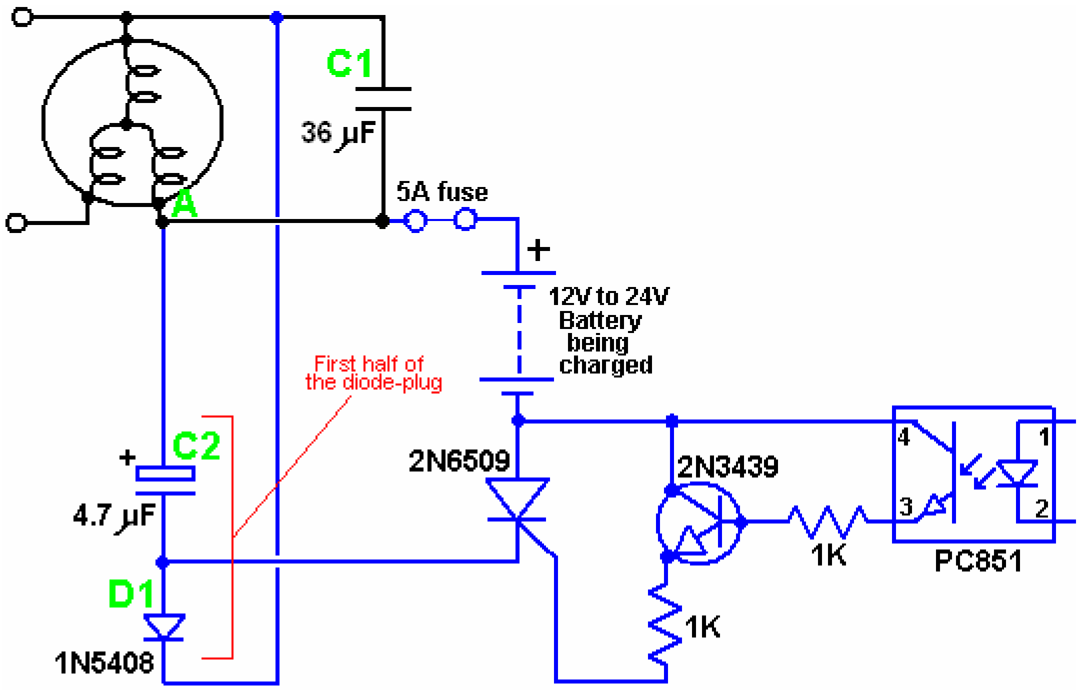
Because the running power draw is so low, it is possible to run this motor from a standard battery-powered inverter, but the current draw at start-up is some 17 amps, so the mains is used to get the motor started and then the motor is switched from the mains to the inverter. The inverter also allows easy measurement of the power input and so makes for easier calculation of the overall power efficiency of the system.

There is a power extraction device called a "diode-plug", which in spite of it's seeming simplicity, is actually much more subtle in it's operation than would appear from a quick glance at the circuit:



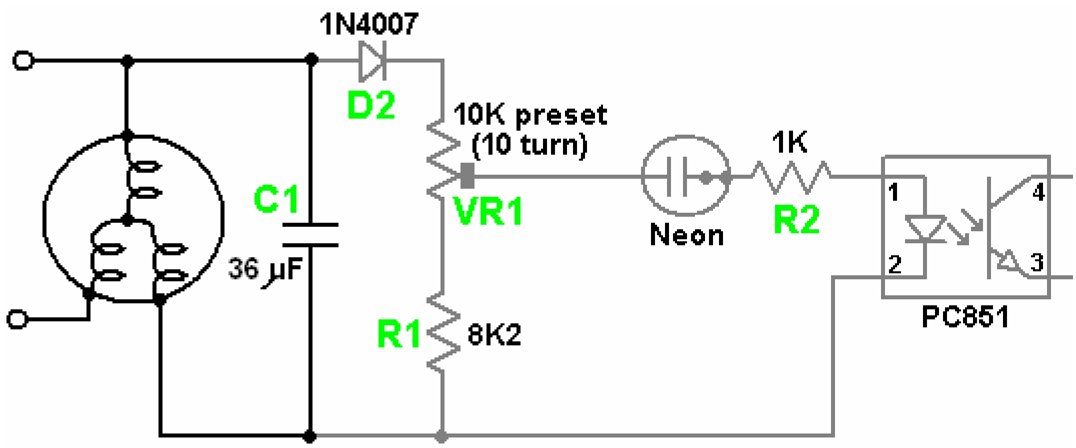
This circuit has been presented as a public-domain non-copyrightable circuit by Hector Perez Torres and it is capable of extracting power from a range of different systems, without affecting those systems or increasing their power draw. In the circuit presented below, just the first half of the diode plug is utilised, though it should perhaps be stressed that it would be perfectly feasible to raise the efficiency of the circuit even further by adding extra components to duplicate the power feed from the battery, drawing on both parts of the diode-plug circuit. For clarity, this is not shown here, but it should be understood that it is a possible, and indeed desirable, extension to the circuitry described here.

When the motor is running, high voltages are developed across the windings of the motor. As only the first half of the diode-plug is being shown here, we will be capturing and using the negative-going voltages. These negative-going pulses are picked up, stored in a capacitor and used to charge a battery using the following circuit:



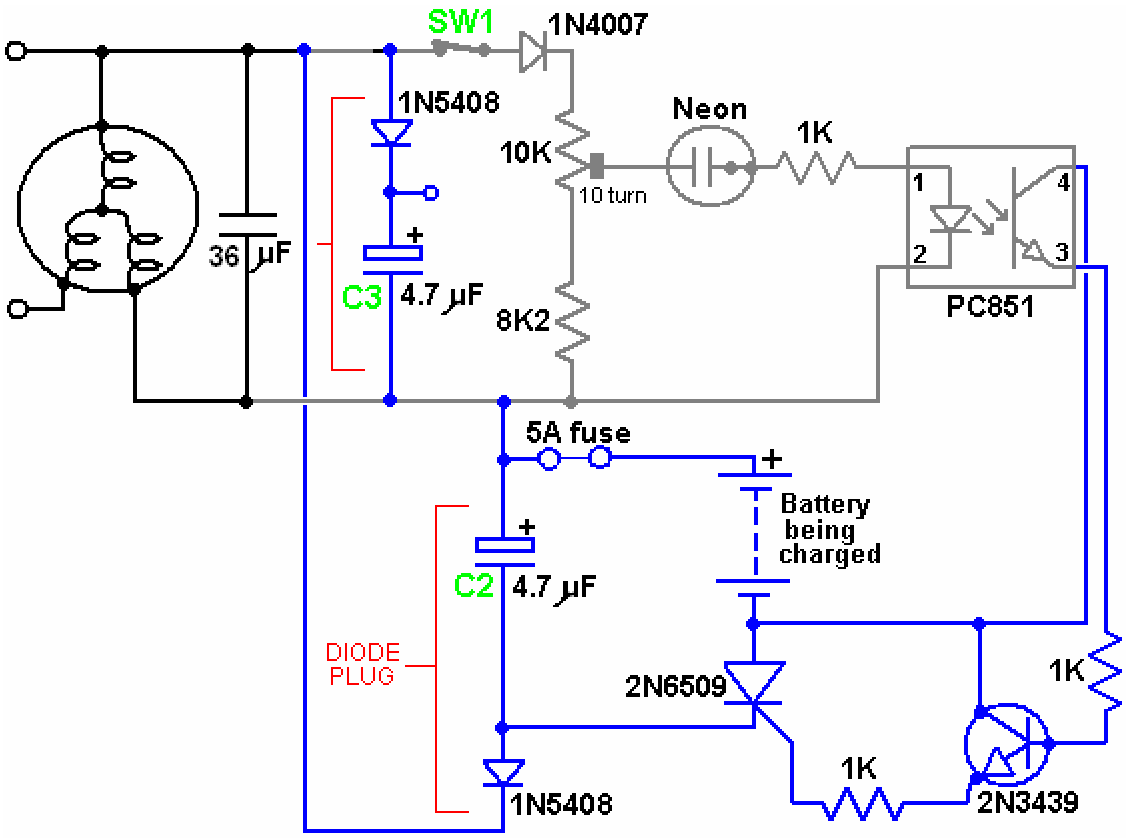
Here we have the same RotoVerter circuit as before, with high voltage being developed across capacitor C1. The battery-charging section is a free-floating circuit connected to point A of the motor. The high-voltage diode D1 is used to feed negative-going pulses to capacitor C2 which causes a large charge to build up in that capacitor. At the appropriate moment, the PC851 opto-isolator is triggered. This feeds a current into the base of the 2N3439 transistor, switching it on and firing the 2N6509 thyristor. This effectively switches capacitor C2 across the battery, which discharges the capacitor into the battery. This feeds a substantial charging power pulse into the battery. As the capacitor voltage drops, the thyristor is starved of current and it turns off automatically. The charging sequence for the capacitor starts again with the next pulse from the windings of the motor.

The only other thing to be arranged is the triggering of the opto-isolator. This should be done at the peak of a positive voltage on the motor windings and has been built like this:



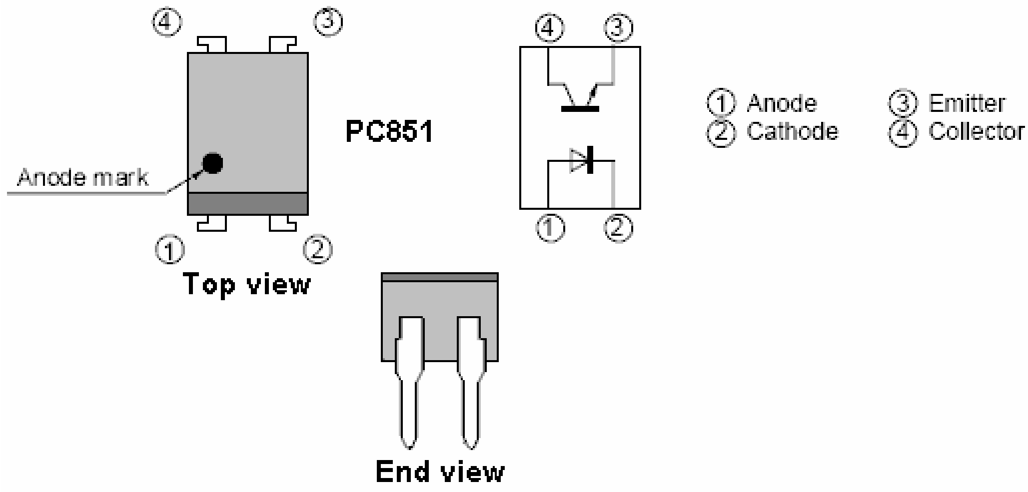
Here, we have the RotoVerter motor as before, with the voltage developed on C1 being used to trigger the opto-isolator at the appropriate moment. The voltage on C1 is sensed by the diode D2, the pre-set resistor VR1 and the resistor R1. These place a load of some 18.2K ohms on capacitor C1 as the neon has a very high resistance when not conducting. The ten-turn preset resistor is adjusted to make the neon fire at the peak of the voltage wave coming from the motor. Although the adjustment screw of most preset resistors is fully isolated from the resistor, it is recommended that adjustment of the screw be done using an insulated main-tester type of screwdriver, or a solid plastic trimmer-core adjustment tool.

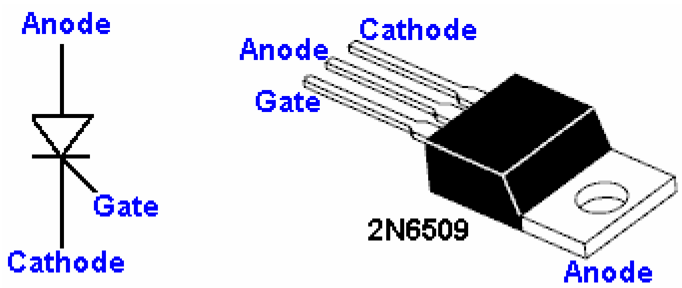
The circuit to test one half of the diode plug is then:



The switch SW1 is included so that the charging section can be switched off at any time and this switch should not be closed until the motor gets up to speed. All wire connections should be made before power is applied to the circuit. Capacitor C1 which is shown as 36 microfarads, has a value which is optimised for the particular motor being used and will normally be in the range 17 to 24 microfarads for a well-prepared motor. The motor used for this development was retrieved from a scrapyard and was not prepared in any way.

The value of capacitor C2 can be increased by experimenting to find at what value the resonance gets killed and the charging section starts drawing extra current from the supply. It should be noted that many new thyristors (Silicon Controlled Rectifiers or "SCR"s) are faulty when supplied (sometimes as many as half of those supplied can be faulty). It is therefore important to test the thyristor to be used in this circuit before installing it. The circuit shown below can be used for the testing, but it should be stressed that even if the component passes the test, that does not guarantee that it will work reliably in the circuit. For example, while 2N6509 thyristors are generally satisfactory, it has been found that C126D types are not. A thyristor passing the test may still operate unpredictably with false triggers.





Please note that the 2N6509 package has the Anode connected inside the housing to the metal mounting tab.

Components List:

Component	Quantity	Description
1K ohm resistor 0.25 watt	3	Bands: Brown, Black, Red
8.2K ohm resistor 0.25 watt	1	Bands: Gray, Red, Red
10K ohm preset resistor	1	Ten turn version
4.7 mF 440V (or higher) capacitor	1	Polypropylene
36 mF 440V (or higher) capacitor	1	Non-polarised polypropylene
1N5408 diode	1	
1N4007 diode	1	
2N3439 NPN transistor	1	
2N6509 thyristor	1	Several may be needed to get a good one
PC851 opto-isolator	1	
Neon, 6 mm wire-ended, 0.5 mA	1	Radiospares 586-015
5A fuse and fuseholder	1	Any convenient type
30A switch 1-pole 1-throw	1	Toggle type, 120-volt rated
Veroboard or similar	1	Your preferred construction board
4-pin DIL IC socket	1	Black plastic opto-isolator holder (optional)
Wire terminals	4	Ideally two red and two black
Plastic box	1	Injection moulded with screw-down lid
Mounting nuts, bolts and pillars	8	Hardware for 8 insulated pillar mounts
Rubber or plastic feet	4	Any small adhesive feet
Sundry connecting wire	4 m	Various sizes

When using and testing this circuit, it is important that all wires are connected securely in place before the motor is started. This is because high voltages are generated and creating sparks when making connections does not do any of the components any particular good. If the circuit is to be turned off while the motor is still running, then switch SW1 is there for just that purpose.

The operating technique is as follows:

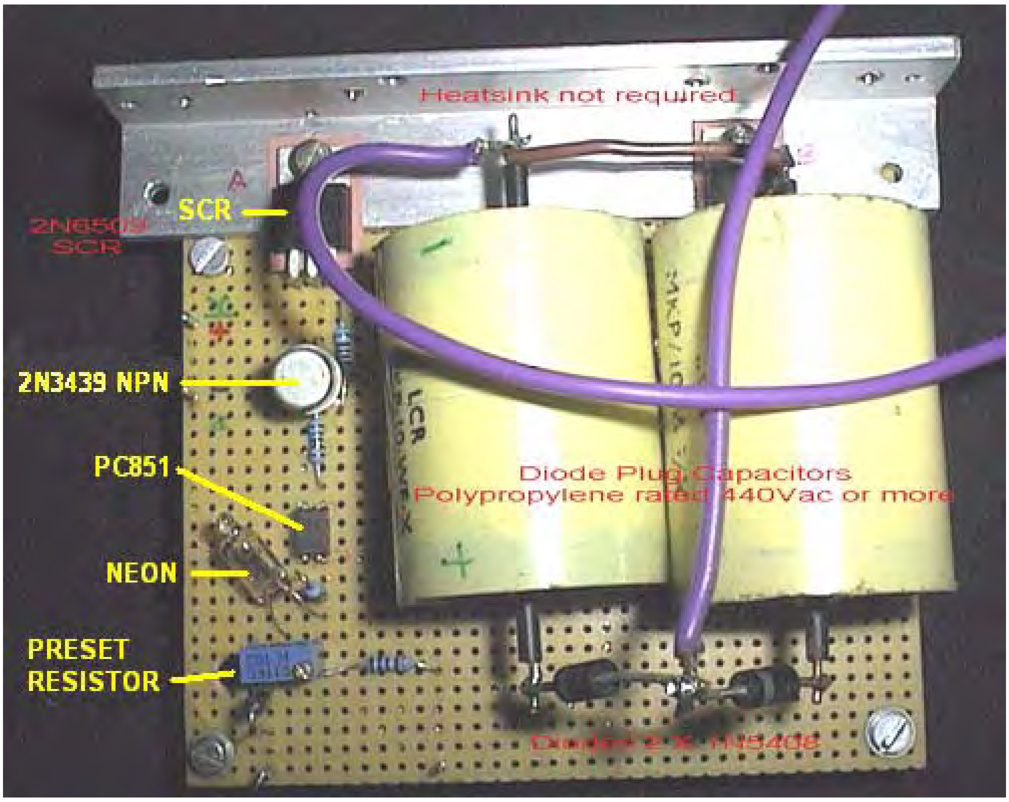
Before starting the motor, adjust the slider of the preset resistor VR1 to the fixed resistor end of it's track. This ensures that the charging circuit will not operate as the neon will not fire. Power up the circuit and start adjusting the preset resistor very slowly until the neon starts to flash occasionally. There should be no increased load on the motor and so no extra current drawn from the input supply.

If there is an increase in the load, you will be able to tell by the speed of the motor and the sound it makes. If there is an increase in the load, then back off VR1 and check the circuit construction. If there is no increased load, then continue turning VR1 slowly until a position is reached where the neon remains lit all the time. You should see the voltage across the battery being charged increase without any loading effects on the motor.

If you use an oscilloscope on this circuit, please remember that there is no "ground" reference voltage and that the circuit is not isolated.

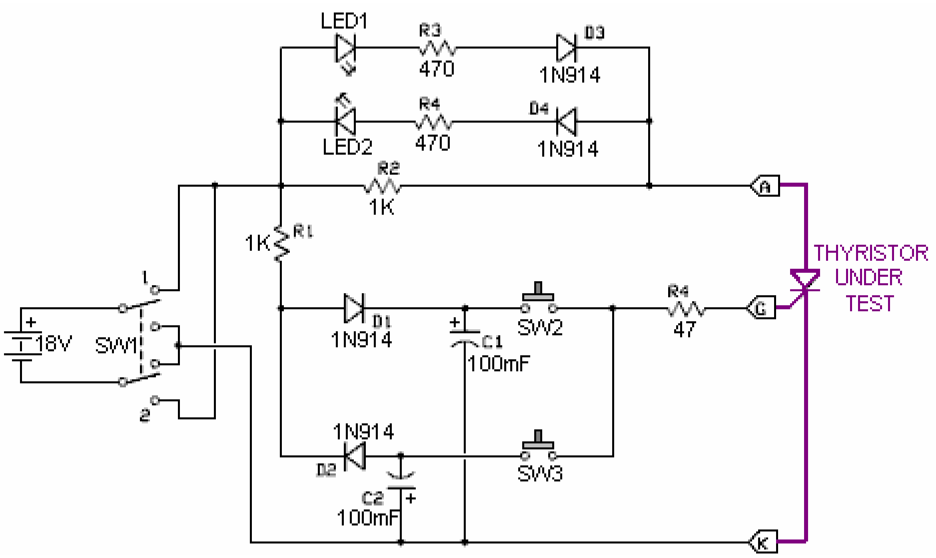
Here is a picture of David's actual board construction. There are various ways for building any circuit. This particular construction method uses plain matrix board to hold the components in position and the bulk of the interconnections are made underneath the board. The charge-collecting capacitor is made here from two separate polypropolene 440 volt capacitors wired in parallel. David has opted to use a separate diode on each capacitor as this has the effect of doubling the current-carrying capacity of a single diode and is a popular technique in pulse charge circuits where sometimes several diodes are wired in parallel.

David has included a heatsink, which he marks as being "not required" but you will notice that there is insulation between the SCR and the heatsink. Mica "washers" available from the suppliers of semiconductors are particularly good for this, as mica is a good insulator and it also conducts heat very well.



Thyristor testing:

The components needed to construct the thyristor testing circuit shown below can be bought as Kit number 1087 from www.QuasarElectronics.com



The circuit is operated by operating SW1 several times so as to get capacitors C1 and C2 fully charged. LED1 and LED2 should both be off. If either of them light, then the thyristor is faulty.

Next, with SW1 at it's position 1, press switch SW2 briefly. LED1 should light and stay on after SW2 is released. If either of these two things does not happen, then the thyristor is faulty.

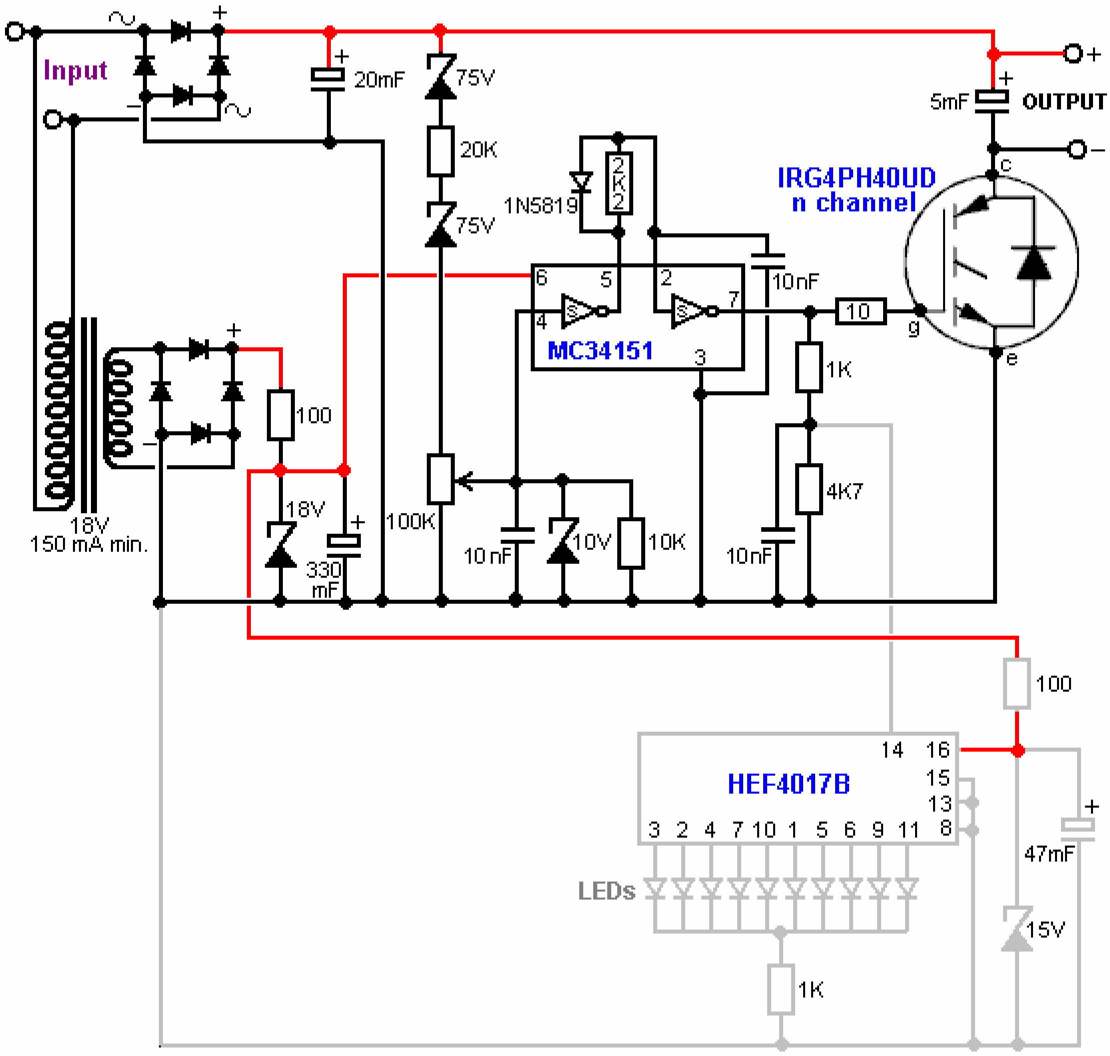
With LED1 lit, press SW3 and LED1 should go out. If that does not happen, then the thyristor is faulty.

As mentioned before, even if the thyristor passes these tests it does not guarantee that it will work correctly in any circuit as it may operate intermittently and it may trigger spuriously when it shouldn't.

Component list:

Component	Quantity	Description
47 ohm resistor 0.25 watt	1	Bands: Purple, Yellow, Black
470 ohm resistor 0.25 watt	2	Bands: Purple, Yellow, Brown
1K ohm resistor	2	Bands: Brown, Black, Red
100 mF 15V capacitor	2	Electrolytic
1N914 diode	4	
Light Emitting Diode	2	Any type, any size
Toggle switch 2-pole 2-throw	1	
Press-button Push-to-Make	2	Non-latching press-on, release off type
9V battery	1	Any type
Battery connector	1	To match chosen battery
Socket	1	Plug-in socket for thyristors
Veroboard or similar	1	Your preferred construction board
Plastic box	1	Injection moulded with screw-down lid
Mounting nuts, bolts and pillars	8	Hardware for 8 insulated pillar mounts
Rubber or plastic feet	4	Any small adhesive feet
Sundry connecting wire	4 m	Various sizes

Phil Wood has developed a particularly effective method for extracting the excess resonant circulating energy of a RotoVerter Prime Mover. This is the circuit:



Care needs to be taken when constructing this circuit. For example, the circuit performance is displayed by an HEF4017B 5-stage Johnson counter, but for some lunatic reason, the 4017 designation is also used for a completely different chip of the same size and number of DIL pins, namely the "CMOS high-speed hex flip-flop with Reset", an action definitely worthy of a stupidity award. Another point to watch out for is that the 1A 1N5819 diode is a very high-speed Schottky barrier component.

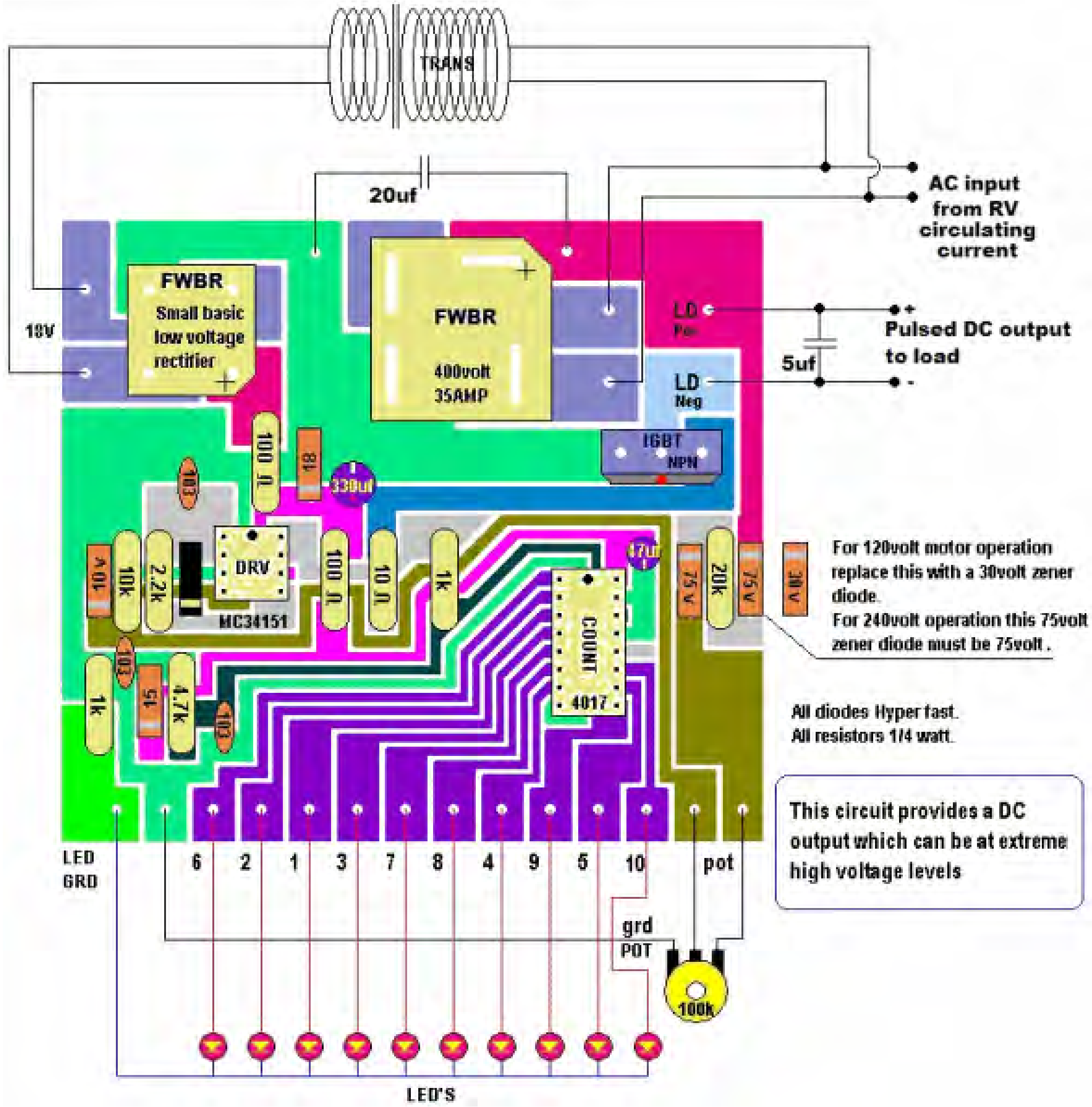
The circuit operation is as follows:

The input from the RotoVertor motor is stepped-down by a transformer to give an 18-volt (nominal) AC output, which is then rectified by a standard rectifier bridge and the output smoothed by an 18-volt zener diode and a 330mF smoothing capacitor, and used to power the MC34151 chip. This DC power supply line is further dropped and stabilised by a 15-volt zener diode and a 47mF capacitor and used to power the LED display chip HEF4017B.

The raw RotoVerter input is also taken direct and rectified by a second 400-volt 35-amp rectifier diode bridge and smoothed by a 20mF capacitor with a high voltage rating. It must be understood that the RotoVerter system is liable to produce considerable power surges from time to time and so this circuit must be capable of handling and benefiting from these surges. This is why the IRG4PH40UD IGBT device was selected (apart from it's very reasonable price) as it robust and can handle high voltages.

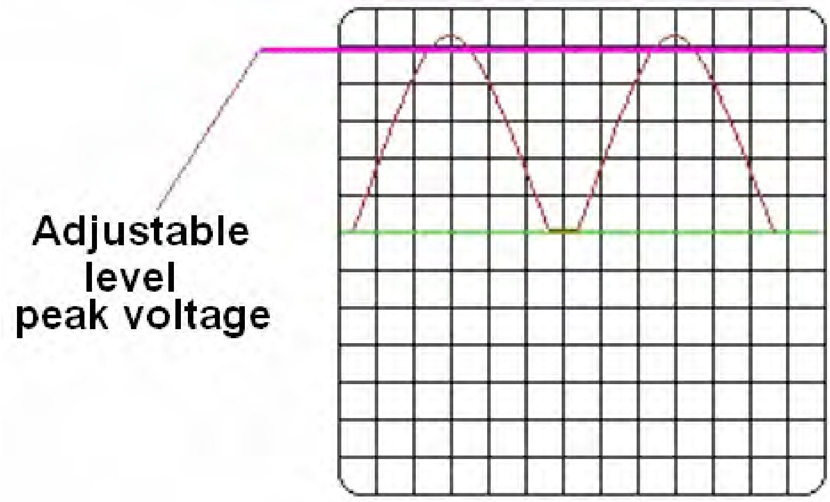
The resulting high-voltage DC is taken by the chain of components two 75-volt zener diodes, 20K resistor and the 100K variable resistor. The voltage developed on the slider of this variable resistor is loaded with a 10K resistor and voltage-limited with a 10-volt zener diode, and decoupled with a 10nF capacitor before being passed to the MC34151 high-speed MOSFET dual driver chip. Both of these drivers are used to sharpen up the pulse and drive the IGBT cleanly. The result is an output which is a series of DC pulses. The operation of the circuit can be seen quite clearly, thanks to the HEF4017B display circuit which drives a row of LEDs, triggered by the IGBT gate signal, divided by the 1K / 4.7K voltage divider decoupled by the 10nF capacitor. This display shows clearly when the IGBT is switching correctly - actually, the display circuit is quite a useful device for people who do not own an oscilloscope, not just for this circuit, but a wide range of different circuits.

The physical board layout for Phil's circuit is shown here:

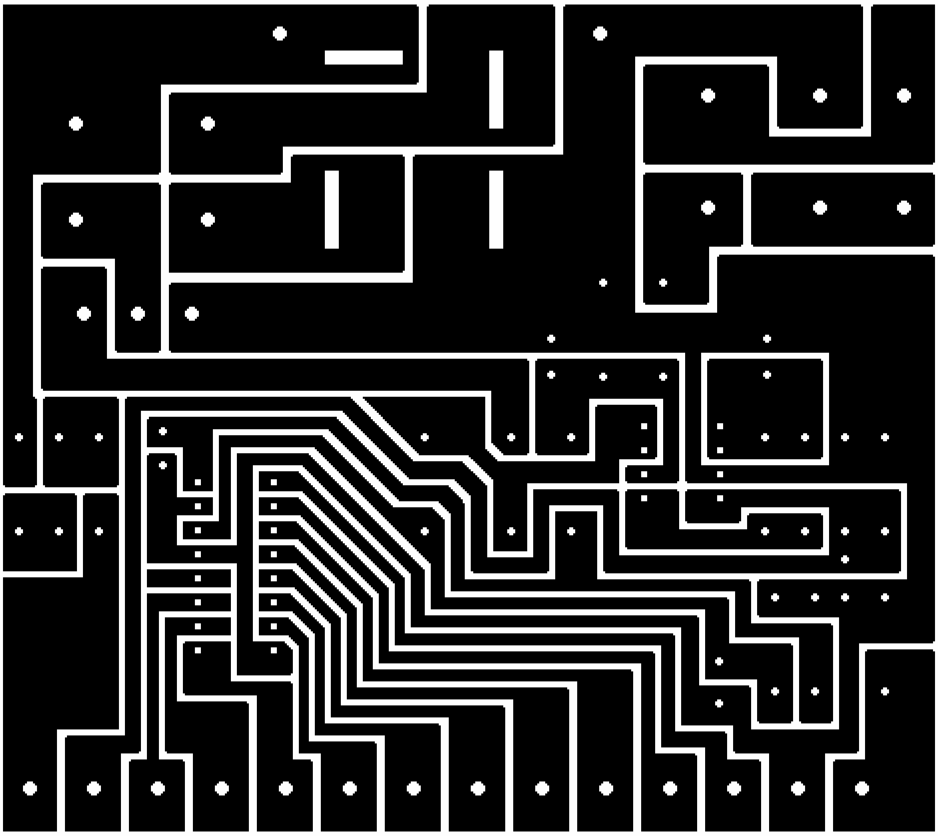


As you will notice from the notes on Phil's board layout shown above, the first of the 75-volt zener diodes used on the direct RotoVerter power feed, should be replaced with a 30-volt zener if a 120-volt motor is used in this circuit.

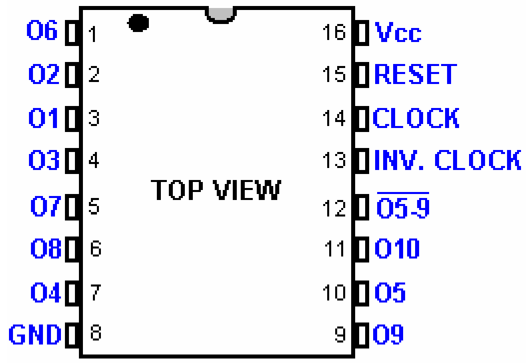
Another important point which needs to be stressed, is that the pulsed DC output from this circuit can be at extremely high voltages and needs to treated with considerable care. This is not a circuit for beginners and anyone who is not familiar with handling high voltages needs the supervision of an experienced person. Also, if either this circuit or the RotoVerter is connected to the mains, then no scope ground leads should be connected as the circuit can be a hundred volts or more below ground potential.



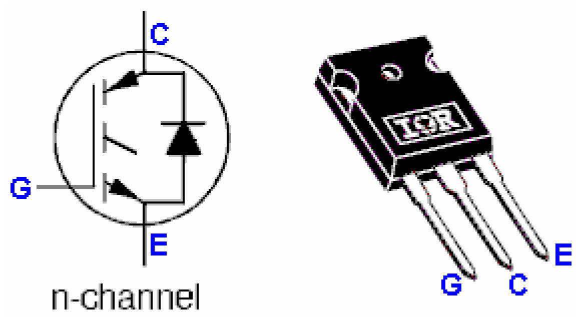
The pattern of the printed-circuit board when viewed from the underside of the board is shown here:



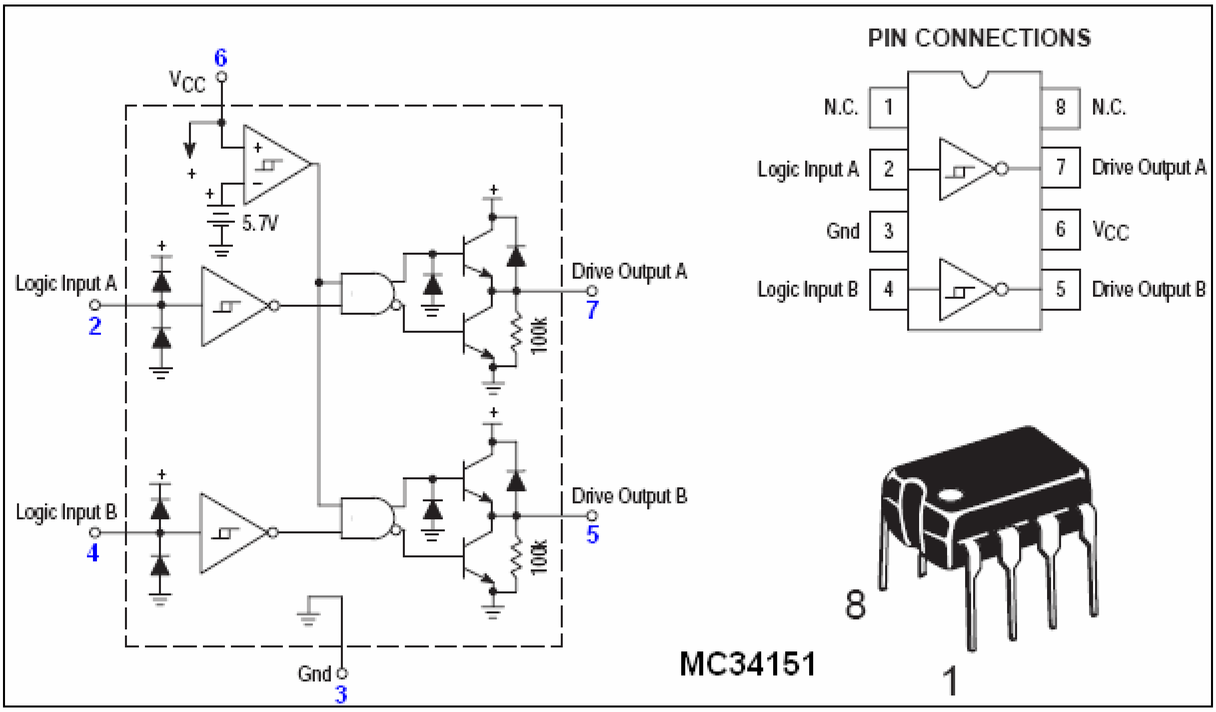
And component packaging is:



HEF4017B



IRG4PH40UD



Phil’s build of his circuit was implemented like this:

Component List:

Component	Quantity	Description
10 ohm resistor 0.25 watt	1	Bands: Brown, Black, Black
100 ohm resistor 0.25 watt	2	Bands: Brown, Black, Brown
1K ohm resistor 0.25 watt	2	Bands: Brown, Black, Red
2.2K ohm resistor 0.25 watt	1	Bands: Red, Red, Red
4.7K ohm resistor 0.25 watt	1	Bands: Purple, Yellow, Red
10K ohm resistor 0.25 watt	1	Bands: Brown, Black, Orange
22K ohm resistor 0.25 watt	1	Bands: Red, Red, Orange
10nF capacitor	3	
5mF 440V (or higher) capacitor	1	Polypropolene
20mF 440V (or higher) capacitor	1	Polypropolene
47mF 25V capacitor	1	
330 mF 25V capacitor	1	
1N5819 Schottky barrier diode	1	
10-volt zener diode	1	
15-volt zener diode	1	
18-volt zener diode	1	
75-volt zener diode	2	
400-volt, 40 A rectifier bridge	1	
35-volt 1 A rectifier bridge	1	
MC34151 IC	1	
HEF4017B IC	1	
IRG4PH40UD transistor	1	
LEDs	10	Any type or alternatively, an LED array
100K ohm variable resistor	1	
Plastic knob for variable resistor	1	
240:18 volt mains transformer	1	150 mA or higher rated
10A switch 1-pole 1-throw	1	Toggle type, 120-volt rated
Veroboard or similar	1	Your preferred construction board or pcb
Wire terminals	4	Ideally two red and two black
Plastic box	1	Injection moulded with screw-down lid
Mounting nuts, bolts and pillars	8	Hardware for 8 insulated pillar mounts
Rubber or plastic feet	4	Any small adhesive feet
Sundry connecting wire	4 m	Various sizes

****

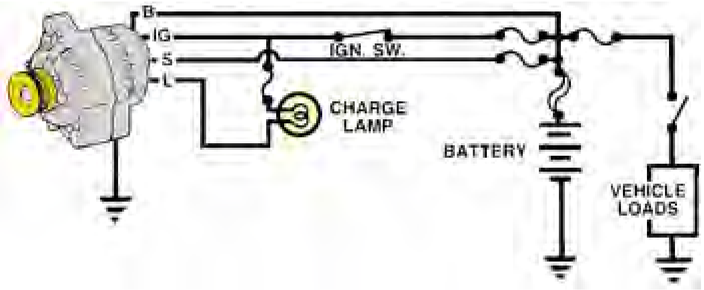
It is felt that some specific information on alternators would be helpful at this point. My thanks goes to Professor Kevin R. Sullivan, Professor of Automotive Technology, Skyline College, San Bruno, California, who has given his kind permission for the reproduction of the following training material from his excellent web site at http://www.autoshop101.com/ which I recommend that you visit. The following material is his copyright and All Rights are Reserved by Professor Sullivan.

UNDERSTANDING THE ALTERNATOR

The Charging System

A vehicle charging system has three major components: the **Battery**, the **Alternator**, and the **Regulator**. The alternator works together with the battery to supply power when the vehicle is running. The output of an alternator is direct current (DC), however the alternator actually creates AC voltage which is then converted to DC as it leaves the alternator on its way to charge the battery and power the other electrical loads.

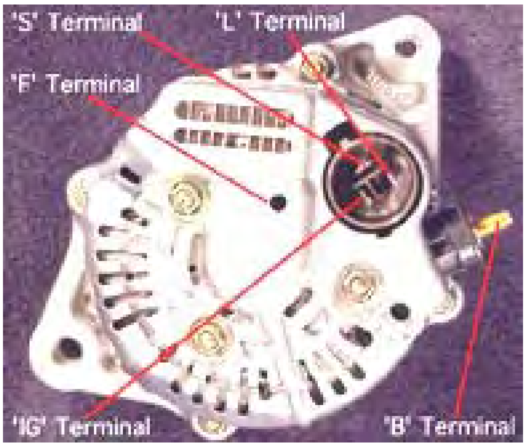
The Charging System Circuit



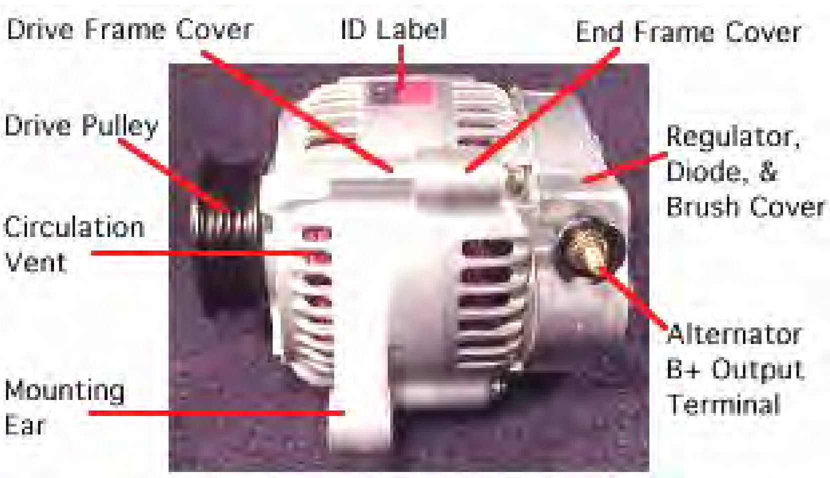
Four wires connect the alternator to the rest of the charging system:

'**B**' is the alternator output wire that supplies current to the battery.
'**IG**' is the ignition input that turns on the alternator/regulator assembly.
'**S**' is used by the regulator to monitor charging voltage at the battery.
'**L**' is the wire the regulator uses to ground the charge warning lamp.

Alternator Terminal ID's



'**S**' terminal: Senses the battery voltage
'**IG**' terminal: Ignition switch signal turns regulator ON
'**L**' terminal: Grounds warning lamp
'**B**' terminal: Alternator output terminal
'**F**' terminal: Regulator Full-Field bypass
The Alternator Assembly



Alternator Overview:

The alternator contains:

A rotating field winding called **the rotor**.

A stationary induction winding called **the stator**.

A diode assembly called **the rectifier bridge**.

A control device called **the voltage regulator**.

Two **internal fans** to promote air circulation

Alternator Design

Most regulators are on the inside the alternator. Older models have externally mounted regulators.

Unlike other models, this model can be easily serviced from the rear of the unit. The rear cover can be removed to expose internal parts.

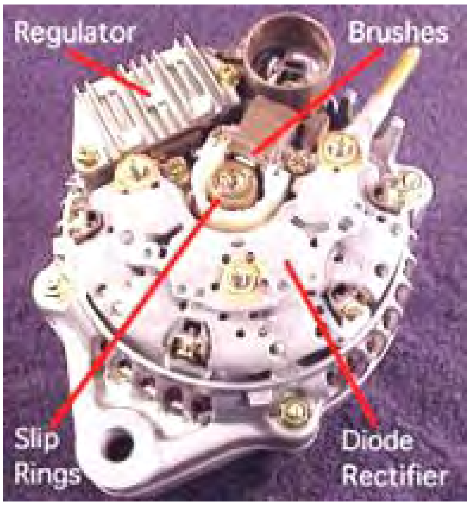
However, today's practice is to replace the alternator as a unit, should one of it's internal components fail.

Drive Pulley

Alternator drive pulleys either bolt on or are pressed on the rotor shaft. Both 'V' and Multi-grove types are used. Please note this alternator does not have an external fan as part of the pulley assembly.

While many manufacturers do use a external fan for cooling. This alternator has two internal fans to draw air in for cooling.

Inside the Alternator



Removal of the rear cover reveals:

The Regulator which controls the output of the alternator.

The Brushes which conduct current to the rotor field winding.

The Rectifier Bridge which converts the generated AC voltage to a DC voltage.

The Slip Rings (part of the rotor assembly) which are connected to each end of the field winding.

Brushes

Two slip rings are located on one end of the rotor assembly. Each end of the rotor field winding is attached to a slip ring. This, allows current to flow through the field winding.

Two stationary carbon brushes ride on the two rotating slip rings. These bushes are either soldered or bolted in position.

Electronic IC Regulator

The regulator is the brain of the charging system. It monitors both the battery voltage and the stator voltage and, depending on the measured voltages, it adjusts the amount of rotor field current so as to control the output of the alternator.

Regulators can be mounted in an internal or an external position. Nowadays, most alternators have a regulator which is mounted internally.

Diode Rectifier

The **Diode Rectifier Bridge** is responsible for the conversion or rectification of AC voltage to DC voltage.

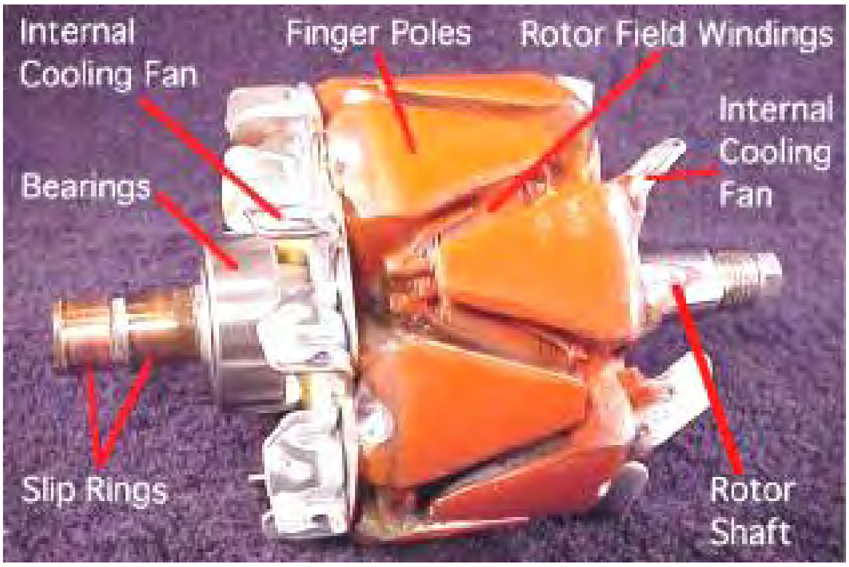
Six or eight diodes are used to rectify the AC stator voltage to DC voltage. Half of these diodes are used on the positive side and the other half on the negative side.

Inside the Alternator

Opening the case reveals:

The **rotor winding assembly** which rotates inside the **stator winding**. The rotor generates a magnetic field and the stator winding develops voltage, which causes current to flow from the induced magnetic field of the rotor.

The Rotor Assembly



A basic rotor consists of an **iron core**, a **coil winding**, two **slip rings**, and two claw-shaped **finger pole pieces**. Some models have support bearings and one or two internal cooling fans.

The rotor is driven or rotated inside the alternator by an engine (alternator) drive belt.

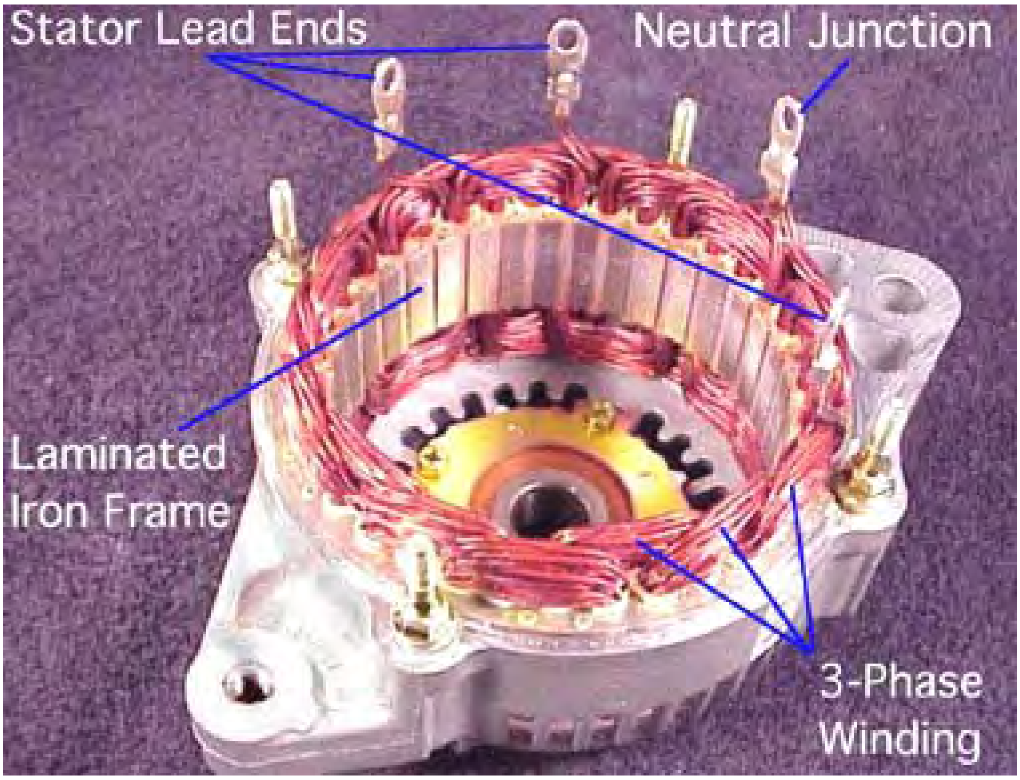
The rotor contains the field winding wound over an iron core which is part of the shaft. Surrounding the field coil are two claw-type finger poles. Each end of the rotor field winding is attached to a slip ring. Stationary brushes connect the alternator to the rotor. The rotor assembly is supported by bearings. One on the shaft and the other in the drive frame.

Alternating Magnetic Field

The rotor field winding creates the magnetic field that induces voltage in the stator. The magnetic field saturates the iron finger poles. One finger pole becomes a North pole and the other a South pole.

The rotor spins creating an alternating magnetic field, North, South, North, South, etc.

Stator Winding

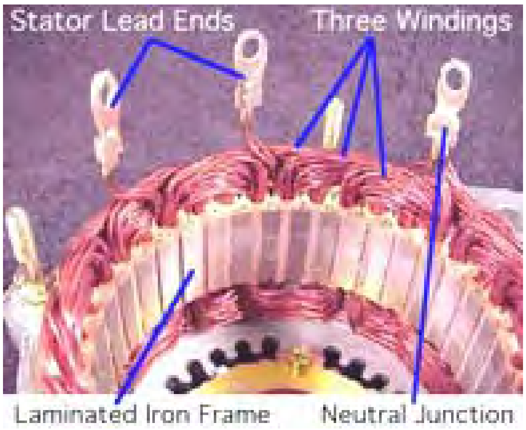


The stator winding looks like the picture above.

Rotor / Stator Relationship

As the rotor assembly rotates within the stator winding: The alternating magnetic field from the spinning rotor induces an alternating voltage into the stator winding. The strength of the magnetic field and the speed of the rotor affect the amount of voltage induced in the stator.

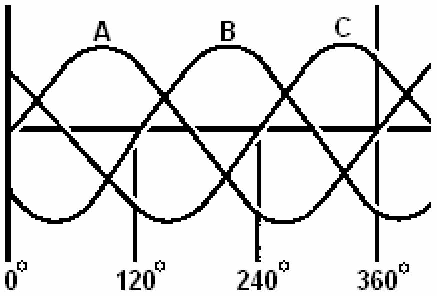
Stator Windings



The stator is made with three sets of windings. Each winding is placed is a different position compared with the others. A laminated iron frame concentrates the magnetic field. Stator lead ends output current to the diode rectifier bridge.

The Neutral Junction in the Wye design can be identified by the 6 strands of wire.

3-Phase Windings



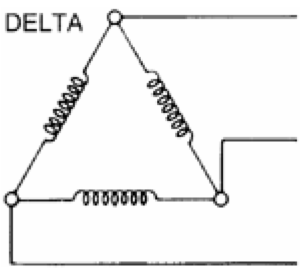
The stator winding has three sets of windings. Each winding is formed into a number of evenly spaced coils around the stator core.

The result is three overlapping single-phase AC sine-wave current peaks, A, B, C.

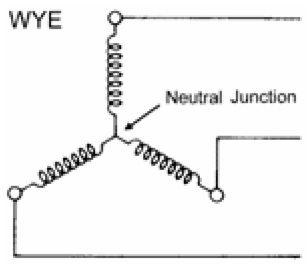
These waves add together to make up the total AC output of the stator. This is called three-phase current.

Three-phase current provides a more even current output than a single-phase output would do.

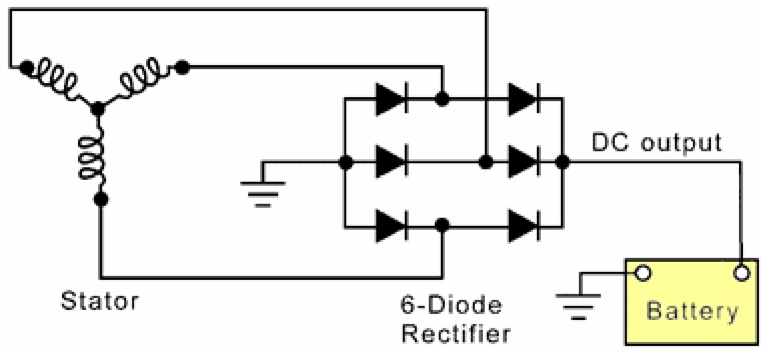
Stator Designs



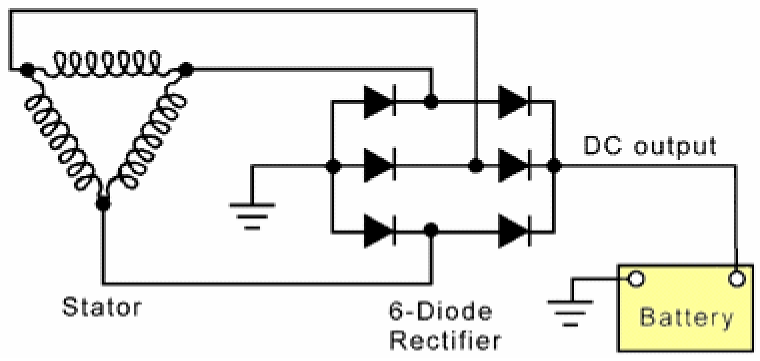
Delta-wound stators can be identified by having only three stator leads, and each lead will have the same number of wires attached.



Wye-style stators have four leads. One of the leads is called the Neutral Junction. The Neutral Junction is common to all the other leads.

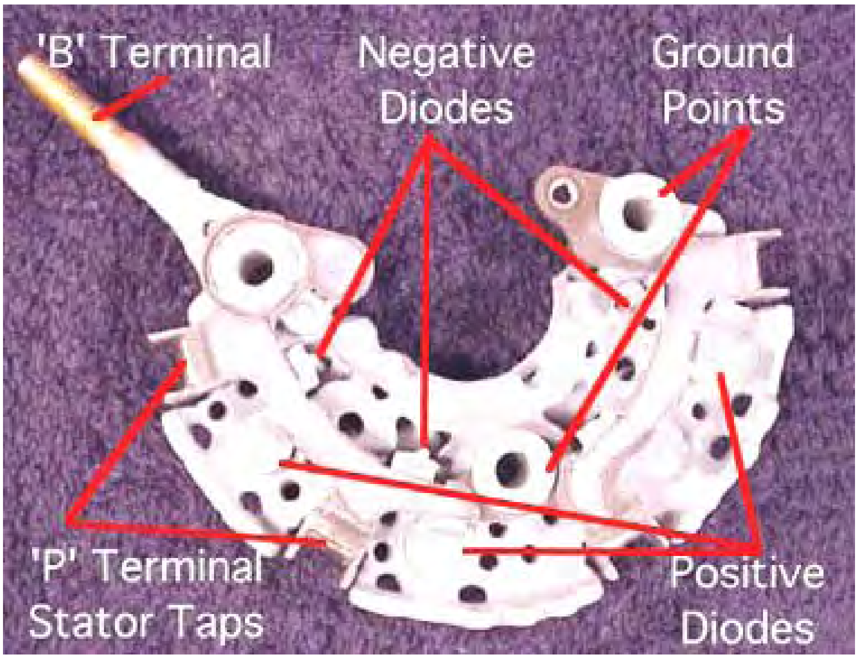


Wye-wound stators have three windings with a common neutral junction. They can be identified because they have 4 stator lead ends. Wye wound stators are used in alternators that require high-voltage output at low alternator speeds. Two windings are in series at any one time during charge output.

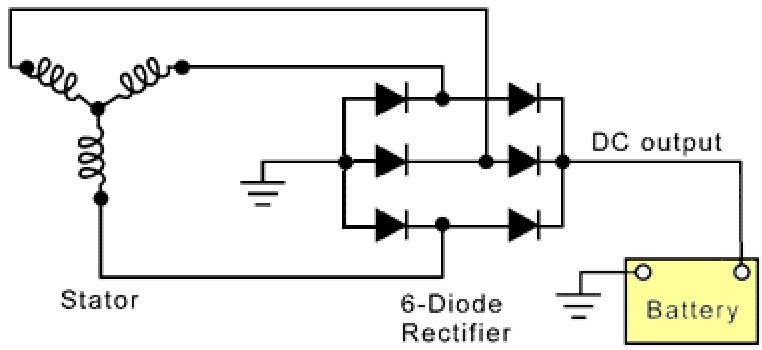


Delta-wound stators can be identified because they have only three stator lead ends. Delta stators allow for higher current flow being delivered at low RPM. The windings are in parallel rather than in series as the Wye designs have.

Diode Rectifier Bridge Assembly



Rectifier Operation:



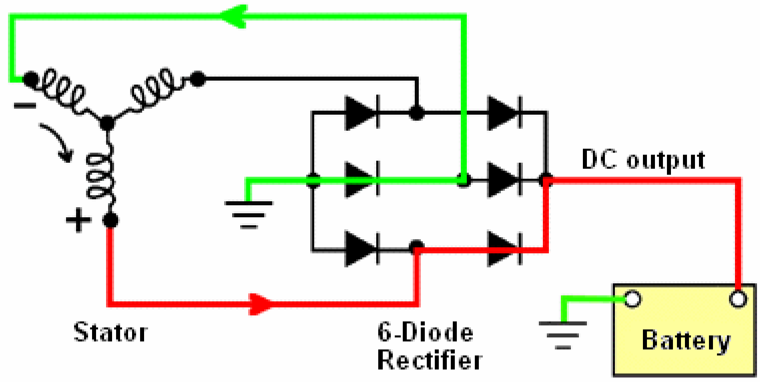
Two diodes are connected to each stator lead. One positive the other negative. Because a single diode will only block half of the AC voltage, six or eight diodes are used to rectify the AC stator voltage to DC voltage.

Diodes used in this configuration will redirect both the positive and negative parts of the AC voltage in order to produce a better DC voltage waveform. This process is called 'Full - Wave Rectification'.

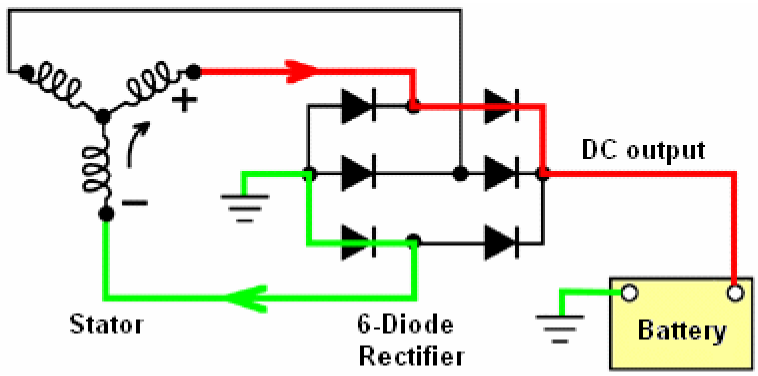
Diodes

Diodes are used as one-way electrical check valves. They pass current in only one direction, and never in the other direction. Diodes are mounted in a heat sink to dissipate the heat generated by the current flow. Diodes redirect the AC voltage and convert it into DC voltage, so the battery receives the correct polarity.

<u>Rectifier Operation:</u>

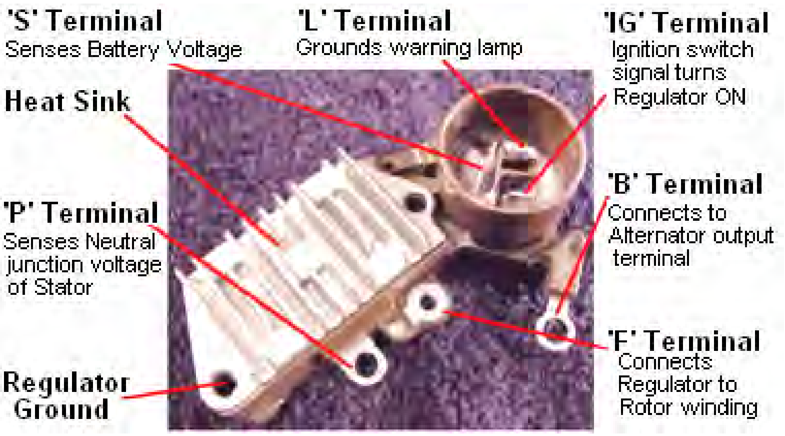


The red path is the positive current passing through the rectifier as it goes to the positive battery terminal. The path shown in green completes the circuit.



As the rotor continues its movement, the voltages generated in the three windings, change in polarity. The battery is still fed current, but now a different winding feeds it. Again, the red path shows the current flow to the battery and the green path shows how the circuit is completed. The same charging continues even though different windings and diodes are being used.

Electronic Regulator



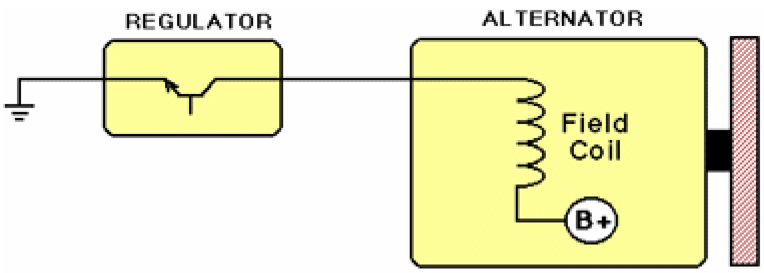
The regulator attempts to maintain a set charging voltage. If the charging voltage falls below this point, the regulator increases the field current, which strengthens the magnetic field, resulting in a raising of the alternator output voltage.

If the charging voltage rises above this point, the regulator decreases the field current , thus weakening the magnetic field, producing a lowering of the alternator output voltage.

Regulator Types:

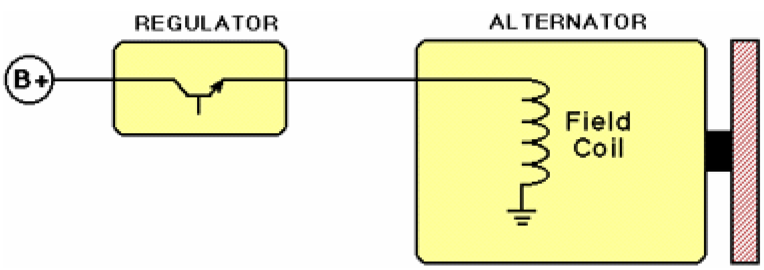
Two regulator designs can be used. The first type is:

The **Grounded Regulator** type. This type of regulator controls the amount of current flowing through the battery ground (negative) into the field winding in the rotor:

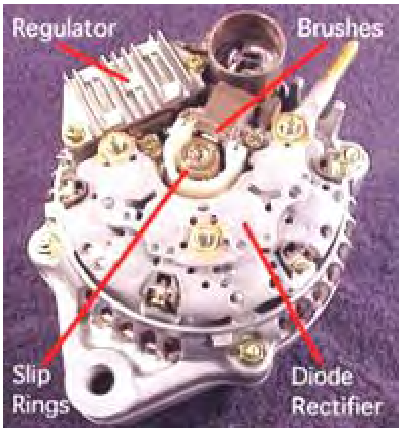


The second type is:

The **Grounded Field** type. This type of regulator controls the amount of current flowing from the Battery Positive ('B+') into the field winding in the rotor.



The Working Alternator



The **regulator** monitors battery voltage and controls current flow to the rotor assembly.

The **rotor** produces a magnetic field.

Voltage is induced in the **stator windings**.

The **rectifier bridge** converts the AC stator voltage to DC output voltage for use by the vehicle.

Patrick Kelly
engpjk@gmail.com
http://www.free-energy-info.co.uk
http://www.free-energy-info.com