

A Practical Guide to 'Free Energy' Devices

Devices Part 15: Last updated: 11th November 2007

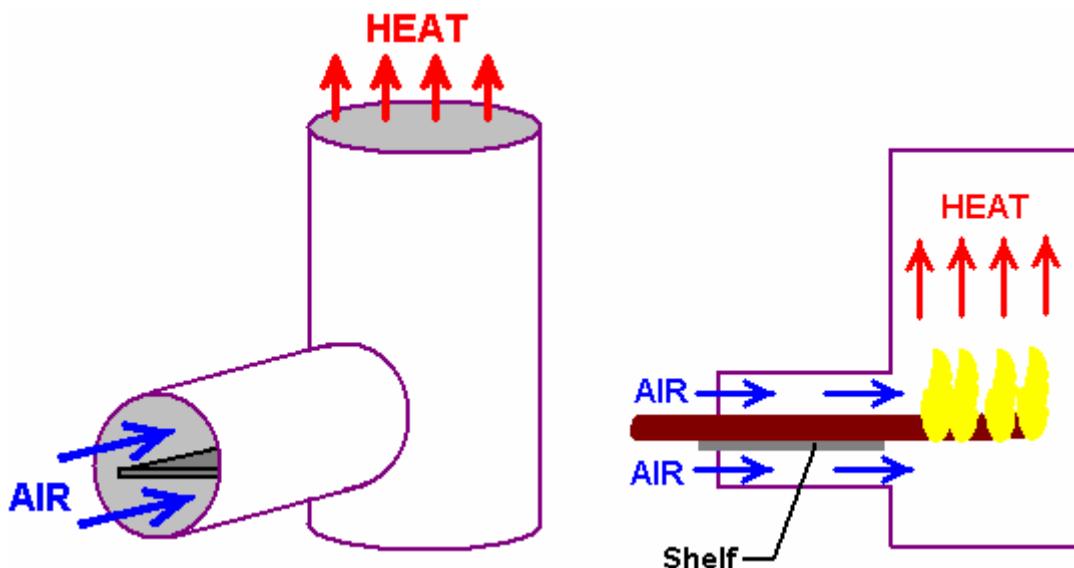
Author: Patrick J. Kelly

Should you choose to build or experiment with any of the devices described in this document, please understand that you do so wholly at your own risk. The author of this document claims all responsibility for any injury or damage which may arise as a result of your actions.

Heaters

The devices described here are probably not "free-energy" devices as such, but in spite of that, it is an area of considerable interest to many people, and the subject is included here because of that.

If you do not live in an urban area, then a solid fuel stove can be an economic solution, especially if the fuel can be collected free from wooded areas. Stove design has advanced considerably and it is now possible to make a simple stove with very high efficiency and very low emissions as shown here:



Although this stove is a very simple construction, its efficiency is very high indeed. The best fuel is made of smaller pieces which rest on a simple shelf. Branches work better than large pieces of wood as the consumption is more complete. As the fuel is consumed, it is pushed further into the stove, which gives the user an appreciation of the rate of consumption. Having the fuel resting on a shelf has the major advantage of allowing air to flow both above it and below it, which gives improved combustion. The operation is said to be so good that there is virtually no residue and no emissions.

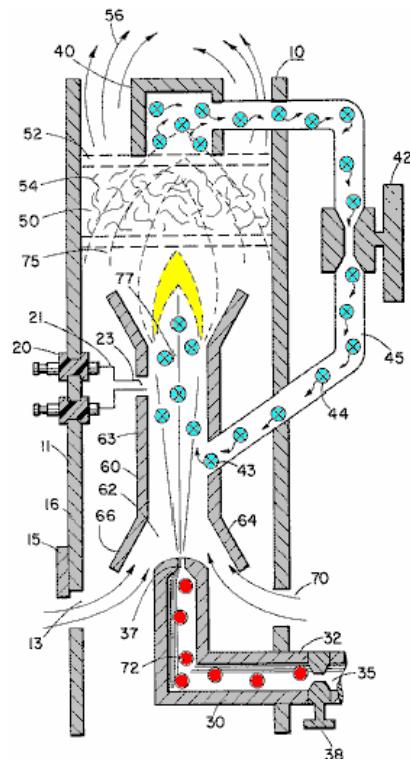
Again, if land space is available, a solar oven (or Stirling motor) can be used, either to store energy for later use or generate heat for cooking or home heating, as can hot-water solar panels. However, it is only realistic to consider the application to be during the night in a built-up area with little or no spare space for equipment.

Electrical heating, while very convenient, is usually expensive, and it often seems that the effectiveness of an electric heater is not directly related to its power consumption. In theory it definitely is, but in practice it just does not seem that way. There are other alternatives.

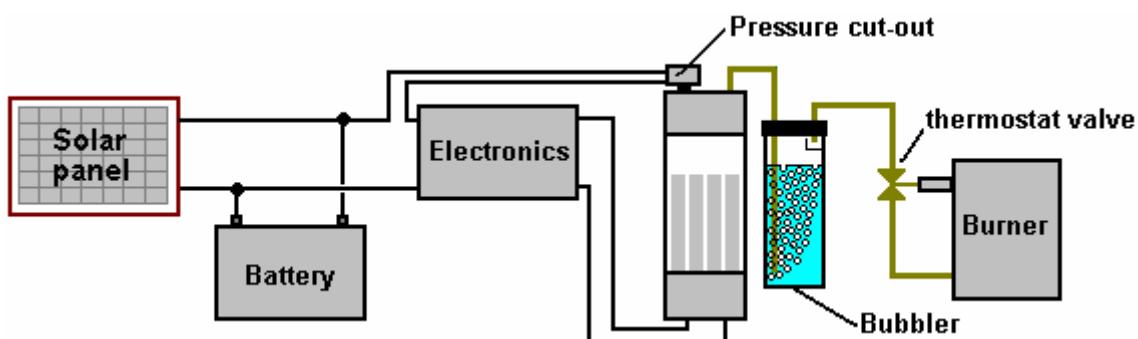
One of the other documents in this set, shows how to construct a Stanley Meyer style electrolyser which uses ordinary tap water and splits it into burnable fuel using just a low power electrical input:



The difficulty in creating a heating system which uses the gas produced by this unit, is in the very high temperature produced when the gas is burnt. Stan overcame this problem with by designing a special burner which mixes air and burnt gasses in with the gas before it is burnt. That lowers the flame temperature to a level which is suitable for heating and cooking:



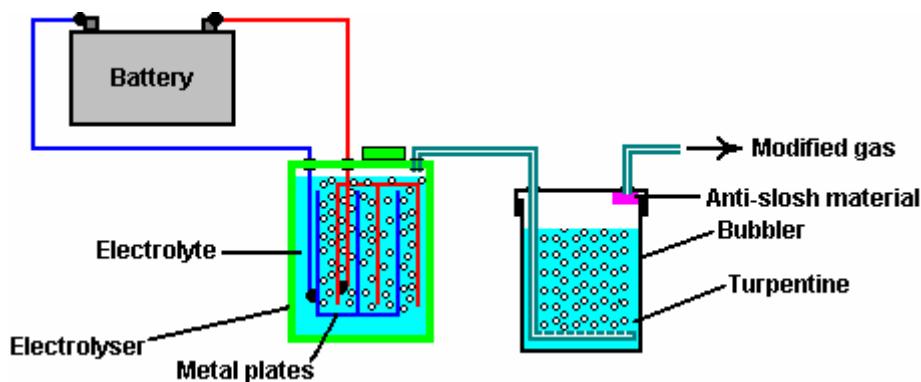
While this looks a bit complicated, its construction is really quite simple. The combination of the Meyer electrolyser and Meyer burner form a system which has the potential of being operated from a solar panel and battery as shown here:



A system like this needs extreme care as the hydrogen / oxygen ("hydroxy") gas produced is explosive. So:

1. It is very important that the electrolyser has the ability to provide sufficient gas to keep the flame(s) sustained.
2. The electrolyser must be fitted with a pressure switch, typically operating at 5 pounds per square inch or so. This is included so that should the gas usage drop, then the drive from the electronics is cut off to stop further gas production, and incidentally, stopping the current draw from the battery.
3. It is absolutely essential that there be a flame-operated valve on the gas supply line to the burner, so that should the flame go out for any reason whatsoever, then the gas supply will be cut off. This type of valve is common on town-gas operated fires for use in homes.

There is an alternative method which it is claimed can convert the explosive hydroxy gas into a much more docile fuel, more suited to conventional burners and stoves. It must be stressed that this system is over 120 years old and it should not be used until you have carried out careful tests on it. The method was patented by Henry M. Paine in US Letters Patent No. 308,276 dated 18th November 1884 and it is very simple:

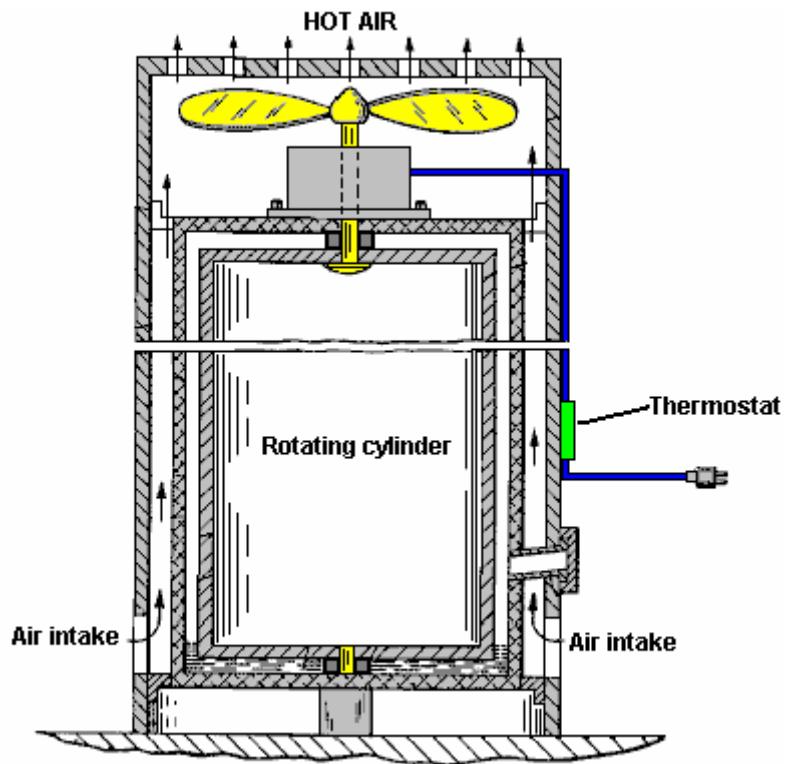


The idea is to bubble the hydroxy gas produced by electrolysis of water, through a liquid hydrocarbon such as turpentine. The bubbler should have a large number of small holes in the incoming tube, so that a very large number of small bubbles of hydroxy gas pass through the hydrocarbon. This brings the majority of the hydroxy gas into intimate contact with the hydrocarbon and the process is claimed to convert the hydroxy gas into a new variety of gas which is not explosive, can be stored for later use, and which burns with the same characteristics as coal-gas ("town gas").

At this point in time, I do not know of any recent tests to confirm this, so the claim should be treated with caution and careful tests carried out in the open, lighting the gas remotely and taking refuge behind a robust protective object. Having said that, in my opinion, it is highly likely that Henry Paine's claim is correct in every respect, but that is only my opinion and I have not confirmed it with any form of practical test,

Electric power is very popular for heaters. However, with most appliances, it is a very expensive form of heating. There is a technique which is reputed to improve the efficiency and lower the cost of electric heating. This method involves rotating a cylinder inside an outer cylinder and filling part of the narrow space between the cylinders with some variety of light oil.

This method has been patented more than once. In 1979, Eugene Frenette was granted patent 4,143,639 where a single motor is used to rotate the drum and power a fan to boost the motion of the hot air:

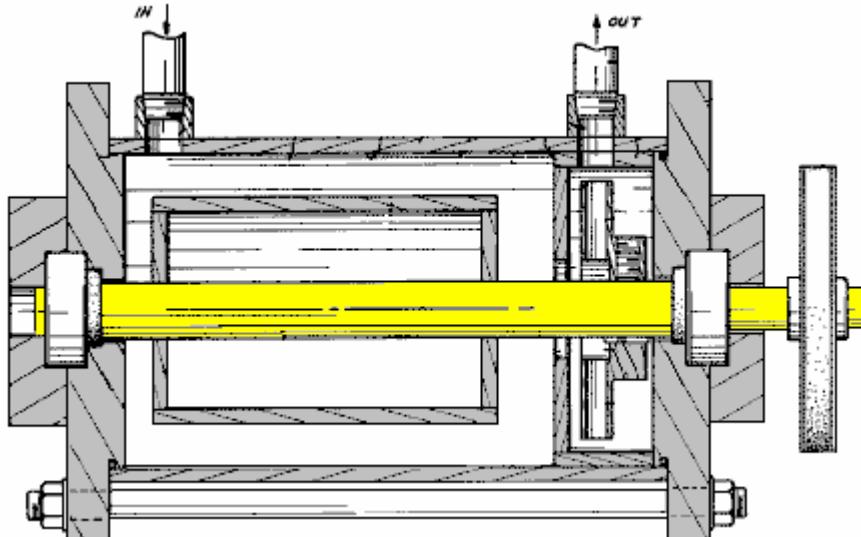


It is not immediately obvious why this arrangement should work well, but it appears that it does. As the inner drum spins around, the oil rises up between the two inner cylinders. It lubricates the bearing under the rotating drum and the rotation causes the oil to heat up. This heats the middle cylinder and air being drawn up around it by the action of the fan blade, is also heated before being pushed out of the top of the heater. After a few minutes, the outer housing becomes so hot that the thermostat attached to it, cuts off the electrical supply.

The heater does not stop heating at this time as air continues to circulate through the heater by ordinary convection. In my opinion, it would be more effective if the fan motor were operated independently and did not cut off when the heater reaches its operating temperature.

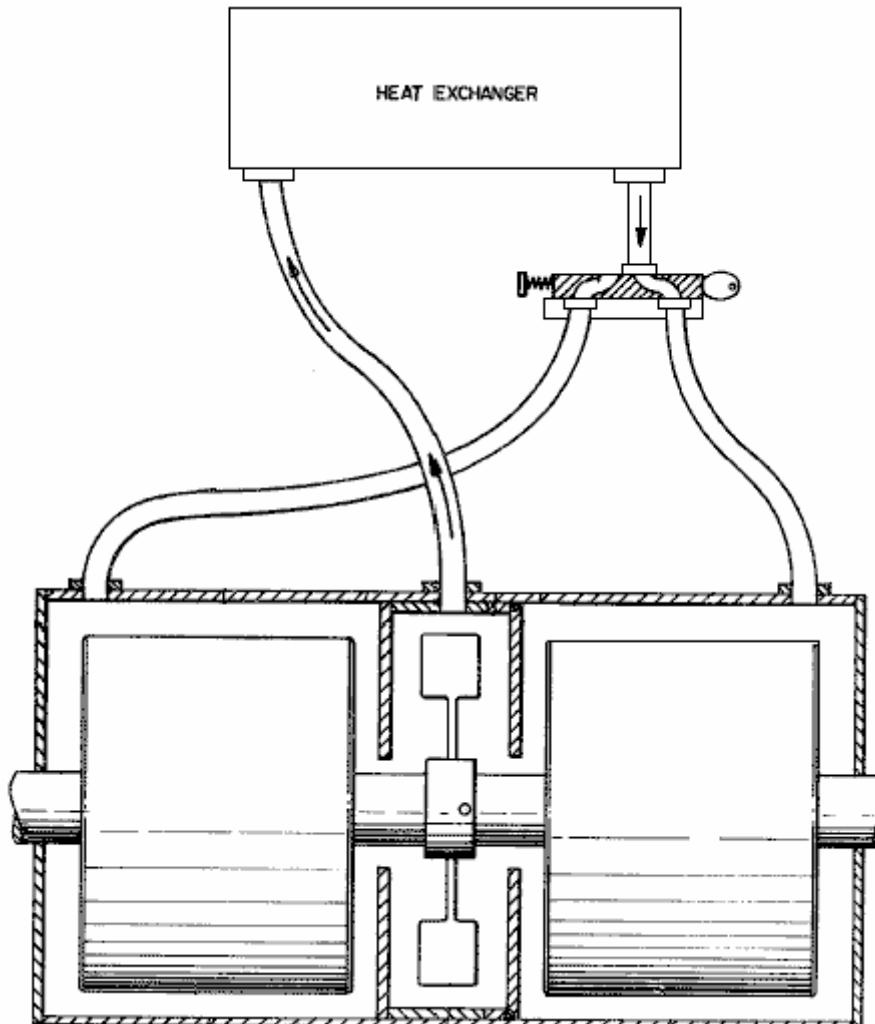
Very similar systems were patented by Eugene Perkins: January 1984 patent 4,424,797, November 1984 patent 4,483,277, March 1987 patent 4,651,681, October 1988 patent 4,779,575, and in January 1989 patent 4,798,176.

His first patent shows a horizontal drum which is completely immersed in the liquid:



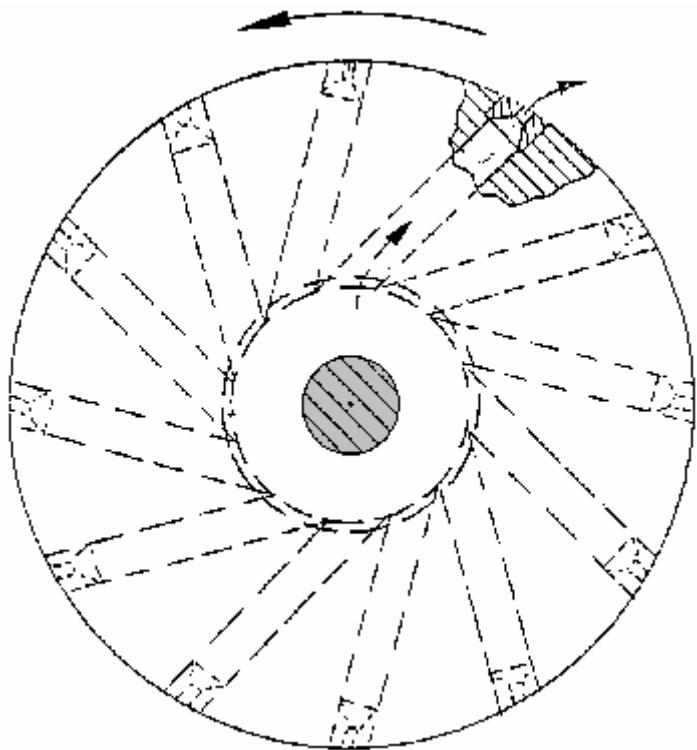
This calls for a much greater accuracy of construction in that the liquid has to be contained even though it has a rotating shaft running through the housing. This device pumps the heated liquid through central-heating piping and radiators.

In his later patent of the same year, he shows a modified version with two drums and an impeller:



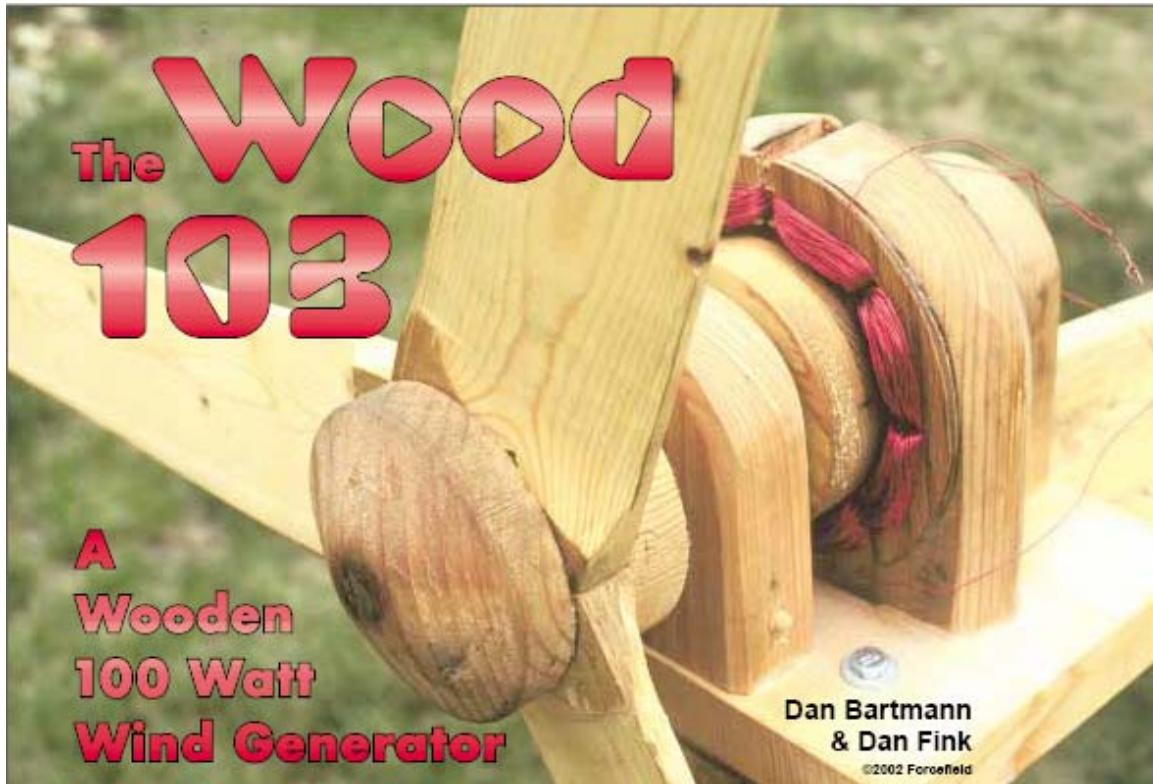
The "heat exchanger" is a radiator or set of radiators.

He progressed to a system where the shaft rotation forces the liquid to be expelled through the tips of arms radiating out from the centre of the impeller hub:



Here, the liquid is forced into a small space between the rotor and its drum housing. This system has been used very successfully for water heating and some measurements indicate that it is at least 100% efficient and some people believe that it is well over the 100% efficiency, though they don't want get drawn into long discussions on methods of measurement. It is sufficient to say here, that this method is very effective indeed.

Here is an interesting article from the Home Power web site. I strongly recommend that you visit their web site and consider subscribing to their magazine as they cover many practical topics using simple wording.



The Wood 103 was built mostly of wood in just a few hours, with very little number crunching.
Producing 100 watts in a 30+ mph wind ain't bad for a weekend project!

The initial goal of our project was to build a functional, permanent magnet alternator from scratch, primarily out of wood. When the alternator was together and working, it became clear that wind was the logical energy source for it. This unit (we call it the "Wood 103") is not intended to be a permanent addition to a remote home energy system, but a demonstration of how simple it really is to produce energy from scratch—and to be a bit silly!

Many home-made wind generator designs require a fully equipped machine shop to build. Our wooden version, built in a day, can be made with mostly local materials and simple hand tools in any remote corner of the world. The alternator design is well suited to hydroelectric, human, or animal power. We plan to use it for a series of magnet and electricity demonstrations at local schools, and for future experiments with different energy sources, windings, cores, poles, and rotors. This project will cost you only US \$50–75, depending on what you pay for magnets and wire.

Alternator Basics

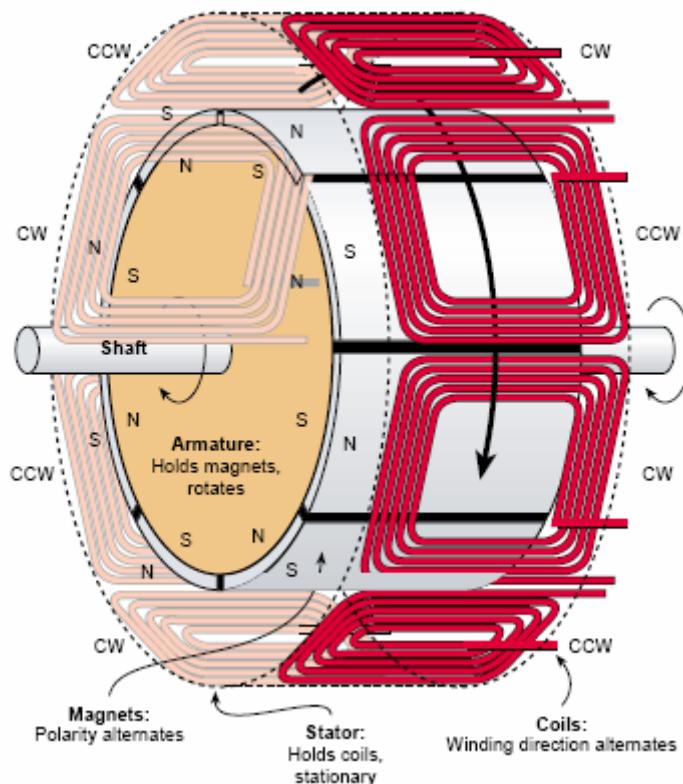
Electricity is simply the flow of electrons through a circuit. When a magnet moves past a wire (or a wire past a magnet), electrons within the wire want to move. When the wire is wound into a coil, the magnet passes by more loops of wire. It pushes the electrons harder, and can therefore make more electricity for us to harvest.

The magnetic field can be supplied by either permanent magnets or electromagnets. All of our designs use permanent magnets. In a permanent magnet alternator (PMA), the magnets are mounted on the armature (also sometimes called the "rotor"), which is the part that spins. It is connected directly to the wind generator rotor (the blades and hub). There are no electrical connections to the armature; it simply moves the magnets. Each magnet has two poles, north (N) and south (S). The magnets are oriented in the armature so that the poles alternate N-S-N-S.

The other half of a PMA is the stator, which does not move. It consists of an array of wire coils connected together. The coils in our stator alternate in the direction they are wound, clockwise (CW) and counterclockwise (CCW). The coils and magnets are spaced evenly with each other. So when the north pole of a magnet is passing a clockwise coil, the south pole of the next magnet is passing the counterclockwise coil next door, and so on.

The coil cores are located inside or behind the coils, and help concentrate the magnetic field into the coils, increasing output. The cores must be of magnetic material, but also must be electrically non-conductive to avoid power-wasting eddy currents. The air gap is the distance between the spinning magnets and the stationary coils (between the armature and the stator), and must be kept as small as possible. But the spinning magnets must not be allowed to touch the coils, or physical damage to them will occur.

Permanent Magnet Alternator



The more loops of wire that each magnet passes, the higher the voltage produced. Voltage is important, since until the alternator voltage exceeds the battery bank voltage, no electrons can flow. The sooner the alternator voltage reaches battery voltage or above in low winds, the sooner the batteries will start to charge.

Increasing the number of turns of wire in each coil allows higher voltage at any given speed. But thinner wire can carry fewer electrons. Using thicker wire allows more electrons to flow, but physical size limits the number of turns per coil. This also explains why enamelled magnet wire is always used in coils. The enamel insulation is very thin, and allows for more turns per coil than does thick plastic insulation. Any alternator design is a compromise between the number of turns per coil, the wire size, and the shaft rpm.

The electricity produced by an alternator is called “wild” alternating current (AC). Instead of changing direction at a steady 60 times per second like standard AC house current, its frequency varies with the speed of the alternator.

Since we want to charge batteries, the wild AC is fed to them through a bridge rectifier, which converts AC to DC (direct current) for battery charging. The alternator may produce much higher voltages than the battery bank does, but the batteries will hold the system voltage from the wind generator down to their normal level when charging.



The Wood 103 has three, 2 foot, hand-carved blades, creating a swept area of 12.5 square feet.

Materials Used

The materials we used are not hard to find:

- Wood, the harder the better. We used pine since it was locally available.
- Copper magnet wire, about 100 feet (30 m), enameled #22 (0.64 mm diameter).
- Eight surplus neodymium-iron-boron magnets, four with the south pole on the convex face, and four with the north pole on the convex face.
- Dirt (magnetite sand).
- A 10 inch (25 cm) piece of $\frac{3}{8}$ inch (9.5 mm) steel shaft with a nut on the end to hold the hub on.
- Two, $\frac{3}{8}$ inch by 2 inch (9.5 mm x 5 cm) bolts, but these are optional.
- Bridge rectifier, rated for least 15 amps, 100 volts.
- Other supplies—glue and linseed oil.

We had successfully converted AC induction motors into PMA wind generators before. But starting from scratch was truly a first-time experiment. Our design choices for wire size, number of windings, number of poles, blade pitch, and other factors were intuitive rather than calculated.

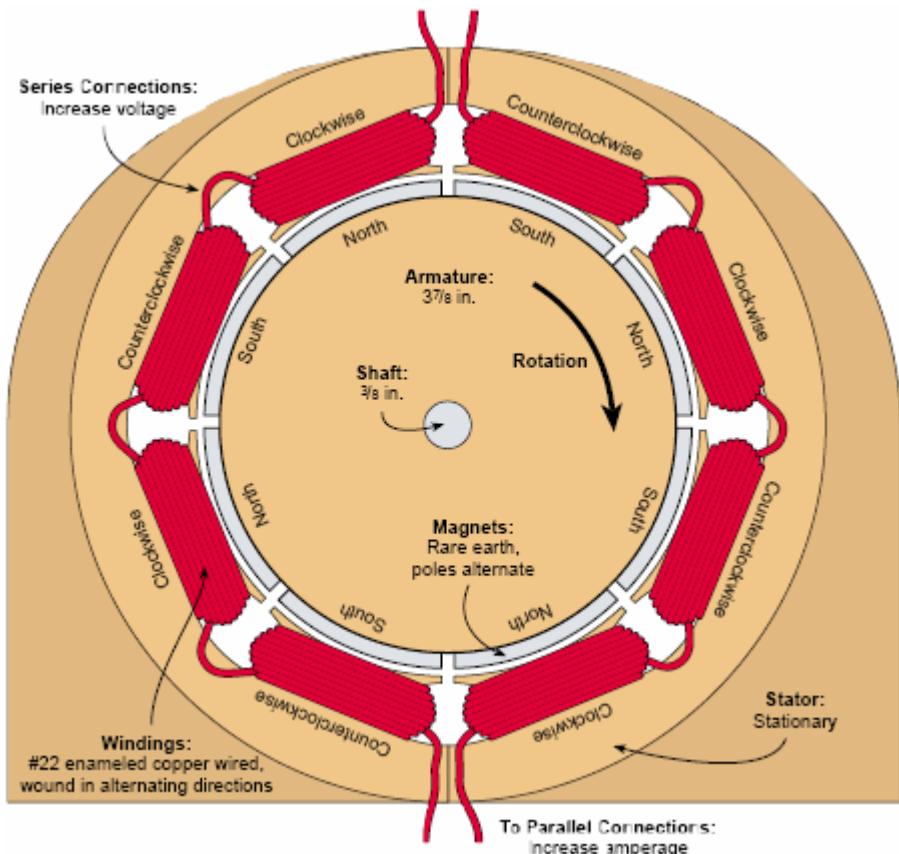
Every wind generator, waterwheel, and alternator we've built has produced usable energy, no matter how strange the design. The trick is matching the generator, rotor, and energy source. You can do a lot of study and calculation to get there. But if the design is quick, cheap, and easy to build, why not just make adjustments by observing the unit's performance?

If you try this project and change the wire size, magnet type, rotor design, and stator cores, you'd still be making usable energy and have a great starting point for further research. Just change one thing at a time until the unit performs to your satisfaction. We're aware that many design improvements could be made to the Wood 103—and we hope that others will experiment with variations.

Wooden Alternator

The biggest problem with building most wind generator designs at home is the need for machine tools - usually at least a metal lathe is required. Headquarters for our business, Otherpower.com, is high on a mountain, 11 miles (18 km) past the nearest utility line. We are lucky enough to have basic tools up here, but many folks around the world don't. That's the main reason we used so much wood in this design.

Wood 103 PM Alternator: End View



It is possible to build human-powered woodworking tools in almost any location. With some patience, only simple hand tools are required for this project. If you want to build it in a day, though, a lathe, drill press, band saw, and power planer can be very helpful!

Building the Armature

The key to the Wood 103's armature is the neodymium-iron-boron (NdFeB) magnets. They are the strongest permanent magnets available. Ours are surplus from computer hard drives. They are curved, and measure about $1\frac{3}{4}$ by $1\frac{3}{8}$ by $\frac{1}{4}$ inch thick (44 x 35 x 6 mm). Eight fit together in a $3\frac{7}{8}$ inch (9.8 cm) diameter ring. That's why we chose this particular diameter for the armature.



The wooden armature holds eight NdFeB (neodymium-iron-boron) magnets arranged in alternating polarity around its perimeter.

Safety Warning!

The large NdFeB magnets in this project are extremely powerful, and can be dangerous. They are brittle, and if allowed to snap together from a distance, they can break and might send sharp shrapnel flying. They are powerful enough to cause painful damage to your fingers if you allow them to pinch you, and can cause malfunctions in cardiac pacemakers if brought too close.

Use safety glasses, gloves, a firm grip, and Zen-like concentration when handling these magnets. Do not get them anywhere near televisions, computer monitors, floppy discs, videotapes, credit cards, etc. They are not toys, and should be kept out of reach of children!

The magnets are available with either the north or south pole on the convex face. For this project, you will need four of each configuration. Don't start tearing your computer apart to get these, though! They are from very large hard drives, and you won't find any inside your computer. Check the Access section at the end of this article for suppliers.

To construct the armature, we laminated plywood circles together with glue. The $3\frac{7}{8}$ inch (9.8 cm) diameter wooden cylinder is $\frac{3}{4}$ inches (9.5 cm) long, with a $1\frac{3}{4}$ inch (4.4 cm) wide slot cut into it $\frac{1}{4}$ inch (6 mm) deep to tightly accept the magnets. To assure that the magnets would be flush with the armature surface, we cut the plywood disks a bit oversized, and turned them down on the lathe to the proper diameter. The same procedure was used to cut the magnet slot to exactly the right depth.

Using a firm grip, we carefully press-fit and epoxied the magnets into place. Remember that these magnets come in two different configurations—north pole on the convex face and south pole on the convex face. The magnets must have alternating poles facing out, and this is how they naturally want to align themselves.

Next, we drilled the shaft hole through the centre of the armature using a lathe, though it could certainly be done with a hand drill if you are careful to align it perfectly. We roughed up the surface of the shaft with a file before epoxying it into the hole. It should be a very tight fit—we had to gently tap it through with a hammer. This may not be strong enough, and it might be wise to actually pin the armature to the shaft. Time will tell!

Construction without a Lathe

We did cheat by using a lathe to shape the armature, but a coping saw and sandpaper would work just fine. If a lathe is not available, our suggestion is to first cut out the disks, making sure that some of them (enough to stack up to $1\frac{1}{4}$ inches; 4.4 cm) are $\frac{1}{4}$ inch (6 mm) smaller in diameter than the rest. Once assembled, the armature will then have a recessed slot for the magnets.

Otherwise some means of "lathing" the slot will have to be devised. It could be done on the alternator's pillow blocks with a sanding block mounted below, or in a drill press. It would also be wise to first drill a shaft hole into each plywood disk, and then assemble, glue, and clamp all the plywood disks together on the shaft before turning.

Building the Pillow Blocks

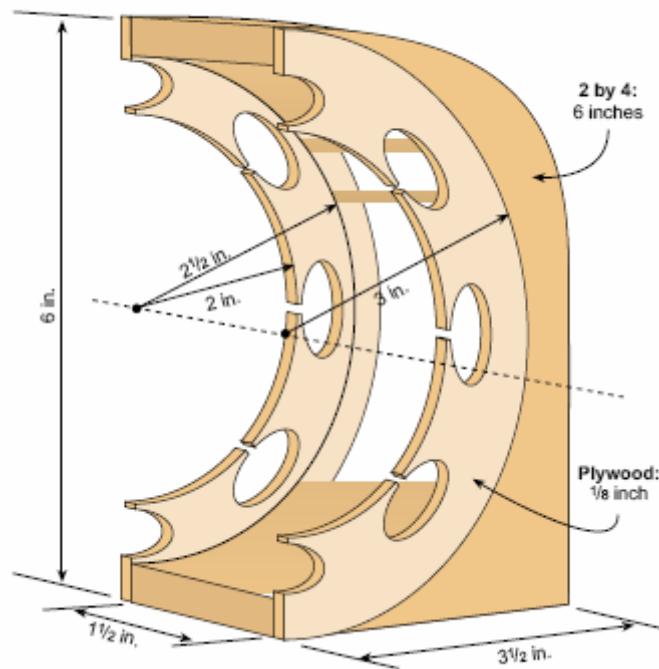
The pillow block bearings were made from pine, since that's the hardest wood we have available up here on the mountain. Certainly hardwood would be much better. First we drilled a hole slightly under $\frac{3}{8}$ inch (9.5 mm) diameter in each pillow block. Using a gas stove burner, we heated the shaft to almost red hot, and forced it through the holes. This gave a good tight fit, hardened the wood, and made a layer of carbon on the inside for better lubrication. We drilled a small hole in the top of each pillow block, down into the shaft hole, so the bearings can be greased.

Pillow blocks support the armature. Charred wood creates "carbon" bearings for the shaft to spin on.



After pressing the hot shaft through the pillow blocks, we were very pleased with how freely the armature turned and how little play there was. In a slow waterwheel design, wood/carbon bearings would probably last for years. This wind generator is actually a fairly high-speed unit, and real ball bearings would be a big improvement. Such bearings could be easily scavenged from an old electric motor of any kind. Wooden bearings were certainly simple, fast, and fun though!

Stator Construction



Building the Stator

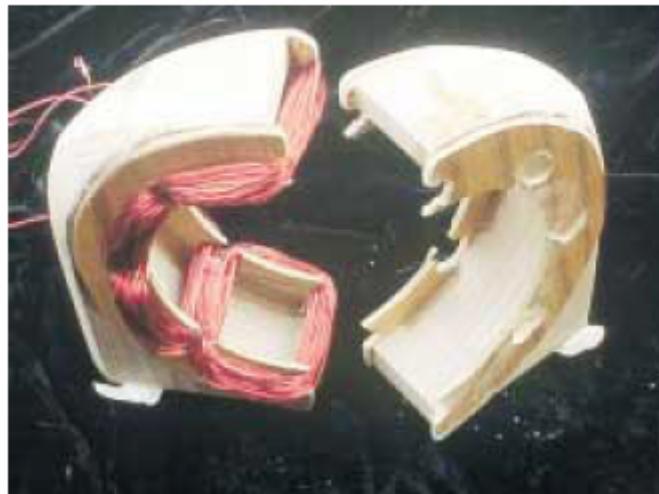
The stator, on which the coils are wound, is made up of two identical halves. Each half is made from 2 by 4 inch lumber, 6 inches long (5 x 10 x 15 cm). A semi-circular cut-out with a 5 inch diameter (12.7 cm) was made on each half. The tolerances are pretty tight, but this allows more than a $\frac{1}{2}$ inch (13 mm) to fit the coils and core material inside.

On the sides of the 2 by 4s, right over the cut-out, we get this type is often available from electronics stores or glued thin ($\frac{1}{8}$ inch; 3 mm) U-shaped plywood "half disks," which have an inner diameter of 4 inches (10 cm) and an outer diameter of 6 inches (15 cm). They have slots cut large enough to accept the coils. These were made with a hand saw, $\frac{3}{8}$ inch (9.5 mm) drill bit, and a rat tail file. The coils are wound in these slots, and

the space inside and behind the coils is filled with the magnetite core material. There are four coils on each half of the stator, and they must be evenly spaced.

Our twin stator halves are wound with #22 (0.64 mm diameter) enamelled copper magnet wire. Magnet wire of this type is often available from electronics stores or from electric motor repair shops. Each stator half contains four coils. Each coil is 100 turns, and every coil is wound in the opposite direction as its neighbour. It's important to wind the coils neatly and tightly, using a wooden dowel to carefully press each winding loop into place.

The two stator halves—one wound with 100 turns per coil, and one ready to be wound.



Most common alternators use thin steel laminates as cores, to help concentrate the magnetic field through the coils. Magnetism in motion pushes the electrons around in the steel too. The laminates are insulated from each other to block these eddy currents, which would otherwise waste energy.

These laminates are difficult to make in a home shop, so we chose dirt as our stator core—actually magnetite sand mixed with epoxy. It is not as effective as real laminates, but was very easy to use, and available for free by separating it from the dirt in our road. We mixed the magnetite with epoxy and simply spooned it into the open cores. If the cores were left empty (an “air core”) the alternator would still work, but with much less power.

Magnetite is a common mineral, a type of iron oxide. It is a by-product of some gold mining operations, and can sometimes be purchased. As an alternative, we simply dragged a large neodymium magnet (just like the ones we used for the armature) around on our local dirt road on a string for a while, attracting all the ferrous sand, which stuck to the magnet.



Magnetite sand collected from Dan's driveway by dragging a magnet around on a string.



The stator cores are filled with a mixture of epoxy and magnetite sand.



An exploded view shows the armature, stator, and pillow blocks ready to assemble into an alternator.

We separated this somewhat magnetic sand into a pile, sifted it through a window screen, and sorted that with the magnet one more time. The remaining black sand sticking to the magnet was nearly pure magnetite. A quick test of any local dirt pile with a neodymium magnet should reveal whether your sand contains magnetite. If not, try dragging the magnet along the sandy bottom of a local river. Any deposits of black sand on the river bottom are most likely nearly pure magnetite.

The clearance between the stator coils and the armature surface is very important. It must be extremely close (within $\frac{1}{16}$ inch; 1.5 mm) without allowing the magnets in the armature to touch the stator. Our model is actually a bit sloppy—the clearances are more like an $\frac{1}{8}$ inch (3 mm). Tighter tolerances would produce more power.

Wiring Configuration

The completed stator consists of two identical sets of four coils. For our wind generator, we connected the stator halves in parallel for more current (amperage). Connecting them in series would double the voltage produced, but halve the amperage. For low wind speeds, a series connection would be the best—the alternator would reach charging voltage at slower speeds. At higher speeds, a parallel connection is optimum for producing the most amperage.

An ideal system would contain a regulator that switched the stator connections from series to parallel when the unit began to spin fast enough. As is the case with many home-brew and commercial wind turbines, we eliminated this entirely, sacrificing a small amount of efficiency for much greater simplicity and reliability. Many people have experimented with such regulators, both solid state and mechanical.

Alternator Performance

We were really surprised by this alternator's performance. We could easily spin it with our fingers and get 12 volts or higher. A cordless drill attached to the shaft would light up a 25 watt, 12 V DU light bulb easily. This might not seem breath-taking, but considering the simplicity of the project and one-day construction time, we were quite impressed.

Our 100 watt rating for the Wood 103 is probably right on, considering the performance we got during testing, and the way commercial wind generator manufacturers rate their products. Our data acquisition system was pretty simple - multimeters and people with pencils and paper to watch them and record measurements.

With a series connection between the stator halves, the unit reached charging voltage for 12 volt batteries at around 300 rpm. With the stator in parallel, it took around 600 rpm to start charging. When installed in our wind machine, the parallel connection gave us 4.8 amps output in a 25 mph (11 m/s) wind.

Building the Frame

To stay with the style of this project, we chose to build the rest of the wind generator out of wood too. It's a very simple design and should be self-explanatory. It's all glued and pinned with dowels. No bolts are used except to connect the alternator to the frame. We admit that we cheated here!

We did not make any provision for over-speed control, since this was intended to be a demonstration unit for all energy sources, not just wind. A canted tail and spring assembly could be added to control speed during high winds. And, of course, making the frame out of surplus steel or aluminium angle would give great improvements in durability.

We also did not include slip rings for power transmission as the wind generator yaws. Instead, we used flexible wire for the first few feet, letting it hang in a loose loop. A piece of aircraft cable cut slightly shorter than the power cable was attached, so if the power wire gets wrapped around the pole too tightly, the connections won't pull loose.

Our normal winds are usually from one direction, and designs without slip rings seem to work fine up here. Wrapping the power wire around the pole is only rarely a problem, and this strain relief cable prevents any damage. Our experience is that if the power cable does wind up all the way, it will eventually unwind itself.

The finished alternator, ready for a power source.



Designing the Rotor

The "rotor" here refers to the blades and hub of the wind generator. We don't profess to be experts in blade design. Once again, we chose our starting point intuitively rather than trying to calculate the proper blades to match our alternator's power curve. Since the blade carving process took us less than an hour for the whole set of three, we figured that any design changes would be quick and easy to make. However, because we glued the blades to the hub, a new hub will be necessary for any blade changes.

There's a great deal of information out there about building blades. Hugh Piggott's Web site and his Brakedrum Wind Generator plans are some of the best sources around.

The rotor was built from 3/4 inch by 4 inch (19 mm x 100 mm) pine lumber. Each blade is 3 1/2 inches (90 mm) wide at the base and 2 1/2 inches (64 mm) wide at the tip. The three blades are 2 feet long (600 mm),

for a total diameter of 4 feet (1.2 m). The pitch of the blades is 10 degrees at the hub, and 6 degrees at the tip.

The hub is made from 2 inch (50 mm) thick wood, press-fit and glued to the roughed-up shaft with epoxy. The blades are held on to the hub by one small nut at the end of the shaft, and several wooden pins with glue.

Carving the Blades

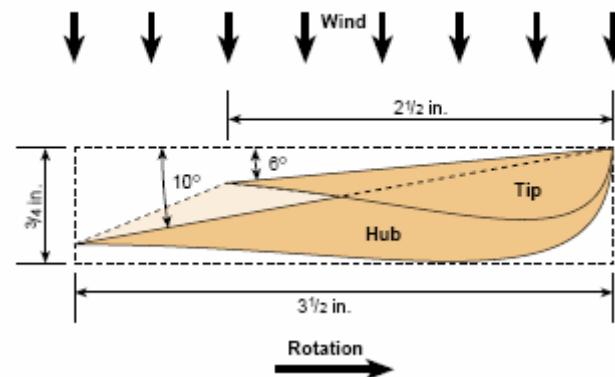
To prepare the blades for carving, we simply drew a few lines so that we knew what material to remove. Each blade starts out life as a 2 foot (0.6 m) long, 1 x 4 inch (25 mm x 100 mm). Starting from the leading edge of the blade at the hub, we simply used a protractor to lay out how far into the wood, 10 degrees of pitch would take us at the trailing edge - about 5/8 inch (16 mm).

At the tip, the pitch is about 6 degrees, so we removed about 3/8 inch (9.5 mm) of material from the trailing edge. We made both marks, and connected the two with a line. We then simply took a power planer, and followed the cut depth line all the way up the blade.

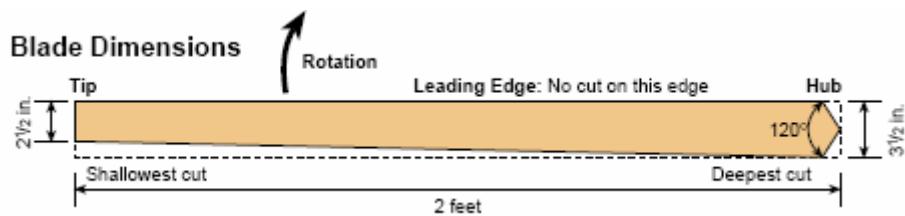


Almost ready—the wooden frame and tail are attached.

Blade Cross Section



Blade Dimensions



For better accuracy (or if you don't have a power planer), you can use a hand saw to make cuts across the blade every inch or so, down to the cut depth line on the trailing edge and not cutting at all on the leading

edge. Using a hammer and chisel, it's easy to break out the chunks of wood to the proper depth. Then smooth the blade down to the proper angle with a hand plane. When the saw kerfs disappear, the blade pitch is correct.

The blade width taper occurs on the trailing edge. We simply used a saw to cut the first taper, and used that first blade as a template for cutting the others. No calculations were made for the airfoil shape on the other side of the blades. We picked a likely looking profile and started cutting with the power planer. A hand planer is fine for this process, too. After everything looked good and even, we sanded the blades and treated them with linseed oil.

Balancing the Blades

To avoid vibration problems and enable easy starting, we made some effort to balance the blades. We considered them reasonably balanced when each blade weighed the same (about 8 ounces; 227 g) and had the same centre of gravity. Adjustments can be made quickly with a planer.

Once this is done, and all three blades are assembled on the hub, balance can be double-checked by spinning the rotor and making sure it has no tendency to stop in any one place. This is a quick process, and we certainly were not concerned about great precision here. As it turned out, a small effort in balancing the blades yielded good results, and the machine seems well balanced and vibration free.

Truly, one could write an entire book on blade design, and it can get complicated. Don't worry, though. It is possible to make a very basic blade that will work quite effectively. Often a simple blade with a constant 5 degree pitch from hub to tip and a reasonable airfoil on the backside will work very nicely. If you are interested, explore the books and Web sites listed at the end of this article for more information on blade design.

Testing

For testing, we strapped the Wood 103 to our trusty Model A Ford. The Model A serves as a reliable daily driver, and with the bracket we made, it makes an excellent testing facility for wind turbines. It has a perfectly accurate speedometer, which has been carefully checked by the Fort Collins, Colorado Police Department's radar machines!

We carry a 12 volt battery, a voltmeter, an ammeter, and pencil and paper in the test vehicle. On a still day, we can observe the speedometer and take accurate windspeed versus output measurements on any wind turbine. We've used this rig with props over 8 feet (2.4 m) in diameter. The cost of a good Model A (about US \$4,000 if you don't mind a jalopy) is *not* included in the price of this project!

Wind generators should be installed high above human activity. For testing purposes, we've run our generator on low towers within reach of people, and on our Model A. Wind generators have parts that spin very fast! The blades could probably take your head off in a high wind if you were silly enough to walk into them. Make all installations well out of reach of curious organisms. You should treat any wind generator with a great deal of respect. This is not a joking matter, though we always shout "Clear prop!" before we fire up the test vehicle...

Model A Ford—a high tech test vehicle
for a high tech wind machine.



The next generation—the WoodAx is for permanent installation, and produces upwards of 300 watts in 30 mph winds.

Improvements

Many improvements could be made to this design. But the intention was to use mostly wood and hand tools, and keep it fast and simple. The wooden alternator is easy and quick to build, but for longest life, it would need to be protected from rain and snow. Maybe a small shingled roof over it?

Using real ball bearings would help friction loss and longevity a bunch. A metal frame and tail would improve high-wind survivability significantly. A furling system to keep the Wood 103 from destroying itself during a gale would be a great addition too. We plan to experiment with many improvements, and we hope this project piques the interest of others too.

Trade-Offs

Designing and building a permanent magnet alternator involves a long series of trade-offs. For example, thicker wire in the windings would give more possible current, but less room for windings and hence lower voltage at the same rpm. Ceramic magnets might be cheaper, but would give far less power than neodymium magnets.

Series wiring on the stator would allow lower rpm at charging voltage, but parallel gives better charging current—and a regulator to switch between the two would be complicated. Using steel laminates instead of air or dirt stator cores would produce more power, but laminate production is extremely difficult.

The trade-offs involved in designing a complete wind generator (or water turbine, or bicycle generator) are even more lengthy and complicated. Wind speed, rotor diameter, number of blades, blade pitch, width and twist, optimum rpm for your winding configuration, generator diameter, and number of poles all factor into a perfect final design.

Improvise, But Do it!

We've tried to demonstrate how easy it is to produce electricity from scratch. Don't let yourself get hung up on complicated formulas, calculations, and machine tools. Even if you make many changes to this simple design, you'll still almost certainly have a unit that makes usable energy for charging batteries.

Then, you can make small improvements until it performs exactly right for your application. And it could be powered by wind, falling water, a human on a bicycle, a dog on a treadmill, or a yak in a yoke!

Access

Dan Bartmann and Dan Fink, Forcefield, 2606 West Vine Dr., Fort Collins, CO 80521 • 877-944-6247 or 970-484-7257 • dانب@otherpower.com danf@otherpower.com • www.otherpower.com Magnets, magnet wire, bridge rectifiers, free information, and a very active discussion board

All Electronics, PO Box 567, Van Nuys, CA 91408 888-826-5432 or 818-904-0524 • Fax: 818-781-2653 allcorp@allcorp.com • www.allelectronics.com Magnets, rectifiers, and lots of electronics parts at great prices

American Science and Surplus, 3605 Howard St., Skokie, IL 60076 • 847-982-0870 • Fax: 800-934-0722 or 847-982-0881 • info@sciplus.com • www.sciplus.com Magnets, magnet wire, surplus electronics, bearings, and other neat stuff

Marlin P. Jones and Assoc., PO Box 530400, Lake Park, FL 33403 • 800-652-6733 or 561-848-8236 Fax: 800-432-9937 or 561-844-8764 • mpja@mpja.com www.mpja.com • Magnet wire, rectifiers, electronics, tools, test equipment

Hugh Piggott, Scoraig Wind Electric, Scoraig, Dundonnell, Ross Shire, IV23 2RE, UK • +44 1854 633 286 • Fax: +44 1854 633 233 hugh.piggott@enterprise.net • www.scoraigwind.co.uk Wind generator and alternator designs, lots of free information about blade design and carving

WindStuffNow, Edwin Lenz, 10253 S. 34th St., Vicksburg, MI 49097 • 616-626-8029 elenz@windstuffnow.com • www.windstuffnow.com Alternator designs, parts, useful formulas, free information, and blade design software

American Wind Energy Association (AWEA) discussion board • <http://groups.yahoo.com/group/awea-windhome> • Join the list by sending a blank e-mail to: awea-wind-home-subscribe@yahoogroups.com www.awea.org

The Peter Davey Heater

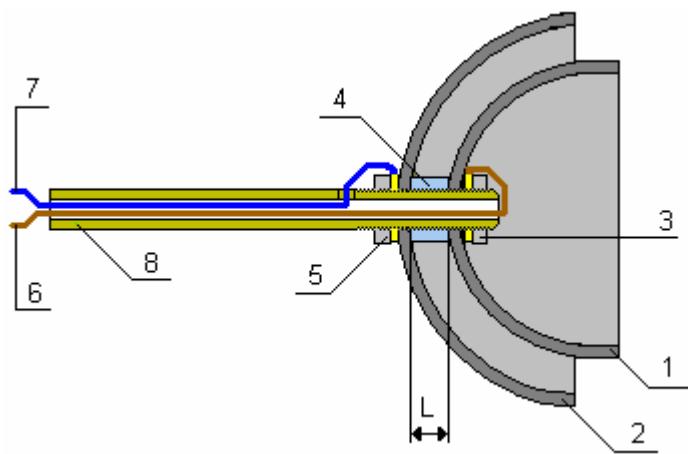


During World War II, Peter Daysh Davey, of Christchurch, New Zealand, a fighter pilot and musician, designed and built an unusual water heater. This design is not particularly well known and information is fairly thin on the ground, however, the basic principle and design details are known.

The device is intended to operate on the New Zealand mains power supply of 220 volts 50 Hz and a requirement of the apparatus is that it resonates at that 50Hz frequency. Resonance is a frequent requirement of free-energy systems, and the need for it is often overlooked by people who attempt to replicate free-energy devices. Properly built and tuned, this heater is said to have a COP of 20, which means that twenty times as much heat is produced by the device, compared to the amount of electrical power required to make it operate. This power gain is caused by additional energy being drawn from the immediate environment and it is very important as the largest use of energy in cool climates tends to be that used for heating. If that can be reduced by a serious amount, then your annual power costs should be much lower as a result of it.

Peter was granted a New Zealand patent for his heater on 12th December 1944 but he found that after the war, the opposition from the utility companies was so great that it prevented him from going into commercial production with it. For fifty years, Peter kept up his attempts to get sufficient approval to bring his heater to the marketplace, but the opposition finally won and he never managed it.

The device comprises a hemispherical resonant cavity, formed from two metallic dome shapes, both of which resonate at 50Hz. Initially, Peter used two bicycle bells and he found that when submerged in water, the device brought the water to the boil in a very short time indeed. The construction is like this:



If construction were to use two identical hemispheres, then the cavity between them would be anything but even width throughout, but the resonance would be the same. On the other hand, if you want the resonant cavity between the two hemispheres to be of constant width, then the outer sphere needs to be markedly larger than the inner hemisphere. The outside of both hemispheres needs to be insulated unless mounted in such a way that it is not possible to touch the hemispheres, as each is attached to the mains.

In the above diagram, the mains live wire **6**, is fed through the connecting pipe **8**, and clamped to the inside of the inner hemisphere **1**, by nut **3** which screws on to the threaded section of tube **8**. It is important that it is the live wire which is connected to hemisphere **1**. The mains neutral wire **7**, is also fed through the connecting tube **8**, exits via a small hole and is clamped on to the outside of the outer hemisphere **2**, by nut **5**, also on the threaded section of tube **8**. The two hemispheres are held apart by a spacing washer **4**, which is made from a high-temperature non-conducting plastic. As the tube **8** connects electrically and mechanically to both mains wires via the two locking nuts **3** and **5**, it is essential that this tube is constructed from an electrically non-conducting material such as plastic. As the tube will be in boiling water on a regular basis, it is also necessary that the tube material is also able to handle temperatures over 100°C (212°F), so possible materials include nylon and teflon.

This washer is a key component of the heater and its thickness is key to the efficiency of the whole device. This thickness **L**, is the tuning control for the cavity. The outer hemisphere is about 8 mm greater in diameter than the diameter of the inner hemisphere. Allowing for the thickness of the metal of the bowl, the resonant cavity will therefore be about 3 mm or one eighth of an inch.

The hemisphere **1** is also tuned to 50 Hz by grinding it carefully until it resonates freely at that frequency. Connecting a loudspeaker in series with a resistor of say, 100K ohms, will give a sound of the exact frequency with which this hemisphere needs to resonate. This tuning needs to be done with the unit fully assembled as the connections to the tube will alter the resonant frequency of the hemisphere. When this is being done, the resonance will be felt rather than heard, so hold the tube lightly so that it can resonate freely. The tuning is done by removing a small amount of metal from the face of hemisphere **1** and then testing for resonance again.

When hemisphere **1** resonates well at the mains frequency, (roughly G two octaves below middle C on a keyboard), the search for high-efficiency heating is carried out by very small adjustments of the gap **L**. The adjustment of the gap **L** is carried out by very careful grinding down of the separating washer **4** and the result is best determined by measuring the length of time needed to boil a known volume of water and the current taken to do that. Repeated tests and recorded results, shows when the best gap has been reached and the highest efficiency achieved. The heater can, of course, be used to heat any liquid, not just water.

This heater is unlike a standard kettle heating element. In the standard method, the water is not a part of the main current-carrying circuit. Instead, the mains power is applied to the heater element and the current flowing through the heater element causes it to heat up, and the heat is then conveyed to the water by conduction. In Davey's heater, on the other hand, the current flow appears to be through the water between the two hemispheres. It seems likely that the actual heating is not produced by current flow at all, but from cavitation of the water caused by the resonating of the cavity between the two hemispheres. This technique is used in small jewelry cleaners where an audio frequency is applied to a cleaning fluid in a small container.

A small amount of electrolysis will take place with the Davey heater as it in effect also forms a single parallel-connected electrolyser. The amounts should be very small as only 1.24 volts out of the 220 volts applied will be used in the electrolysis process.

An early construction of the original heater is shown in the photograph below. The coin shown in the picture is 32 mm (1.25 inch) in diameter. The heater is submerged in water when it is being used, and it brings that water to the boil exceptionally quickly. The unit was tested by New Zealand scientists who were able to vouch for its performance, but who were unable to state exactly how its operation allowed it to output such a high level of heat for such a low level of electrical input. You will notice from the photograph, how carefully the electrical connections and outer bowl are insulated.



The original prototype which Peter made was constructed from the tops of two bicycle bells, only one of which was tuned to 50 Hz. This shows that the device will definitely work if the inner hemisphere is tuned correctly.