THREE-PHASE EXPERIMENTS

BUILDING A WIND GENERATOR FROM A THREE-PHASE MOTOR

The biggest problem with wind generators for charging 12 volt batteries is that the low voltage and high current creates excessive losses in the windings of the alternator (or generator) and also in the cables coming down the tower and feeding the batteries. By converting a three-phase AC induction motor into a PM alternator, it's possible to generate 3 phase AC at a higher voltage. This can then be stepped down and rectified to provide low voltage and high current for charging the batteries without the losses normally experienced. These experiments were intended to find out if ordinary surplus transformers would handle the constantly varying voltage and frequency from the wind generator, and if the gain in efficiency would more than offset the losses and complexity of the system.

The first step was to disassemble a surplus 1 hp, 3 phase motor and turn down the rotor to accept curved neodymium magnets. Two magnets end-to-end were needed to cover each pole. This was a four-pole motor, so four sets of magnets was glued to the rotor using slow-set, high-strength epoxy glue. This was not easy... the magnets are very powerful and really did not want to touch end-to-end. The trick is to install the first four, secure them with a stainless steel hose clamp, then install the second four. By the way, these magnets are available from Dan at the OTHERPOWER web site.

Once the epoxy had cured, I filled the area between them with epoxy as well. The motor was cleaned, the windings were sprayed with a fresh coat of urethane varnish, new bearings were installed and the motor (now an alternator) was re-assembed.

Three wooden blades were carved, each 48" long.

The blades were then assembled onto a hub made from an 8" steel disk (a go-cart disk brake) along with a mounting backplate and front disk made from 3/4" plywood. Everything was thoroughly coated with slow-set epoxy, then through-bolted and drawn down tightly before the epoxy could start to set up. One blade ended up a bit heavy, and the other two needed small lead weights inletted into the blades to bring the prop into balance.

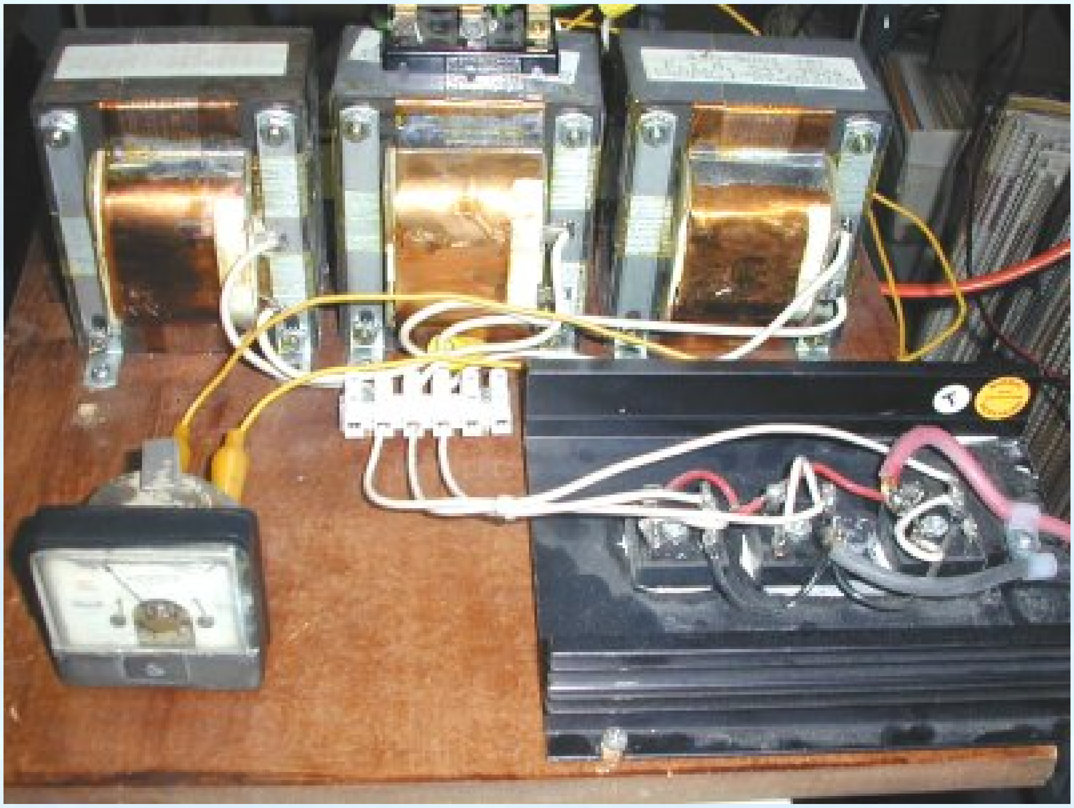
With the help of my cousin Brent, the three-phase genny ended up on top of the tower without much trouble. We hoisted it up with the help of a rope and gin pole, while carefully guiding it between the guy wires. I left the prop off for this operation, and the next morning while it was still dead calm, I hoisted the big 8 foot prop up and fastened it in place. Due to the cogging effect of the alternator, it takes a good 15 mph gust to break the magnetic lock and start it spinning. Once it's in motion, it will keep spinning with the slightest breeze.

With the wind generator in operation, the voltage output was measured and found to be in the 100 to 150 volt range. In order to step this down to something useful, I mounted three heavy transformers to a breadboard. Each transformer is rated at 13 volts, 20 amps with a 120 volt primary. There is also a tap on the primary to boost the output if the input is less than 120 volts.

The first experiment was to connect the three primaries in a delta configuration. This would give the highest output from the secondary. The results were not promising... when the genny was spinning slowly, connecting the leads made a spark and the prop stopped turning. The transformer winding (designed for 60 hz) was pretty much a dead short at the almost-DC frequency of the wind generator when it was just starting. This might work once it's up to full speed, but it would likely never start.

The next attempt was to Y-connect the three primaries. Surprisingly, this seemed to work down to the lowest speed. The Y configuration places two windings in series for each leg, increasing both the DC resistance and the inductance of the windings. I connected the three wires from the center of the Y to a knife switch so that I could open the circuit for testing, and found that the genny starts as easily in this configuration with the switch closed as it does with the windings open.

Since the Y-connection worked so well, I tried using the lower voltage taps (for 108 - 110 volt input) and it also worked fine, with about a volt higher output from the transformers.



Once the primaries were connected, I measured the voltage from each secondary and decided to try them with a Y-connection. Measuring the output showed a 6 to 1 step down ratio. I made up a three-phase bridge rectifier for the output using three 35 amp bridge rectifier modules. By jumpering the two AC terminals together, each module became essentially two 70 amp diodes in series. Three of these made up the six diodes necessary for a three-phase bridge, and this was fed through a meter shunt to the batteries with a section cut from an old set of jumper cables.

In the few windy days since this system has been up and flying, it looks promising. It starts around 15 mph. This is a little higher than most of the wind generators I've built, and is due to the cogging of the magnets in the alternator. At around 20 mph, the output of the alternator hits around 100 volts, which is enough to bring the output of the transformers and rectifier up to the charging point.

Once the wind exceeds 20 - 25 mph, the charging current jumps up fast. It hits 10 amps almost instantly. So far, the strongest gust I've measured here was in the 35 - 40 mph range, and the charging current was measured at 42 amps. Since this was the DC current coming from the bridge, each leg of the three-phase coming down from the tower was carrying around 7 amps. This is well within the capacity of the 80 foot long #12-3 extension cord wire connected from the wind generator to the transformers down here in the shop.

I *really* don't like three-bladed props. Two blades are stronger, lighter, faster, easier to balance and are quite a bit more efficient. The reason for the three blades on this machine is to generate the starting torque needed to overcome the cogging of the magnets.

Two-bladed props made from a single piece of wood can stand up to just about any winds we're likely to encounter around here, but since the three-blade hub is a weak point, I wanted some way to shut this one down. I used an old TV antenna rotor to mount the tail boom, so by rotating the tail 90 degrees I can align the rotor sideways to the wind. It should be able to ride out a serious storm in this mode.

The next experiment on this machine will be to carve a two-bladed prop and compare the performance to this one. By making the blades about 8 or 9 inches wide at the root, a ten-foot prop should outperform this one and should still have enough torque to start in a reasonable wind. I'll update this page as the experiment progresses.

BACK

OTHERPOWER.COM

The CUTTING EDGE of Low Technology

The first of the Triplets is set free and flies!

Over the last few weeks, Otherpower.com has been building a set of Wind Triplets -- 3 axial-flux brake disc wind turbines named Curly, Moe and Larry. The 3 brake disc alternators are identical, but Curly and Moe sport 10-foot props and Larry an 8-footer. This one is Moe, and it's up and flying at TomH's cabin. So far so good -- Moe starts spinning in 5 mph winds and has been producing good power at under 15 mph windspeeds. .**We completed a detailed series of web pages about the construction of the triplets--you can check it out HERE.**

Thank you for dropping by!

We are a group of alternative energy enthusiasts who want to spread the message that *It's EASY to make your own power FROM SCRATCH!* Otherpower.com's headquarters is located in a remote part of the Northern Colorado mountains, 15 miles past the nearest power pole or phone line. All of our houses and shops run on only solar, wind, water and generator power...not because we are trying to make some sort of political or environmental statement, but because *these are the only options available.* And we refuse to move to town.

We could never have made it to our current level of electrification up here without the help of friends, neighbors--and folks we've never met, thanks to the internet. Our goal is to share our information about experimental successes and failures alike, free of charge, with anyone who is interested. We also offer a wide selection of books and hard-to-find alternative energy parts and components on our web Shopping Cart. We hope you find our pages informative, useful and enjoyable!

The Blunt Edge of High Technology

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dont, please email again and remind us. THANKS for being considerate!

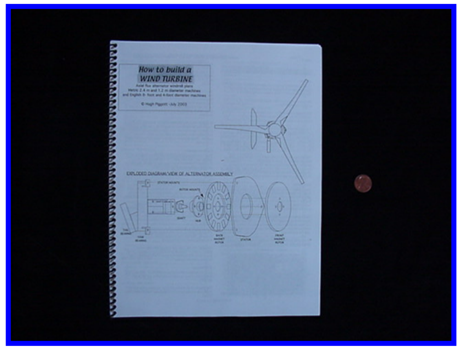
OUR NEWEST PAGE

Rocky Mountain Sustainable Living Fair 2003

Forcefield had a booth at this year's Fair in Fort Collins, Colorado. The Dans had a BLAST! We met and talked to a whole bunch of folks interested in home-built wind power. Kids got to make power and light up a bulb with our hand-crank alternator, and Larry the Wind Turbine was a big attraction. You can check out our web page/dairy about the event here!

OUR NEWEST PRODUCT

Axial Flux Alternator Windmill Plans by Hugh Piggott



The latest of Hugh Piggott's axial-flux wind turbine plans. Detailed CAD drawings, dimensions, photos, instructions, and theory. Build for 12, 24 or 48 vdc, both an 8-foot and a 4-foot diameter version. All the information you need to build a wind turbine from scratch!

SAFETY NOTE: Some of the experiments described on our pages may present various hazards. Please be cautious. We are not responsible for injury resulting from neglecting safety precautions when performing experiments.

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