

ANOTHER SMALL WIND GENERATOR

MADE FROM A LARGE STEPPER MOTOR AND PLASTIC BLADES

With the success of the "Microwind" genny made from a surplus NEMA 34 stepper motor, a prop from a trashed 20" box fan and some pipe fittings, I wanted to scale the design up to produce a bit more power, yet still retain the simplicity and the storm survival ability of the little genny.



After months of searching, I found a much larger surplus stepper motor. This one has the same diameter, shaft and flange dimensions, but is about twice as long. In addition, the shaft comes out of both ends, which brings up the possibility of coupling several together to be driven from a single prop. While the small stepper had one amp coils, the larger one has coils rated for four amps each. By using a bridge rectifier on each phase and connecting the DC outputs in parallel, this one should produce several times the power of the original Microwind.



I first thought about carving a set of wooden blades, but I ran across some scrap plastic pieces that were nearly the correct size, weight and shape. These were routed cutouts from a large plastic bin, and were curved in such a way as to form a somewhat undercambered airfoil. I cut a set of three tapered blades from this material and used a rotary file to thin the trailing edge. Since these were scrap cutouts from a molded plastic part, each piece had a vent hole in the center. Being small, it shouldn't hurt anything. Each blade is 21" long, 4 1/2" wide at the root, and 2 3/4" wide at the tip.



I found a scrap of heavy gauge steel about 1 1/2" wide, and cut it into three equal strips about 7 inches long. These I sandwiched between two very large washers. A bolt and nut squished the washers together, capturing the steel strips. Once they were perfectly aligned, I welded them all together, forming a solid three-blade hub.

I bored a short piece of 1" aluminum barstock to fit the stepper motor shaft and added two #10 setscrews, then turned the piece around and counterbored it halfway, then tapped it for a 7/16" x 14 screw. While it was in the lathe, I turned a step on the O.D. to fit the hole in the washers. The step

is a bit shorter than the width of the hub, so the center screw will draw it down tight and square.

The aluminum piece wouldn't fit all the way through the hub, since the three steel strips had actually stuck through a little way into the hole in the washers (the bolt was smaller than the hole.) Rather than file them away, I instead filed three small flats on the aluminum piece. This way it could not rotate inside the hub... simpler than cutting a keyway!



The three steel strips were marked and drilled, then tapped for three 1/4"-20 screws in each one to mount the blades. At this time I also scribed a line an inch out from the washer across each one. Each strip was then clamped in the vice at this line, and using a large crescent wrench I twisted each one to the proper blade angle, sighting it with another line drawn across the top of the vice with magic marker.

The blades were mounted on the hub using three 1/4"-20 bolts and washers for each one. Since the hub itself is tapped, once the bolts were drawn down very tight, a nut was threaded on to the back side of each bolt and tightened down to lock everything together.

Once the blades were installed, I mounted the hub onto one of the large stepper motors and took it

out into the back yard. Shortly we had a small gust of wind, and as soon as I felt it on my face the genny started to rotate. It seems to start in a fairly low windspeed, and once spinning it maintained it's rotation quite well. With some of the larger gusts, it picked up quite a bit of speed. Since I can rotate it by hand and light a good-sized 12 volt bulb with each phase, it looks like this thing will produce some power once it's up in the air.



Since we've been known to get some storms around here with winds in excess of 85 mph, I thought it would be a good idea to reinforce the hub to prevent it from bending backwards. Rather than using a 7/16" bolt to secure the hub, I cut a piece of threaded rod and tightened it into the adapter. I then used a nut to secure the hub, leaving a few inches of rod sticking out. This gave me a point to attach three support rods from the center back to the outermost bolt on each blade. Before fastening the rods, I bent the arms of the hub slightly forward. This "rake" will allow the blades to flex a bit in high winds without risk of hitting the mast.



Here it is, up on the shop roof. To the right is the original Microwind prototype, fastened to the vent pipe where it's been adding it's share to the station batteries for over a year now. I've seen an amp out of the little guy, and I hope the bigger version will do much better.



This side view shows the forward rake of the blades. This should allow plenty of room for flexing in extreme weather.

The mini genny is an ongoing project. Now that it's up, naturally we have winds of less than 2 mph predicted for the next several days. Once we see some real wind, it won't take long to see what it's going to do. I expect to do some experimenting with the blade pitch to get the right angle to get as much out of the stepper motor as possible. Adjustment is a matter of putting the hub in the vice and twisting each arm with a very large wrench. So far, it seems to start in very light winds, and in a few light gusts shortly after it went up, it lit a 12 volt trailer light easily. Since these were very light gusts, this is a good sign... it should spin up much faster once the wind picks up. I'll post more data here as the project unfolds.

UPDATE!

Once we got some gusty winds peaking around 15 to 18 mph, I took some measurements on the new wind generator. It starts easily, and when feeding power to a battery through a blocking diode, it would begin charging somewhere around 10 mph. At higher windspeeds the RPM and the current would increase, but not as fast as I had hoped. Since the plastic blanks were straight, I had no twist to the blades, and I suspect that under load, the tips were stalling at the higher wind

speeds.

I brought the rotor down and trimmed some taper to the leading edge of the blades. Since the shape is undercambered, this did two things... first, it made the airfoil thinner at the tips. Second, it also made the airfoil fly at a lower angle of attack, adding a bit of "twist" to the blade.



The result is a bit more speed in the gusts. As I write this we're having winds with gusts up over 20 mph, and I'm seeing an easy 1 to 1 1/2 amps going into the batteries on the average, more in the strongest peaks. This is certainly not bad for a little NEMA 34 stepper motor. I have a feeling that it will do better in some real wind, at least as long as it holds together.

The biggest thing it needs now is good, clear, unobstructed wind. Once I'm sure it's doing what I want it to do, I'll move it from the shop roof to the top of one of the towers.

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