Subject: Portable Hand Crank/water powered DC Generator from a cordless electric drill
Date:

The unit is light weight, portable, low cost and can be used to recharge single cell batteries at from 1-3.5 amps. This can be made from a cordless electric drill in a primitive environment. See http://www.harborfreight.com/CrankGen-6.JPG

A) Simplest way: How to make a hand crank DC generator using a standard 12 Volt or 14.4 Volt Cordless drill from Harbor Freight Tools (see below for more info). With no modification hook an alligator clip jumper on to the two charging terminals (on the bottom that the battery plugs into) see picture http://www.harborfreight.com/CrankGen-7.JPG. Note that when the drill is laid down pointing to the left then the upper terminal is most likely to be the plus and the lower terminal the minus for these units.

When one pulls the variable speed trigger the crank handle will began to rotate slowly acting like a drill. Grab the handle and crank faster in the same direction it is turning (trigger switch still held down). If an amp meter is hook in series with generator then one can tell when it changes from running as a motor to becoming a generator and charges the battery. The current flow will change sign going from "-" to "+" (or vice versa) on the meter. The forward and reverse switch works as normal and allows one to crank in the opposite direction to charge the battery while holding the trigger switch closed.

If you have a different drill then hook it up one way and see how many amps you get when cranking vigorously. Then hook it up the other way reversing the polarity of the wires and compare the amps using an amp meter in series with a one celled battery. One way will charge the battery the other way will bring the charging current to near zero and it will become hard to crank. Use the polarity that charges the battery. This paragraph outlines the basic way you can check any cordless drill to see if it is a permanent magnet motor and wired such that will work as a DC generator.

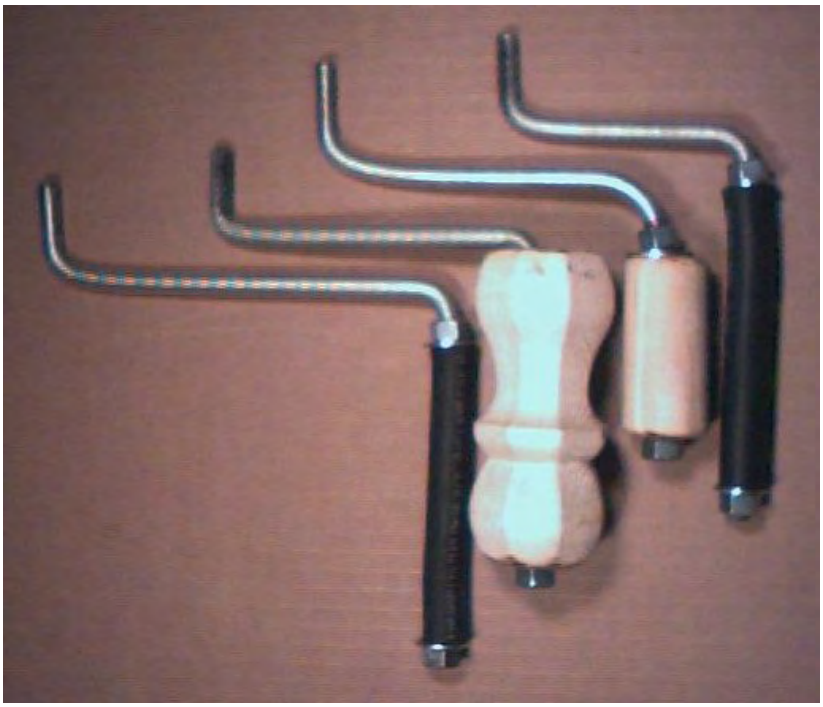
If one uses a 3-5 amp external diode in series with the jumper wires (wired in the direction of the current flow) then if one stops cranking the drill as a generator it will not continue to turn as a motor. One can then tape the trigger switch in the full on position. This approach produces a hand crank battery charger that in a pinch could easily be reversed and used as a drill again. This can be done by taking the diode out of the circuit and plugging in the battery pack and untapping the trigger switch.

Note: Be sure to lock the drill into direct drive mode (locks out the ratchet screw torque gear arrangement). Chouse a cordless drill that has a high figure of merit or highest ratio of input voltage to RPM. Both the 12 volt/500 rpm and 14.4 volt/550 rpm have a ratio of .024 and .0262 respectively. Note that the 14.4 volt unit is slightly more efficient than the 12 volt unit. The 18 volt runs at 900 RPM and this gives .02 which is not as high as the other two. The 12 Volt drill item 47156-5VGA currently sells for $9.99 with keyed chuck and the 14.4 volt drill item 4285-1VGA currently sells for about $ 15.99. The 12 Volt units are currently the best deal cost wise. The 14.4 volt is slightly more voltage at a greater cost. The 18 volt unit is not worth purchasing for this purpose. Search for the appropriate item number at http://www.harborfreight.com/ I recommend using the Keyed chuck type drill instead of the hand tighten type. It is a bit cheaper and the hand crank can be tightened a bit tighter so it doesn't come loose while cranking. In actual fact either will work. Use what you have.

B) Modified Cordless electric drill: If one takes out the variable speed trigger switch and uses a diode (one way flow device) in series with the permanent magnet motor then we have a unit that can stay hooked up to a battery without acting like a motor. When one cranks, it charges the battery. This becomes a dedicated one direction DC generator without the added small amount of resistance of the variable speed trigger switch. There is also a internal device that can be rewired to act as a diode. see picture http://www.harborfreight.com/CrankGen-1.JPG.

The white wire from the PM motor is positive when cranked counter clockwise facing the chuck and negative when cranked clockwise. The three wire transistor that has a heat sink can be used as a diode. It will flow in one direction when the black wire is hooked to a positive source (the motor-generator) and the white is negative. Use a 2 or 3 cell battery and check current in the blocked direction. This back flow should be well below a ma, if it is not, then use another rectifier diode from another source (junk parts). Otherwise your batteries will slowly discharge if left hooked up and not turning. I found for clockwise cranking, hook black to black. For counter clockwise cranking hook white motor lead to black diode lead. See picture http://www.harborfreight.com/CrankGen-2.JPG. for clockwise wiring and picture http://www.harborfreight.com/CrankGen-3.JPG. Note that the blue wire is not used and is left disconnected but taped.

Crank can be made from an 11” long by 3/8” diameter plated treaded rod. Bend at 1” and at a 5” cranking radius. The rest of the length becomes the handle. Make your bends gentle and not too sharp or it will break. Find a chunk of round wood (closet coat hanger dowel is about right) and drill a 3/8” hole through the middle of it. Slip over the shaft and put a nut on with lock tight or epoxy in the threads to make it stay in a permanent location. Optional: Sand a flat on three sides of the 3/8” threaded rod to keep it from coming loose easily in the chuck of the drill. I experimented with different radiuses and handles. The one that worked the best for me is the one with the round wood dowel handle at 5 inch radius. See http://www.harborfreight.com/. See picture http://www.harborfreight.com/CrankGen-5.JPG.



Drill weight is about 2.1 lbs with lead wire. Crank is about 8 Ozs.

Output test results of hand cranking one 14.4 Volt Cordless Drill.

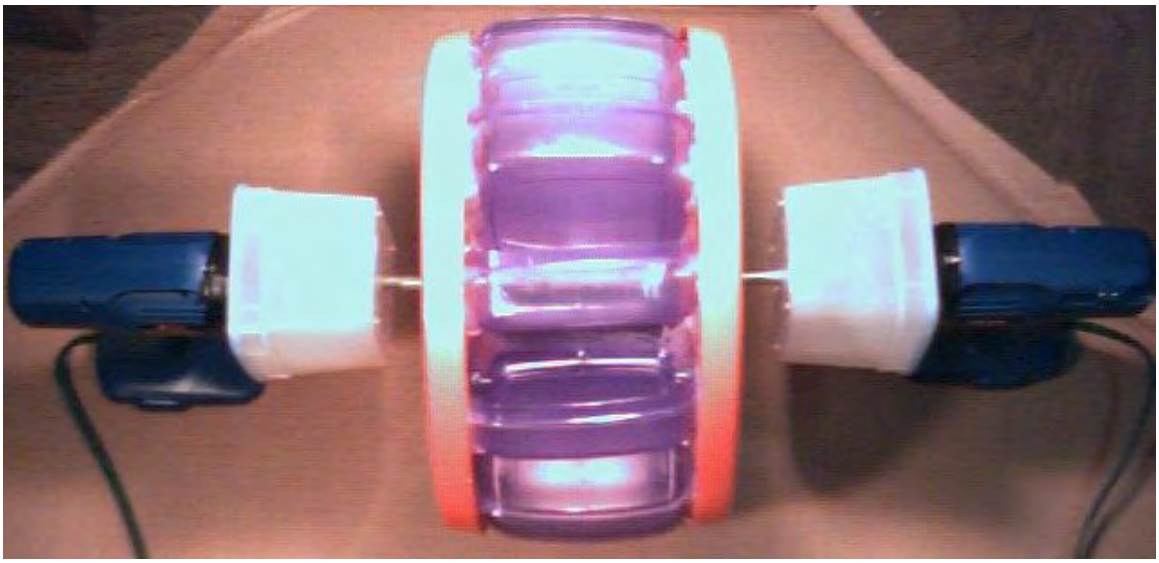
Charging two cells in series:
Fast cranking 1.2 to 1.5 amps at 3.1 volts or an average 1.35 amp x 3.1 volts = 4.19 watts.
Normal Cranking .3 to .6 amps at 2.75 volts or an average of .45 amp x 2.75 volts = 1.24 watts.

Changing one cell:
Fast cranking 2.5 to 3.5 amps at 1.8 volts or an average 3 amp x 1.8 volts = 5.4 watts.
Normal Cranking 1.1 to 1.6 amps at 1.6 volts or an average of 1.35 amp x 1.6 volts = 2.16 watts.

Pico-hydro generator water wheel construction

One soon will get tired of hand cranking and want to find a better way. In near continuous raining condition as is predicted after a PS, water flow in uneven land conditions creates some interesting opportunities. Even small areas colleting water will create a significant amount of run off water flow. All one need do is position a portable constructed paddle wheel where there is as small as 1 to 1.5 foot water flow drop at a rate of about 20 gallons/min.

Small plastic containers and several 5 gallon bucket lids can be used to create a water wheel. See http://home1.gte.net/mikelob/WaterW-9.JPG



Stack one at a time plastic container on top and nested in the lower one. Then drill in a hole in the middle of one of the longer sides. Use a #8-32 by .5" long machine screw and nut to fasten them together. The containers are positioned so the overlap is just enough to bolt them together. See http://home1.gte.net/mikelob/WaterW-1.JPG

Use one container of a different color to aid counting revolutions in a given time to determine rpm. It takes 12 containers (Good Buy Mini Container distributed by PTS long Beach Ca) and two 5 gallon bucket lids. Once all 12 are bolted together then unbolt the bottom container and place it on top drilling and bolting it in. Now take a disk sander and sand off the lip on the sides that will be bolted to the bucket lid. Now open the stack of containers into a circle and put the last bolt in to hold it circular. See http://home1.gte.net/mikelob/WaterW-2.JPG

Mark and drill holes in one lid then use this lid as a guide to drill the holes in the other lid. Add a ring of “silicon-I” sealer and centered the now circular ring of plastic containers and drill-bolt the buckets to the lid.

Cut a 4.75” long .5” diameter aluminum or copper tubing put 3/8” washers at each end and glue with silicone sealer. See http://home1.gte.net/mikelob/WaterW-3.JPG

Use this pipe as a spacer between the lids in the center when assembling the last side. One water wheel weight is about 3 lbs two is about 5 lbs. Caution: the 3/8”shaft will bend if nuts are tighten against a pipe that has a non-square end. Use a pipe cutter and get a square end. Don’t use a hacksaw. See http://home1.gte.net/mikelob/WaterW-6.JPG

To keep the water form getting to the chuck of the drill take a small square shaped plastic container and drill a hole in the bottom and pie shape cut the lid. Bend some (3 in my case) of the pies up and most down. Drill a small drain hole at the lowest corner so that if any water leaks in it will drain out. The pie tabs will be taped to the drill to hold it in place. See http://home1.gte.net/mikelob/WaterW-5.JPG and http://home1.gte.net/mikelob/WaterW-4.JPG and http://home1.gte.net/mikelob/WaterW-7.JPG.

Pico-hydro generator water wheel Output power

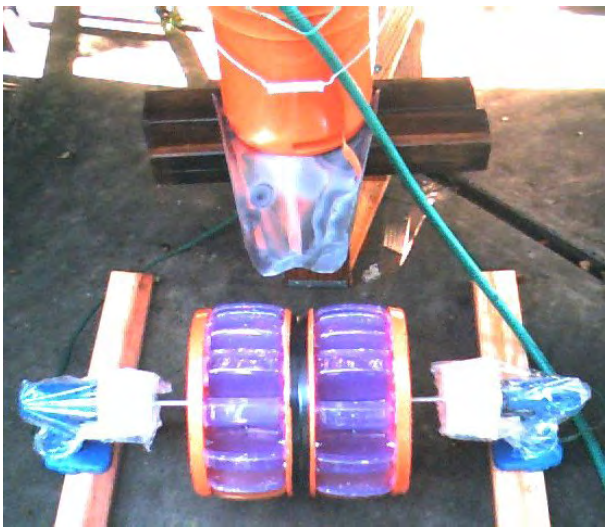
Tested output for one set of 12 cups in one water wheel driving two 14.4 volt cordless drills: I measured .3 to .7 amps (average .5 amps or .8 watt) when charging one cell. I noticed it was barley able to overcome gear friction to start about half the time. Hose running in bucket by it's self is not enough to cause rotation, but dumping in another 5 gallon bucket of water did cause rotation for a short time (about 15 sec). Drills were taped in a clear plastic bag. Meter and battery were in a plastic bag with a tie wrap to

seal it. Both generators were wired in series. See http://home1.gte.net/mikelob/WaterW-10.JPG

I also tested a 1/8" water hose nozzle blasting water out at city water pressure (about 45 lbs/sq.inch). This approach would charge two cells at about .45 amps and one cell at about .5 amp (or .8 watt). This approach uses the inertia of the water. Both generators were wired in series. See http://home1.gte.net/mikelob/WaterW-9.JPG for the setup.

Next I tested output for two sets or 24 cups making two water wheel driving two 14.4 volt cordless drills. I measured between .5 to 2.9 amps (or .8 to 5.2 watts) charging one cell. Both generators were wired in series.

I used about 20 gallons/minute flow rate for testing. My feeling is less would have also worked. Trying to tune up the process when my tests only lasted 15 sec at a shot (one bucket full) was a bit of a problem. I did see enough that I feel confident that this unit will turn and generate electricity in a conscious stream. See http://home1.gte.net/mikelob/WaterW-11.JPG for the setup. and http://home1.gte.net/mikelob/WaterW-12.JPG for the setup.



Summary: Cordless drills can be converted to generate a small amount of electricity in emergency. If hand cranked expect about 2 watts. If water powered could be tuned up to produce about 4 watts charging one cell. How long will the plastic gears last in continuous operation? This is anyone's guess. I think with regular maintenance of opening the gear box and relubricating that it may last a time. However, at about $10 per generator one could stock up on a few extras.

Power usage for a white LED is about 3.2 volts times .020 ma = .064 Watt. At 2 watts charging rate 1 min of hand cranking will keep one LED burning at full power for 31 minutes. 62 minutes for water power. Another way to look at it. If water power is charging at 4 watts running 24 hrs per day this would allow one to be able to burn all night for 12 hours 124 LED bulbs every night. This is all theoretical and in practice would need to charge 3 separate cells to get the necessary voltage to run the LEDs. They could be charged all at once in parallel then rearranged to run the LEDs.

scienceshack hand crank dc generator testing:

Charging 1 cell: .45-.55 amp (.33 watt)
Charging 2 cell: .2-.3 amp (.75 watt)
Charging 3 cell: .1-.2 amp (.67 watt)
Charging 4 cell: .02-.05 amp (.19 watt)
Cells were wired in series when charging more than one cell.
I only recommend using this unit for only charging 2 or 3 cells wired in series at a time. 4 is a waste of time and 1 is very hard on the gears that are weak anyway. There is even a note for the seller not to crank it with the unit shorted or it could strip the gears. Bottom line this is a light portable unit but not designed for much use. Use a cordless drill for a more durable unit.

Power usage for a white LED is about 3.2 volts times .020 ma = .064 Watt.

The battery packs that plugs into the drill. This now becomes a source of single cell batteries that can be individual charged. If one takes the cover off and attach a wire to each end of each cell without taking the series string apart, one can then charge each cell independently. Then depending on the voltage needed to run the intended device one can tap off that voltage. Another way is to break them into individual cell charge them and rewire temporally back into a series pack of the voltage necessary to run radios or lights etc.

4.2 ma back flow from one cell battery when not turning after being wet.

16" propeller blade got it up to 70 MPH and no will turn a drill motor and gears.

Comfortable Hand crank speed is about 85 rpm.

Exercise bicycle
I can easily (comfortably slow) turn the peddles at 55 rev/min
Ratio of peddle to wheel is 5 to 2.1 or 2.38:1
Bicycle wheel is turning at 55*2.38=131 rpm
Generator needs to run at about 550 rpm
550 rpm/131 rpm = 4.2 or diameter of bike wheel (19.5") to pressure wheel (19.5/4.2=4.6")
lawn mower wheel or wood

14.4 volt blue drill gives 9.8 volt max at 14.4 volt drill speed. 11 volt max.
2.5 amps at 6.2 volts charging 4 cells. 1.2 amps 5.9 volts.
4.5 amps 7.9 volts open circuit 12.87 votes. 12.6
4.5 amps 7.7 volts open circuit 12.5 volts

12 volt red drill gives output of 8.7 volt max at 14.4 volt drill speed

10.0 volts OC 2.9 amps 6.85 volts
Hand cranking red drill charging 1 cell: maximum of 4.5 amps approximately 2 volts. normal sustaining is about 1-3 amps. My maximum at night was 3 amps at 2 volts after changing out trigger sw and putting in diodes.

One drill turning another of the same type testing: Done under no load as a single drill and then turning another drill no load then generating current.

Charging 4 Cells	# of Drills	Input volts	Input Current	Input Power	Output Volts	Output Current
12 volt drill	500 rpm max					
Off OC	0.00	13.37	0.00	0.00	5.42	0.00
No load	1.00	12.40	1.93	23.93		0.00
Open Circuit	2.00	11.51	4.08	46.94		0.00
Generating	2.00	11.32	7.51	85.04	6.42	1.92
14 Volt drill	550 rpm max					
Off OC	0.00	15.46	0.00	0.00	5.46	0.00
No load	1.00	15.50	1.17	18.14		0.00
Open Circuit	2.00	13.83	2.89	39.93		0.00
Generating	2.00	12.68	6.83	86.51	7.29	3.04

Output Power	Power Losses	Percentages	
12 volt drill			
	23.62	0.49	average /drill gear train power loss
12.32	12.73	0.26	average /drill gear electrical power loss
		0.25	efficiency generating at test speed
14 Volt drill			
	19.36	0.36	average /drill gear train power loss
22.14	12.83	0.24	average /drill gear electrical power loss
		0.41	efficiency generating at test speed

Some factors that may have affected the measurements are the 12volt units were brand new just taken out of the box without break in. It also may have been more effect charging 3 cells at that speed and produced more power than charging 4. The trigger switch was left in the generating unit and just held closed for the test.

Bicycle driven cordless drill 12 V DC generators:

Can get up to 6 amps at 16.8 Volts or 100 watt as a maximum. More sustainable rate is 1 to 3 amps at 14-15 volts or about 15 to 45 watts.

Charging 1 cell I have seen over 9 amps at 3 volts and 7 amps at 9 volts for 4 cells. I think a maximum of 3-4 amps should be considered the maximum for continuous sustained operation. One should feel the generator and see if it is getting worm from time to time. This can be done by sticking a finger in the empty trigger switch hole and feeling the temperature of the metal housing to the permanent magnet motor or DC generator.

Red 12 volt unit:
take apart and test:
Clock wise facing the drill black is positive and red is negative from motor when generating.

When I hooked up a .5" 2600 rpm drill to turn this red 12 volt unit. I blocked the trigger so it was turning about half speed. It produced about 25 volts OC then rapidly degraded to about half that. Hand cranking I get only half the amount of output volts. I think one bar on the commentator flew off from the excessive speed. I think the sort circuit effect of laving the trigger sw not closed when I first tried it heated it up too much. I think the rule of thumb is don't try to generate more than the voltage of the input. In general don't go over half the input voltage as a generator this will insure the speed does not overload and ware too fast the gear train.

Determining switch setting for 18 Volt drill: Wire the trigger variable speed switch wide open or all the way held down. Hook up a dc volt meter according to the polarity that the battery was hooked up. For this drill if one lays the drill pointing to the left then the upper terminal is positive and the lower is negative. Now give a twist clock wise to the chuck with your hands (no crank). Watch the voltage reading and the sign plus or minus then give a counter clockwise twist and note the sign and voltage. Also note how hard it is to turn. Pick the direction that gives the most voltage and is easiest to turn. Note the L ver R switch setting. I found that for this 18 volt drill when R was set that a counter clockwise turn was best and gave a correct polarity as the battery hook up. In like manner when "L" was set then a clockwise turn worked best.

Warning: One can not leave it connected to a battery without a diode to keep it from draining the battery.

18 volt cordless drills: Fastest cranking gave 3.8 volts OC.
2 volts 3 amps fast cranking by hand.

Testing on the bicycle generator setup: see spreadsheet. My current thinking is: A 18 cordless drill might last longer than the lower voltage ones especially if one uses a series hook up instead of parallel. The gear ratio is lower in this unit with less drag than the lower voltages.

I don’t recommend running any unit faster than is was designed to run originally. I have noted that one gets about 80 percentage of the input voltage as output voltage when acting as a generator at rated maximum speed.