Hand Crank Generator

(9 May 05)

Converting a Portable Cordless Drill to a Hand Crank DC Generator

The unit is light weight (2.5 lb), portable, low cost ($10-$20) and can be used to recharge single cell batteries at from 1-3.5 amps. It can be made from a cordless electric drill in a primitive environment. See http://home1.gte.net/mikelob/CrankGen-6.JPG

A) The simplest way of how to make a hand crank DC generator using a standard 12, 14.4 or 18 Volt Cordless drill from Harbor Freight Tools (see below for more info). With no modification hook an alligator clip jumper to the two charging terminals (on the bottom that the battery plugs into) see picture http://home1.gte.net/mikelob/CrankGen-7.JPG. Note that when a 14.4 Volt 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.

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When one holds down on the variable speed trigger switch, the crank handle will began to rotate slowly acting like a drill. Grab the handle with your other hand and crank faster in the same direction it is turning (trigger switch still held down). If an amp meter is hook in series with the generator then one can tell when it changes from running as a motor to becoming a generator and begins to charge 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 an unknown 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 rechargeable battery (NiMH or NiCad). 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. The procedure outlined above gives 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.

Determining switch setting for 18 Volt drill: Wire or tape the trigger variable speed switch wide open or all the way held down. Look at the top of the battery for the plus and minus. Hook up a dc volt meter according to the polarity that the battery was hooked up. If one lays the drill pointing to the left then the upper terminal is positive and the lower is negative. Now give a twist clockwise 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" or "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: With the trigger switch wired or tape closed, one can not leave it connected to a battery without a diode to keep it from draining the battery.

Incremental improvements can now be made. Use a 6-10 amp external diode in series with the jumper wires (wired in the direction of the current flow). If one stops cranking the drill as a generator it will not continue to turn as a motor. The diode bocks the battery flow. One can then tape or wire 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 still used as a drill again. This reversal can be done by taking the diode out of the circuit and un-taping the trigger switch and plugging in the battery pack.

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. 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 a ratio of .02 which is not as high as the other two but not that far off.

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 18 volt item 90120-8VGA sells for about $19.99. The 12 Volt units are currently the lowest cost but after testing are the least desirable (harder to crank). The 14.4 Volt tests as most efficient with the 18 volt units coming in second due to ease of cranking (lower gear ratio) with resulting lower output power.

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. So use what you have available.

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 losses of the small amount of resistance of the variable speed trigger switch. The following items can be removed from the 14.4 Volt drill see picture http://home1.gte.net/mikelob/CrankGen-1.JPG.

The white wire from the PM motor is positive when cranked counter clockwise facing the chuck and negative when cranked clockwise for the 14.4 Volt drill. There is also an internal 3 wire component (transistor or SRC I don't know which) that has a heat sink that can sometimes be rewired to act as a diode. Do this in a pinch or emergency, not recommend using if you have a diode available. A diode will work more reliably. For the

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14.4 volt drill this 3 wire component will flow in one direction when the black wire is hooked to a positive source (the motor-generator) and the white is negative. I found this component will not work for the 12 and 18 volt drills as a diode. Sometimes it blocks the flow and sometimes is does not block the flow (unreliable).

Use a 4-6 cell battery and check current flow of this 3 wire component in the blocked direction. This back flow test should be well below one ma. If it is not, then use a rectifier diode from another source (junk parts). Otherwise your batteries will slowly discharge, if left hooked up and not turning.

For this 3 wire component I found for the 14.4 volt drill and clockwise cranking to hook black to black. For counter clockwise cranking hook white motor lead to black diode lead. See picture http://home1.gte.net/mikelob/CrankGen-2.JPG and http://home1.gte.net/mikelob/CrankGen-3.JPG. Note that the blue wire is not used and is left disconnected but taped up with electrical tape so it will not short to anything.

A diode must be used with the 12 and 18 volt units. When turning the chuck clockwise facing the 12 volt drill then the black lead from the motor is positive and red is negative. Note that one can use say 4 three amp diodes in parallel if that is all one can find. See http://home1.gte.net/mikelob/CrankGen-9.JPG

For the parts taken out of the 12 volt drill and the end result See http://home1.gte.net/mikelob/CrankGen-8.JPG

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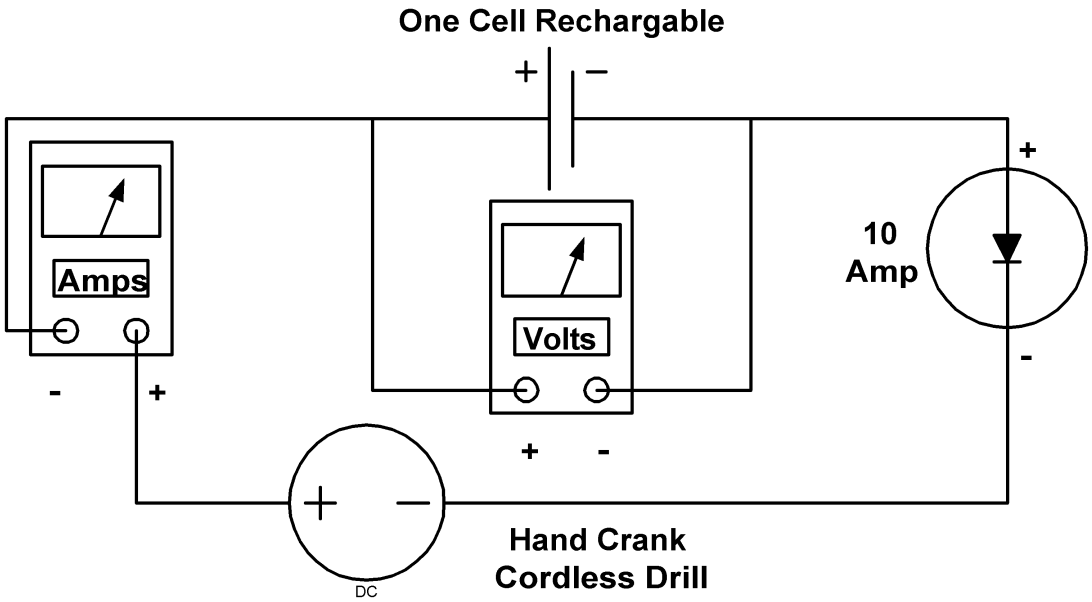
The following is the basic circuit of how to hook up a cordless drill to charge a single cell. Notice that no switch is needed. This will be true as long as the reverse flow on the diode chosen is very low. The amp and volt meter are for testing once satisfied all will work ok they can be removed from the circuit. http://home1.gte.net/mikelob/CrankGen-1.gif



The crank can be made from an 11" long by 3/8" diameter plated treaded rod. Bend at 1" and to make 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 it with lock tight or epoxy in the threads (to make it stay in a permanent location). I also tested a 3/8" ID rubber hose as a handle but didn't like it as much as a bigger diameter wood approach. Optional: Sand or file 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 a 5 inch radius. These are the wooden handle ones in the picture http://home1.gte.net/mikelob/CrankGen-5.JPG.

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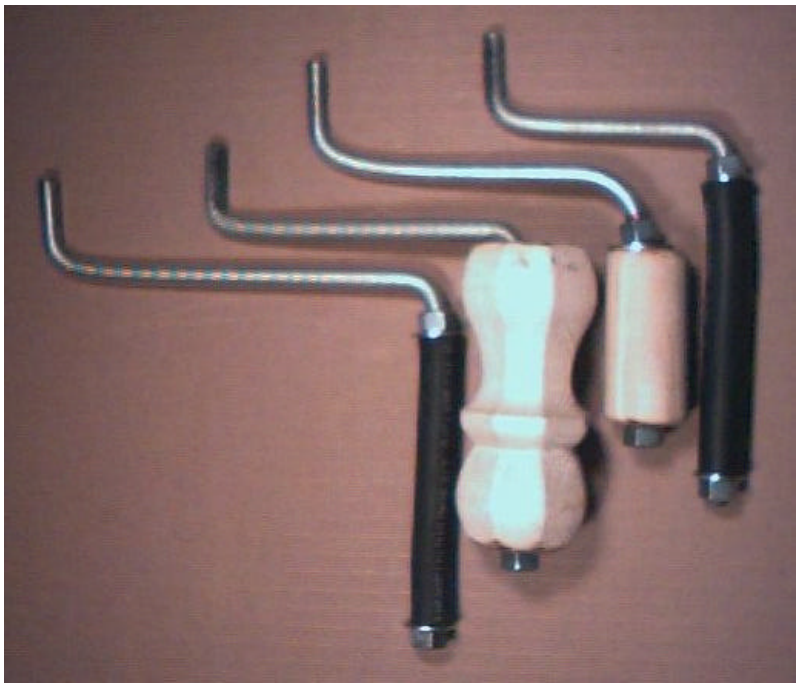

The 12 volt and 14. 4 volt hand crank modified drill generator weighs about 2 lb 2 Oz with the lead wires and clips. The crank is about 6-7 Oz. Total weight is about 2.5 lbs.

What to do with the battery packs that come with and plugs into the drill. This now becomes a source of single cell batteries that can be individual charged. One takes the cover off and attaches a wire to each end of each cell without taking the series string apart. These wires are run to the outside of the case where the alligator clips from the drill generator can be used to charge each cell individually. Then depending on the voltage needed to run the intended device one can tap off the voltage needed. Another way is to break them into individual cells charge them separately and rewire temporally back into a series to get the voltage necessary to run radios or lights.

Output test results of hand cranking One Cordless Drill.

Comfortable Hand crank speed is about 80-90 RPM (normal cranking). High speed is about 1.5 to 2 times that speed.

12 volt red drill charging one cell: (.5 to 3 watts)
Fast cranking open circuit 4.1 volts max and 1 to 2 amps at 2 volts or an average 1.5 amp x 2 volts = 3 watts. Normal Cranking produces .2 to .5 amps at 1.5 volts or an average of .35 amp x 1.5 volts = .5 watts.

14.4 volt drill charging one cell: (2.2 to 5.7 watts)
Fast cranking open circuit 5.4 volts max and 2.5 to 3.5 amps at 1.9 volts or an average 3 amp x 1.9 volts = 5.7 watts. Normal Cranking produces 1.1 to 1.6 amps at 1.6 volts or an average of 1.35 amp x 1.6 volts = 2.2 watts.

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14.4 volt drill charging two cells in series: (1.2 to 4.2 watts)
Fast cranking open circuit 5.4 volts max and 1.2 to 1.5 amps at 3.1 volts or an average 1.35 amp x 3.1 volts = 4.2 watts. Normal Cranking produces .3 to .6 amps at 2.75 volts or an average of .45 amp x 2.75 volts = 1.2 watts.

18 volt drill charging one cell: (1.8 to 4.8 watts)
Fast cranking open circuit 3.9 volts max and 2 to 3 amps at 1.9 volts or an average 2.5 amp x 1.9 volts = 4.8 watts. Normal Cranking produces .9 to 1.4 amps at 1.6 volts or an average of 1.15 amp x 1.6 volts = 1.8 watts.

Summary: Hand cranked cordless drills can be converted to generate a small amount of electricity in an emergency. Expect to charge a one cell at about 1 to 3.5 amps or 2 to 5 watts. For each watt of power generated for one minute (1 watt-minute) will run one white LED for 15 minutes. Thus 5 watts generated for one minute theoretically could result in 75 min run time for one LED.

In practice one would need to charge 3 separate cells to get the necessary voltage to run one LED. The cells could be charged all at once in parallel then rearranged in different battery holders to be wired in series to run the LED(s) or charge each cell separately while staying connected in series.

Bottom line: In an emergency one could crank out enough power to keep a night or task LED light going while it is needed.

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