

Bicycle Generator Using Cordless Drills

(9 May 05)

A stationary supported normal bicycle or an exercise cycle can be used to generate electricity and charge a 12 volt battery. The unit can be made from commonly available parts with not much time needed for assembly. The sustainable output power is between 10 to 45 watts with the peak power at about 100 watts. Low cost commonly available cordless drills can be used as the generator. See <http://home1.gte.net/mikelob/BicGen-10.JPG>



To properly choose, prepare, and wire the individual cordless drill generators see “Converting a Portable Cordless Drill to a Hand Crank DC Generator”.

Design Considerations

From the results of testing with an exercise bicycle I have come to the conclusion that approximate definition of pedaling speeds to be:

Slow ----- 50 RPM

Medium ---- 70 RPM

Fast -----90 RPM

The most optimum usable sustainable pedaling is slow to medium speed. Design the unit to allow a fast speed of 90 RPM without going over the rated drill speed, and then use it at less RPM.

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Let:

P = Pedal RPM (90 RPM)

G = Generator RPM (Can use up to the maximum speed of the drill or 550 RPM for 14.4 V drill and 900 RPM for 18 volt unit and 500 RPM for the 12 volt unit)

R = bicycle wheel to Pedal turns ratio = 2.38 to 1 = 2.38(for my unit). This ratio can be determined for any unit by counting the turns the pedal makes to complete one turn of the bicycle wheel.

D = diameter of bicycle wheel (19.25" in my case)

d = diameter of lawn mower or wood drill driver wheel

$$G = P * R * (D/d)$$

Or

$d = (P * R * D) / G = (90 * 2.38 * 19.25) / 550 = 7.5$ " diameter to give maximum power output for 14.4 volt and 12 volt drill units producing maximum power at fast pedaling speeds.

$d = (90 * 2.38 * 19.25) / 900 = 4.6$ " diameter to give maximum power output for 18 volt drill units producing maximum power at fast pedaling speeds.

In actual practice one finds that if the interfacing drive wheel is too small that it tends to slip or that too much spring tension is needed to keep it from slipping. This causes inefficiency, drag, and can cause excessive wear on the drill bearings. If one uses bigger driver wheels then this is reduced. But bigger wheels mean the drills will be turning at a slower speed and not generating maximum designed power. However, if the drill is capable of producing more power than can easily be output in a sustainable mode then this is not a problem and one could easily pull back on the speed. This is certainly the case with the 18 Volt drills. I found 5" diameter wheels to work best instead of the smaller 4.6" maximum power design determination. 4" works but had too much slippage at medium speeds. Even the 5" has a tendency to slip at higher speeds.

For the 14.4 Volt drills I found that 7" diameter wheel worked just fine with minimal slippage at all speeds. I would choose this setup over the 18 volt as being more workable and comfortable to pedal.

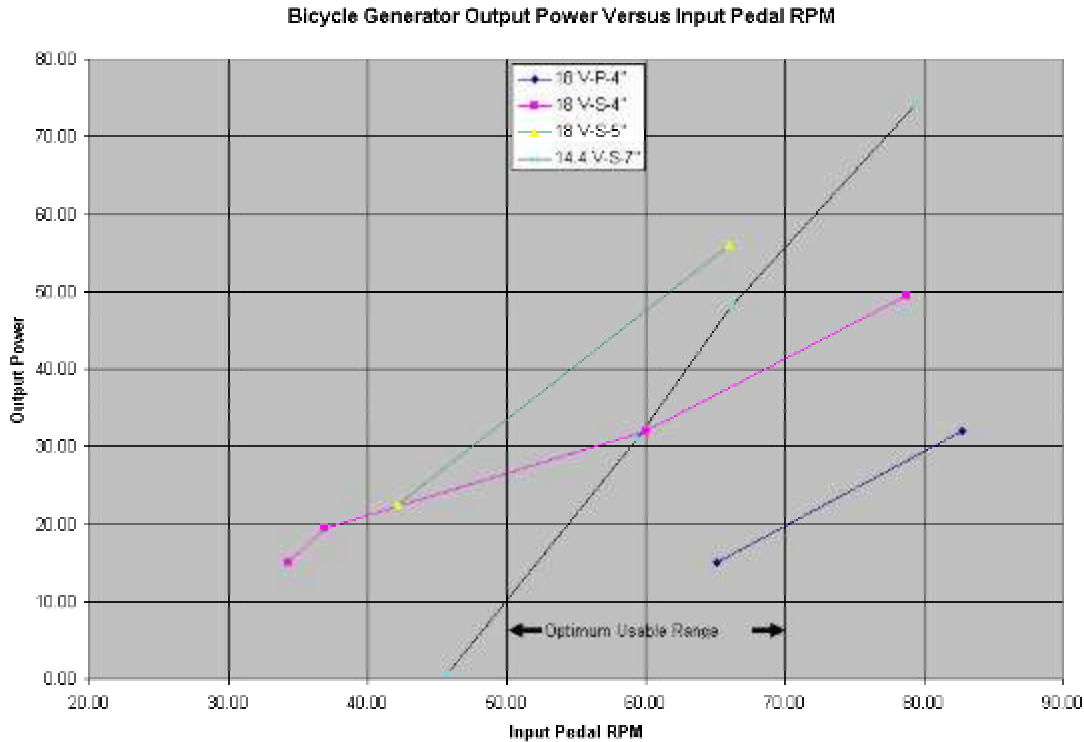
A 18 volt cordless drill might last longer than the lower voltage ones especially if one uses a series hook up instead of parallel. The gear ratio is lower in this unit with less drag.

Bottom line --- the above formula will get you into the ball park with respect to choosing the best diameter for your generator drive wheel. After that building and testing it will refine the result. The bigger the wheel used the slower the drill generators will turn given the same speed for input pedaling.

See the following graph that shows the power output for different RPMs of pedaling speed. <http://home1.gte.net/mikelob/BicGen-1.gif>

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18 V-P-4" stands for 18 volt drill wired in parallel using a 4" lawn mower wheel.

18 V-S-4" stands for 18 volt drill wired in series using a 4" lawn mower wheel.

18 V-S-5" stands for 18 volt drill wired in series using a 5" lawn mower wheel.

14.4 V-S-7" stands for 14.4 volt drill wired in series using a 7" lawn mower wheel.

Power from the first choice or the 14.4 Volt drills using a 7" wheel is about 10 to 55 watts in the optimum usable range of input pedaling speed. Power from second choice or the 18 Volt drills using a 5" wheel is about 35 to 60 watts in the optimum usable range of input pedaling speed. The 18 Volt units are estimated to last longer than the 14.4 volt when used in this application. A good non-slip wheel needs to be used and is the key if this is chosen.

It is interesting to note that the open circuit voltage is equal to about 37 volts for either unit at a high non-sustainable pedaling speed of 106 RPM (14.4 volt drills) and 96 RPM (18 volt drills).

Construction Notes

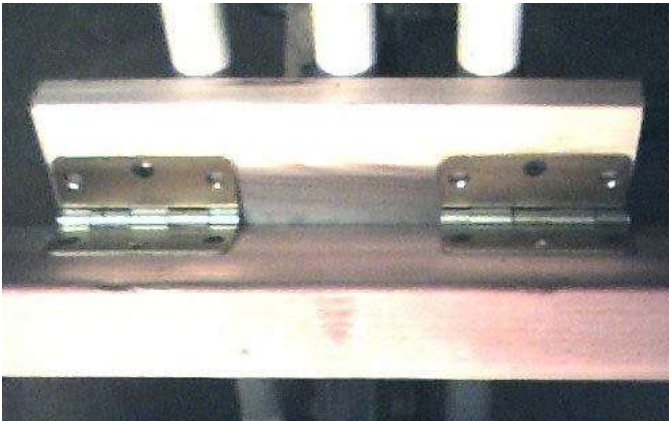
Use commonly available wood, dry wall screws, 2 door hinges, 2 small screen door strength springs, 2 hose clamps, wire, amp and volt meter, and car battery. See <http://home1.gte.net/mikelob/BicGen-9.JPG>

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The hinge (door hinges with dry wall screws holding it) point that holds the drills as generators in place is a 2" x 4" wood as show in <http://home1.gte.net/mikelob/BicGen-6.JPG>



A 1" x 4" peace of wood and 3/4 inch copper pipe clamps are used to hold the unit to the frame see <http://home1.gte.net/mikelob/BicGen-5.JPG>



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The base of each drill is screwed down to the hinged 2" x 4" base using 3 or more dry wall screws (one long screw is behind and out of site) and a wood spacer to level it out. See <http://home1.gte.net/mikelob/BicGen-13.JPG>



A hose clamp with wire around it is attached to a spring as show. See <http://home1.gte.net/mikelob/BicGen-12.JPG>



The following shows how the springs are attached to the frame to hold tension on the generator drive wheel with respect to the hinge point. See <http://home1.gte.net/mikelob/BicGen-2.JPG>



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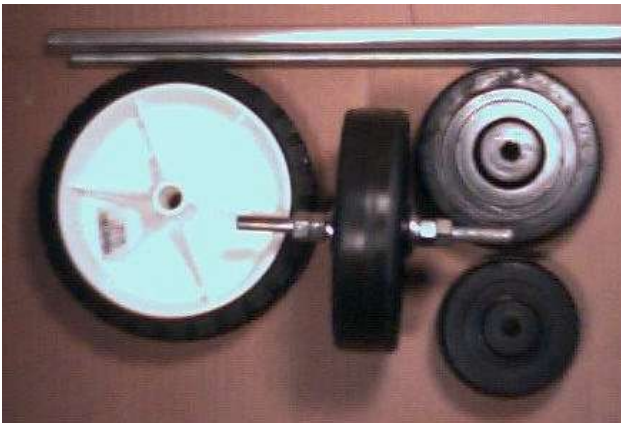
The following shows a 3/8" flat washer, lock washer, and two nuts being used on each side of the drive wheel to lock the 3/8" shaft in place on the lawn mower wheel. See

<http://home1.gte.net/mikelob/BicGen-3.JPG>



Lawn mower wheels come with different size holes. Typically 3/8 inch and .5 inch are the most common. If you use a wheel with a .5 inch hole for the shaft then use a short section of .5 inch OD aluminum pipe (Home Depot has it) as a bushing. A 5.5" length of 3/8 inch threaded bolt can be used for the shaft. A flat is sanded or filed on each of three sides to allow the drill chuck to easily grip the shaft. See the following for typical parts

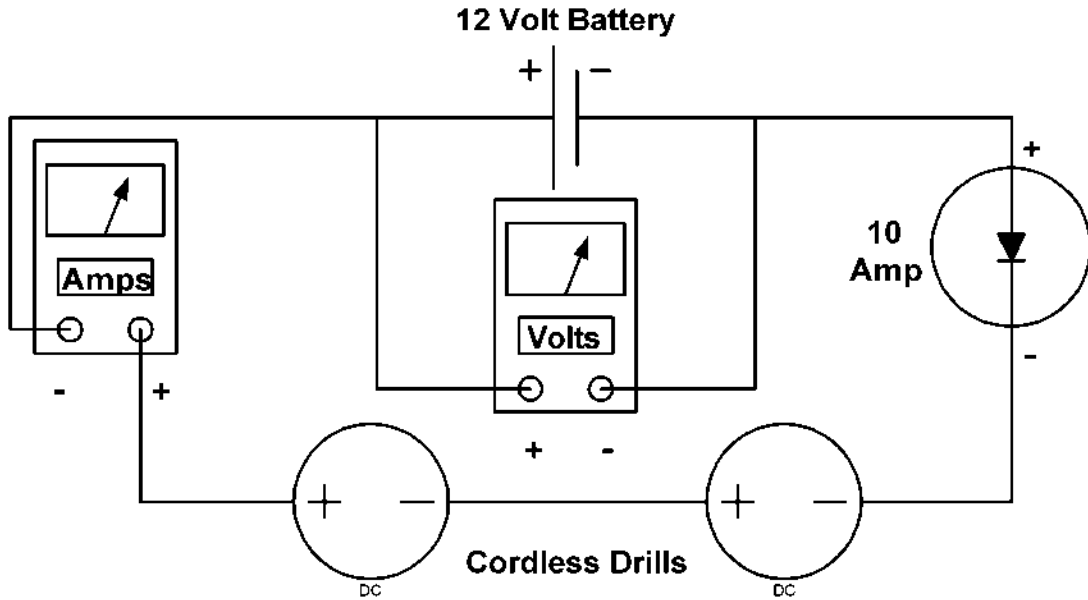
<http://home1.gte.net/mikelob/BicGen-16.JPG>



The following is the basic circuit of how to hook up 2 cordless drills to charge a 12 volt battery. Notice that no switch is needed. This will be true as long as the reverse flow on the diode chosen is very low. <http://home1.gte.net/mikelob/BicGen-2.gif>

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Summary: A bicycle driven emergency battery charger can be made rather simply from two cordless permanent magnet drills and commonly available parts that will produce from 10 to 45 watts charging capacity. This can be used to charge 12 Volt storage batteries or a modified drill NiCad battery pack.

Take the cover off the battery pack that came with the drill and attaches a wire to each end of each cell without taking the series string apart. These wires are then run to the outside of the case. Then depending on the voltage needed to run the intended device one can tap off that voltage. The series string of cells is charged all at once by hooking the bicycle generator across the battery pack as a whole.

MikeL