There are many pros and cons to this arrangement, but overall it works best for 12 volt systems. 12-volt wiring needs to be very heavy to reduce the losses of power inherent in the high currents required. Using two DC wires is more efficient than three AC wires. It is not hard to cool a rectifier up there in the wind. But the rectifier on the turbine is harder to inspect and repair if necessary. See also page 48 for how to mount this.

With DC transmission, the short-circuit brake is also more complex because you have to disconnect the battery before you connect the two wires to each other (see c/o switch in diagram on page 36).

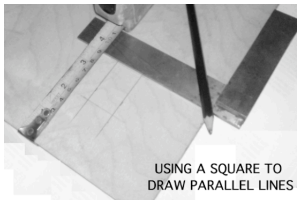
Making the coil winder

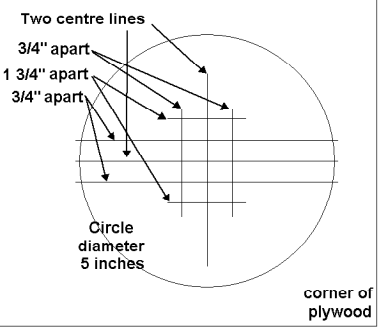
The coil winder is the same for any of the wind turbines. Only the spacer thickness varies.

The shaft is made of 3/8" threaded rod, bent into a crank shape, and fitted with a handle made of pipe. Use pairs of nuts tightened securely against each other to position the handle and also to retain the shaft in a hole through a piece of 1 ½" pipe that supports it. Weld the pipe to a piece of steel angle that you can screw to the edge of the workbench. Feel free to modify the details of the design. If you think ahead then the same upright piece of pipe can also be used as a stand for assembling the turbine on later. Make sure the pipe is long enough that the blades do not hit the floor.

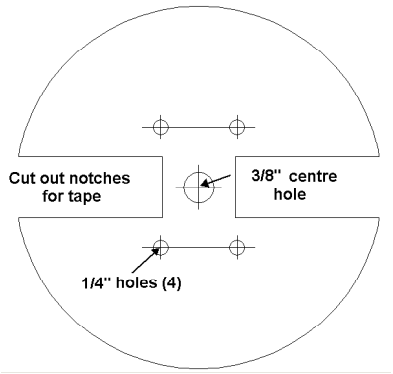
You need two 'cheek pieces' to contain the coil. They can be made from pieces of ½" plywood. Before cutting anything out, precisely mark out the hole patterns for the pins that the coil is actually wound on.

The simplest way to mark the hole pattern accurately is to work near the corner of a sheet of plywood. Use a square riding on the edges of the plywood to draw parallel lies. Keeping a distance of roughly 3" from each edge, draw two centre lines for the piece. Next draw two lines ¾" apart in one direction, and then two lines 1 ¾" apart at right angles. Your hole centres for the pins will be at the four corners where these lines meet. Draw a third pair of lines ¾" apart for the two notches that you will cut out for taping the coils.


USING A SQUARE TO DRAW PARALLEL LINES



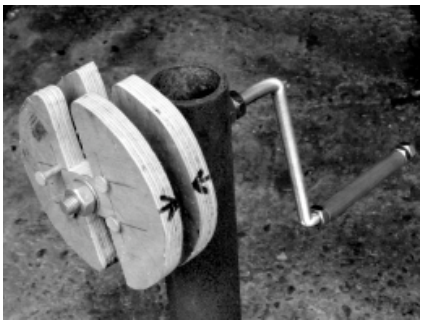
Draw the overall circle (radius about 2 ½") on the centre point. Cut out this notched cheek piece with a jig saw. Curved corners are a good idea, to prevent the wires snagging. Mark the shape of the second by drawing around this first piece and cut that one out too.

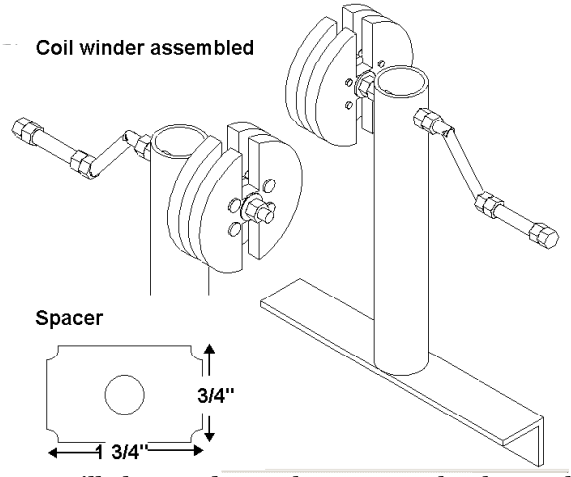


Carefully punch the centre point and each of the pin centres with a centre punch. Clamp the first piece on top of the second, and drill the holes through both pieces at once.

Using a drill-press, cut the five holes neat and square, through both disks. Make sure there is some waste wood underneath so that the drill does not burst out at the back. Start each hole by lifting the plywood so as to fit the tip of the drill into a punched hole, then bring the drill down so the disks lie flat on the support and drill through.

Mark the disks so that they can be reassembled in the same way in future. This will make it easier to fit the pins and to ensure that they are parallel.





You will also need to make a spacer that keeps the two cheek pieces the correct distance apart. This should be ¾ x 1 ¾" with corners cut off to fit between the pins. ½" thick (or 3/8" thick for the 4' turbines). You can adjust the thickness if the first coil attempt does not fit the stator. Drill a 3/8" diameter hole at the exact centre.

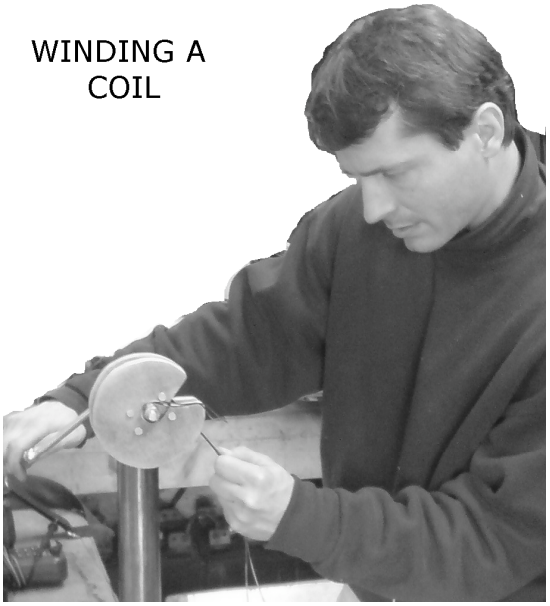
Assemble the threaded crank shaft into its supporting stand and lock the nuts to each other so that there is about 2" of bare thread projecting. Place a big washer, one cheek piece and then the spacer onto the shaft. They will stay on during the winding job. You may wish to glue the spacer onto the rear cheek piece. Make sure that it does not bulge outside the space defined by the four pins.

Put on the front cheek piece and clamp the assembly together with a nut and washer. Make sure the cheeks are assembled in the original orientation, using your marks. Fit the four pins into their holes. Tighten the nut securely so that the plywood pieces cannot spin on the rod.

Winding the coils

Place the reel(s) of wire on the floor beneath the winder. If it is a large reel then it is best to place the side of the reel flat on the floor, so that the wire pulls off the other side. If it is a small reel then it may be better to slide the reel onto an axle so that the reel unrolls as the wire is used.

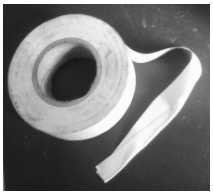
Do not manipulate the wire unnecessarily. Ideally it should be free of kinks and bends. But do make a sharp 90 degree bend about 8" from the end and fit this into a notch so that the tail comes out at right angles. Press the wire against the outer cheek and wrap the tail of wire loosely around the tail of the threaded rod. The photo shows the idea although the notch is different in this case.



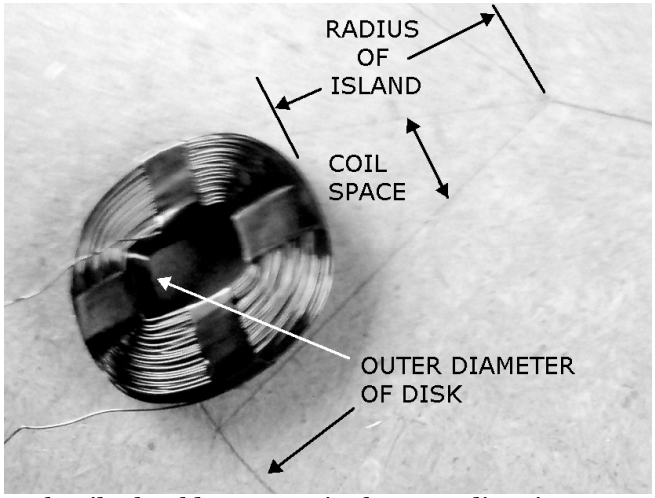
From now on you need to keep hold of the wire(s) with one hand and the handle of the winder with the other hand. Keep a gentle tension in the wire(s). If you release the wire then the coil may lose its shape and be impossible to salvage.

Start winding the handle and keep count of the turns. Make sure that the turns build up in an even layer, one wire snugly next to the other, until you have reached the rear cheek piece. Then start a second layer working back toward the front again. Do not allow the wires to zigzag in a random fashion, as this wastes space. You need to make coils that fit into the stator.

The count of turns does not have to be perfect, but try to be accurate. When you have reached the correct number of turns, do not release the tension in the wire, or you will lose the shape of the coil and it can be ruined. Tape the coil up neatly with a single layer of PVC tape passed under the coil at the base of each notch. (Fold the end of the tape in half against itself before you start each coil, to make it easy to feed the tape through. Cut this end off after.)



Snip the winding wire off leaving an 8" long tail at the 'finish'. Remove the four pins and the front cheek so that the coil is released from the winder.



Both tails should come out in the same direction as shown. When the first coil has been wound you should check its size to make sure that it will fit into the stator. For example if there are 12 coils they must fit within a 30 degree segment (9 coils each fit within 40 degrees, 6 coils each fit 60 degrees). Draw out the shape on paper or plywood. Lay the coil in its place so that the outer edge of the hole matches the outer edge of the magnet disk. If it looks fine, then carry on and wind more coils. You can also find out the ideal size for the island at this stage (see page 40).

I like to weigh each coil so as to check that they are consistent (+/- 5% say). A heavier coil may indicate a mistake with counting turns or it may simply be more loosely wound, but if one coil is radically different from the others then I prefer to reject it.

If the coil is well formed but does not fit the stator, then you may have to try again using a thicker spacer or making the central hole smaller, but this is very unlikely to be necessary if the coils are wound with care. If the coil is too small, then try winding with less tension or use a thinner spacer so as to get the optimum overall size.

Connecting the coils

In most cases, the coils in the stator will be connected series/star. See next page for an example wiring diagram using 9 coils.