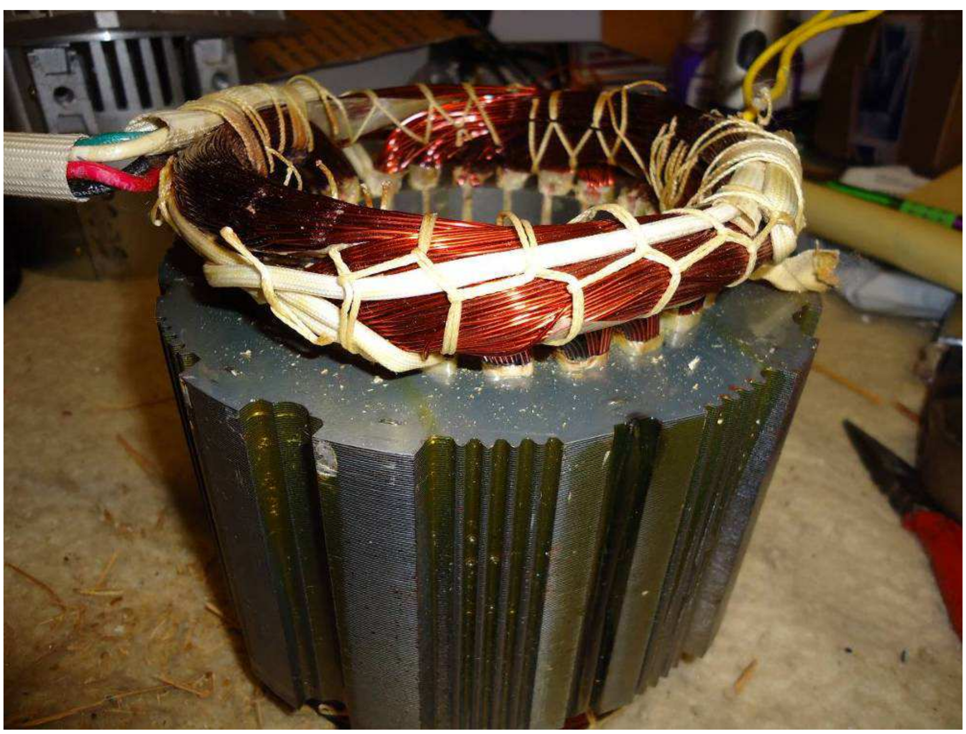
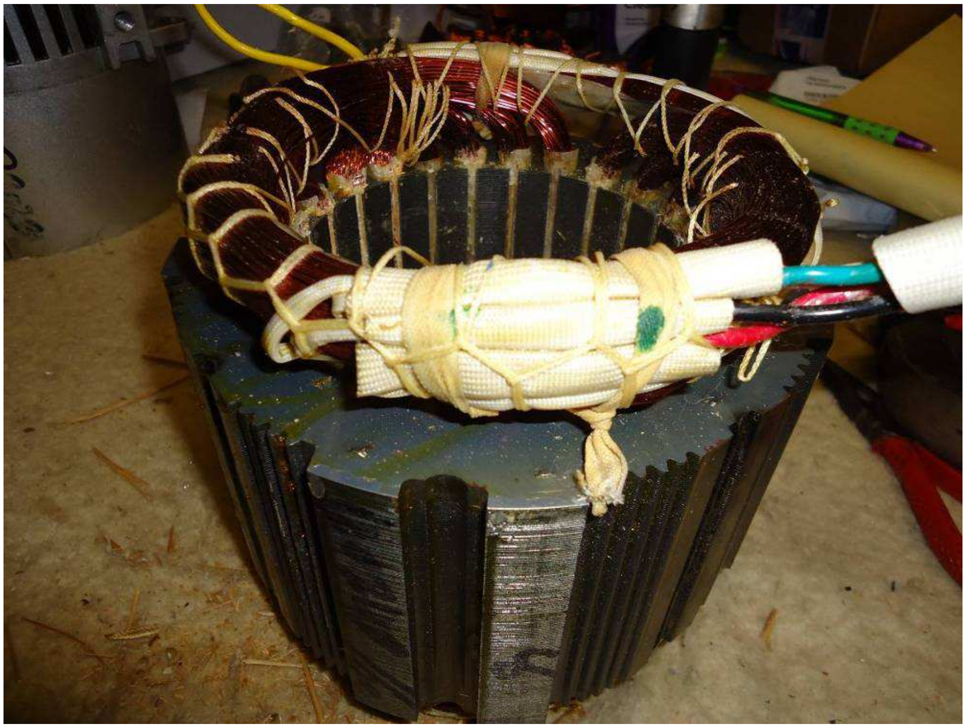
Rebuild of a 3.5kW generator stator.

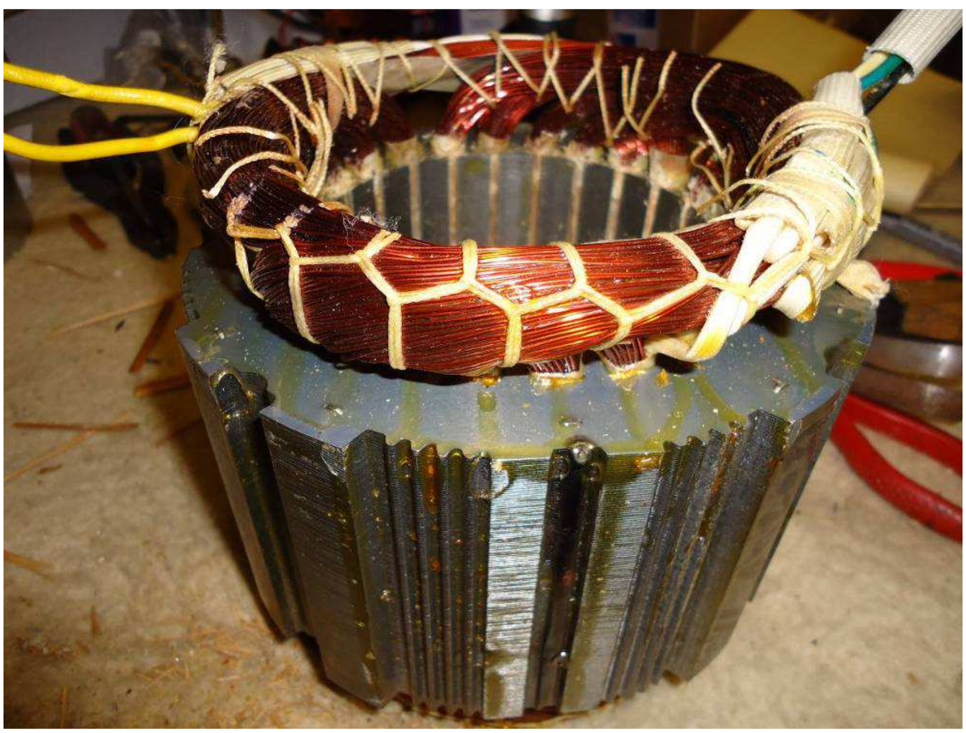
Jim Martz 7/1/13

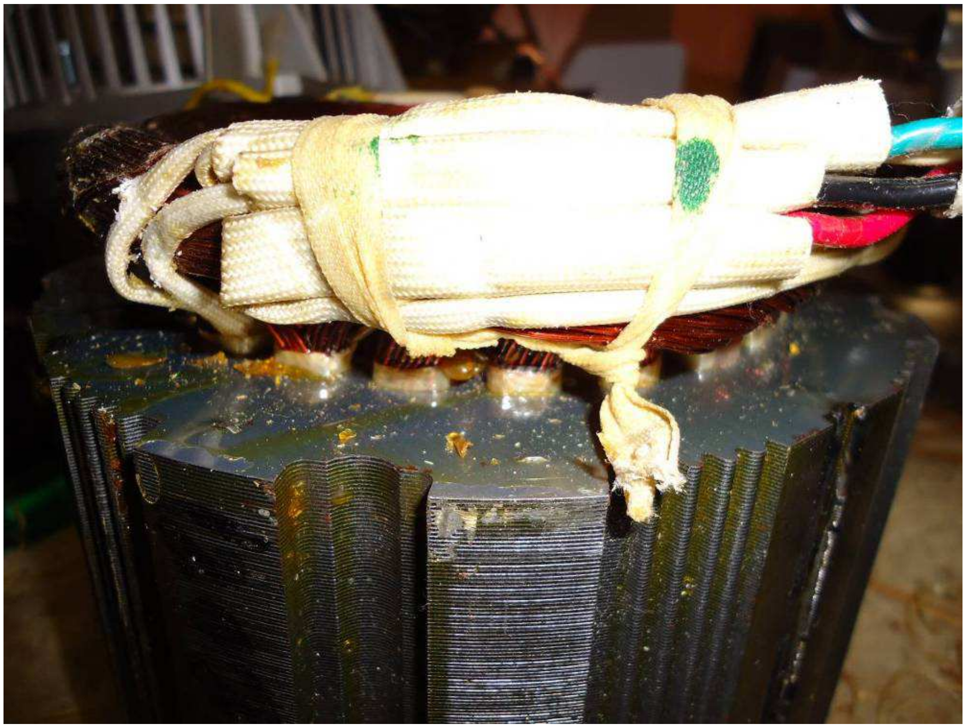
Burnt up 3.5kW generator stator. Notice blackened windings in the back.



Another photo of the bad stator. Take lots of photos to put it back together.


Another photo of the bad stator.


Another photo of the bad stator.


Another photo of the bad stator.


Another photo of the bad stator.

Number the slots so you can document it and put it back together.

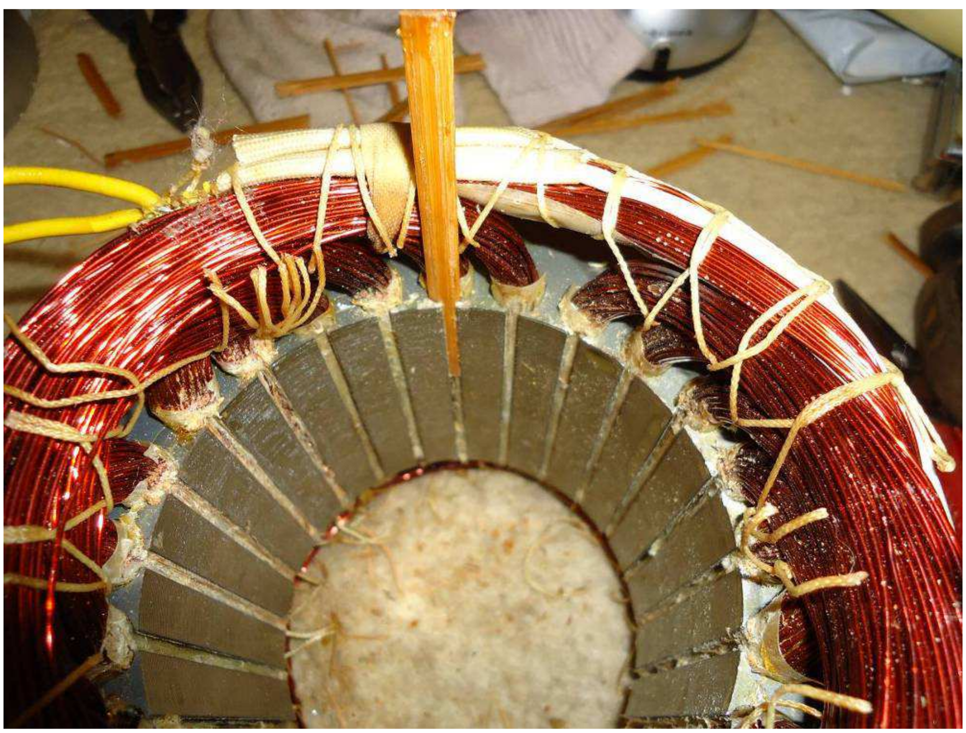
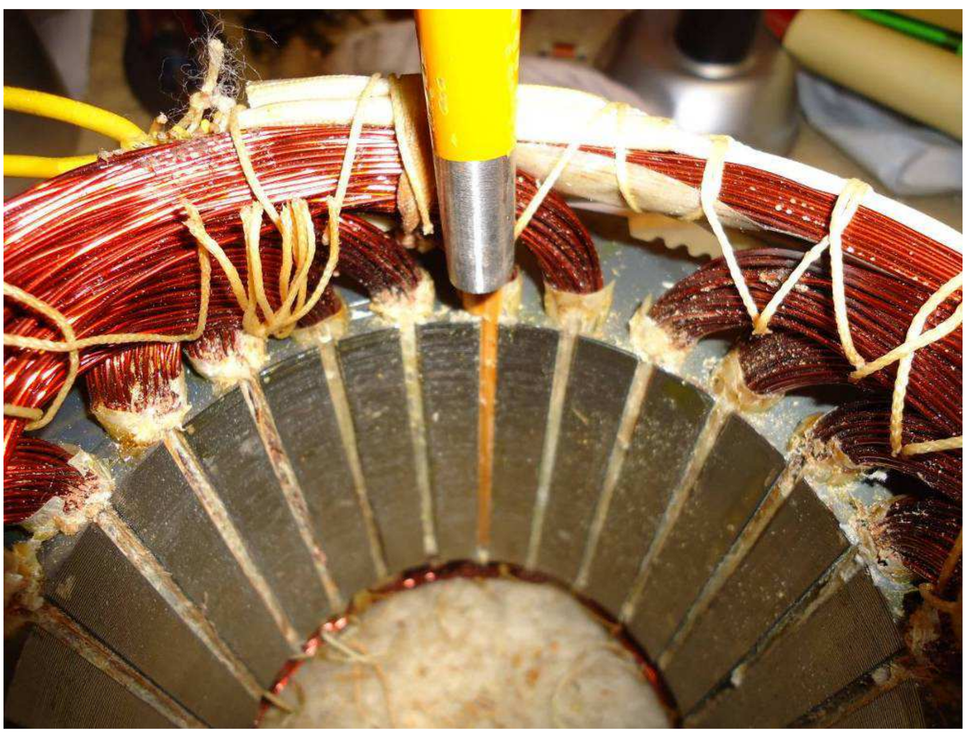
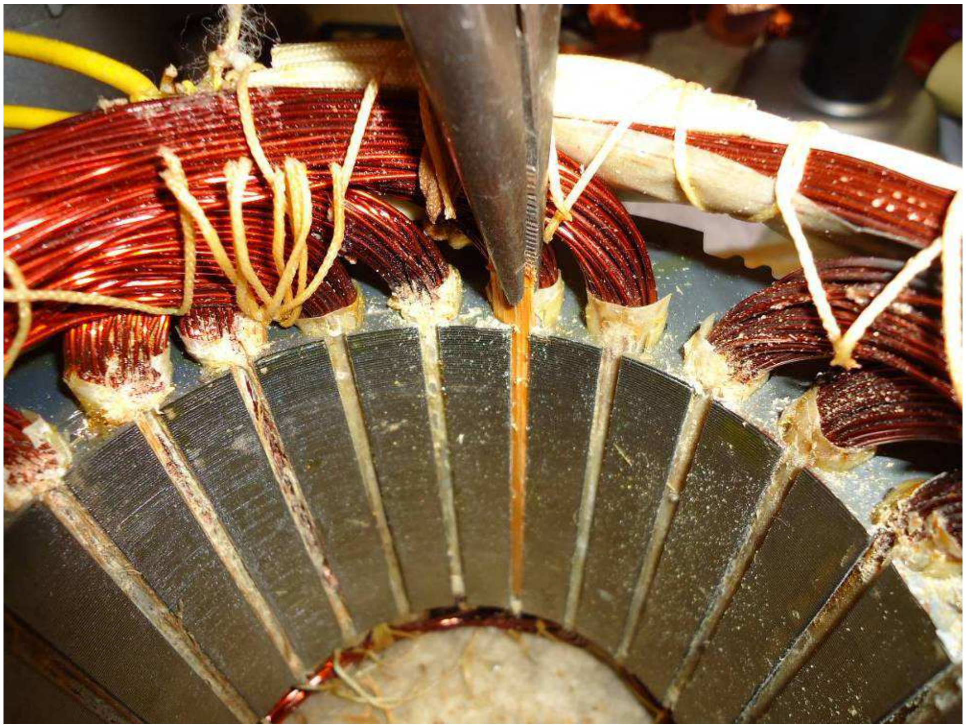


Photo of the wooden wedges that were in each slot.

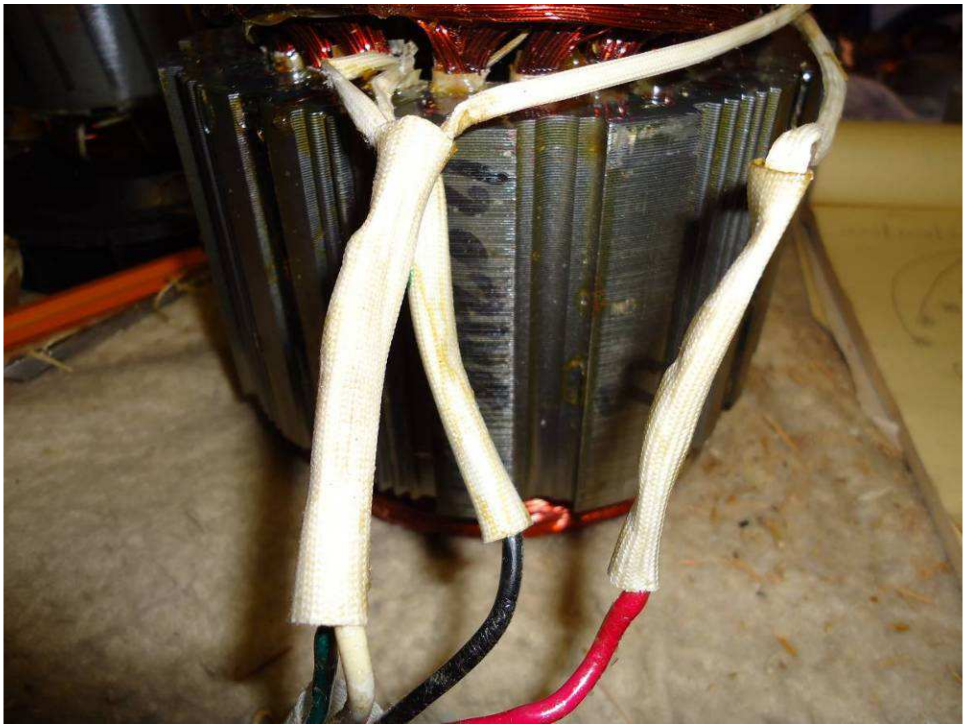

Another photo of the wood wedges.

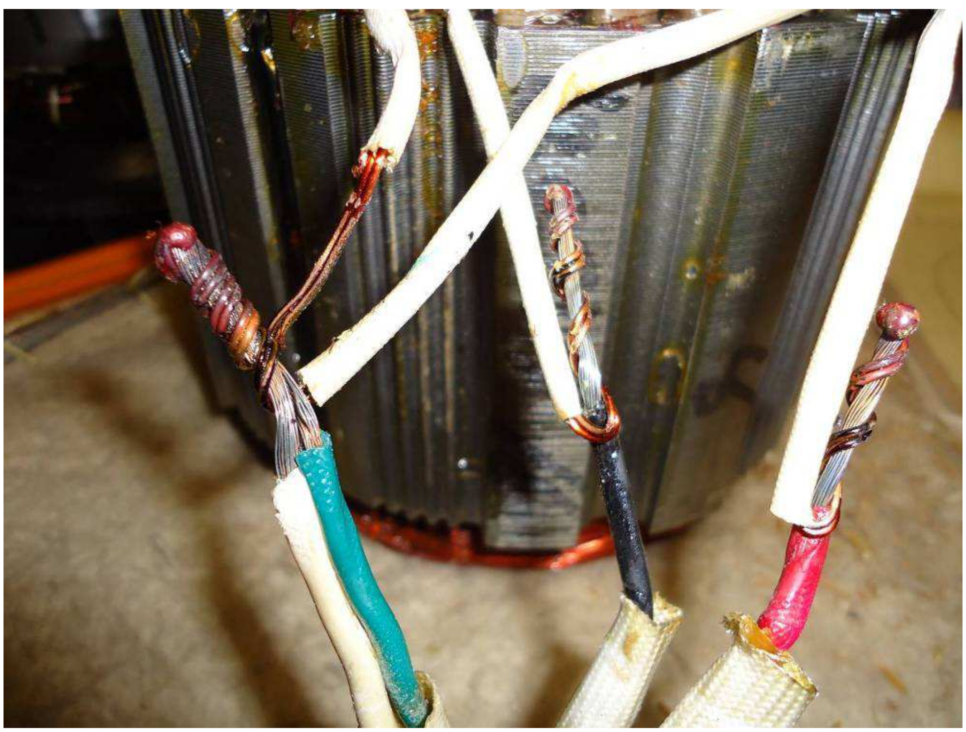

Try to break the wedges lose with a flat punch. Then drive it through the slot with a flat screw driver. Be carefully not to damage the stator steels. If you are unable to get some wedges out, don’t worry, you can cut through then down the slot and take them out in pieces with the winding.

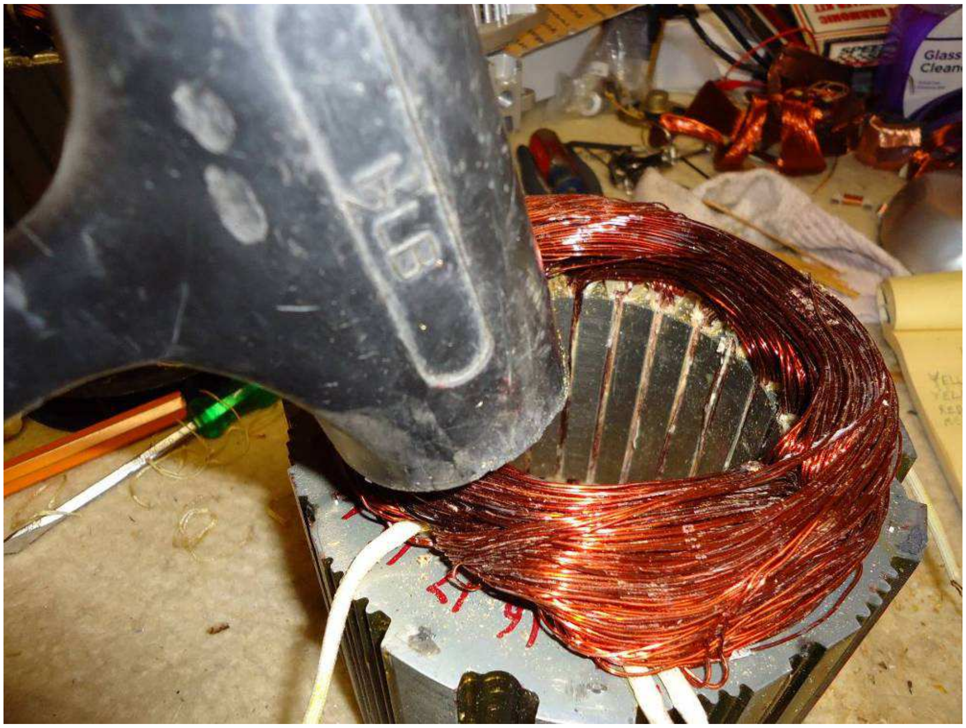


Once lose try to pull the wedge out with pliers.

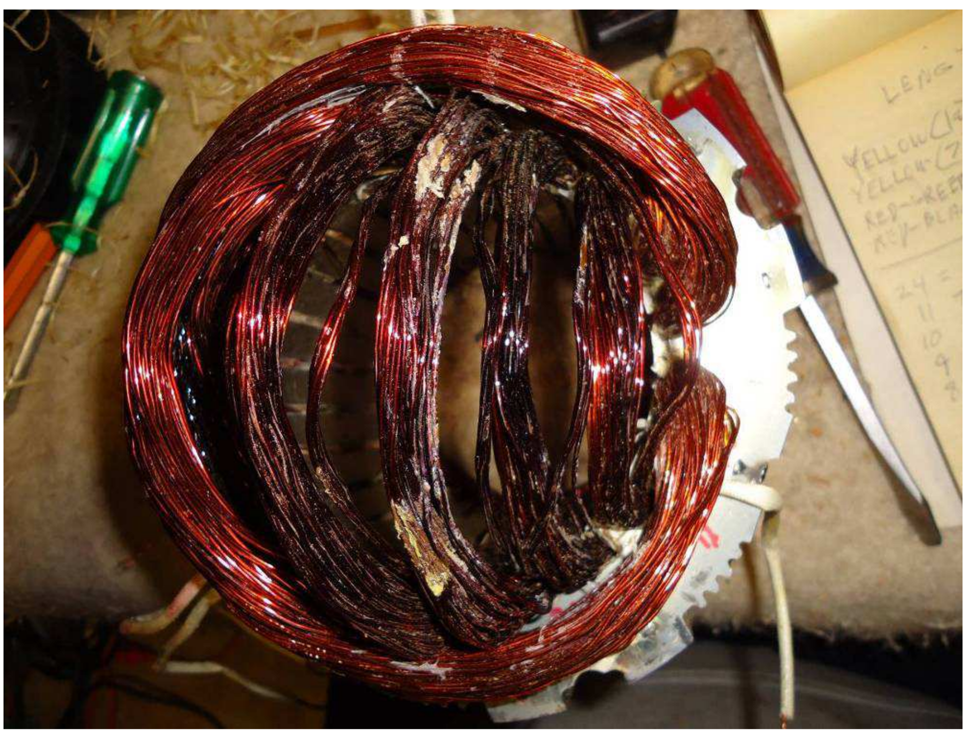
Take something and run up and down the slot to cut through the insulation and remaining wedges covering the windings. A 3-in-1 tool worked good for me.


Make notes as to what wires connect to what slots.

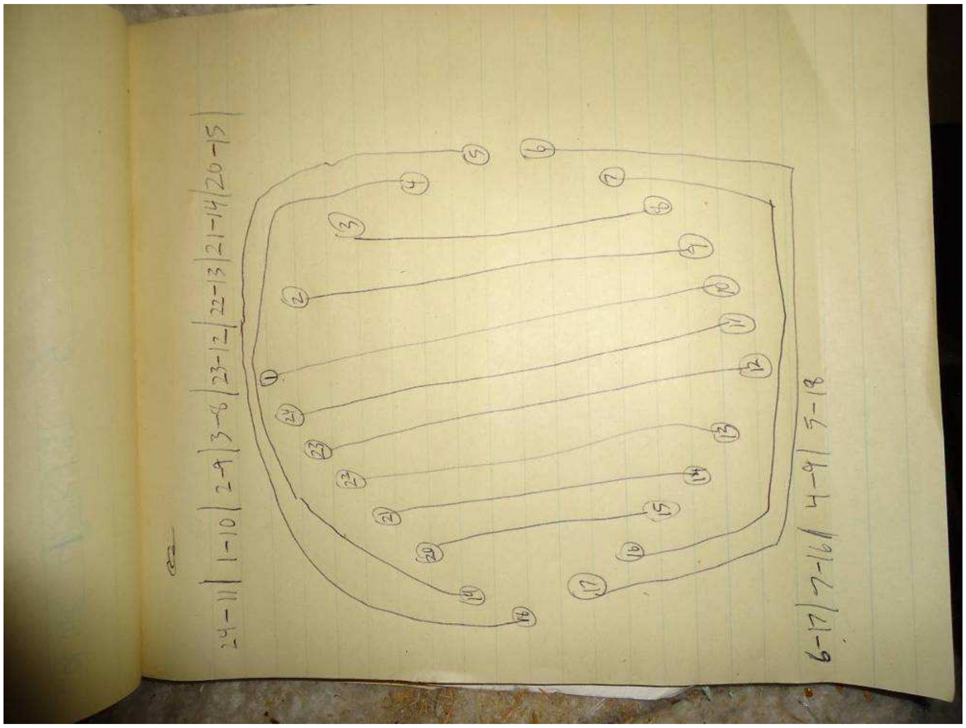

Exposed connections, note the ends are welded.



Beat the windings around with a rubberized hammer to loosen the windings up from being stuck together with varnish. Note, a motor shop would normally just bake it in an oven for a few hours and burn the varnish off.

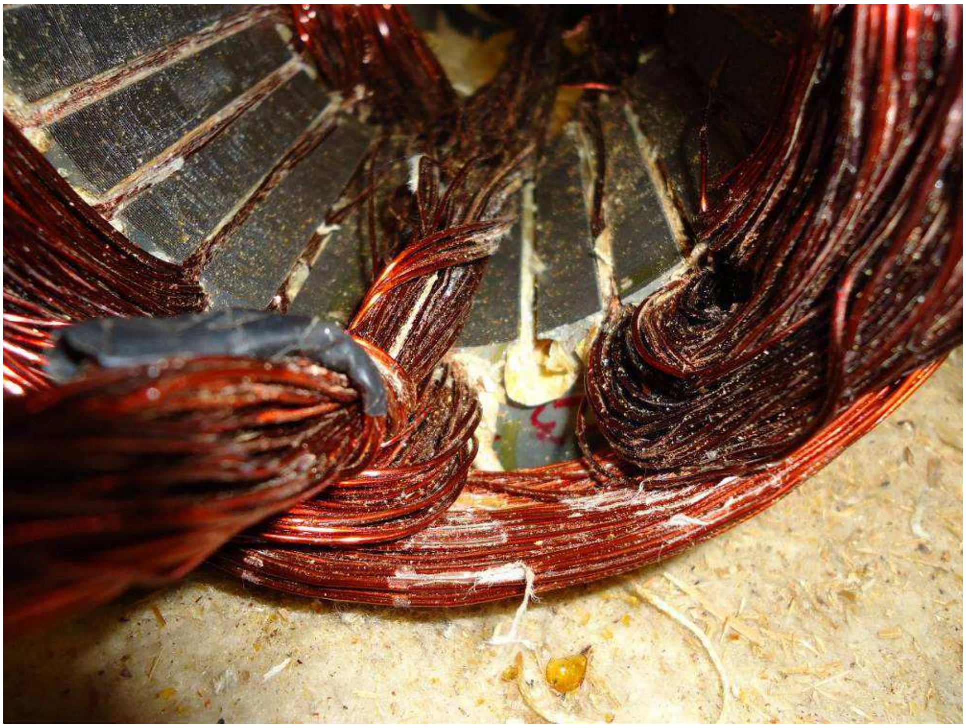


Bend the windings up and note the inter connections from one winding to the next, slot to slot connections. The burnt up windings are more obvious when taken apart.

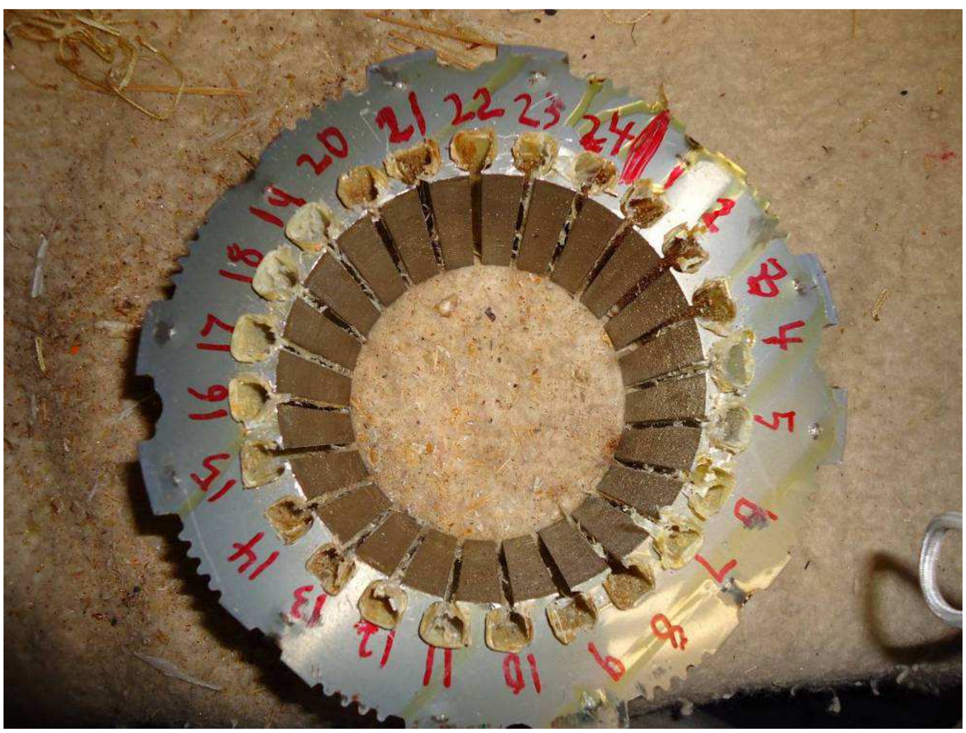


A quick diagram of the winding locations.

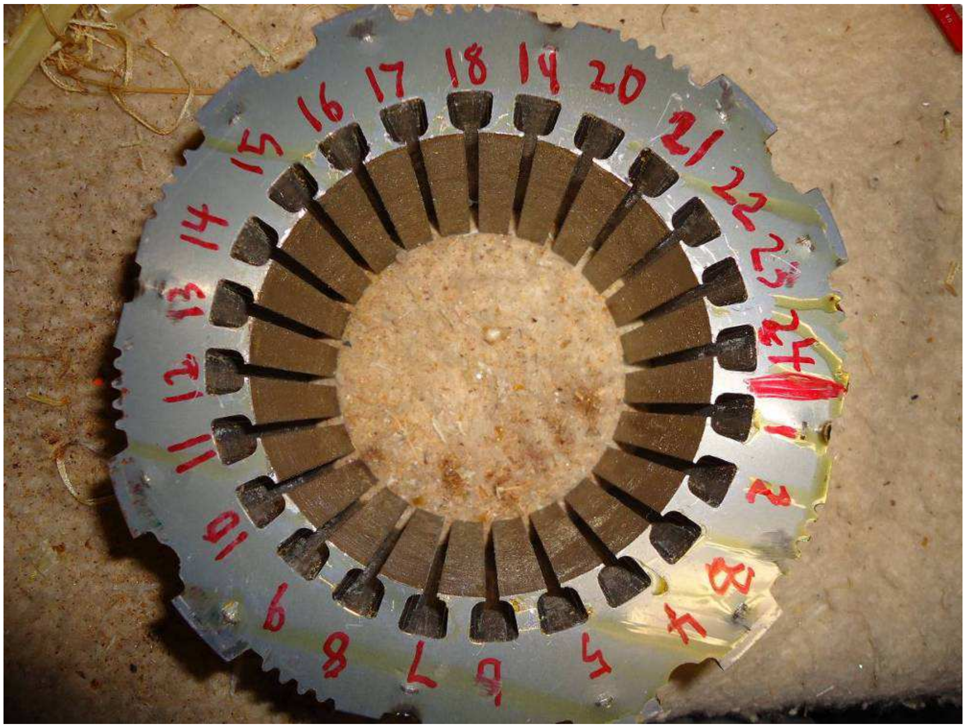
Remove each winding a few wires at a time to fit through the slot openings.



A slot with all the wires pulled out of it. Make sure to label each group of wires after they are pulled out of the slot.



The stator core with all the windings removed.

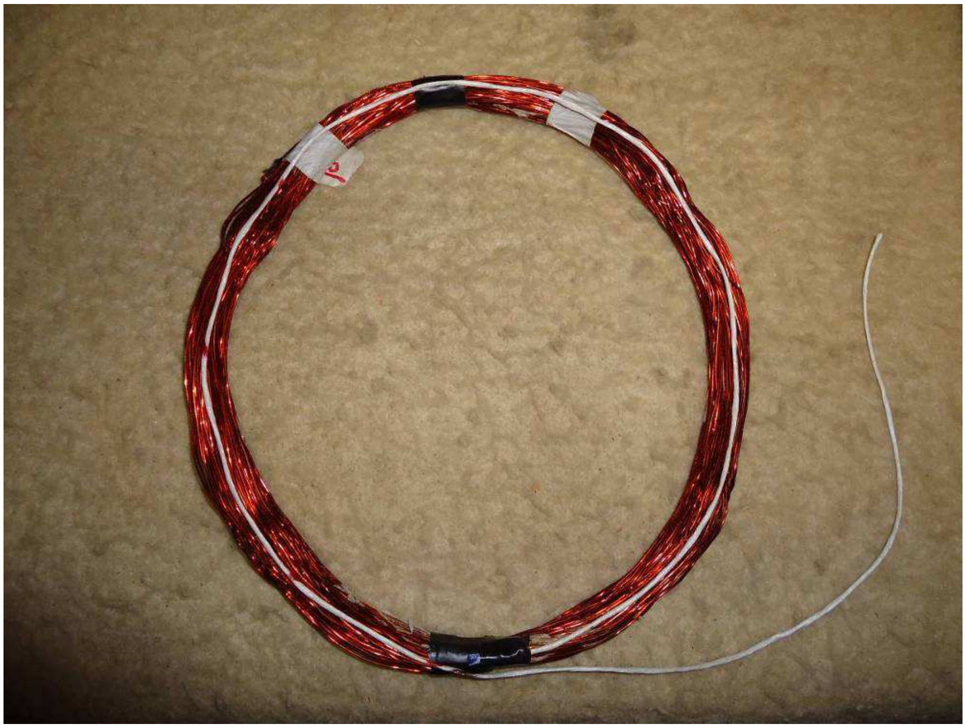


Carefully run a small screw driver between the core and insulator in each slot to break it free and remove it.

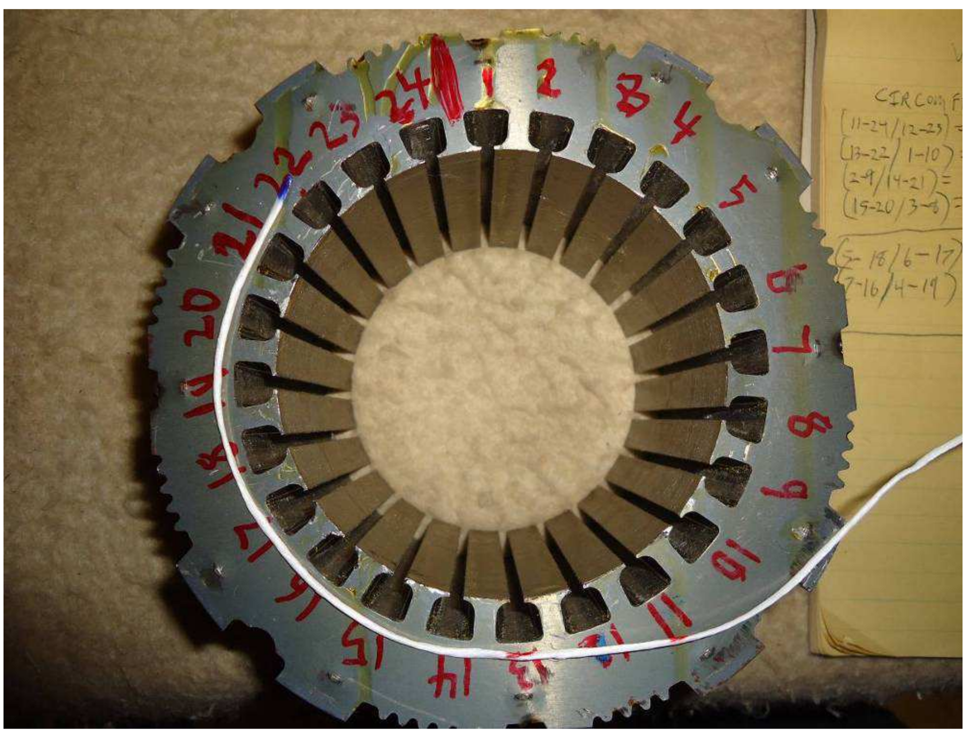
A test tube cleaning brush I had that is just the right size to fit in the slots.


Run the brush up and down the slots to clean out any remaining varnish in the slot.

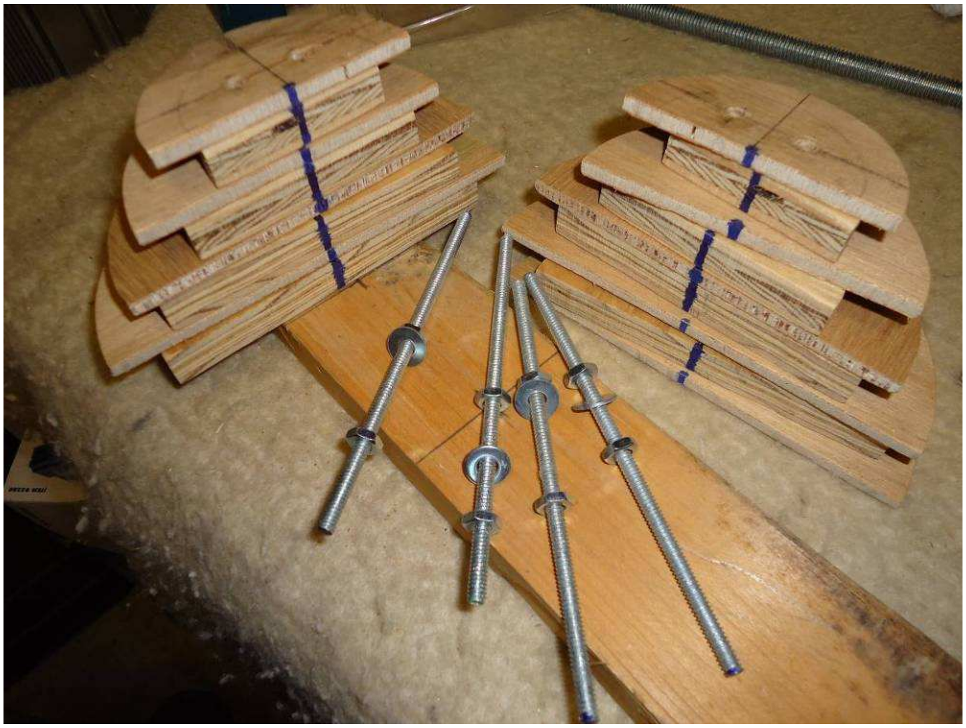

All of the windings that had been removed from the stator. Note that each winding is labeled indicating what slots it come out of. Also count the number of turns in each winding and note it, some winding may have a turn more or less then others. Also there is often 2 or more parallel wires that make up the windings. In this case the main winding used 4 parallel wires and the aux. windings used 2 parallel wires.



Straiten each winding out into a circle, then a string laid around the center can be used to easily measure the circumference of the winding. This is used to build the winder.



The ½ circumference ends of the windings can be found by laying a string a little bit behind the slots between each slot that the winding goes through. Note, that I just used a string longer then the longest distance and just marked the string with a marker.

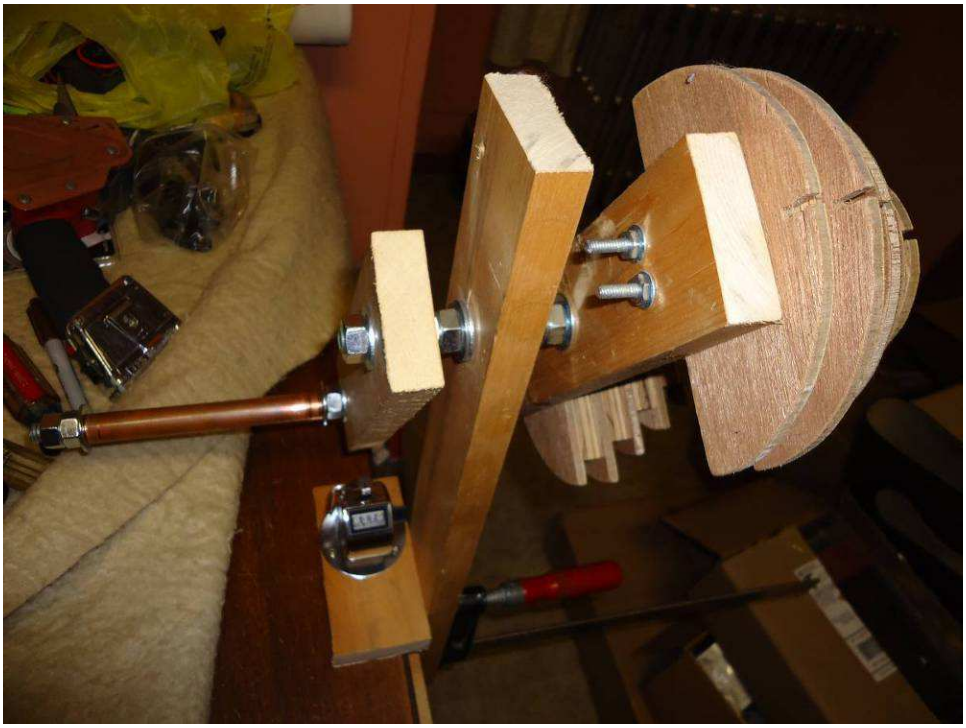


Circle pieces cut in two for winding the windings on.

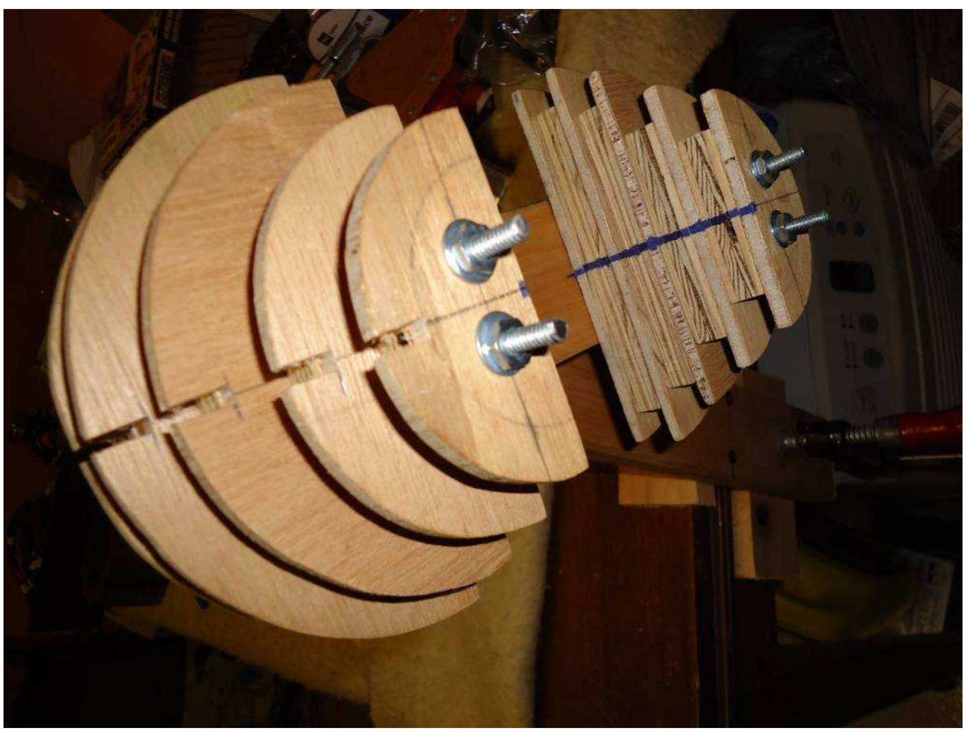
The circumference of these circles is calculated by first listing the main winding circumferences(4 different sizes in this case) and subtracting two times the ½ circumference end lengths of each, measured as above. The resulting number is twice the distance between the ½ circumference ends, take this number and find the average. Divide the calculated average by two, this will be the distance between all of the winding mold half circles.

Now that the distance between the winding mold half circles is known, we now need to adjust the ½ circumference end lengths. Now subtract two times the distance between the mold half circles from the circumference of each winding. The result is the circumference of each of the winding mold half circles. This circumference can then be divided by 2π to get the radius of the mold half circles.

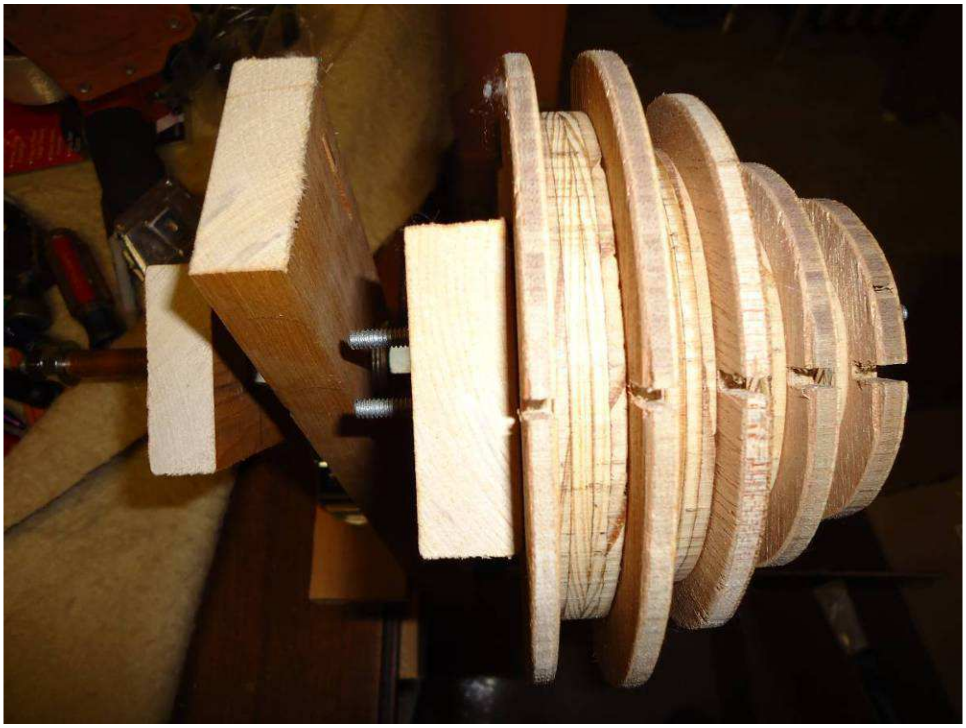
For example if the winding circumferences are 600mm, 545mm, 460mm, and 395mm. Also the ½ circumference end lengths are 190mm, 155mm, 120mm, and 90mm respectively. The distance between the ½ circumference ends is calculated:
600 - 2*190 = 220mm, the other 3 are 235mm, 220mm, and 215mm respectively.
The average distance between the ½ circumference ends is then (220+235+220+215)/4 = 222.5mm, this can be rounded to 220mm. So the distance between the winding mold half circles would be 220 / 2, or **110mm**. Then we back calculate to get the winding mold half circle circumferences. For the first winding 600 – 2*110 = 380mm, the other 3 are 325mm, 240mm, and 175mm respectively. Then each of these circumferences is divided by 2π to get the radius of each mold half circle, **60.5mm, 52mm, 38mm, and 28mm** respectively.



A photo of the completed coil winder.



Another photo of the winder. Note that the mold half circles are ½ plywood and the separator between them is 3/16 plywood. The separator has a radius 10mm grater then that of each mold half circle. There is also a notch cut into the separators to allow for the wires to jump to the next size coil.


Another photo of the winder.

The counter that I added to count the number of turns.

I had to add a small screw to slow down the counters button from popping back up instantly. Before I added to screw the counter would stop counting after a few turns.

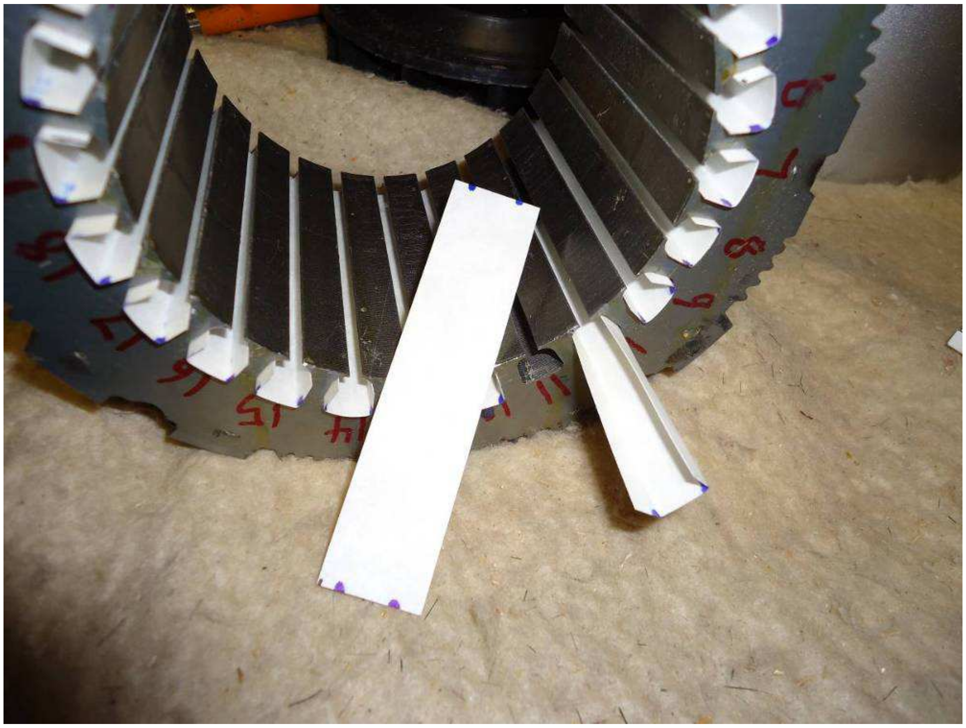
Wire going to the winder, ready to start winding the coils.
Make sure to wind the coils in the correct direction.

A real “First Class” wire spool holder.

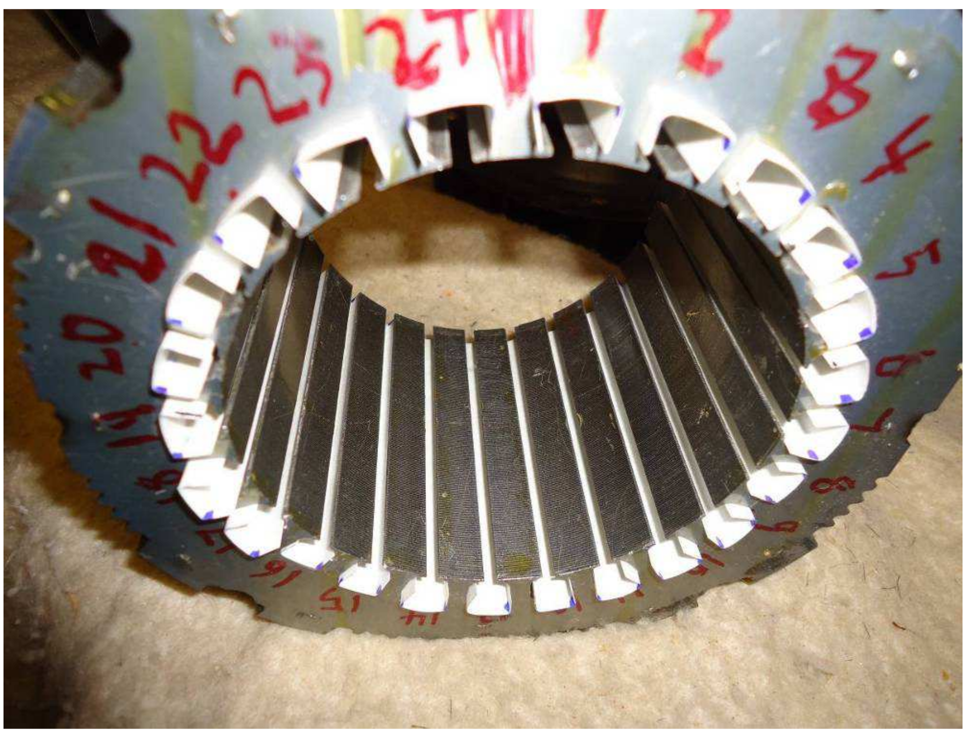

Four of the main winding coils wound. After labeling and removing these completed coils I taped them fast to the board at the front of the winder.

Second set of 4 main windings. Note that each side of each coil is labeled with the slot number, before being removed. You can also see the first set of main winding coils hanging there, after I had un-taped it from the front board.
The 4 Aux. coils were made in the same way, I just needed to separate the mold half circles a little more, and only the first two steps on the winder were used.

All 8 continuously wound main coils, after being removed from the winder.



Made the slot insulators by cutting a square piece of 10mil nomex and bending up the edges.

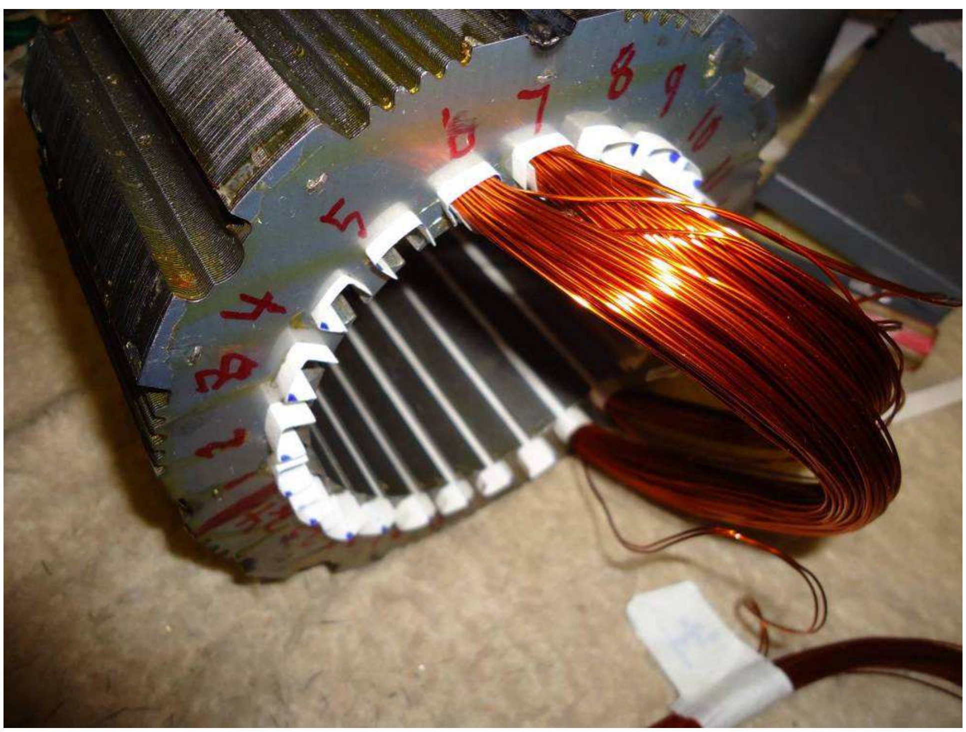


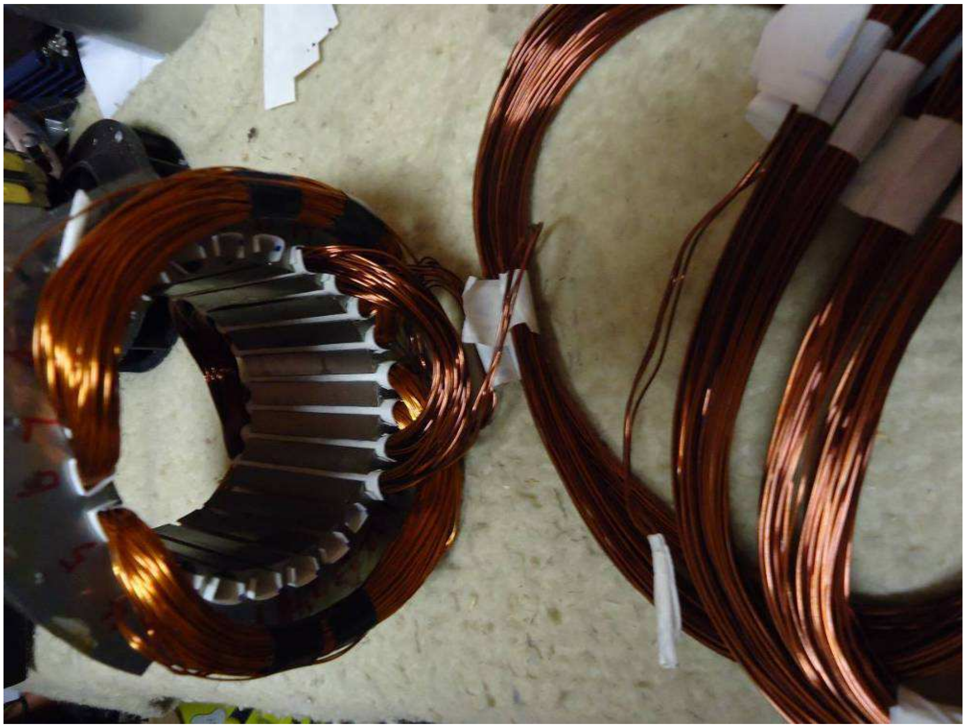
All the slot insulator inserted into the core.

The first coil of the Aux. winding placed into its stator slot.

Inserted the slot cover, made of a square piece of 10mil nomex.


The first two Aux. winding coils inserted.


Another photo of the first two Aux. winding coils.

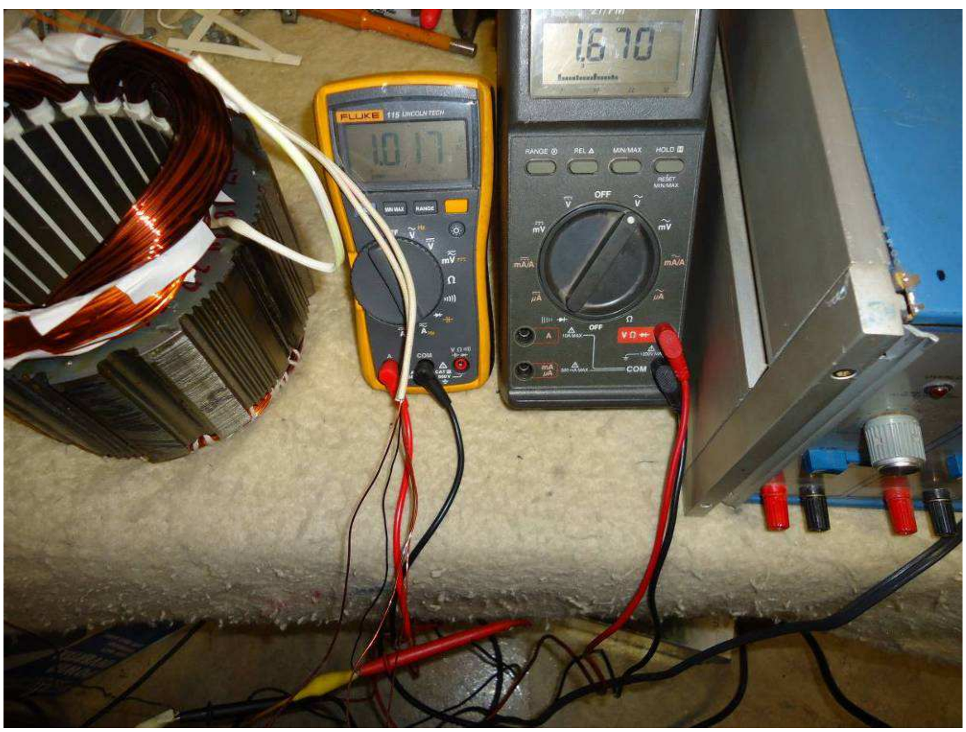

All the Aux. coils installed and the first two coils of the main winding.
Note to start with the smaller coil and work to the larger coils.


All the windings installed in stator core.

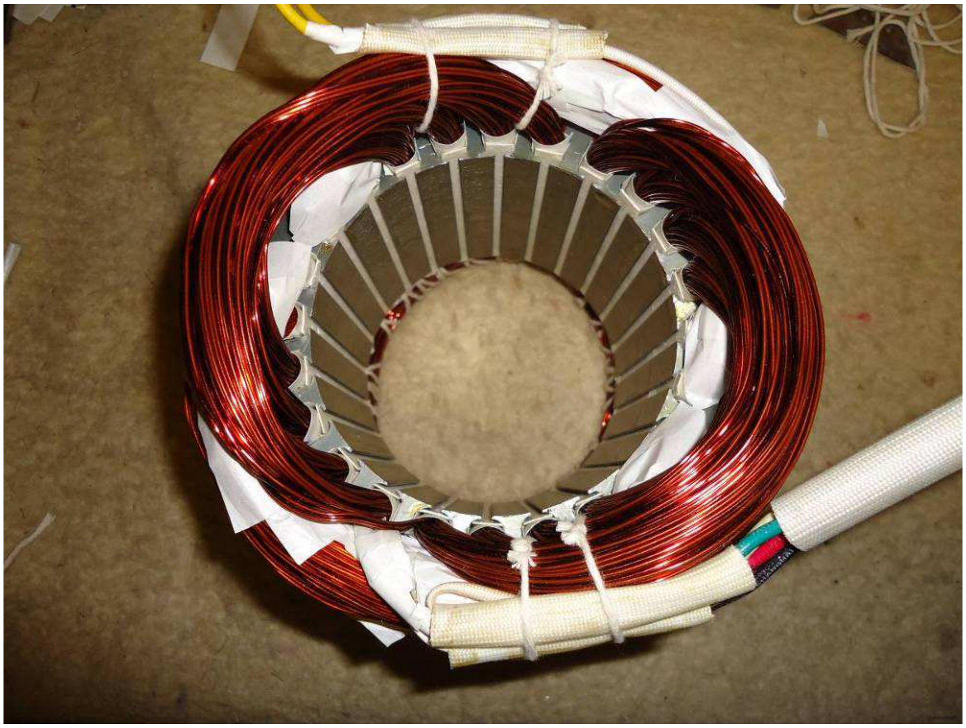
Some tape is placed between the Aux. coils and the main coils, for insulation.
Then the coils are pushed into about there final position.
After that a small piece of 20mil nomex in slid into the top of the slot as a wedge, this replaces the original wooden wedges.

A rubberized hammer may be used to gently tap the coils into place.

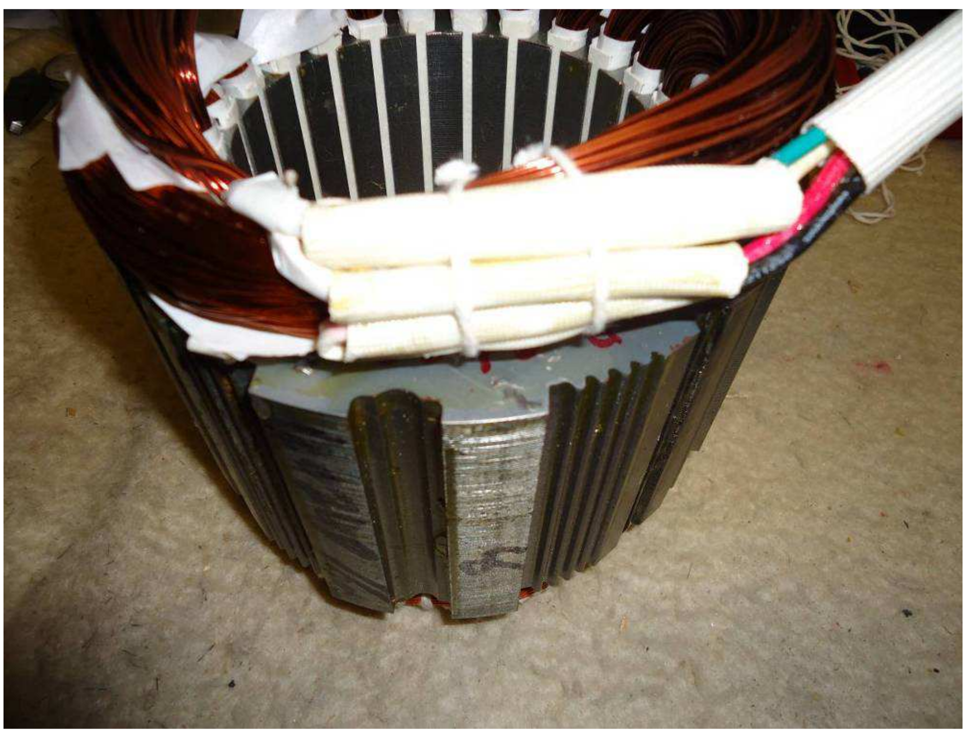
More taping the coils into shape.



Before lacing and varnishing, do some basic tests. Do a continuity test between each wire of a parallel wire winding, between each set of windings, and each winding to the core. Also as seen in the above photo, connect a variac across each of the wires in the parallel wire windings and make sure that each wire has about the same voltage and current. The meter on the left is the current(raised to about 1A), the meter on the right is voltage.

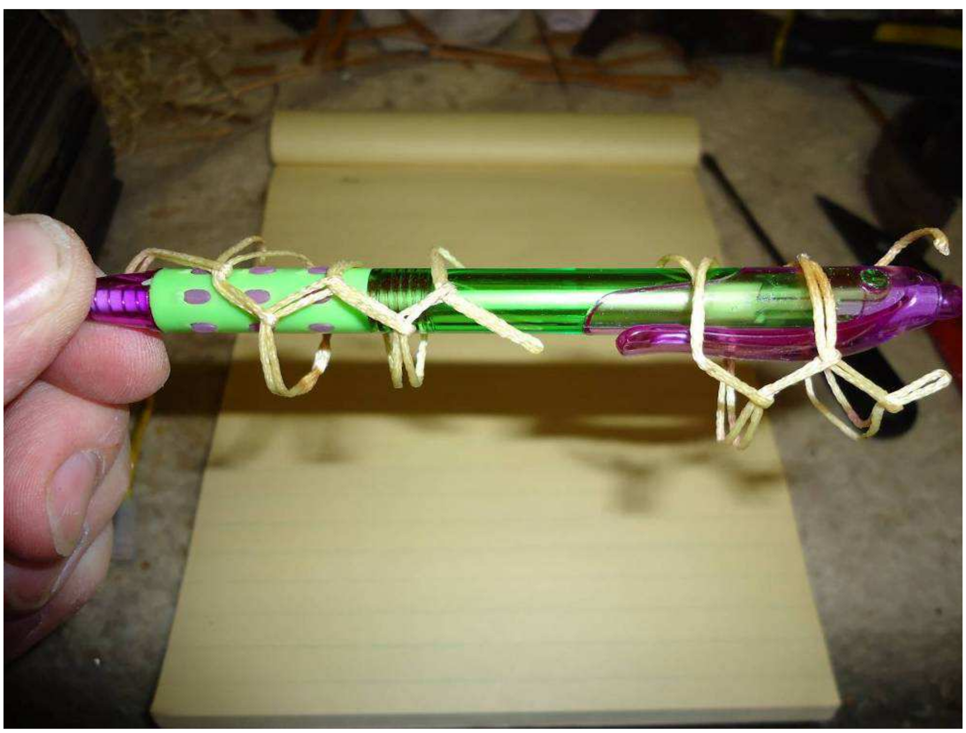


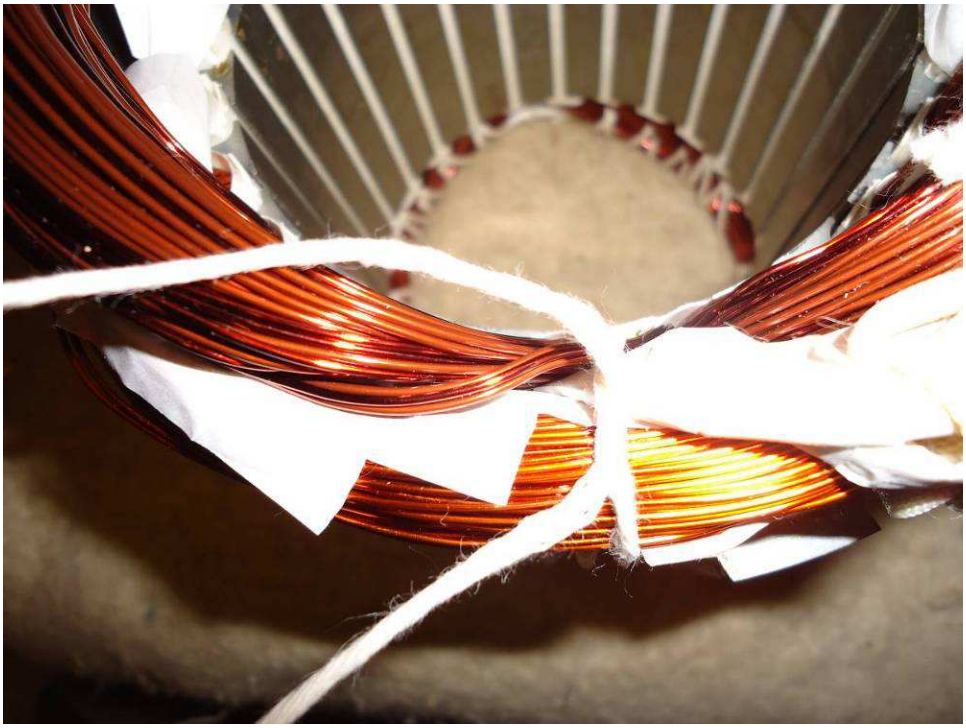
The stators with the connectors attached.



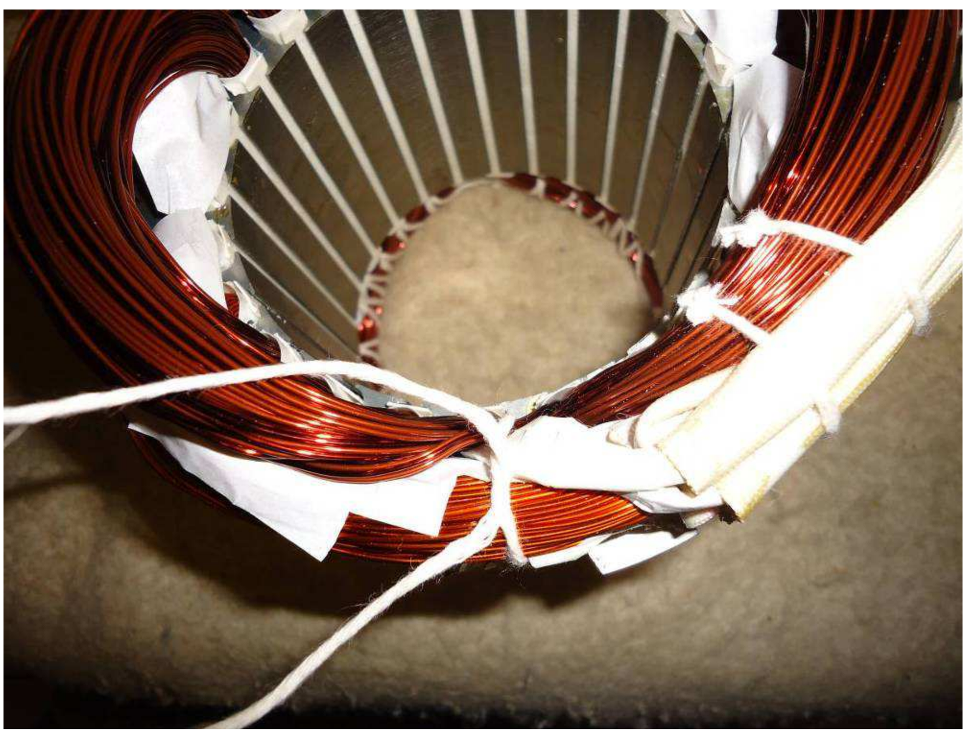
The connection to one on he connectors. Tied on with some butchers string.


A photo of some of the original lacing.


Another photo of some of the original lacing. I was not sure how to replace the lacing with this style of stitching, so I did it another way as below.

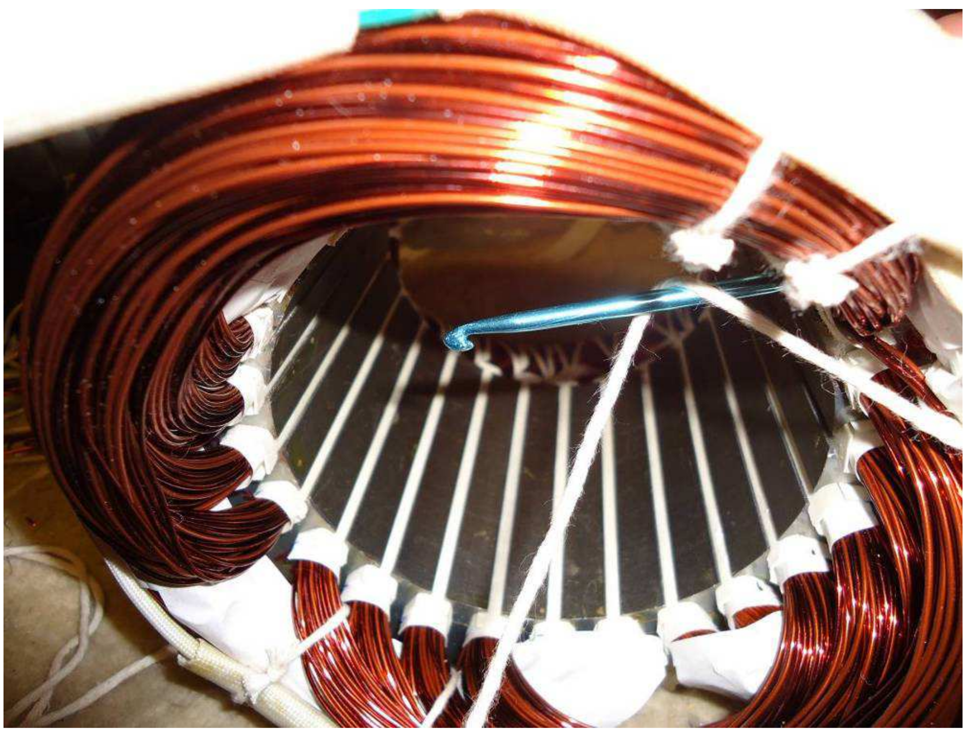


Start with a long length of sting, in the case of this stator 8 feet was enough to lace half way around one side. Tie a loop in the string around the coils, you should have equal amounts a sting left on each end of the string, like tying a shoe.

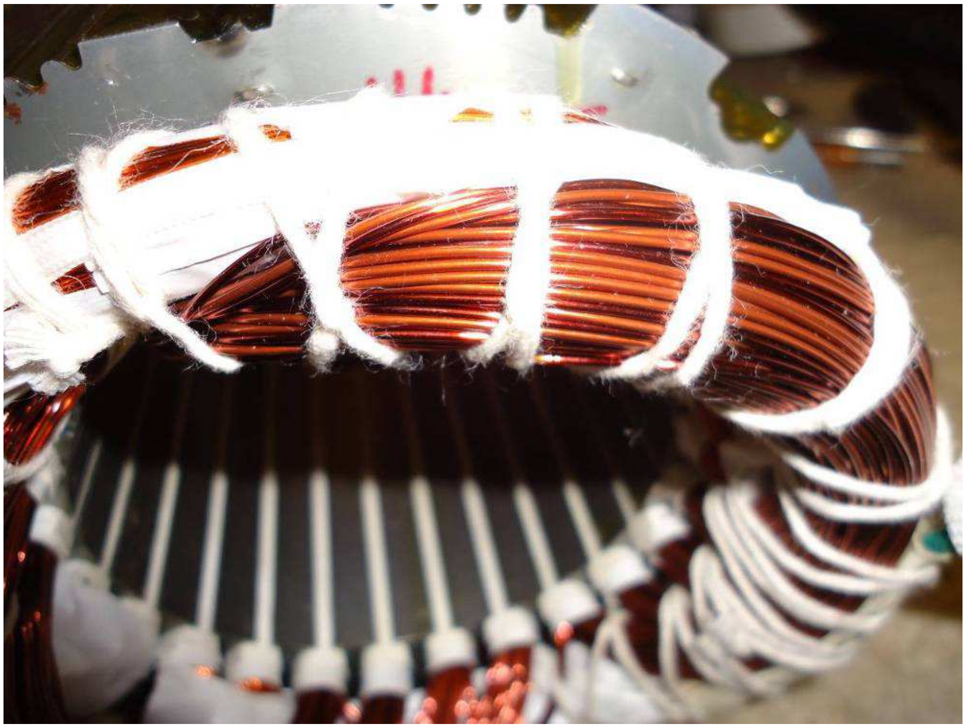


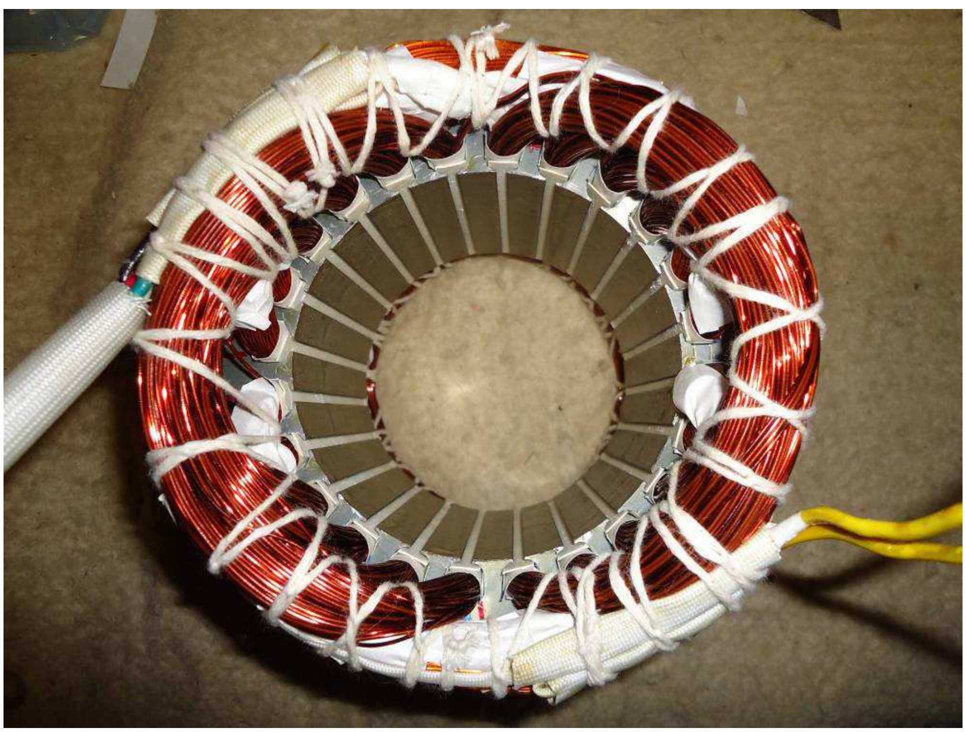
Another photo of the start of the lacing. Note that I used butcher string, hey if you can tie up your stuffed pork loin with it and baked at 400F it should work on your winding.
It is 100% cotton so it will not melt, and it can be bought at a local store.

A small crochet hook can be used to pull the string thought the space between the slots, below the windings. Loop each end of the string through this hole in opposite direction, then loop back around again to the top. Then on the top wrap the strings around each other and then back down to the next hole between slots.

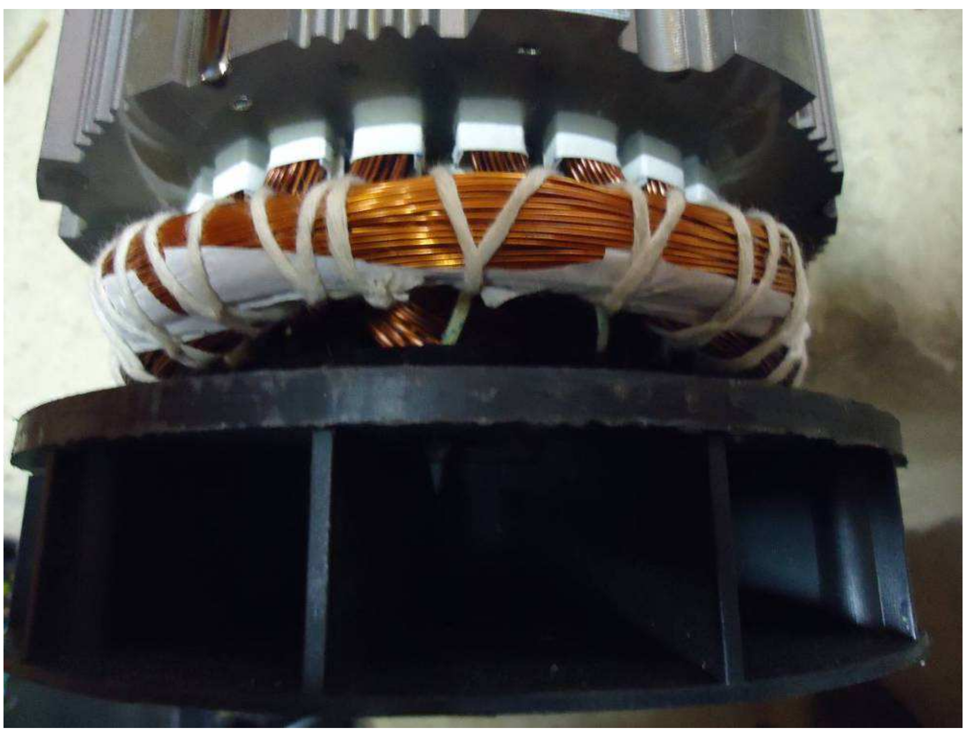


The string should be laced through each hole between the slots, then tied in a knot after the last loop around is made.

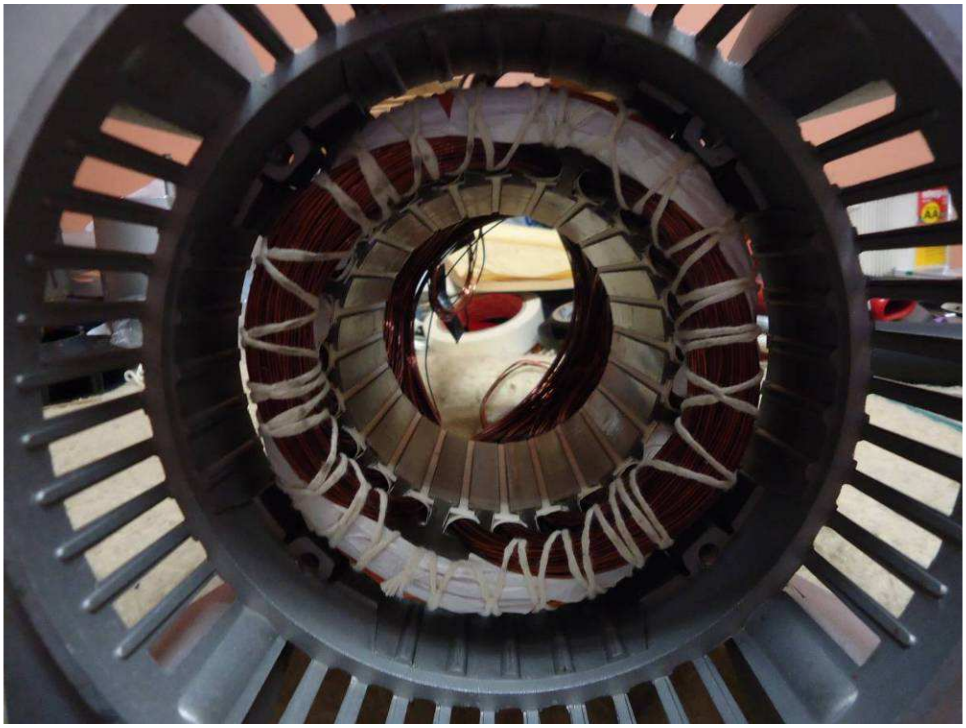

A photo of the completed lacing.


Another photo of the completed lacing.

Yet another photo of the completed lacing.



Insert the rotor and make sure nothing hits the windings, especially make sure the fan has clearance to the windings. Some adjustment with the rubberized hammer may be needed.



Also make sure the case does not hit the windings, adjust as needed.
Finally after all fits good, then you need to varnish the windings. There are two ways that I know of doing this commercially, heat the whole thing up and pour varnish over the windings. Or VPI(Vacuum Pressure Impregnation), submerge in varnish and vacuum it, then remove it and bake in an oven. I was able to get it VPI-ed at a winding shop.(no pic)

After putting it all back together. IT WORKS!!! Notice the yellowed varnished coils.