



instructables

Rewinding and Renovation of the Electric Motor



by robosap

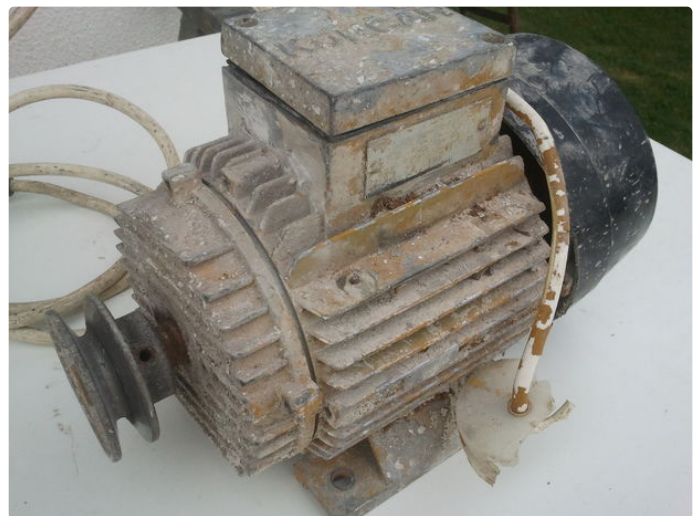
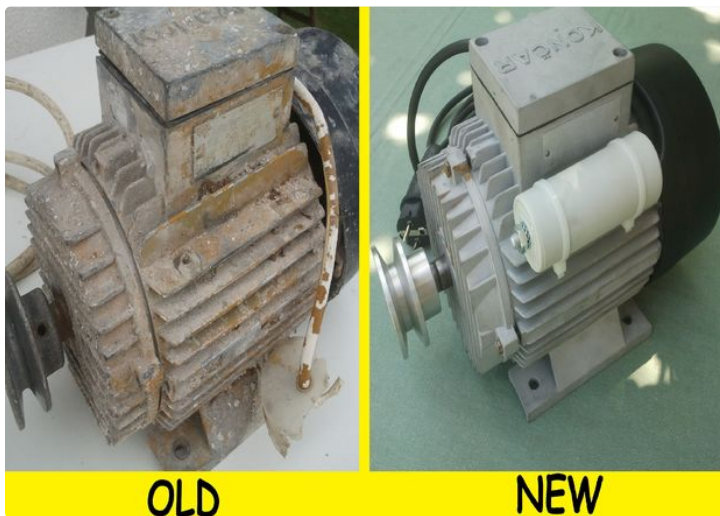
Hello, i am Niko, memeber of RoboSap team. In this instructables i will show you, how to rewind and renovate old electric single phase electric motor.

I bought this electric motor on garage sale. It was cheap and we known that motor burned out. I decided to buy motor and try to renovate it.

In next steps I will show you how do disassemble

electric motor, remove bearings, make winding diagram, rewind motor, chose right capacitor and reassemble it with new bearings.

Rewinding is very long process. It took about two days to rewind it, replace all old parts and reassemble it.



Step 1: How Do I Know If I Have Single Phase Motor?

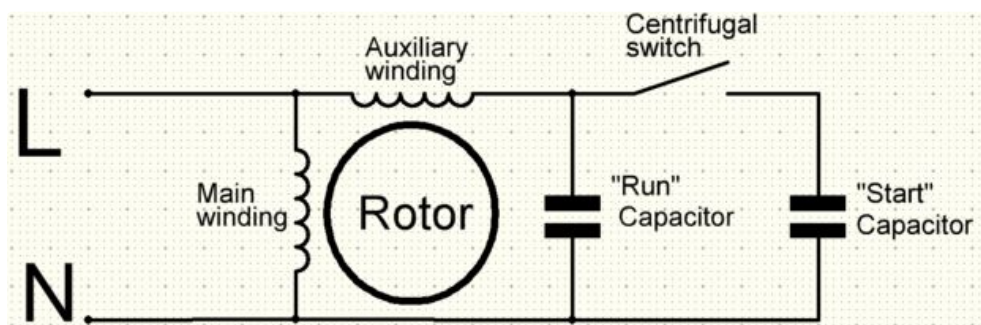
Single phase motor usually has two coils, main with bigger resistance (generating a pulsating magnetic field) and auxiliary with smaller resistance (gives motor a direction of rotation). There must be a capacitor on the motor. Its value is different for different electric engines (for smaller electric engines around 20 microF). 2 capacitor can be on motor, "run" capacitor (always connected, lower value capacitor) and "Start" capacitor (connected with centrifugal

switch, higher value capacitor)

Picture 1: Scheme of single phase electric motor

Picture 2: Run and star capacitor

Picture 3: Wires from stator (there should be 4 wires from stator)



Step 2: Tools

Rewinding and disassembling motor is very time consuming work, if you don't have professional equipment. You will need following tools:

- Basic tools (screwdrivers, hammers, wrenches...)

Special Material:

- Copper wire
- Isolate paper

- Pulleys for bearings

- Chisels, to cut off old winding

- Butane torch (or other heating device)

- Stator lacing thread

- Spray Lubricant (WD-40 or similar)

- Motor lacquer

Step 3: Disassembling Motor

Take few pictures of motor, and Remove the fan protective cover. Usually the cover is not screwed with screws on housing but it's just plugged on housing.

Put all removed parts of motor in one box so you don't lose them.



Step 4: Disassembling Motor

Gently heat up motor fan and remove it. Be careful you don't break it, it should go very smooth. You can help yourself detaching it with two big screwdrivers.

As you see on picture our motor fan is broken and we need new one.

After detaching motor fan remove clamp from axis.



Step 5: Disassembling Motor

Mark the position of individual covers, on the side of covers (usually we put numbers 1, 2, 3 on side of covers, so we will know to assemble it).

Unscrew the screws securing the cover (picture 2). Remove the cover of motor and put it in the box with other parts.



Step 6: Disassembling Motor

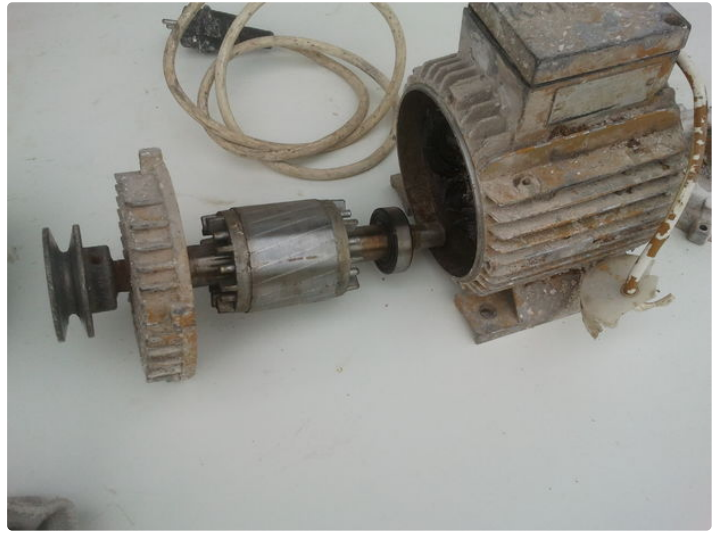
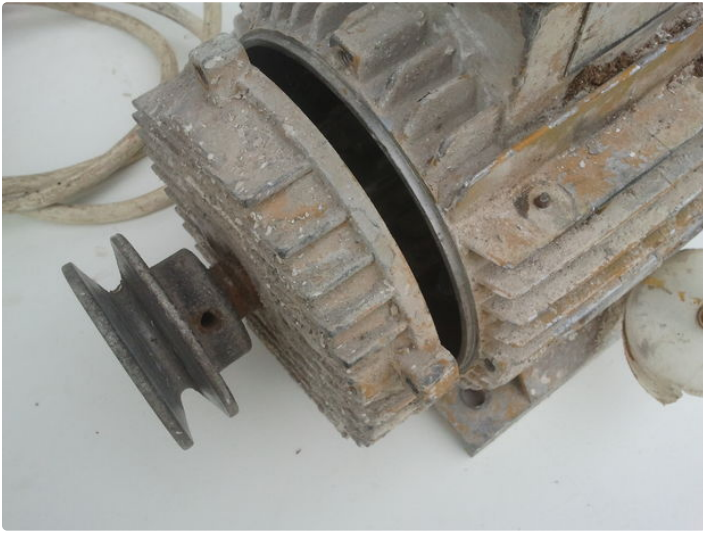
When I removed cover my expectations came true. One of the motors winding burned out (black colour and smell of burned lacquer).

I find out that bearings are broken too (when you spin it, it creates loud sound).



Step 7: Disassembling Motor

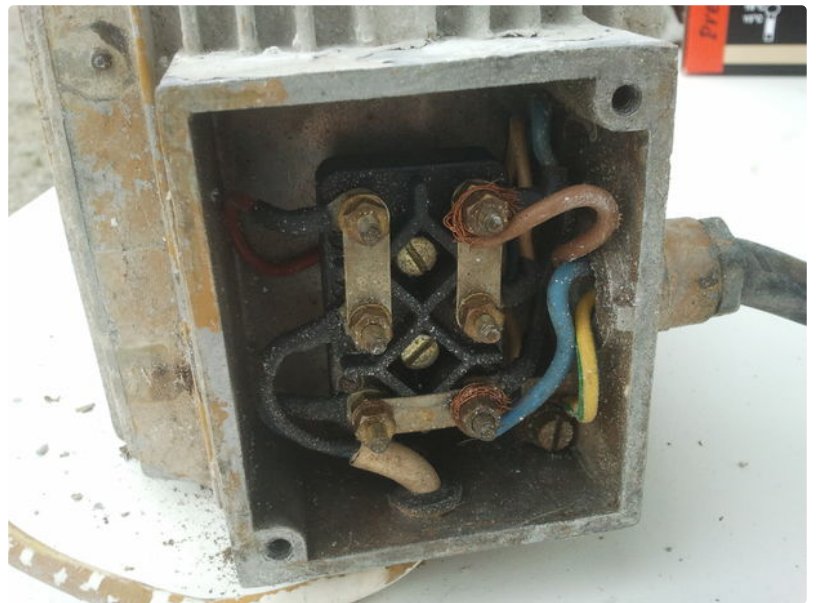
Unscrew the screws securing the front cover (as you've done 2 steps before). Gently remove the front cover with rotor out of main housing and put it in the box with other parts.



Step 8: Disassembling Motor

Unscrew the screws securing the top cover. Remove the top cover and sealing and put it in the box with other parts.

Take few pictures of electrical installation and remove all the wires and electrical clips. Remove capacitor, if you have one on motor (our was cut off).





Step 9: Motors Inscription Board

Try to write down all information from inscription board. It is located on motors housing. There are some useful information on it (voltage, current, number of turns per minute, capacitor...).



Step 10: Winding Diagram

In next steps we are going to make winding diagram. If you have one, you cant skip titles "Winding diagram"

What is winding diagram?

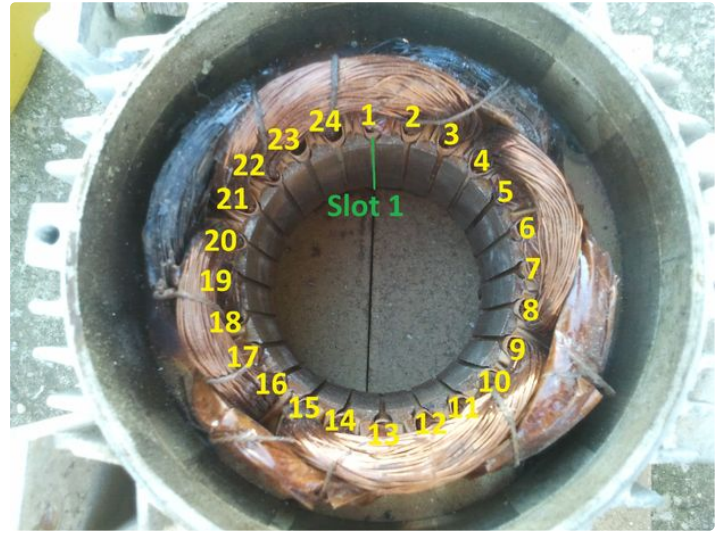
Winding diagram is diagram which helps you rewind motor. It show how stator coils are connected with each other.



Step 11: Winding Diagram

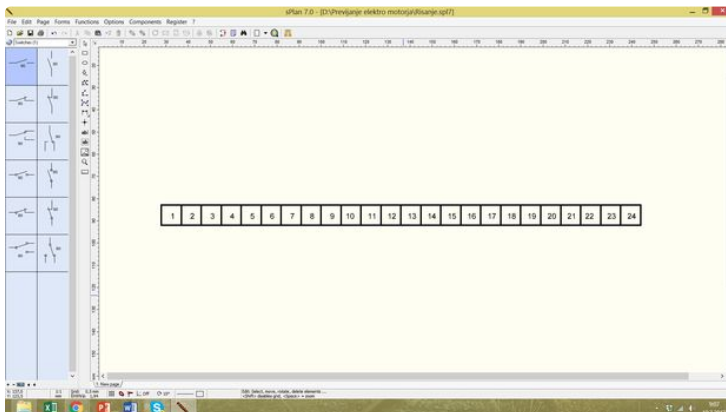
Count number of slots (gaps in stator, look at pictures).

I counted 24 gaps.



Step 12: Winding Diagram

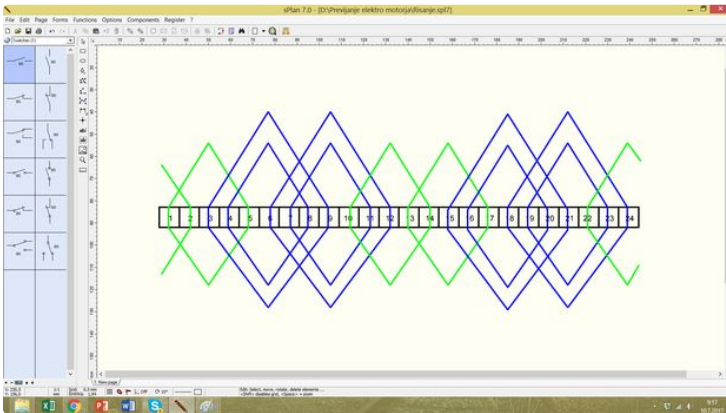
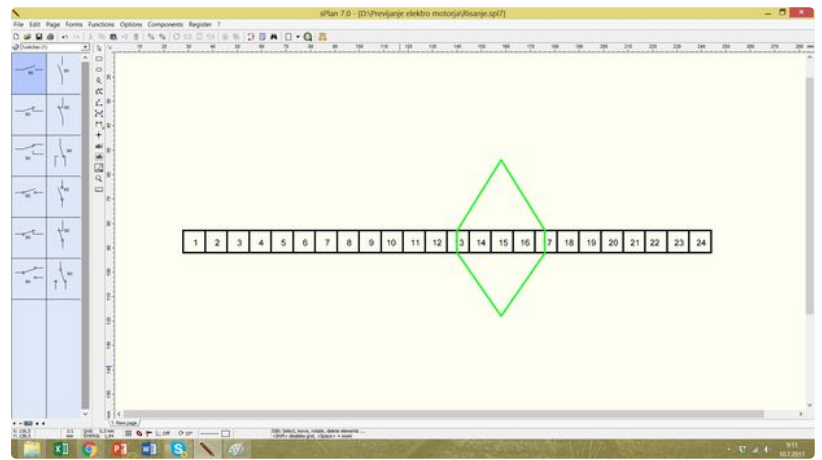
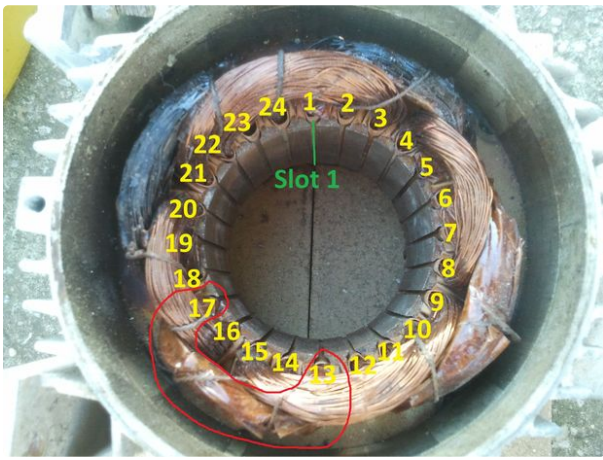
Open your best drawing program and draw 1 square for each slot connecting each other.



Step 13: Winding Diagram

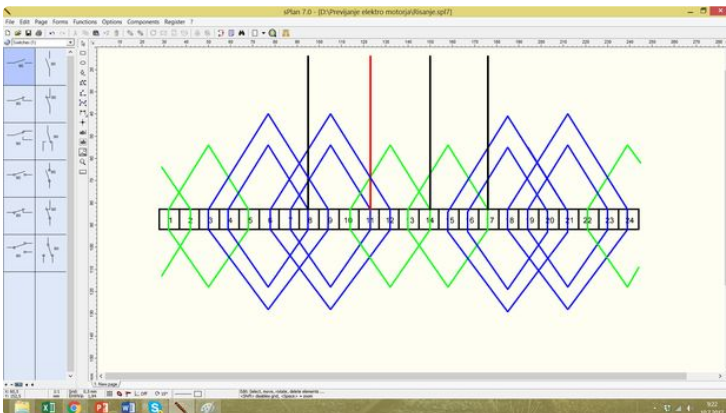
Each of coil is placed in 2 slots. Draw coils from your stator to your winding diagram.

Do same for all coils. There cant be 2 coils in one gap (if you have Single-layer winding). All of gaps needs to be full.



Step 14: Winding Diagram

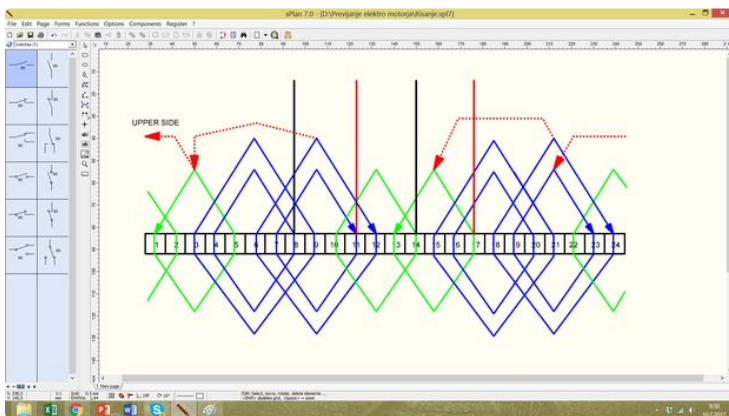
Mark output coil wires (wires that were connected on electrical clips).



Step 15: Winding Diagram

Heat up old winding, so you burn out old lacquer, but be careful, you must not damage copper wires.

When you can clearly see hot coils are connected, chose one of the output wire and draw path of it with arrows.

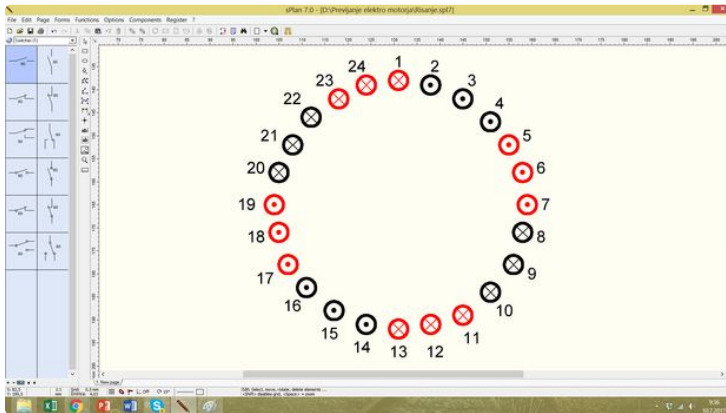
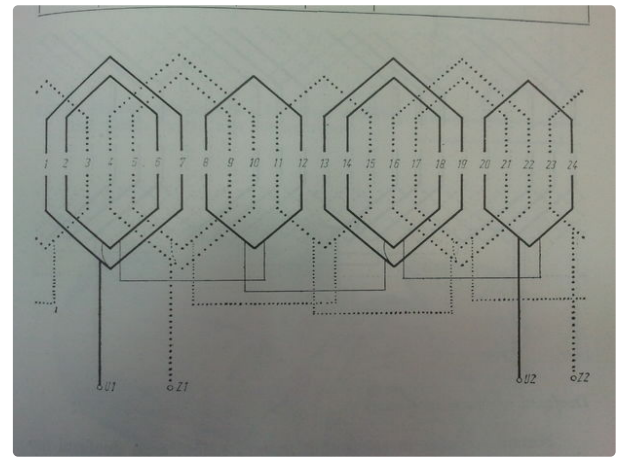
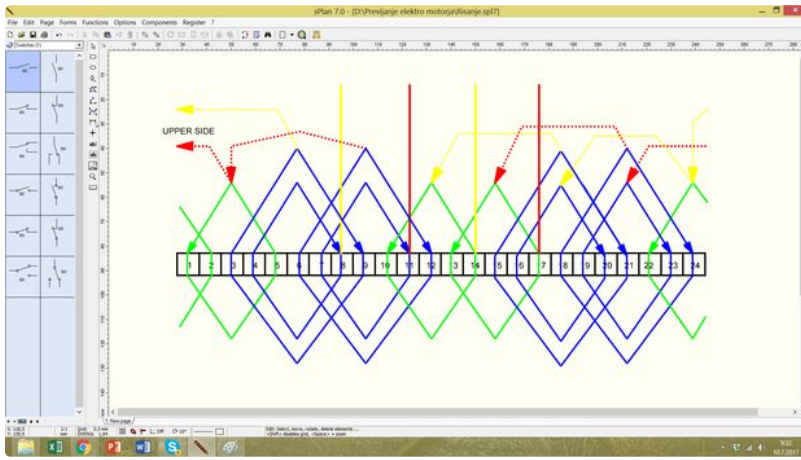


Step 16: Winding Diagram

Make same thing for second pair of output wires.

I found same winding in the book (it is just rotated for 180°).

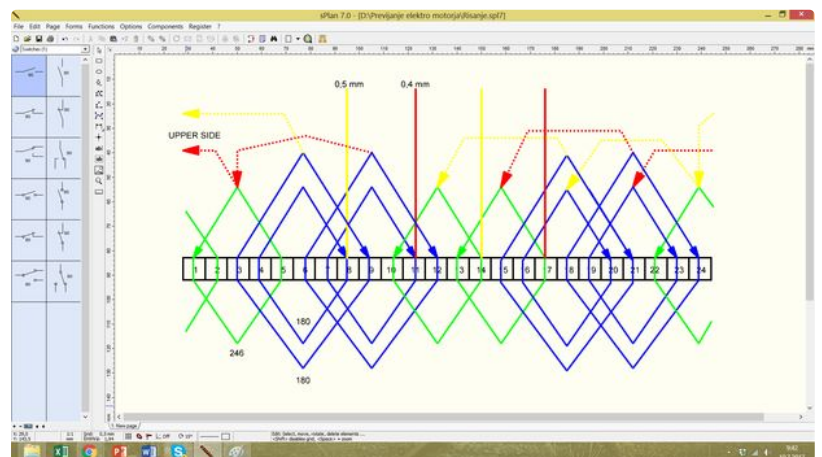
You can draw gaps in circle and mark x (wire in) and . (wire out). Now you are able to draw path of magnetic field (picture 3).



Step 17: Winding Diagram

Cut wires of different coils and count them and measure their diameter. Write number of wires in each coil in winding diagram.

Now your winding diagram is complete!



Step 18: Winding Diagram (Skip This If You Have One Wire Coil)

Be careful. If your coil is made out of 2 parallel wires, you can replace them with one wire. Measure diameter of 1 wire. Calculate plate of 1 wire and multiply with 2. Now calculate 1 wire from your plate. (New wire must have same plate as old 2 wires together).



Step 19: Cut of Winding

Use hammer and Chisels to cut off old winding. Try not to damage stator lamellas. You can continue when you cut the old winding on one site (Picture 5).



Step 20: Pull Out Winding

Heat up other side of old winding and pull it out using crowbar. Do these for all coils.



Step 21: Clean Gaps

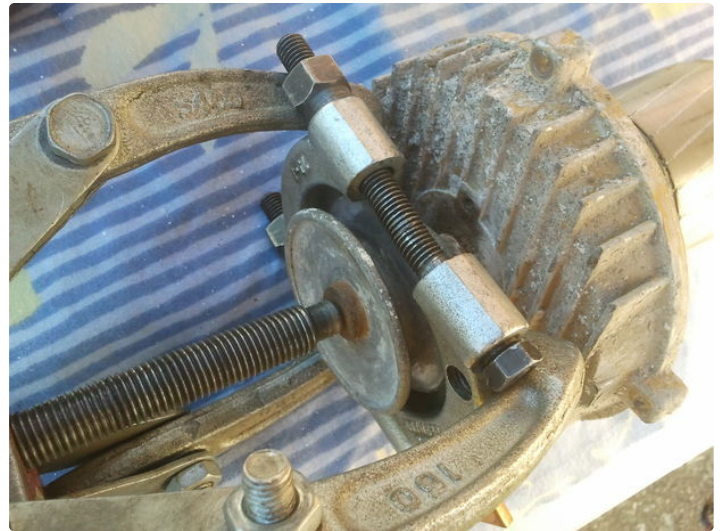
Until stator is hot, clean gaps with screwdriver or iron stick, but don't damage stators lamellas.





Step 22: Remove Pulley

If you have one, remove screw or safety metal stick, and then pull pulley with puller from axis. If you need, heat pulley (not axis!!!!) with butan torch.





Step 23: Remove Front Cover

Put cover on wood, so rotor doesn't touching the bottom. Put piece of wood on axis of rotor and hit it with hammer until rotor separates from cover.



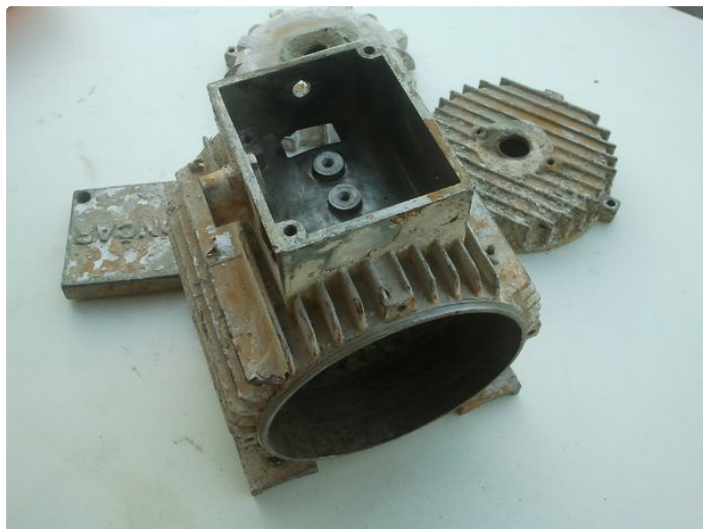
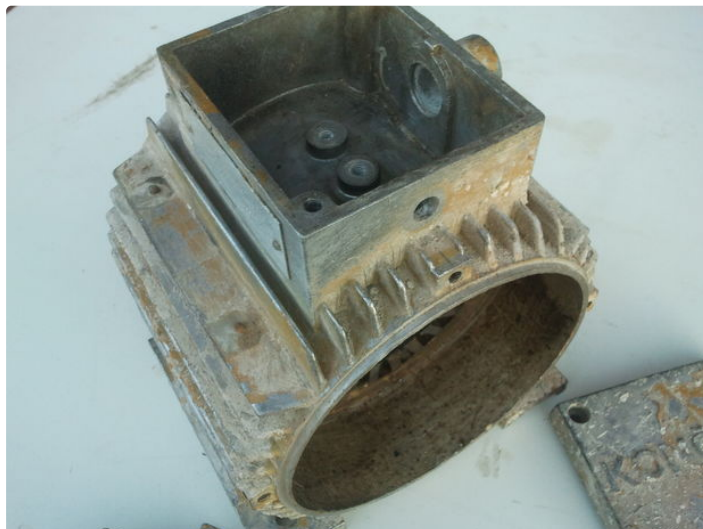
Step 24: Removal of Bearings

Use puller to remove bearings on both sides. You must not damage the axis of rotor.



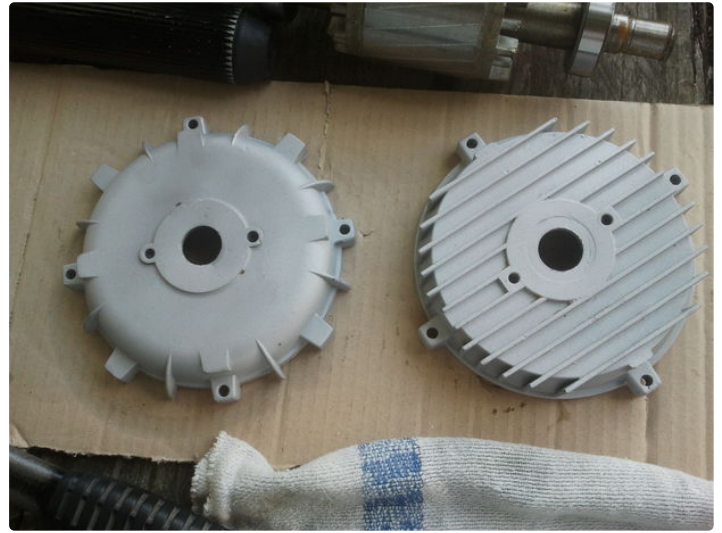
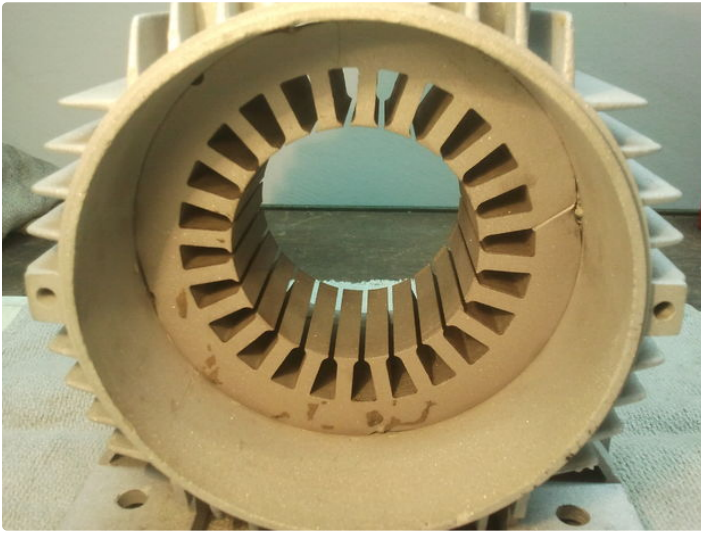
Step 25: Clean Housing of Motor

Motor was covered with concrete so we decided to sandblast it.



Step 26: After Sandblasting

Don't sandblast or scratch stator lamellas too much, they are made of iron which can rust.



Step 27: Twisting Edges of Insulating Paper

Put isolate paper on table, and place ruler on it, so you get about 4mm gap in witch you will insert isolate paper and then twist it.



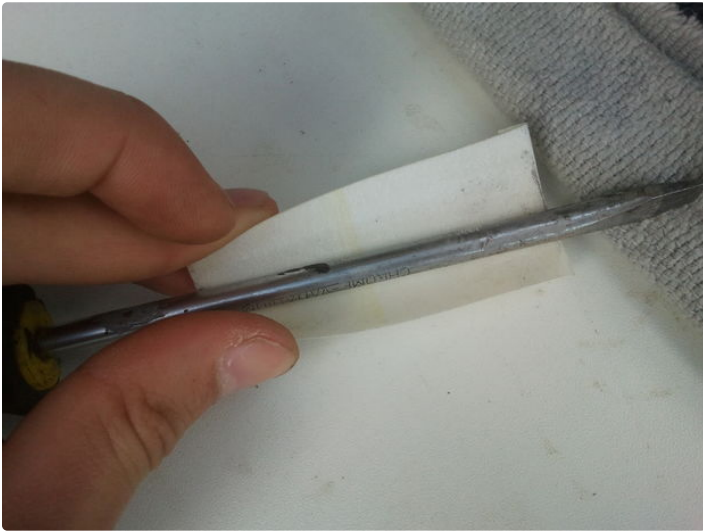


Step 28: Insert Isolate Paper in Stator

Mesure lenght of gap, and add about 16mm (depends of how you will twist paper). Cut it and twist it as I have done on pictures. Use screwdriver to bend it and insert it in gap. It should fit perfectly so you cant pull it out. Picture 11, front side of motor, and picture 12, back side of motor.







Step 29: Insert Isolate Paper in Stator

Do same thing for all gaps

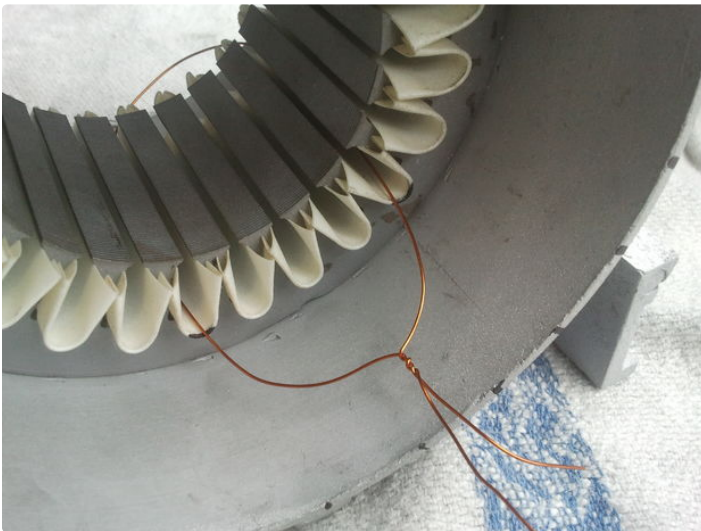


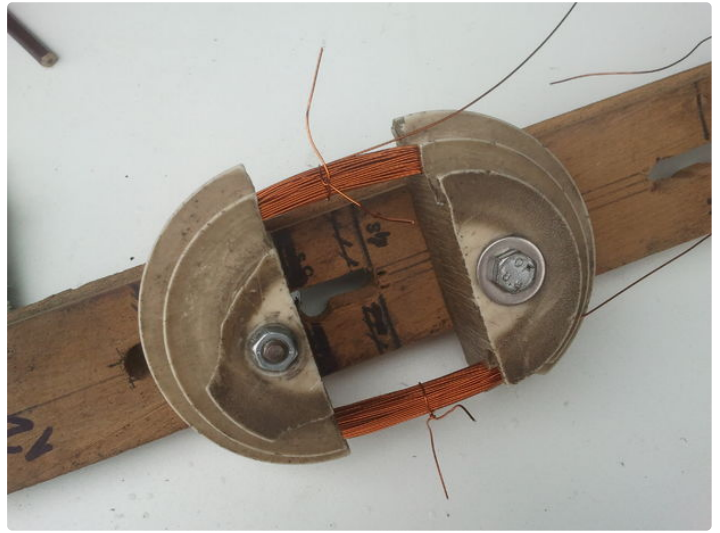
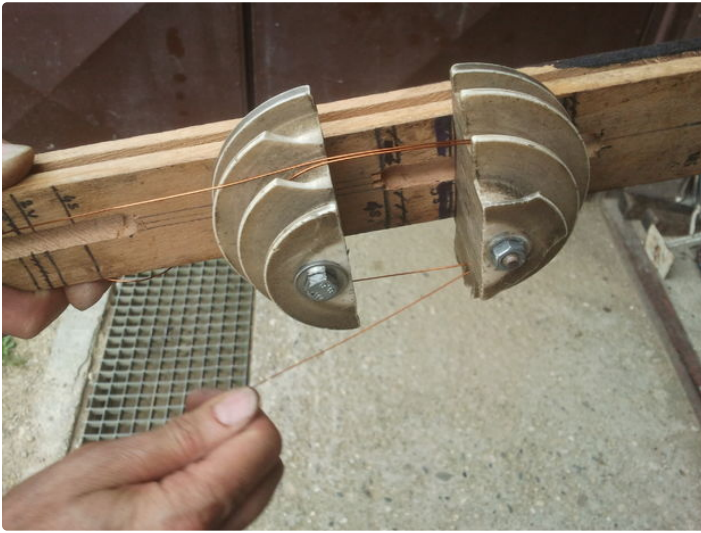


Step 30: Coil Winding

Make model of coil with one wire leaving a little bit more space. Put it on "Winder" to get distance. Put model off, and set winder to right distance, then start winding coil (you written numbers of wires in coils before). You can use same distance for winder for same coils.

You can make winder at home. I redraw my in fusion 360 so you are able to print it and make one for yourself.



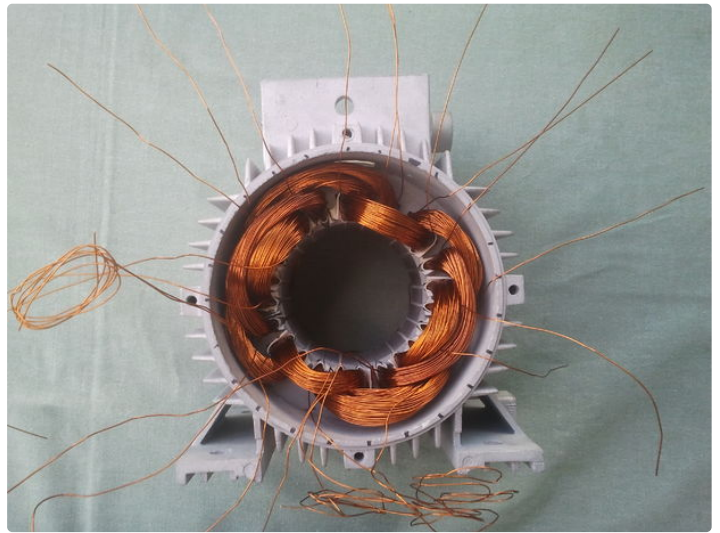


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(<https://cdn.instructables.com/orig/F31/UR3W/J4SQETPF/F31UR3WJ4SQETPF.stl>) Print with 3D Hubs!

Step 31: Place Coils in Stator

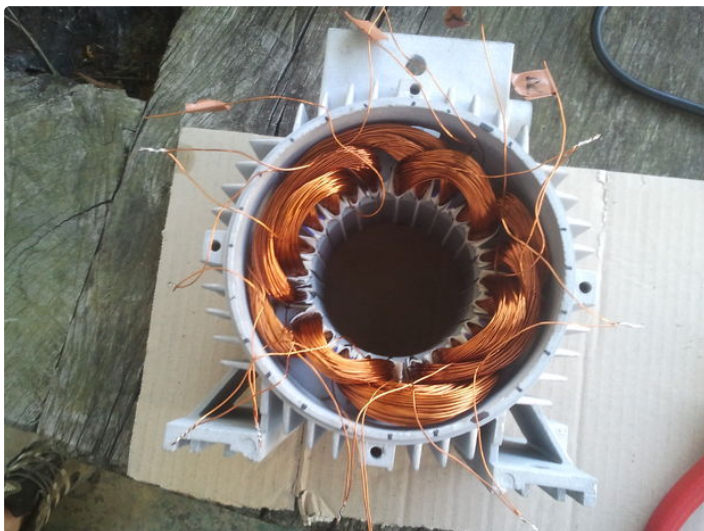
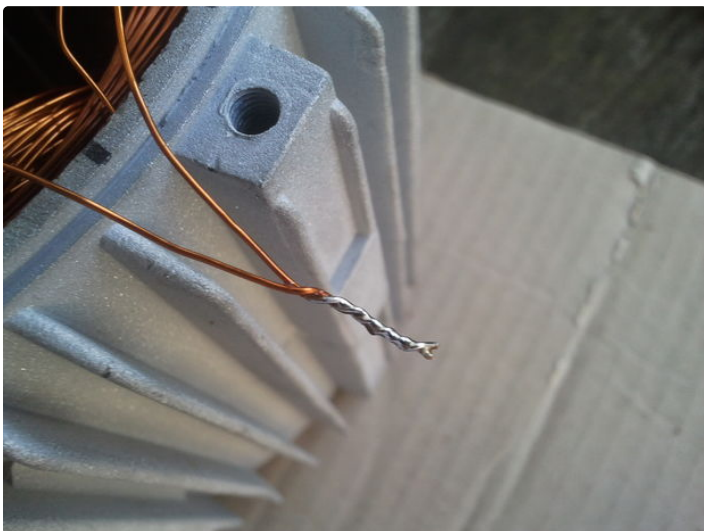
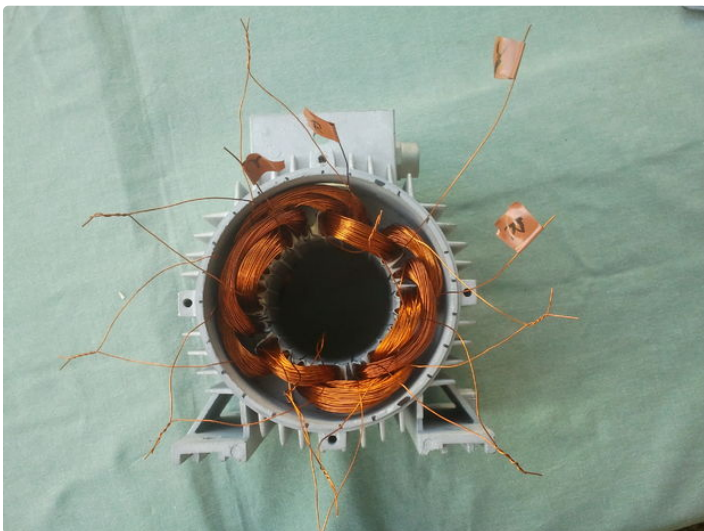
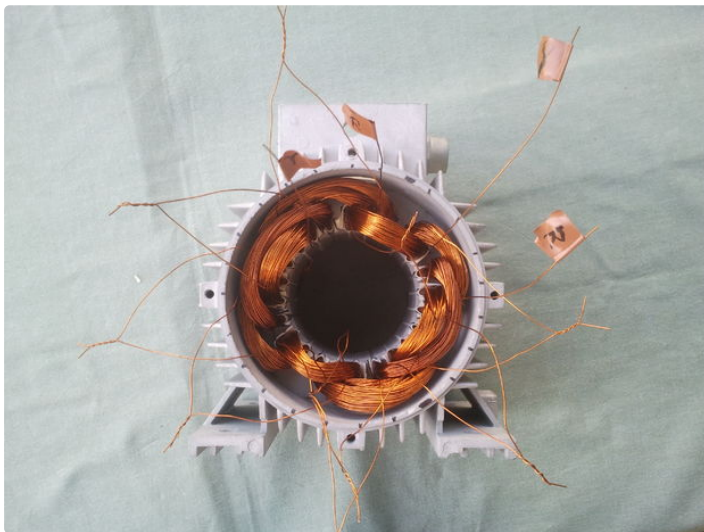
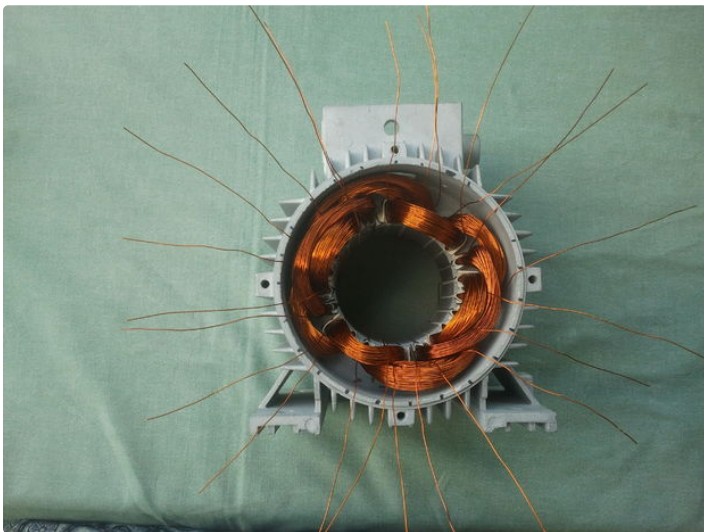
Careful place coils in stator. This can take a long time to do. Be gently so you don't damage wires lacquer. Rotate coils so their end wires will come out on the side, where is the hole from stator to electrical clips.

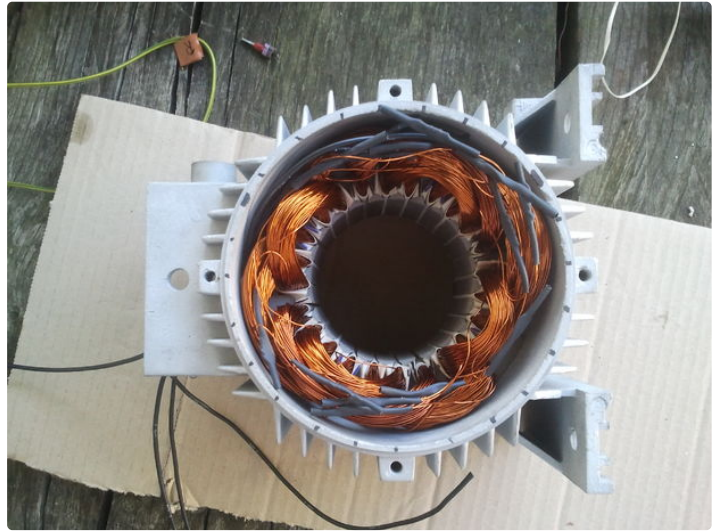
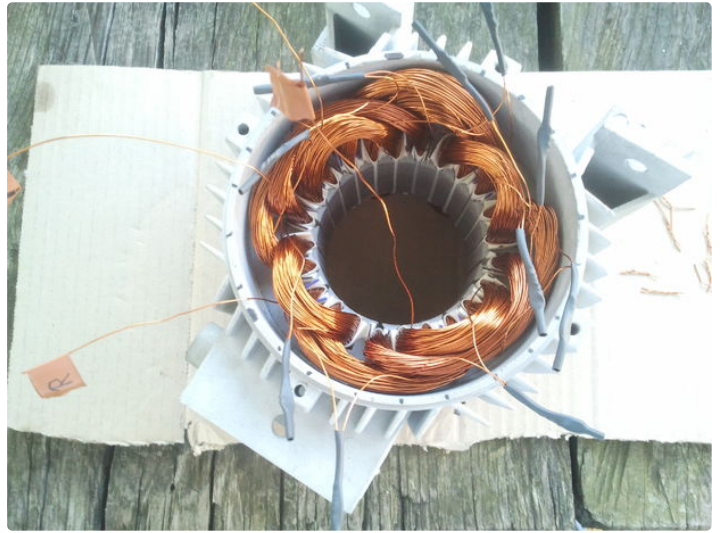
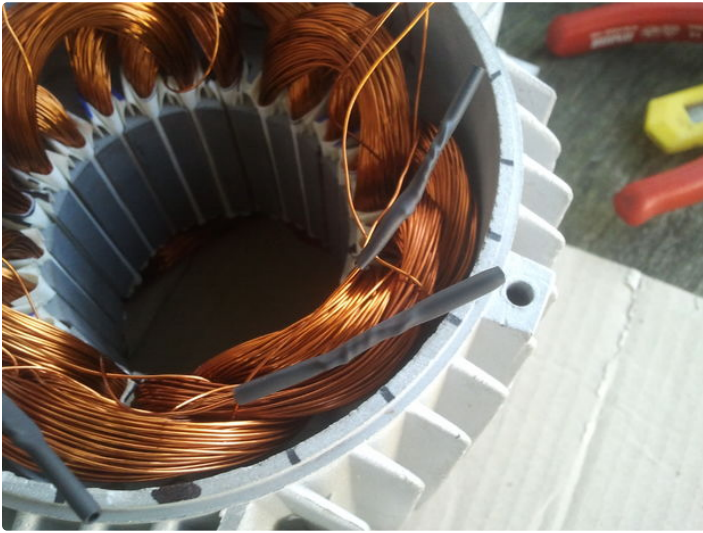




Step 32: Wire Coils With Winding Diagram

Connect coils according to the winding diagram. Remove isolation, then solder copper wires and isolate them with heat shrinks. Connect normal wires with end coil wires, and isolate them with heat shrink (picture 9). Wire them to electrical clips.





Step 33: Bind the Coils

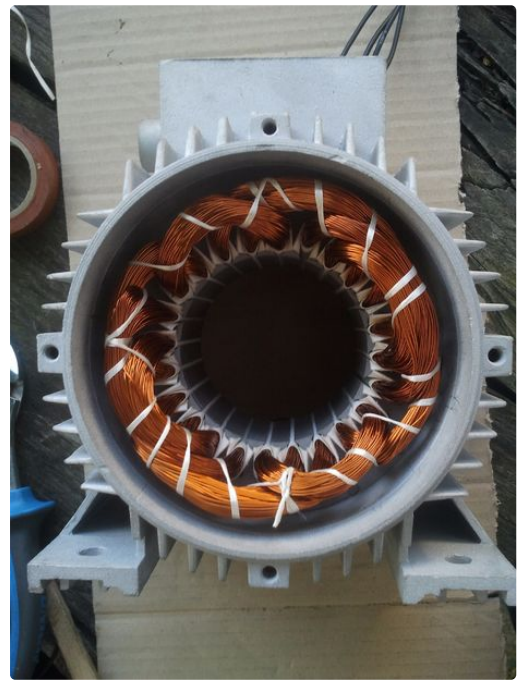
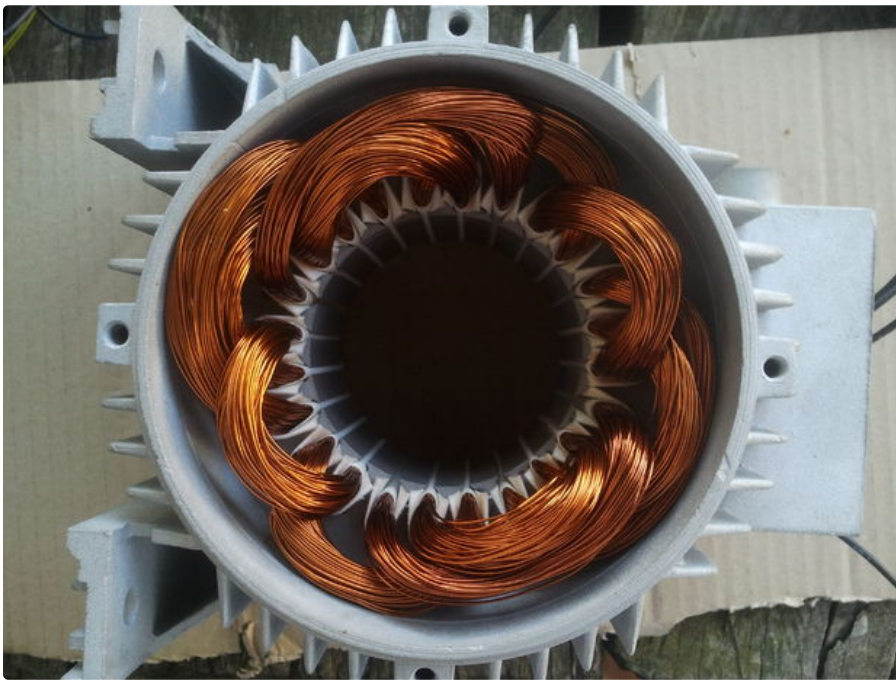
Bind the coils with the stator lacing thread. Sew stator lacing thread around coils, as you can see on pictures.





Step 34: Bind the Coils

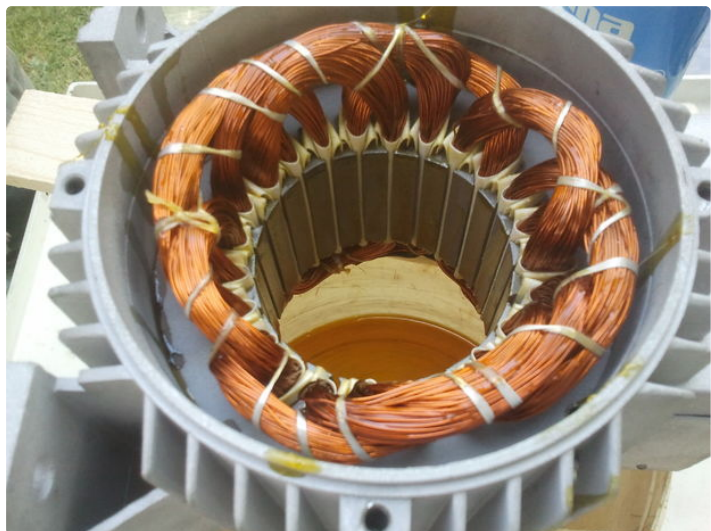
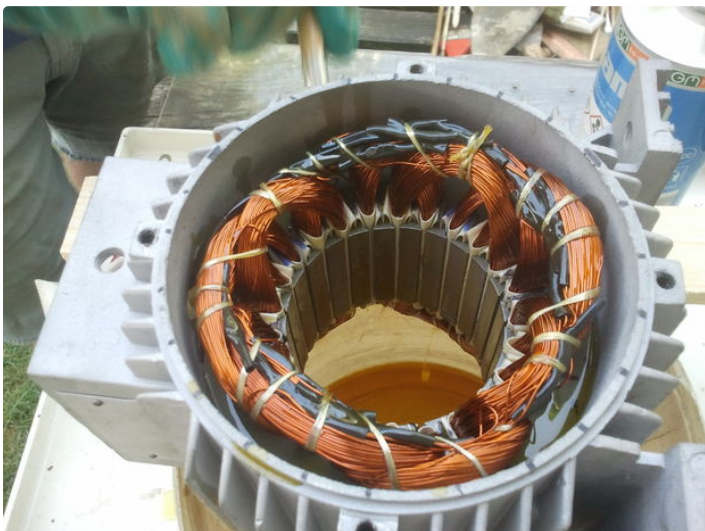
Do the same thing on other side of motor.

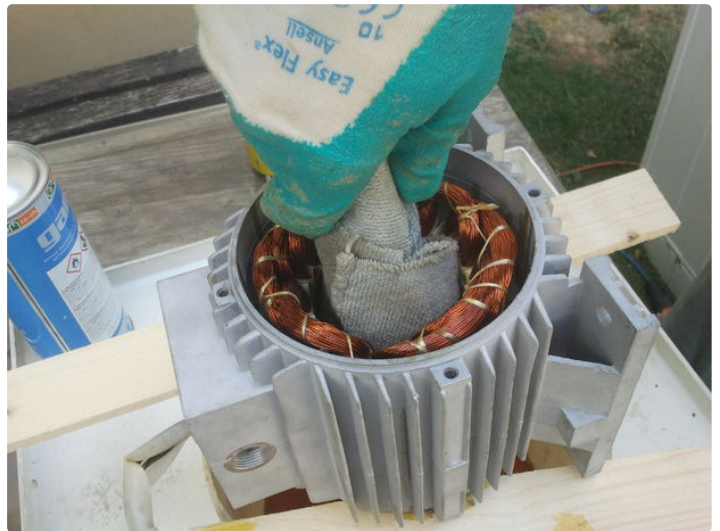
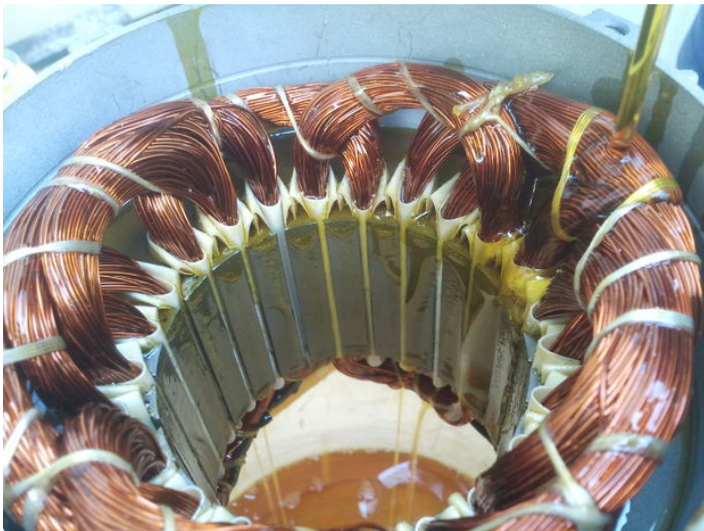


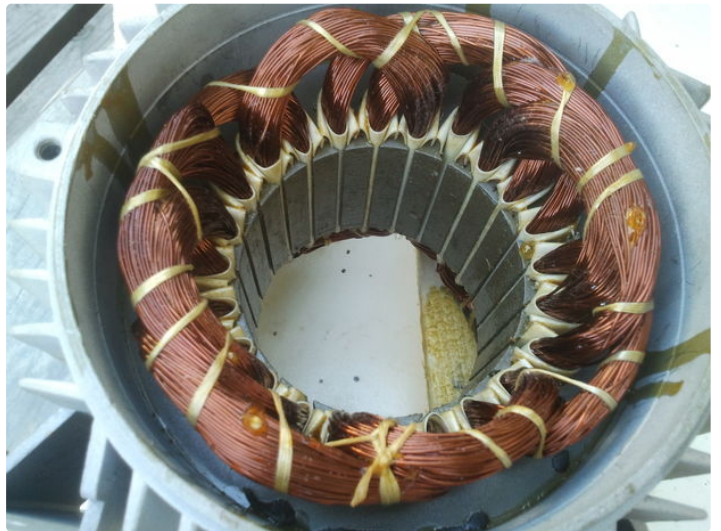
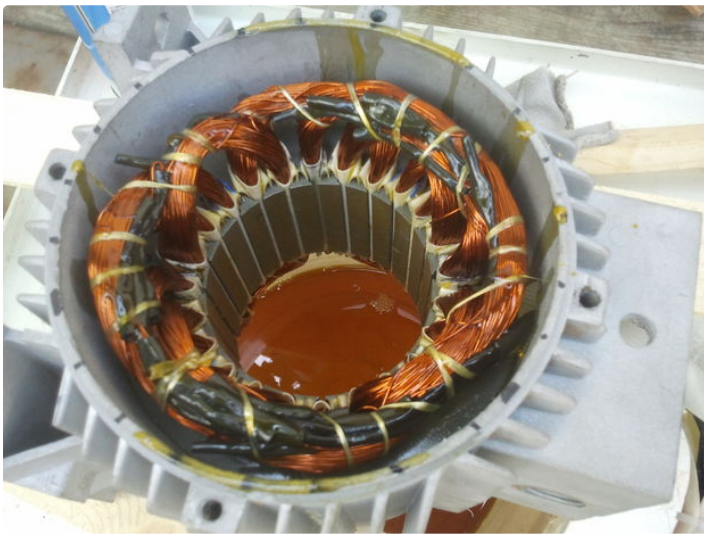
Step 35: Varnishing the Motor

1. Heat up cooking oven to 100 °C. Put motor in it.
2. When motor heats up, spills lacquer on motors coils as you see on pictures
3. Turn motor around and do the same
4. You can reuse old lacquer.
5. Put motor in hot oven, and cook it for about 4 hours
6. Take motor out and clean edge (so cover will fit perfectly).









Step 36: Bearings

You can find appropriate bearing, by measuring old bearings diameters. Then you can find new ones in this catalog.

There are also small numbers on edge of bearings, and you can read them (for example 6302).



Step 37: Assembling Bearings

Grease the axle of rotor with lubricant and mount bearings on axle.

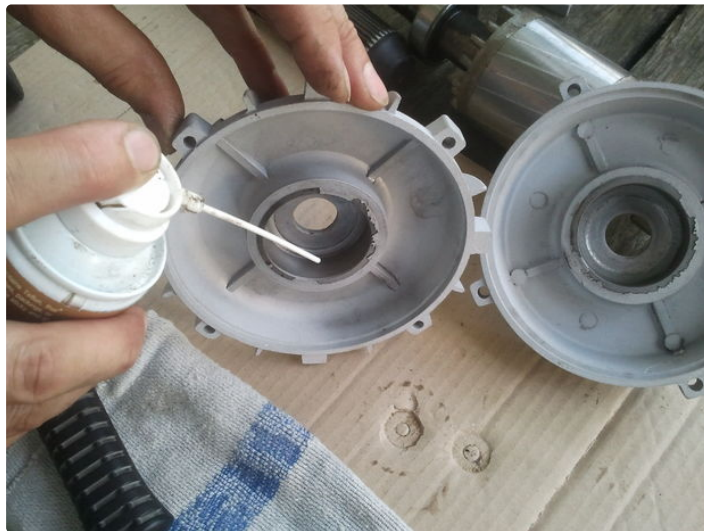






Step 38:

Grease the bearing bed with lubricant, on both covers. Place first cover on rotor (don't forget for spring washer). Then place stator over rotor on first cover, and screw it (don't forget to glue screws). After that place second cover on top of the stator and screw it (glue screws).









Step 39: Motor Fan

When i cleaned fan i realise, that it is cracked. I made aluminium ring on lathe and glue it on fan.

Put clamp on rotors axle. Mount motors fan on rotor (you can heat it with an industrial fan, but dont overheat it because it becomes really soft and can change shape). If you have cracked fan, you can buy new one, they are cheap. I just wanted to show you that you can repair it.





Step 40: Fans Protective Cover

I sandblasted it and repaired cracks, with soldering iron and iron mesh, witch i heated in plastic. I painted it in black and install it on motor (no screws needed).

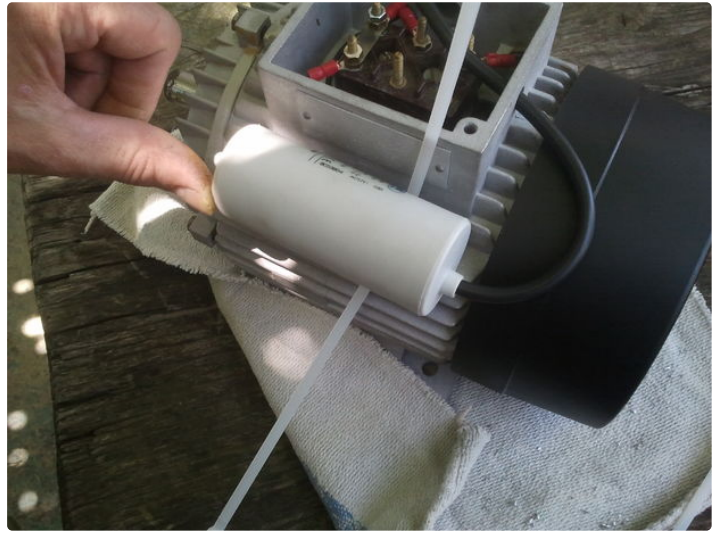
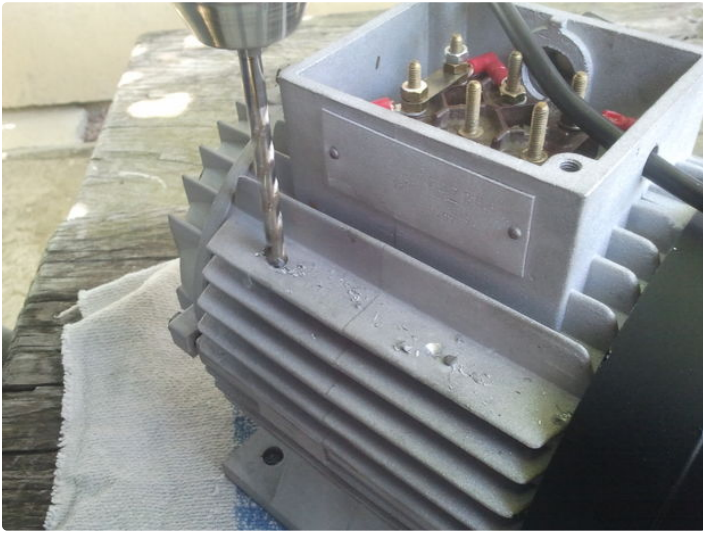




Step 41: Capacitor

Mount capacitor on motor with zip ties (drill holes in housing as i have done on pictures). If you don't have capacitor there is right value on motors inscription label on housing (for my motor is 20 microF). Lead wires to connection box of motor.

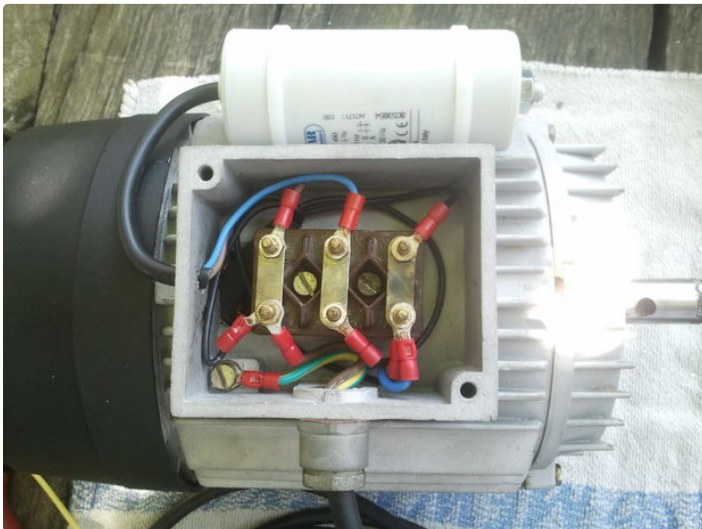
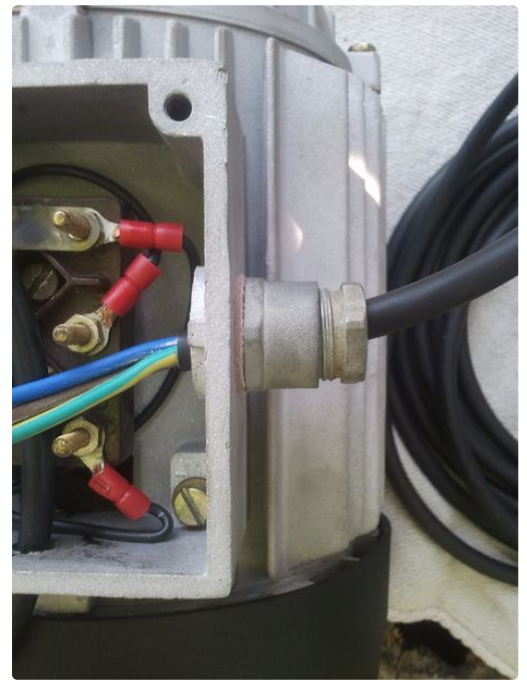


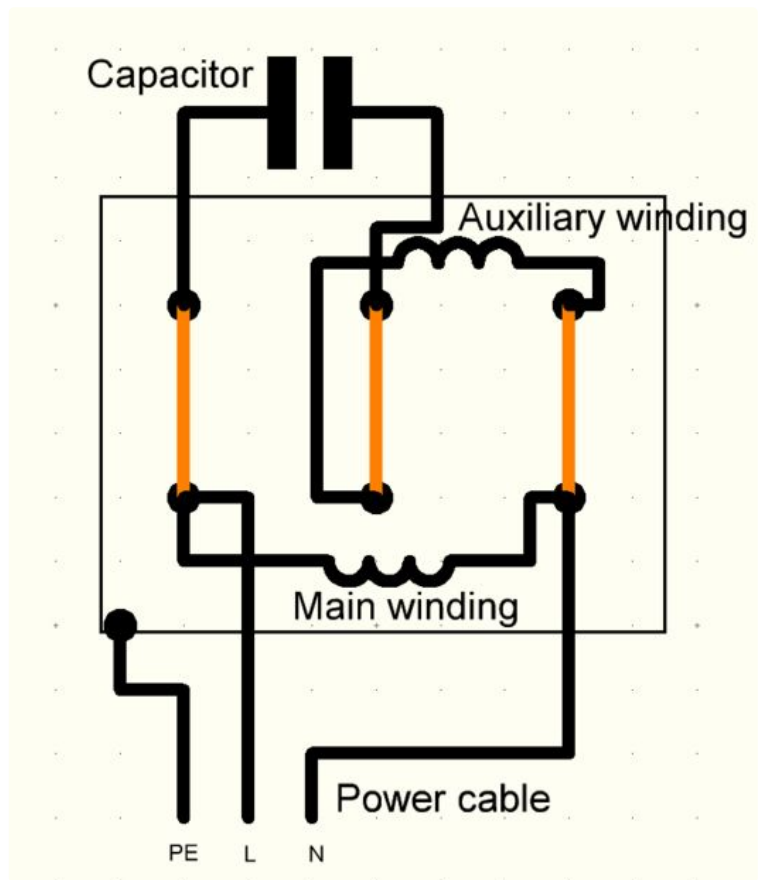


Step 42: Electrical Clips

Lead power cable into connection box and tighten it, so you can't pull it out. wire clips as i draw on picture 3.

My seal of cover was damaged, so i made new one from old rubber sponge. Screw cover on motor.





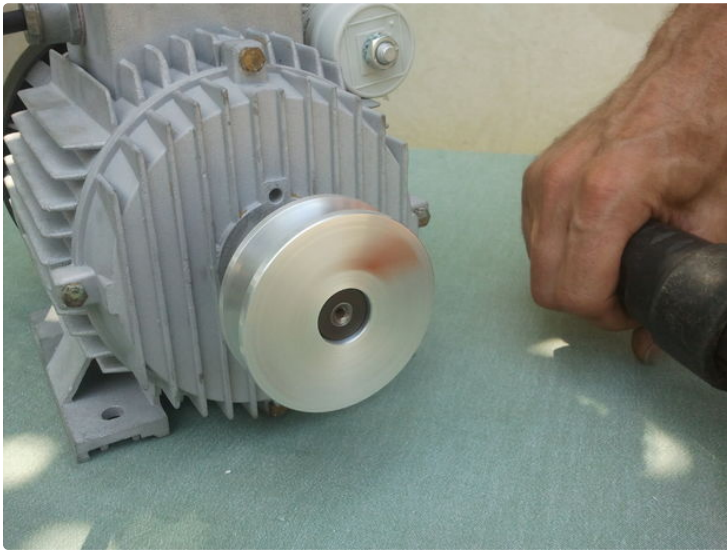
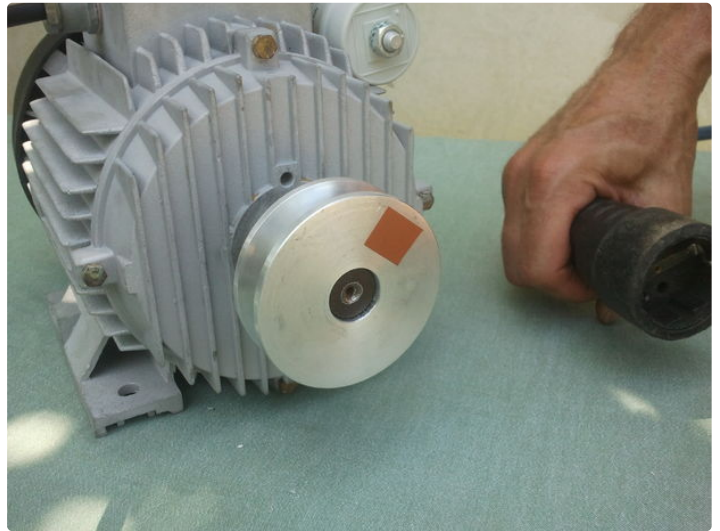
Step 43: Mounting Pulley

Grease the rotors axle with lubricant, and mount on pulley.



Step 44: Test

Plug in the motor and measure its current (it is about 1A for my motor). If it runs smooth than you finished.



Step 45: Conclusion

Rewinding the electric motor takes a lot of time, as specially if you are doing it for first time. But when you see finished product, wasted time pays off.

If you have any problem, write it in comments bellow and i will try to solve it.

