

DC Motor: Assembly Overview

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V1.0, September 2026

In this exercise, you will be building a DC motor! Although you will be provided with all the pieces to build a working motor, there are many different motor implementations, some of which we will demonstrate to you (shown below) in this overview: a single coil motor with carbon brushes, a double coil motor with carbon brushes, and a single coil motor with metal brushes; if you wish to use a double coil motor, ensure that you have a sufficient number of commutator strips so that only one coil is energized at a time.

In addition to these overall design considerations, certain aspects of this motor build are up to you; aspects including magnet placement and the number of magnetic wire turns will affect the performance of the motor that you are building. The procedure shown below is for building a motor with a single coil and a single-coil set of wire end caps, but you may wish to use two coils if your wire cap supports either one or two coils.

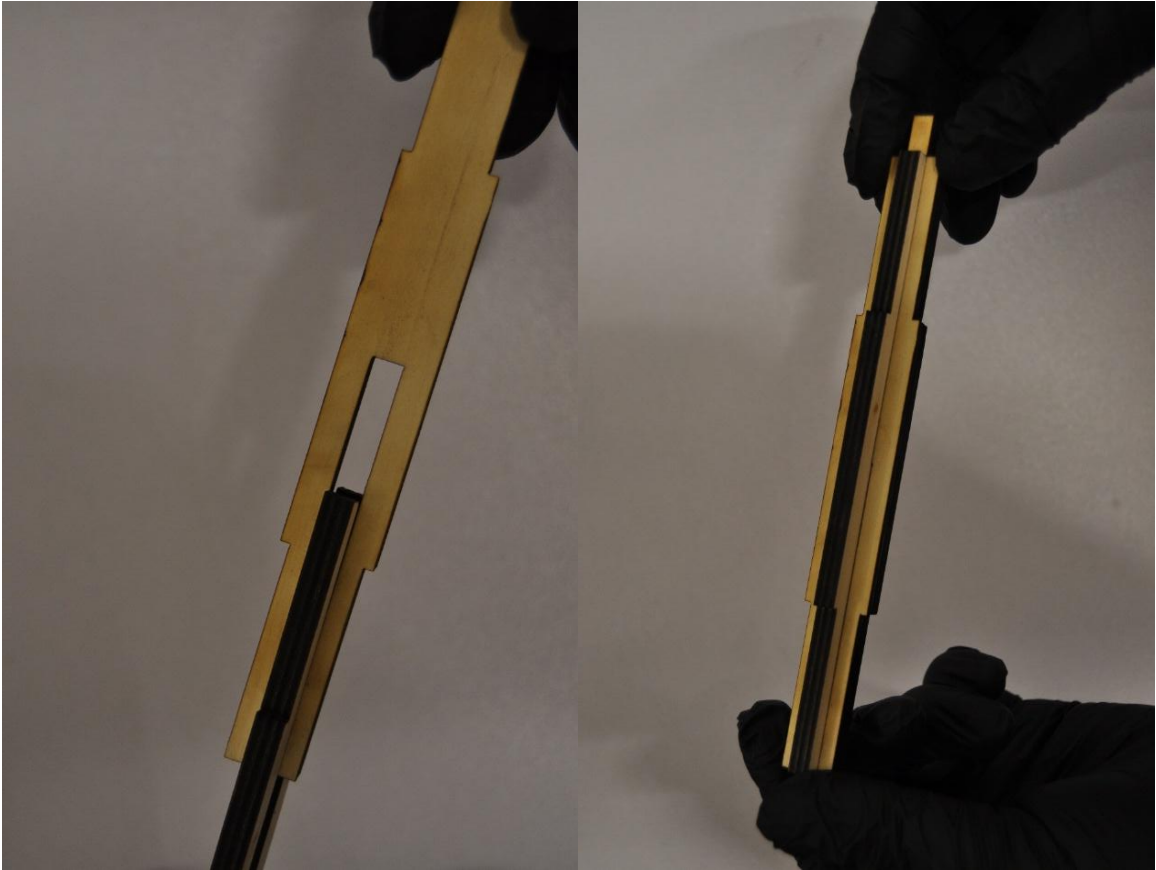


I. Assemble Rotor

CAUTION: The parts of the rotor are intended to fit tightly and will not come apart once assembled. Make sure all pieces are properly aligned prior to mating pieces together.

NOTE: The parts of the rotor are intended to fit tightly and will require moderate force to insert together.

- 1) Insert rotor shaft halves into each-other to form a plus shape.



- 2) Slide the wire caps onto the rotor. **NOTE:** This may require some force.(Caps that would support up to two coils are illustrated below:)

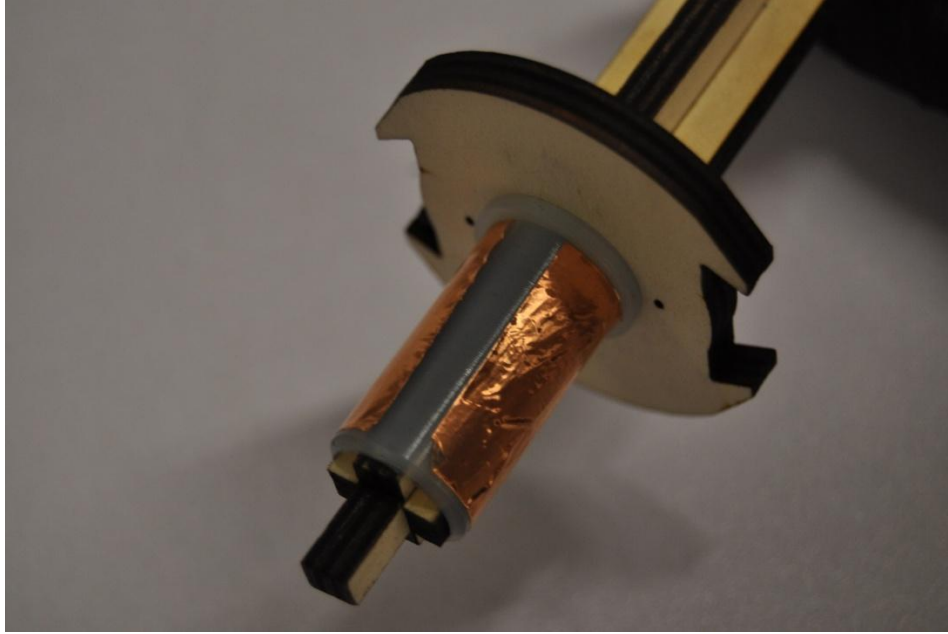




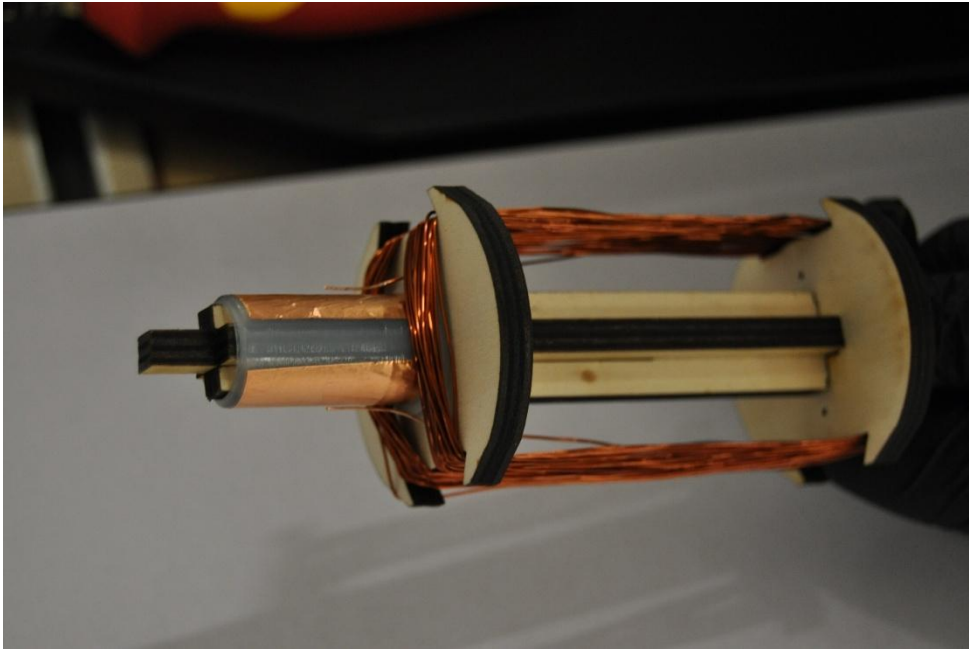
- 3) Select one of the two large bushings to be the commutator. Attach two pieces of copper tape lengthwise along the bushing, leaving a gap between the pieces slightly larger than a carbon brush. This gap should be greater than the 6.0mm width of the carbon brush.
- a) **CAUTION:** The motor will not work if the two pieces of copper tape touch (causing an electrical short). If the carbon brush can sit on the commutator in such a way as to touch both pieces of tape simultaneously, the motor may not work correctly. It is recommended to place one of the brushes on the commutator to ensure spacing.



- 4) Slide the commutator over one end of the rotor until flush with the wire cap. Repeat on the other end using the other large bushing. Note that the illustrated wire cap is for a “single coil” design:



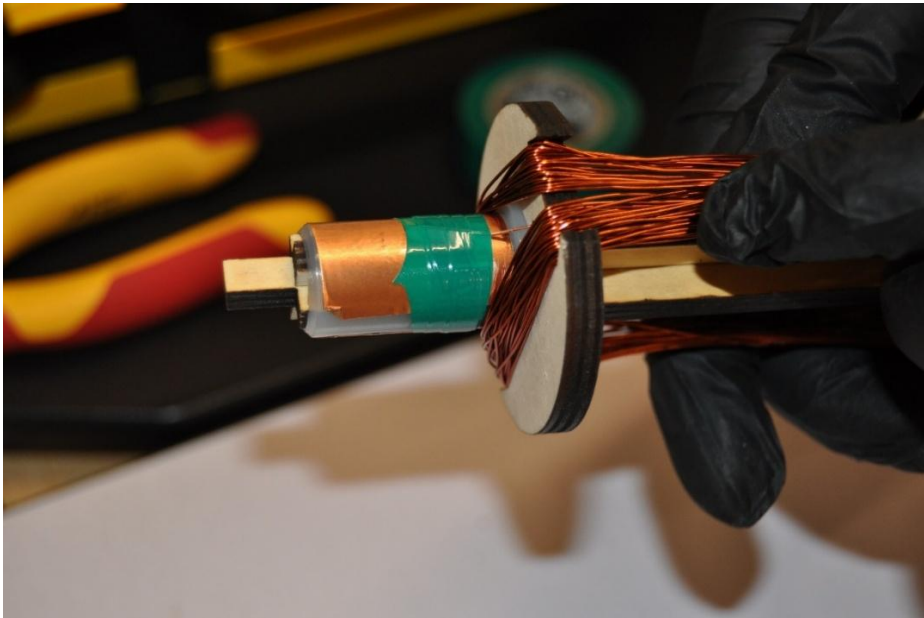
- 5) Remove the enamel coating on the magnetic wire to expose the copper wire underneath. This will allow electrical contact to be made between the magnetic wire and copper tape. Removing the enamel coating is easiest using sandpaper or other abrasive material.
- 6) Thread the wire through one of the small holes on the wire cap. Center the stripped end of the wire over one of the pieces of copper tape.
- 7) Wind the wire lengthwise along the rotor until reaching your desired number of turns, use the wire caps to aid with alignment while winding.
- 8) Once you have reached your desired number of turns, thread the other end of the wire through the unused hole in the wire cap.



9) Once again, remove the enamel coating from the end of the wire to expose the copper underneath. Cut the wire to length as needed.

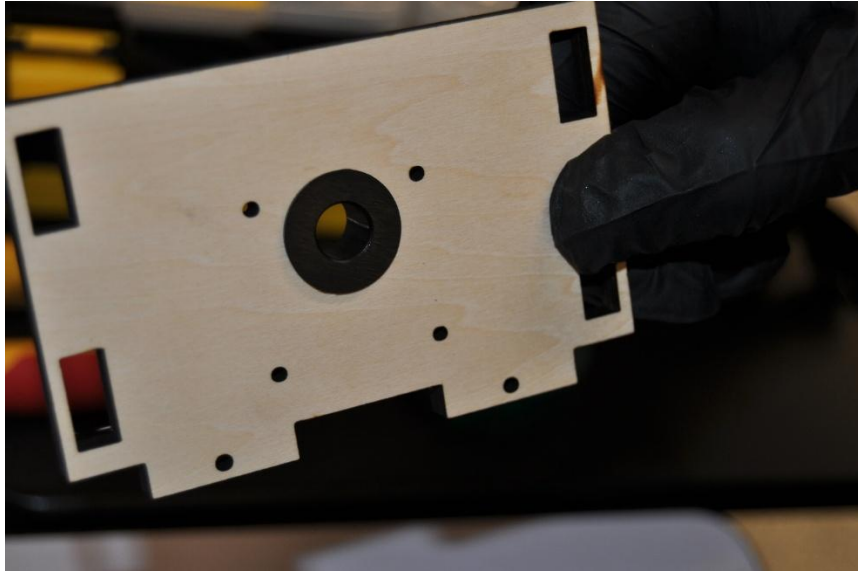
10) Cut electrical tape into thin strips and wrap around the commutator to secure wires to copper tape.

NOTE: The electrical tape will need to be secured tightly to the bushing. Electrical tape should be pulled tightly while applying for best results.



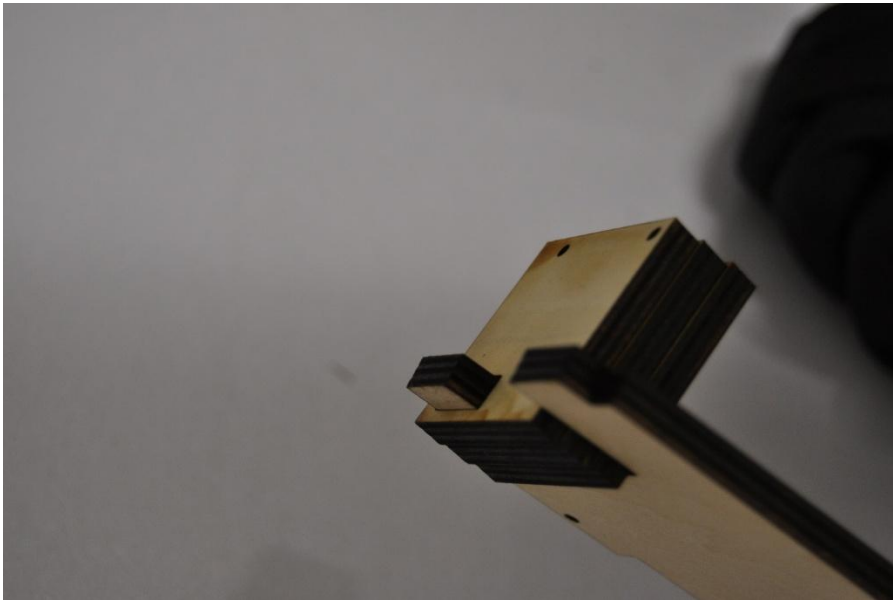
II. Assemble Brush Holders

- 1) Insert the small bushings through the holes on the front and end panels of the case. The flat side of the bushing should be pointing inside the box. **CAUTION:** The bushings cannot be installed on the front panel after carbon brush holders are assembled. Make sure to complete this step first.

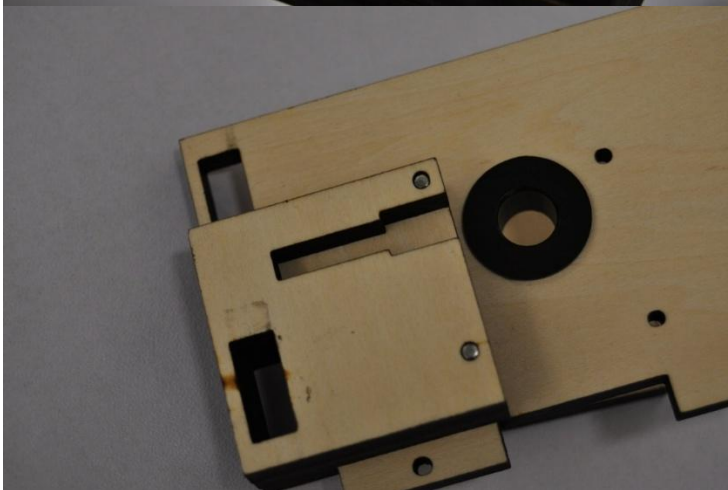
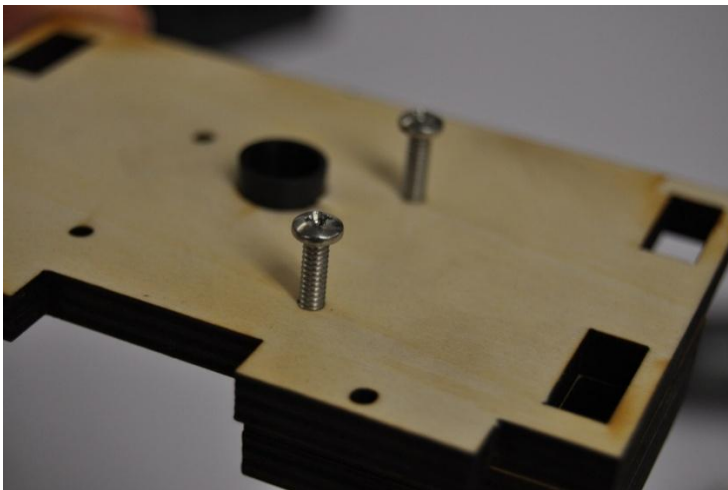


- 2) Align the front of the case with the three pieces of one brush holder, optionally using the long prong on one of the case walls to hold pieces together

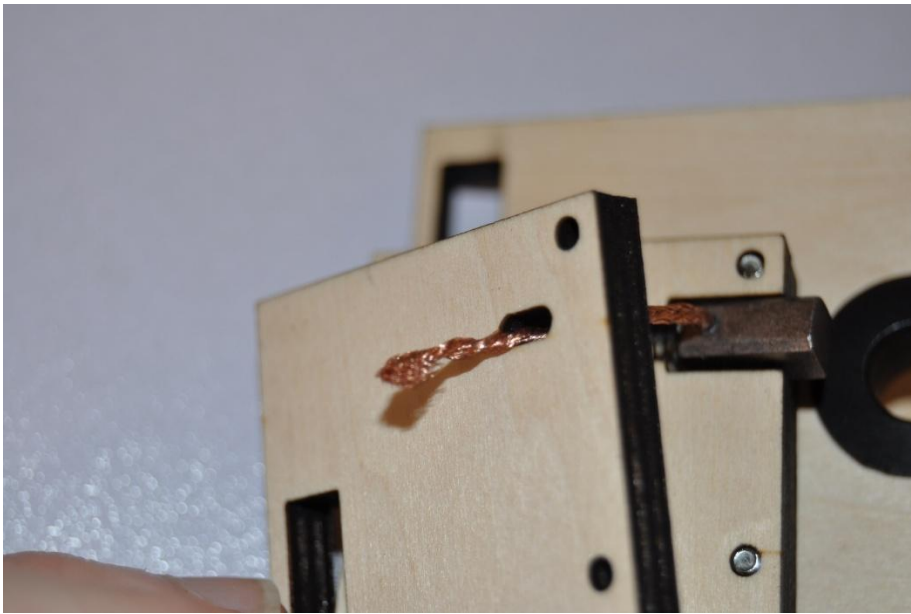
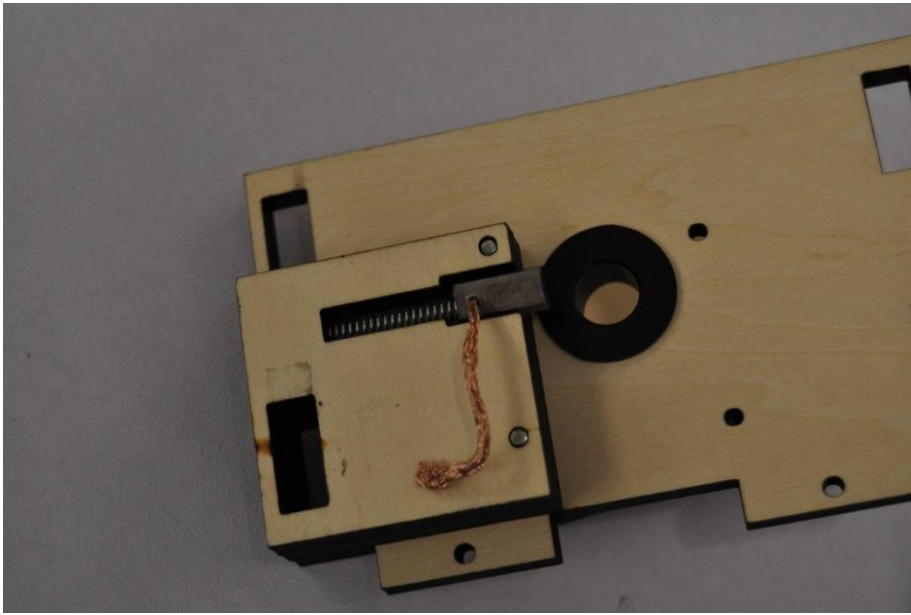




- 3) Use a Phillips head screwdriver to tighten two machine screws through the front of the case until the end of the screw is flush with the middle of the brush holder.

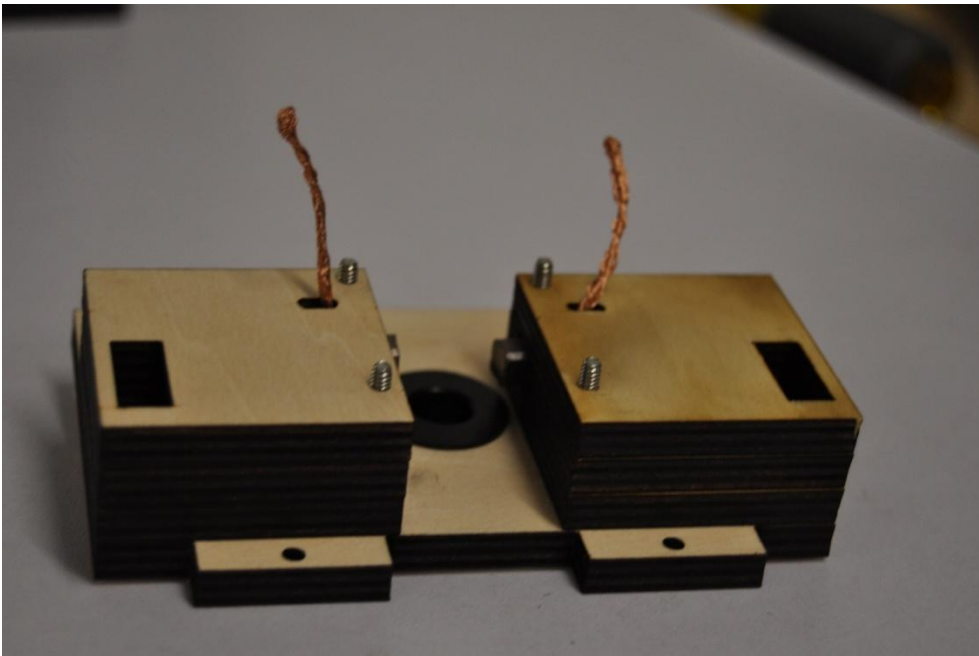
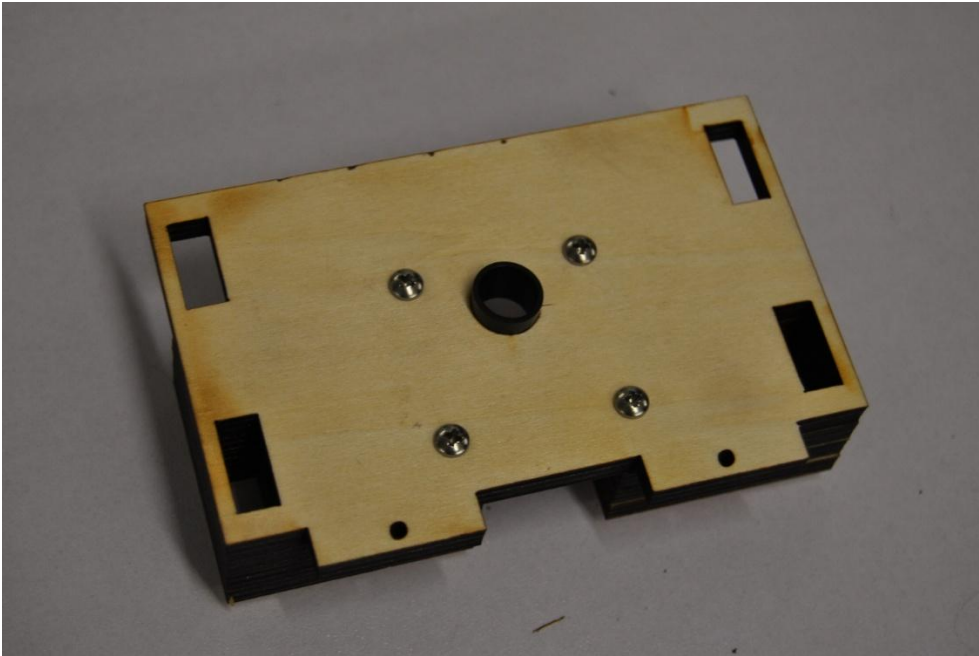


- 4) Place one spring and carbon brush in the slot inside the middle panel of the brush holder. Thread the wire on the brush through the slot in the back plate of the brush holder and realign the holes in the back of the brush holder with the machine screws.



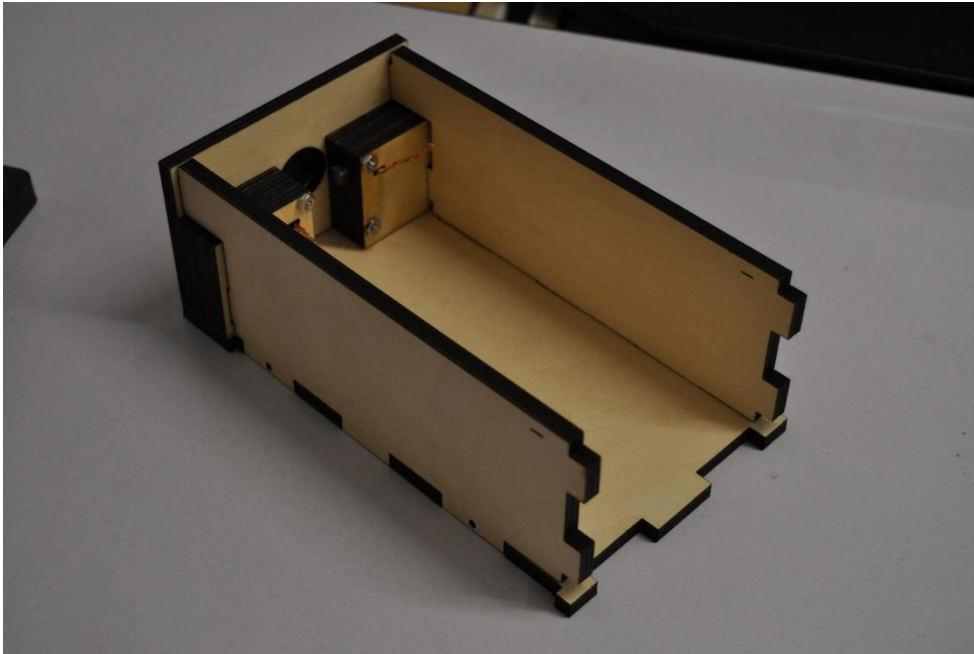
- 5) Tighten the machine screws until flush with the front of the case. The screws should be all the way through the brush holders with the copper wire from the carbon brush sticking out and easily accessible.
- 6) Install nuts onto the machine screws. The brush holder assembly should be securely held together against the case front.

7) Repeat steps 2-6 to assemble the brush holder on the other side

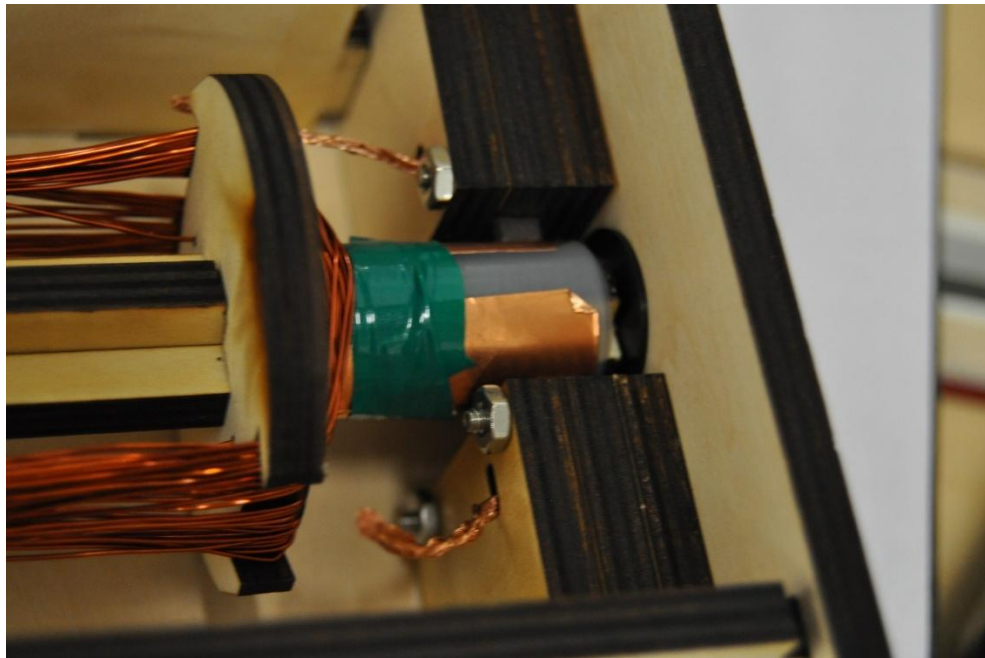


III. Assemble Case

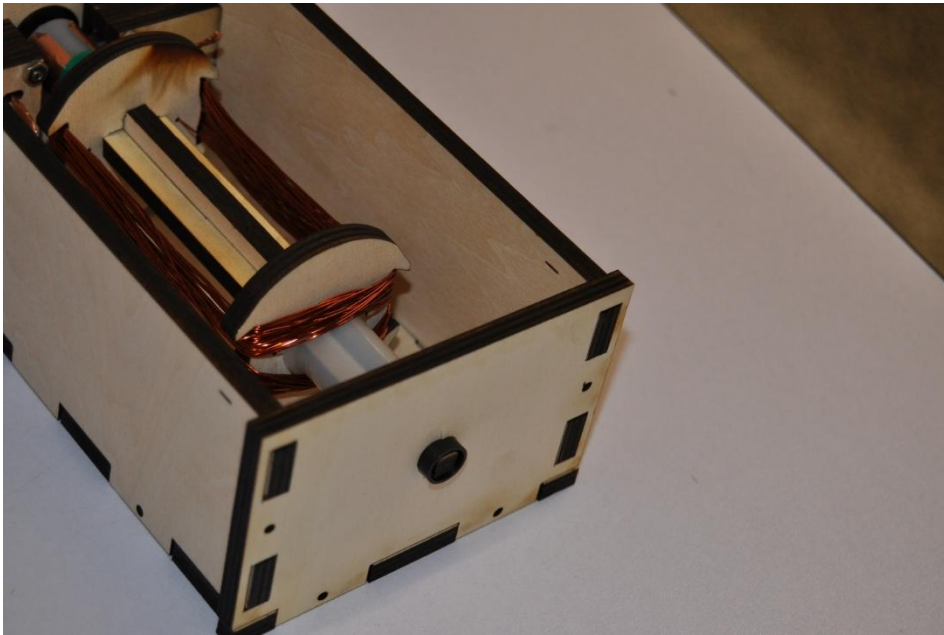
- 1) Loosely fit together all pieces of the case except the back-end panel.



- 2) Insert the assembled rotor into the case wall that has the carbon brushes.
 - a) To use carbon brushes, point the commutator towards the front end of the case with the carbon brush holders
 - b) **(Alternative Option)** To use brads, point the commutator towards the back end of the case



- 3) Slide the back end of the case on so that it fits properly and holds the rotor securely



- 4) Using a Phillips head screwdriver, install wood screws (10) in the pre-drilled pilot holes along the sides and ends of the case.
- 5) Check rotor for free rotation
 - a) **CAUTION:** Excessively tightening the screws can cause friction between the rotor and the case, preventing the motor from spinning as designed. Slowly loosen the wood screws on the back-end panel until the rotor spins freely.
- 6) Attach magnets to case.
- 7) (**Alternate Option**) If the alternative option was used in step 2 above, insert brads into pre-cut slots at the back end of the assembly. Bend the shanks to provide tension so that they remain in contact with the commutator.

IV. Your motor is built!