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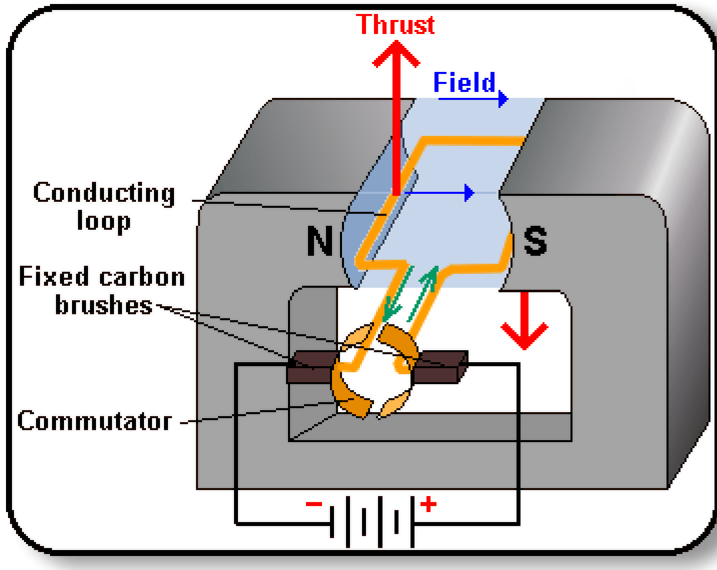
Commutation Motor

Commutation occurs when a current is passed through a coil on a rotor that is placed in a stationary magnetic field. It creates a force on the rotor and thus a torque. A commutation motor is an object that uses the power of commutation to make another object spin. I will build different version of a commutation motor with three different loops of wire. First I will talk about how commutation motors work, then how I put together my motor, then which motor design spins works the best throughout and finally trends that make the motor spin faster or slower, including magnetic field and the voltage of the battery.

A commutation motor allows turning seamlessly while current is passed through the loops of wire. To do so, the current is created by rings of copper that have gaps in them. Then, two carbon brushes or wire are connected to the copper rings. To illustrate, below is a picture showing how the motor rotates seamlessly:



As the carbon brushes pass the gaps in the copper ring, the current is automatically switched, therefore keeping the rotational force in one direction. If the copper ring did not have the gaps the motor would rotate until it flip 180 degrees then the force would be in the opposite direction causing the motor to stop or reverse.

My motor will be a little more complicate than the one pictured above. Instead of rotating one coil within the magnetic field, I will be rotating three total coils. The current will be switched three times through each rotation. To do so, my copper ring was cut into three pieces. Each end of the loops is connected to a separate piece of the copper ring, with two ends in each piece. With the two carbon brushes, it creates one circuit in one of the rotors and switches when it reaches the gap in the ring. This allows the seamless turning of my motor.

To make my motor I started with a various lengths of wooden dowels that have various diameters. I nailed three two inch nails equal distance apart on one end of the dowel. With 24 gauge wire I wound the wire around each of the nails. I did this as evenly as I could going up and down the entire nail. Now to create the gap copper ring. Since I have three coils on the dowel, I will have to create a ring with three gaps in it to ensure that the motor will not stop. To do so, I cut copper foil into even pieces the fit around the circumference of the dowel. Now I would have to create a loop for which the current to run through. I would have to create three loops that end and started at two different pieces of the copper foil. I ran the wire from one piece of copper foil around the nail and then to the piece of copper foil directly next to it. I repeated this step three time to create the series of loops around the nails.

Once the dowel had everything it needed I mounted it between two L brackets to allow it to rotate. The supplied current would be provided by a six volt battery. For the carbon brushes I bought two pieces of thicker wire and stripped the ends of the wires to expose the wire underneath. I connected one end of each of the wires to the battery. The other ends were touched to the copper foil. The brushes have to be touching two pieces of copper foil that are right next to each other in order to rotate the motor. Once connected the motor rotates until the battery dies or it is disconnected.

The design that worked the best, was a ¾ inch diameter wooden dowel that was three inches long. The lightweight dowel required less force to rotate it. With the two inch nails, it allowed for a lot of torque creating even more force on an already lightweight motor. I wrapped the wire on the nails up and down twice creating four layers. Adding a lot more wire created unnecessary weight that slowed the motor down.

Although I could not take exact measurements I was able to notice trends as I moved around different parts of the motor. The more current I was able to push through the wires, caused the motor to spin faster. To do so I connected two or three six volt batteries together in order to create twelve of eighteen volts instead of six. The other component that was easily manipulated was the strength of the magnetic field that the motor was placed in. To do so, I could move the two permanent magnets further from or closer to the coils. When the magnets were placed close to the motor it completely stopped the motor since the force of attraction between the nails and wire was to great to be overcome by the torque. When placed about three inches away, it spins at its greatest speed and when they are moved back from there the motor will slow down. In order to create the fastest motor the best combination would be to used a potential difference of 18 volts with the magnets being placed about three inches away from the end of the nails.

The motor spins somewhat fast. I think the main part that causes problems occurs at the carbon brushes. The complete voltage is not transferred all the way to the copper ring and likewise from the copper ring to the wire. To help improve the motor, smaller wire could have been used, but I was unable to find any smaller wire that was in stock.

Works Cited

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