

A Simple Spinner

Tiny Electric Dancer

Truly, the World's simplest electric motor

Introduction:

A wire can be made to spin about a magnet by using the interactions of magnetism and electric current.

Materials:

- Copper magnet wire (25 to 35 cm)
- Sand paper or something to strip the magnet wire
- New single cell battery: AA, A, C or D size.
Note: this motor design uses batteries quickly
- Circular Neodymium Magnet

Careful: Always use caution when working with Neodymium magnets. These magnets are extremely strong and can fly towards each other and shatter.

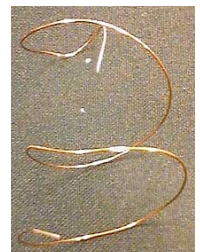
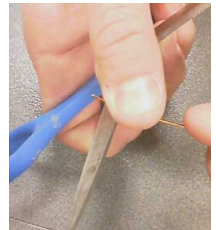
Optional equipment:

- Aluminum foil
- Standard Ceramic magnets

Assembly:

This device can be made in multiple ways. Presented here, is but one. See the links to images and videos at the end of this document to discover other ways to make this device.

1. Cut off a piece of copper magnet wire about 25 to 35 cm long
2. Scrape the ends of wire so that they will conduct electricity when in contact with the battery (I'm using a scissors here to scrape the insulation).
3. Use your battery as a guide to coil the wire around it. Two or three turns will do.
4. Remove the wire and expand or loosen the coil so that it will easily move around the body of the battery.
5. Carefully attach and center a neodymium magnet on the negative terminal of your single cell battery.
6. Bend one end of the wire so that the coil can rest and spin on the top center of the battery.
7. Place the battery on a tabletop magnet side down (or positive terminal up).



8. Place the coil on the tip of the positive battery terminal so that it can freely spin.
9. Gently pull the other end of the coil downward so that the coil extends just below the battery, but not so far it touches the tabletop.
10. Bend the lower portion of wire so that the uninsulated portion of coil can gently touch or scrape along the magnet as it spins.



To do and notice:

Let go of the coil and see it spin.... if it does, cool...if doesn't, make adjustments.



Trouble shooting hints:

- a. Make the lower portion of wire touch the magnet in a more perpendicular angle.
- b. Move the coil so it's just off center, allowing the coil to only occasionally contacts the magnet.
- c. The battery might be underpowered.... try a new battery.
- d. You might need a better electrical contact between the wire and magnet.
 - i. Re-scrape the insulation.
 - ii. Wrap the neodymium in aluminum foil (limit the wrinkle in the foil).

Options:

1. Flip the magnet over to make the motor spin the other way.
2. Try using regular ceramic magnets. The motor won't spin as fast, but these magnets are much easier to get and safer too.
 - a. Stick at least two circular ceramic magnets together.
 - b. Wrap the magnets in aluminum foil. Make sure there are not many wrinkles in the foil. This foil "coating" will help in the conduction of current from the battery to the coil.



What's going on?

Magnetism and electricity interact with each other to produce a force. This is how an electric motor works. This pushing force is called the Lorentz Force.

An electric current and a magnet field oriented perpendicular to each other, in the X and Y directions, cause a push in the Z direction. This type of electromagnet interaction can be shown with the "right-hand rule." Switching the current flow direction or flipping the orientation of the magnet will change the direction of the Lorentz force, which will make the coil spin to change direction.



Do more!

More variations and designs are on-line and in video at:
www.exo.net/~emuller

Find out more about the history and some science of this type of motor:

- http://en.wikipedia.org/wiki/Homopolar_motor
- <http://www.evilmadscientist.com/article.php/HomopolarMotor>
- <http://hyperphysics.phy-astr.gsu.edu/hbase/magnetic/magfor.html - c2>
- <http://scitoys.com/scitoys/scitoys/electro/railgun/railgun.html>

Variations of this motor are also viewable on youtube.com.

Credits:

Michael Faraday originally developed this type of simple motor back in the 19th century. This type of electric motor has various names such as: a Homopolar motor and disk dynamo.

My colleagues at the Exploratorium went nutty with this thing. They made many great design changes and suggestions. Thanks to: Paul Doherty, Julie Yu, Don Rathjen, Anna Rochester and Blake Wigdahl (AKA Hans Ahn)