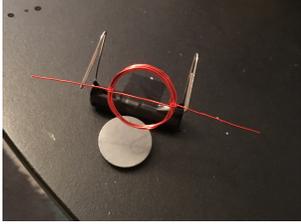


Build a DC motor

Slides adapted from Prof. Anderson, Electrical and Computer Engineering, Ohio State



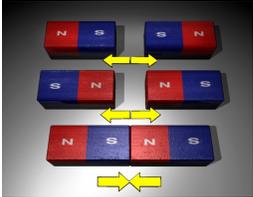
Simple DC Motors

2

- ◆ Use electric current to produce a magnet
- ◆ Use the interaction of that magnetic field with a fixed magnet to spin a wire
- ◆ How does that work?

Magnets

3



- ◆ Magnets produce force
 - ◆ Like poles repel
 - ◆ Opposite poles attract
- ◆ That can move objects in the world
- ◆ (A thing that robots need to do...)

http://www.swe.org/iaac/tp/magnets_03.html

Magnetic Field

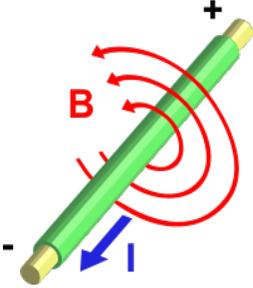
4

- ◆ Magnet emits a **field**
- ◆ It can act on objects
 - ◆ Repel or attract them
- ◆ This is the source of the force we perceive

hyperphysics.phy-astr.gsu.edu/.../elemag.html

Generating EM Fields

5



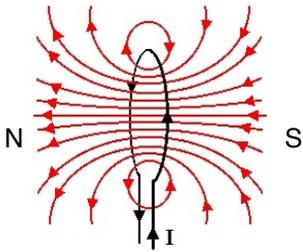
- ◆ When current (I) flows through a wire, it creates a magnetic field (B)
- ◆ Properly, an electromagnetic, or EM, field
- ◆ Use right hand rule to find direction

<http://en.wikipedia.org/wiki/Electromagnet>

A Wire Loop

7

- ◆ All the field lines inside the loop go the same direction
- ◆ The field gets **concentrated**



physicسد.buffalostate.edu/.../rhr/rhr.htm

Loop Plus Magnet

8

- ◆ The two EM fields now interact
- ◆ Which direction is the force?

Now suppose loop is tilted

9

- ◆ What will happen to the loop?
 - ◆ N attracts S
 - ◆ N repels N
- ◆ Loop will rotate

But wait...

10

- ◆ Once loop rotates halfway around, poles will be pointing the other way, and it will want to come back
- ◆ Will flap back and forth or stick in one position

Trick: Insulate ONE side of wire

11

- ◆ When loop is turned one way:
 - ◆ Current flows
 - ◆ Magnet points in one direction
- ◆ When loop is turned the other way:
 - ◆ No current → no electromagnet
- ◆ Momentum keeps it spinning

Ok! We can rotate the loop!

12

- ◆ Field is still weak
- ◆ Amplify by looping the wire repeatedly
- ◆ Many loops = many overlapping fields

General Idea:

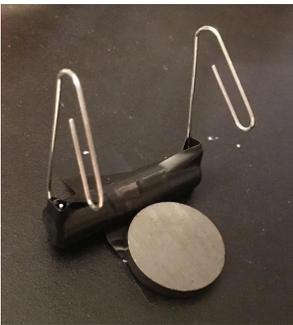
13

- ◆ Battery produces current
- ◆ You make a coil
- ◆ Suspend between conducting loops (paper clips, safety pins, ...)
- ◆ Put a magnet under loop
 - ◆ Spin spin spin!
- ◆ Okay! Ready?

Build Frame from Parts

14

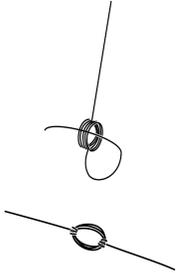
- ◆ Magnet
- ◆ 2 paper clips
- ◆ Battery
- ◆ ~2 feet of magnet wire
 - ◆ Plus a spare
- ◆ Sandpaper
- ◆ Come grab a short and a long piece of tape
- ◆ We have spares of everything, just ask!



Building the Coil

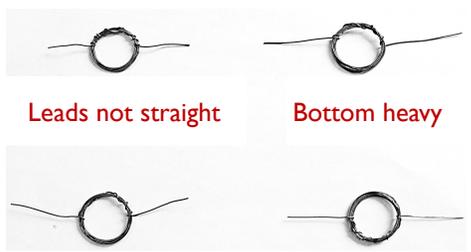
15

- Leave about 4 inches of wire unwrapped at the beginning and end of your coil
 - These are your leads
- Make 5-10 loops (about the diameter of the magnet)
- Wrap each lead around the coil at least twice
- Keep wrapping the leads until they stick out at opposite sides of the coil



Common Coil Problems

16



Leads not straight

Bottom heavy

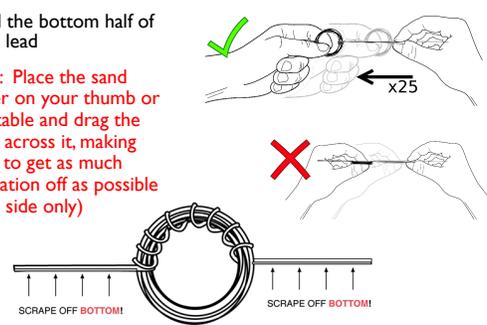
Leads not straight out

Just right!

Make the commutator

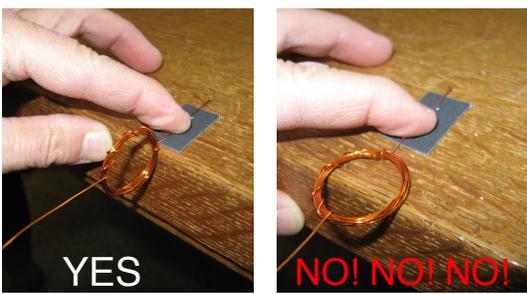
17

- ◆ Sand the bottom half of each lead
- ◆ Hint: Place the sand paper on your thumb or the table and drag the wire across it, making sure to get as much insulation off as possible (one side only)



This is Important

18

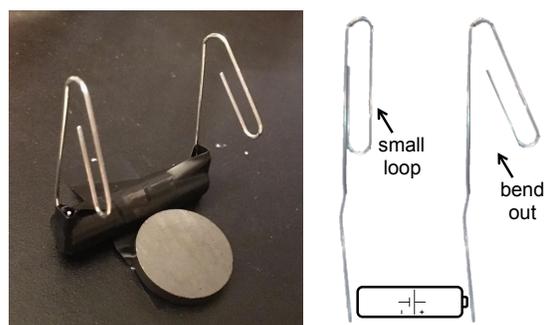


YES

NO! NO! NO!

Build the Supports

19



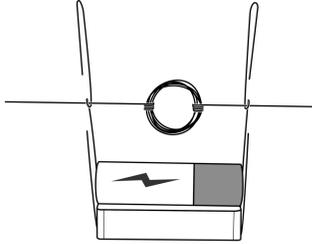
small loop

bend out

Add the coil

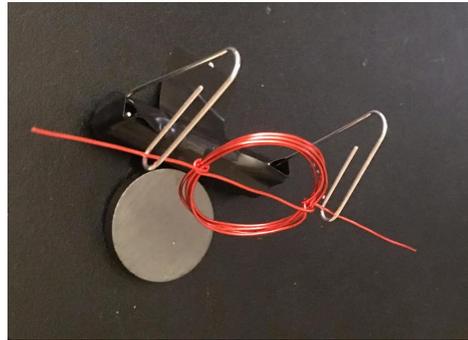
20

- ◆ Hang the coil in the loops made by the paper clips
- ◆ It will complete the circuit when the sanded side of the commutator is down
- ◆ **Hint: Make sure all components are level and that the wires coming out of the coil are as straight as possible.**



Assembled

21



Making Your Motor Run

22

- ◆ Just spin coil and let go!

Troubleshooting:

- ◆ Coil is bottom-heavy or leads aren't straight
 - ◆ Does it spins easily when you turn it in the supports?
 - ◆ We have plenty of wire; feel free to start over
- ◆ Not enough insulation sanded from bottom of coil leads
 - ◆ Try to get as close to the coil as possible when sanding
- ◆ No current through paper clips
 - ◆ Is it taped firmly and in place on the metal?
 - ◆ We have plenty of tape; come get more and try again

Let's Do It

23

