6.2: Activities

Equipment

- wire (2 or 3 different gauges)
- magnets
- dc power supply
- paper clips
- tape
- assorted cups
- sandpaper
- Pasco box and laptop
- banana-tip connecting wires
- alligator clips

The General Idea

This lab involves no experimentation. Rather, it is an opportunity to use some of our knowledge about magnetic forces and torques on current-carrying wires to design and construct two basic devices: a direct-current electric motor, and a sound speaker. The main goal is to get these working, but if you do this relatively quickly and have some spare time, then you can feel free to improve your design – have some fun with this!

Some Things to Think About

Part 1: DC Motor

- **safety** – The power supply you use for the motor in this lab has the potential to hurt you, so be careful with it. If you want to see how your motor functions at higher voltage (which results in a faster speed), *ask your TA to assist you*. Otherwise the setting at which you find the voltage will be plenty to demonstrate your motor's operation.
- **axle** – The parts of the wire that serve as an axle need to rest on the conducting leads connected to the battery, and must be free to turn while not falling off the leads. Using paper clips with small loops in them (into which the axle goes) work well for these conducting leads. Also note that you want the axle as straight as possible – if the coil "dips", then the weight imbalance provides torque that the magnetic torque may not overcome.
- **commutator** – The Background Material describes how to create a working commutator for your motor. You need to figure out what orientation the coil needs to have when the current flips from 'on' to 'off', and then use the sandpaper to take off the insulation such that this is actualized. Be sure that you are correct (maybe check with your TA?) before actually sanding, or you may end up wasting wire.
- **magnets** – This motor works best when the magnetic field at the coil is as strong as possible. These fields weaken with distance, so getting the magnets as close as possible to the coil (without the coil rubbing on it) is key.
- **starting it up** – You will need a small "kick" to get it going, but then it should keep going (and even speed up!). You'll find that it only maintains it rotation in one direction (why?), but typically a kick in either direction will do the trick (if you kick it the wrong way, it will reverse direction and keep going).

Part 2: Speaker

- **bladder** – As mentioned in the Background Material, the vibration of the coil can best be heard when it causes a bladder to vibrate that compresses/rarefacts larger volumes of air than the coil would by itself. You don't need to be fancy about this attachment – just taping the coil to the bottom of a cup works fine.
- **function generator** – The Pasco application "Engineering_with_Magnetism" is used here to provide the periodic time-varying voltage (and therefore current) needed to get the coil to vibrate. Just connect the two jacks from the Pasco box to the two leads of your coil. You may need to increase the amplitude somewhat from the default in order raise the decibel level of the sound to the audible range. You should check several frequencies to see that the pitch of the sound changes as you would expect.
- **magnets** – There is no need to attach the magnets to your speaker. Once the current is flowing, just bring the magnets close to the coil, and listen for the sound (and note that when you take them away, the sound goes away!).

Clean Up

When you are finished, you need to disassemble your devices, so that future lab participants can work from scratch like you did. We would like to re-use most of the seemingly-disposable materials (certainly the cups, and possibly even the paper clips). Your wire coils you can take home, or give to your TA for recycling.

Lab Report

The lab report you upload in this case will consist of a short video of your two working prototypes (obviously sound will be necessary for the speaker video). The videos should include a piece of paper in the frame with the names of your group members.

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