6.1: Background Material

Text References

- a direct-current motor

Building a Commutator for a DC Motor

From the standpoint of designing a dc motor, the trickiest part is designing the commutator (see the text reference given above for an explanation of what this is). In this lab, we will stick to the simplest design for a commutator possible. Unlike the diagram of the motor in the text reference, our commutator will not reverse the direction of the current with every 180 degree rotation. Rather, it will simply cut off the current for 180 degrees out of every full revolution. So for half of every revolution there will be a torque driving the rotation, and for the other half, the motor's angular momentum will carry it around until it can get it's next "kick" of torque.

To accomplish this, we will exploit the fact that the wire we will be using for our coil is insulated. In our simple design, the wire used for our coil also serves the purpose of the motor's axle. The wire is wound several times until a coil has been fashioned, with the ends of the wire sticking out both ends. Then those loose ends are wound around the opposite sides of the coil, so that the coil is held tightly together, and the loose ends provide an axle for the coil's rotation.

Figure 6.1.1 – Single Wire Makes Both Coil and Axle

Now if the insulation is stripped from the two loose ends, this can be rested on leads that are at a potential difference – with gravity assuring a good connection, but nothing to impede the coil's rotation – and current will flow through the coil. But as stated above, we don't want the current to flow through the coil at all times, but only half of every rotation, so for one side of the axle, we should only strip off the insulation on 180 degrees of the wire. You will have to determine where that stripping begins and ends, based on what orientation you want the coil to have in the magnetic field when the current begins and ends (hint: see the diagram in the text reference!).

Building a Speaker

We know that the force on a wire in a magnetic field depends upon the current flowing through that wire. So if, in some fixed magnetic field, we vary the current in a wire in some periodic fashion (let's say harmonically), then the force on that wire varies with the same period. This varying force leads to mechanical vibration of that wire with the same period, and this mechanical vibration can produce sound with – you guessed it – the same frequency. This is how a speaker works.

Like the motor, we will need a coil to concentrate a lot of current into a small space in order to get a decent amount of magnetic force. Unlike the motor, we will not need to use wire heavy enough to work as an axle. Thinner wire is also preferred in part because it has less inertia, which means it is accelerated more by a magnetic force. This allows it to vibrate more effectively, especially at higher frequencies.

Also, the coil itself does not move a lot of air when it vibrates, so it is best to attach it to a sort of "bladder" (in our case, the bottom of a lightweight cup) which will move a lot of air when it vibrates with the coil.