

Experiment: Building a DC Motor

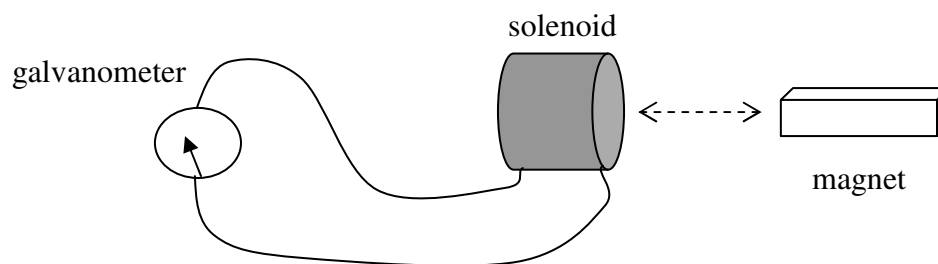
Objective: To investigate electromagnetic induction and use it to build a simple DC motor.

Equipment:

- solenoid
- connection wires
- analog galvanometer
- 4-6 strong block
- 2 bar magnets
- 5V DC power supply (or battery)
- a drinking straw
- 1 empty thread spool
- 2 needles
- masking tape
- bare copper wire
- 4-6 strong block magnets

Part 1: Electromagnetic induction

1. Set-up the simple solenoid circuit shown below:

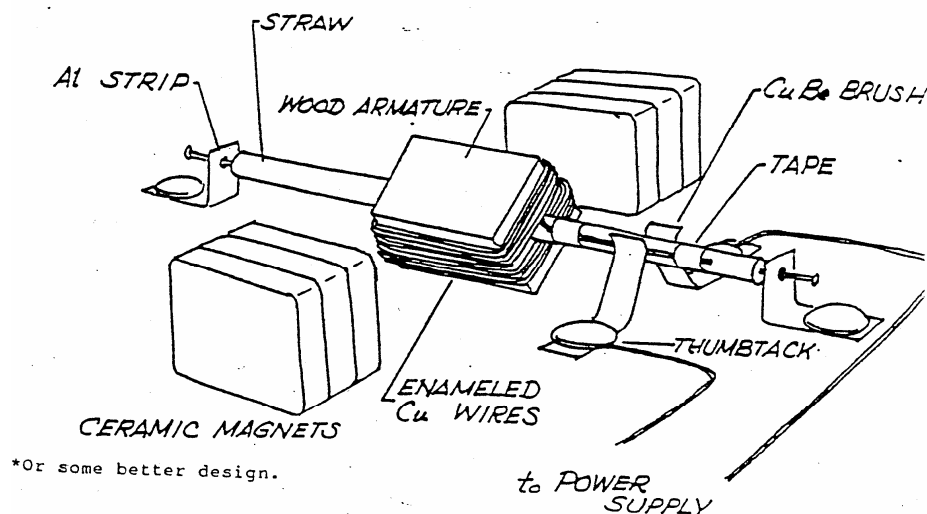


2. Move a pair of block magnets (pole facing solenoid) back and forth along the axis of the solenoid opening. What do you observe?

3. How does the motion of the magnet affect the current observed by the meter? Be specific.

Part 2: Building a simple DC motor

1. Set-up the simple solenoid circuit shown below:



- Construct the armature.** Insert straw into middle of spool
- Obtain 2 pins. Wrap masking tape individually around each pin (enough to secure the pin in the end of the straw). The pin must be in the center of the tape winding or it will be off-balance and won't rotate properly. Place a tape wrapped pin into each end of the straw with the flat head pointing outward.
- Wrap the armature.** Cut a piece of thin copper wire approximately 3 to 5 meters in length. Wrap the wire around the spool as many times as possible and attach the ends of the wire to opposite sides (on the same end) of the straw using tape (see above diagram). Try to keep the windings as tight together as possible.
- Set-up a spin support for the motor and attach the armature.** Set straw onto the support surface. Attach a support strip to the support surface at each end of the straw and secure them with a thumbtack (as shown in the diagram).
- Place the ends of the pins into the support strips. You want the spool & straw to freely rotate while the pins support it.
- Attach the motor "brushes".** Secure a couple copper strips to the support structure on opposite sides of the straw near the exposed wire using thumbtacks.
- Connect the DC power supply.** Attach connecting wires to the base of the brushes (one for each of the power supply). Connect the other end of the wires to the power supply terminals. Use the middle terminals of the power supply (5 V, 0-3 A).
- Have instructor check your set-up before turning on the power supply. Once checked, turn on the power supply.
- Start your motor.** Place several block magnets near opposite faces of the armature and get your motor runnin'. You will need to "fiddle" with the brush positions to get decent performance. Also, you will need to play with the position of the magnets to get the best performance for the motor.

Questions:

1. How does the position of the magnets affect the operation of the motor? Be as specific as possible.
2. Vary the quantity of magnets and observe the effects on motor operation. How does the number of magnets affect the motor operation?
3. Go around the room and compare the motors constructed by other class groups. How does your motor compare with the motor constructed by other groups? What could you do to make your motor better?
4. Describe how electrical energy is converted to mechanical energy in your DC motor. Be as specific as possible.
5. Sketch a diagram of the appropriate vectors acting on your DC motor, as described in question #4.