Name_____ Period_____ Date_____

CONCEPTUAL PHYSICS | **Activity**

36.8 Magnetism: Meters to Motors

MOTOR MADNESS

Purpose

In this activity, you will investigate the principles that make electric motors possible.

Required Equipment and Supplies

hand-held generator (Genecon® or equivalent)
connecting wires
about 50 cm of lead-free solder
2 collar hooks (or 2 10-cm lengths of lead-free solder)
about 30 cm of 1/4" diameter wood dowel
support rod with base and rod clamp
2 bar magnets (strong alnico magnets are recommended)
small block of wood (about 2" × 2" × 1")
2 rubber bands
2 D-cell batteries

Discussion

Perhaps the most important invention of the 19th century was the electric motor. You use a motor whenever you use electric power to make something move. A motor is used to start the engine of a car. Motors are used to spin compact discs. Motors are used to move elevators up and down. A list of motor applications would go on and on. But how do motors turn electric energy into mechanical energy? Let's find out!

An electric current can exert a force on a compass needle (which is simply a small magnet). But Newton's third law of motion suggests that something else must be going on here. What is it? Finish the statement:

If an electric current can exert a force on a magnet, then a magnet

Procedure

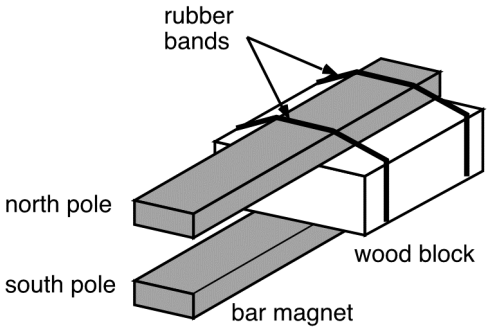
Part A: The Magnetic Swing

Step 1: Arrange a solder "swing" by following the instructions below.

a. Make a "sandwich" with the two bar magnets and the wood dowel as shown in Figure 1. The magnets must have opposite poles facing each other. Secure the sandwich with the rubber band. See Figure 1.

b. Attach the support rod to the table clamp or ring stand base.

c. Attach the wood dowel to the support rod.



MAGNET: Sandwich a small wood block between two bar magnets. Secure the arrangement with rubber bands as shown. Note that the magnets are antiparallel: opposite poles face each other.

Figure 1

d. Place the collar hooks on the wood dowel about 10 cm apart. (You can use the short lengths of solder to make two hooks if collar hooks are not available.)

e. Bend the long length of solder into a square U-shaped "swing." Make wide hooks at the ends and hang the swing from the solder hooks on the wood dowel. **The swing must sway freely on its hooks.** See Figures 2 and 3.

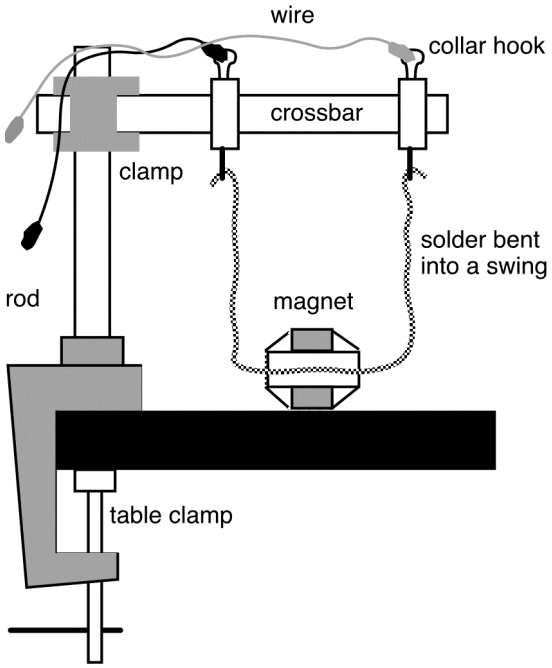


Figure 2. Front view of arrangement.

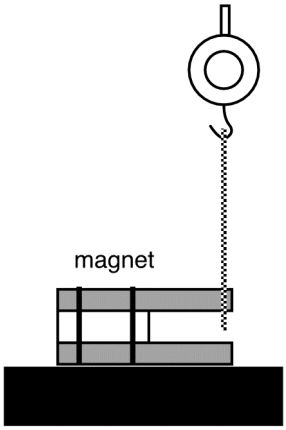


Figure 3. Side view of arrangement.

f. Arrange the height of the crossbar so that the bottom of the solder swing hangs between the magnets.

g. Attach the generator leads to the top leads of the hooks.

Step 2: Crank the generator one way. This will send electric current one way through the swing. Then crank the generator the other way.

1. What effect—if any—does the magnetic field of the bar magnets have on the current in the swing?

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2. How do you know that this effect is caused by the current's interaction with the bar magnets? (Would the swing sway if the magnets weren't there?)

Step 3: Try "pumping" the swing by cranking the generator back and forth.

3. Do your observations of the magnetic swing confirm or contradict to what you stated in the Discussion section above?

Part B: The Simple Motor
Once it was found that a magnetic field could exert a force on an electric current, clever engineers designed practical ways to harness this force. They started to build electric motors. A motor transforms electric energy into mechanical energy. Some simple motors are made of coils of wire and magnets arranged so that when electric current flows through the wires, some part of the motor rotated.

The hand generator you've been using in this and other labs is, in fact, **a motor!**

Step 1: Hold the grip of the generator but not the crank handle. Touch the two leads of the generator to opposite terminals of a single D-cell battery. What happens?

_____
_____

Step 2: Put two batteries together in series (in a line end to end) and touch the leads of the generator to opposite terminals of the arrangement. How is the result different what happened in Step 1?

_____
_____

Summing Up

1. The magnetic swing swayed due to interaction between the current in the wire and the magnetic field of the bar magnets. What are some ways this force could be made stronger (and thereby push the swing further in or further out).

2. Which of the devices listed below uses a motor?

___alarm clock	___toilet	___shower
___blow dryer	___shaver	___cassette player
___CD/DVD player	___radio	___vending machine
___light bulb	___computer	___TV
___VCR	___washing machine	___car

3. List two more devices that use motors.