

CONCEPTUAL PHYSICS**Activity***37.4 Electromagnetic Induction: Motor and Generator Comparison***GENERATOR ACTIVATOR****Purpose**

In this activity, you will investigate electromagnetic induction, the principle behind electric generators.

Required Equipment and Supplies

bar magnet (strong alnico magnet is recommended)
air core solenoid or a long wire coiled into many loops
connecting wires
galvanometer ($-500 \mu\text{A} - 0 - +500 \mu\text{A}$ recommended)
hand-held generator (Genecon[®] or equivalent)
access to a second hand-held generator

Discussion

In 1820, Hans Christian Ørsted found that electricity could create magnetism. Scientists were convinced that if electricity could create magnetism, magnetism could create electricity. Still, 11 years would pass before the induction of electricity from magnetism would be discovered and understood. The best minds of the day set out to make this widely anticipated discovery, but it was Michael Faraday who put all the pieces together. In this activity, we will use a magnet to create an electric current and see how this effect is applied in electric generators.

Procedure**Part A: Electromagnetic Induction**

Step 1: Connect the galvanometer to the coil (air core solenoid or looped wire).

Step 2: Determine a method for producing current in the coil using the bar magnet.

1. Describe your findings.

2. Can current be produced if
a. the coil is at rest? If so, how?

b. the magnet is at rest? If so, how?

c. both the coil and the magnet are at rest? If so, how?

Part B: The Generator

Once it was found that a changing magnetic field could induce an electric current, clever engineers figured out practical ways to harness induction. They started to build electric generators. A generator transforms mechanical energy into electrical energy. Some simple generators are made of coils of wire and magnets arranged so that when some part of the generator is rotated, and electric current moves through the wires.

The hand-crank generator you have used in previous labs is such a device.

Step 1: Disconnect the coil from the galvanometer and attach the leads of the hand-crank generator to the galvanometer. Slowly turn the handle until the meter responds.

3. What does the galvanometer show?

4. What happens if you turn the handle the other way?

The invention of the generator allowed the production of continually flowing electrical energy without the use of chemical batteries. Further developments led to the wide-scale distribution of electrical energy and the availability of household electricity.

Large-scale electrical distribution grids are powered by large-scale generators. These generators are commonly powered by steam turbines. The heat used to generate the steam is typically produced by burning coal or oil, or as a byproduct of controlled nuclear reactions.

Step 3: Use a generator to power a motor! Connect two hand-crank generators to each other. Crank the handle of one of the generators.

5. What happens to the handle of the other generator? Would you say the other generator is acting as a motor?

6. Not all the energy you put into the generator turns into mechanical energy in the motor. What is your evidence of this?

Summing Up

- Name each device described below
 - Transforms electric energy into mechanical energy: _____
 - Transforms chemical energy into electrical energy: _____
 - Transforms mechanical energy into electrical energy: _____
 - What happens to the energy lost between the generator and motor in Step 3 (Part B) above?
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3. A classmate suggests that a generator could be used to power a motor that could then be used to power the generator. What do you think about this proposal and why?
