ElectroMagnet

P8-8100

INSTRUCTIONAL GUIDE

Contents

- Electromagnet
- Crossbar with eyelet
- Instructional Guide

Recommended for activities:

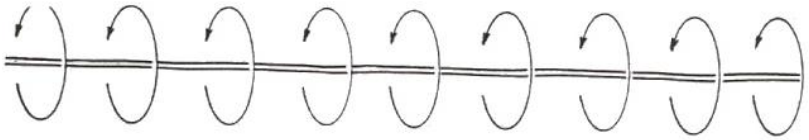
- Hooked Mass Set of 9 (91-1000)
- AC/DC Precision Variable Power Supply (P4-3300)
- Genecon Hand Crank Generator (P6-2631)
- D-cell Battery Holder (P4-1600)
- D Battery (2 Pack) (04-2106)
- Alligator Leads (Pack of 10) (P4-3000)

Background

The discovery that an electrical current produces a magnetic field was made by Hans Christian Ørsted in 1820. Ørsted made his discovery during a classroom demonstration on electricity, galvanism, and magnetism. Because Ørsted made his important discovery while teaching, the American Association of Physics Teachers awards a medal named after him each year to a teacher who has made a significant impact on the teaching of physics.

Ørsted's discovery led to some further surprising features of electromagnetism. First, the magnetic field created by a current is perpendicular to that current. Second, the field is not at right angles to the current, but rather goes in a particular direction around the current. **Figure 1** shows a wire carrying a current from right to left and the magnetic field it creates is represented by the arrows going around the wire. The Right-hand Rule shows the direction of the arrows or the magnetic field lines.

Figure 1



If you take this same wire and put a loop in it you will get the magnetic field configuration in **Figure 2**.

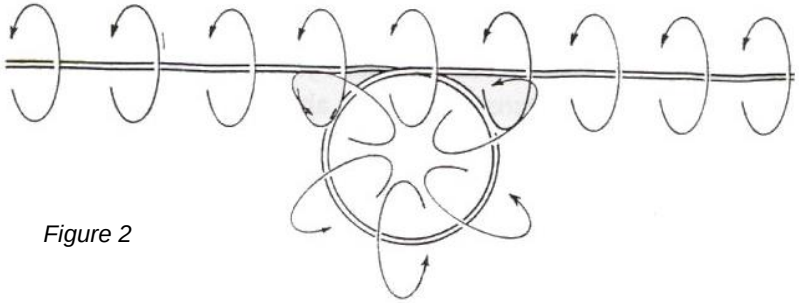


Figure 2

Notice the high concentration of arrows in the center of the loop that all point in the same direction. This represents a strong magnetic field in the center of the loop. Someone got the bright idea of adding a bunch of these loops in a row to make a “tunnel” of high magnetic field pointing in the same direction. **Figure 3** shows a series of these loops and the effect their magnetic field has on iron filings.

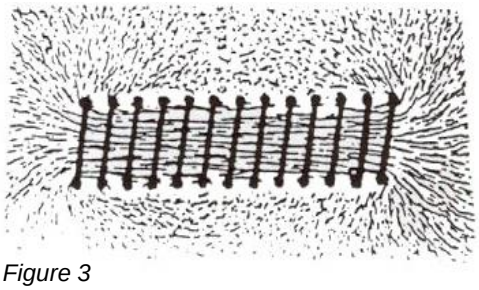


Figure 3

Introduction

If you take a look at your electromagnet, you will notice that there are two solenoids of wire. These coils have soft iron inserted into the middle of them. By following the wire closely with your eye, you can also see that the coils are wrapped around in *opposite* directions. The coils, when carrying a current, induce two magnetic fields and force the iron to become magnetized. Each coil, because the current flows in opposite directions, creates a different magnetic pole on the ends of the horseshoe shaped iron bar.

Activities

1. The **Genecon Hand Crank Generator (P6-2631)** is an ideal companion to our electromagnet. By hooking up the Genecon’s clips to the electromagnet (unscrew the small screws and clip the Genecon leads into the plastic covers), students can turn the crank and create enough current to induce magnetism. Have students hang weights from the hook and determine how much force they are creating. What happens when they stop cranking?
2. Students can use a **compass (P8-1170)** to study the magnetic field of the iron horseshoe and the coils. Does the north pole coincide with predictions based on the right-hand rule? What happens when students change direction with the Genecon?
3. Batteries work even better in creating a magnetic field. The more current, the more weight the electromagnet can carry.

Trouble Shooting

If your electromagnet doesn’t seem to be working, try tightening the two lowest screws on the clips. The screws must actually pierce the wire’s outer coating for the clips to make good contact. The electromagnet can hold up to 2kg of weight maximum.

Related Products

Electricity and Magnetism Discovery Bundle (P6-2500) Understand the important relationship between electricity and magnetism—and how one can produce the other -- with this collection of equipment and activities.

Electromagnetic Force Demonstrator (P6-2625) Watch how the aluminum pipe travels along the track in the direction the current is applied, reinforcing the interrelated concepts of Current, Magnetic fields and the Lorentz Force.

Electric Swing Apparatus (P8-8009) Study the interaction between a current-carrying wire and a constant magnetic field with the Electric Swing Apparatus.