Making Radio Waves

Telegraph

Background Information

What better way to demonstrate the detection of electromagnetic waves then to produce the electromagnetic waves (Radio waves) that are detected. Radio waves can be made by making a telegraph and a cohere detector can receive those radio waves.

This early style telegraph generates a radio wave signal by producing a spark when the circuit is completed. Radio waves are produced by the spark. When there is a spark, electrons are transferred from one electrode to another as the electrons move, energy is transferred into heat, light, and a standing wave at the frequency of a radio wave. This allows the operator to generate radio waves by connecting and disconnecting the circuit respectively. In this design the switch is a piece of metal that is depressed to make contact, and released to open the circuit breaking the connection. (See photograph below) This circuit can be opened and closed easily in a pattern known as Morse code to send information wirelessly.

A coherer detector is a historic radio wave detector made of common everyday materials. It consists of a tube containing some metal filings and two electrodes within millimeters of each other. Each electrode is connected to an observable resistor like a light bulb, speakers, or headphones. In the presence of a radio wave the metal filings form a bridge that completes a circuit. When the circuit is closed the radio wave becomes observable, success! The tube needs to be taped so that the metal filings will decoher and the detector is primed to detect another transmission. The cohere detector requires attention to make the metal filings decohere, and therefore has been replaced in the world with more sophisticated detectors.

Materials

For the Telegraph (Radio Wave Transmitter)

- Board or base that materials can be fastened telegraph to
- Five strips of any metal (Copper plated hanging strips)
- Two D batteries
- Two nails
- Wire (copper)
- Eight screws (Shorter than the thickness of the board)

Note: if you are using a battery holder you will need two less metal strips and two less screws.

Coherer Detector (Radio Wave Receiver)

- Plastic insulated ballpoint pen barrel or transparent plastic tubing
- Two Nails of the same length that fit snugly into the tubing (electrodes)

- Two D batteries
- Wire (copper)
- Light bulb (light cut from christmas tree lights)/ Speakers/ headphones
- Nickel, silver, or iron filings

Alternative setup (Radio Wave Receiver)

- Antenna
- Wire
- Ground
- Diode
- speakers/headphones/light bulb/fan

Alternative to the alternative radio receiver

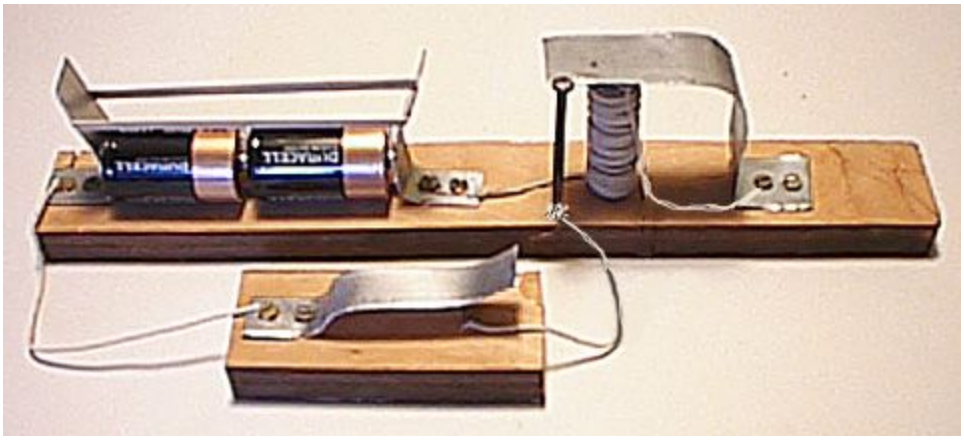
- Radio set to AM station

Tools

- Wire stripers/cutters
- Tin snips
- Screwdriver

Safety

- Never work on a circuit while power is applied.
- Do not apply power to the circuit until the circuit is complete and you have carefully checked your work.
- If you smell something burning immediately disconnect your power and examine your cricut to find out what went wrong.
- Keep your work area dry.
- Be especially careful when soldering because hot soldering irons can burn.



Photograph taken from Perera T. Website.

Telegraph Procedure

1. Acquire the required materials for the Telegraph.
2. Determine the appropriate layout for your Telegraph.

3. Assemble the battery holder: First cut two ~13 cm sections of metal strips. Measure the size of two D Cell batteries connected in series. Bend the metal strips so that the metal will remain in contact with the end of the battery. Screw the strips into place, leaving the second screw loose so that the wire can be positioned underneath the strip. Safety Note: Do not place the batteries into the holder until the apparatus is complete.
4. Assembly of the switch: Measure the distance from one end of the battery holder to the switch location and cut a piece of wire to fit. Strip about 2 cm of the coating from the end of the wire so that the wire is exposed. Secure the one end of the wire underneath the end of the battery holder so that when the screw is tightened the wire is in contact with the metal. Cut two more ~13 cm section of metal. Bind one so that it is a base of your switch. The other metal strip will need to be bent so that the switch can be closed by pressing down on the strip. Secure the end of the wire under the metal strip that will be one side of the switch. On the other side of the switch place a striped wire piece long enough to attach to the spark nail.
5. Assembly of the electromagnet: On an iron nail wind a continuous section of wire approximately 200 times creating a tightly coiled solenoid. Remember to leave excess wire at the beginning and the end of the coil, so that the wire will reach the base of the metal strip that will be above the coiled wire and the battery with the other. Nail the wrapped nail into the board. Connect one side of the wrapped wire to the battery holder. Cut a ~13 cm section of metal and position this sparking metal so that it is ~2 to 3 mm above the top of the wrapped nail. Connect the wire wrapped nail to the base of this sparking metal strip. Nail the remaining nail so that the underside of the nail head is above and barely touching the side of the sparking metal strip. This unwrapped nail should be attached to the switch.
6. Once all the components are assembled check that all of the connections are good. The battery should be attached to the switch. The switch should be attached to the unwrapped nail. The wrapped nail should be attached to the metal sparking strip and the battery. Then put the batteries into the battery holder. The Telegraph is complete.

Procedure for Coherer

1. Assemble the battery holder: First cut two ~13 cm sections of metal strips. Measure the size of two D Cell batteries connected in series. Bend the metal strips so that the metal will remain in contact with the end of the battery. Screw the strips into place, leaving the second screw loose so that the wire can be positioned underneath the strip. Safety Note: Do not place the batteries into the holder until the apparatus is complete.

2. Cut two ~7 cm piece of metal strip and bind them into an L shape. Slide the nail through one side of the L shaped metal strip and into the plastic tube. Place the iron filings into the tube. Slide the remaining nail through the other L shaped metal strip and into the remaining side of the plastic tube. There should be a visible amount of iron filings in the tube between the nails. The nails should be no more than 2 mm apart. Attach the two L shaped metal strips to the board. One side of the L shaped metal strip should be attached to a light bulb. The light bulb should be attached to the battery. The battery should be attached to the other L shaped metal strip. The Coherer is complete.

Questions

On a separate piece of paper answer the following questions.

1) How does the Telegraph create a radio wave?
2) How do you know that a radio wave has been detected?
3) What are some applications for the Telegraph or Receiver?
4) What is the maximum distance apart that the Receiver and the Telegraph can be?
5) List two ways that the distance between the Receiver and the Telegraph could be increased.