Unit 4 Effects Of Current

Chapter 12:

Magnetic Effects Of Electric Current

Hans Christian Oersted (1777 - 1851)

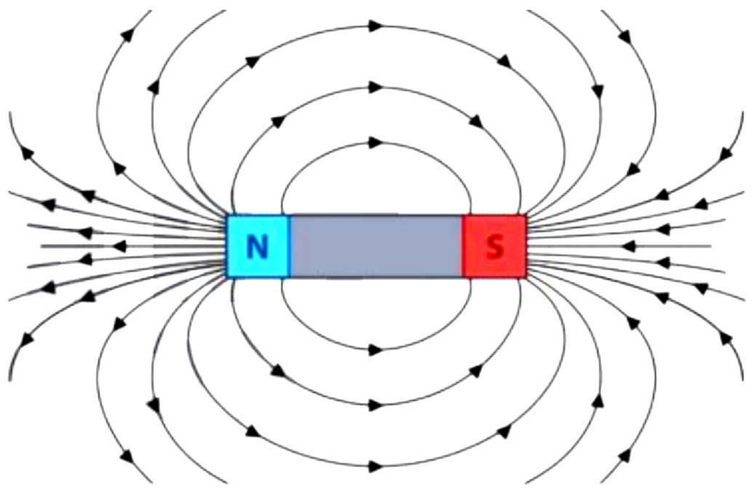
Hans Christian Oersted, one of the leading scientists of the 19th century, played a crucial role in understanding electromagnetism.

➡ Magnetic Field

The area surrounding a magnet where magnetic forces are experienced is termed the magnetic field. It is a vector quantity, with its unit in the International System of units (SI) being the tesla.

➡ Magnetic Field Lines

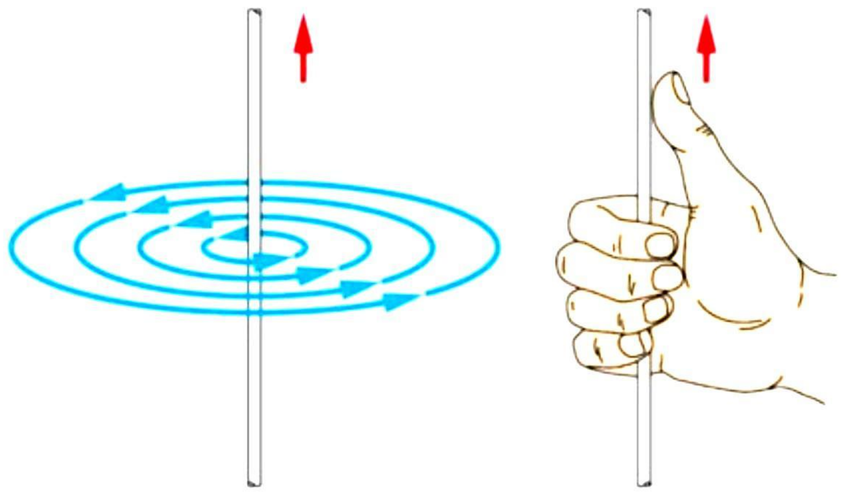
When iron fillings are placed near a magnet, they align to form patterns representing the magnetic field lines. These lines illustrate the organization of the magnetic and exhibit several characteristics.



- Magnetic field lines originate from the North pole of a magnet and extend outward to the South pole outside the magnet. However, with in the magnet, the direction is from South to North.
- They form continuous, closed loops.
- The direction of the magnetic field at any point along the magnetic field lines is indicated by the tangent to the line at that point.

- Magnetic field do not intersect each other.
- The Spacing between magnetic field lines reflects the strength of the magnetic field: when lines are closely packed, the magnetic field is stronger, while wider spacing indicates a weaker magnetic field.

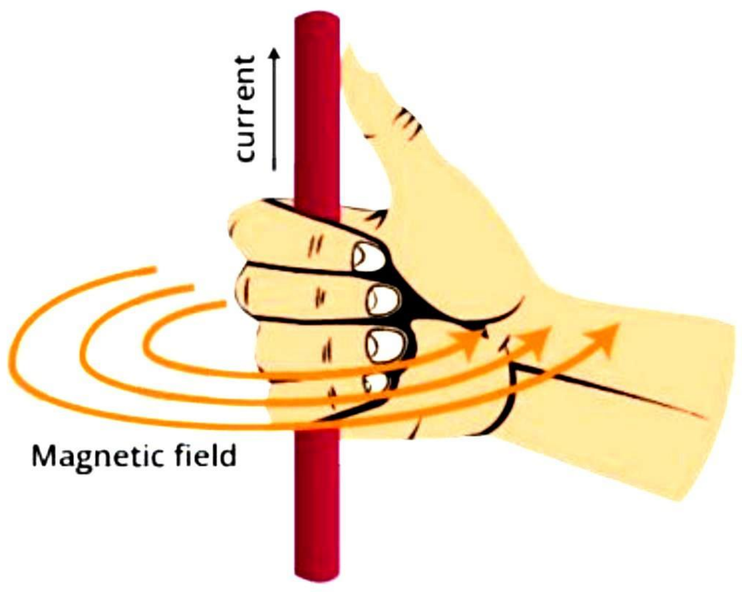
A straight conductor carrying an electric current generates a magnetic field



- The magnetic field lines produced by the current form concentric circles centered around the wire.
- The intensity of magnetic field amplifies with higher currents.
- As one moves further from the wire, the magnetic fields strength diminishes.

➡ Maxwell's Right hand thumb Rule

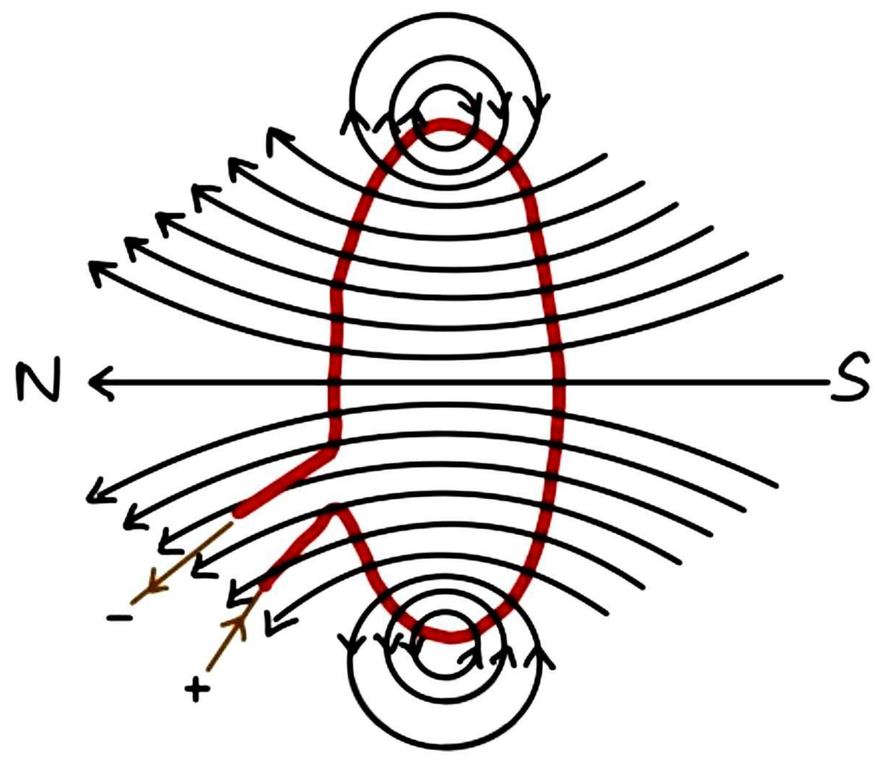
Use Maxwell's Right Hand thumb Rule to determine the magnetic field's orientation around a current carrying wire. Align your thumb with the direction of the current and observe the curling of your fingers to indicate the magnetic field's direction.



➡ Magnetic field due to a current through a circular loop

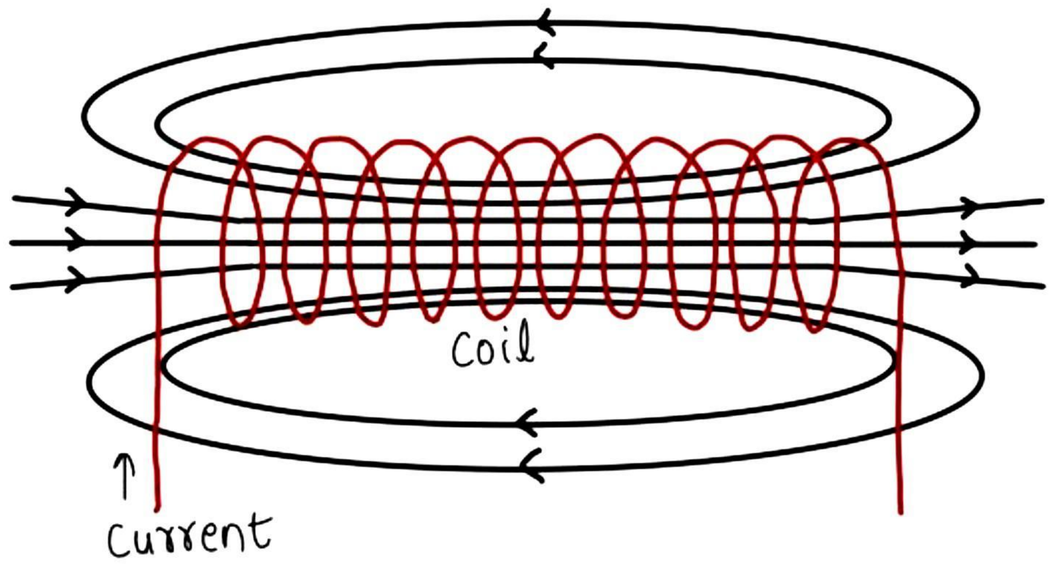
when a circular loop carries current

- Along the loop's axis, the magnetic field flows
- Beyond the loops, it takes the shape of concentric circles.
- The field intensity is contingent on both the current and the loop's dimensions.
- The inner direction is dictated by the current employing the right-hand rule.



➡ Magnetic field due to current in a solenoid

- The core has magnetic lines
- It looks like magnetic field of bar magnet.
- Its strength change with the current and coil turns
- Use the right hand to find its direction.

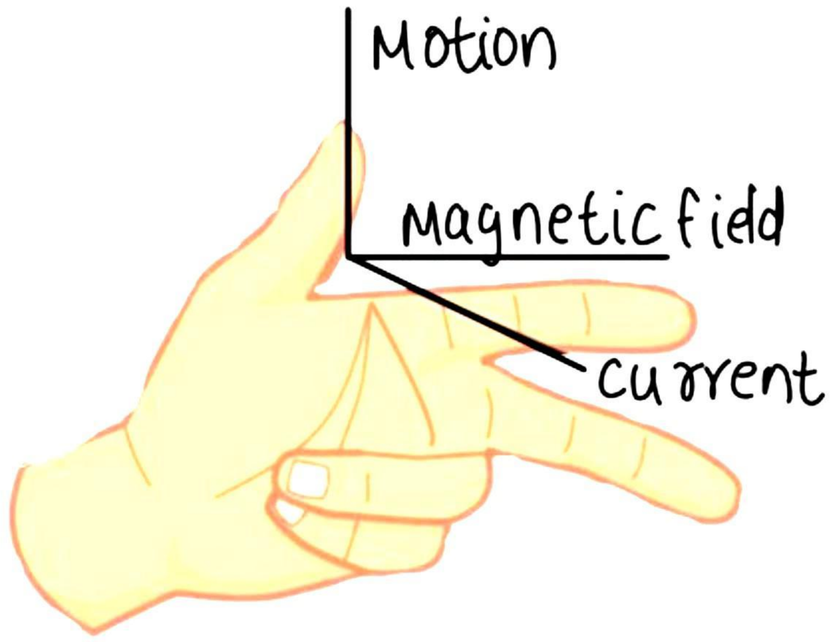


➡ Force on a current carrying conductor in magnetic field

- A Current-Carrying conductor undergoes a force perpendicular to both the direction and the magnetic field's direction.
- The force magnitude escalate with both the Current's intensity and the magnetic field strength.
- Fleming's Left-Hand Rule governs the force's direction: the thumb signifies motion, the forefingers points to the magnetic field and the middle finger indicates the Current's direction.

➡ Fleming's Left Hand Rule

Fleming's Left hand rule provides a method to determine the orientations of three elements: the magnetic field (Represented by the first finger), the current (Indicated by the Second finger), the force or motion (depicted by the thumb).



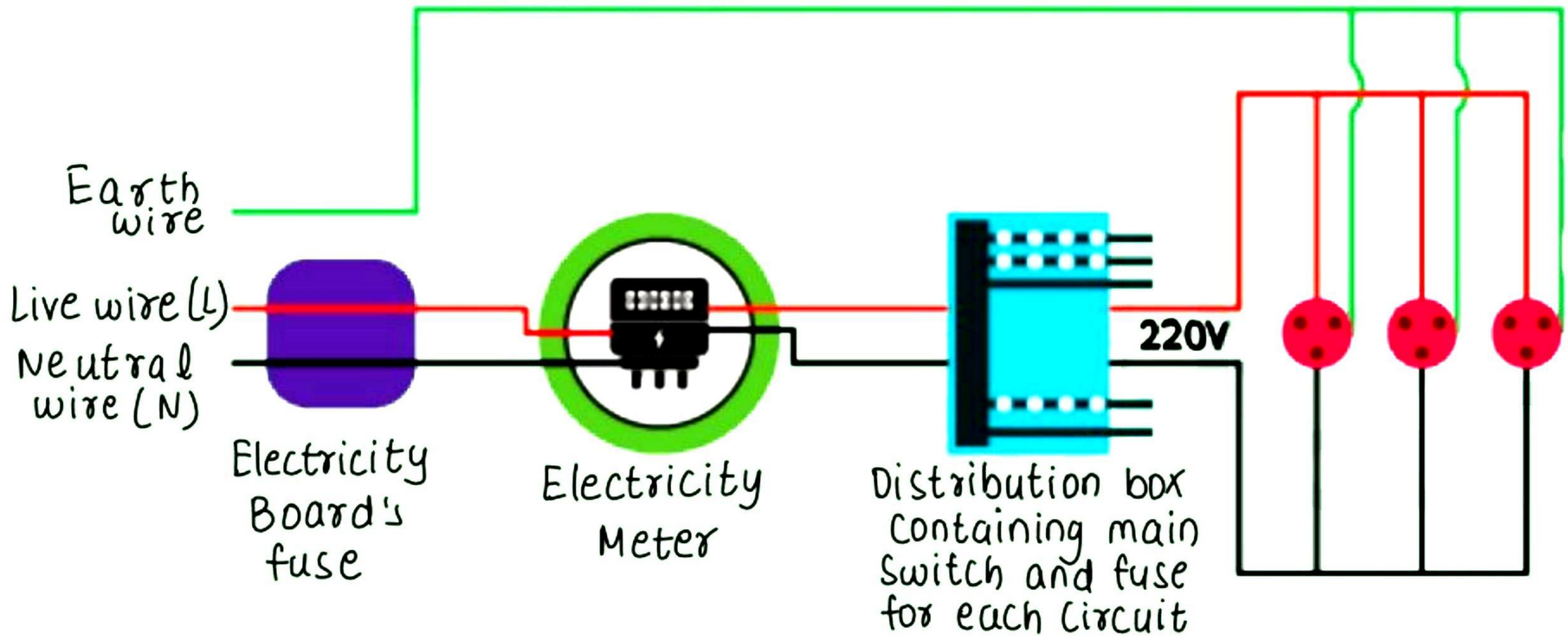
Imagine your Left hand with the thumb, first finger and second finger forming right angles to each other, If you align your first finger with the current's direction, then your thumb will indicate the force or motion's direction. This mnemonic aids in recalling the relationship between these elements within a magnetic field.

➡ Domestic Electric Circuits

- Electricity from power station is transported to our residence via two sturdy copper or aluminium wires.
- One of these wires, the live wire is identifiable by its red

insulation cover and operates at 220 V with a frequency of 50 Hz.

- The other wire, called the neutral wire, is distinguish by its black insulation and maintains zero potential.



A Schematic Diagram of one of the common domestic circuit.

- Both live and neutral wires pass through an electricity meter, typically found in homes, via primary fuse.
- They connect to the household's line wires through primary switch.
- Each distribution circuit is equipped with its own fuse. In case of a fault, like a short circuit in one circuit, its respective fuse blows while the other circuit remains unaffected.

The electric supply reaching our homes has two wires

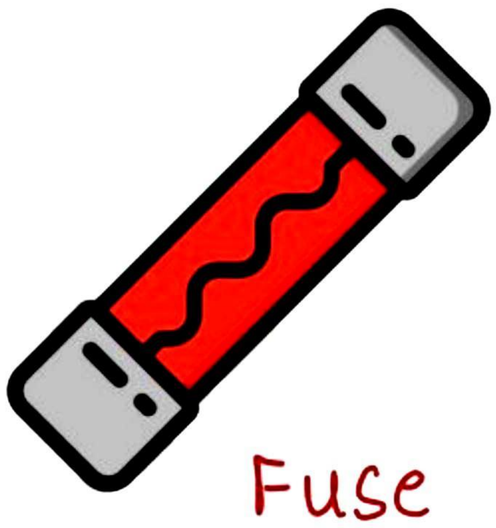
Live wire - Ofted marked with red or brow, it transport current from the Power source to electrical appliances.

Neutral Wire - Commonly blue or black, it closes the circuit by offering a pathway for the current to return to the power source.

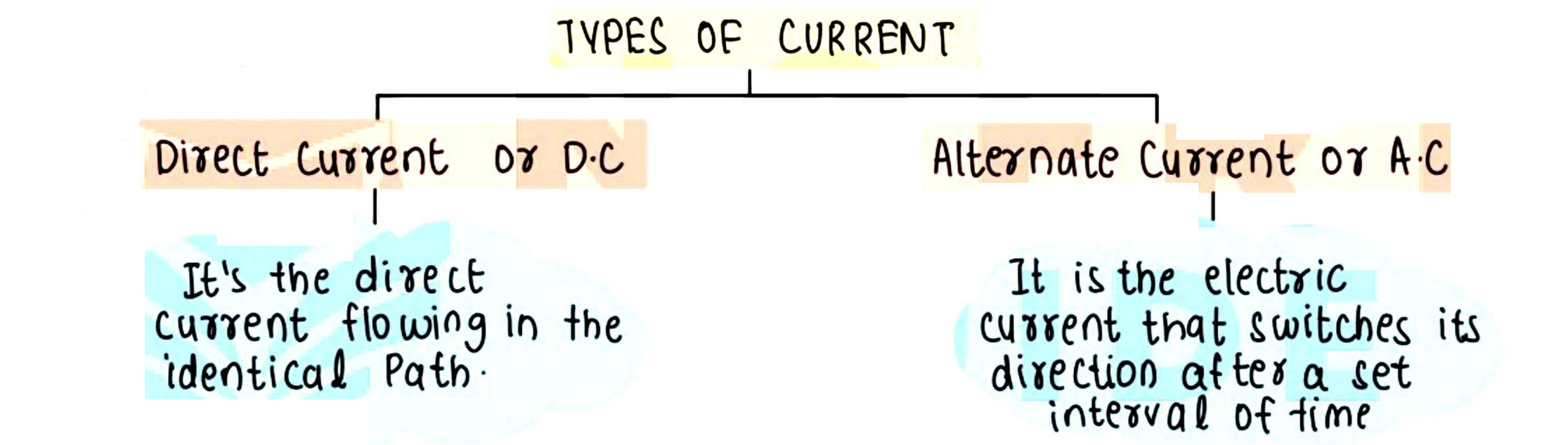
- Earth wire - The earth wire typically green or bare serves as a safety measure in electrical systems. It offers a route for surplus electrical current to discharge harmlessly into the ground, thus averting electric shocks and ensuring safety during faults.

➡ Fuse

An electric fuse is a protective component within electrical circuits, crucial for preventing damage due to overcurrent. Comprising a thin wire or strip, it acts as a safety mechanism. When the current exceeds a predefined threshold the wire melts, breaking the circuit and halting the flow of electricity. This interruption shields electrical appliances and equipment from potential harm caused by excessive current, ensuring the safety and longevity of the circuit and its components.

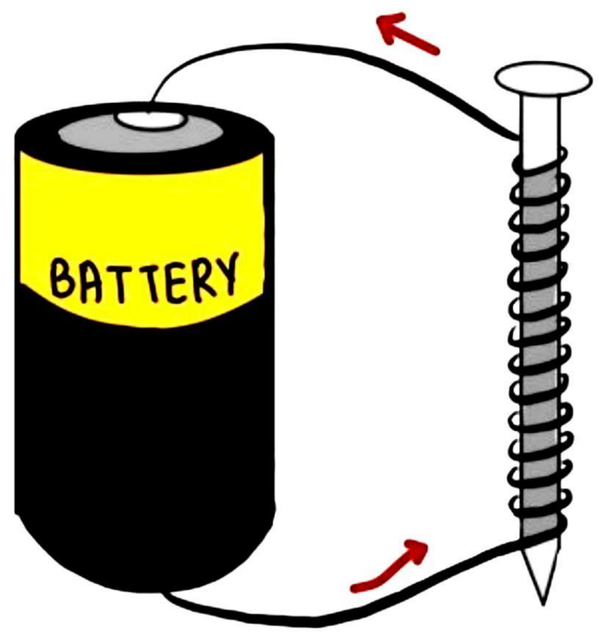


Fuse



➡ Electro magnet

An electromagnet forms when an electric current flows through a wire coil, but its magnetic effects vanish once the current stops. It finds utility in devices like doorbells and electric locks. Altering the current or coil count allow for adjusting its magnetic strength.



Electromagnet

Remember!

A compass needle is a small magnet. Its one end, which points towards north is called a northpole, and the other end, which point towards south is called a south pole

A magnetic field exists in the region surrounding a magnet, in which the force of the magnet can be detected.

fuse is the most important safety device, used for protecting the circuits due to short circuiting or overloading of the circuits

An electromagnet consists of a core of soft iron wraped around with a coil of insulated copper wire

A generator converts mechanical energy into electrical energy. It works on the basis of electromagnetic induction.