

Homopolar motor

A **homopolar motor** is an electric motor that works without the need for a commutator, by rotating along a fixed axis that is parallel to the external magnetic field produced by a permanent magnet. The name *homopolar* indicates that the electrical polarity of the motor does not change (i.e., that it does not require commutation). Such motors necessarily have a single-turn coil, which restricts their practical applications, since they must be used with low voltages and produce relatively small torques.

Principle of operation

Like any other electric motor, the homopolar motor is driven by the Lorentz force: as they move through an external magnetic field, the current carriers in the conductor experience a push that is perpendicular to both their velocity and to the external magnetic field. This force induces a torque around the axis of rotation.^[1] Because the axis of rotation is parallel to the external magnetic field, no commutation is required for the conductor to keep turning. This simplicity is achieved at the cost of not being able to have more than one coil turn, which makes the homopolar motor unsuited for most useful applications.

Like most electro-mechanical machines, a homopolar motor is reversible: if the conductor is turned mechanically, then it will operate as a homopolar generator, producing a direct current voltage between the two terminals of the conductor. The direct current produced is an effect of the homopolar nature of the design.

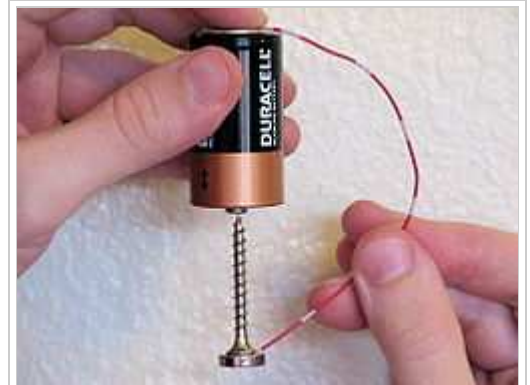
History

The homopolar motor was the first electrical motor to be built. Its operation was demonstrated by Michael Faraday in 1821 at the Royal Institution in London.^{[2][3]}

Building a simple homopolar motor

A homopolar motor is very easy to build. A permanent magnet is used to provide the external magnetic field in which the conductor will turn, and a battery causes a current to flow along a conducting wire. It is not necessary for the magnet to move, or even to be in contact with the rest of the motor; its sole purpose is to provide a magnetic field that will interact with the magnetic field induced by the current in the wire. However, the magnet must be made of a conductive material if it is to be used to complete the circuit powered by the battery. One can attach the magnet to the battery and allow the conducting wire to rotate freely while closing the electric circuit by touching both the top of the battery and the magnet attached to the bottom of the battery.^{[4][5]}

Gallery



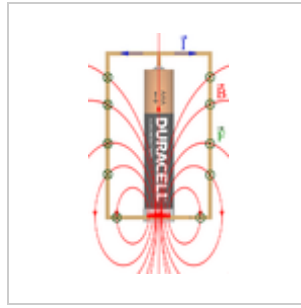
DIY simple homopolar motor made with drywall screw, an alkaline battery cell, a wire, and a neodymium disk magnet. The screw and magnet make contact with the bottom of the battery cell and are held together by the magnet's attraction. The screw and magnet spin.



Homopolar motor 3D



Homopolar motor 2D



Intensity, magnetic field lines and Lorentz force on Homopolar motor