An **electromagnet** is a type of [magnet](https://en.wikipedia.org/wiki/Magnet) in which the [magnetic field](https://en.wikipedia.org/wiki/Magnetic_field) is produced by an [electric current](https://en.wikipedia.org/wiki/Electric_current). Electromagnets usually consist of wire wound into a [coil](https://en.wikipedia.org/wiki/Electromagnetic_coil). A current through the wire creates a magnetic field which is concentrated along the center of the coil. The magnetic field disappears when the current is turned off. The wire turns are often wound around a [magnetic core](https://en.wikipedia.org/wiki/Magnetic_core) made from a [ferromagnetic](https://en.wikipedia.org/wiki/Ferromagnetic) or [ferrimagnetic](https://en.wikipedia.org/wiki/Ferrimagnetic" \o "Ferrimagnetic) material such as [iron](https://en.wikipedia.org/wiki/Iron); the magnetic core concentrates the [magnetic flux](https://en.wikipedia.org/wiki/Magnetic_flux) and makes a more powerful magnet.

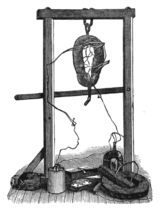
The main advantage of an electromagnet over a [permanent magnet](https://en.wikipedia.org/wiki/Permanent_magnet) is that the magnetic field can be quickly changed by controlling the amount of electric current in the winding. However, unlike a permanent magnet, which needs no power, an electromagnet requires a continuous supply of current to maintain the magnetic field.

Electromagnets are widely used as components of other electrical devices, such as [motors](https://en.wikipedia.org/wiki/Electric_motor), [generators](https://en.wikipedia.org/wiki/Electric_generator), [electromechanical solenoids](https://en.wikipedia.org/wiki/Solenoid#Applications), [relays](https://en.wikipedia.org/wiki/Relay), [loudspeakers](https://en.wikipedia.org/wiki/Loudspeaker), [hard disks](https://en.wikipedia.org/wiki/Hard_disk), [MRI machines](https://en.wikipedia.org/wiki/Magnetic_resonance_imaging), scientific instruments, and [magnetic separation](https://en.wikipedia.org/wiki/Magnetic_separation) equipment. Electromagnets are also employed in industry for picking up and moving heavy iron objects such as scrap iron and steel.[[2]](https://en.wikipedia.org/wiki/Electromagnet#cite_note-Merzouki-2)

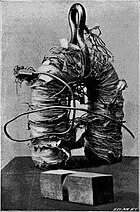
**History**

[[edit](https://en.wikipedia.org/w/index.php?title=Electromagnet&action=edit&section=1)]

Sturgeon's electromagnet, 1824

[](https://en.wikipedia.org/wiki/File:Joseph_Henry_electromagnet.png)

One of Henry's electromagnets that could lift hundreds of pounds, 1830s

[](https://en.wikipedia.org/wiki/File:Joseph_Henry_electromagnet_closeup.jpg)

Closeup of a large Henry electromagnet

Danish scientist [Hans Christian Ørsted](https://en.wikipedia.org/wiki/Hans_Christian_%C3%98rsted) discovered in 1820 that electric currents create magnetic fields. In the same year, the French scientist [André-Marie Ampère](https://en.wikipedia.org/wiki/Andr%C3%A9-Marie_Amp%C3%A8re) showed that iron can be magnetized by inserting it into an electrically fed [solenoid](https://en.wikipedia.org/wiki/Solenoid).

British scientist [William Sturgeon](https://en.wikipedia.org/wiki/William_Sturgeon) invented the electromagnet in 1824. [[3]](https://en.wikipedia.org/wiki/Electromagnet#cite_note-3)[[4]](https://en.wikipedia.org/wiki/Electromagnet#cite_note-4) His first electromagnet was a horseshoe-shaped piece of iron that was wrapped with about 18 turns of bare copper wire. ([Insulated](https://en.wikipedia.org/wiki/Insulator_(electricity)) wire did not then exist.) The iron was [varnished](https://en.wikipedia.org/wiki/Varnish) to insulate it from the windings. When a current was passed through the coil, the iron became magnetized and attracted other pieces of iron; when the current was stopped, it lost magnetization. Sturgeon displayed its power by showing that although it only weighed seven ounces (roughly 200 grams), it could lift nine pounds (roughly 4 kilos) when the current of a single-cell power supply was applied. However, Sturgeon's magnets were weak because the uninsulated wire he used could only be wrapped in a single spaced-out layer around the core, limiting the number of turns.

Beginning in 1830, US scientist [Joseph Henry](https://en.wikipedia.org/wiki/Joseph_Henry) systematically improved and popularised the electromagnet.[[5]](https://en.wikipedia.org/wiki/Electromagnet#cite_note-Cavicchi-5)[[6]](https://en.wikipedia.org/wiki/Electromagnet#cite_note-Sherman-6) By using wire insulated by silk thread and inspired by [Schweigger's](https://en.wikipedia.org/wiki/Johann_Schweigger" \o "Johann Schweigger) use of multiple turns of wire to make a [galvanometer](https://en.wikipedia.org/wiki/Galvanometer),[[7]](https://en.wikipedia.org/wiki/Electromagnet#cite_note-7) he was able to wind multiple layers of wire onto cores, creating powerful magnets with thousands of turns of wire, including one that could support 2,063 lb (936 kg). The first major use for electromagnets was in [telegraph sounders](https://en.wikipedia.org/wiki/Telegraph_sounder).

The [magnetic domain](https://en.wikipedia.org/wiki/Magnetic_domain) theory of how ferromagnetic cores work was first proposed in 1906 by French physicist [Pierre-Ernest Weiss](https://en.wikipedia.org/wiki/Pierre-Ernest_Weiss), and the detailed modern quantum mechanical theory of ferromagnetism was worked out in the 1920s by [Werner Heisenberg](https://en.wikipedia.org/wiki/Werner_Heisenberg), [Lev Landau](https://en.wikipedia.org/wiki/Lev_Landau), [Felix Bloch](https://en.wikipedia.org/wiki/Felix_Bloch), and others.

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