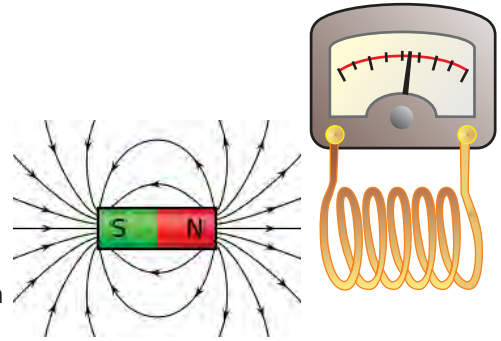


# ELECTRIC GENERATOR

## HOW IS ELECTRICITY MADE?

So many things run with electricity around us, but what is electricity and where does it come from?

Electricity is basically electrons in motion. **Electrons** are very tiny particles that are part of all materials. There are two kinds of materials: conductors and nonconductors. The electrons inside **conductors** can move around and go from one side to another but in nonconductor materials the electrons cannot move. Metals such as copper or aluminum are conductors.



Moving a coil of wire in a magnetic field generates electric current.

The electrons inside a copper wire, for instance, are able to move, but normally will stay still unless there is a force that pushes them. One of the forces that can push electrons inside a wire is the magnetic force. The invisible effect around magnets is called a **magnetic field**. When a wire is moved next to a magnet, electrons inside the wire are propelled by the magnetic field and start circulating along the wire. Electrons circulating through a conductor is electric current or electricity.

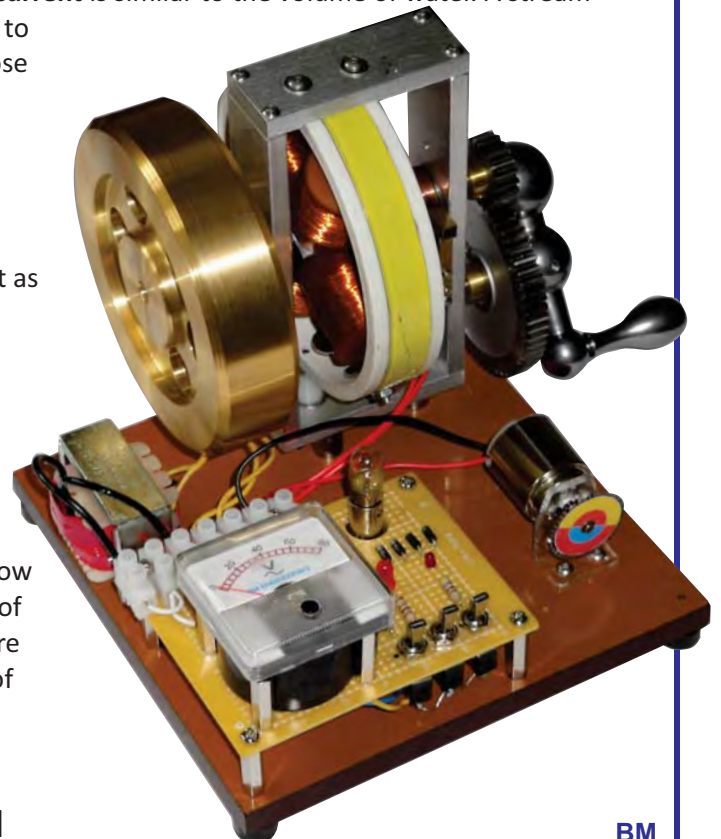
An electric current is similar to water current. Farmers used to harness the power of moving water to do some of their work. They had the water from a creek turn a paddle wheel which turned a mill to make flour. Electric current also makes things work. Electricity runs the motor of your garage door and the lights in your house.

Three different measurements of electricity are the volt, the ampere (amp) and the watt. The **volt** or voltage is similar to the pressure in a water system. A squirt gun may have a lot of pressure (high voltage) but it does not have the power to extinguish a house fire. The **ampere or current** is similar to the volume of water. A stream may have a lot of water but without pressure it is of no use to fight a fire. The **watt** measures the **electric power**. A fire hose has high pressure and high volume, so it has a lot of power. The power lines on the street poles have high voltage and high current, so they provide power for many houses.

Electricity also does many other things. A light bulb shines because a tiny wire inside, called the filament, gets very hot as electrons run through it, so hot it produces light. The television, the oven, the air conditioning, all work with electricity.

## DEMONSTRATION ELECTRIC GENERATOR

This electric generator is a demonstration model to show how electricity is produced with magnetic force. The basic part of the generator is the **rotor** which has four coils of copper wire mounted on a shaft. Each **coil** is a spool with 2,000 loops of wire.



The coils are connected to each other in series, like a chain, with the two extremes connected to two copper rings called **collectors**. Two small graphite rods push against the collector rings, these are called **brushes**. Graphite is not a metal but is a good conductor of electricity. Pencil leads are made of graphite.

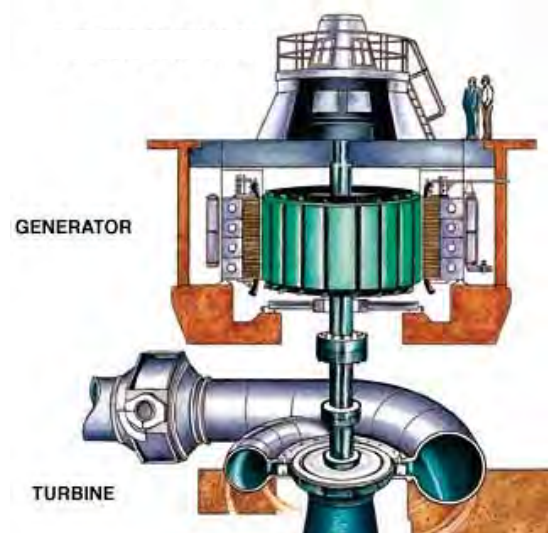
The ring around the rotor, called the **stator**, holds 12 magnets evenly spaced. All magnets have two poles N and S (North and South like the Earth). The magnets on the stator alternate, N then S then N then S and so forth.

When the rotor turns, the coils move fast in front the magnets producing electric current. Each loop makes a tiny amount of electricity but it adds to the electricity made by the other loops (a total of 8,000). The electric current flows to the collector rings and is picked up by the brushes.

This generator produces **alternating current or AC**. This means that the current is constantly changing direction between positive and negative. This happens because as the rotor turns, the coils face alternating magnetic poles, N, S, N, S... If the crank is turned once per second the rotor turns 3 times per second, because the crank gear is three times larger than the rotor gear. The stator has 12 magnets so the current will have 18 reversals or cycles per second (cps). This is called the **frequency**.

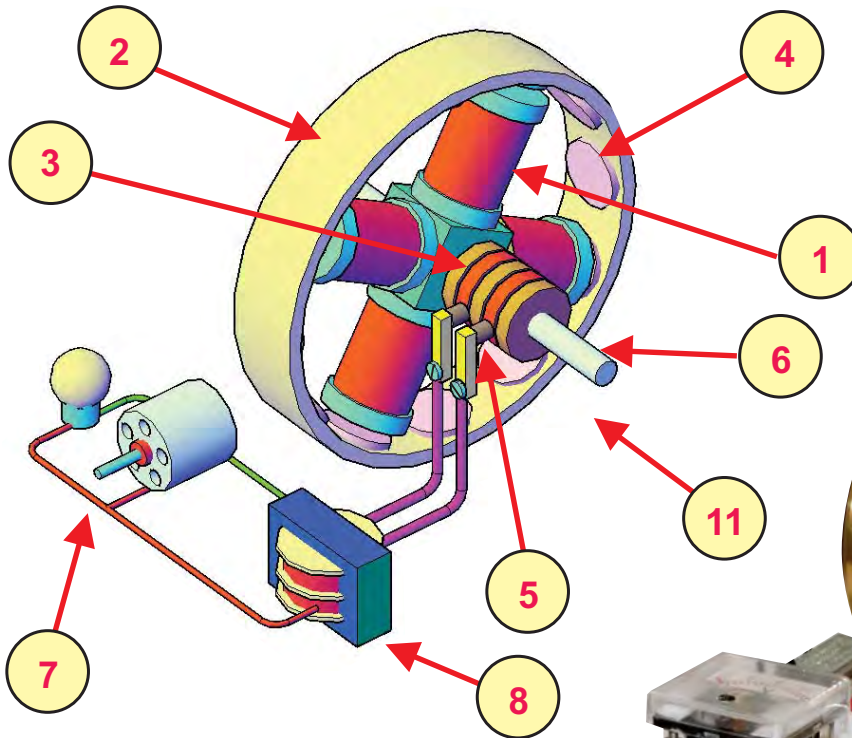
This generator produces about 60 volts, 0.25 amps or 15 watts (watts = volts X amps). A **transformer** lowers the voltage and increases the current to light the bulb, the LEDs (light emitting diodes) and the small motor.

The heavy brass wheel on the rotor shaft is called a **fly wheel**, it serves to smooth the rotation of the generator. Without it, the rotation would feel bumpy.

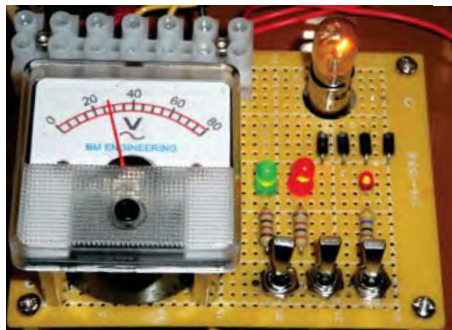
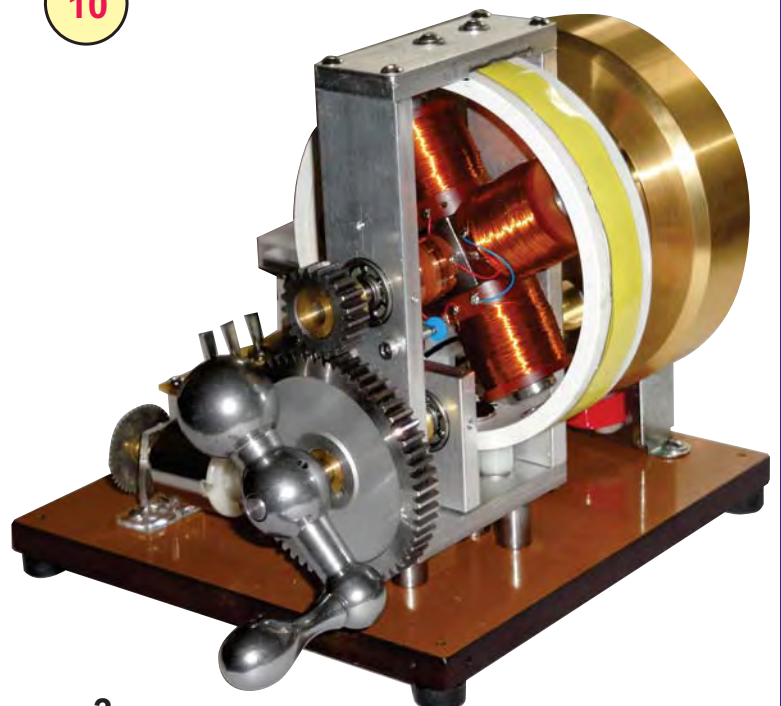
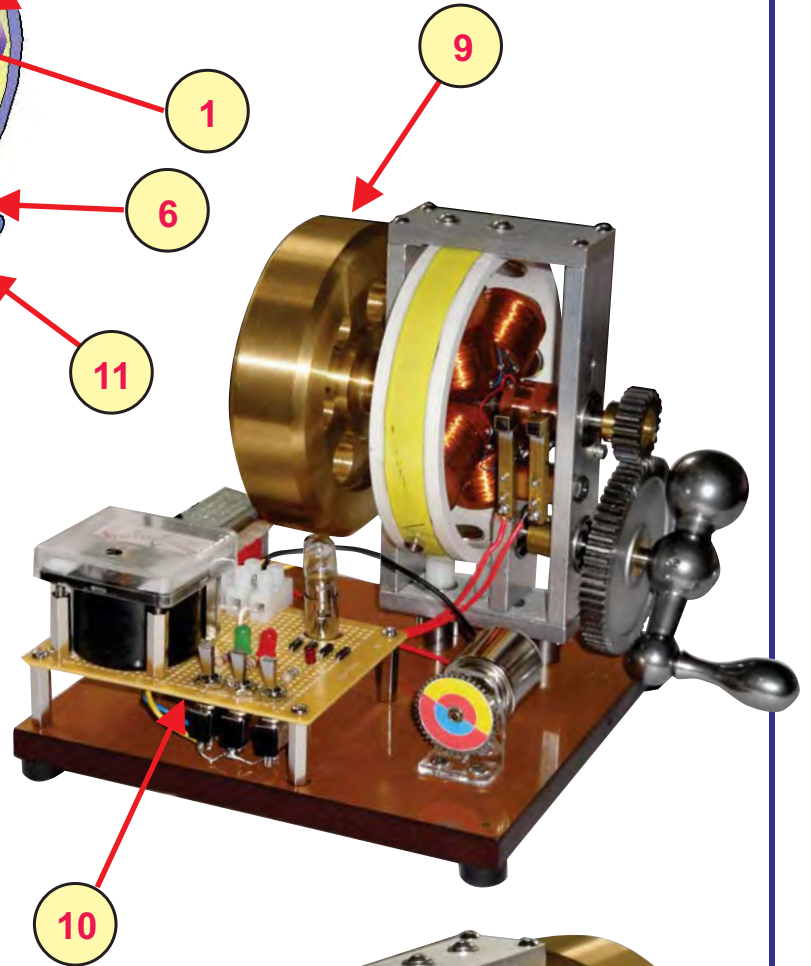


Electric generators that supply electricity to cities and factories are built the same way as this generator. They have coils, a rotor, a magnetic stator, collectors and brushes. Except that everything is very big, the generator itself is about the size of a house. Some of these generators are moved by a turbine with water rushing out of a dam at high pressure. But many are turned by steam created by burning coal and heating water. Transmission lines bring electricity at high voltage to transformers that convert it to low voltage, safe to use in house lights and appliances.

# ELECTRIC GENERATOR PARTS



- 1 Coil
- 2 Stator
- 3 Collector
- 4 Magnet
- 5 Brush
- 6 Shaft
- 7 Motor & Light
- 8 Transformer
- 9 Fly Wheel
- 10 Circuit Board
- 11 Rotor



Circuit board showing the light and LEDs powered by the generator. The small LED indicates the electric motor is also running.