GENERATOR AND THE TRANSFORMER

A basic generator, v, consists of a permanent magnet that rotates within a coil of wire. The magnet is turned by a motor or crank, (not shown). As it spins, the nearby magnetic field changes. This changing magnetic field results in an electric field, which has a curly pattern. This electric field pattern creates a current that whips around the coils of wire, and we can tap this current to light the lightbulb.

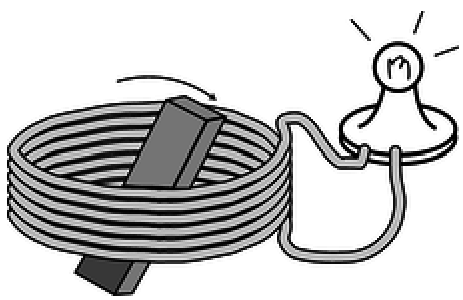

Figure v: A generator.

If the magnet was on a frictionless bearing, could we light the bulb for free indefinitely, thus violating conservation of energy? No. It's hard work to crank the magnet, and that's where the energy comes from. If we break the light-bulb circuit, it suddenly gets easier to crank the magnet! This is because the current in the coil sets up its own magnetic field, and that field exerts a torque on the magnet. If we stopped cranking, this torque would quickly make the magnet stop turning.

self-check:

When you're driving your car, the engine recharges the battery continuously using a device called an alternator, which is really just a generator. Why can't you use the alternator to start the engine if your car's battery is dead?

The transformer

It's more efficient for the electric company to transmit power over electrical lines using high voltages and low currents. However, we don't want our wall sockets to operate at 10000 volts! For this reason, the electric company uses a device called a transformer, w, to convert everything to lower voltages and higher currents inside your house. The coil on the input side creates a magnetic field. Transformers work with alternating current (currents that reverses its direction many times a second), so the magnetic field surrounding the input coil is always changing. This induces an electric field, which drives a current around the output coil.

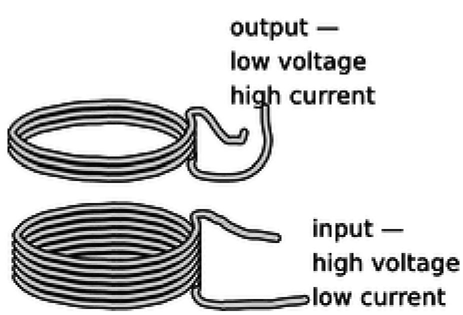

Figure w. A transformer.

Since the electric field is curly, an electron can keep gaining more and more energy by circling through it again and again. Thus the output voltage can be controlled by changing the number of turns of wire on the output side. In any case, conservation of energy guarantees that the amount of power on the output side must equal the amount put in originally,

equations

so no matter what factor the voltage is reduced by, the current is increased by the same factor. This is analogous to a lever. A crowbar allows you to lift a heavy boulder, but to move the boulder a centimeter, you may have to move your end of the lever a meter. The advantage in force comes with a disadvantage in distance. It's as though you were allowed to lift a small weight through a large height rather than a large weight through a small height. Either way, the energy you expend is the same.

Source: http://physwiki.ucdavis.edu/Electricity_and_Magnetism/Fields/Induction