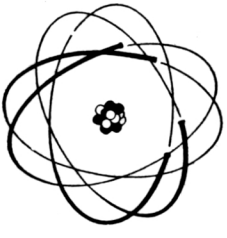
GED-1068

A Primer of Electronics

A simple introduction to the electron and the principles that govern its use



GENERAL ELECTRIC

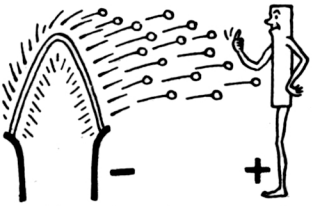
ELECTRONS are almost the smallest particles of matter. *Thirty thousand trillion trillion* (30,000,000,000,000,000,000,000,000,000) electrons weigh less than one ounce. Electrons are also particles of negative electricity. *Six million trillion* (6,000,000,000,000,000,000) electrons flow each second through the filament of a 100-watt lamp to keep it burning. All atoms contain electrons. In metals, which are the best conductors of electricity, these electrons are relatively free to move about. And that is why metals are the best source of electrons for electronic tubes.

THE RADIO TUBE

When a tungsten filament is heated by electricity in a vacuum, electrons boil out of it.

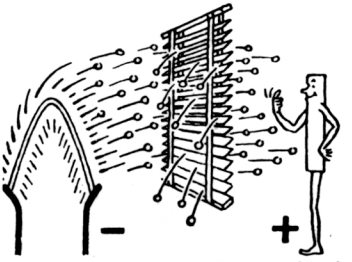
The first job of electronics is to get the electrons out of the metal. You can get electrons out of metals in several ways. One is by yanking them out with a high electrical voltage; another is by scaring them out with a beam of light. But the easiest and most common way is by boiling them out with heat. That is why most electron tubes have hot filaments, something like the filaments of incandescent lamps.

Once you have the electrons free from the filament, you can do things with them. For instance, by applying a positive electric voltage to a nearby metal plate, you can attract electrons to the plate. Since a stream of electrons, either in a wire or in empty space, is an electric current, this is a way to create and control a current of electricity.

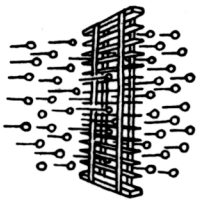


A positive voltage beckons to electrons and attracts them to the plate.

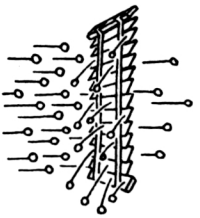
The controlling is usually done with a metal grid between the filament and the plate. The grid acts like a Venetian blind. By changing the voltage on the grid, we can let through as many or as few electrons as we choose. A very



The grid acts like a Venetian blind between the filament and plate.

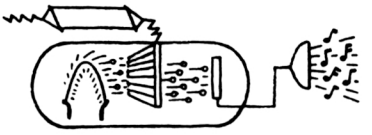


When the blind is open, lots of electrons can pass.



When the blind is closed, very few electrons can pass.

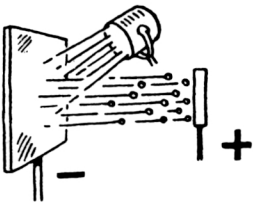
little change of voltage on the grid will produce a big change in the current of electrons. And this is how an amplifier tube in your radio set works—the tiny amount of radio energy caught by your aerial, applied to the grid of the tube, controls the ever-so-much-greater current that operates your radio loud speaker.



The energy caught by your aerial is amplified by the electron tube so as to operate your loud speaker.

THE ELECTRIC EYE

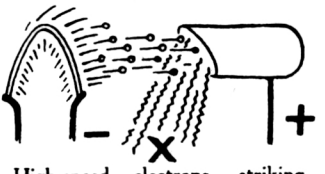
The phototube, or "electric eye," doesn't have a hot filament. Instead, electrons are chased out of the metal by shining a light on it. Since the brighter the light, the more electrons are chased out, light changes are converted into electric changes. Thus the variations of black and white on the sound track of a movie film can be turned into variations of electric current to run the loud speaker in the movie theatre.



Light falling on a metal produces the electrons in a phototube.

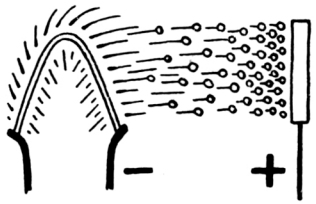
THE X RAY

In the X-ray tube, electrons are attracted to the metal plate by a very high voltage, sometimes *millions* of volts. The electrons strike the plate with terrific force—so hard that they almost shake the metal atoms to pieces. And those disturbed atoms, when they go back to normal, give off the radiations we call *X rays*—radiations so penetrating that they can pass right through the human body and even through inches of hard steel.



High-speed electrons, striking metal atoms, make those atoms give off penetrating X rays.

TUBES WITH GAS

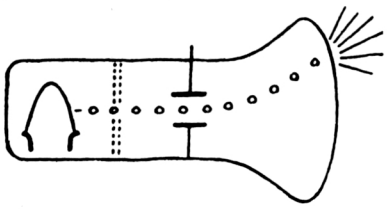


Collisions with gas atoms help increase the current carried by gas-filled electron tubes.

All electron tubes are not vacuum tubes. Some contain small amounts of special gases. And when electrons, on their way to the plate, strike the gas atoms, they knock out some of the electrons in the atoms. The current flowing is greatly increased by the presence of the remaining positively charged parts of the gas atoms. So these tubes, called *thyratrons* or *ignitrons*, can conduct large amounts of power such as are needed to make aluminum.

ELECTRON BEAMS

Electrons can be made to do some peculiar things. Magnets and electric fields can swing beams of electrons in much the same way you can swing the stream of water from a garden hose. In a television tube, a beam of electrons is swung back and forth many thousands of times a second. It strikes a glass screen coated with fluorescent material, producing light wherever it strikes. And it traces on the screen an image of the picture seen by the television camera.



In a television tube, an electron beam, deflected by electricity, produces a light image on the fluorescent picture screen.

Practically all the applications of electronics make use of one or more of these simple principles. It has taken years of work by some of the world's best scientists to discover them and put them to work. And some of the applications are almost unbelievably complicated.

Already electronic tubes have given us radio; they are serving us in the factories that make the things we use, in the physician's X ray. They are fighting for us in the radar equipment that detects enemy planes. In days to come they will bring us new developments like television, and they promise even newer developments that are not yet even imagined.

GENERAL ELECTRIC

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