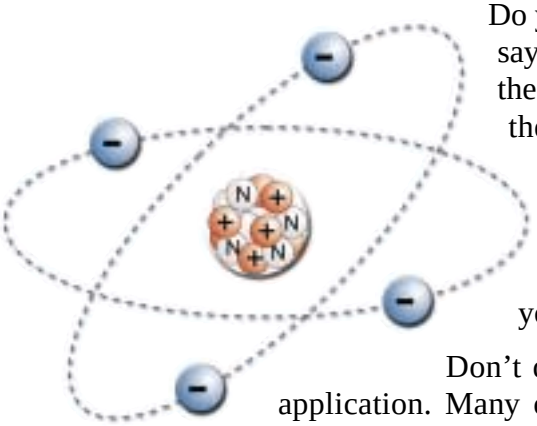
UNIT 1 Matter

Introduction



Do you know where electricity comes from? To be able to say yes to that question, you must understand a bit about the physics of matter. What value does a brief study of the nature of matter have for the student of electrical theory? The understanding that comes from that study lays the foundation for understanding electrical theory. Only when you know the theory can you truly have confidence in the practical aspects of your electrical work.

Don't discount the role of physics in electrical theory and application. Many of the electrical innovations of the 20th Century—things such as radar—originated with physicists, not electrical engineers.

When people have a hard time understanding and applying the *National Electrical Code (NEC)*, the root cause is often a lack of knowledge of the basic physics behind electricity. When you know the physics, then you can understand the rules, codes, and laws that arise from it.

1.1 Matter

Everything on earth that has weight and occupies space is called matter, which is made up of atoms of elements. When the atoms of elements combine, they produce compounds. The smallest particle of a compound is called a molecule. Figure 1–1

1.2 Atomic Theory

An atom contains three types of subatomic particles: electrons, protons, and neutrons. The central part of the atom is called the nucleus and it contains protons (positive charge) and neutrons (no charge). Electrons (negative charge) orbit around the nucleus. Figure 1–2

Electrons—Electrons are much smaller than protons and they are 1,840 times lighter. Because of their light weight and mobility (ease of separation from the atom), electrons actively participate in the transfer, or flow, of electrical energy.

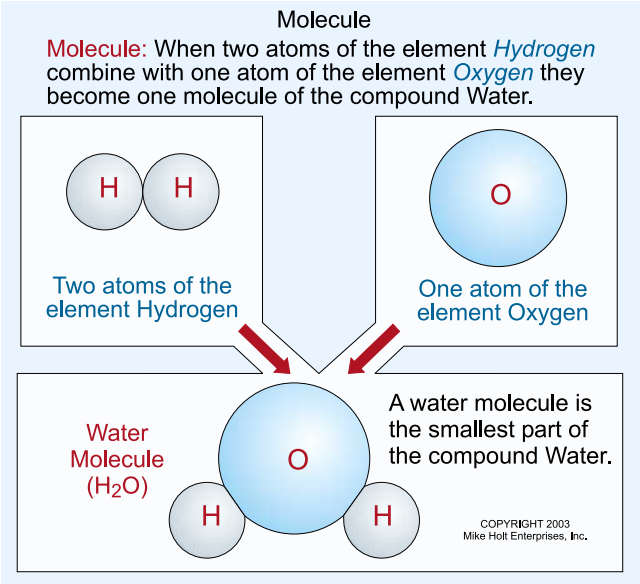


Figure 1–1

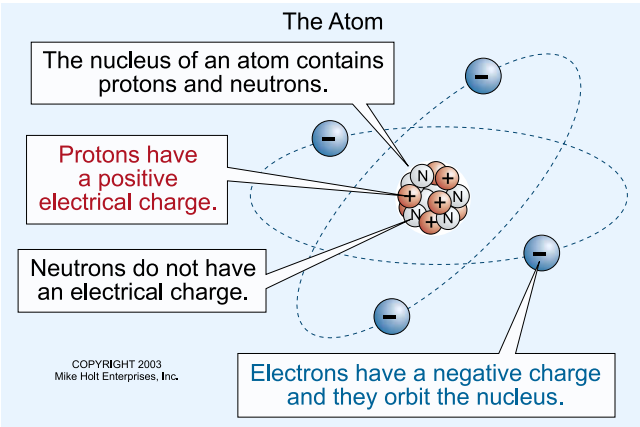


Figure 1–2

Electrons have a negative electrical charge that is visualized as lines of force coming straight into the electron from all sides. Figure 1–3

Protons—Protons are the same size as neutrons and have nearly the same mass (1,840 times as heavy as an electron), therefore they don't actively participate in the flow of electrical energy. Protons have a positive electrical charge with lines of force going straight out in all directions. Figure 1–3

Neutrons—Neutrons have a neutral electrical charge, no lines of force, and do not take an active role in the flow or transfer of electrical energy. Figure 1–3

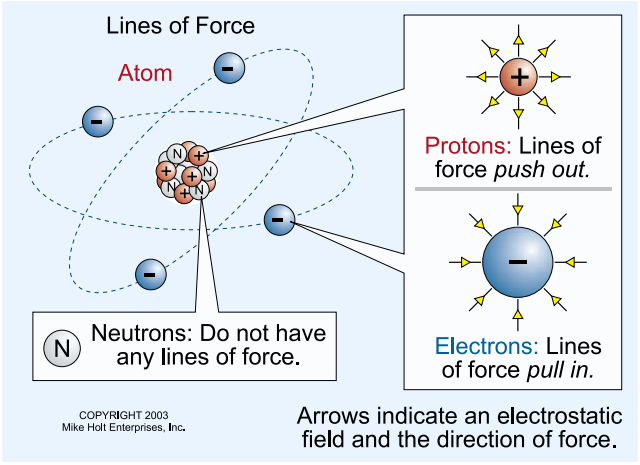


Figure 1–3

1.3 Law of Electrical Charges

Subatomic particles that attract or repel other subatomic particles follow the Law of Electrical Charges. The Law of Electrical Charges states that "subatomic particles with like charges repel each other and particles with unlike charges attract each other." Therefore, electrons repel electrons and protons repel protons, but electrons and protons are attracted to each other. Figure 1–4

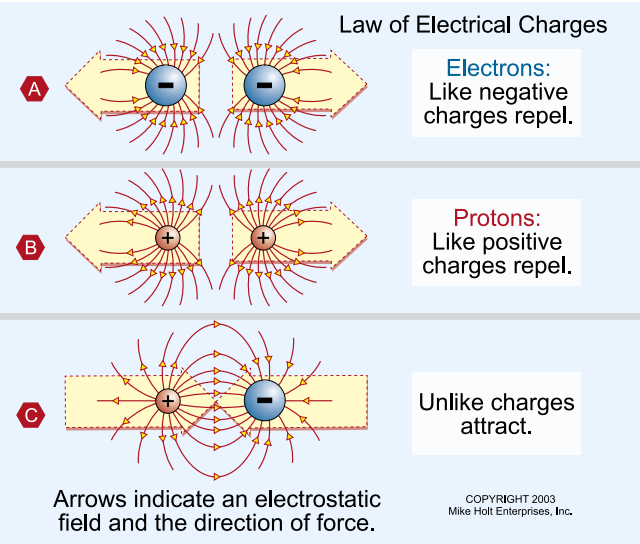


Figure 1–4

AUTHOR'S COMMENT: This attracting and repelling force on subatomic particles (charged materials) is sometimes called the electrostatic field.