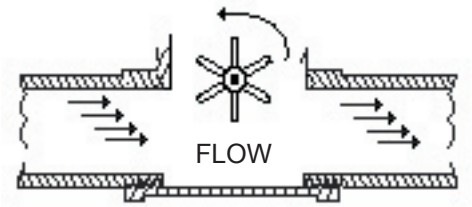
Student Notes

Current Flow

Mechanical engineers are concerned about the flow of a liquid in a pipe. Sometimes they have to measure the flow rate of the liquid. The units for the flow rate are given in volume per unit time, such as gallons per minute or liters per second. A device called a paddle wheel flow meter measures the flow rate and is shown below. When a liquid flows in the pipe the paddle wheel rotates and one of the blades of the paddle wheel alerts an electronic sensor that sends an electronic pulse to a circuit that calculates the frequency, or the number of pulses per second. Once the frequency can be determined the flow rate can be calculated. The important issue here is that in order to install the meter, an intervention has to take place. The pipe had to be cut, the flow meter inserted, and the pipe reattached to the meter. The liquid flow is also called a current flow. Mechanical engineers use the symbol Q, to symbolize the flow rate.



An electric current flow takes place much in the same manner as fluid flow in a pipe. Electric current flows when charged particles flow through a wire or any conductor of electricity. The definition of current is:

$$I = q/t$$

Eq 3

Where q, the charged particle moving in the wire, is measured in Coulombs and T is time, in seconds, that it takes to move the charged particle and I can be expressed either in the units of amperes (amps) or coulombs per second. One ampere is the equivalent of one Coulomb per second.

Figure 8 illustrates the method that schematic diagrams represent current flow. Figure 8a shows the current flowing toward the right with a value of 3 amps while figure 8b shows the same current flowing toward the left with a value of -3 amps. Both schematics are correct. Any time a current is shown with a negative value, the direction can be reversed and the value replaced with a positive value. Likewise, any time a current is shown with a positive value, the direction can be reversed and the value replaced with a negative value.

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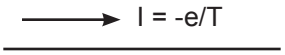
Suppose that in equation 3, q represents an electron, whose charge is commonly expressed as –e because an electron is negatively charged. Now equation 3 becomes:

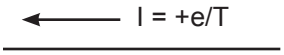
$$I = -e/T$$

Eq 4

Figure 9 illustrates the difference between electron current flow and conventional current flow. In figure 9a we have electrons moving in a wire toward the left and the result is called electron current flow. Because electrons are negatively charged and the current has a negative value, we can also say that conventional current flow is toward the right as shown in figure 9b.



Direction of electron flow
Figure 9a



Direction of conventional current flow
Figure 9b

Example problem Number 1

If 8x10-8 Coulombs flow through a wire in 2 microseconds, determine the I, the current flow.

Solution:

Using Equation 3, we have:

$I = q/T = 8 \times 10^{-8}$ amperes = 4×10^{-2} amperes = 40 ma

A special meter that has been designed to measure the electric current is called an ammeter. The ammeter has two terminals that a red lead and a black lead are to be connected. The red lead is connected to the A terminal of the meter and the black lead is connected to the COM terminal of the meter. Note that just like the paddle wheel flow meter, the wire in the ammeter circuit has to be cut, and then attached to the meter, as shown in the picture on the following page.

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