Theoretical Elements *of AC* Electricity

Alternating Current (AC) and voltage

1. It can be transmitted over long distances more readily and more economically than direct current. since AC voltages can be increased or decreased by means of transformers

advantages in airplanes

1, Space and weight can be saved

2, In most AC motors no brushes are required

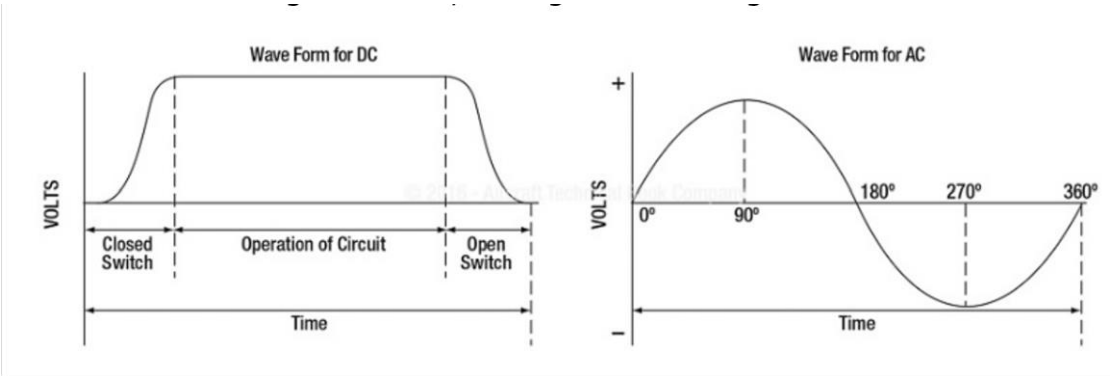
AC and DC Compared

DC: flows constantly in only one direction with a constant polarity. It changes magnitude only when the circuit is opened or closed.

AC: changes direction at regular intervals

1. increases in value at a definite rate from zero to a maximum positive strength

2. decreases back to zero; then it flows in the opposite direction increasing to a maximum negative value.



Since alternating current constantly changes direction and intensity, the following two effects: Ac

1. Inductive reactance.

2. Capacitive reactance

Generator Principles

an electric current can be created by a magnetic field: an electric current flowing through a conductor creates a magnetic field around the conductor. Measured by galvanometer.

When a conductor is moved through a magnetic field, an electromotive force (EMF) is induced in the conductor. These results obey a law first stated by the German scientist, **Heinrich Lenz**.

Lenz's law states: *The induced current caused by the relative motion of a conductor and a magnetic field always flows in such a direction that its magnetic field opposes the motion*

The direction (polarity) of the induced EMF is determined by:

1, the magnetic lines of force

2, the direction the conductor is moved through the magnetic field.

The generator **left-hand rule**: can be used to determine the direction of the induced EMF

1: The first finger of the left hand is pointed in the direction of the magnetic lines of force (north to south)

2, the thumb is pointed in the direction of movement of the conductor through the magnetic field

3. the second finger points in the direction of the induced EMF**.**

Generator Principles

When a loop conductor is rotated in a magnetic field, a voltage is induced in each side of the loop.

The value of an induced **EMF** depends on three factors:

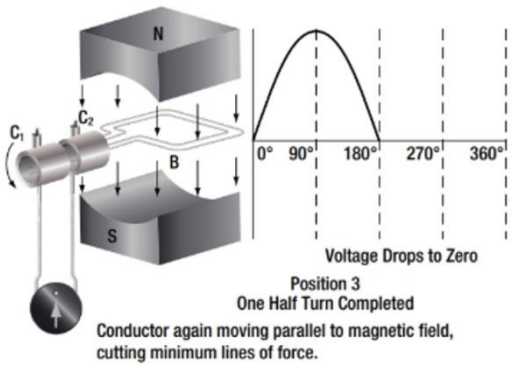
1, The number of wires moving through the magnetic field.

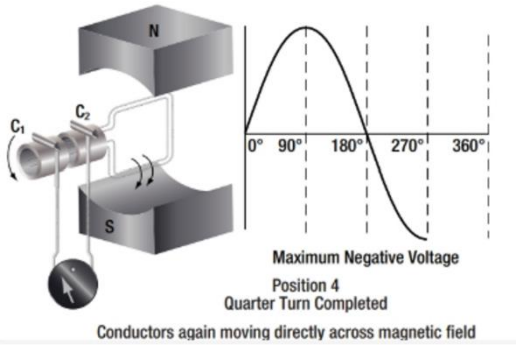
2, The strength of the magnetic field.

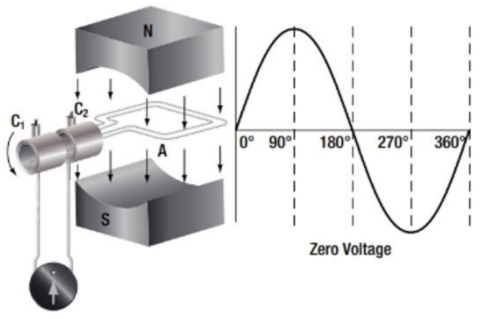
3, The speed of rotation

Generator of Alternating Current

Generators used to produce an alternating current are called **AC generators** or **alternators**.



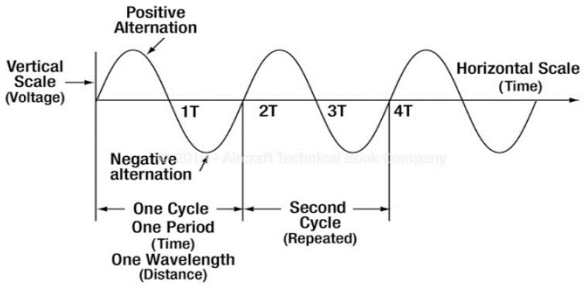




Cycle and Frequency

1, A cycle is a repetition of a pattern

Whenever a voltage or current passes through a series of changes, returns to the starting point, and then again starts the same series of changes, the series is called a **cycle**.



Cycle is Defined as a Repetitive Pattern

FREQUENCY

The frequency: is the number of cycles of alternating current per second.

The standard unit of frequency measurement is the hertz (Hz)

$$F = \frac{\text{Number of Poles}}{2} \times \frac{\text{rpm}}{60}$$

Example:

If in a 2-pole generator, the conductor is turning at 3 600 rpm, the revolutions per second are:

Period Defined

Period: is a sine wave to complete one full cycle

The period of a sine wave is inversely proportional to the frequency.

Period is: $t = \frac{1}{f}$

Frequency is: $f = \frac{1}{t}$

Wavelength Defined

Wavelength: The distance that a waveform travels during a period

wavelength is indicated by the Greek letter lambda (λ).

Phase Relationship

In a circuit that is fed (supplied) by one alternator, there must be a certain phase relationship between voltage and current if the circuit is to function efficiently.

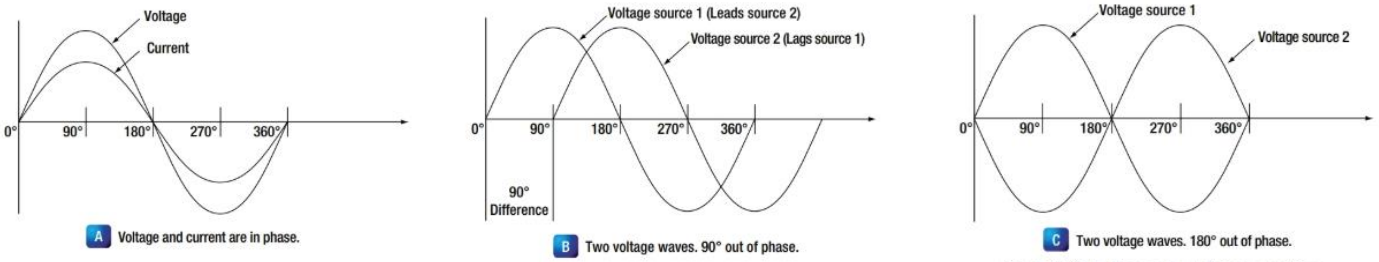


Figure 13-10. In phase and out of phase conditions.

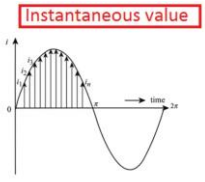
Values of Alternating Current

There are three values of alternating current:

1. instantaneous
2. peak
3. effective (root mean square, RMS)

Instantaneous Value:

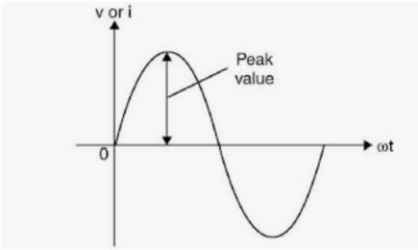
An instantaneous value of voltage or current is the induced voltage or current flowing at any instant during a cycle.

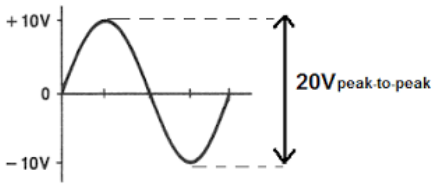


i1, i2, i3.....i n at instant time of t1, t2, t3....t n

Peak Value: peak to peak:2 x vp

The peak value is the largest instantaneous value.





Effective Value:RMS = 0.707x vp