

AC Generator: (Alternator)

AC generator is an electrical instrument which is used to convert mechanical energy into sinusoidally varying electrical energy.

Principle: It works upon the principle that "when a closed conducting coil is rotated in uniform magnetic field, the flux linked with the coil changes continuously and an amount of emf will be induced in it.

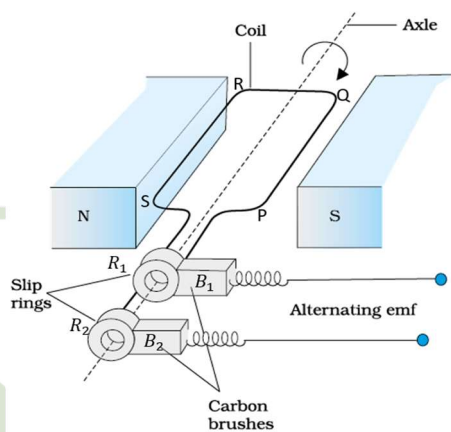
Construction:

An AC generator consist of mainly following parts:

Armature: It consists of a rectangular coil ($PQRS$) made up of insulated copper wire wound on non-magnetic metallic frame with soft iron as a central core.

Field magnet: It consist of concave pole piece of permanent magnet. The permanent magnet is used for small generator but electromagnet is used for large generator.

Slip ring and brushes: In figure, R_1 and R_2 are slip rings and B_1 and B_2 are brushes. The slip rings are connected with two ends of armature. The slip ring rotates when the armature is rotated. The brushes B_1 and B_2 are in contact with slip rings which are used to transfer current from armature to external circuit.



Working

When the coil rotates, the angle between normal to the plane of coil and magnetic field changes continuously due to which the magnetic flux linked with the coil becomes variable and an amount of emf is induced in the coil.

i.e.

$$E = NBA\omega \sin \omega t$$

$$\text{or, } E = E_0 \sin \omega t \text{ --- (1)}$$

At $t = 0$,

$$\text{or, } E = E_0 \sin 0$$

$$\text{or, } E = 0$$

At $t = \frac{T}{4}$,

$$E = E_0 \sin \omega t$$

$$\text{or, } E = E_0 \sin\left(\frac{2\pi}{T} \times \frac{T}{4}\right)$$

$$\text{or, } E = E_0 \sin\left(\frac{\pi}{2}\right)$$

$$\text{or, } E = E_0$$

Similarly, At $t = \frac{T}{2}$, $\longrightarrow E = 0$

At $t = \frac{3T}{4}$, $\longrightarrow E = -E_0$

At $t = T$, $\longrightarrow E = 0$

And the current is given by, $I = \frac{E}{R} = \frac{E_0}{R} \sin \omega t = I_0 \sin \omega t$, Here $I_0 = \frac{E_0}{R}$

An alternating emf is generated by a loop of wire rotating in a magnetic field as shown below.

(Note: Draw graph only [Stages is for understanding])