ELECTROMAGNETIC INDUCTION

AC GENERATOR

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An alternating current (AC) generator is an electrical device designed to transform mechanical energy into electrical energy in the form of an alternating electromotive force (emf) or alternating current (AC). The fundamental operating principle behind an AC generator is electromagnetic induction.



Components of an AC Generator

An AC generator comprises essential components, which include two magnet poles, the north and south poles, designed to create a uniform magnetic field. The core component is a rectangular coil called the armature. This coil is connected to slip rings, which are further connected to carbon brushes. The slip rings, made of metal, are electrically insulated from each other. Carbon brushes connect to the rings, forming a circuit. The rectangular coils rotate about an axis that is perpendicular to the magnetic field, and the rotation is facilitated by a rapidly spinning shaft.

Operation of an AC Generator

The AC generator operates as the armature rotates between the magnetic poles on an axis perpendicular to the magnetic field. As the armature moves, the magnetic flux linking with it continuously changes, inducing an electromotive force (emf) within the armature. This emf generates an electric current, which flows through the galvanometer, slip rings, and brushes. The galvanometer displays alternating values, indicating the presence of alternating current.

Emf Induced in an AC Generator

In an AC generator with an armature of N turns and area A, rotating at v revolutions per second in a uniform magnetic field B, the induced emf can be expressed as $e = NBA(2\pi v) \sin(2\pi vt)$, assuming that at t = 0 seconds, the coil is perpendicular to the magnetic field. The direction of the induced emf can be determined using Fleming's right-hand rule or Lenz's law.

CLASS 12

3-Phase AC Generator

In a balanced three-phase power supply system, three conductors carry alternating currents with the same frequency and voltage amplitude, but with a phase difference of one-third of a complete cycle. Typically, a common reference point connects to the ground and, in some cases, to a neutral current-carrying conductor.

The phase differences in these three conductors result in each conductor reaching its peak voltage one-third of a cycle apart from the others. This phase shift allows for consistent power transfer to a balanced linear load, and it enables the creation of a rotating magnetic field in electric motors and various phase arrangements through transformers.

Question.

What modification is necessary to transform an AC generator into a DC generator?

- **A.** Replacing the armature with a coil.
- **B.** Replacing the concave magnets with a horseshoe magnet.
- **C.** Replacing the slip rings with split rings.
- **D.** All of the above.

Answer.

C. The essential alteration to convert an AC generator into a DC generator involves replacing the slip rings with split rings. In an AC generator, the slip rings maintain a connection between a moving rotor and the stationary rotor, resulting in the periodic change of current in the loop, thus generating alternating current (AC). On the other hand, a DC generator employs split rings, causing the current to change direction every half rotation, ensuring a constant flow of direct current (DC) without a change in direction.

Question.

What is the factor that establishes the frequency of the alternating current (AC) generated by a generator?

- **A.** The number of rotations completed by the coil in one second.
- **B.** The velocity at which the coil rotates.
- **C.** Both A and B.
- **D**. None of the above.

Answer.

C. The frequency of the alternating current (AC), denoted as 'v,' is determined by the formula $v = w/2\pi$, where 'w' represents the speed of rotation. Therefore, both the number of rotations completed by the coil in one second and the velocity of the coil's rotation are influential factors in determining the AC frequency.