

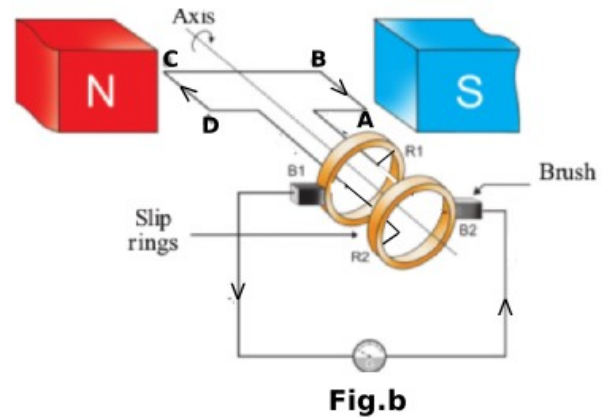
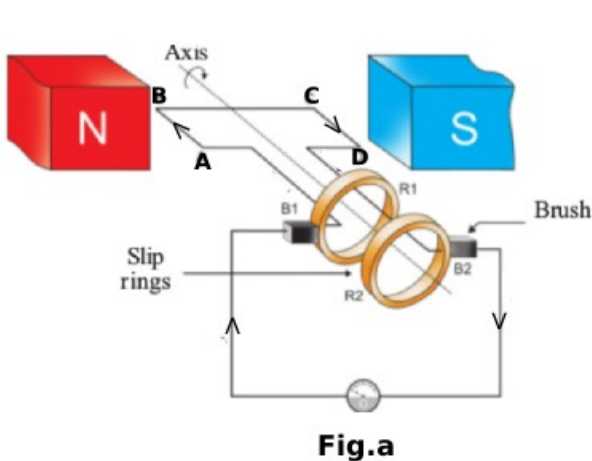
CHAPTER.3. ELECTROMAGNETIC INDUCTION

Class.3.Video

AC Generator: Generator is a device which generate Electric current using the principle of Electromagnetic induction. It converts mechanical Energy into Electrical Energy.

AC Generator

AC Generator is a device works on electromagnetic induction. It converts mechanical energy into electrical energy.



Main Parts:

(i) Armature(ABCD): An arrangement of insulated conducting wire wound on a soft iron core. It is arranged in between the poles of the field magnet so as to rotate freely. It is in the armature, the current is induced.

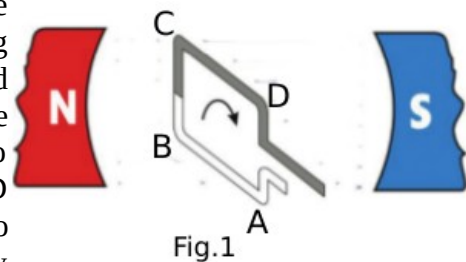
ii) Field Magnet: NS- It creates magnetic flux in the generator.

iii) Slip rings: There are two metal rings(R_1 & R_2) in a generator which are welded with the armature coil. As it is joined to the armature, slip rings are rotated alongwith the armature on the same axis.

iv) Brushes: The two graphite brushes (B_1 & B_2) always make contact with the slip rings. It is through brushes & slip rings induced current from armature flows to the external circuit.

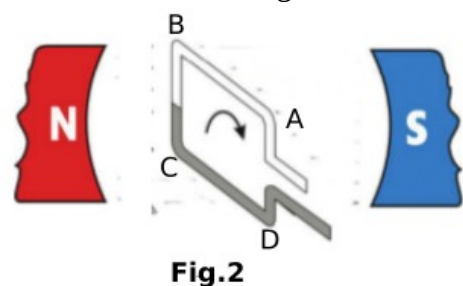
i) **Working:** Using suitable source of energy, the armature is made to rotate. As it is moving through a magnetic field, a current will be induced in the armature due to electromagnetic induction.

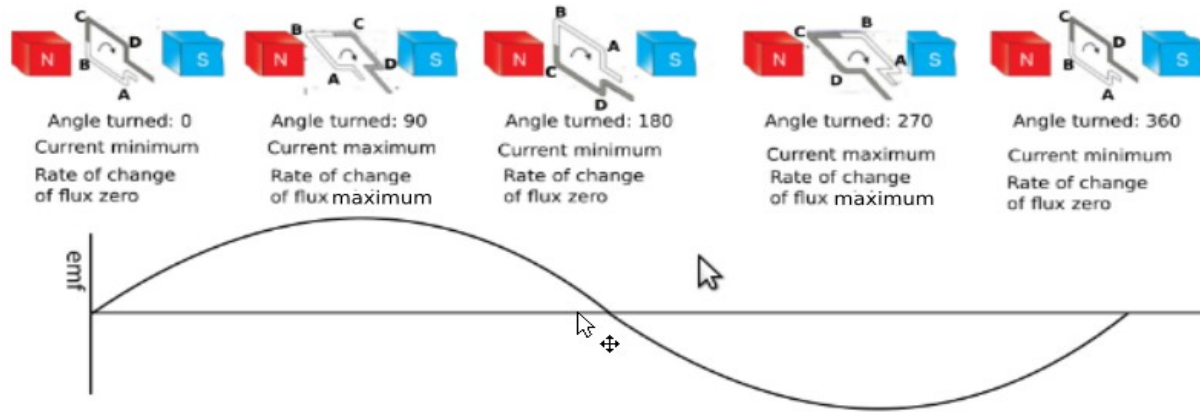
Suppose the armature rotates in clockwise direction. Let the initial position of the armature be as shown in fig.1. During the first half rotation (up to 180°) the arm AB moves up and CD moves down. Then the direction of induced current in the portion AB is from A to B and in the portion CD is from C to D. That is, current in the armature is in the direction ABCD and current through the external circuit is from brush B_2 to brush B_1 . The direction of this current can be found out by applying Fleming's right hand rule to the **fig.a.** above.



After completing half rotation, the position of armature will be as shown in Fig.2.

In the second half rotation (from 180° to 360°), CD moves upwards and AB downwards. Then current through AB is from B to A and in the arm CD is from D to C. That is, in the second half rotation the current in the armature is in the direction of DCBA and hence current through the external circuit is from B_1 to B_2 . The direction of current during second half rotation can be detected from Fig.b above.





When the arms of the armature moves perpendicular to the field, induced current is maximum. And when it moves parallel to the field, current is minimum. That is why current is maximum at the angles 90 and 270 and minimum at zero and 180.

Frequency and Period of AC: The induced emf generated in two successive half rotation together form one cycle of AC. The number of cycles per second is the **frequency** of AC. The frequency of AC generated for distribution in our country is 50 Hz. That is, the direction of current changes 100 times in one second. The time taken by the armature coil for a full rotation is called **period T**.

Note: In an AC Generator, the slip rings and brushes arrangement are used for taking out current from the generator to the external circuit. In this system, brushes are sliding over the slip rings. The rubbing of slip rings on brushes may produce spark. If the field magnet is made to rotate instead of armature, slip rings and brushes can be avoided. So this method is being followed in heavy generators.

SAMPLE QUESTIONS & ANSWERS

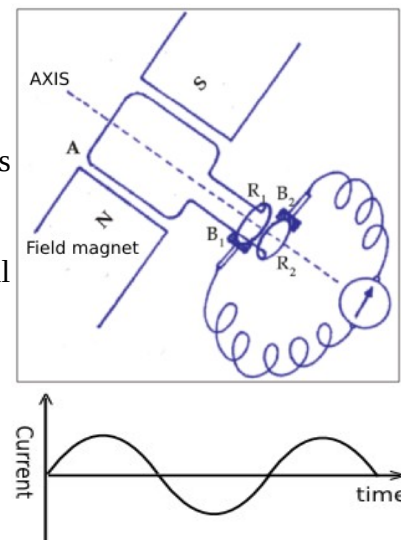
- Generator is device that generates electric current.
 - What is its working principle?
 - Identify the energy conversion in it.

Answer: a. Electromagnetic induction. b. Converts mechanical energy into electrical energy.
- What is the angle between direction of motion of the armature and direction of field at which induced emf in the coil is maximum. **Answer:** 90° .
- How many times does the direction of induced current change when the armature completes one rotation? **Answer:** Two times.
- The frequency of current available in our house through distribution line is 50Hz. If so how many times does the direction of current change per second? **Answer:** $50 \times 2 = 100$ times.

5. See the figure.

- Identify the device.
- What is its working principle?
- What are the functions of brushes and slip rings in this device?
- Give the graphical representation of current obtained from this device.

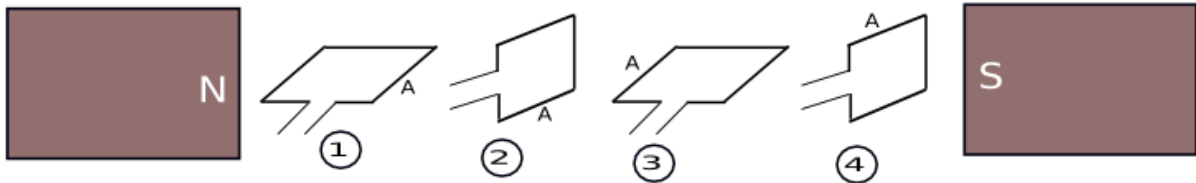
- Answer:** a. AC Generator. b. Electromagnetic induction
c. Take out the current induced in the armature to the external circuit.
d.



6. Induced current increases when rotational speed of the armature of a generator is increased. It is due to (increase of flux density/ increase of rate of change of flux)

Answer: Increase of rate of change of flux

7. The four stages of rotating armature of an AC generator are indicated as 1,2,3 &4.



- What are stages at which Armature moves parallel to the field?
- What are the stages at which the maximum emf is induced?
- Give graphic representation of turning of the coil and induced emf.

Answer:a. Stages 2&4 b. 1&3

c.

