DC Machines Construction

Acknowledgement: *The materials presented in this lecture has been taken from open source, reference books etc. This can be used only for student welfare and academic purpose.*

Recap

- Torque in Rotational System
- Multiply Excited Magnetic System
- MMF of Distributed AC Windings

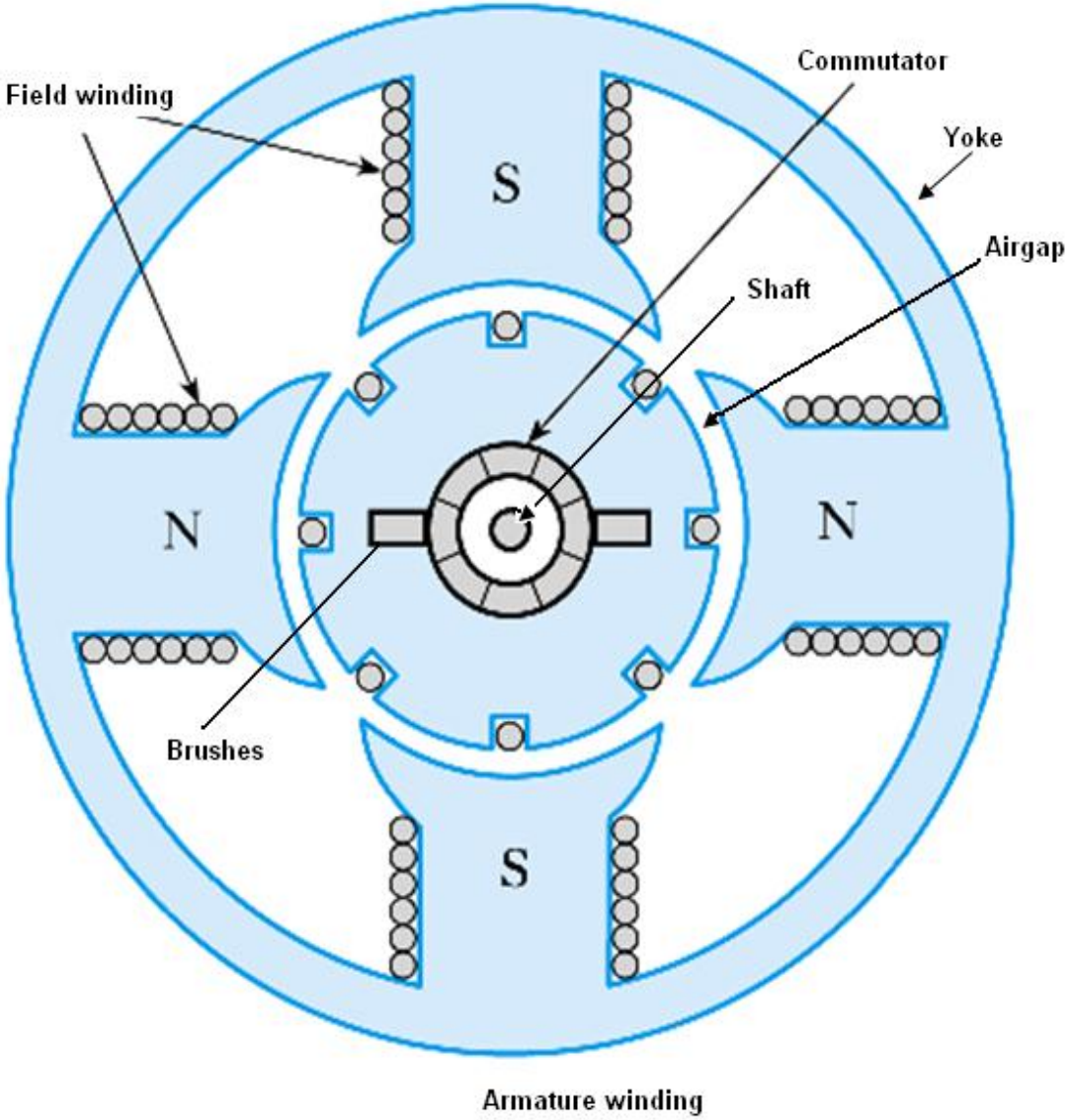
Lecture-12 Objectives

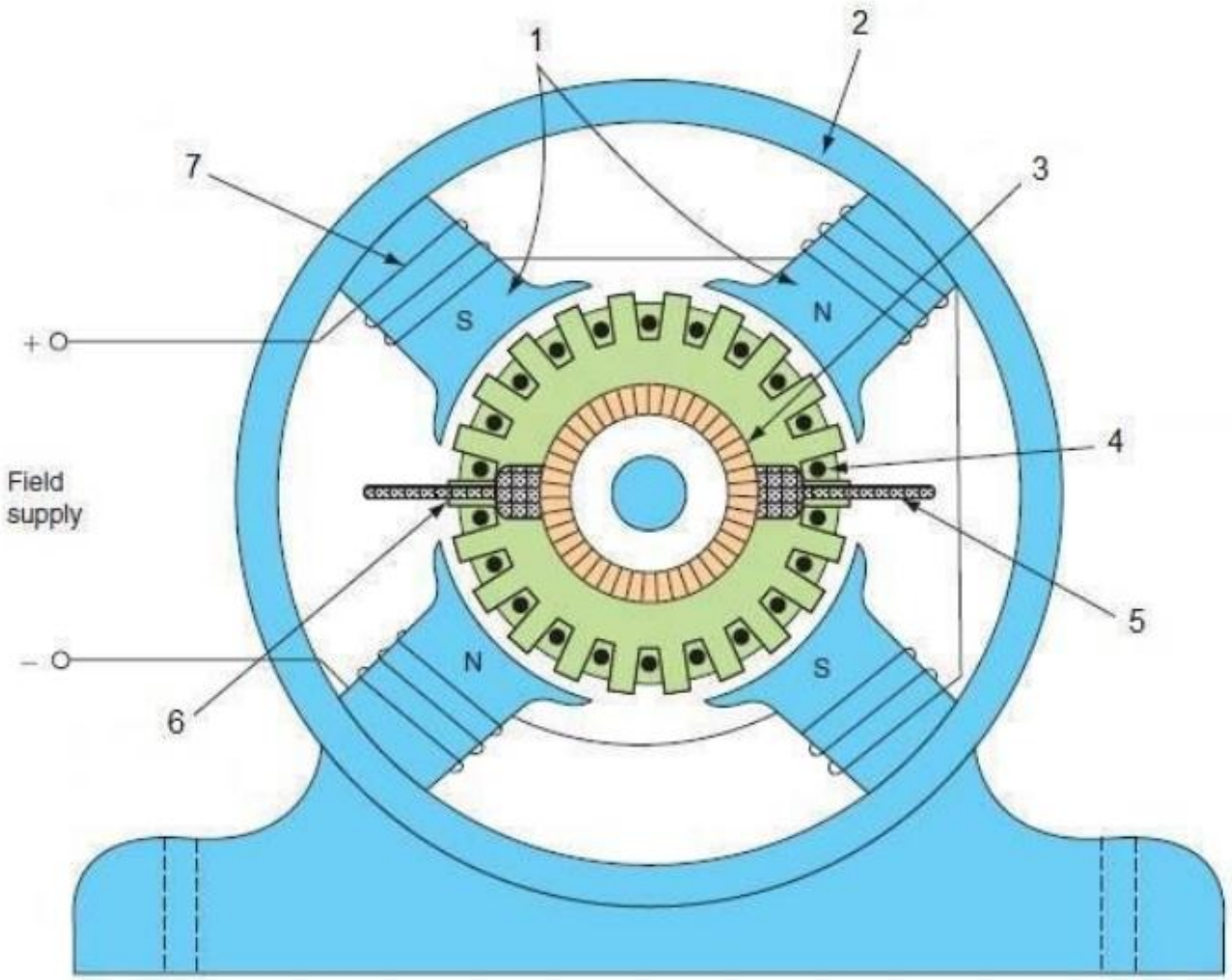
- Constructional details of DC Machines
- Fleming's Right Hand Rule
- Operation of the generator and motor
- Induced EMF
- Armature Winding

Constructional Details of D.C Machine

- The d.c. generators and d.c. motors have the same general construction.
- Any d.c. generator can be run as a d.c. motor and vice-versa.
- All DC machines have the following basic parts.
  - ❖ Armature (Rotor)
  - ❖ Field Poles (Stator)
  - ❖ Commutator
  - ❖ Brushes
  - ❖ Yoke

DC Machines Construction

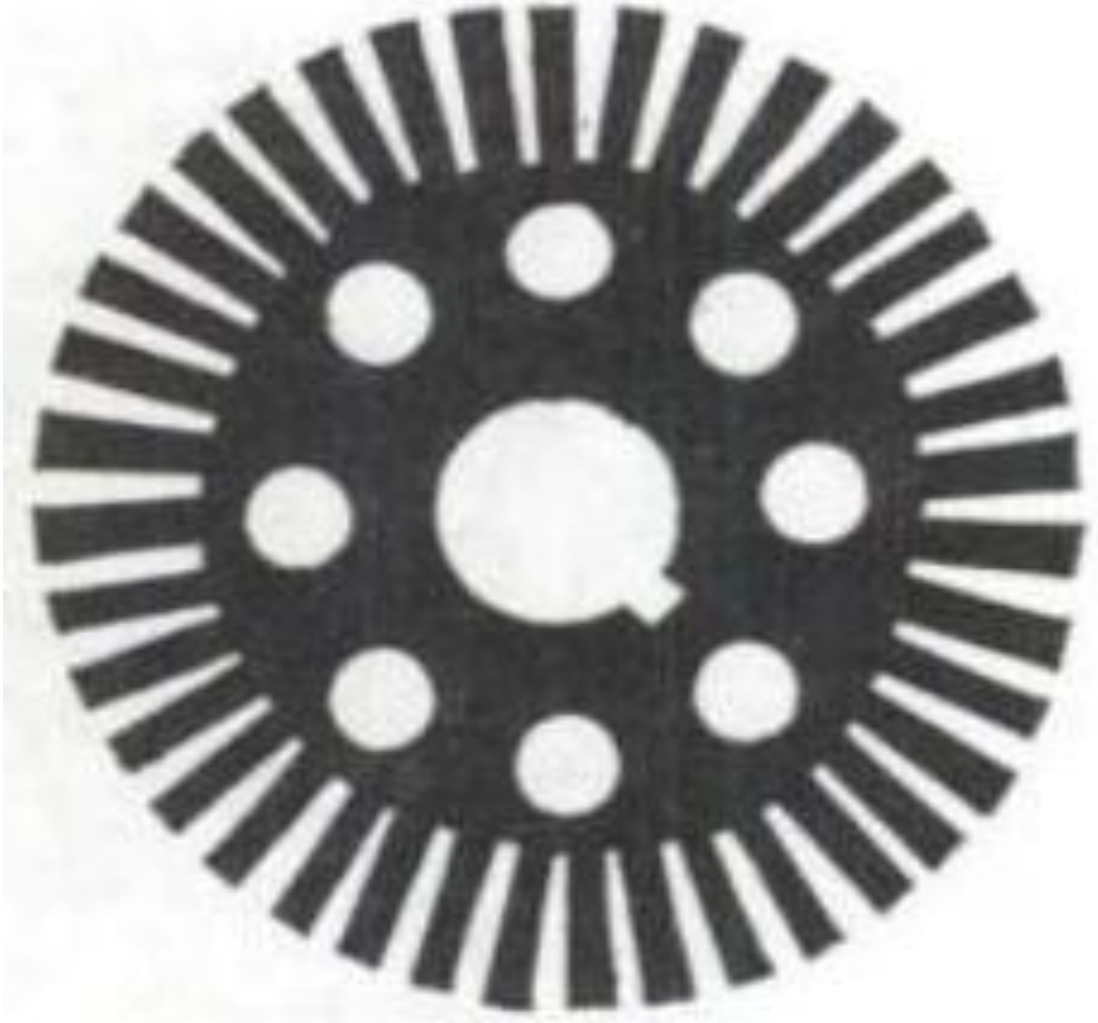




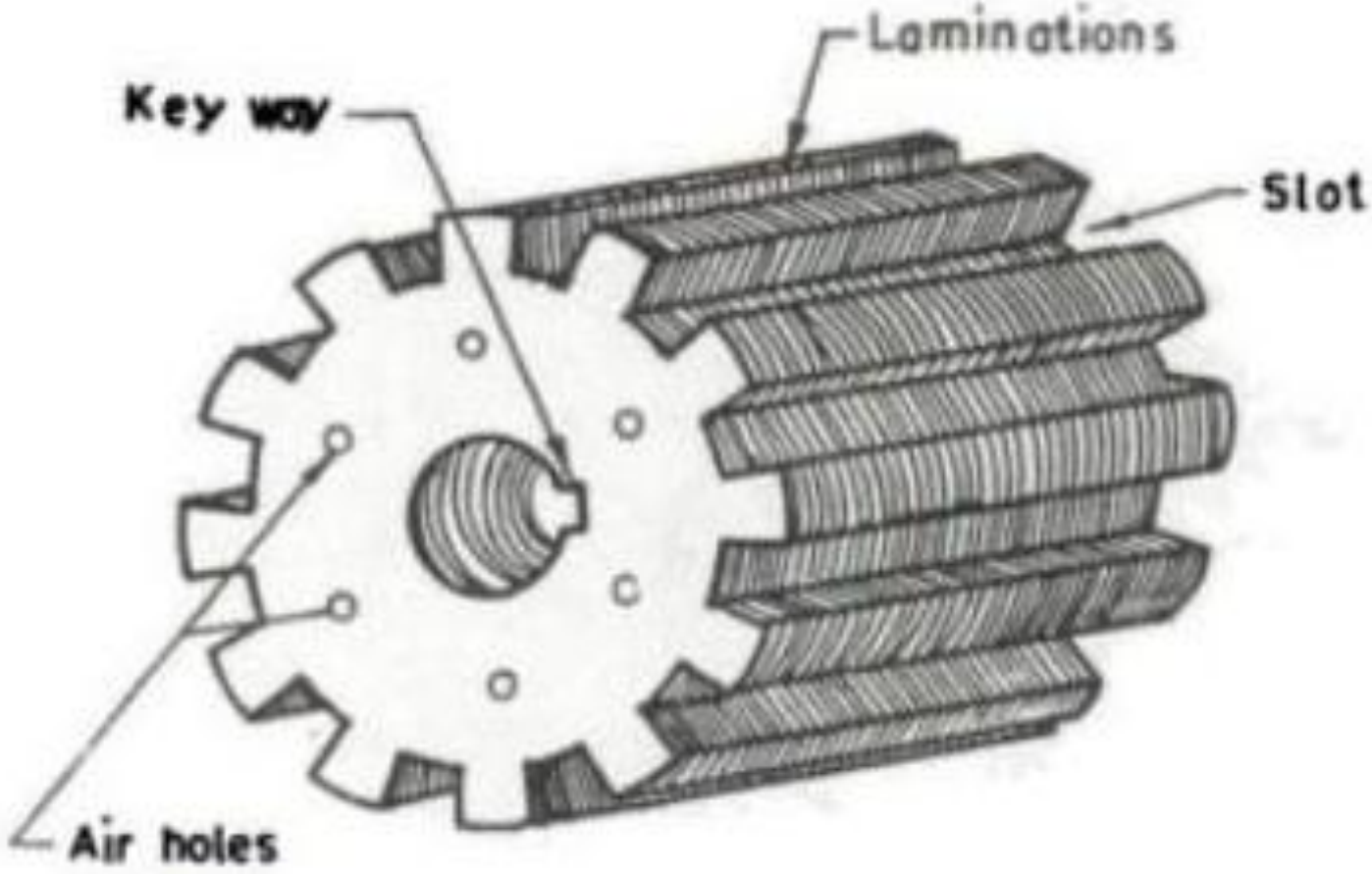
Armature

- It is the rotating part of the DC machine.
- It rotates in between field poles.
- It is a laminated cylinder mounted on shaft which is supported by bearings.
- Made up of Silicon steel laminations of 0.4 mm – 0.6 mm thickness and are insulated from each other.
- Armature core has slots for placing armature conductors.
- The armature is laminated to reduce the eddy current loss in the core.

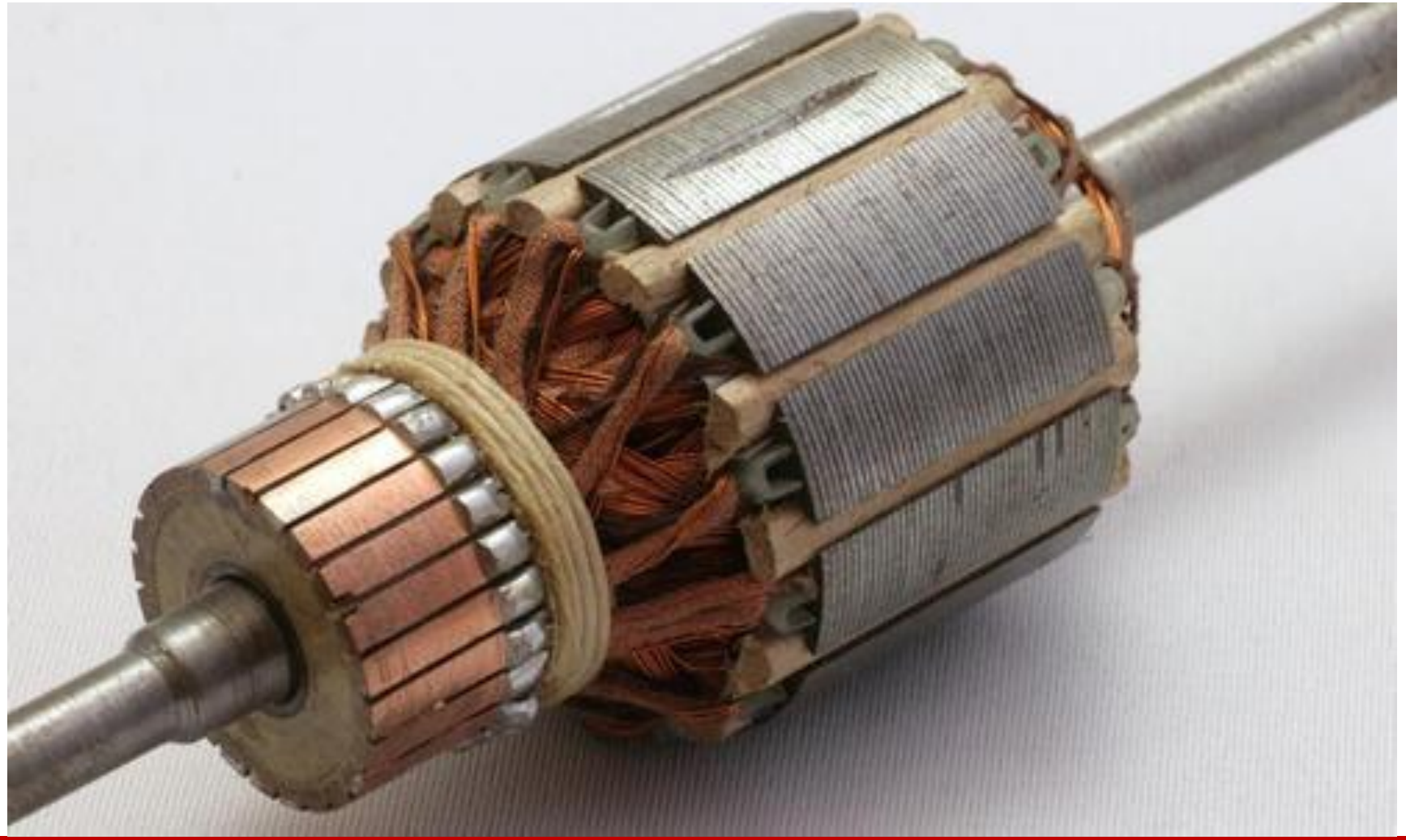
Armature Laminations



Armature Core

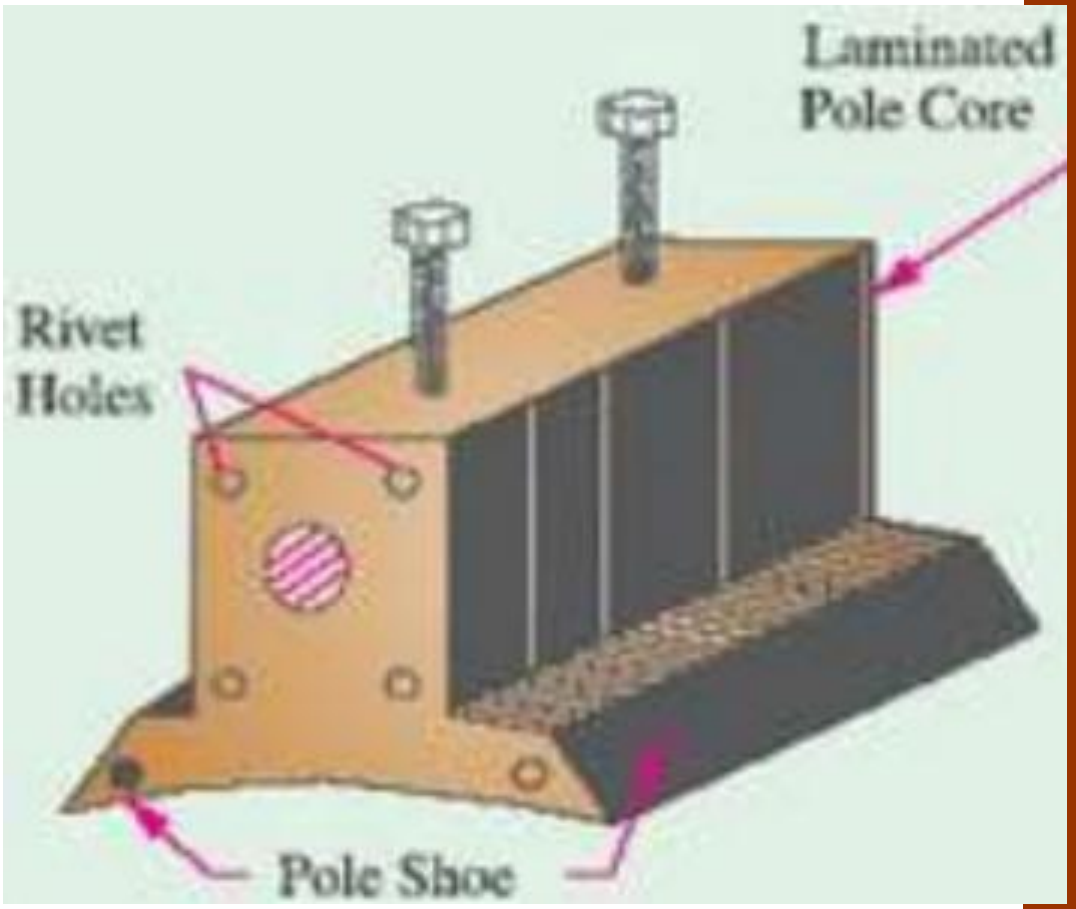


Armature of a DC Machine



Field Poles

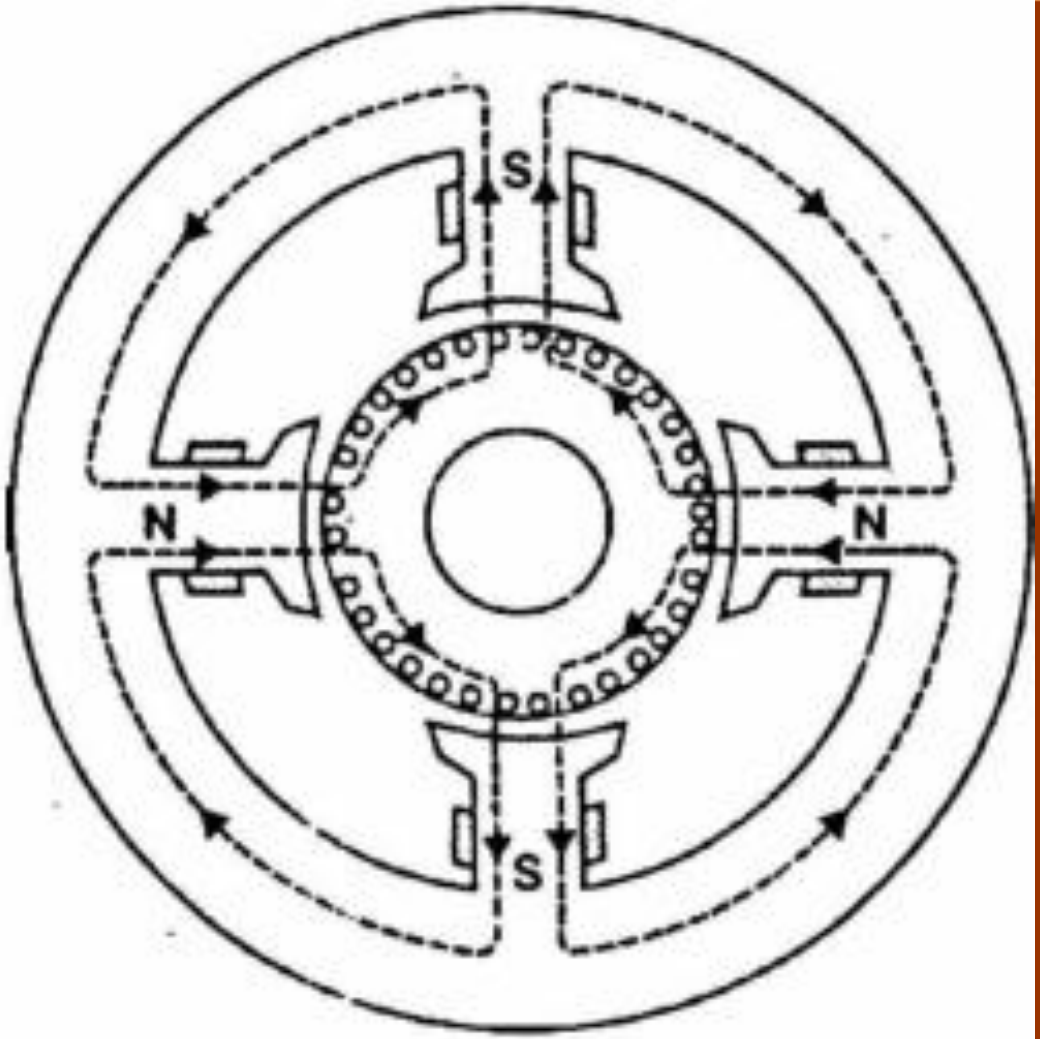
- It is the stationary part of the DC machine and consists of number of salient poles
- Field poles are made up of laminated steel sheets stacked & riveted together.
- Pole cores are then bolted to a hollow cylinder frame called yoke.



DC Machines Construction

- Field windings are placed over the field poles.
- The function of the field winding is to produce uniform magnetic field within which the armature rotates.

- The field coils are connected in such a way that adjacent poles have opposite polarity.
- The m.m.f. developed by the field coils produce a magnetic flux that passes through the pole pieces, the air gap, the armature and the frame.
- Practical d.c. machines have air gaps ranging from 0.5 mm to 1.5 mm.



Commutator

- A commutator is a mechanical rectifier which converts the AC voltage generated in the armature winding into DC voltage across the brushes.
- It is made of copper segments insulated from each other by mica sheets and mounted on the shaft of the machine.
- Armature conductors are connected to commutator segments.

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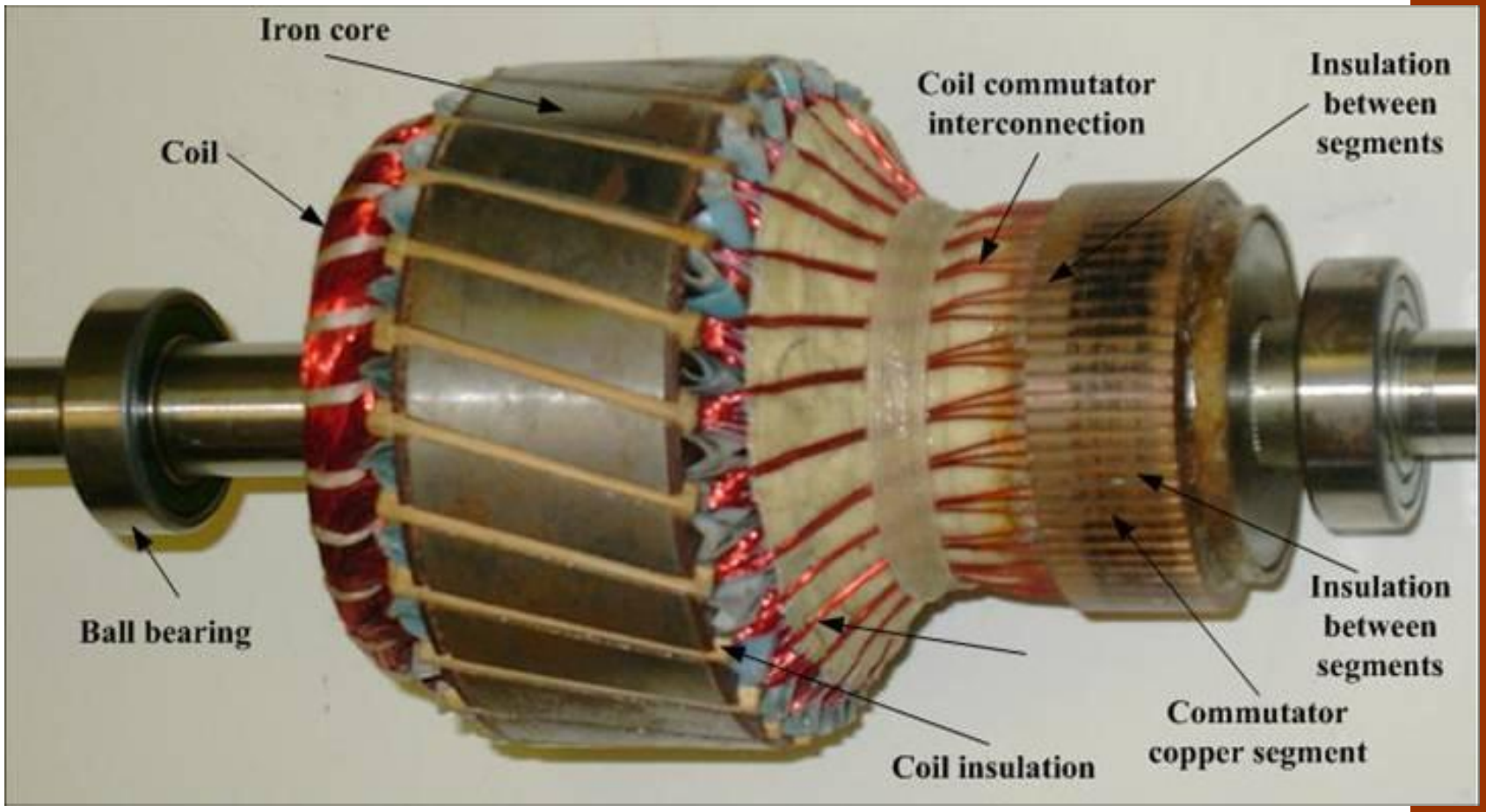
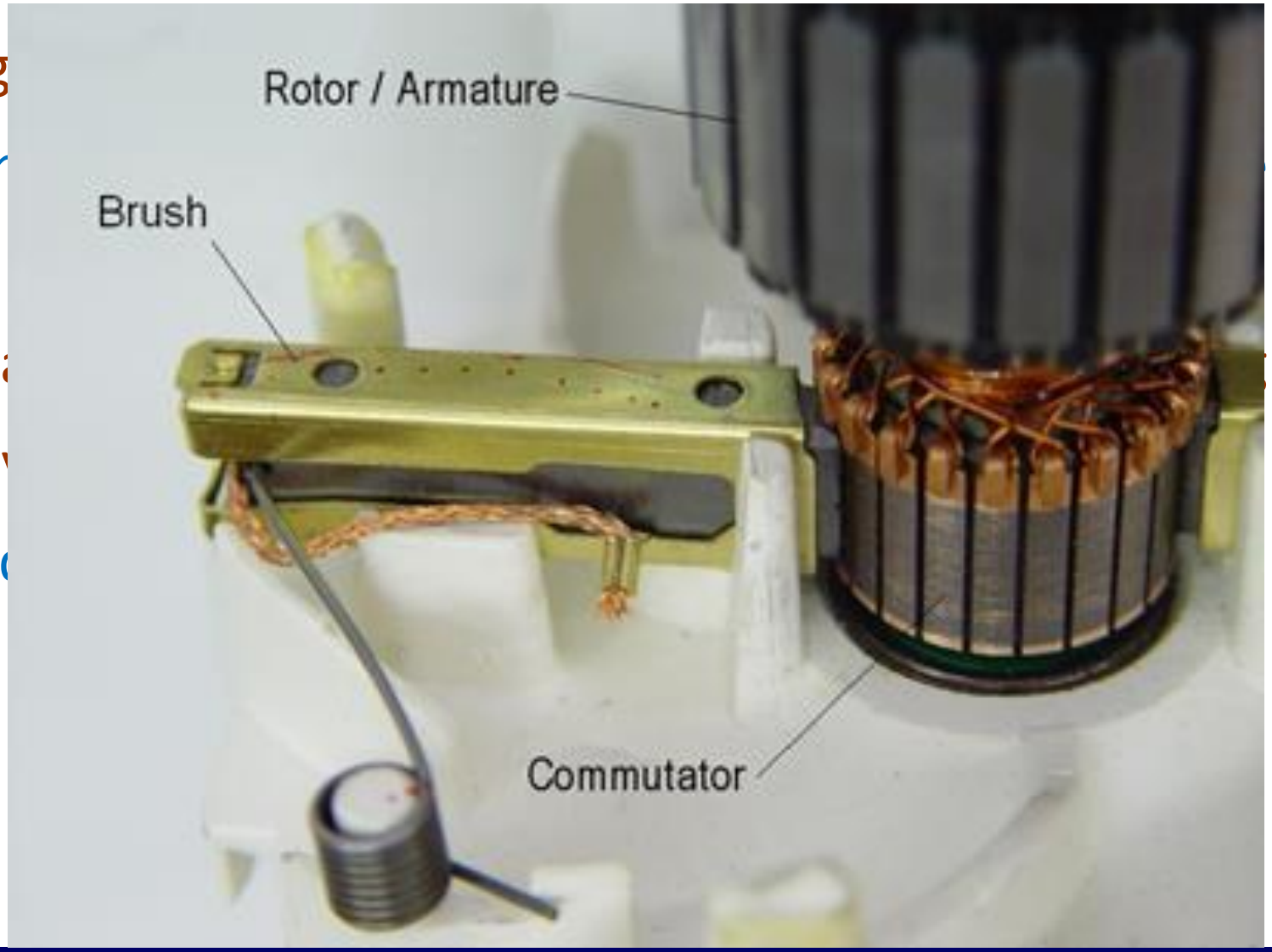


Brushes

- Made up of carbon or g
- They are fixed on th commutator smoothly.
- Brushes are used to ca armature and stationar
- The brush pressure is ac

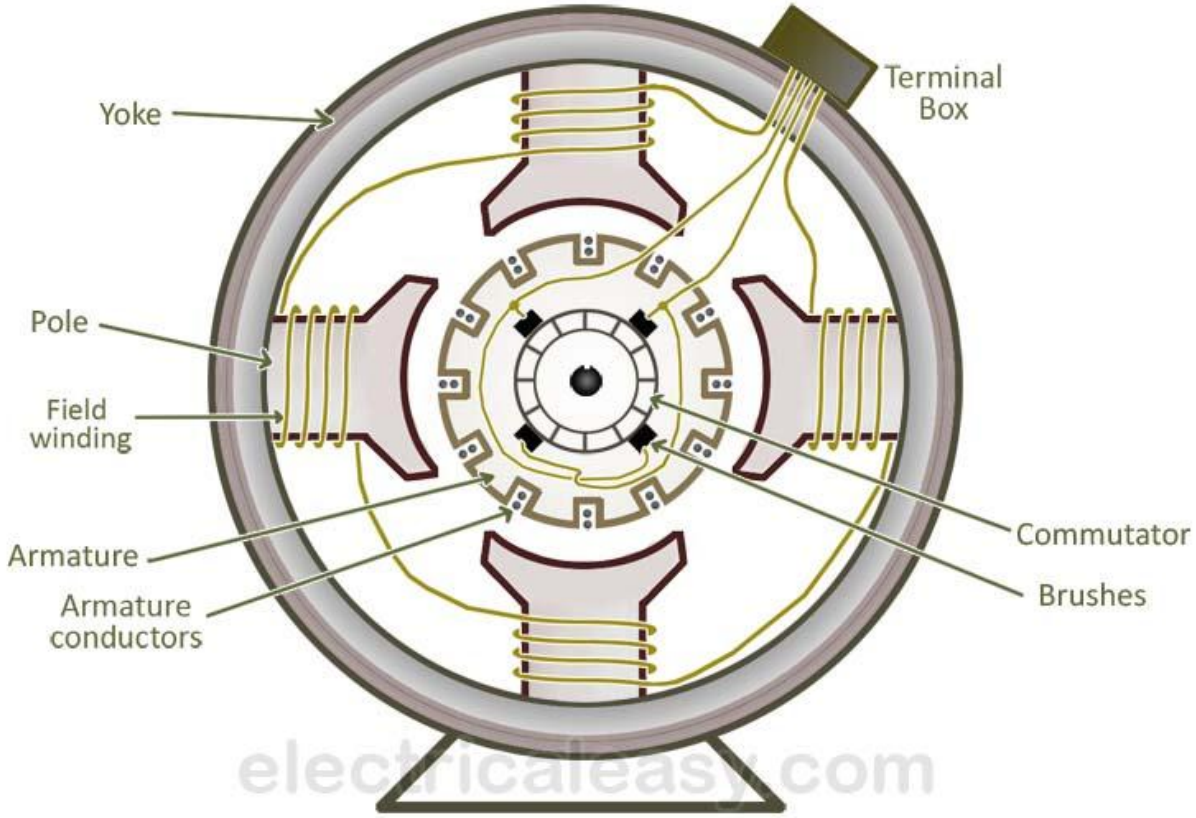


Brushes

- Made up of carbon or graphite material.
- They are fixed on the commutator segments to move over the commutator smoothly.
- Brushes are used to carry the electrical connection between rotating armature and stationary load or source.
- The brush pressure is adjusted by means of adjustable springs.

Yoke

- The magnetic frame or the yoke of DC motor made up of cast iron or steel.
- Its main function is to form a protective covering over the inner parts of the motor and provide support to the armature.



- It also supports the field system by housing the magnetic poles and field winding of the dc motor.

Faraday's Law of Electro Magnetic Induction

- Whenever the flux linking with a coil changes, an EMF is induced in that coil.
- The magnitude of EMF induced in a conductor depends on the rate at which the conductor cuts the magnetic field.

Fleming's Right Hand Rule

- Stretch the thumb, fore finger and middle finger of your right hand so that they are at right angles to each other.
- If the fore-finger points the direction of field & thumb in the direction of the motion of the conductor, then the middle finger will indicate the direction of induced emf.


Motion of the conductor
Thumb
Magnetic field
Forefinger
Induced current
Middle finger
GENERATOR
RULE

Fleming's Right Hand Rule

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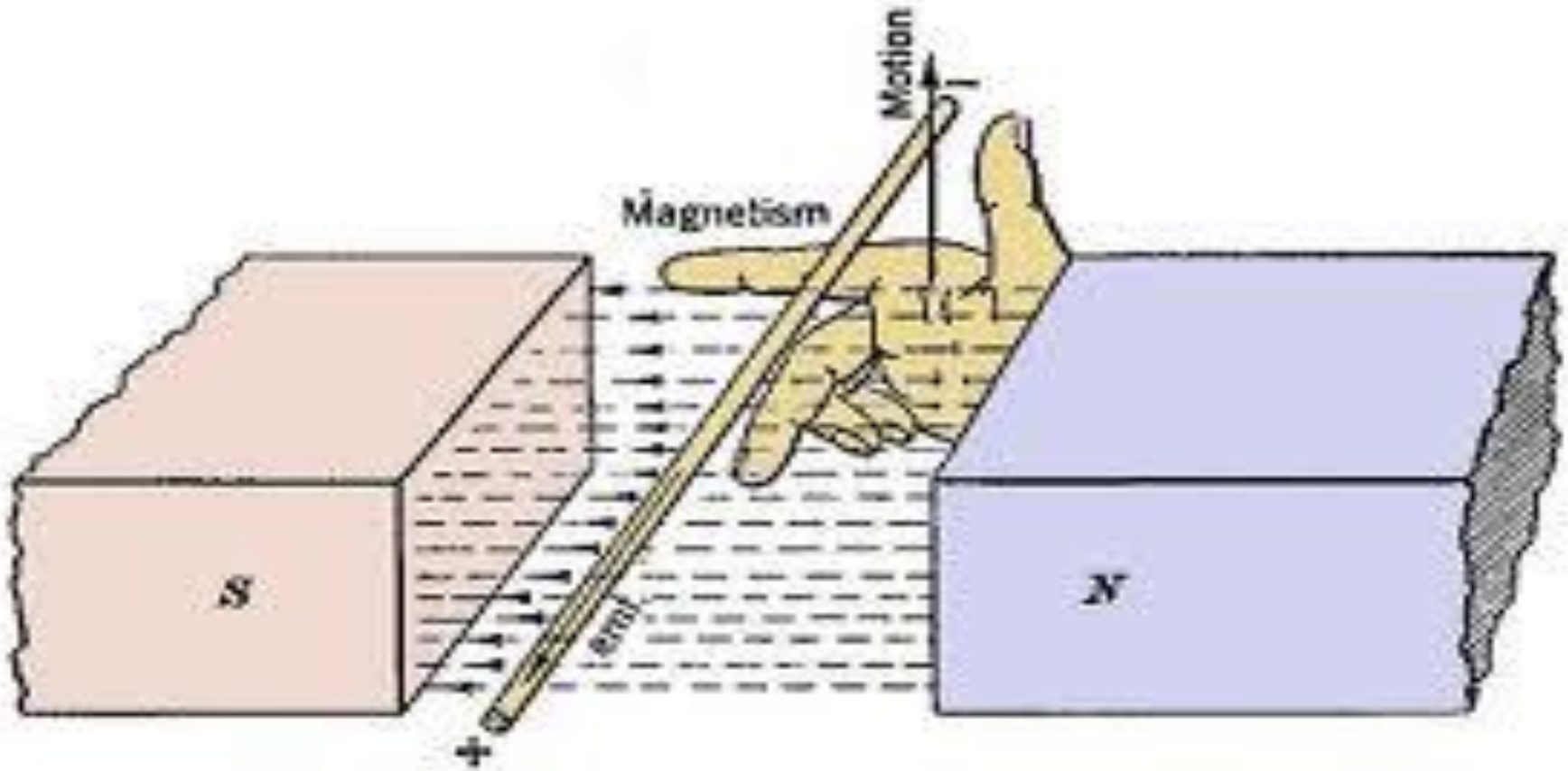
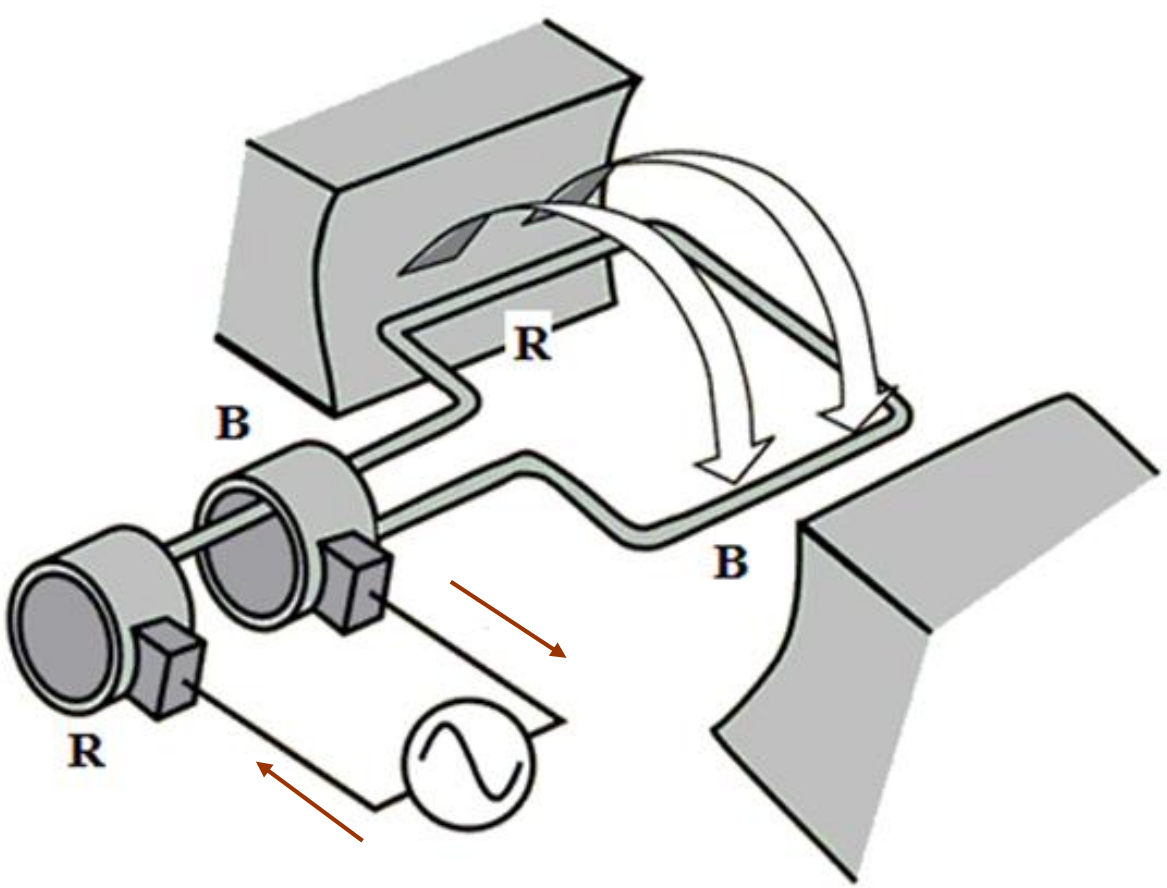
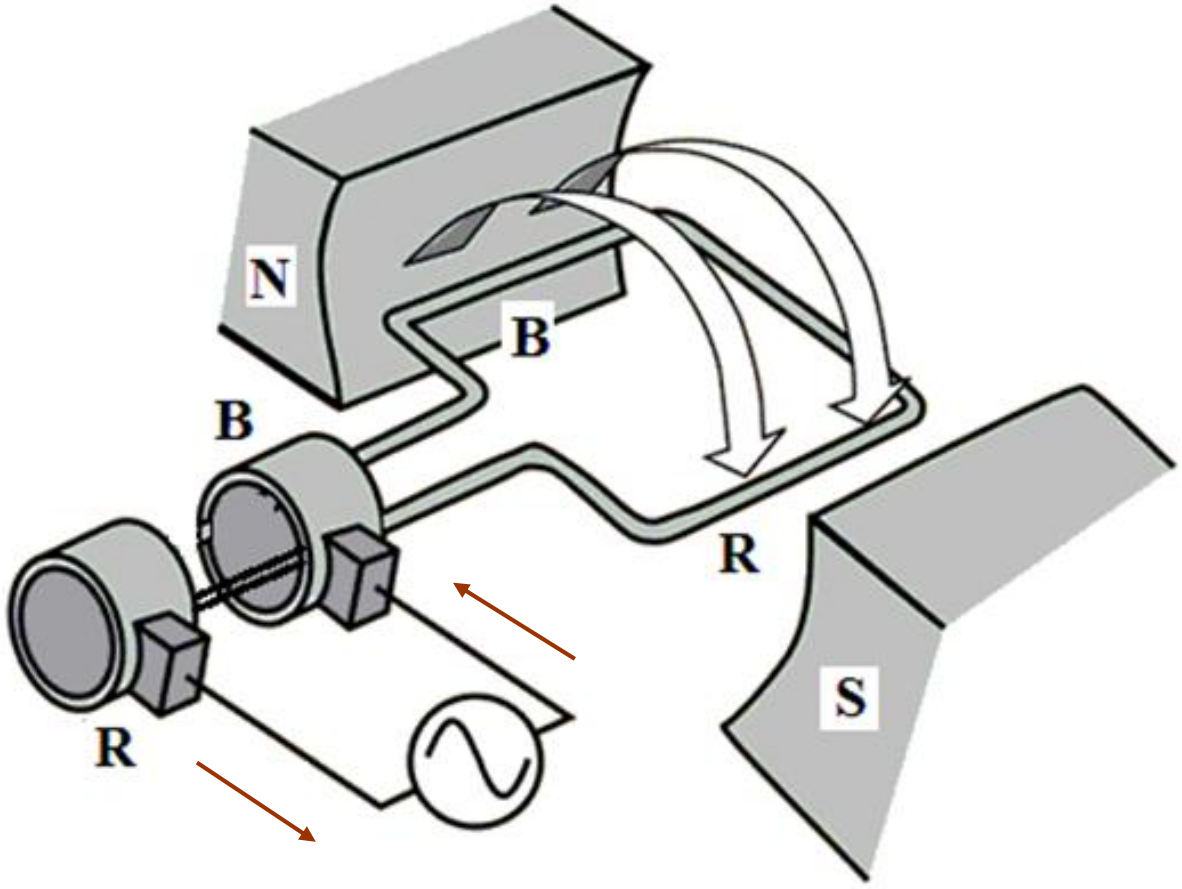
Fleming's Right Hand Rule

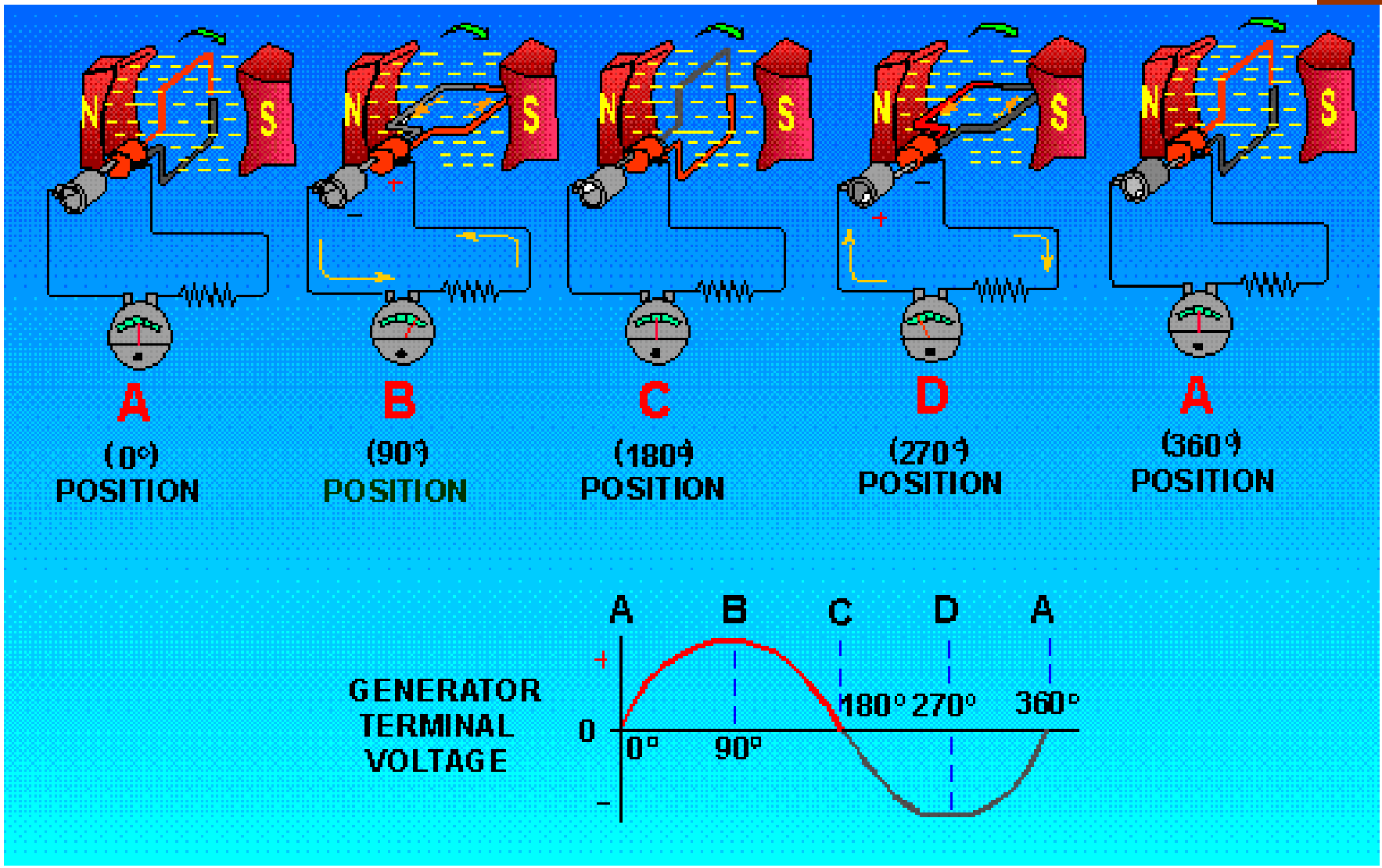


Operation of Generator

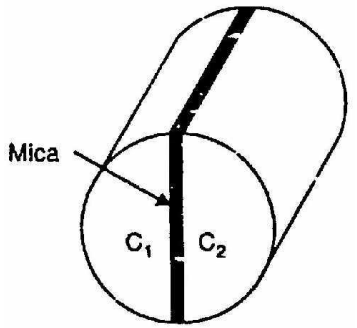


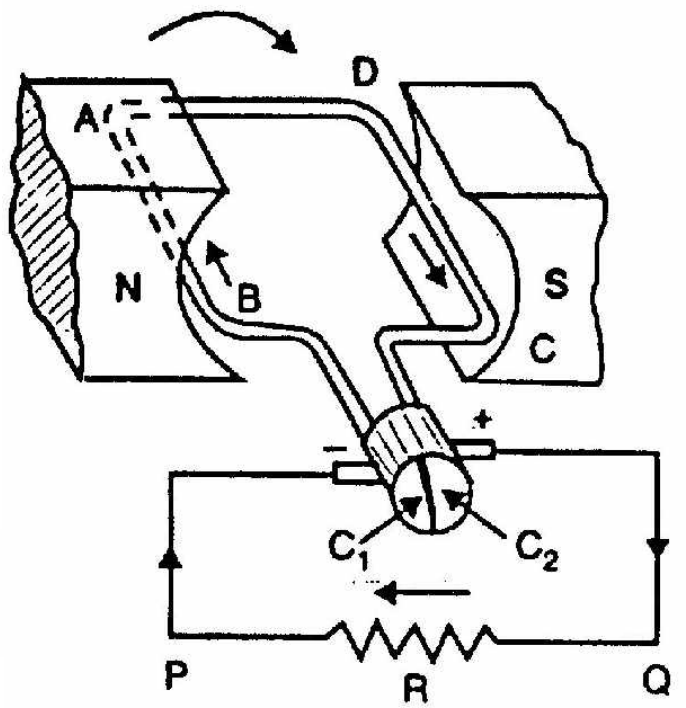


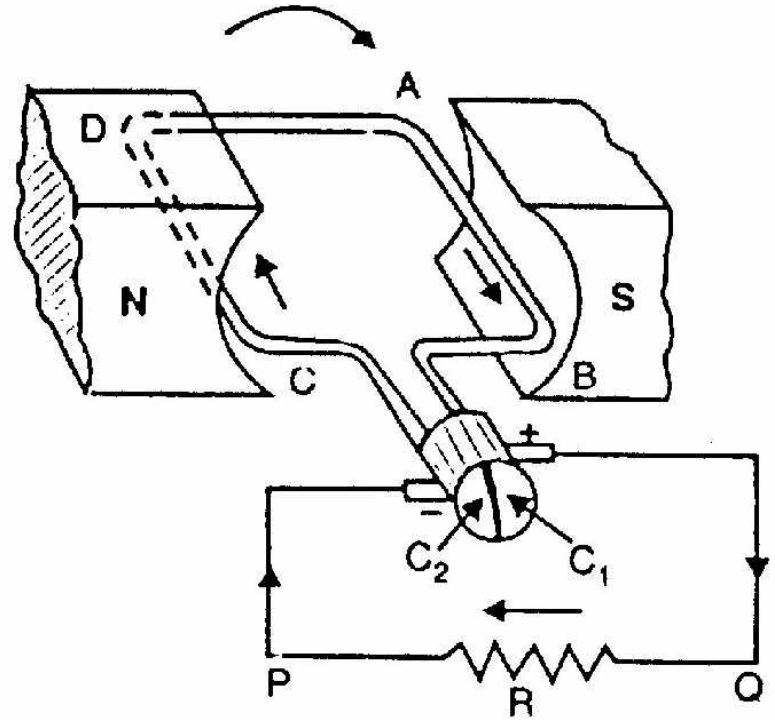
EMF Induced in a Generator

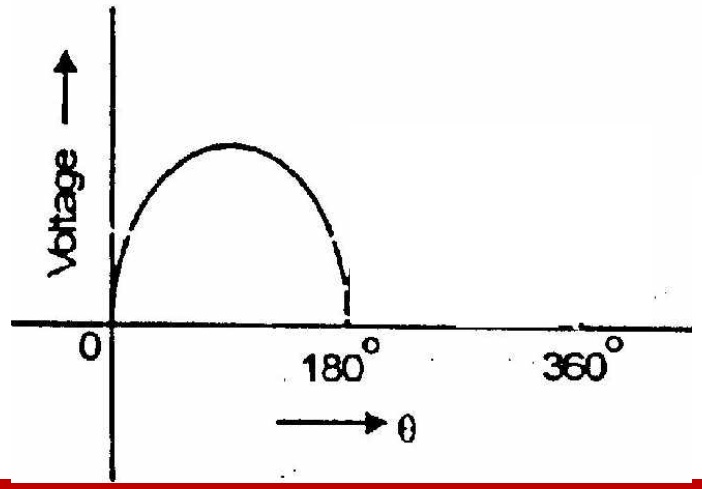


Action of Commutator









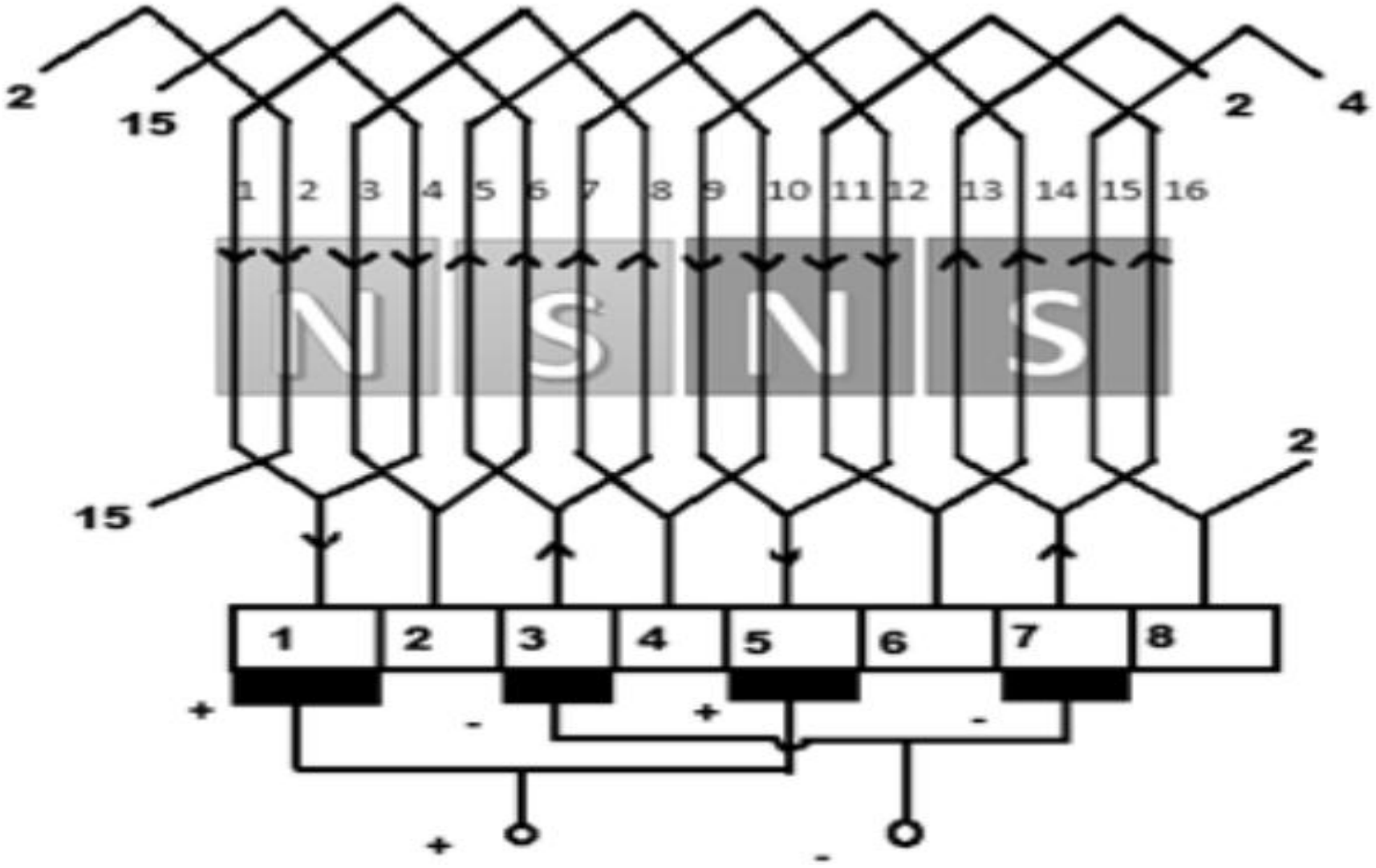
Armature Windings

- There are two types of armature windings.
  - Lap winding
  - Wave winding

Lap Winding

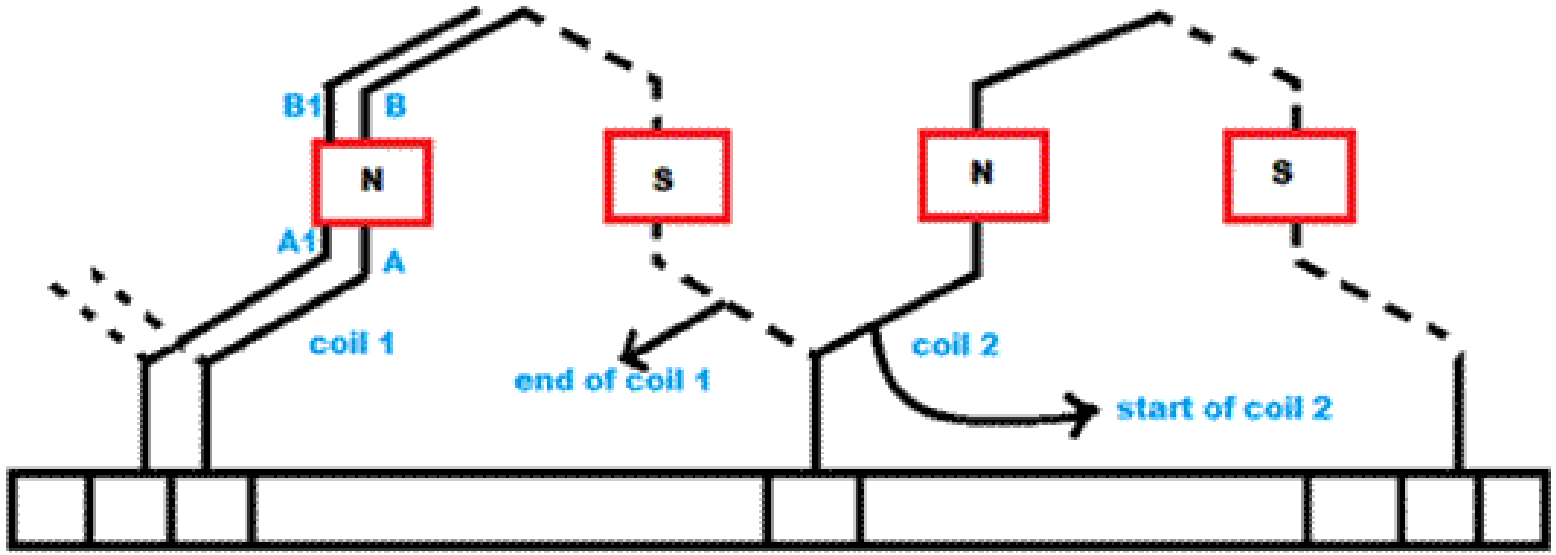
- Any coil has two ends. The **Start end** and **Finish end**.
- In lap winding, the Finish end of each coil is connected to the Start end of next coil.
- Suitable for low voltage high current generators. Because it gives more parallel paths.
- No. of parallel paths = No. of poles. A = P.

DC Machines Construction



Wave Winding

- In wave winding, the Finish end of one coil is connected to the Start end of another coil placed well away form the first coil.
- Suitable for high voltage low current machines.
- No. of parallel paths -



wave winding

Summary

- Constructional details of DC Machines
- Fleming's Right Hand Rule
- Operation of the generator and motor
- Induced EMF
- Armature Winding