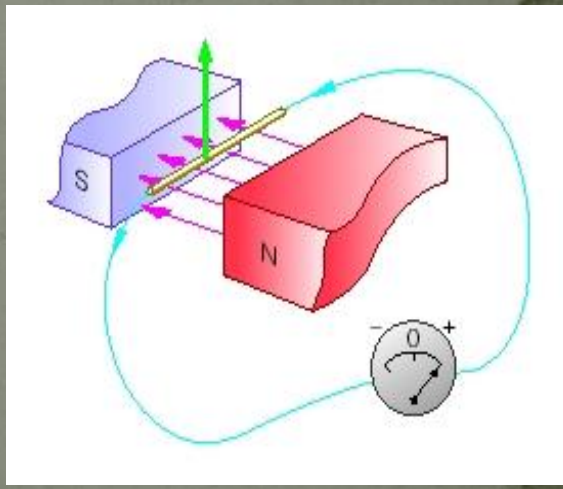
DC Generator

Mechanical energy is converted to electrical energy

Three requirements are essential

1. Conductors
2. Magnetic field
3. Mechanical energy



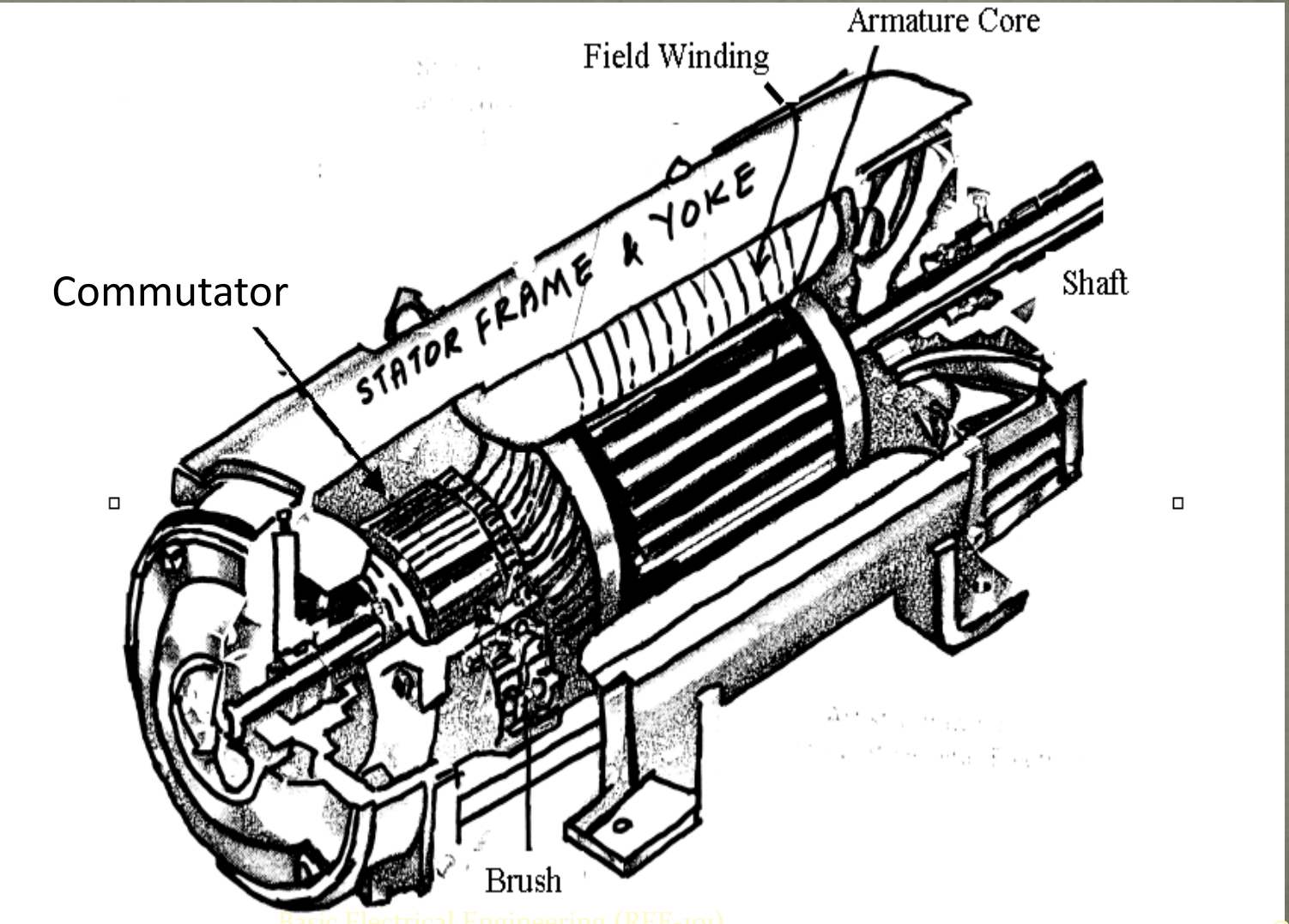
Working principle

- A generator works on the principles of Faraday's law of electromagnetic induction

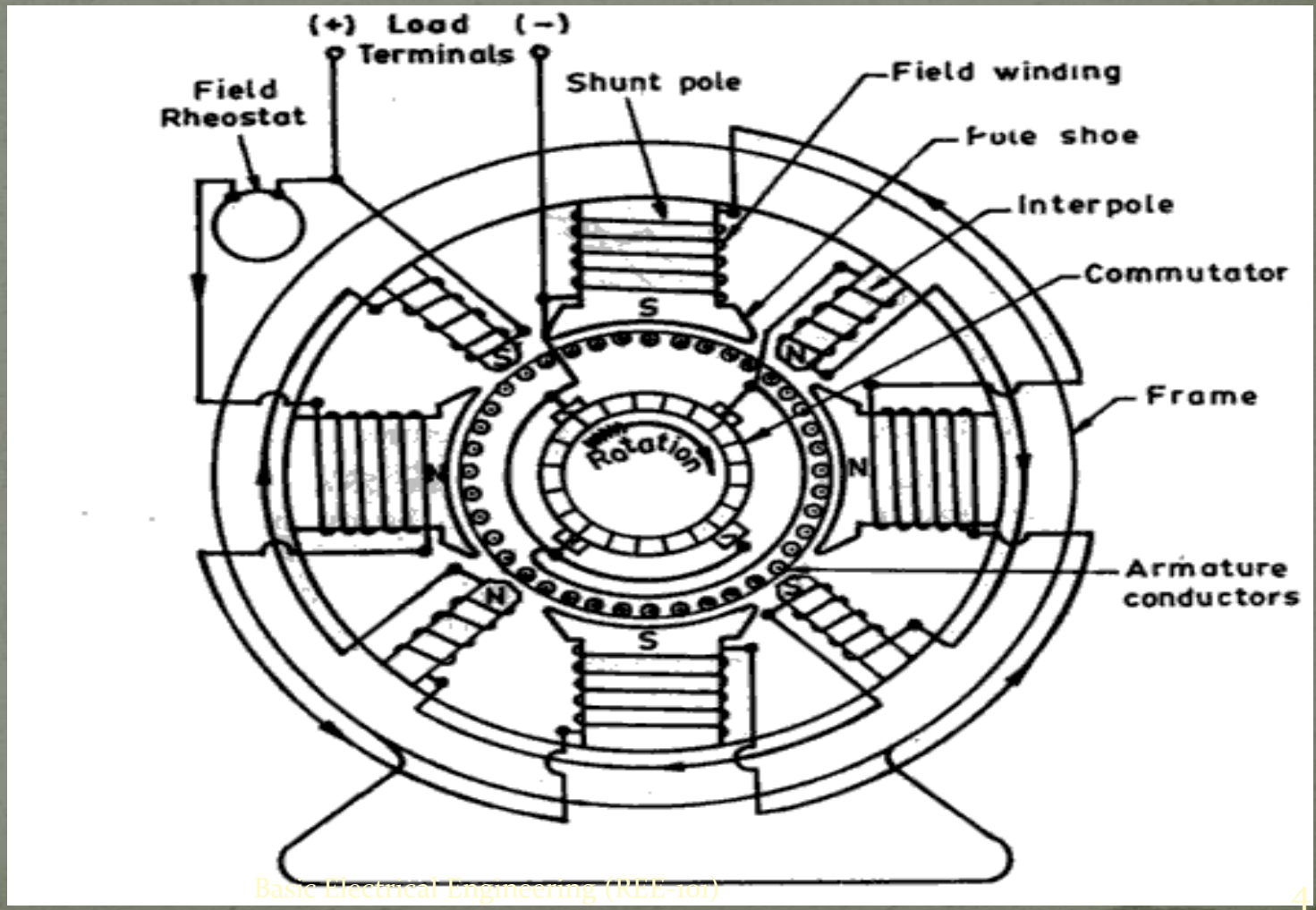
- Whenever a conductor is moved in the magnetic field , an emf is induced and the magnitude of the induced emf is directly proportional to the rate of change of flux linkage.

- This emf causes a current flow if the conductor circuit is closed .

DC Machine

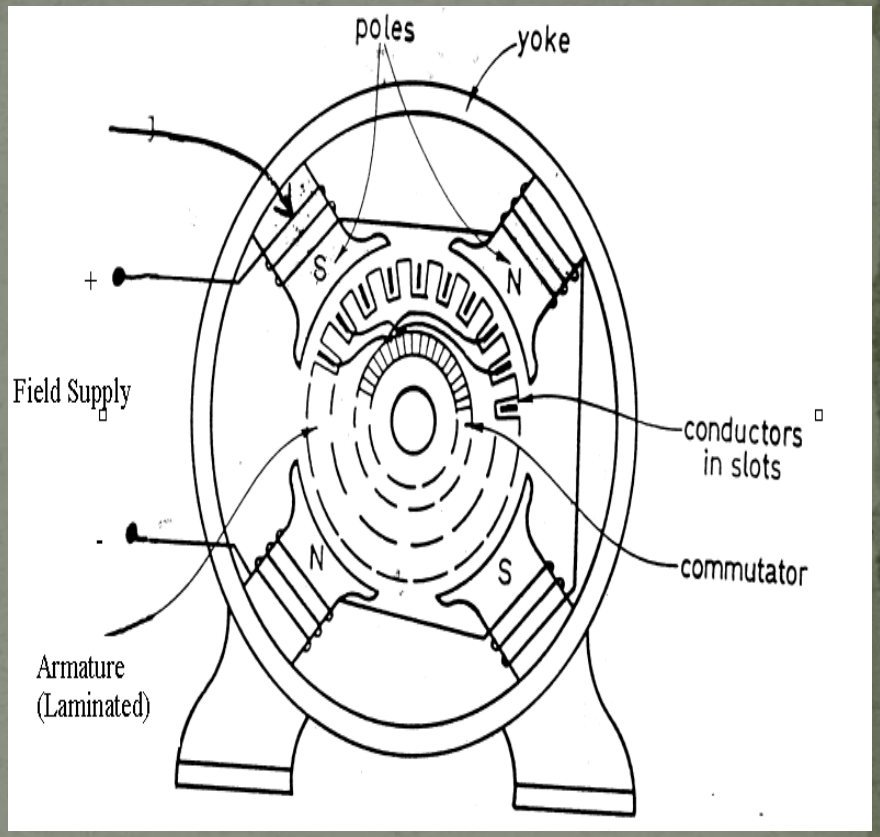

Armature Core
Field Winding
STATOR FRAME & YOKE
Commutator
Shaft
Brush

Sectional view of a DC machine

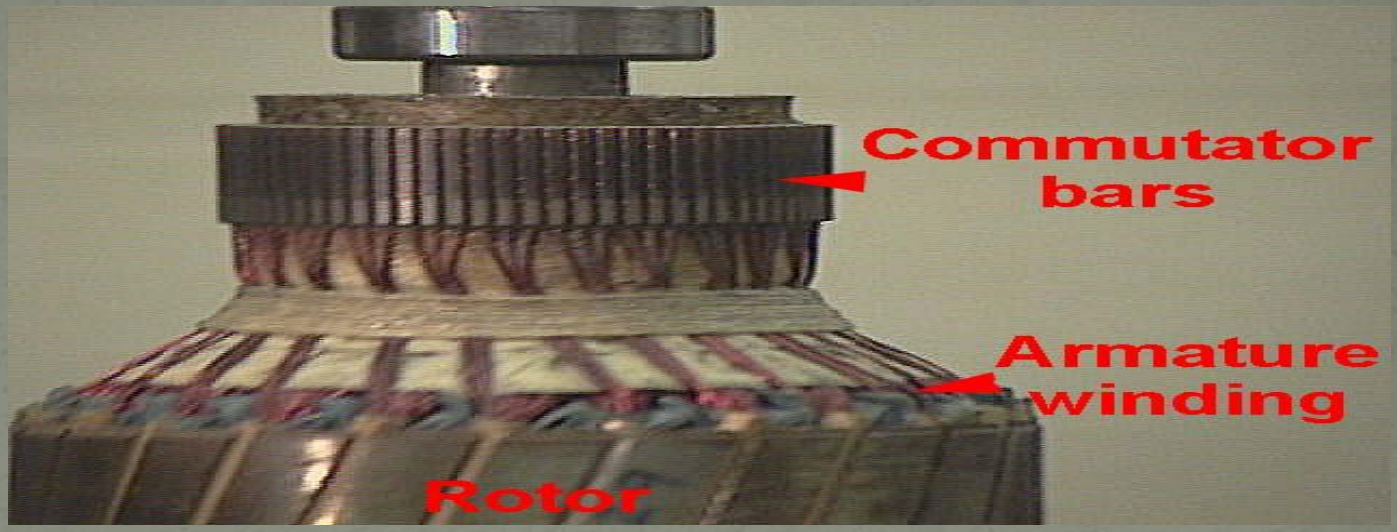


Construction of DC Generator

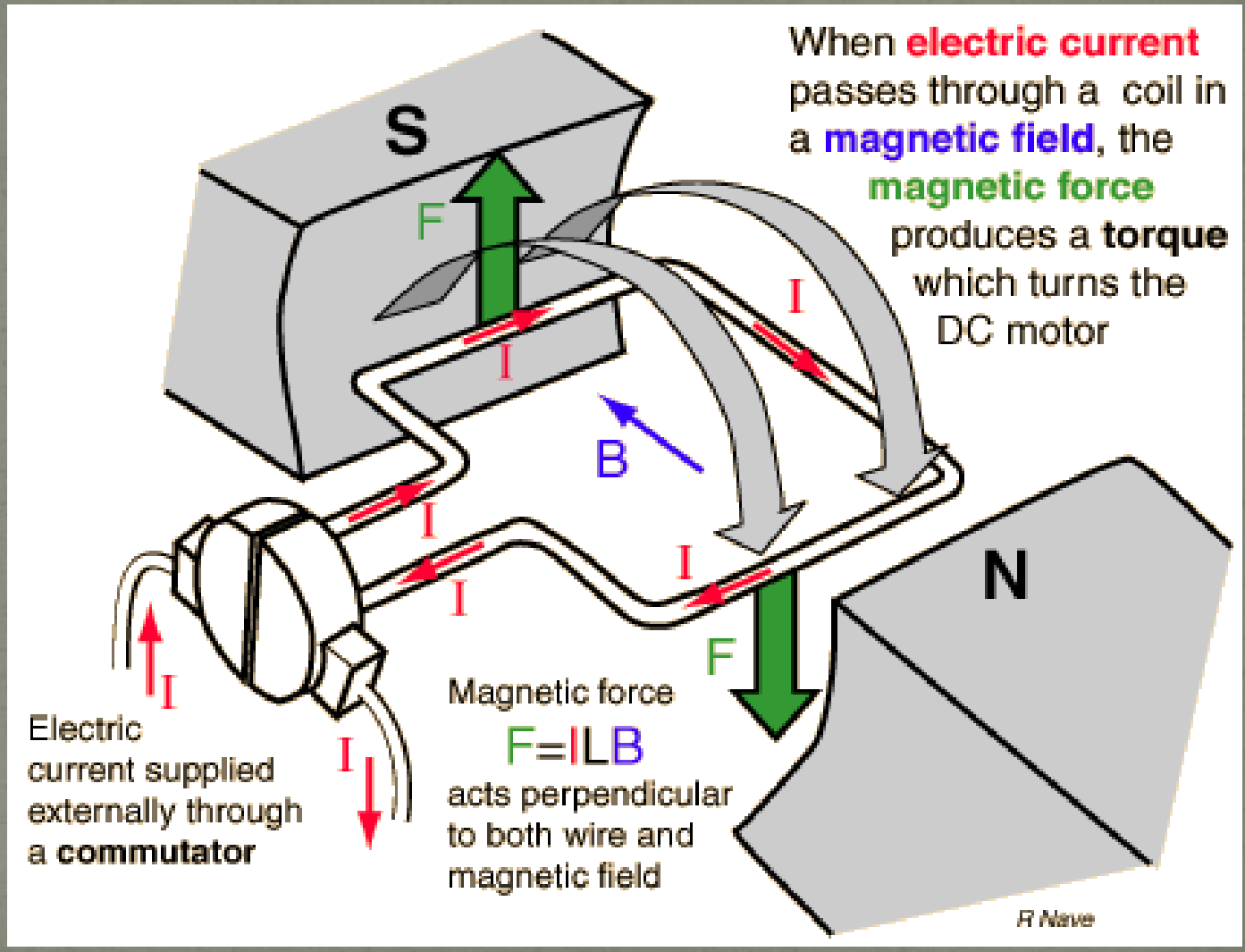
- Field system
- Armature core
- Armature winding
- Commutator
- Brushes



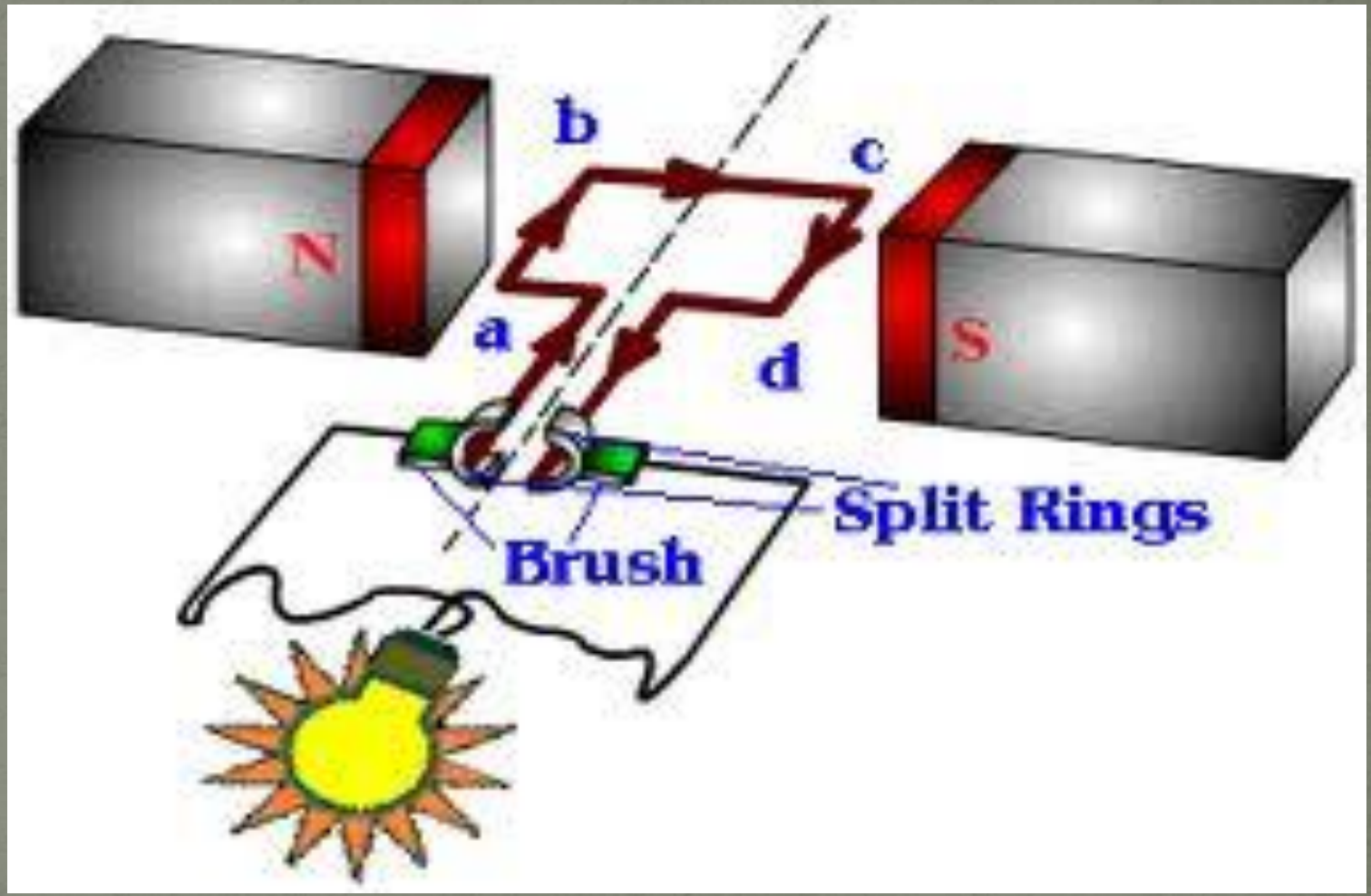
Rotor and rotor winding



Working principle of DC motor



Working principle of DC motor



Armature winding

There are 2 types of winding

Lap and Wave winding

Lap winding

- **A = P**
- The armature windings are divided into no. of sections equal to the no of poles

Wave winding

- **A = 2**
- It is used in low current output and high voltage.
- 2 brushes

EMF equation

Let,

- Ø= flux per pole in weber
- Z = Total number of conductor
- P = Number of poles
- A = Number of parallel paths
- N =armature speed in rpm
- Eg = emf generated in any on of the parallel path

EMF equation

Flux cut by 1 conductor in 1 revolution = $P * \phi$

Flux cut by 1 conductor in 60 sec = $P \phi N /60$

Avg emf generated in 1 conductor = $P\phi N/60$

Number of conductors in each parallel path = Z /A

Eg = $P\phi NZ/60A$

Types of DC Generator

DC generators are generally classified according to their method of excitation .

- Separately excited DC generator
- Self excited D C generator

Further classification of DC Generator

- Series wound generator
- Shunt wound generator
- Compound wound generator
  - Short shunt & Long shunt
  - Cumulatively compound

    &

    Differentially compound

Characteristics

- No load saturation characteristic (Eo/If)
- Internal or Total characteristic (E/ Ia)
- External characteristic (V/I)

Losses in DC Generators

1. Copper losses or variable losses
2. Stray losses or constant losses

Stray losses : consist of (a) iron losses or core losses and (b) windage and friction losses .

Iron losses :

occurs in the core of the machine due to change of magnetic flux in the core . Consist of hysteresis loss and eddy current loss.

Hysteresis loss depends upon the frequency , Flux density , volume and type of the core .

Losses

Hysteresis loss depends upon the frequency , Flux density , volume and type of the core .

Eddy current losses : directly proportional to the flux density , frequency , thickness of the lamination .

Windage and friction losses are constant due to the opposition of wind and friction .

Applications

Shunt Generators:

a. in electro plating

b. for battery recharging

c. as exciters for AC generators.

Series Generators :

A. As boosters

B. As lighting arc lamps