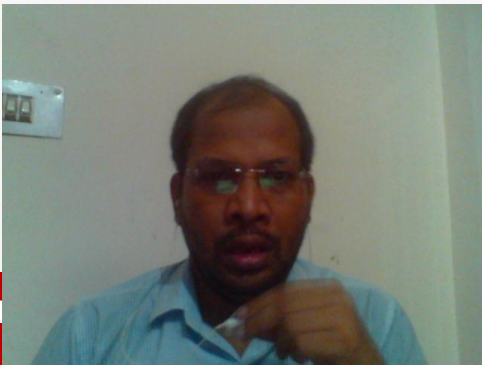
Armature Reaction in DC Machines

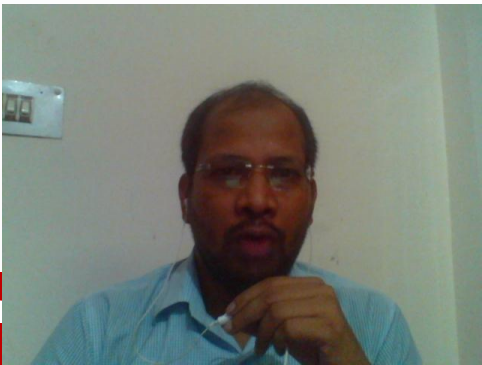


Recap

- Open circuit characteristics of DC generators (Eg vs If)
- Internal characteristics of DC generators (Eg vs Ia)
- External characteristics of DC generator (Vt vs IL)
- Critical resistance and its calculation
- Critical speed and its calculation

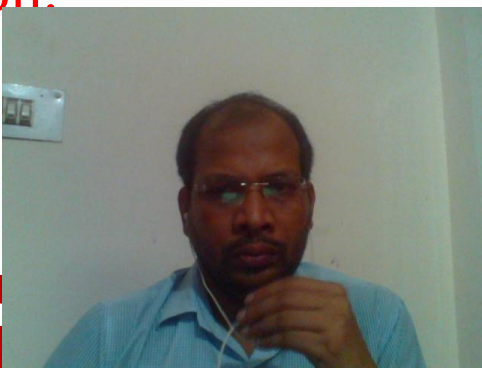
Lecture-14 Objectives

- Armature reaction in DC generators
- Position of geometric neutral axis and magnetic neutral axis
- Resulted magnetic neutral axis due to armature reaction
- Compensation windings and its applications



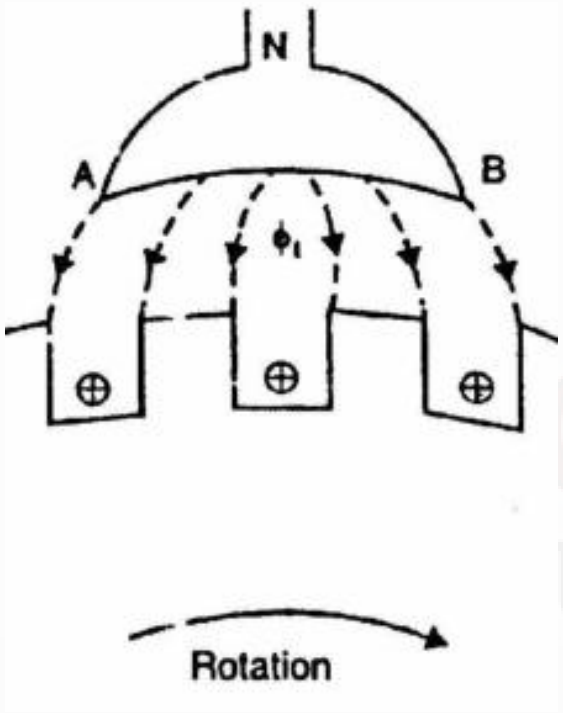
Armature Reaction in DC Generators

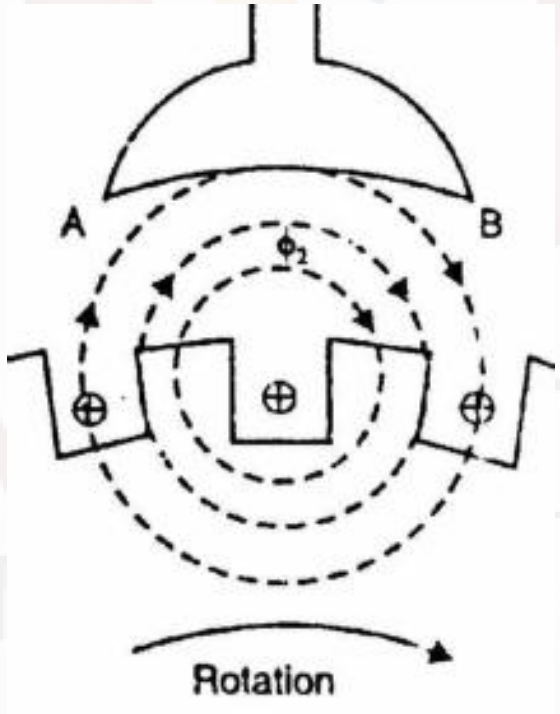
- In a d.c. generator, the field winding produces magnetic field (main flux) and the armature winding carries armature current.
- The current in the armature winding will also produce magnetic flux (called armature flux).
- The armature flux distorts and weakens the main flux.
- The effect of armature flux over the main flux is called armature reaction.

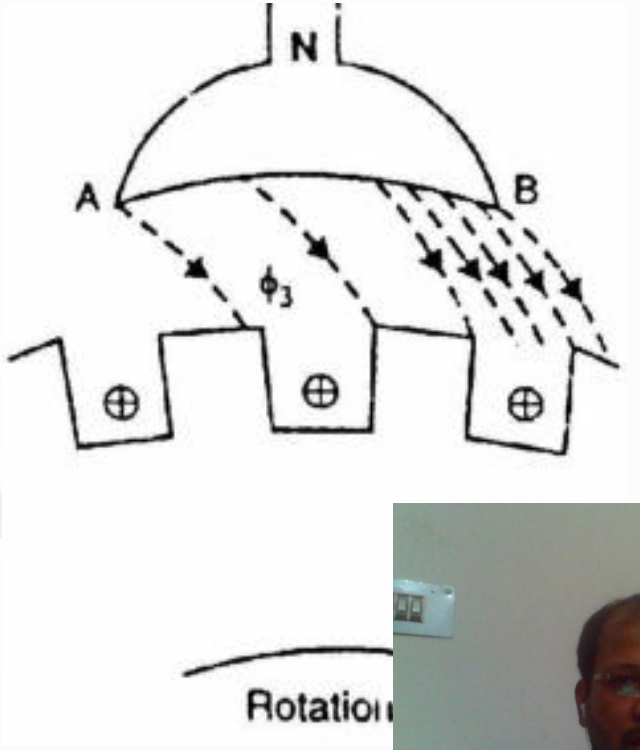


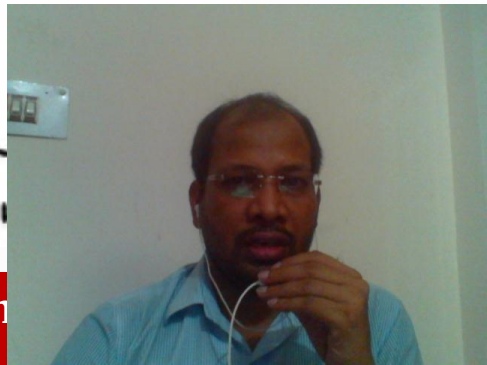
Armature Reaction

- Flux density at the trailing pole tip (point B) is increased while at the leading pole tip (point A) it is decreased. This unequal field distribution produces the following two effects:



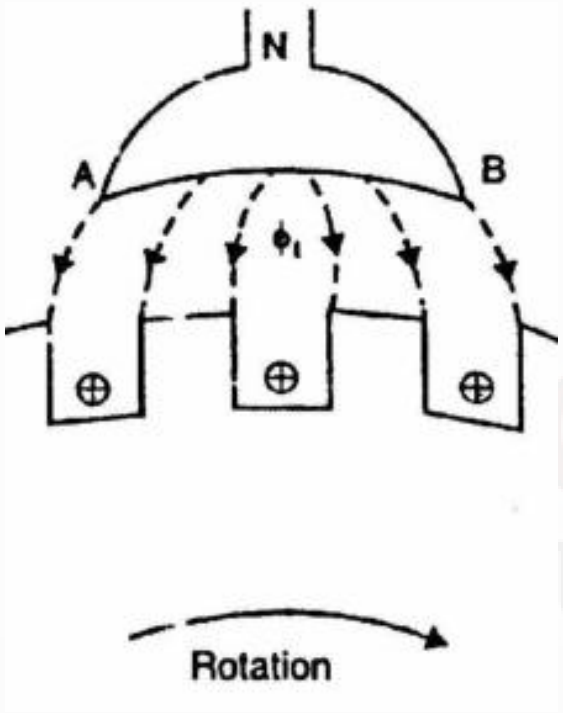


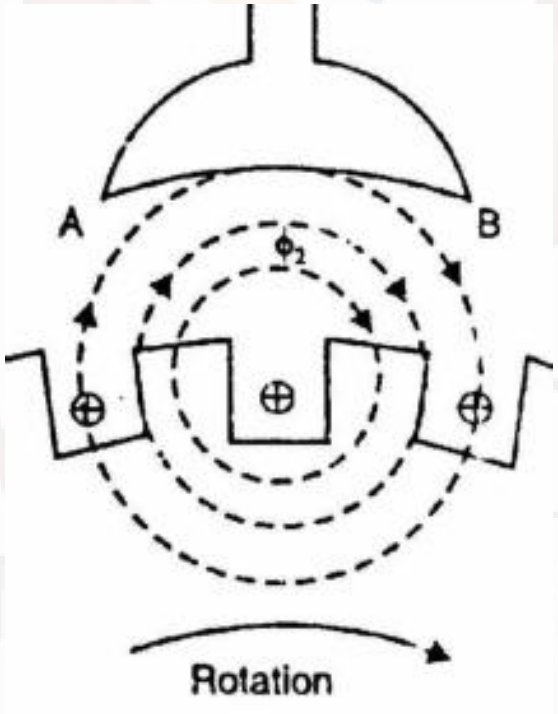


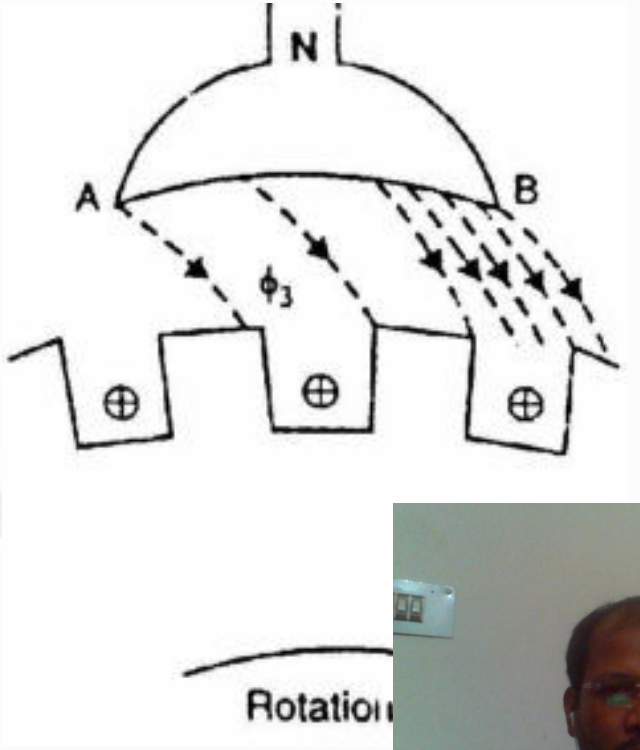


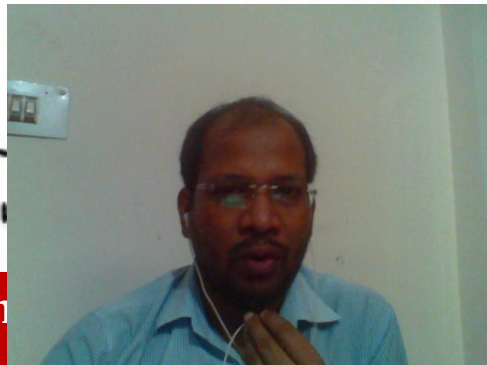
Armature Reaction

- The main flux is distorted.
- Due to higher flux density at pole tip B, saturation sets in.



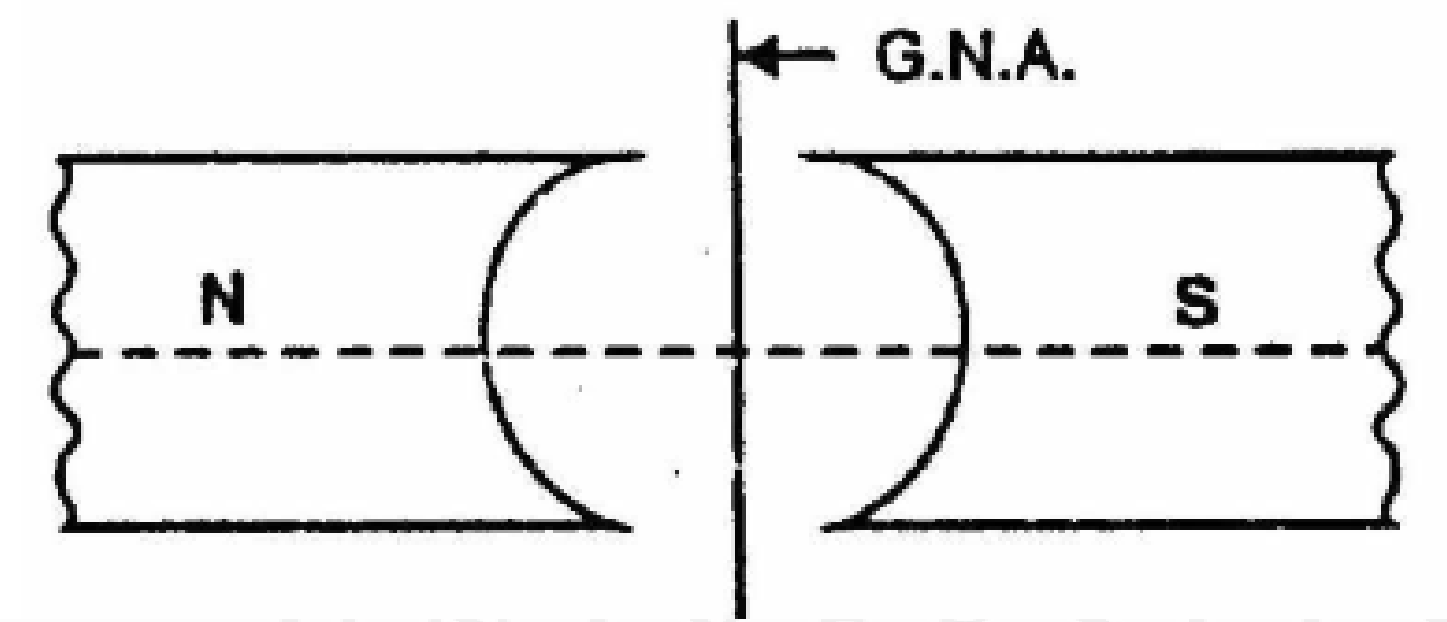


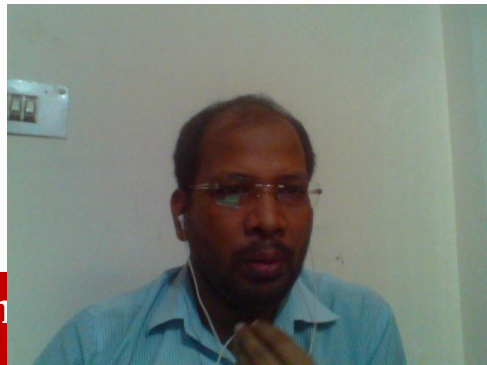




Geometrical Neutral Axis (G.N.A)

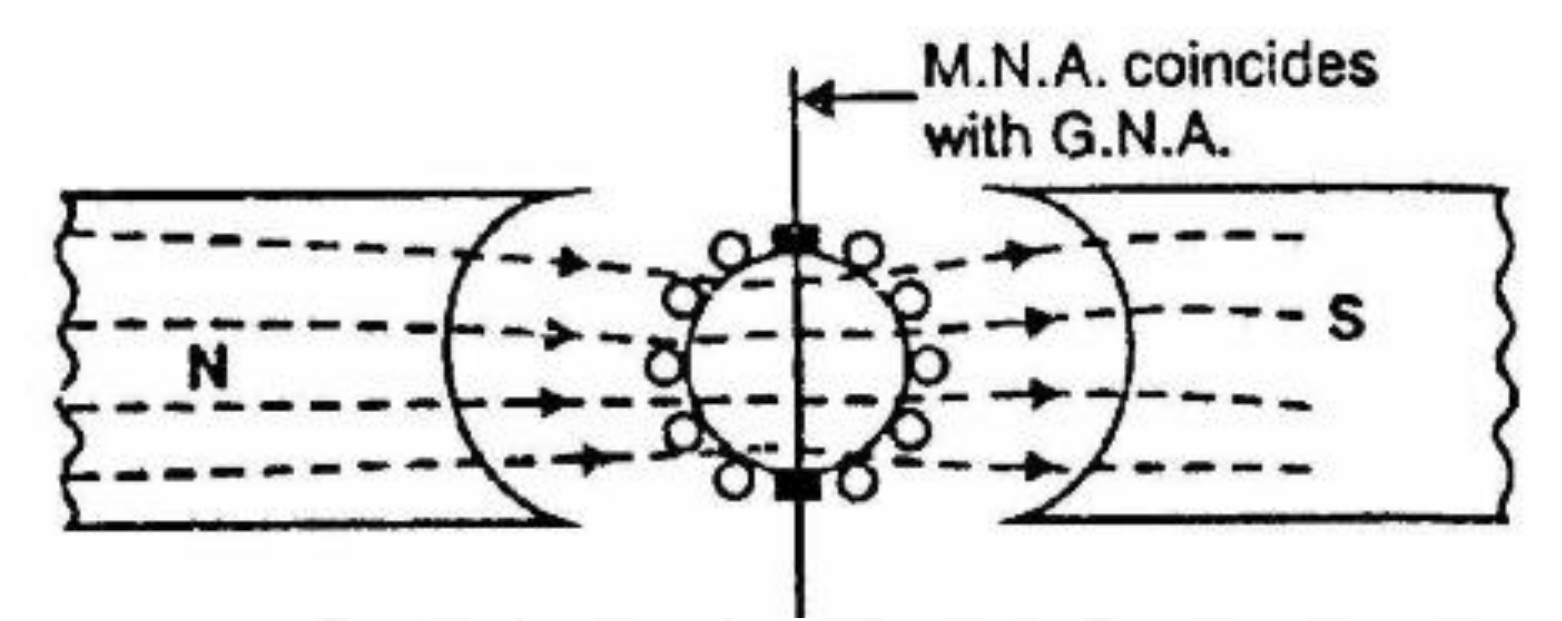
- The axis that bisects the angle between the centre line of adjacent poles.

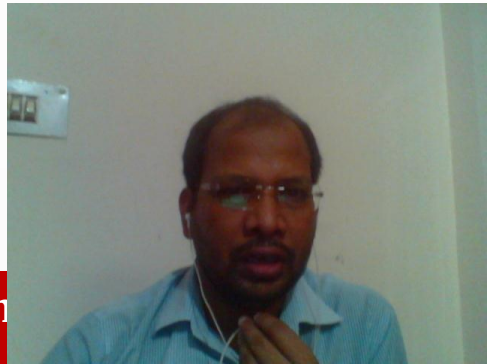




Magnetic Neutral Axis (M.N.A)

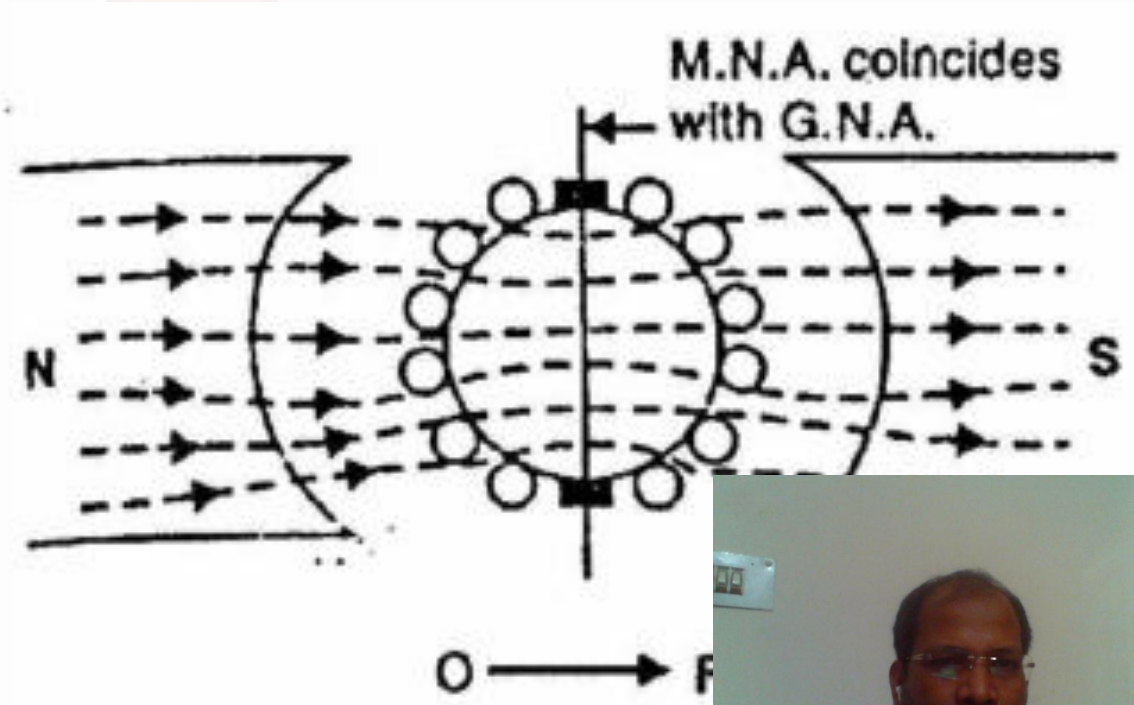
- The axis drawn perpendicular to the direction of the flux passing through the centre of the armature.





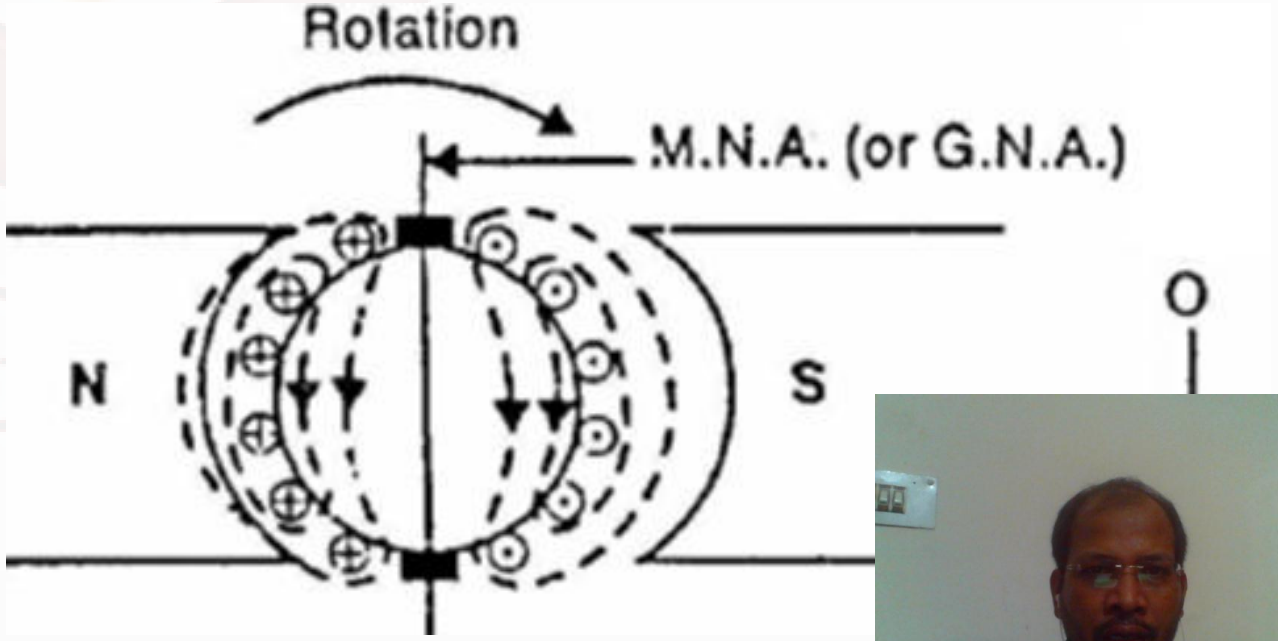
Explanation of Armature Reaction

- The axis drawn perpendicular to the direction of the flux passing through the centre of main flux when the armature conductors carry no current is shown.
- The m.m.f. producing the main flux is represented by the vector OF_m.
- Note that OF_m is perpendicular to G.N.A.



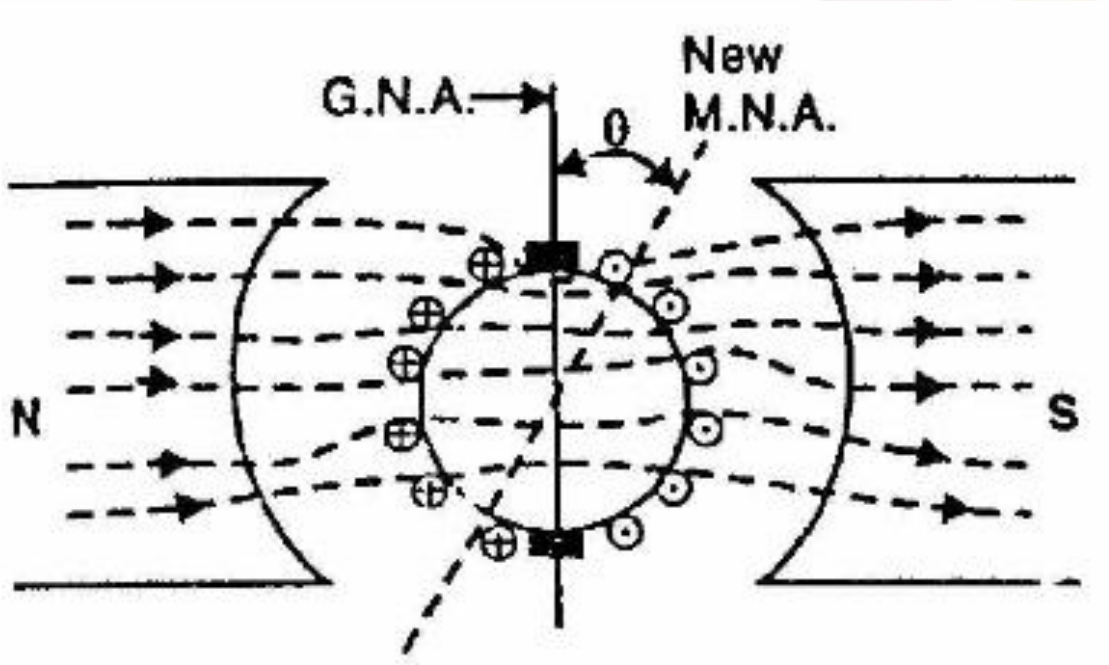
Explanation of Armature Reaction

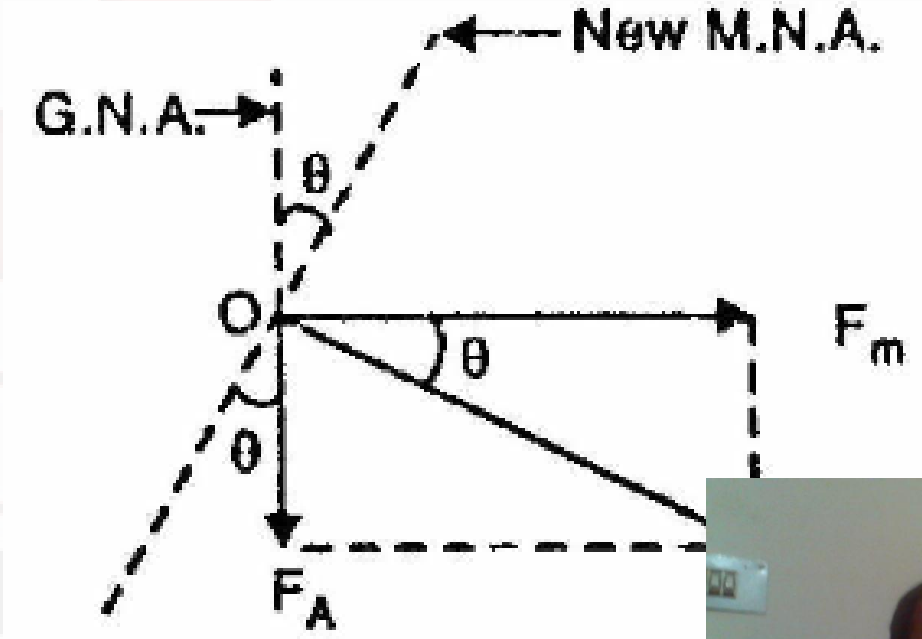
- Flux due to current flowing in armature conductors alone is shown.
- Armature flux is directed downward parallel to the brush axis.
- The m.m.f. producing the armature flux is represented by the vector OF_A.

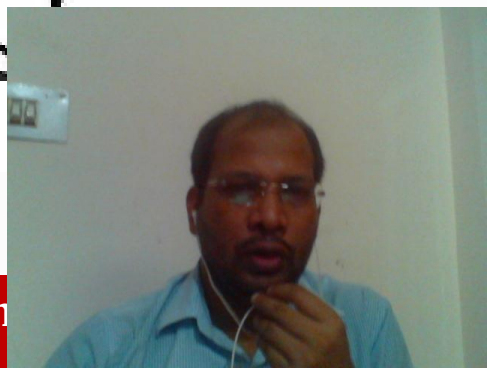


Explanation of Armature Reaction

- The resultant m.m.f. OF is the vector sum of OF_m and OF_A.
- M.N.A. is shifted through an angle Θ.

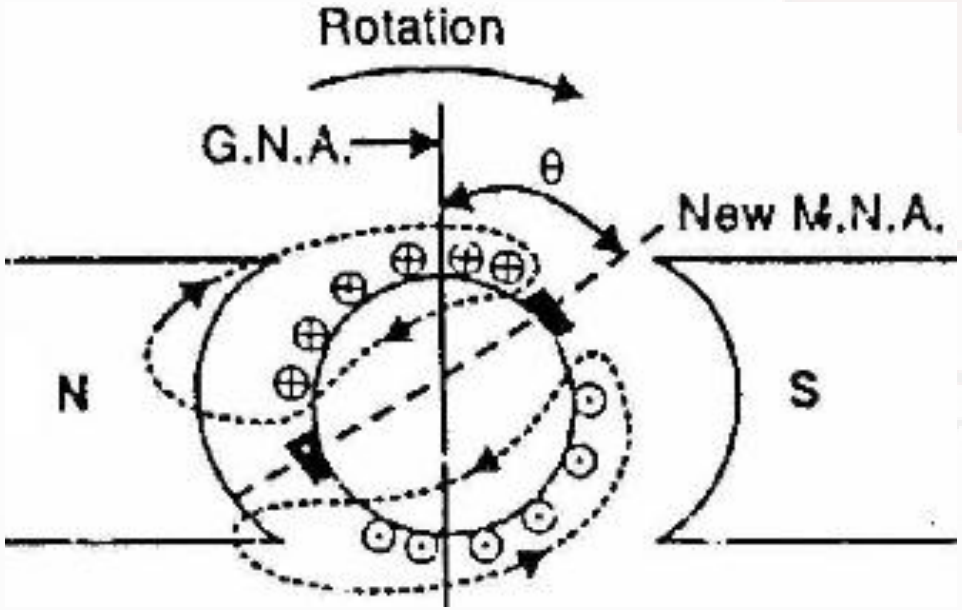


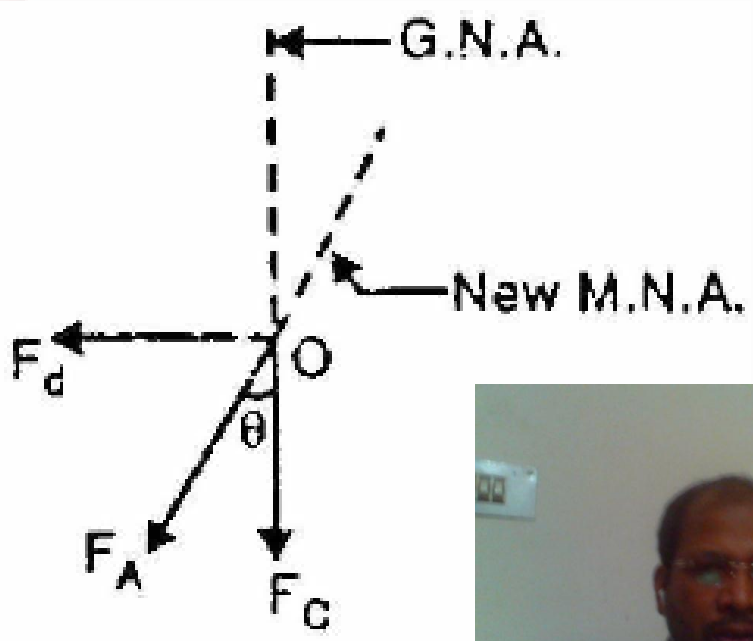




Explanation of Armature Reaction

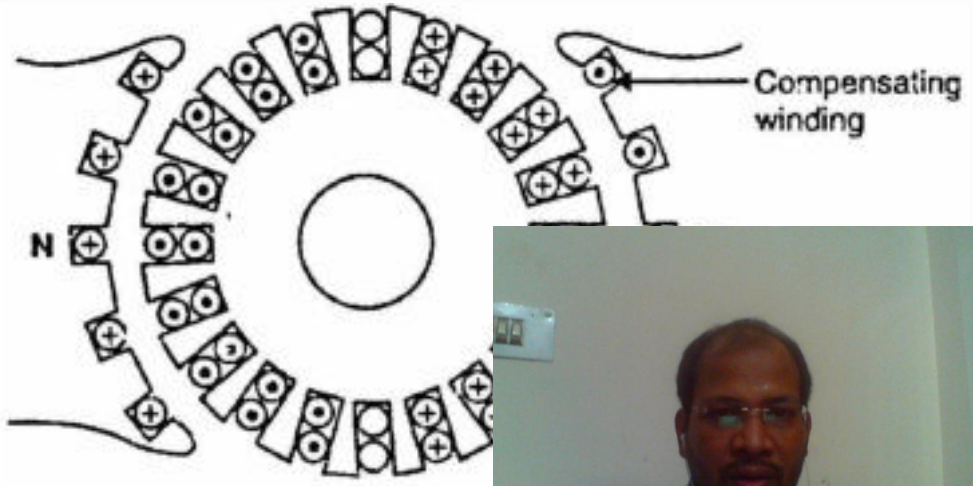
- Brushes are shifted through an angle Θ so as to lie along the new M.N.A.
- Due to brush shift, the m.m.f. F_A of the armature is also rotated through the same angle Θ.





Neutralising Armature Reaction

- A compensating winding is used to neutralise the effect of armature reaction.
- It is an auxiliary winding placed in slots in the pole faces and they are connected in series with armature coils.
- Direction of current through the compensating conductors will be opposite to the direction of the current through the adjacent armature conductors.



Armature Reaction in DC Machines

Summary

- Armature reaction in DC generators
- Geometrical Neutral axis (GNA)
- Magnetic Neutral axis (MNA)
- Position of GNA and MNA against armature reaction
- Compensating winding and its position as well as connection