Energy Conversion - 1

by

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# ARMATURE REACTION

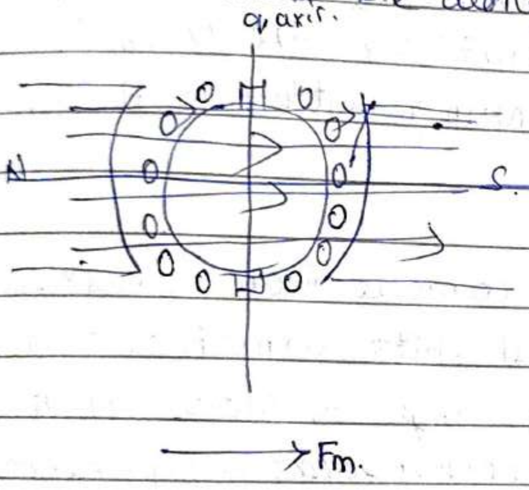
The effect of armature flux on the main flux is known as Armature reaction.

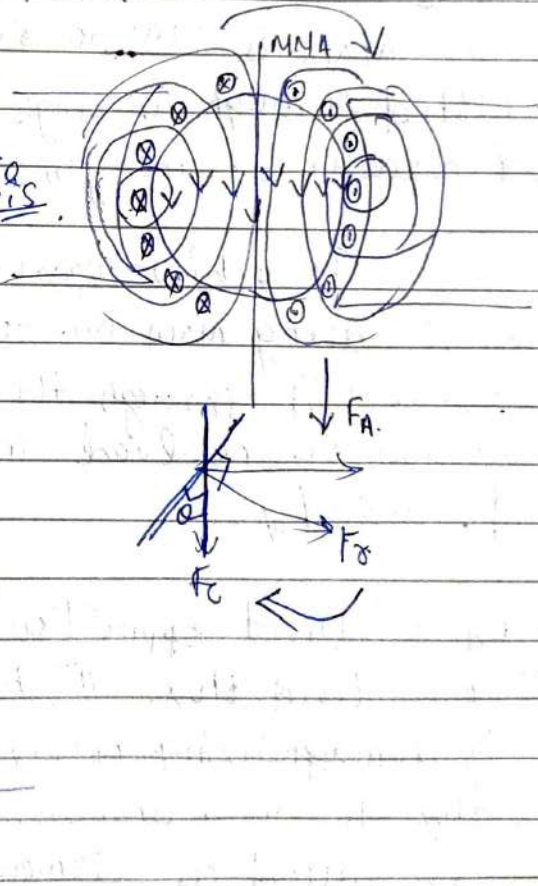
Geometric Neutral Axis & Magnetic Neutral Axis

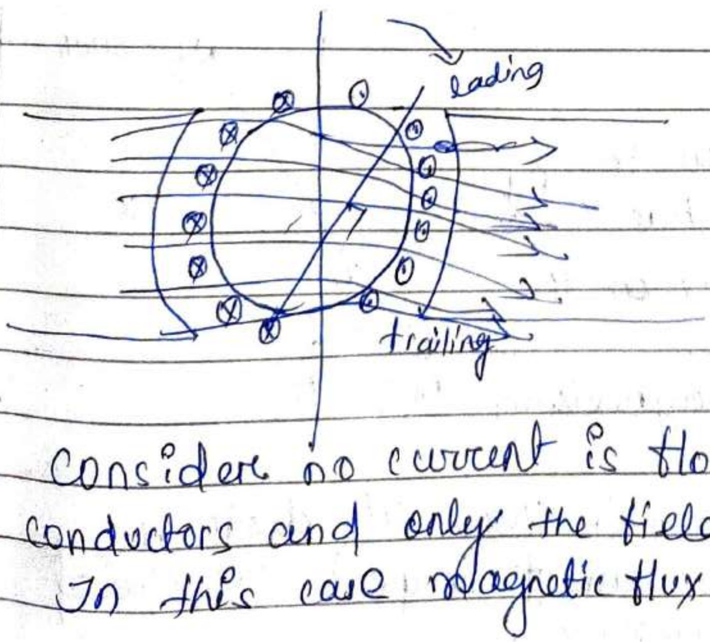
GNA - Axis of symmetry between two adjacent poles.


MNA - It is the axis drawn $\perp^{lar}$ to the mean dirⁿ of flux passing through the centre of the armature.


No emf is induced in the armature conductor along the axis. So to achieve sparkless commutation, the brushes must lie along M.N.A.



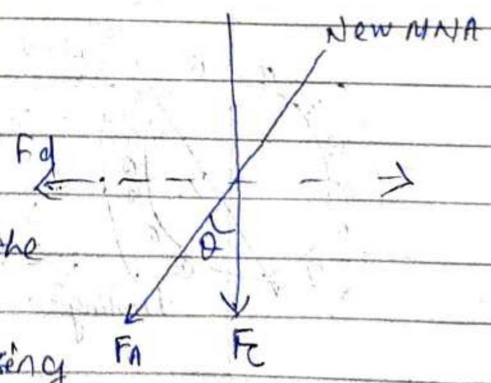




Consider no current is flowing in the armature conductors and only the field wdg is energized. In this case magnetic flux lines due to the field

poles are uniform & symmetrical to the polar axis.
The MNA coincides with GNA.
consider no current flowing through the field. Armature conductor to the left of G.N.A carry current 'in' (x) & those to right carry current "out" (.). The dirⁿ of magnetic lines of force can be found by cork screw rule. so, the armature flux is directed downward parallel to brush axis.

Now, in case the machine is running, main flux & armature flux acting together. so, the resultant flux is the vector sum of main flux & armature flux. Since MNA is ⊥lar to resultant flux, the MNA is shifted through an angle 'θ'. MNA is shifted in the dirⁿ of rotation of the gen.

To achieve sparkless commutation, brushes must lie along MNA. Due to brush shift, armature flux also rotated through the same angle θ. Now armature flux can be resolved into rectangular components $\phi_c$ and $\phi_d$.

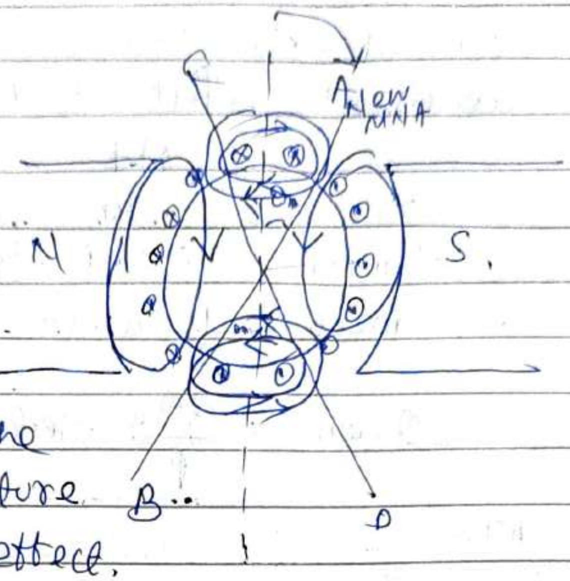



→ $F_d$ is in direct opposition to main field flux. It has a demagnetizing effect on the flux due to main poles.
So, called as demagnetizing component of flux.

→ $F_c$ is at right angle to main flux. It distorts the main flux (twist out of shape). so, called cross-magnetising component.

# Demagnetising & Crossmagnetising conductors.

→ The armature conductors $\theta_m^\circ$ on either side of G.N.A. produces flux in direct opposition to main flux.
→ Thus the conductor lying within angle AOC = BOD = $2\theta_m$ at the top & bottom of armature produced demagnetising effect.




→ The remaining conductors lying betn AOD & BOD is at right angles to main flux. These conductor produces cross-magnetising effect

## Calculation of Demagnetising AT per pole.

Z = Total no.
I = current in each armature conductor
$\theta_m$ = forward lead.

Total demagnetizing armature conductor

$$= \frac{4\theta_m}{360} \times Z,$$

since two cond constitute one turn.

Total demagnetising AT

$$= \frac{1}{2}\left[\frac{4\theta_m}{360} \times Z\right] I = \frac{2\theta_m}{360} \times ZI$$

The demagnetising ampere-turns are due to pair of pole.

$$AT_d/\text{pole} = \frac{\theta_m}{360} \times ZI.$$

No. of extra turns requaried to neutralize the effect of AR

$$\frac{AT_d}{I_{sh}}.$$

$$360^\circ \text{ mech} = 360 \times \frac{P}{2} \text{ elect}.$$

$$1^\circ \text{ mech} = \frac{P}{2} \text{ elect}$$

$$\theta_{mech} = \frac{2\theta_e}{P} \text{ elect}.$$

$AT_c$

$$\text{Total AR } AT/\text{pole} = \frac{Z/2 \times I}{P}$$

$$AT_c/\text{pole} = AT/\text{pole} - AT_d/\text{pole}$$

$$= \frac{ZI}{2P} - \frac{\theta_m}{360} ZI.$$

$$= ZI\left(\frac{1}{2P} - \frac{\theta_m}{360}\right).$$