Voltage Buildup

V.B.up in self excited generators

(1) SHUNT generator:-

In a separately excited D.C. generator there is a separate source which is taking care of excitation. In a self excited shunt generator, there is no such source, but the terminal voltage act as excitation.

without the flux there will be no induced emf or terminal voltage, In order to have voltage build up there are certain necessary cond^n's in self excited generators. the first essential cond^n is —

⟹ (1) (Imp) Poles should contain residual flux., this is achieved by doing field flashing. (Connecting the field wdg across a suitable DC Vtg source. for 10-15 minutes. Due to retentivity property of ferromagnetic materials, due to the previous operation as a magnet for 10 to 15 minutes, there will be small alignment remained in the pole. which exhibit small magnetism. which result's in small residual flux.

This is sufficient or equivalent to a separate source in case of separately excited generator.

(2) Second essential condition is the field wdg should be properly connected to the armature in a such way that the initial current or mmf should assist or add the existing residual flux. If the field is correctly connected vtg build up process become successful commulatively. There are 3 additional conditions for successful voltage buildup.

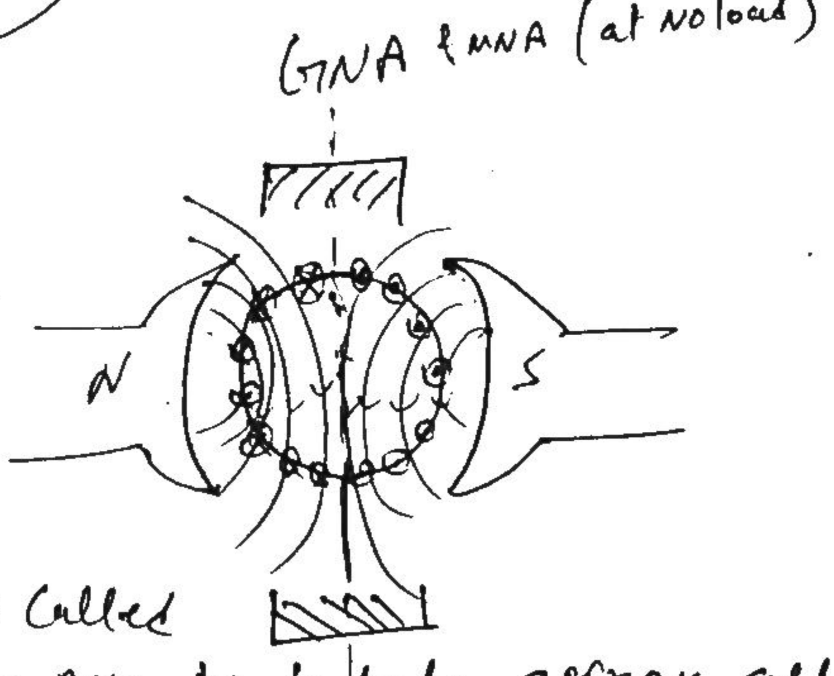
(3). The field resistance should be less than critical resistance.

(4) Speed of rotation of generator should be greater than critical speed.

(5) Best condition for a shunt generator for the smooth buildup of voltage is, it should be on no load. If the armature terminals are s.ckted (load resistance = 0) no build up of emf take place, therefore load resistance should be also greater than a critical value.

*Armature Reaction (Imp.)

→ The effect of armature flux on main field flux in air gap is known as armature reaction.



On no load, there will be only main field flux also called as working flux. When the m/c is loaded approx. all the load current flow through armatr turns & result in armature mmf which gives rise to

Armature flux.

This Armatr flux will taken an action on main field flux distribution in the air gap. & effect it in two ways. →

1. Demagnetization.
2. Cross magnetization.

Demagnetization is reduction in main field flux which reduce the induced emf or terminal voltage. In a generator, as well as it reduces the torque or speed (increase) in case of motor.

Crossmagnetization is distortion in the main field flux which influence successfull commutation. If the brushes collect current without any sparking means it is called as successful commutation.

G.N.A (Geometrical N. axis) :- It is the axis of symmetry (center of m/c) between two poles.

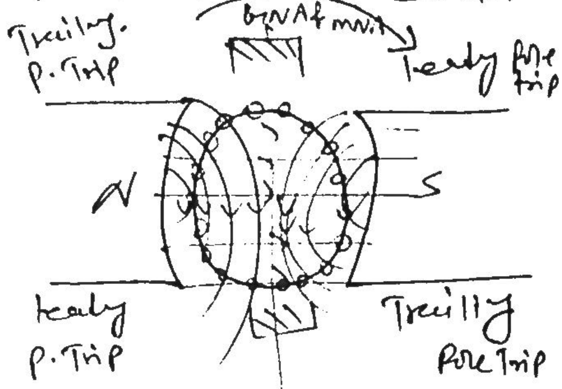
M.N.A — (magnetic neutral axis) → axis of neutral zone, where emf becomes zero. on the armature.

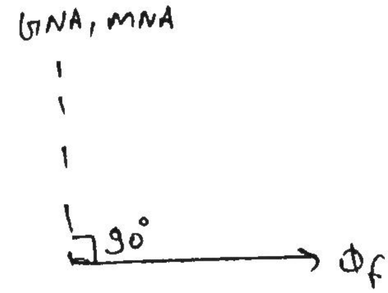
MNA is always perpendicular (90°) with flux in the machine. It significantly depends on flux axis. The armature mmf & armature flux are rotating with r. to armature. but the armature flux is stationary. w.r. to poles. or main field flux.

Brushes are placed on M.N.A. to collect the current of all armature conductors without any sparking which is known as successful commutation.

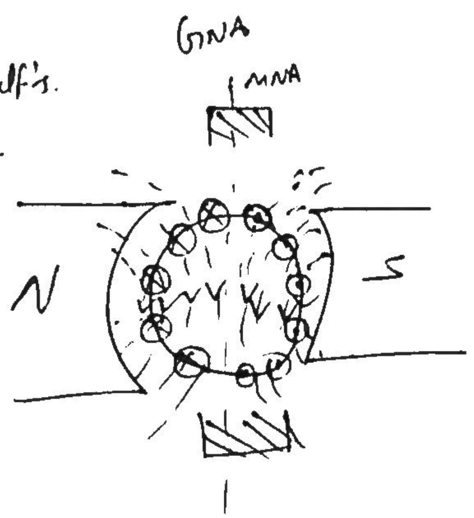
Due to armature flux main field flux distortes & inturn shift M.N.A. therefore commutation becomes unsuccessful

Consider a 2-pole machine with only main field flux flowing from North to South poles.

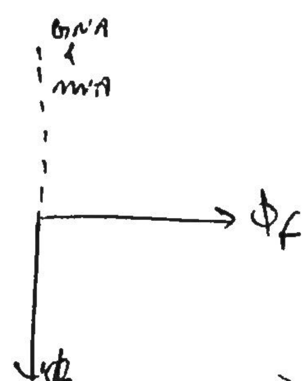




Consider both armature flux & main field flux, the effect of armature flux is different under a pole. In it's both polehalf's. therefore based on the direction of rotation. of the machine the pole tip's are named as leading & Trailing pole tip's.



The first pole tip in the direction of rotation of a pole is called as leading & the other of the same pole is known as trailing pole tip

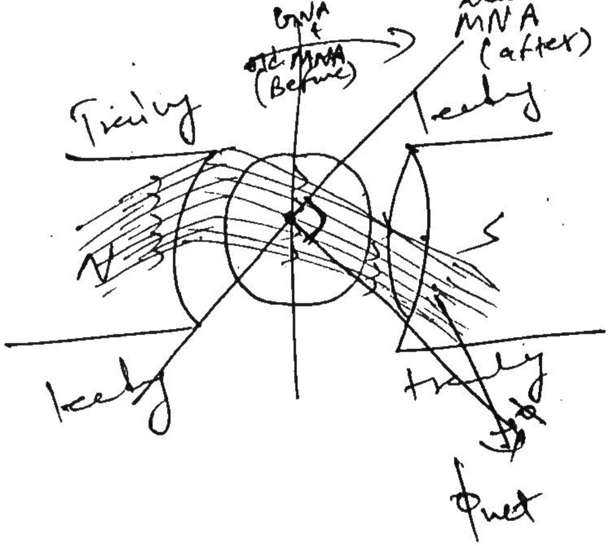


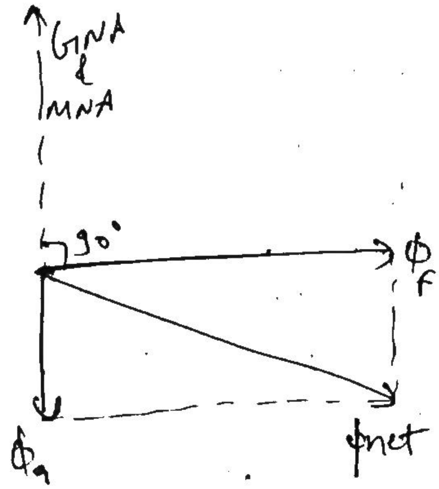
The armature flux under the trailing pole tips of a generator is adding in nature (aiding) therefore the net flux density increases under ~~trailing~~ pole tips.

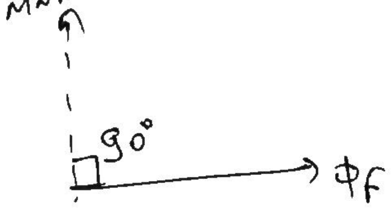
The armature flux under leading pole tips of generator opposes main flux therefore it reduces main flux. which is known as demagnetization

If the reduction in the flux under leading pole tips is equal to increase in the flux, under trailing pole tips. the net flux remains same in magnitude & there is No demagnetization.

Due to saturation in the half of the pole particularly trailing pole tips, the increase in the flux density is less then decrease in the flux density. therefore there will be a demagnetization which is around 1 to 5% at full load.



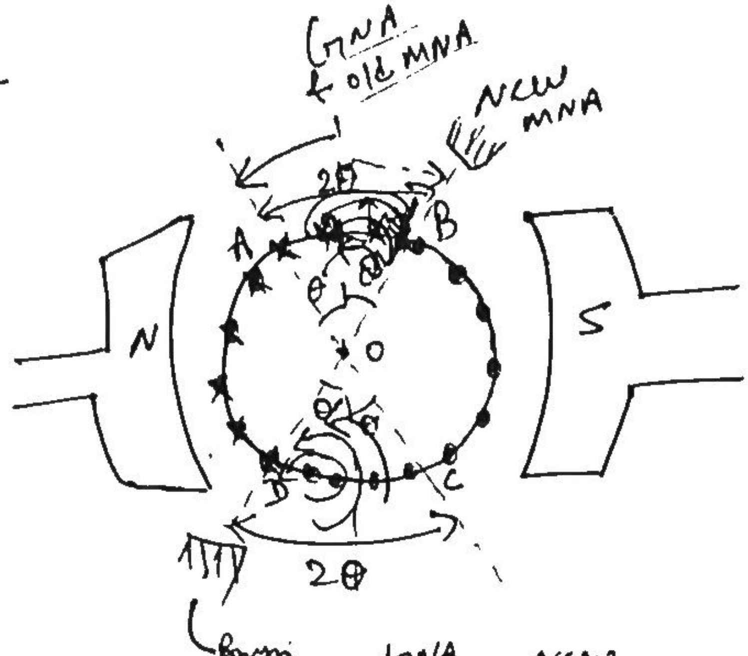




The net flux in the generator is cross-magnetized that is distorted. which shift's magnetic Neutral axis (MNA) in the dirn of rotation of generator to angle θ. the brushes which are on old MNA also need to be shifted to angle θ. In the dirn of rotation of generator to improve Commutation.

Shifting of Brushes improve Commutation but also results in additional demagnetization.

Effect of Brush Shift



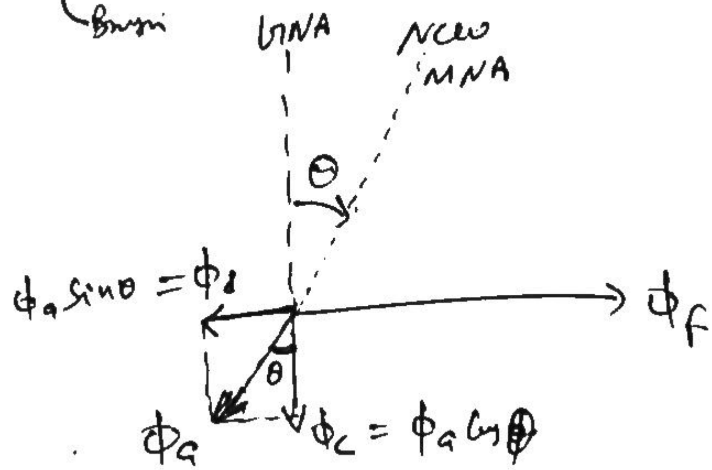
The armature flux, when the Brushes are shifted Can be resolved into two Components.

(1) $\phi_c = \phi_a \cos\theta$

which is known as Cross-magnetizing Component of armature flux.

(2) $\phi_d = \phi_a \sin\theta$

which is known as demagnetizing Component of armature flux.



If θ = 0, which means Brushes are not shifted there is No additional demagnetization. But only Cross-magnetization. This demagnetization is directly proportional to the angle of Brush shift (θ.)

Other effect's of Armature Reaction.

① Increase in the iron losses.

The Core loss (eddy current + hysteris loss) Significantly depends on flux density as the flux density increase under the trailing pole tips of a generator when the core passes. through high flux density region. the Iron losses or Core losses increases.

In general iron loss are turned to be Constant losses. as they doesn't depend or vary with load.

But in a d.c. machine when it is loaded due to Armature reaction, there is an increase in Iron loss. But in general in DC m/c also iron loss is Considered as Constant loss.

Iron loss reduce the efficiency as well as rise the temp. Of the Core, which damage the Insulation.

② High maintenance & repairing →

Due to cross magnetization & shifting of MNA Commutation is affected, which result's in Sparking. Due to this there will be Increased maintenance repair & even replacement of Brushes.

③ Increased design Cost – In order to Compensate armature reaction effect's the design Cost Increases.