EEE363

Electrical Machines

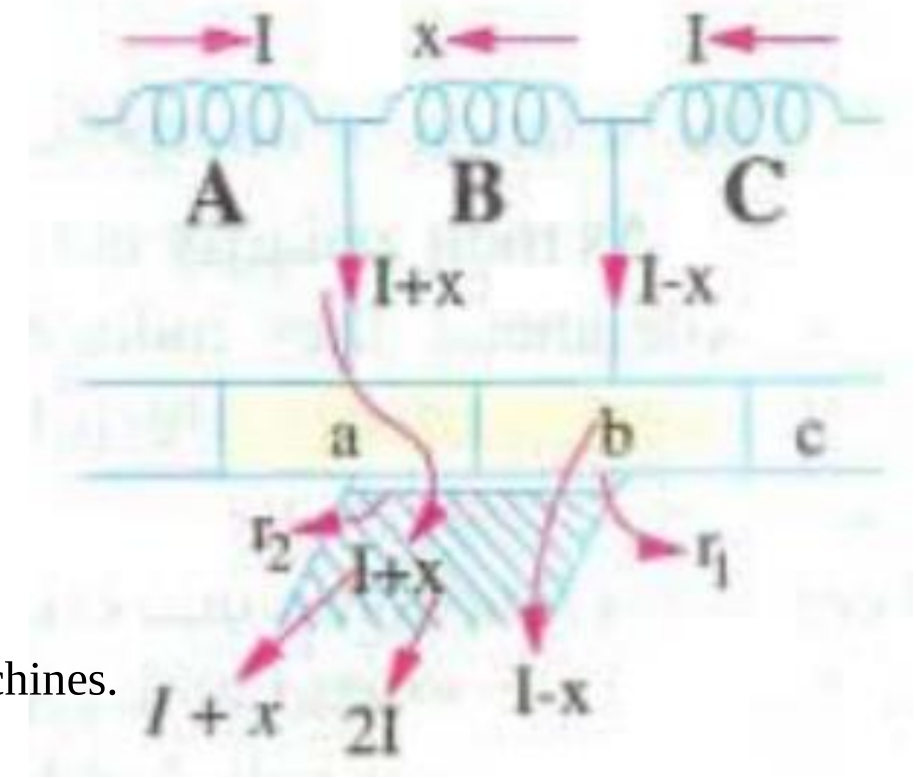
Lecture # 7

Dr Atiqur Rahman

Resistance commutation

- This method of improving commutation involves replacing

  low resistance Cu brush with high-resistance Carbon brush.



Additional advantage

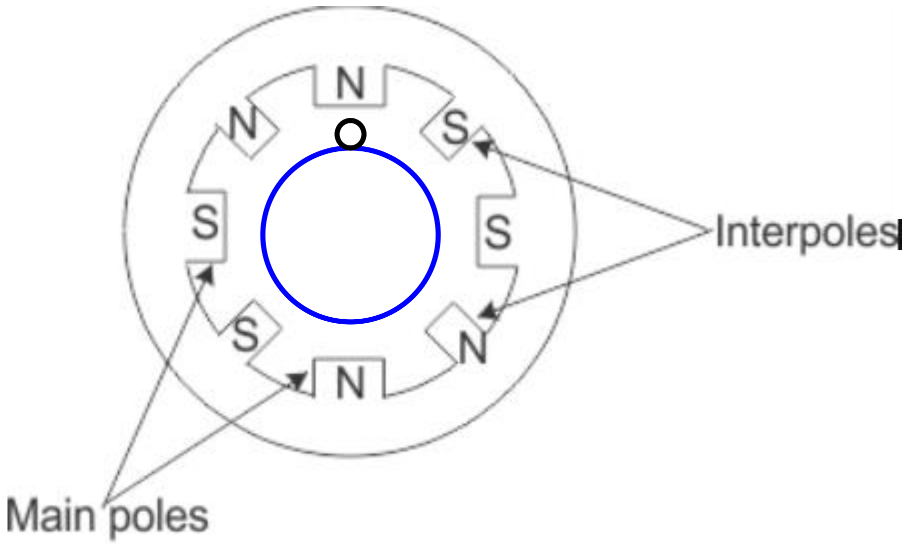
- ✓ Self-lubricating to some degree.
- ✓ Should sparking occurs they damage commutator less

Disadvantage

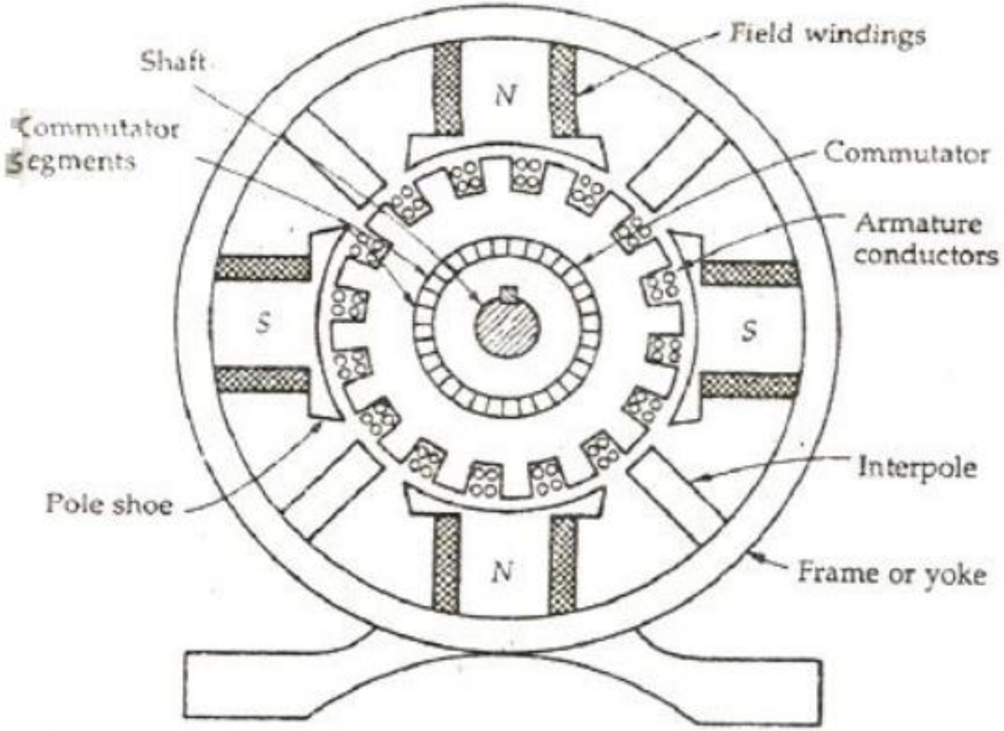
- Due to high resistance they are not suitable for smaller machines.
- Commutator has be made somewhat larger.
- Need larger brush holder

EMF Commutation

- Involves inserting smaller poles (called Interpoles) in between the main poles.
- Their job is to start the current reversal process a bit earlier.
- Interpoles are also called Compoles.



Interpole Commutation

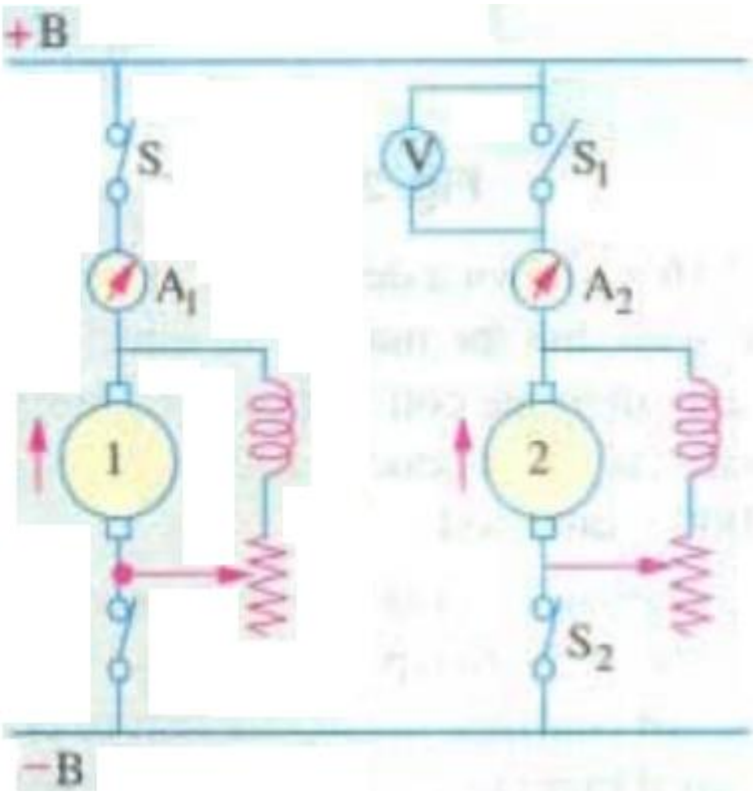


Parallel operation

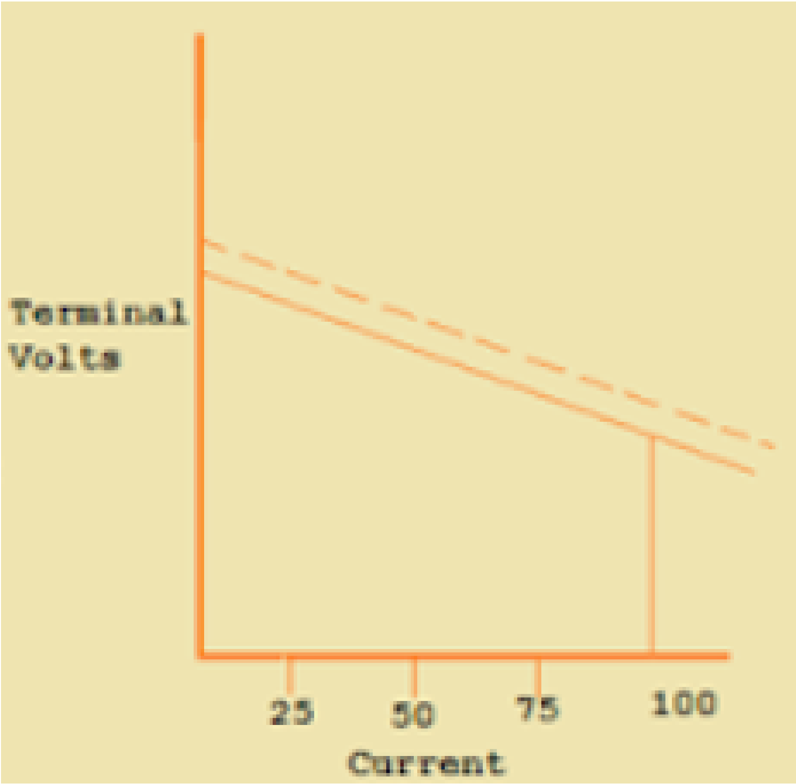
- The Major Advantages of Many Units Operating in Parallel are :
  - ✓ Service continuity
  - ✓ Efficient working
  - ✓ Repair facility
  - ✓ Extension facility
  - ✓ Stand by unit capacity reduces

Parallel operation

- The +ve and -ve terminals (i.e. polarity) of generators must be connected to +ve and -ve of bus-bars (otherwise a serious short-circuit will occur).
- Induced e.m.fs of generators should be preferably same
- Armature is speeded up to the rated speed and then switch S2 is closed.
- Excitation of the G2 is changed until voltmeter **V** reads zero.
- Switch S1 is closed after that.
- Under this condition G2 is not taking any load (floating condition).
- Excitation of G2 is increased until it takes the proper share of load.



Load sharing



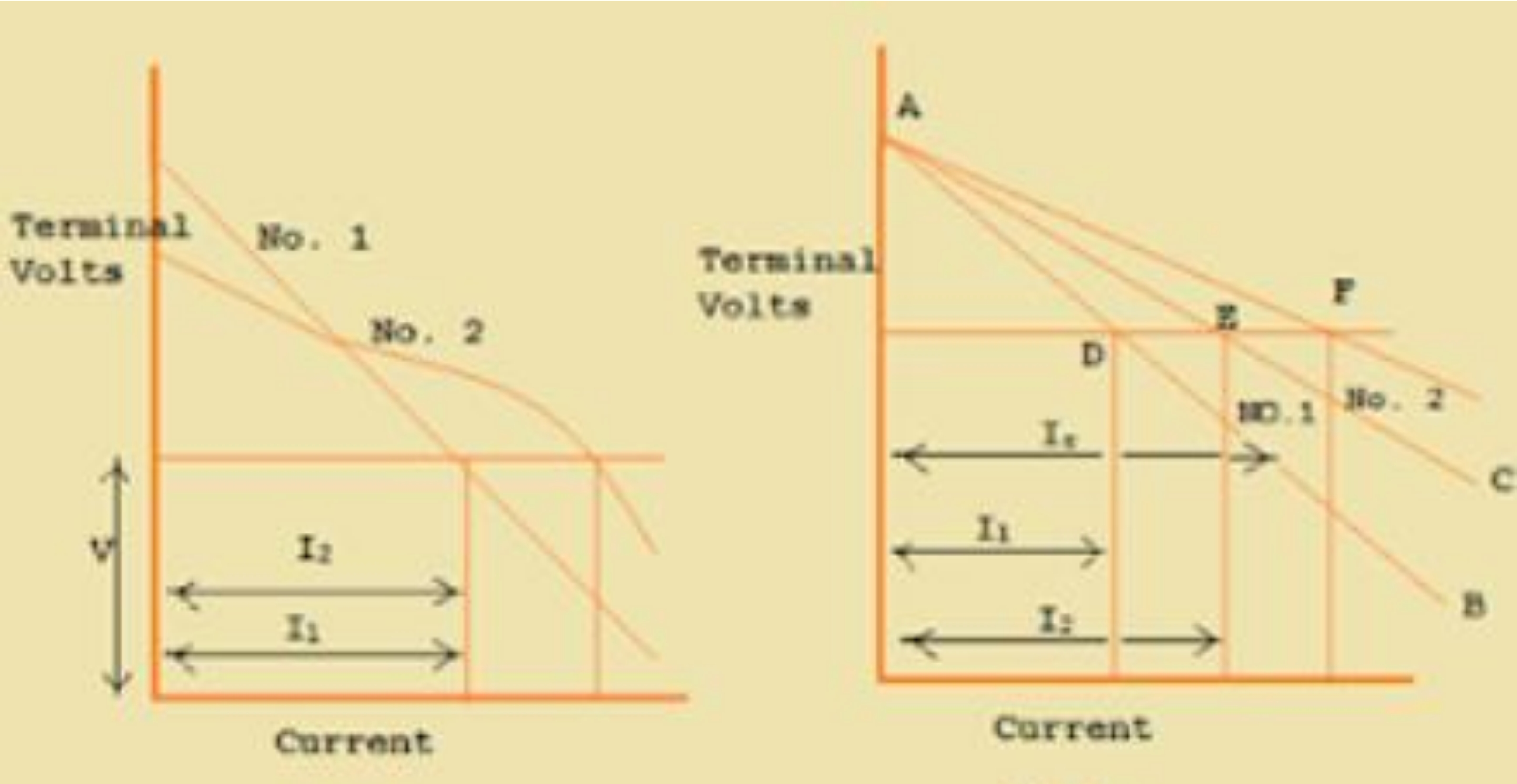


Fig-a

Fig-b

$$\frac{I_2}{I_1} = \frac{E_2 - V}{E_1 - V} \cdot \frac{R_1}{R_2}$$

Where E1, E2 are no-load voltages and R1, R2 are armature resistances

$$I_1 = \frac{E_1 - V}{R_1} \qquad I_2 = \frac{E_2 - V}{R_2}$$

Parallel operation

Two shunt generators operating in parallel deliver a total current of 250 A. One of the generators is rated 50 kW and the other 100 kW. The voltage rating of both machine is 500 V and have regulations of 6 per cent (smaller one) and 4 percent. Assuming linear characteristics, determine (a) the current delivered by each machine (b) terminal voltage.

50 kW generator

F.L. voltage drop $= 500 \times 0.06 = 30$ V ; F.L. current $= 50{,}000/500 = 100$ A

Drop per ampere $= 30/100 = 3/10$ V/A

100 kW generator

F.L. drop $= 500 \times 0.04 = 20$ V ; F.L. current $= 100{,}000/5000 = 200$ A

Drop per ampere $= 20/200 = 1/10$ V/A

If I_1 and I_2 are currents supplied by the two generators and V the terminal voltage, then

$$V = 500-(3I_1/10) \quad \text{–1st generator}$$

$$= 500-(I_2/10) \quad \text{–2nd generator}$$

$$3I_1/10 = I_2/10 \text{ or } 3I_1 = I_2 ; \qquad \text{Also } I_1 + I_2 = 250$$

(*a*) Solving the above two equations, we get I_1 = **62.5 A** ; I_2 = **187.5 A**

(*b*) $V = 500-(3 \times 62.5/10) =$ **481.25 V**

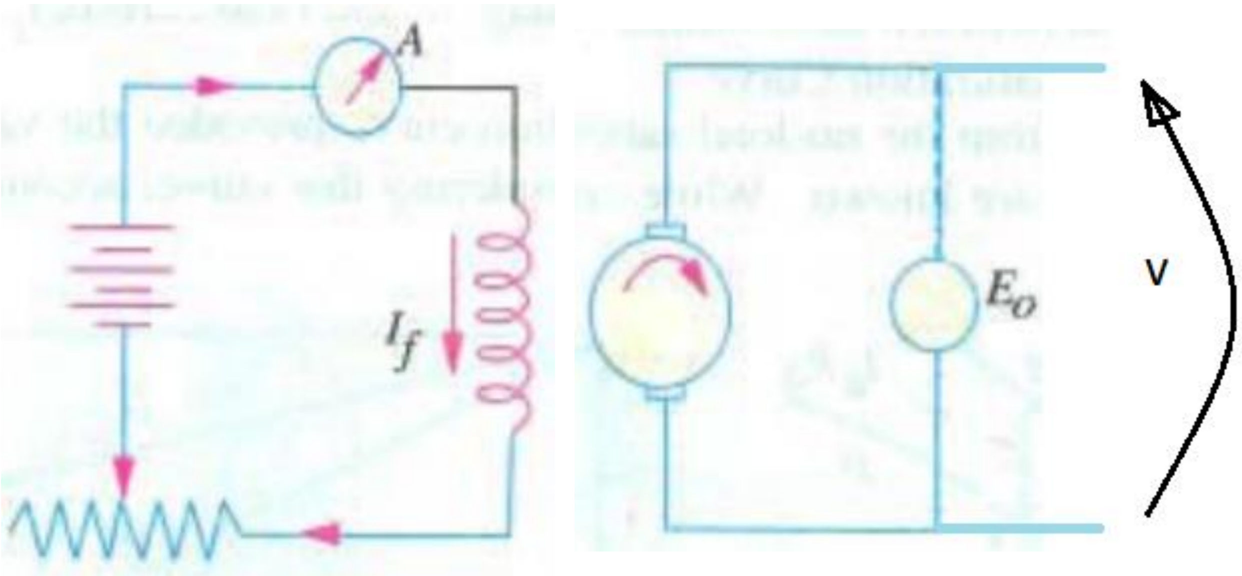
Generator Characteristics

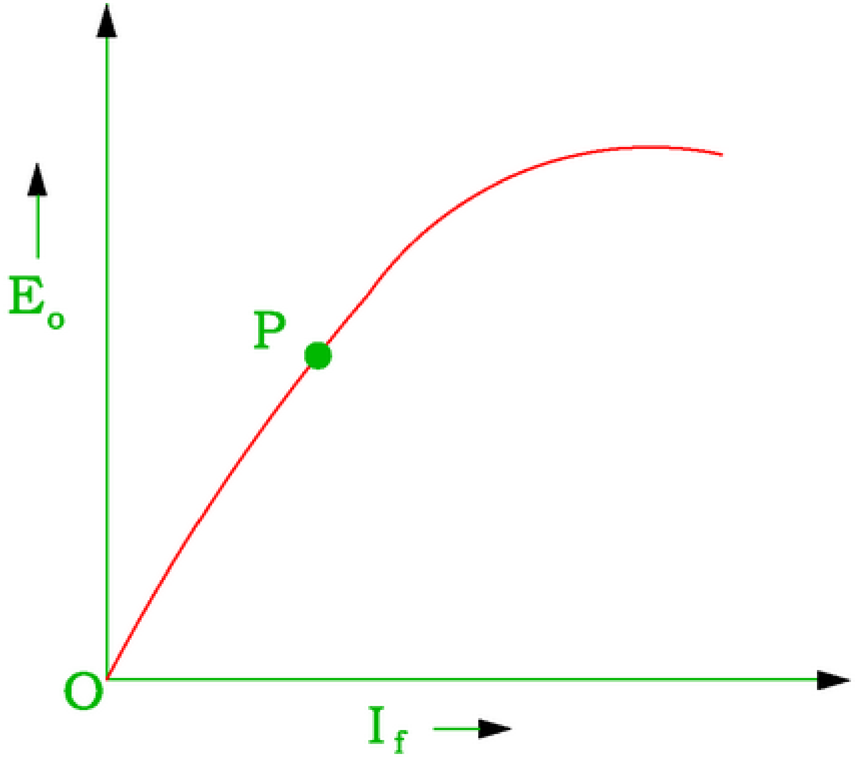
I. No-load saturation characteristics (open circuit char.)

II. Internal characteristics

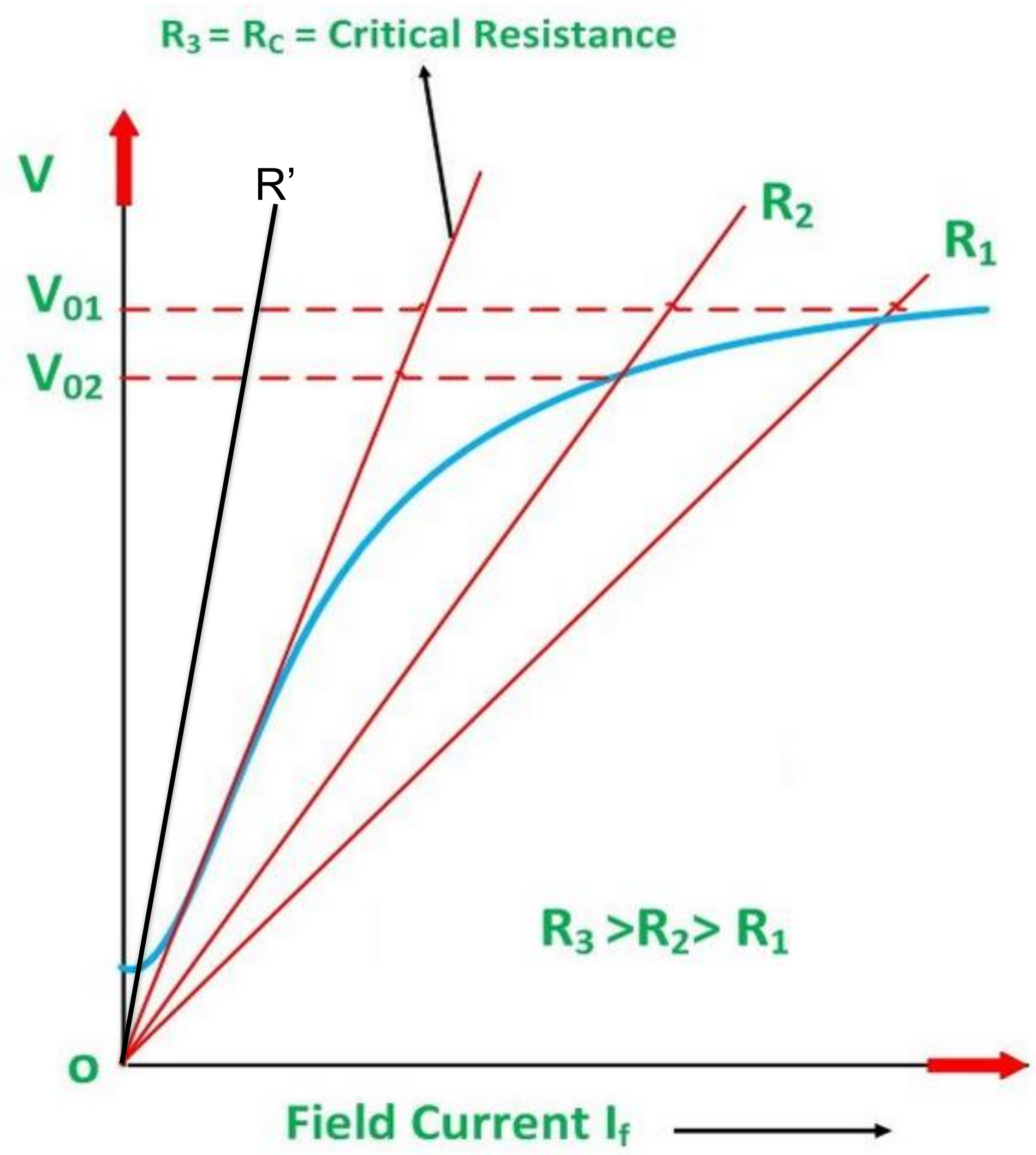
III. Enternal characteristics

OCC (open ckt char)

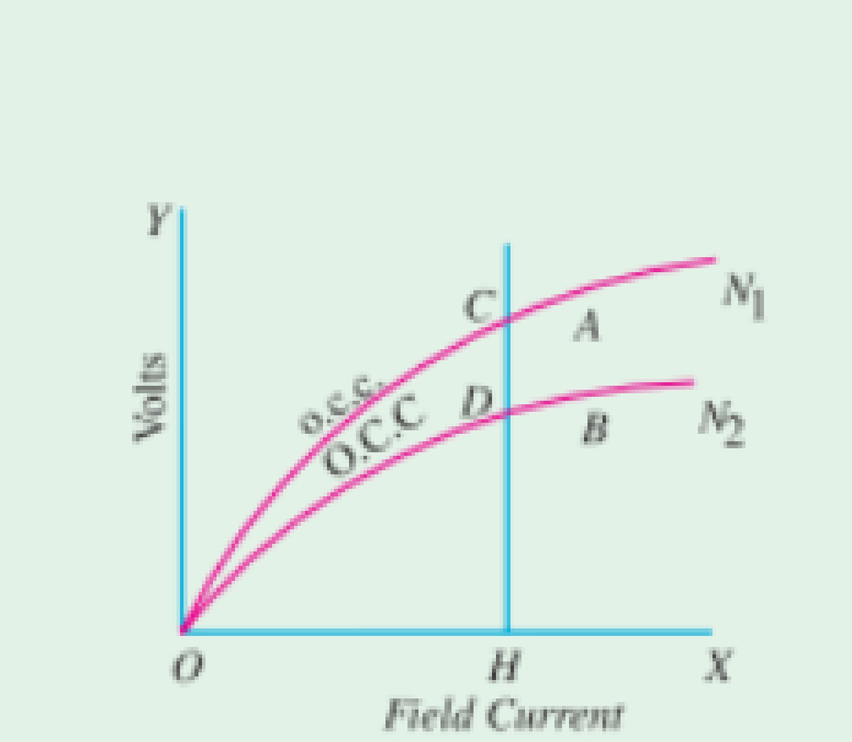


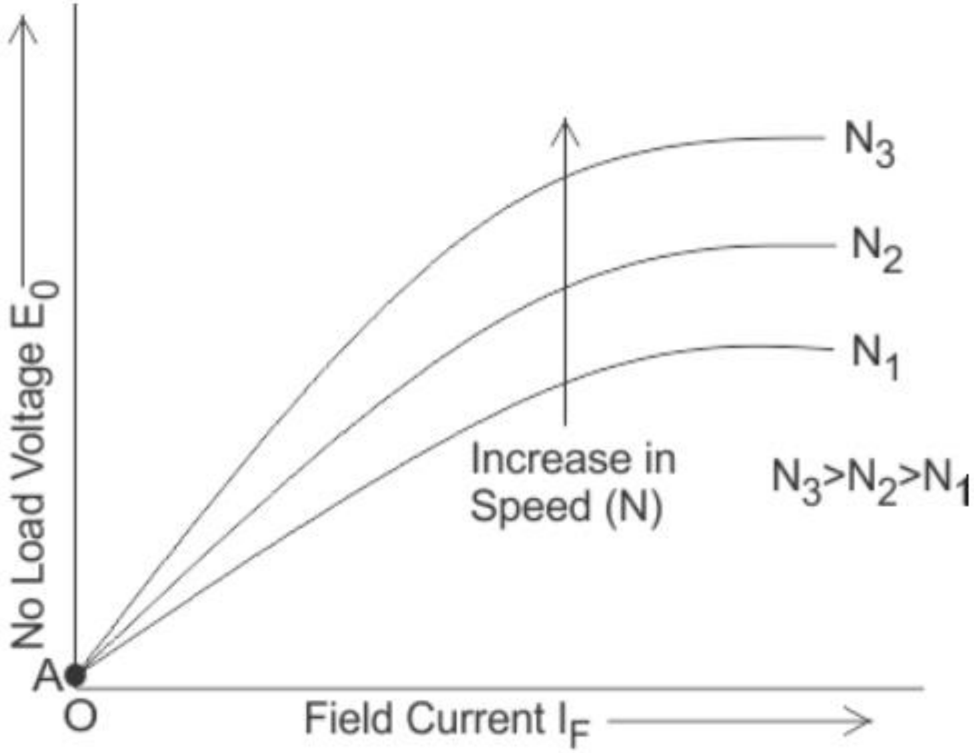


Critical resistance



OCC for different speeds

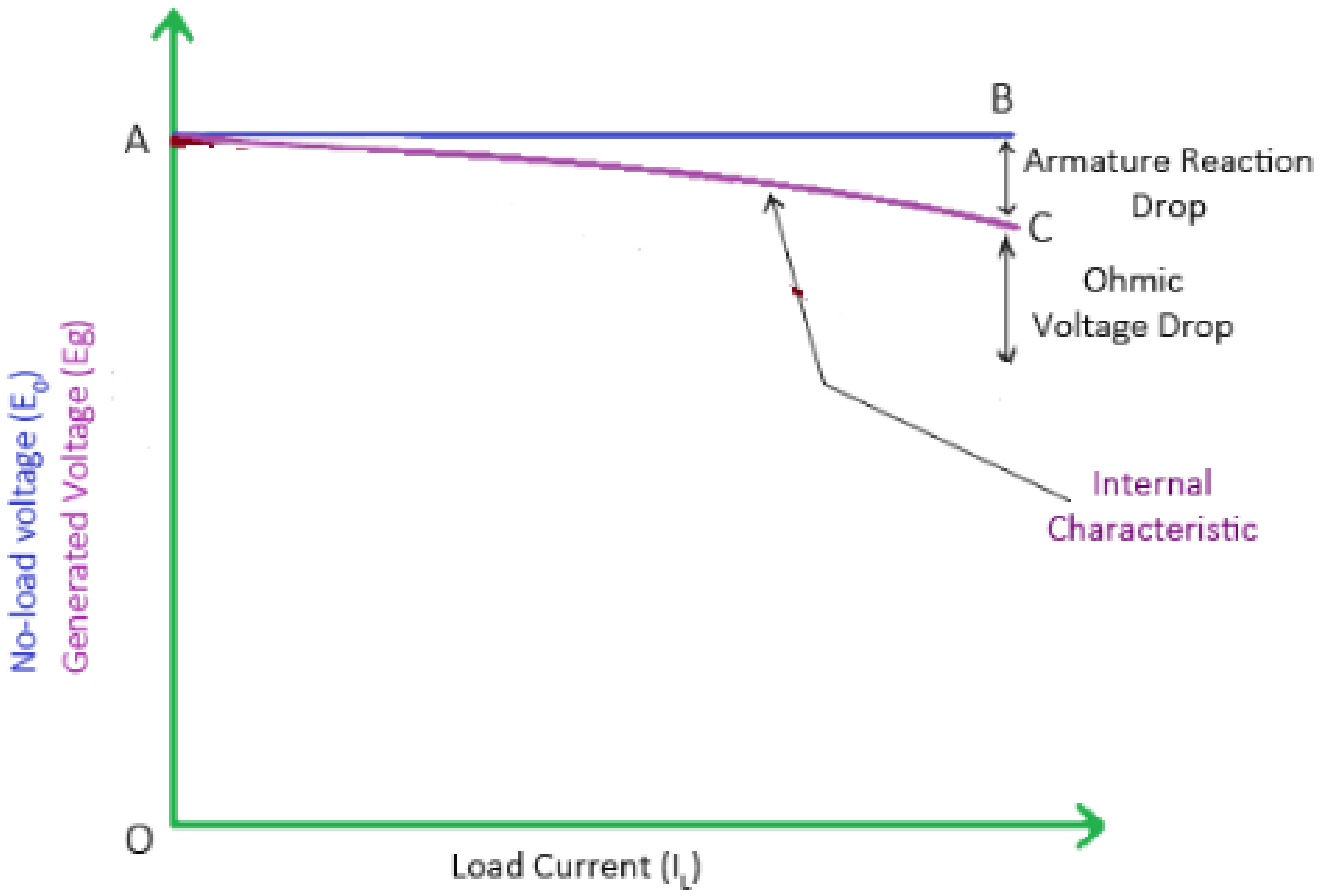




Since $E \propto N$ for any fixed excitation, hence $\frac{E_2}{E_1} = \frac{N_2}{N_1}$ or $E_2 = E_1 \times \frac{N_2}{N_1}$

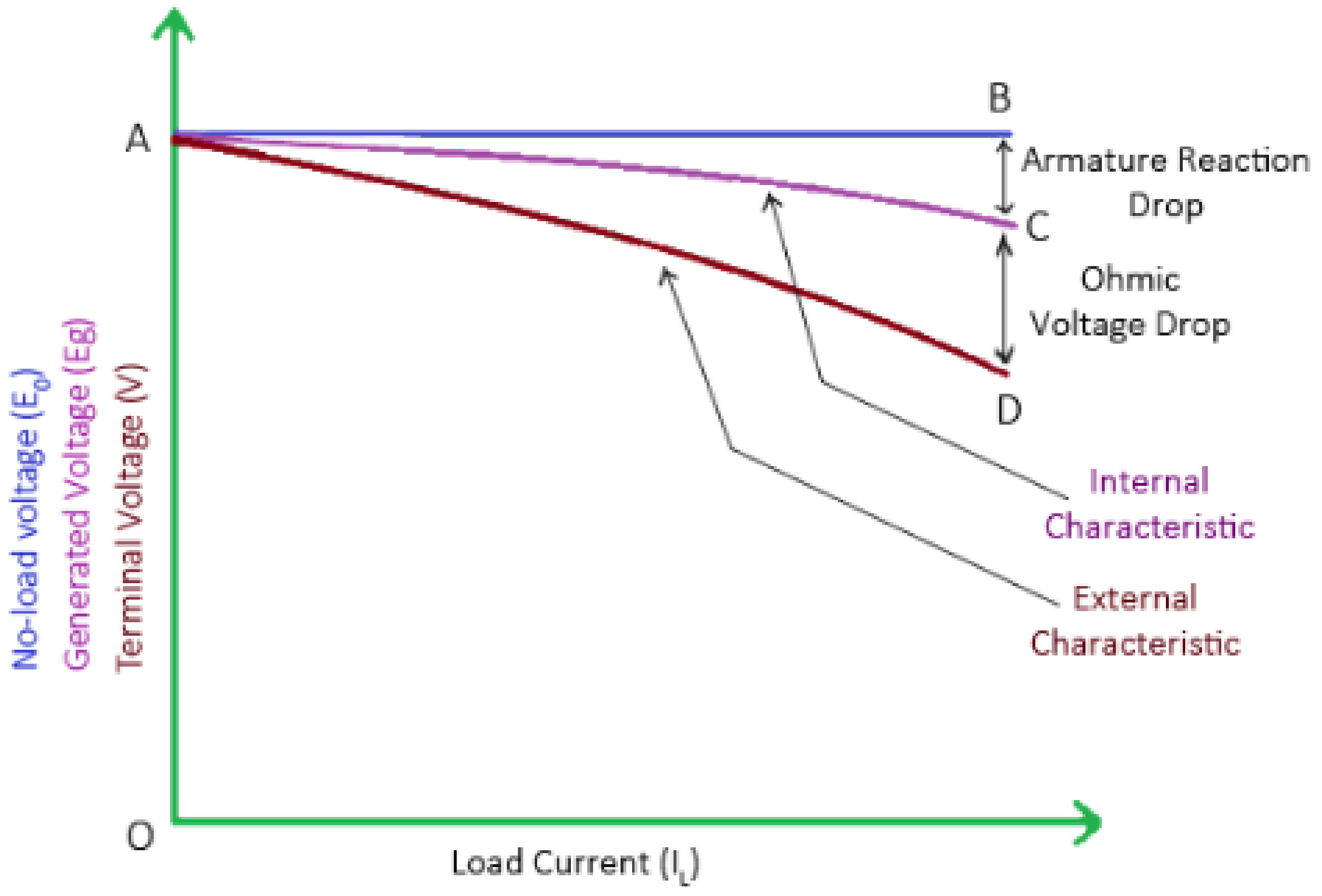
Internal characteristics

E – I characteristics

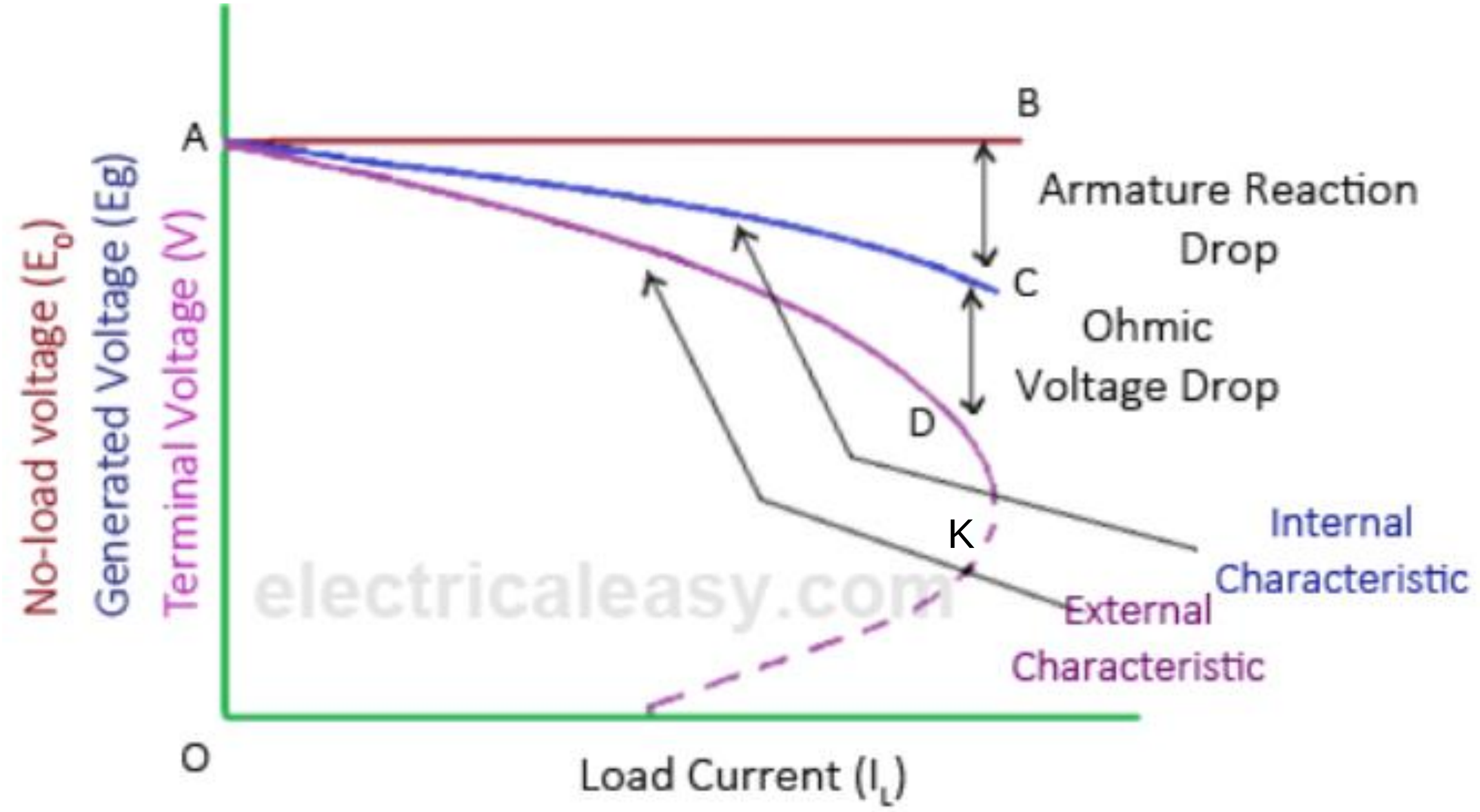


External Characteristics

V – I characteristics



Breakdown region



Load resistance can be decreased up to a certain limit, after which the terminal voltage drastically decreases due to excessive armature reaction at very high armature current and increased I^2R losses.

Beyond this limit any further decrease in load resistance results in decreasing load current.