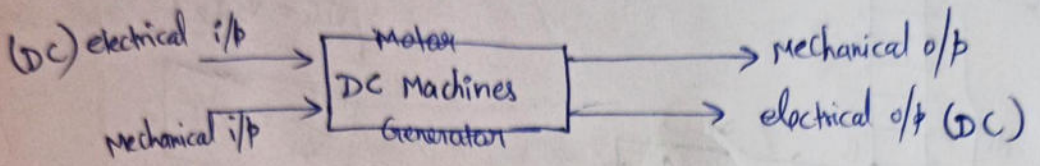
Unit-5

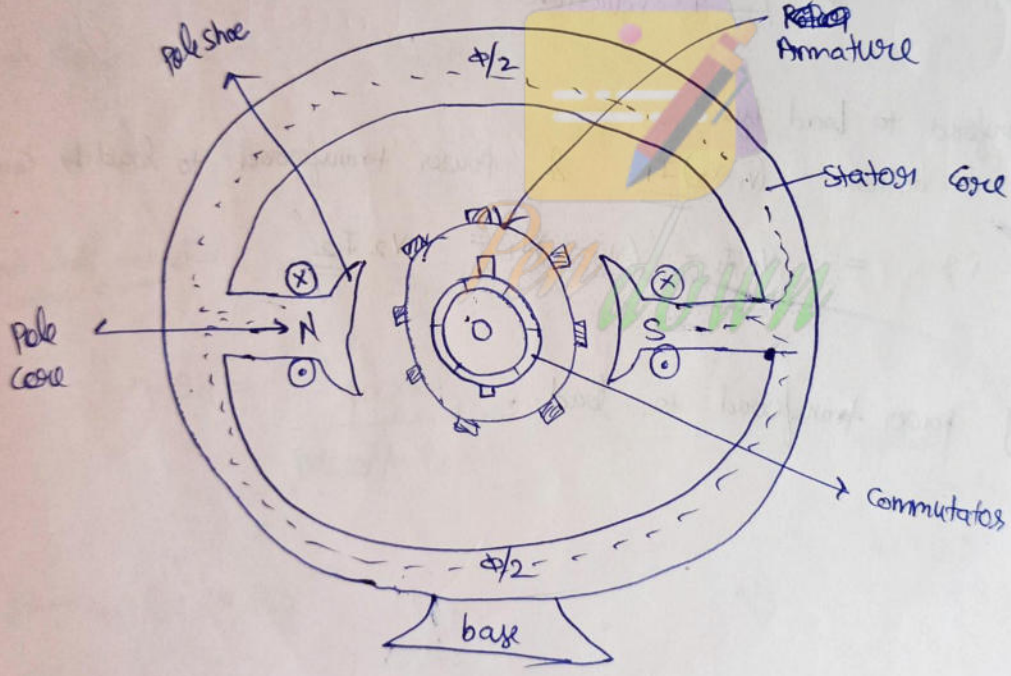
Electrical Machines

DC machines :-



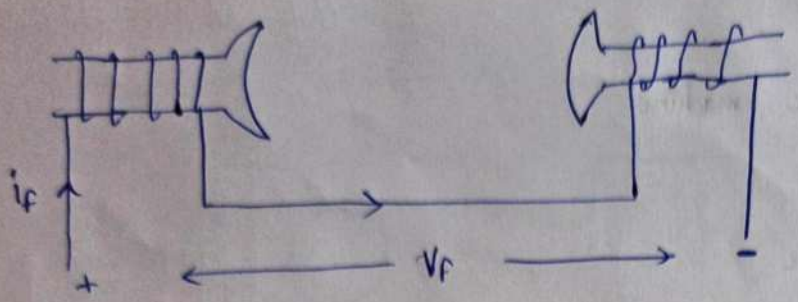
DC Motor :-

i/p = electrical DC
o/p = mechanical



★ 2 main parts → Stator (Static part)
→ Rotor (Rotating part)

{min. number of pole in any machine = 2}



Purpose of stator core is to provide path for flows of flux.

Core → Cast iron
winding → Core

for big machines, core is laminated (0.14 - 0.6)mm of laminate core size

winding for DC Machines → ① field winding
② Armature winding → ⓐ lap winding
ⓑ wave winding

in lap winding
Number of core parallel path = No. of pole for Armature.

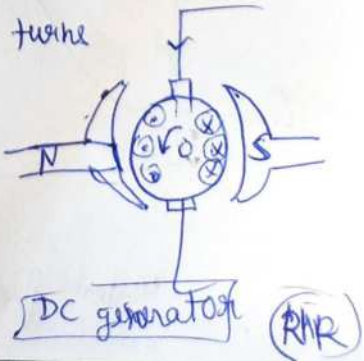
in wave winding
fixed parallel path & No of parallel path = 2

Commutator → when a dc machine used as a motor then it works as a Inverter or Convert AC → DC

for a motor → works as Inverter
for a generator → " " Commutator
the function of Commutator is to rectify the AC supply in the Armature to DC supply

No of commutator signal segment = No of coil turns

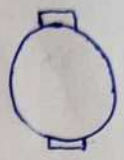
flaming LHR → for DC machines
fleming RHR → for DC generators

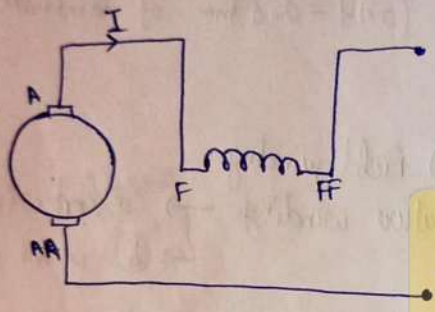


Field winding excitation :

① separately excited dc machine

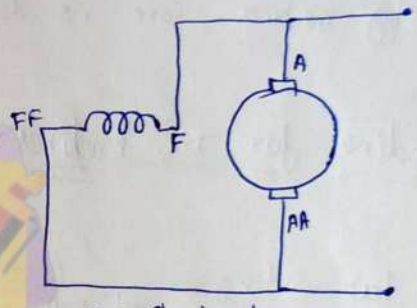
② self excited
- DC series m/c
- DC shunt m/c
- DC compound m/c





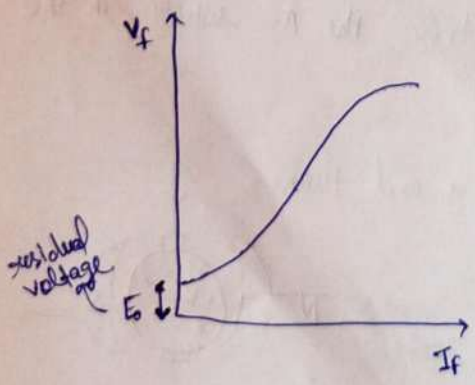
DC series m/c

excitation depend on armature current & if R of F, FF is large current less so larger cross sect area here.



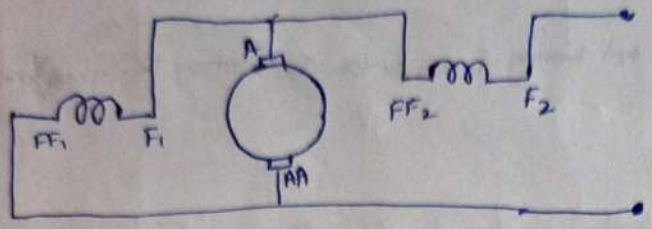
DC Shunt m/c

larger turns. Cross sect area is lesser



Residual flux

★ self excited DC machine starts with residual flux.



DC compound M/C (2 types)

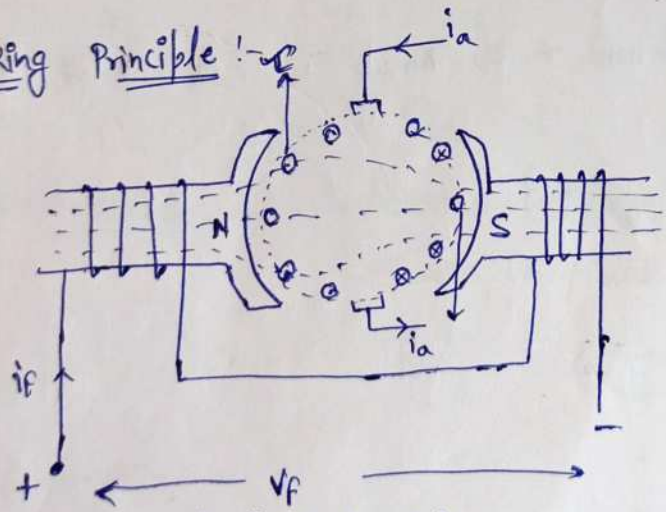
① cumulative compound M/C

② Differentially compound M/c

* If the flux of the 2 field windings adds to each other such that the resultant flux increases then the compound M/C is cumulatively compound M/C.

* If the flux of 2 field windings oppose to each other such that the resultant flux decreases then the compound M/C is differentially compound M/C.

#working Principle :-



for motor (ia incoming) (left hand rule)
here rotate in clockwise dirn

for generator (ia outgoing) (right hand rule)
we apply mechanical rotation

① Slots always exist in pair
② constant flux induced in machine
③ In current carrying conductor constant E.M Torque will develop & this rotor or armature CKt will rotate.

fleming left hand rule give dirn of rotation

(Let clockwise so cross thumb dot)

Electrical Machine

DC Machines

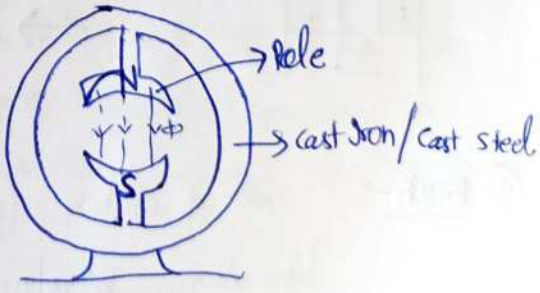
- (1) DC Motor
  - (1) Seperately excited DC-Motor
  - (2) self excited dc Motor
    - (a) Series dc Motor
    - (b) Shunt DC Motor
    - (c) Compound DC Motor
      - (i) Commulative compound dc Motor
      - (ii) differential compound dc Motor
- (2) DC Generator
  - (1) Seperately excited dc Generator
  - (2) Self Excited dc Generator
    - (a) series dc Gen
    - (b) Shunt DC Generator
    - (c) compound DC Gen
      - (i) Commulative compound dc Gen
      - (ii) differential compound dc Gen

Parts of DC Machines →

1. Stator
2. Rotar
3. Commutator
4. Brush
5. Armature Core
6. Armature winding
   - (1) Lapwinding
   - (2) wave binding

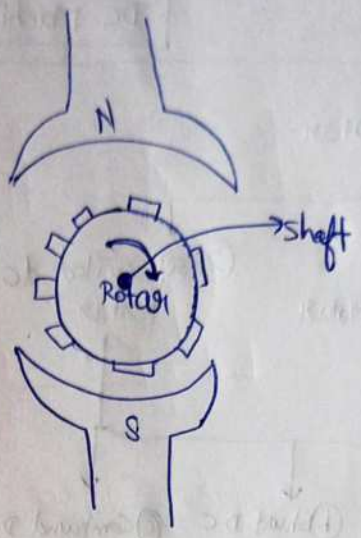
(1) **Stator** :- It is stationary part of DC machine. It provide accomodation for poles.

* The poles can be permanent or binding both (field winding)
* It provide magnetic path as
  $R_{air} >> R_{iron}$. [R = Reluctance]



(2) **Rotar** :-

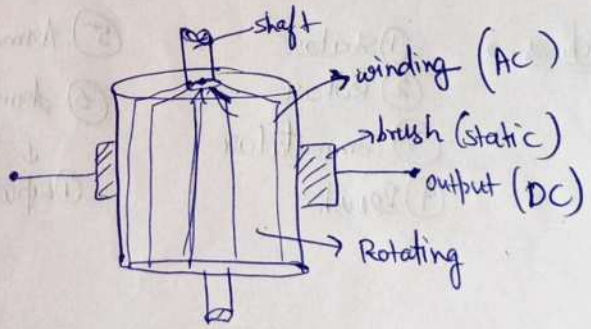
Rotar is on shaft

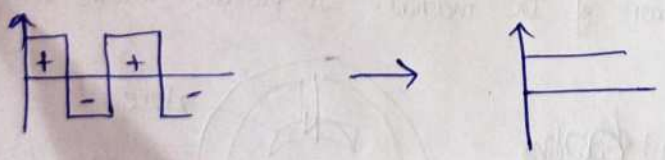


(3) **Commutator** → only present in DC machine (not present in AC)

☆ It converts (AC to DC) and (DC to AC) so it is called mechanical (Rectifier) or (Inverter)

☆ It is made up of hard drawn copper





(4) **Brush** → made of carbon (for less heating) because it provide self lubrication. to reduce friction.

⑤ Armature Core:- the slots on rotor & rotor is Armature Core

★ slots for winding

★ The winding on armature core = Armature winding

★ Core provide low reluctance path for flux.

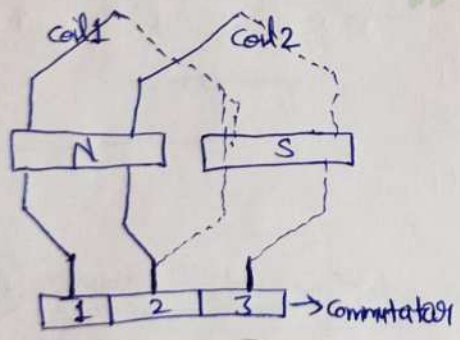
Note:- ★ field winding has very low current

★ Armature winding has v

ent in AC)

⑥ Armature winding:- on the basis of connection to commutator they are of 2 types

① Lap winding



finishing end of coil 1 is connected to started end of coil 2

i.e finishing & starting end of adjacent coils are connected respectively

for Lap winding

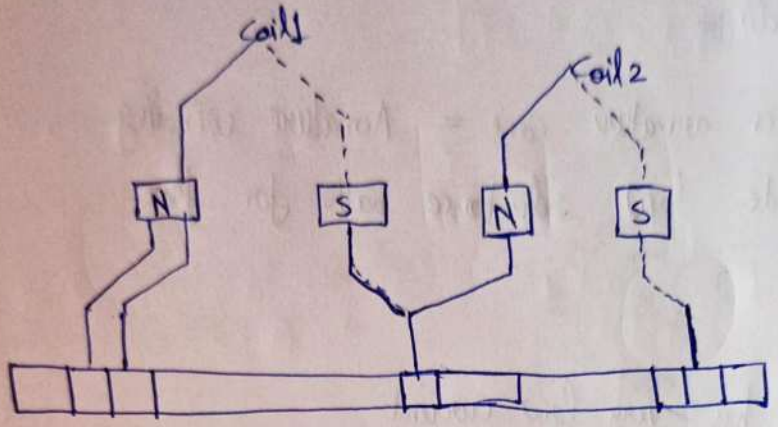
$$A = P$$

A = no. of parallel paths through armature

P = total Number of poles

★ Lap winding is used when the current capacity of machine is high whereas voltage capacity is low

② wave binding -



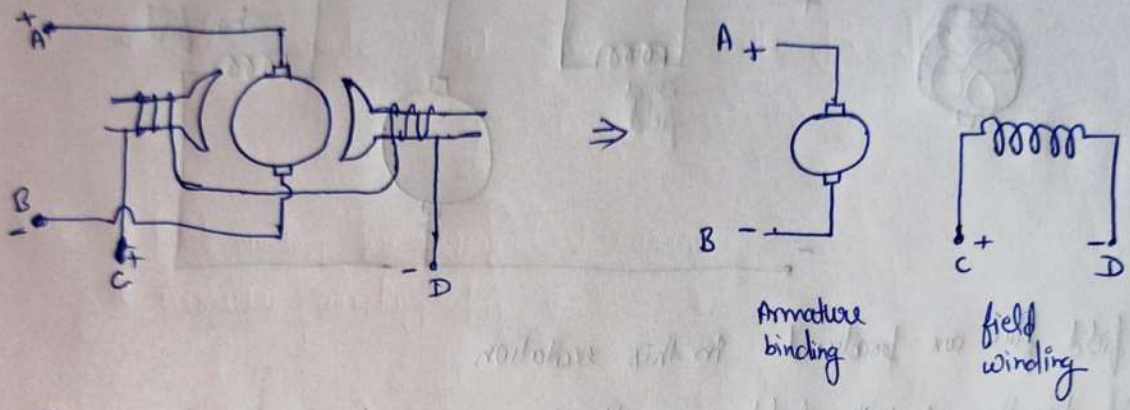
the starting end of Coil2 is number of segments away from starting of first coil.

★ here there are only 2 parallel paths hence $A = 2$

★ this type of winding is only used when machine require low capacity of current & high voltage.

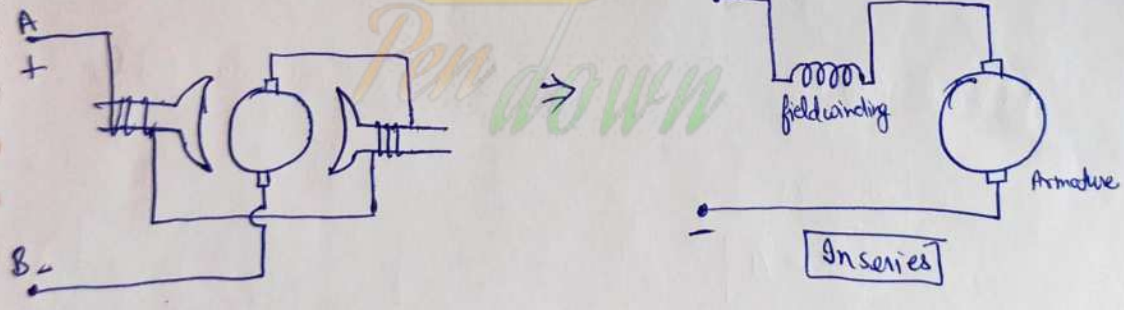
field winding Excitations:

① separate Excitation -



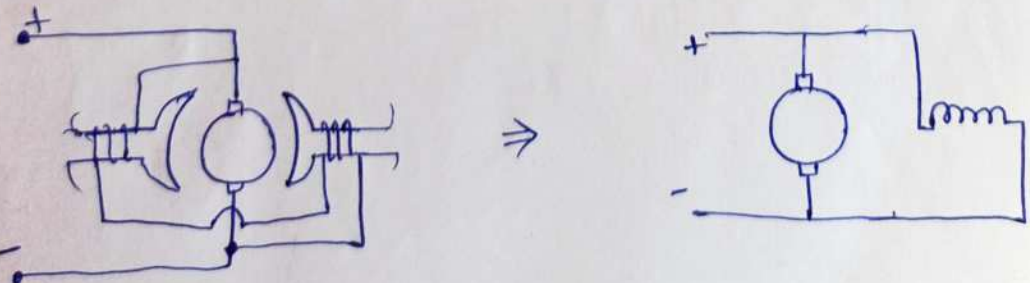
② self Excitation -

ⓐ series excitation →

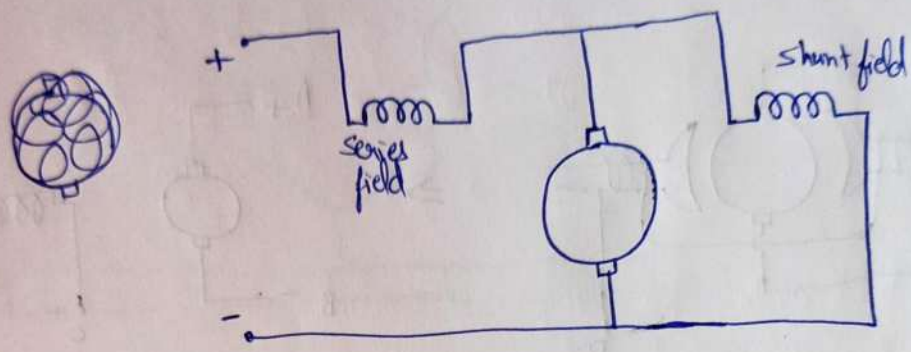


ⓑ Shunt Excitation - (also known as voltage operated field)

Voltage of Armature = voltage of shunt i.e field winding



③ Compound excitation :- here 2 field windings are present



2 field flux are produced in this excitation

(i) if direction of both field are opposite ⇒ resultant flux ↓es

(ii) " " is same ⇒ resultant flux ↑es

hence if flux ↑ ⇒ Cumulative Compound DC machine

" " ↓ ⇒ Differentially " " " .