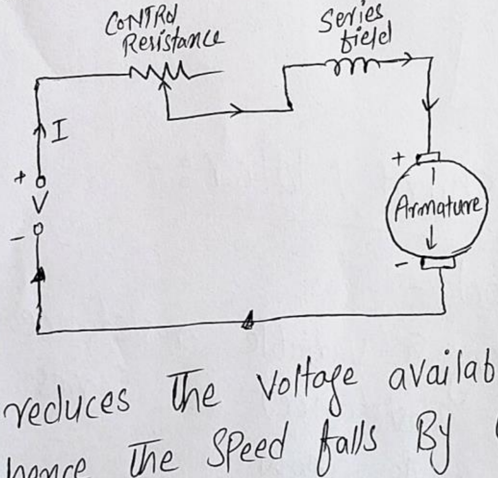
Nâme	Salman Khan
i-D	5778
Subject	Electrical Machine
Paper	Final term
Date	25-09-2020

Q-1 (A) Discuss any two methods of Speed Control each for Series & Shunt wound DC Motors?

ANS:- (a) Speed Control of DC Series Motor:-

① Armature Resistance Control Method:-

This is the most common method employed. Here the controlling Resistance is connected directly in series with the supply of the motor as show in fig.



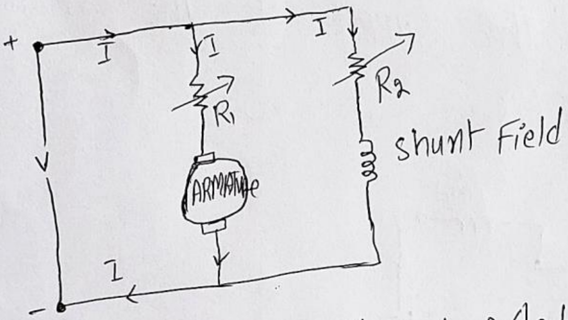
This reduces the voltage available across the armature & hence the speed falls By changing the value of variable resistance.

This method of speed control is most economical for constant Torque.

② Shunted Armature Control:-

The combination of a rheostat shunting the armature & a rheostat in series with the armature is involved in this method of speed control.

The Voltage applied to the armature is varies by Varying Series rheostat R_1. The exciting current Can be varied by varying the armature Shunting Resistance R_2. This method of Speed Control is not economical due To Considerable Power losses in Speed Controlling resistances. Here Speed Controll is obtained over wide range but below normal speed.

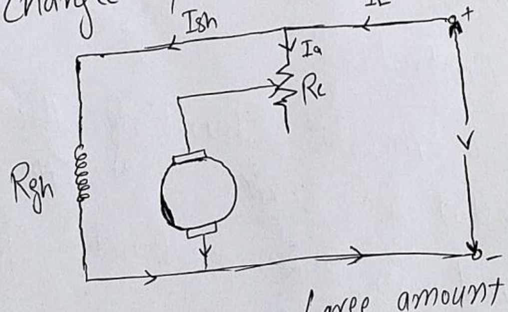


Speed Control of DC Shunt Motor:-

① Armature Control method:-

This is done by inserting a Variable resistance RC(Known as Controller Resistance) in Series With the armature as Shown:-

The Flux remains Constant while armature Current is Changed Produces Change in Speed.

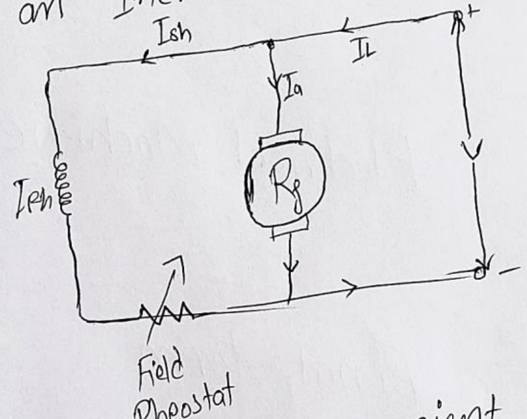


Large amount of Power is wasted in the Controller resistance Since it Carries full armature current Ia.

② Flux Control method:-

In This method, a Variable resistance (Known as Shunt field rheostat) is Placed in a Series with Shunt field winding as Shown:.

An Increase in Controlling resistances reduces the field Current with a reduction in flux & an Increase in Speed.



This is an easy & Convenient method. it is an inexpensive method Since very little Power is wasted in The Shunt field rheostat due to relatively Small Value of Ish.

Q-1 (B) Consider a 8 Poles DC Generator, Number of Conductors Z are 480, emf Induced Per Conductor is 2.2V, Current Per Conductor is 100A Find the terminal Voltage E, output current I & Power generated for both lap & wave windings? (4)

Sol:- (a) With the armature lap-Connected, number of Parallel Paths in the armature winding = no of Poles = 8 (3)

$\therefore$ No. of Conductors Per Path = $\frac{480}{8} = 60$

Terminal Voltage on no load = e.m.f Per Conductor x No of Conductors Per Path

Which is $2.2 \times 60 = 132V$

Output current on full load is

Full-load current Per Conductor x no of Parallel Path

$= 100 \times 8 = 800A$

Total Power generated on full load is

output current x generated e.m.f

$= 800 \times 132 = 105{,}600 W$

$= 105.6 KW$

(b) With the armature wave-Connected

No of Parallel Paths = 2

$\therefore$ No of Conductor Per Path = $\frac{480}{2} = 240$

Terminal Voltage on no load $2.2 \times 240 = 528V$

output current on full load = $100 \times 2 = 200A$

Total Power generated on full load is

$200 \times 528 = 105600W$

$= 105.6 KW$

Q=2 (A) Determine Relationship between torque & armature Current?

ANS:-

$$P_e = P_m$$

Here P_e = Electrical Power

P_m = Mechanical Power

$P_e = E_a I_a$ as $(E_a = E_b + I_a R_a)$ KVL

So

$P_e = (E_b + I_a R_a) I_a$

$P_e = E_b I_a$ + ~~$I_a^2 R_a$~~ (as dissipate in form of heat)

$$\boxed{P_e = E_b I_a}$$

Now $P_m = T_g W$

Here T_g = Torque in N.M

W = (angular speed in rad/sec)

As we know that

1 radian = $1/2\pi$ ∴ In RPM = $N \times 2\pi/60$ = rad/sec

$P_m = T_g N \, 2\pi/60$

$P_m = P_e$

$$T_g N 2\pi/60 = E_b I_a$$

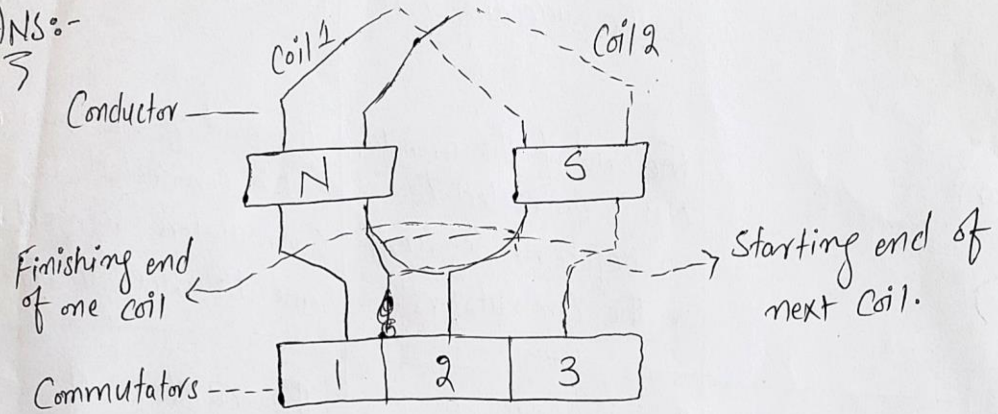
$$E_b = \frac{P.\phi.Z.N}{60.A}$$

So $$T = \frac{P.Z.\phi.I_a}{2.\pi.A}$$

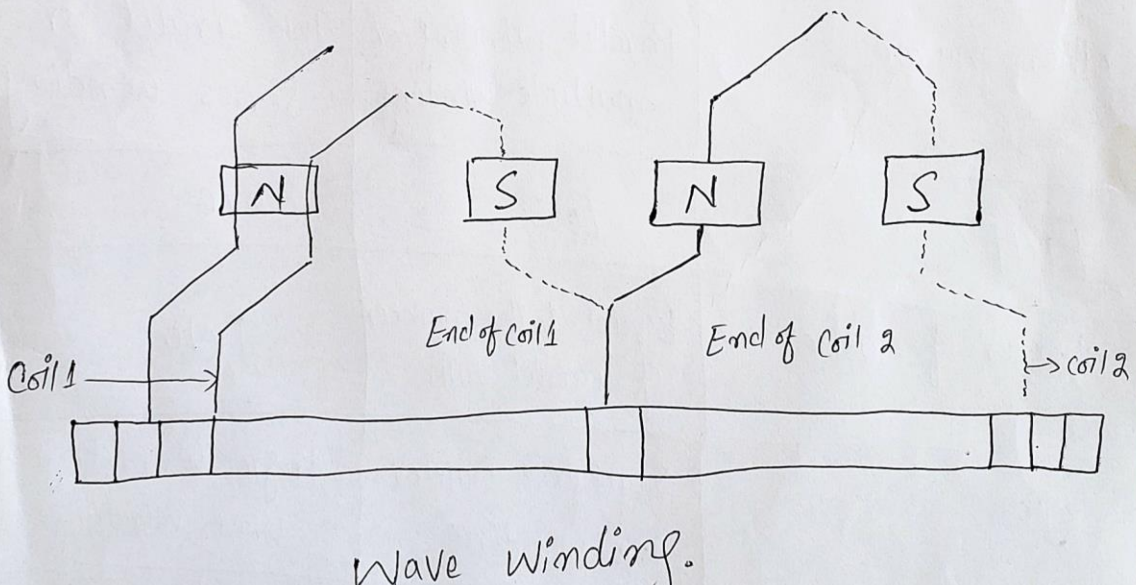
Hence T_g is directly Propositional to I_a.

Q=2 (B) Differentiate between Lap winding & wave winding?

ANS:-



LAP winding



Wave winding.

Basic for Comparison	Lap winding	Wave winding
Definition	the Coil is Lap back to the succeeding Coil	The coil of winding form the wave shape
Connection	The end of the armature coil is Connected to an adjacent Segment on the Commutators.	The end of the armature coil is Connected to Commutators Segments Some distance apart.
Parallel Path	The numbers of Parallel Path are equal to the total of number Poles	The number of Parallel Paths is equal to two.
other name	Parallel winding or multiple winding	Two-circuit or Series winding
EMF	Less	More
Number of Bushes	Equal to the number of Parallel Path	Two
Types	Simplex & Duplex lap winding	Progressive & Retrogressive wave winding.
Efficiency	Less	High
Additional Coil	Equalizer Ring	Dummy Coil
Winding Cost	High	Low
Uses	in low Voltage, high current machine	in high voltage, low Current Machie