⇒ Speed control of DC shunt Motors:-

The methods are

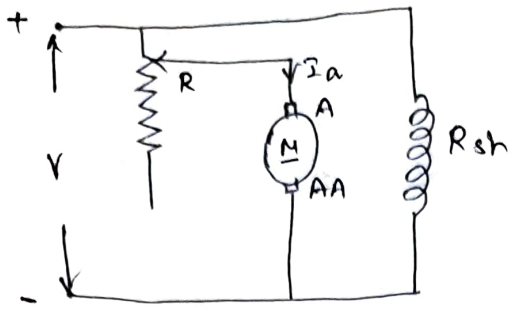
(i) Armature control method

(ii) Field control method

(iii) Voltage control Method

(16)

(i) Armature control Method:



* A variable resistance 'R' is connected in series with armature circuit.
* Here the input voltage 'V' is constant.
* The speed of the motor can be controlled by varying the resistor.

The speed equation is

$$N \propto \frac{V - I_a(R_a + R)}{\phi}$$

* By increasing the controller resistance R, the Potential drop across the armature is decreased (because Ia decreases).
* Therefore the motor speed also decreases.
* This method of speed control is applicable only for speed less than No load speed (base speed) ∵ If not the speed is dangerous

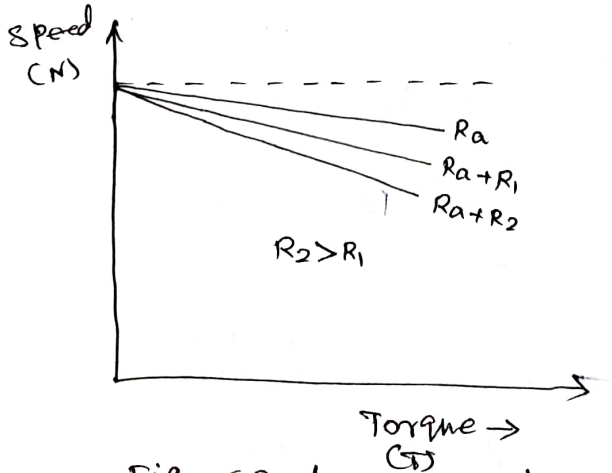


Fig: Speed. Torque characteristics.

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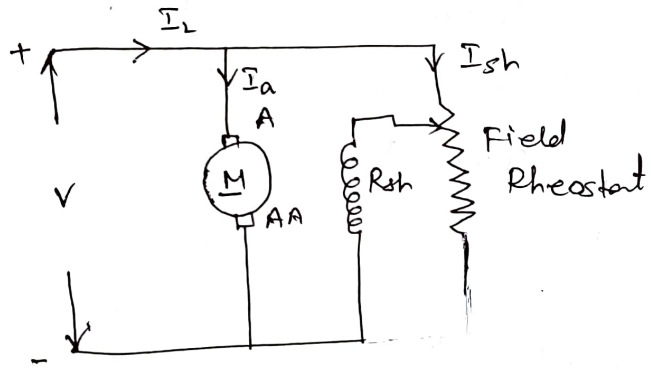
Advantages:

* simple method of speed control.

Disadvantages:

* Here, the input power is not changed (V*I). i.e input is constant. The output power is 'Eb.Ia'. It becomes less, ∴ for lower speeds more and more power is wasted in this controller resistance Hence this method of speed control is highly inefficient.
* charge in speed with the charge in load becomes large.

(ii) Field (or) Flux control Method:

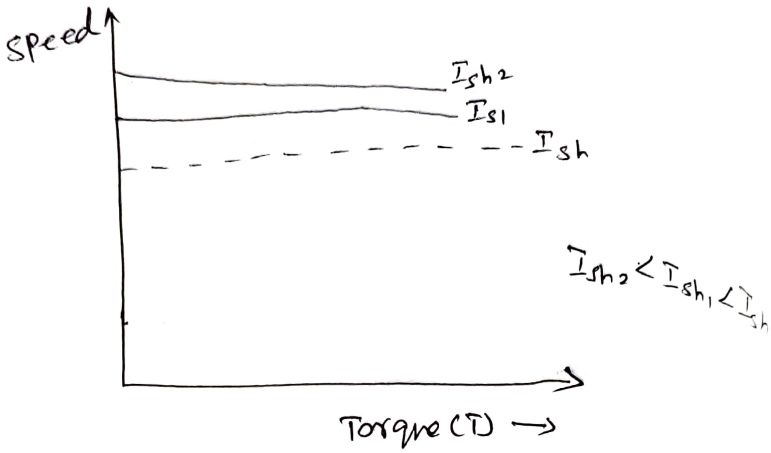


* The speed is inversely proportional to flux i.e

$$N \propto \frac{1}{\phi}$$

* By varying the flux, the motor speed can be varied.
* The flux of a DC motor can be changed by changing the field current (I_{sh}). It's obtained by a variable resistance connected in series with shunt field winding. $I_{sh} = \frac{V}{(R_{sh}+R)}$
* By varying the field circuit resistance, the shunt field current can only be decreased. i.e the flux will be decreased.

* Thus motor speed can be increased by decreasing the flux.
* This method of speed control can be used for increasing the speed of the motor above it's rated speed (based speed).



* Here, the field current I_{sh} is less. ∴ the shunt field rheostat has to carry only a small current and I^2R loss is also less.
* But this method of speed control can not be used to obtain large variations of speed.
* The main reasons is, the deterioration in commutation conditions that take place with increase in speed.

Advantages:

* Convenient and easy method
* little power is wasted as heat.
* speed is independent of load

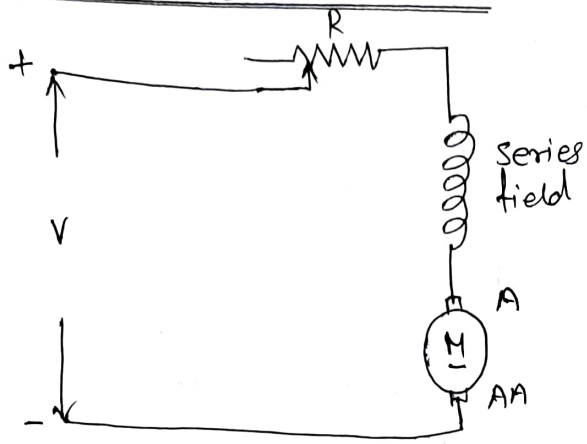
Disadvantages:

* only speeds higher than the rated speed can be obtained.

(100) ⇒

Speed control of DC series Motor:

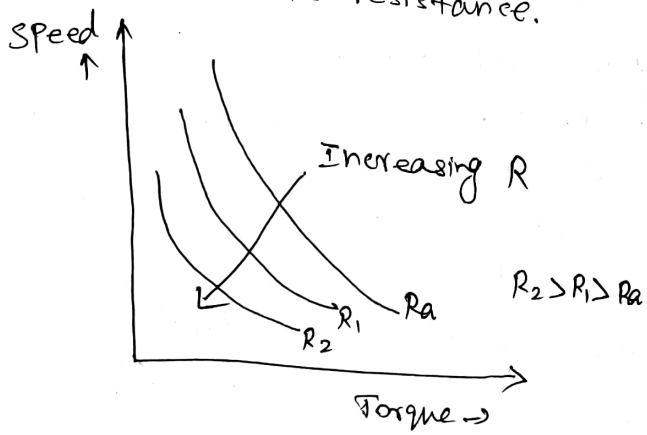
(i) Armature control method:



* The variable resistance is connected in series with armature.
* By increasing the resistance, the voltage applied across the armature terminal can be decreased.
* By reducing the voltage across the armature, the motor speed also decreases. Because the applied voltage is directly proportional to the speed, $N \propto E_b$, $E_b \propto V$.

$$\therefore N \propto V$$

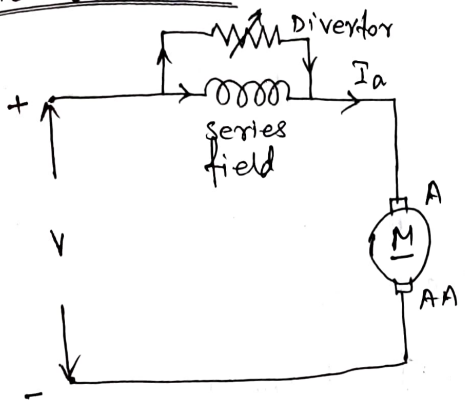
* Here, the full motor current passes through this resistance. Due to this, more power loss occurs in this resistance.



(ii) Field (or) Flux control method:-

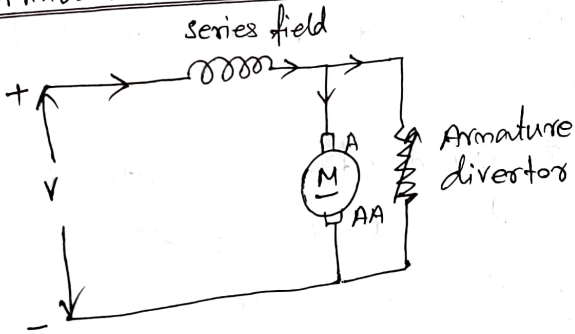
The flux of a series motor can be varied in any one of the following methods.

(a) Field diverter:



* Field diverter means, a variable resistance is connected across the series field winding.
* By varying the resistance, the current flow through the series field changes.
* Due to decrease in field current, the flux can be decreased and consequently, the motor speed also increases.

(b) Armature diverter:

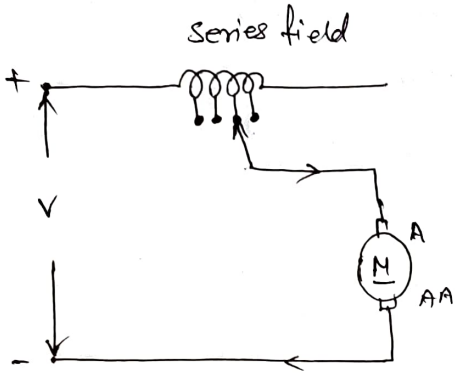


* Here, a variable resistance is connected across the armature.
* The DC Motor speed can be controlled by the armature diverter.
* This method of control gives speeds lower than the normal speed. For constant load torque operation, the armature current Ia is decreased due to armature diverter and

flux 'ϕ' must increase, because the load torque is directly proportional to flux and armature current ($T \propto \phi I_a$).

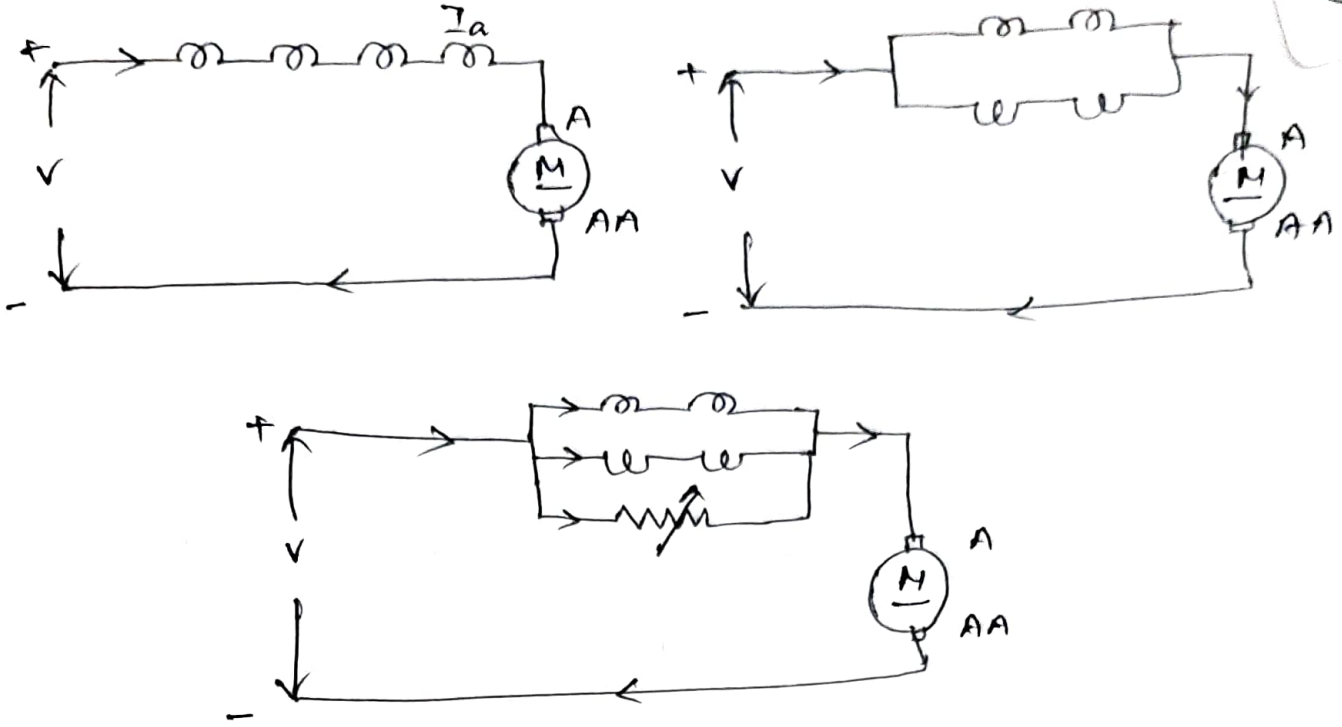
* This results in an increase in current taken from the mains. Due to current increase in series field flux also increases.
* Then the speed of the motor can be decreased ($N \propto \frac{1}{\phi}$).

(iii) Tapped field control:



* The speed of the motor is controlled by variation of the number of field turns.
* This method of speed control is applicable where the speed control required is above the base speed.
* Because by varying the series field turns, the flux can be decreased and motor speed can be increased, this method is mainly used in electric traction.

(d) Paralleling field coils:



* The speed control is achieved by rearranging the field coils.
* This method is mainly used for fan motors.
  Here, we can get three speeds easily by using a 4 pole motor.