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Speed control for D.C motor

Factors controlling the speed of D.C motor : The speed of D.C motor is given by the relation :

$$N = \frac{V - I_a R_a}{Z\text{Ø}} \times \frac{a}{P} = K \frac{V - I_a R_a}{\text{Ø}}$$

From the above equation it is clear that the speed can be controlled by varying the following :

i) Flux Ø (flux control) .

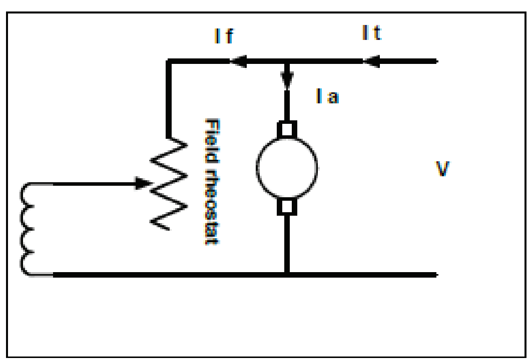
ii) Resistance R a of armature circuit (rheostat control) .

iii) Applied voltage (voltage control) .

Speed control of shunt D.C motors:

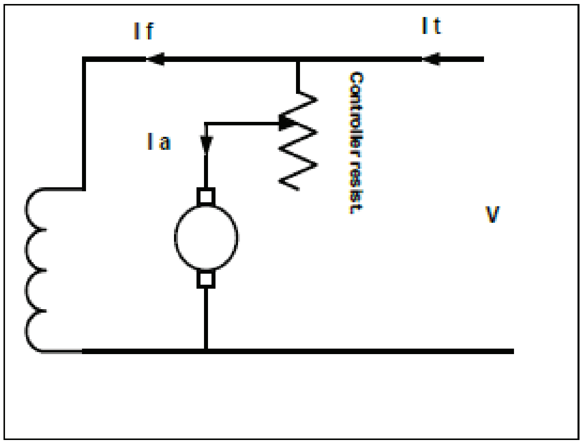
1. **Variation of flux or flux control method:**

The speed is inversely proportion to the flux, therefore the speed can be increased by decrease the flux and vice versa .The flux of D.C motor can be changed by changing the field current (I) with the help of shunt field rheostat



as shown in fig attachment in the lecture .

2. Armature resistance or rheostatic control method :



As the supply voltage is normally constant , the voltage across the armature is varied by inserting a variable resistance (controller resistance) in series with the armature circuit

As a controller resistance increased , the potential difference across the armature decreased , therefore the armature speed decrease.

3. Voltage control method: In this method the shunt field of the motor is connected to a fixed exciting voltage , while the armature is supplied with different voltages .

Example : A 250 V , D.C shunt motor has a shunt field resistance of 250 Ω and an armature resistance of 0.25 Ω . It runs at 1500 r.p.m ,   drawing an armature current of 20 A. If a resistance of 250 Ω is inserted in series with the field , the load torque remaining the same and (T ά Ø I a) . Find out the new speed and armature current .

$$\frac{N_2}{N_1} = \frac{E_{b2}}{E_{b1}} \times \frac{Ø_1}{Ø_2}$$

Since we have shunt motor , it means that the flux is directly proportional to field current .

$$\frac{N_2}{N_1} = \frac{E_{b2}}{E_{b1}} \times \frac{I_{f1}}{I_{f2}}$$

Load torque remain the same

$$T_1 = T_2$$

$$T_1 \propto Ø_1 I_{a1} \quad \text{and} \quad T_2 \propto Ø_2 I_{a2}$$

Therefore :

$$Ø_1 I_{a1} = Ø_2 I_{a2}$$

$$I_{a2} = I_{a1} \frac{Ø_1}{Ø_2} = I_{a1} \frac{I_{f1}}{I_{f2}}$$

$$I_{f1} = \frac{250}{250} = 1 \text{ A}$$

$$I_{f2} = \frac{250}{250 + 250} = 0.5 \text{ A}$$

$$I_{a2} = 20 \times \frac{1}{0.5} = 40 \text{ A}$$

$$E_{b1} = V - I_{a1} R_a = 250 - (20 \times 0.25) = 245 \text{ V}$$

$$E_{b2} = V - I_{a2} R_a = 250 - (40 \times 0.25) = 240 \text{ V}$$

$$\frac{N_2}{1500} = \frac{240}{245} \times \frac{1}{0.5}$$

$$N_2 = 2939 \text{ r.p.m}$$

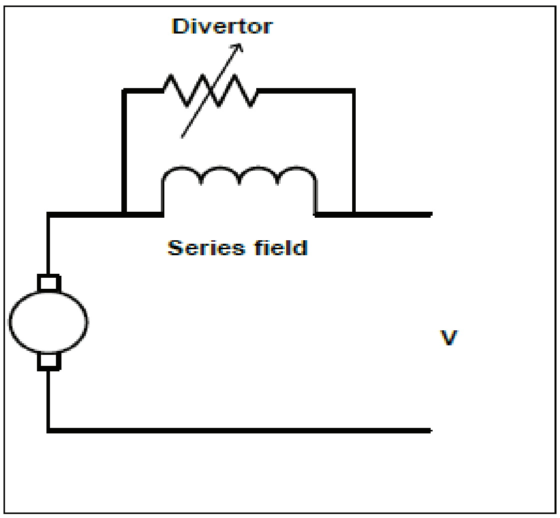
3. Speed control of D.C series motor:

1. Flux control method

Variation in the flux of a series motor can be brought about in any one of the following ways :

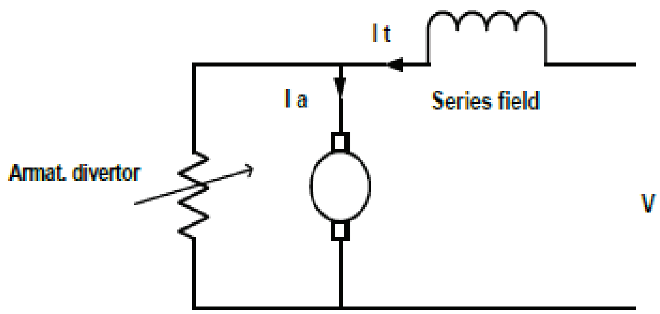
A – Field diverter : The series windings are shunted by a variable

resistance know as field diverter. Any desired amount of current can be passed through the diverter by adjusting its resistance Hence the flux be decreased and consequently the speed of the motor increased .



B – Armature diverter :

A diverter across the armature can be used . If the armature current is reduced due to armature diverter the flux (Ø) must be increased . This results in an increase in the current taken from the supply which increase the flux and a fall in speed is achieved .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