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Starting of D.C motor

If a D.C motor is directly connected to a D.C power supply , the starting current will be dangerously high .

$$I_a = \frac{V - E_b}{R_a}$$

The back e.m.f (E b) is zero at starting , therefore

$$I_a = \frac{V}{R_a}$$

Since Ra is small , the starting current is very large . The starting current can be limited to a safe value by the following methods :

Methods of starting:

The starting current can be limited to a safe value by the following methods:

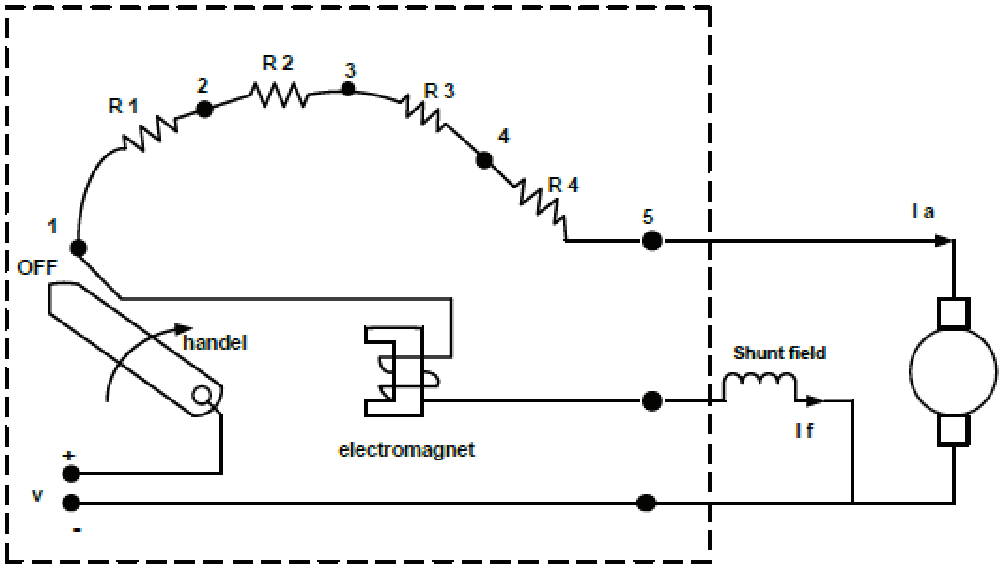
1. Insert an external resistance (R ae) in series with the armature circuit at

the moment of starting .

2. Use a low D.C terminal voltage at the moment of stating , this requires a variable voltage supply.

Starter connection

For a D.C motor , the starter is connected as shown in fig attachment with lecture . At start the handle is moved to position 1 , that is mean all resistance R1,R2,R3 and R4 are connected in series with the armature resistance and thereby limit the starting current . As the motor speed up , the handle is moved to positions 2 ,3 ,4 and finally 5 . At position 5 all the resistance in the starter are taken out of the armature circuit . The handle will be held in position 5 by electromagnet , which excited by the field current .



Torque of D.C motor

Consider a pulley of radius (r) meters, shown in fig . 1 , acted upon by circumferential force of (F) Newton which causes it to rotate at (N) r.p.s .

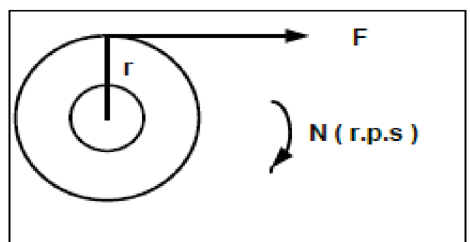


Fig. 1

T = F x r

Work done in one revolution = force x distance

$$= F \times 2\pi r$$

Power developed $= F \times 2\pi r \times N$

$$= (F \times r) \times 2\pi N$$

$$= T \times 2\pi N$$

Armature torque :

Let T a be the torque developed by the armature of a motor running at N r.p.s , then

Power = T a x 2 π N watt

It is known that electrical power converted into mechanical power in the armature which equal to **E b * I a** .

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$$T_a = \frac{E_b I_a}{2\pi N}$$

$$E_b = \text{Ø} Z N \frac{P}{A}$$

$$T_a = \frac{1}{2\pi} \text{Ø} Z I_a \frac{P}{a}$$

Shaft torque:

The whole of the armature torque (T a) , is not available for doing useful work because a certain percentage of this is required for supplying iron and friction losses in the motor.

The torque which is available for doing useful work is known as shaft torque (T sh). The horse – power obtained by using shaft torque called brake horse – power (B. H. P).

$$B.H.P = \frac{T_{sh} \times 2\pi N}{746}$$

$$T_{sh} = \frac{746 \times B.H.P}{2\pi N} = \frac{\text{output power (watt)}}{2\pi N}$$