



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 :

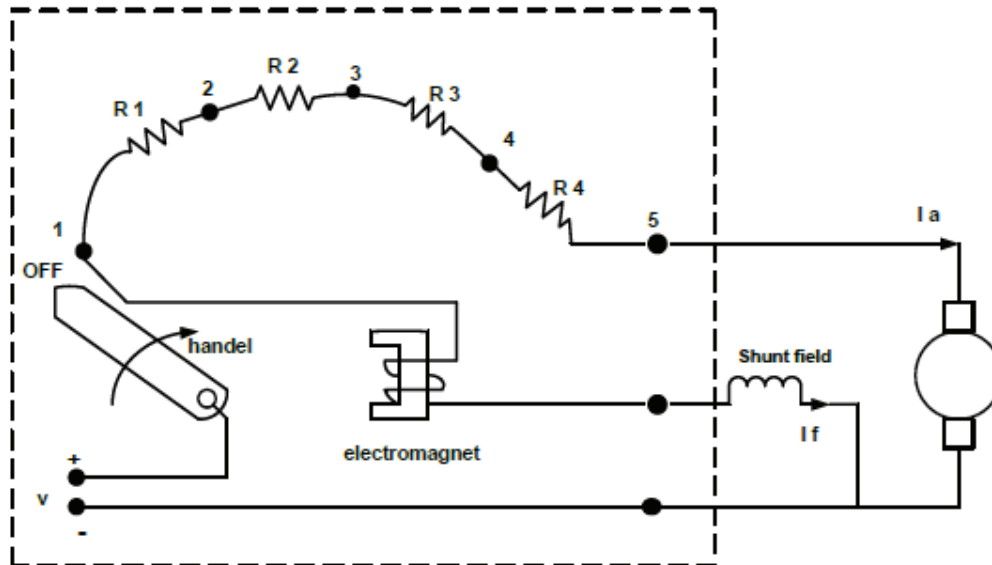
Methods of starting:

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 .

$$T = F \times r$$

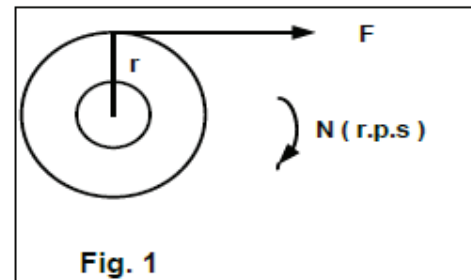
Work done in one revolution = force x distance

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

$$\text{Power developed} = F \times 2 \pi r \times N$$

$$= (Fxr) \times 2 \pi N$$

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



Armature torque :

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

$$\text{Power} = T_a \times 2 \pi N \quad \text{watt}$$

It is known that electrical power converted into mechanical power in the armature which equal to $E_b \times I_a$.



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

$$E_b = \Phi Z N \frac{P}{A}$$

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

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).

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

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