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Back e.m.f.

When the motor armature rotates , the conductors also rotate and hence cut the flux. .Therefore e.m.f induced in them whose direction is in opposition to applied voltage . From the equivalent circuit of a motor which shown in fig.1 , it will be seen that :

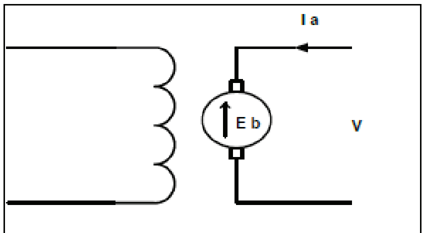

Fig. 1

$$I_a = \frac{\text{net voltage}}{\text{resistance}}$$

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

Where

I_a armature current
V applied voltage
E_b back e.m.f
R_a armature resistance

$$E_b = V - I_a R_a$$

***For shunt motor** $I_t = I_a + I_f$

***For series motor** $E_b = V - I_a (R_a + R_f)$

$$I_t = I_a = I_f$$

Types of windings:

There are three types of windings:

1. **Lap windings** : In this type ,the two ends of each coil are taken to adjacent segment. The number of parallel path equal to the number of poles .

$$E_b = \frac{\emptyset Z N}{60} \times \frac{P}{a}$$

$a = P$

$$E_b = \frac{\emptyset Z N}{60}$$

Where

Ø flux / pole (weber) .

Z number of conductors .

p number of poles .

a number of parallel paths in armature .

N speed of motor (r.p.m) .

2. **Wave windings** : In this type , the two ends of each coil are taken to segment some distance a part . The number of parallel paths = 2 .

$$E_b = \frac{\emptyset Z N P}{120}$$

Effect of back e.m.f on speed of D.C motors

it is seen that the speed is directly proportional to back e.m.f and inversely to the flux .

$$\frac{N_2}{N_1} = \frac{E_{b2}}{E_{b1}} \times \frac{\emptyset_1}{\emptyset_2}$$

Example : A 4 – pole , 220 volt shunt motor has 540 lap – wound conductors. It takes 32 A from the supply mains . The field winding takes 1 A.The armature resistance is 0.09 Ω and the field flux per pole is 30mwb Calculate the speed of the motor .

$I_a = I_t - I_f = 32 - 1 = 31$ A

$E_b = V - I_a R_a$

$E_b = 220 - (31 \times 0.09) = 217.2$ V

$$E_b = \frac{\text{Ø} Z N}{60} \times \frac{P}{a}$$

$$217.5 = \frac{30 \times 10^{-3} \times 540 \times N}{60}$$

N = 804 r.p.m