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FACULTY OF ENGINEERING & TECHNOLOGY

Electrical Machine-1

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Speed control methods of DC motor

Speed of a DC motor

Back emf E_b of a DC motor is nothing but the induced emf in armature conductors due to rotation of the armature in magnetic field. Thus, the magnitude of E_b can be given by EMF equation of a DC generator.

$E_b = {}^{P\O NZ}/_{60A}$

(where, P = no. of poles, Ø = flux/pole, N = speed in rpm, Z = no. of armature conductors, A = parallel paths)

E_b can also be given as,

$E_b = V - I_a R_a$

thus, from the above equations

$N = {}^{E_b\ 60A}/_{P\O Z}$

but, for a DC motor A, P and Z are constants

Therefore, $N \propto K\ {}^{E_b}/_{\O}$ (where, K=constant)

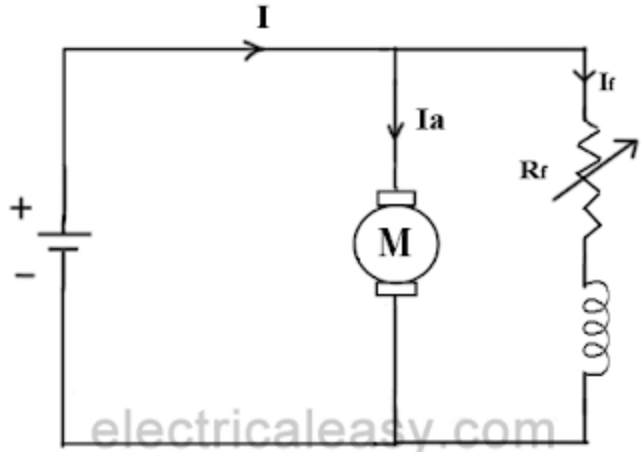
This shows the speed of a dc motor is directly proportional to the back emf and inversely proportional to the flux per pole.

Speed control of Shunt motor

1. Flux control method

It is already explained above that the speed of a dc motor is inversely proportional to the flux per pole. Thus by decreasing the flux, speed can be increased and vice versa.

To control the flux, a rheostat is added in series with the field winding, as shown in the circuit diagram. Adding more resistance in series with the field winding will increase the speed as it decreases the flux. In shunt motors, as field current is relatively very small, I_{sh}^2R loss is small. Therefore, this method is quite efficient. Though speed can be increased above the rated value by reducing flux with this method, it puts a limit to maximum speed as weakening of field flux beyond a limit will adversely affect the commutation.



2. Armature control method

Speed of a dc motor is directly proportional to the back emf E_b and $E_b = V - I_aR_a$. That means, when supply voltage V and the armature resistance R_a are kept constant, then the speed is directly proportional to armature current I_a. Thus, if we add resistance in series with the armature, I_a decreases and, hence, the speed also decreases. Greater the resistance in series with the armature, greater the decrease in speed.