DC MOTORS

19/8/13

DC machines are basically electromechanical conversion devices.

The same DC m/c can be operated as DC generator or DC motor. In generating mode a DC machine converts mechanical movement into electricity. In motoring mode the DC machine converts electricity into mechanical movement.

This electromechanical energy conversion is due to electro-magnetic induction. Proposed by michael faraday.

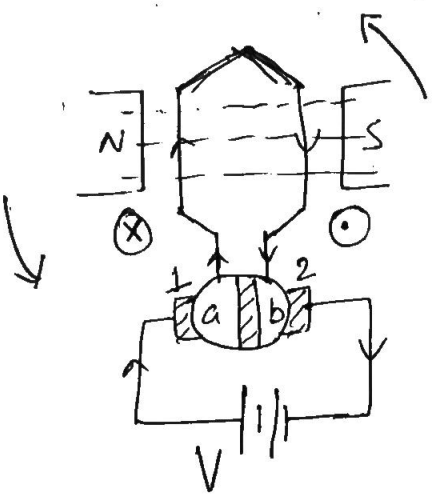
He is the man behind DC motor.

Principle when a current carrying conductor is placed in a magnetic field, it will experiance a mech. force & rotates in the dirn of force. given by F.L.H. Rule or Motor rule.

Its magnitude is —

$$F = BIl \text{ newtons}$$

- B → flux density (Tesla)
- I → Current (Ampere) flow in conductor
- l → active length of the conductor



By changing
→ Pole
or
Polarity of applied V, the rotation will be change.

⇒ Consider a simple coil connected across commutator segments & there are two stationary sliding contacts known as brushes. where DC Vtg is supplied. across the coil through them.

⇒ According to Flemings left hand Rule assume the same current dirn as in the case of DC generator coil. The force experienced by the conductor under North pole is in the downward direction.

⇒ Similarly as the commutator rotate with the coil, the force exerted on the conductor under South pole is in the upward direction.

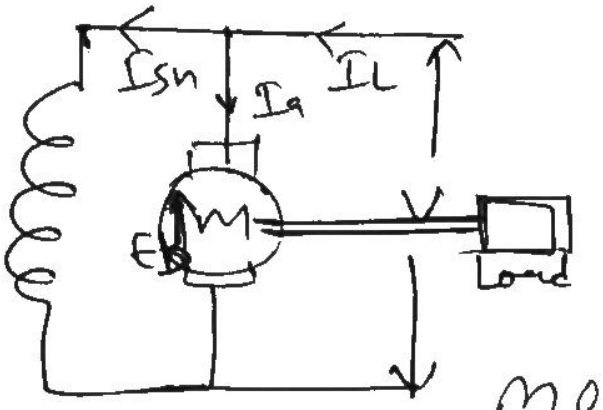
⇒ The force experienced by the all conductors will give rise to an net force and the armature rotates in anticlockwise direction.

⇒ The Purpose of Commutator in a DC motor is to produce a uni-directional torque through it's rotation with the coil. (Convert DC to AC)

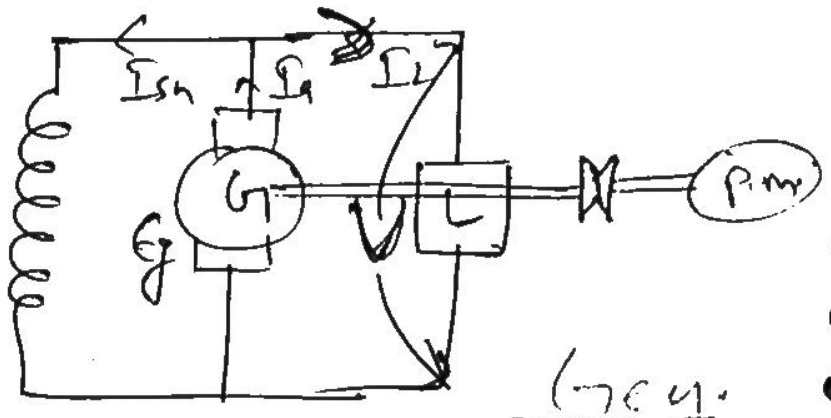
⇒ The dirn of rotation depends on the force or torque developed. It can be reversed by reversing either Armature Polarity or Field Polarity. But NOT Both. Simultaneously.

⇒ For the same pole structure and current rotation in armature coils, if the generator is rotated clockwise, the motor will rotate anticlockwise. (opposite to dirn of rotation of generator)

Comparison b/w Motor & Generator



MOTOR



Gen.

MOTOR	GEN.
① Converts electrical to mech. energy	① Convert's mech. to el. energy.
② mech. O/p is collected through shaft.	② mech. I/p is given through shaft. By connecting a Prime mover.
③ Loading is mechanical done across shaft.	③ Loading is electrical Connected across terminals.
④ E_b → Induced emf called as back emf.	④ E_g - Induced emf called as generated emf.
⑤ V → Supply Vtg	⑤ V → terminal Voltage
⑥ $E_b \cdot I_a$ ⇒ electrical equi. of mech. Power developed	⑥ $E_g \cdot I_a$ → electrical power generated or developed.
⑦ $V \cdot I_L$ ⇒ el. I/p	⑦ $V \cdot I_L$ ⇒ ~~Power~~ delived to the load.

⑧ For motoring action

$E_b < V$

or $\boxed{V > E_b}$

⑨ As $E_b \propto \phi N$, Increasing in the flux or speed, increase the E_b. If it is — greater than V the motor behave as generator. (Delivering current)

⑧ For generating action

$\boxed{E_g > V.}$

⑨ If the generator operating across a bus bar — reduction in E_g. make the generator operate as motor ⇒

⇒ If $E_g < V$, as the bus bar voltage is constant at 'V'.