DC MOTOR

Date __/__/____

DC motors:- A DC motor is a mechanical rotating device which converts electrical energy into mechanical energy.

principle:- It is based on the principle of force acting on a current carrying wire in a magnetic field.

Constructions

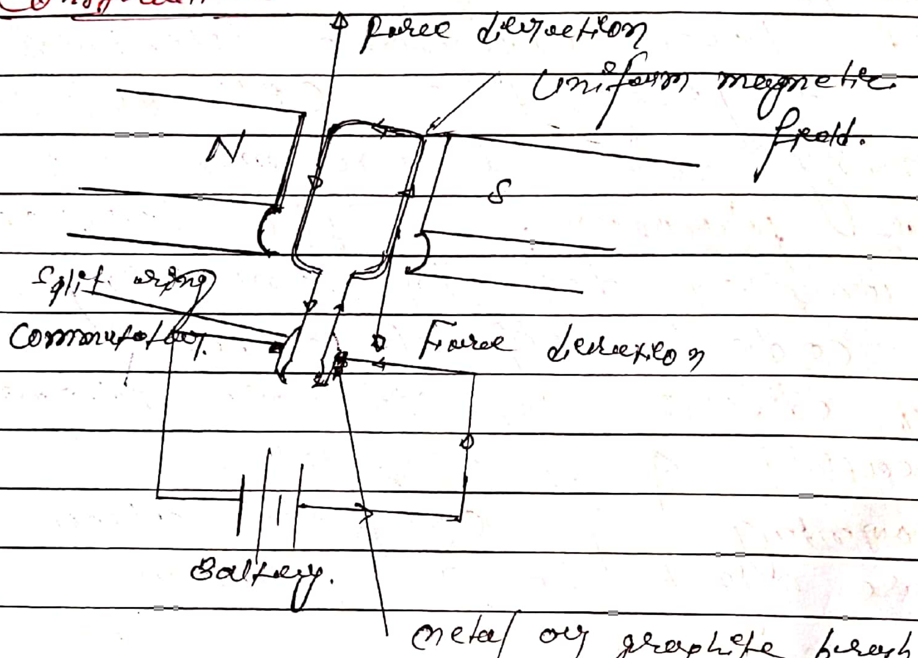


fig D.C motor

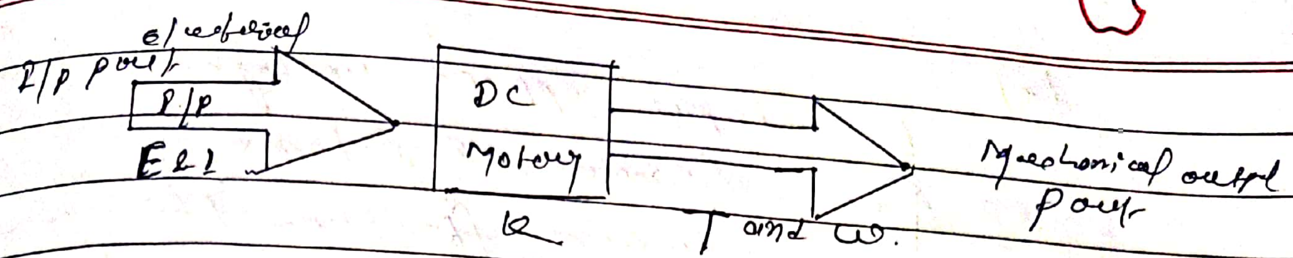
When an electric current is passed through the coil as shown above an equal and opposite forces act on opposite arms of the coil due to which the coil starts rotating.

The direction of rotation of the motor is given by Fleming's left hand rule, ~~which~~

In the DC motor we supply electrical energy to the input port and derive mechanical energy from the output port which is shown on on the overleaf page

Page No.

Date __/__/____



In DC motor we supply voltage 'V' and current 'I' is given to the electrical port or input port that drive the mechanical output port that gives torque and angular speed 'ω'.
The relation between the torque 'T' and current 'I' is given by.

$$T = kI \quad \text{--- (I)}$$

and

$$E = k\omega \quad \text{--- (II)}$$

Now, consider the following circuit of the DC motor

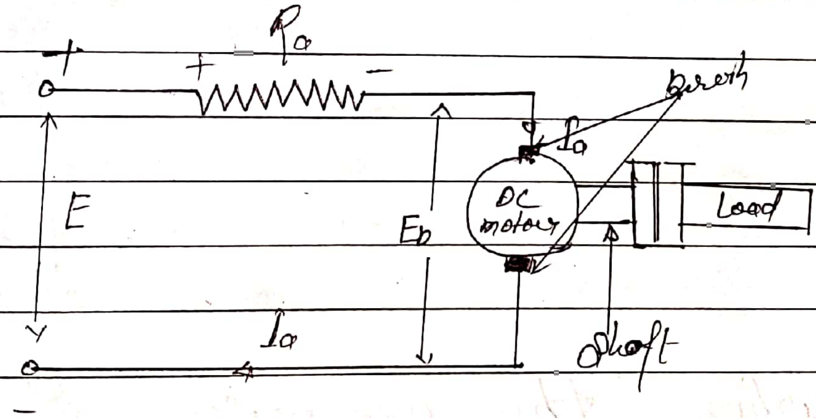


Fig: DC motor circuit

The circle represents the DC motor with two brushes at the top and bottom side of the motor. On the mechanical terminal, a shaft coming out from the centre of the armature, that couples to mechanical load.

Date __/__/____

Let

E = Input supplied voltage

R_a = Armature resistance

I_a = current flowing through the armature

~~ϕ~~ T = Torque produced in the magnetic field.

As the armature conductor (wires) carrying currents that rotates in the uniform magnetic field and produces back emf E_b which is opposite to supplied voltage (E). The back emf induced in the circuit is given by,

$$E_b = \frac{P.\phi.ZN}{60.A}$$

where

P = No. of poles

ϕ = flux per pole

Z = No. of conductors

A = No. of || paths

N = speed of DC motor

So, when the application of load reduces the speed of the motor, E_b decreases. and hence $E - E_b$ increases and hence also, the armature current increases.. So torque and hence the speed increases. Thus, a DC motor is capable of maintaing the same speed under variable load.

Date __/__/____

∴ The armature current I_a is given by

$$I_a = \frac{E - E_b}{R_a} \quad \text{--- (1)}$$

At starting, speed $\omega = 0$.

$\Rightarrow$ $E_b = 0$.

so, $I_a = \frac{E}{R_a}$

Since, the armature winding electrical resistance (R_a) is very small, this motor has a very high starting current in absence of back emf or a circuit we need a starter to start the motor.