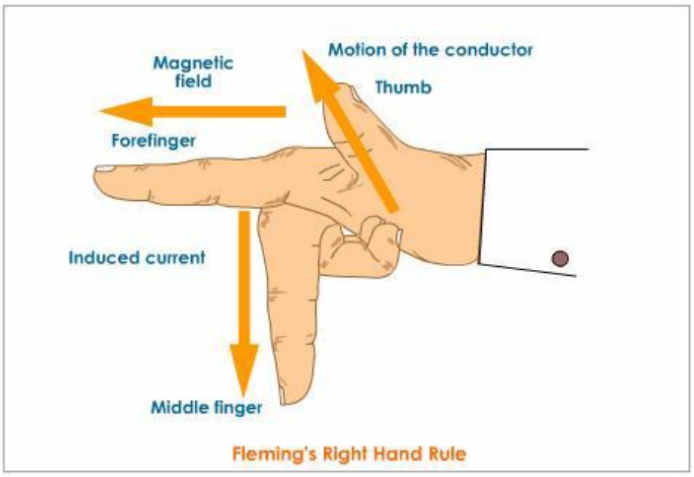
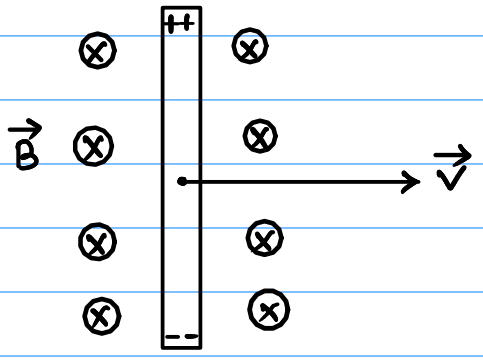
Flemming's Right Hand Rule :-

This rule is used to find out the direction of induced emf

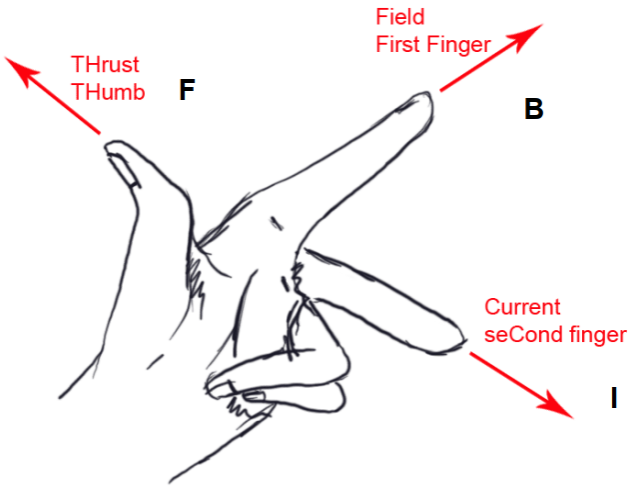


$\vec{e} = l\vec{v} \times \vec{B}$ $\quad$ $\vec{v} \Rightarrow$ speed of the conductor



Flemming's Left Hand Rule :-

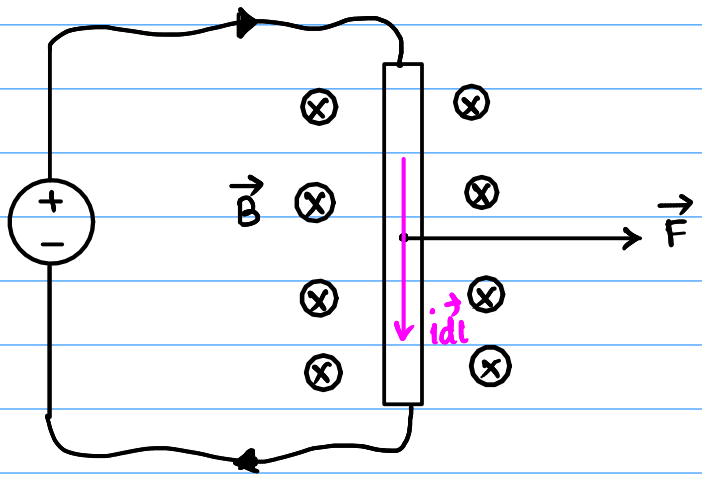
This rule is used to find out the direction of the force developed in the conductor



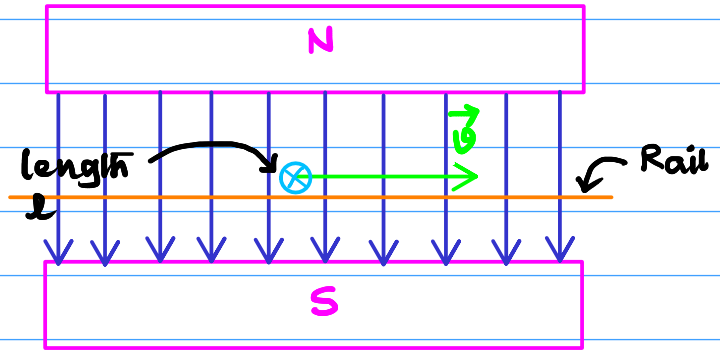
$$\vec{F} = i\vec{dl} \times \vec{B}$$

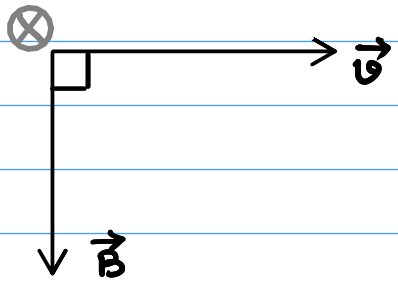
↓

current element



DC Generator :-

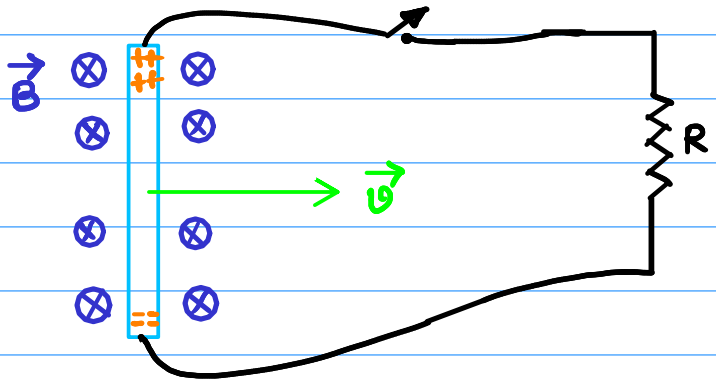




[The Rail is frictionless]

EMF induced in coil $\vec{e} = l\vec{v} \times \vec{B}$

$$|\vec{e}| = BlV\sin\theta = BlV\sin 90^\circ = BlV$$

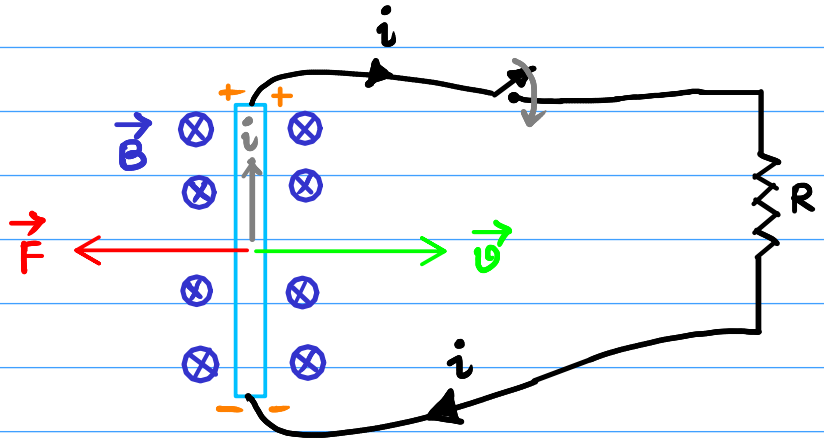


Let us assume initially $v = v_0$ [When the switch is opened]

Now at some time $t=0$, the switch is closed.

KVL equation of the loop is

$$\boxed{e = BlV = Ri}$$



Now as soon as the current starts to flow through the main conductor it will experience a force according to Flemming's Left Hand Rule.

$$\vec{F} = i\vec{l} \times \vec{B} = BilSin\theta = Bil$$

The force vector $\vec{F}$ is in the opposite dirn of $\vec{v}$

This retarding will try to stop the conductor to make velocity $v = 0$

In this case the kinetic energy is converted into electrical energy.

& Therefore for a generator, without a prime mover will eventually come to stop.

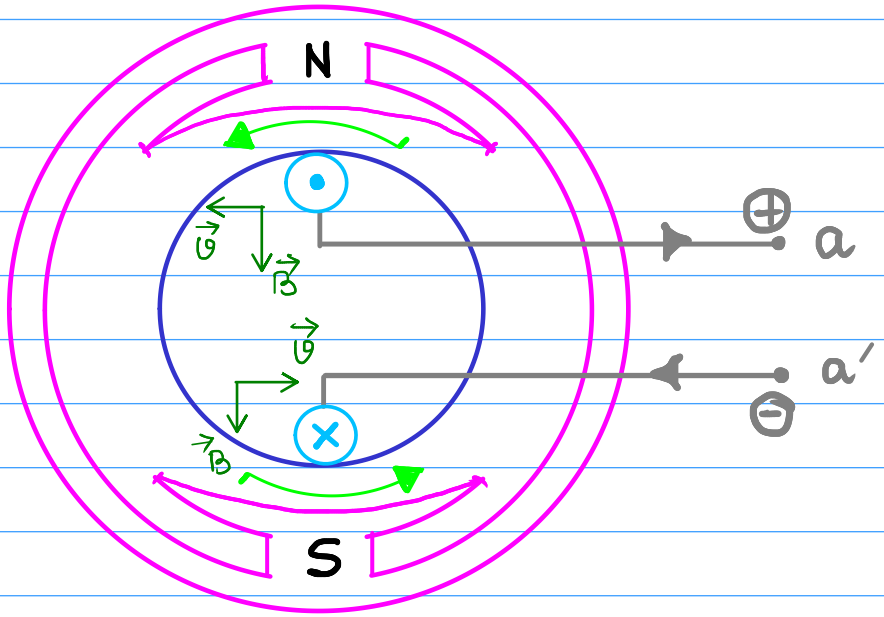
& So as the current starts to flow through the conductor the prime mover should exert a force in the right side direction & this force will be (Bil) and the generator runs at constant speed Vo

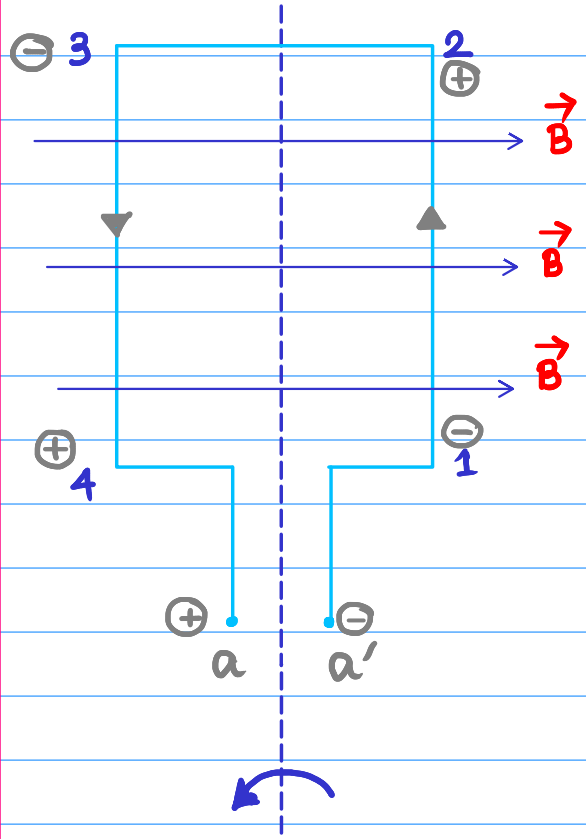
& In case of generator, the electromagnetic torque develops in the opposite dir^{n} of the rotation.

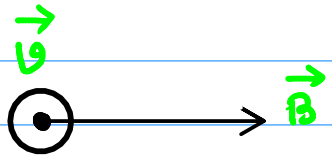
& Now as we want to draw more power from the conductor, more current will flow through the Conductor, therefore, more electromagnetic force is developed in the conductor. So, the prime mover should exert more force.

& So always a generator should be provided with a prime mover.

Generation of EMF:-







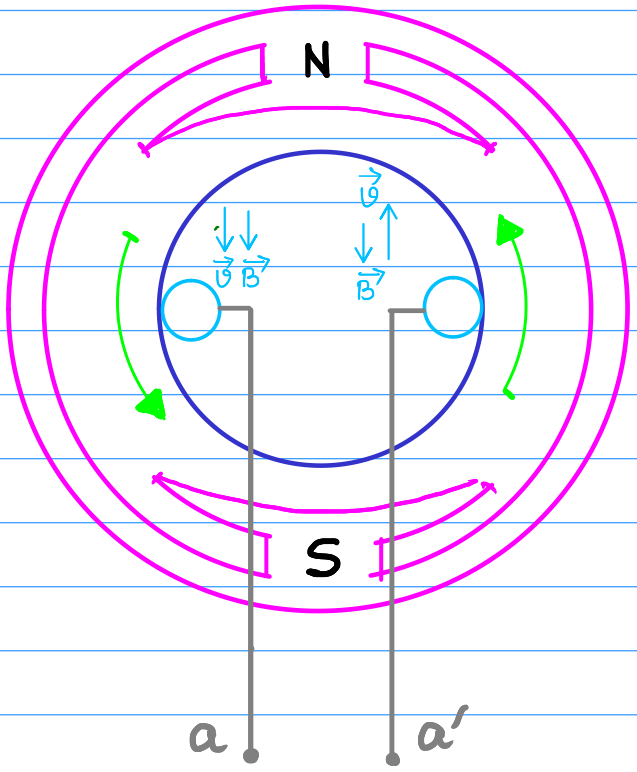
Segment (1-2) = Blv

Segment (3-4) = Blv

Total generated emf

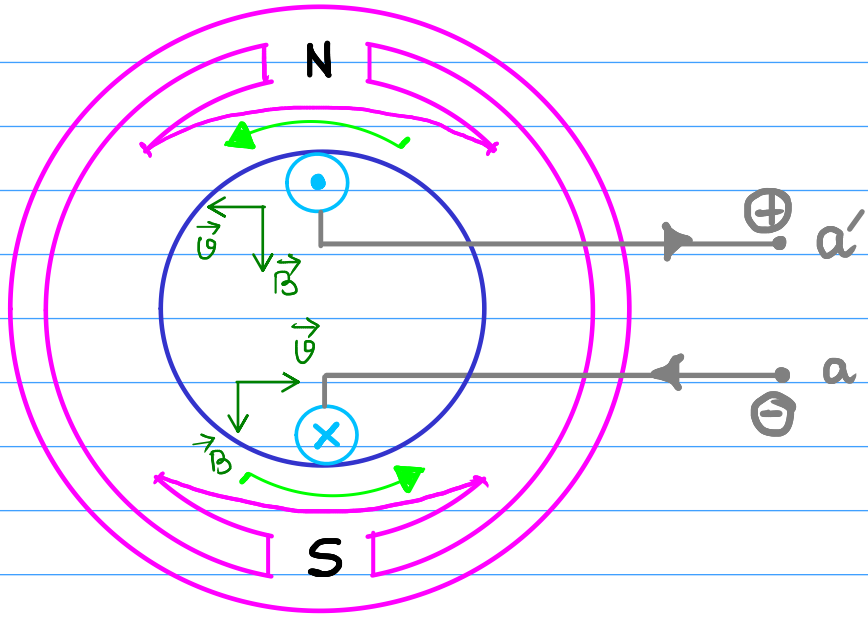
$V_{aa'}$ = Blv + Blv = 2Blv

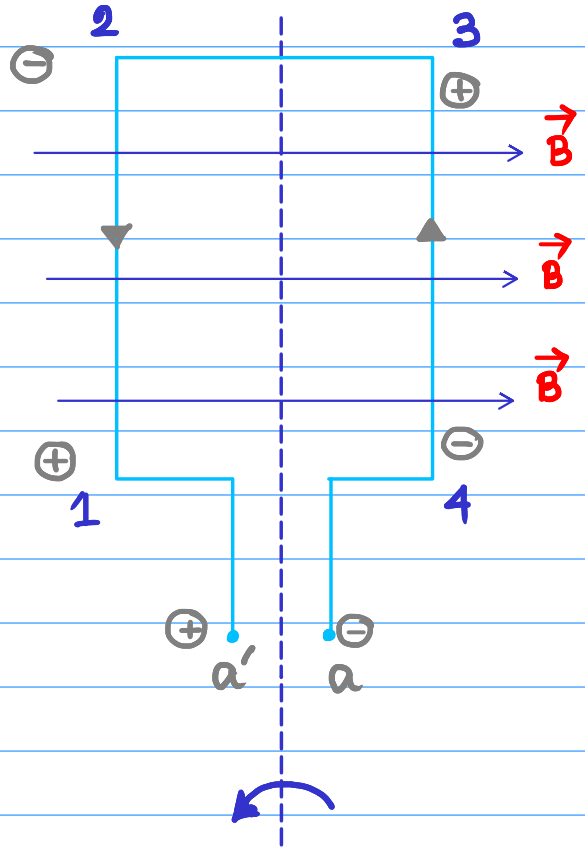
After some times the coil position changes to ⇒

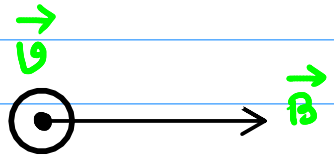


As $\vec{v}$ and $\vec{B}$ are parallel vector therefore no emf will be induced in any conductor

$V_{aa'}=0$







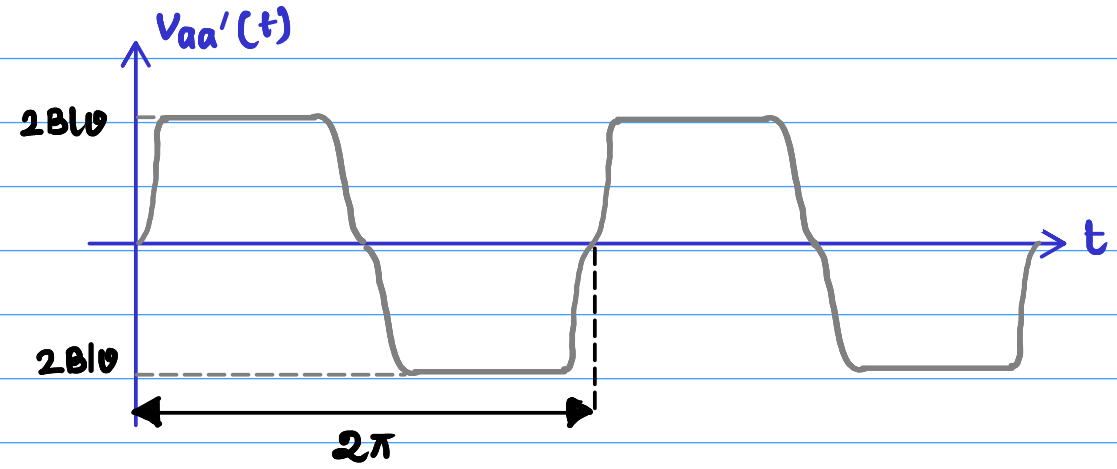
Segment (1-2) = $B l v$

Segment (3-4) = $B l v$

Total generated emf

$V_{aa'} = -(Blv + Blv) = -2Blv$

Therefore the generated voltage waveform of the coil should be



However for DC M/c we need the o/p voltage as dc. Therefore to get the output voltage as dc we will use an arrangement here.

Semi circular arrangement
+
Brush arrangement

Brush is made of carbon and remains fixed, whereas the semi circular segment rotates with the coil.

The semicircular segments are made of cu to carry the current. This semicircular segments are known as commulator segments