Mode of arc extinction

- High resistance arc interruption
  - This method is used in DC CB and low and medium voltage AC CB

- Low resistance or zero point interruption
  - This method is used in HVAC CB

Let \( V_{arc} \) is the voltage required to establish arc

\[ I_{arc} \text{ and } R_{arc} \text{ is the corresponding arc current and resistance} \]

Then \( V_{arc} \) is proportional to \( R_{arc} \) for a constant arc current

Therefore, \( V_{arc} \) can be increased by increasing arc resistance

Thus \( V_{arc} \) can is increased till it is more than system voltage across the contact

Hence arc is extinguished
The method of increasing arc resistance

- Lengthening the arc by means of arc runner [as resistance of arc is proportional to length]
- Splitting up the arc into a number of small arcs
- Cooling or arc: voltage required to maintain arc increases with the decrease of temperature.

Splitting up of an arc
Low resistance or zero point interruption

- For alternating current, the arc is vanished for a brief moment when the arc current goes zero
- The arc is extinguished at the ‘current zero’
- The contact space is de-ionized quickly by introducing fresh air or SF6 gas
- The dielectric strength is increased to such an extent that arc does not continue after current zero
- However arc may re-establish if dielectric strength of gap is less than the re-striking voltage

Low resistance or zero point interruption (Cont.....)

- In this case arc may continue another half cycle and may get extinguished in next current zero
- Therefore CB are designed such a way to provide a provision to remove the hot gases from the contact space immediately after the arc extinction so as to fill the contact space by fresh dielectric medium.
# Classification of CB based on voltage level

<table>
<thead>
<tr>
<th>Name</th>
<th>Voltage rating of CB</th>
</tr>
</thead>
<tbody>
<tr>
<td>LV CB</td>
<td>Up to 1000V</td>
</tr>
<tr>
<td>MV CB</td>
<td>Up to 33 KV</td>
</tr>
<tr>
<td>HV CB</td>
<td>Above 33KV</td>
</tr>
</tbody>
</table>

# Classification of CB based on arc quenching medium [Ref : Table 2.1]

<table>
<thead>
<tr>
<th>Name</th>
<th>Voltage rating</th>
<th>Power rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air break CB [ACB] {air in atmospheric pressure}</td>
<td>Up to 600 V</td>
<td>5-15-35 MVA</td>
</tr>
<tr>
<td>Oil CB [OCB] {Bulk or tank oil}</td>
<td>12 KV</td>
<td>500 MVA</td>
</tr>
<tr>
<td>Minimum Oil CB [MOCB] {Dielectric oil}</td>
<td>33-245 KV</td>
<td>30000 MVA</td>
</tr>
<tr>
<td>Air Blast CB [ABCB] {Compressed air: 20kg/cm²}</td>
<td>245-400 KV</td>
<td>35000 MVA</td>
</tr>
<tr>
<td>SF₆ CB {SF₆ gas}</td>
<td>245-700 KV</td>
<td>35000-50000 MVA</td>
</tr>
<tr>
<td>Vacuum CB [VCB] {in vacuum}</td>
<td>11 KV</td>
<td>500 MVA</td>
</tr>
</tbody>
</table>
Air break Circuit Breaker

Oil Circuit Breaker (OCB)
Air Blast Circuit Breaker (ABCB)

SF₆ Circuit Breaker
Vacuum Circuit Breaker

What type of CB is this?
What type of CB is this?

Breaking current of a CB

- The rms value of current at the instant of contact separation of the CB is called breaking current.
- It is equal to the rms value of fault current in the transient period. Why?
- Expressed in KA.
Making current of a CB

- It is the rms value of current at the instant of a closing (making) of contacts of the CB on existing fault
- It is equal to the rms value of fault current in the sub-transient period. Why?