Types of lightning arresters :

1. Rod gap arrester
2. Horn gap arrester
3. Multigap arrester
4. Expulsion type lightning arrester
5. Valve type lightning arrester

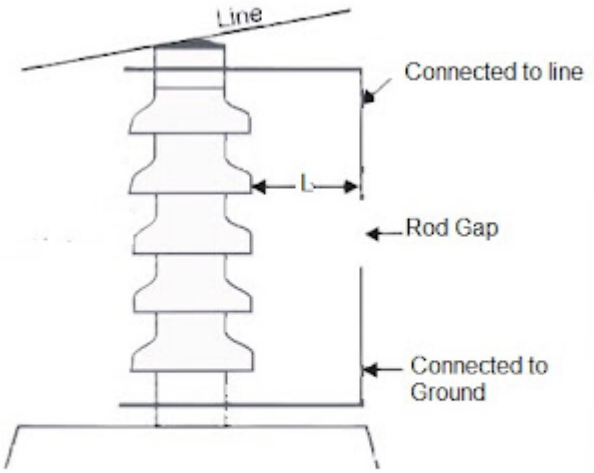
Rod Gap Arrester:-

A **Rod Gap Arrester** is a simple type of diverter used in electrical systems to protect against high voltage surges, particularly those caused by lightning strikes. Here are the key points about Rod Gap Arresters:

1. Construction:
   - The arrester consists of two 1-5 cm rods.
   - These rods are bent at right angles and placed above an insulator on an insulating base.
   - There is a gap between the rods.
2. **Operation**:
   - A rod gap arrester functions by using two metal rods, bent at right angles and separated by a specific air gap. Under normal operating conditions, this gap remains non-conductive, meaning the rods do not allow the normal supply voltage to spark across the gap. However, when a high voltage surge, such as from a lightning strike, occurs on the line, the surge voltage is sufficient to spark across the air gap between the rods.

     Once the air gap breaks down and the spark occurs, the surge current is immediately conducted through this spark to the ground, thereby protecting the equipment from the high voltage.

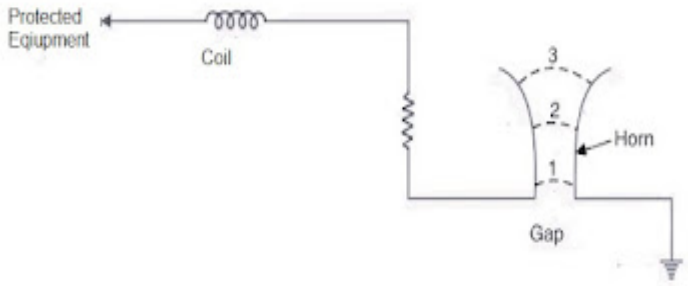
3. **Gap Length**:
   - The distance between the rod and conductor (gap length, denoted as “L”) must not be less than one-third of the distance to any nearby metal part.
   - This ensures that the gap can handle surges at more than one-third of the spark-over voltage without causing damage.



Horn gap arrester:-

Construction:

- Consists of two horn-shaped metal rods separated by a small air gap.
- Distance between the rods increases towards the top.
- Mounted on porcelain insulators.
- One end connected to the line through a resistance and choke coil, the other end grounded.



Operation:

- Under normal conditions, the air gap is non-conductive. During an overvoltage event, the air gap sparks over, creating an arc that travels upwards due to the heated air and magnetic effects. The increasing gap eventually extinguishes the arc, safely dissipating the surge to the ground.

Use:

- Typically used as a secondary line of defense in conjunction with main arresters.

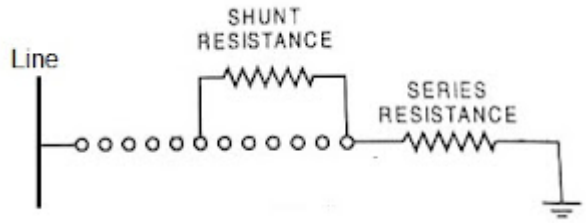
Multiple-gap arrester:-

Construction:

- It consists of a series of metallic cylinders, typically made from an alloy of zinc, which are insulated from each other.
- These cylinders are separated by small air gaps.
- One end of the series of cylinders is connected to the line, and the other end is connected to the ground through a series resistance.
- Some gaps are shunted by resistances to help manage the flow of current.

Operation:

The first cylinder in the series is connected to the line and the other to the ground through a series resistance. The series resistance limits the power arc. By the inclusion of series resistance, the degree of protection against travelling waves is reduced. In order to overcome this difficulty, some of the gaps are shunted by a resistance.



Under normal operating conditions, the voltage across each spark gap is below the breakdown voltage of the air gaps, so no current flows through the arrester. When an over-voltage event occurs, the voltage across the arrester exceeds the breakdown voltage of the air gaps. The excessive voltage ionizes the air in the gaps, causing the air to become conductive. This ionization process creates a path for the current to flow through the arrester to the ground. Once the air gaps are ionized, they effectively short-circuit the over-voltage by providing a low-resistance path to ground. This diverts the surge current away from the protected equipment.

Uses:

- Such arresters can be employed where system voltage does not exceed 33 kV.

Expulsion type lightning arrester:-

Construction:

- Consists of a rod gap in series with a second gap enclosed within a fiber tube.
- The upper electrode is connected to the rod gap, and the lower electrode is connected to the earth.

Operation:
When an overvoltage occurs on the line, an arc is struck between the electrodes inside the tube. The heat of the arc vaporizes some of the fiber tube walls, producing a neutral gas. The gas builds up high pressure and is expelled through the lower hollow electrode. The expelled gas carries away ionized air around the arc, effectively extinguishing it.

Uses: It is commonly used in systems operating at voltages up to 33 kV.

Valve type lightning arrester:-

Construction:

- The arrester comprises a series of identical spark gaps, each containing two electrodes with a pre-ionization device to facilitate the initiation of the arc.
- Each spark gap is connected in parallel with a nonlinear resistance element, which helps in the voltage grading across the gaps and enhances the device’s ability to handle surges.
- A set of resistors is connected in series and across the spark gaps to manage the voltage distribution and limit the follow current after the surge.

Working Principle

Under normal operating conditions, the voltage across the spark gaps is below the breakdown threshold, and no current flows through the arrester. During a surge

event, the voltage exceeds the breakdown voltage of the spark gaps, causing the gaps to ionize and conduct.
The surge current flows through the ionized gaps to the ground, thereby protecting the connected equipment. After the surge, the resistors limit the follow current, preventing it from maintaining the arc. The system reverts to its normal state once the surge is over.