Object-To study construction (cut-section model), working principle of different components of LT switchgear.

Theory:

Circuit Breaker:
An electrical circuit breaker is a switching device that can be operated manually or automatically for controlling and protecting the electrical power system. There are different types of circuit breakers which are based on voltage, installation location, external design and interrupting mechanism.

Miniature Circuit Breaker
There are two arrangements of operation of miniature circuit breaker. One due to thermal effect of over current and other due to electromagnetic effect of over current. The thermal operation of miniature circuit breaker is achieved with a bimetallic strip whenever continuous over current flows through MCB, the bimetallic strip is heated and deflects by bending. This deflection of bimetallic strip releases mechanical latch. As this mechanical latch is attached with operating mechanism, it causes to open the miniature circuit breaker contacts, but during short circuit condition, sudden rising of current, causes electromechanical displacement of plunger associated with tripping coil or solenoid of MCB. The plunger strikes the trip lever causing immediate release of latch mechanism consequently open the circuit breaker contacts. This was a simple explanation of miniature circuit breaker working principle.

Molded Case Circuit Breaker
A *molded case circuit breaker*, abbreviated MCCB, is a type of electrical protection device that can be used for a wide range of voltages, and frequencies of both 50 Hz and 60 Hz. The main distinctions between molded-case and miniature circuit breaker are that the MCCB can have current ratings of up to 2,500 amperes, and its trip settings are normally adjustable. An additional difference is that MCCBs tend to be much larger than MCBs. As with most types of circuit breakers, an MCCB has three main functions:

- Protection against overload – currents above the rated value that last longer than what is normal for the application.
- Protection against electrical faults – During a fault such as a short circuit or line fault, there are extremely high currents that must be interrupted immediately.
- Switching a circuit on and off – This is a less common function of circuit breakers, but they can be used for that purpose if there isn't an adequate manual switch.

Difference Between MCB and MCCB

The wide range of current ratings available from molded-case circuit breakers allows them to be used in a wide variety of applications. MCCBs are available with current ratings that range from low values such as 15 amperes, to industrial ratings such as 2,500 amperes. This allows them to be used in both low-power and high-power applications.
The main difference between the two is their capacity, with the MCB rated under 100 amps with an interrupting rating of under 18,000 amps. Consequently, their trip characteristics may not be adjusted since they basically cater to low circuits.
On the other hand, an MCCB comes with an adjustable trip characteristic for the higher models. Usually, this type of circuit breaker would provide amps as high as 2,500 or as low as 10, depending on what is necessary. Their interrupting rating ranges from around 10,000 amps to 200,000 amps.

Earth Leakage Circuit Breaker (ELCB)
An ECLB is one kind of safety device used for installing an electrical device with high earth impedance to avoid shock. These devices identify small stray voltages of the electrical device on the metal enclosures and intrude the circuit if a dangerous voltage is identified. The main purpose of Earth leakage circuit breaker (ECLB) is to stop damage to humans & animals due to electric shock.
An ELCB is a specific type of latching relay that has a structure's incoming mains power associated through

its switching contacts so that the circuit breaker detaches the power in an unsafe condition. The ELCB notices fault currents of human or animal to the earth wire in the connection it guards. If ample voltage seems across the ELCB's sense coil, it will turn off the power, and remain off until manually rearrange. A voltage sensing ELCB doesn't detect fault currents from human or animal to the earth.

Earthing

To connect the metallic (conductive) Parts of an Electric appliance or installations to the earth (ground) is called **Earthing** or **Grounding**.

In other words, to connect the metallic parts of electric machinery and devices to the earth plate or earth electrode (which is buried in the moisture earth) through a thick conductor wire (which has very low resistance) for safety purpose is known as *Earthing or grounding*.

Types of Earthing

Earthing can be done in many ways. The various methods employed in earthing (in house wiring or factory and other connected electrical equipment and machines) are discussed as follows:

1). Plate Earthing:

In plate earthing system, a plate made up of either copper with dimensions 60cm x 60cm x 3.18mm (i.e. 2ft x 2ft x 1/8 in) or galvanized iron (GI) of dimensions 60cm x 60cm x 6.35 mm (2ft x 2ft x ¼ in) is buried vertical in the earth (earth pit) which should not be less than 3m (10ft) from the ground level.

2). Pipe Earthing:

A galvanized steel and a perforated pipe of approved length and diameter is placed vertically in a wet soil in this kind of system of earthing. It is the most common system of earthing.

The size of pipe to use depends on the magnitude of current and the type of soil. The dimension of the pipe is usually 40mm (1.5in) in diameter and 2.75m (9ft) in length for ordinary soil or greater for dry and rocky soil. The moisture of the soil will determine the length of the pipe to be buried but usually it should be 4.75m (15.5ft).

3). Rod Earthing

it is the same method as pipe earthing. A copper rod of 12.5mm (1/2 inch) diameter or 16mm (0.6in) diameter of galvanized steel or hollow section 25mm (1inch) of GI pipe of length above 2.5m (8.2 ft) are buried upright in the earth manually or with the help of a pneumatic hammer. The length of embedded electrodes in the soil reduces earth resistance to a desired value.

4). Strip or Wire Earthing:

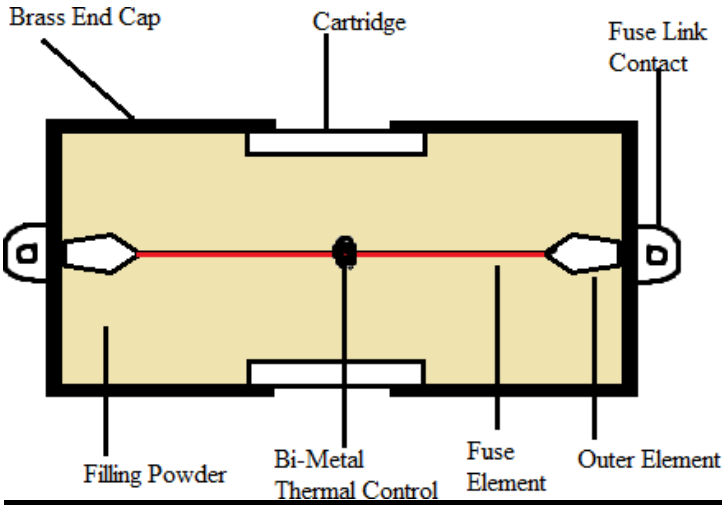
In this method of earthing, strip electrodes of cross-section not less than 25mm x 1.6mm (1in x 0.06in) is buried in a horizontal trenches of a minimum depth of 0.5m. If copper with a cross-section of 25mm x 4mm (1in x 0.15in) is used and a dimension of 3.0mm^2 if it's a galvanized iron or steel.

Fuses

Fuses are the protectors, these are the safety devices which are used to protect the home appliances like televisions, refrigerators, computers with damage by high voltage. The fuse is made up of thin strip or strand of metal, whenever the heavy amount of current or an excessive current flow is there in an electrical circuit, the fuse melts and it opens the circuit and disconnects it from the power supply.

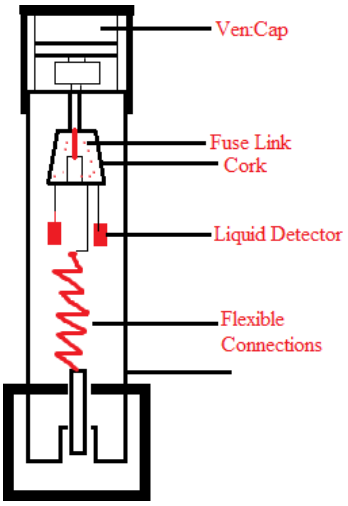
Types

- **Rewireable/ Kit-Kat Type:-** In this type of fuse, the main advantage is that the fuse carrier is easier to remove without having any electrical shock or injury. The fuse base acts as an incoming and outgoing terminal which is made up of porcelain & fuse carrier is used to hold the fuse element which is made up of tin, copper, aluminum, lead, etc. This is used in domestic wiring, small industries etc.
- **Cartridge Type HRC Fuses:-** It is similar to low voltage type, only some designing features are different.



Cartridge Type HRC Fuses

- **Liquid Type HRC Fuses:** These are used for circuit up to 100A rated current& systems up to 132Kv. These fuses have the glass tube filled with carbon tetrachloride. The one end of the tube is packed and another is fixed by phosphorous bronze wire. When fuse operation starts, the liquid uses in the fuse extinguish the arc. This increase the short circuit capacity.



Liquid Type HRC Fuse

Result:

We have studied different types of circuit breakers, earthing and fuses and their applications.