SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

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DEPARTMENT OF BIOMEDICAL ENGINEERING

COURSE NAME: 23EET103/ ELECTRIC CIRCUITS AND ELECTRON DEVICES

I YEAR / II SEMESTER

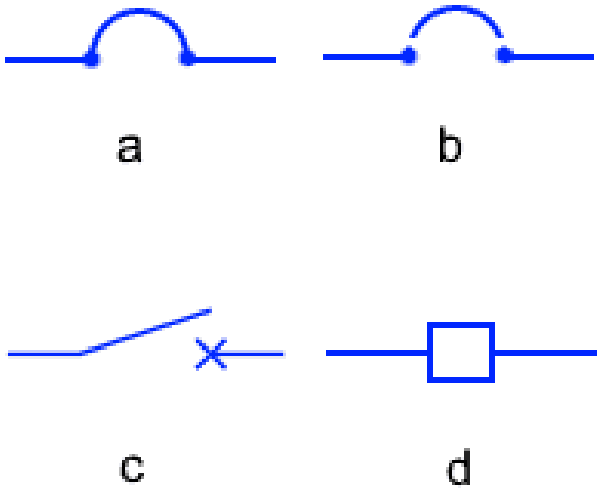
Unit III – ELECTRICAL WIRING AND SAFETY

Topic : Circuit Breakers (MCB & ELCB),Electronic Fuses

CIRCUIT BREAKER

A CB (Circuit breaker) is a device which:

- Control (make or break) a circuit manually or by remote control under normal and fault conditions.
- Break a circuit automatically under fault conditions (like overcurrent, Short circuit, etc.).

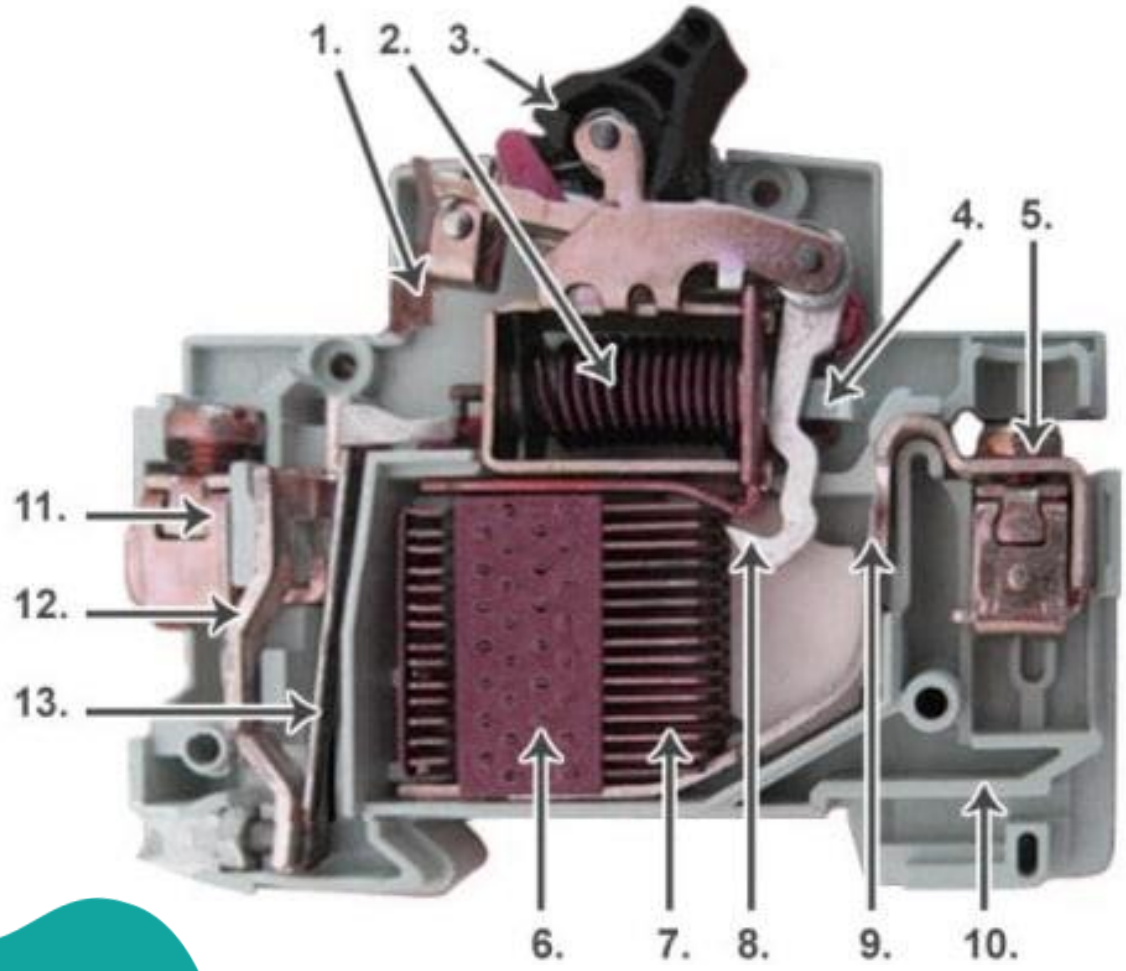


Circuit Breaker Symbols

MCB (Miniature Circuit Breaker)

- It is designed to turn off electrical circuits automatically if there is a fault in the circuit, such as an overload or a short circuit.
- MCB is much more sensitive to over current than a fuse.
- Trip characteristics may not be adjusted.
- Working principle based on thermal or thermal magnetic operation.
- Suitable for low current circuits (low energy requirement), i.e. home wiring.
- Generally, used where normal current is less than 100 Amps.

MCB (Miniature Circuit Breaker)



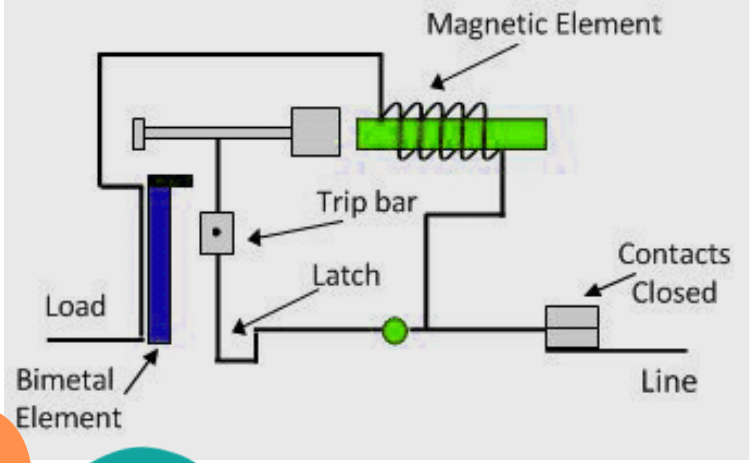
1. Latch
2. Solenoid
3. Switch
4. Plunger
5. Incoming Terminal
6. Arc Chutes Holder
7. Arc Chutes
8. Dynamic Contact
9. Fixed Contact
10. Din Rail Holder
11. Outgoing Terminal
12. Bi-metallic Strip Carrier
13. Bi-metallic Strip

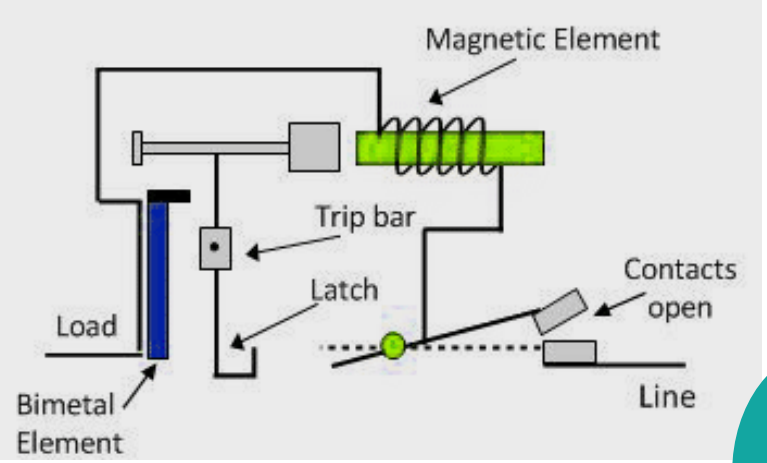
MCB - Construction

- **Main contacts:** These are the contacts that carry the load current and are connected to the incoming and outgoing wires of the circuit.
- **Trip Unit:** This is the core component of an MCB, which monitors the current flowing through the circuit and trips the breaker in case of an over-current or short-circuit. The trip unit consists of a bimetallic strip, a magnetic actuator, and an operating mechanism.
- **Terminal:** These are the connections for the incoming and outgoing wires.
- **Housing:** The housing is the protective casing that houses the MCB components and provides insulation between live parts and other electrical components.
- **Trip Indicator:** An MCB typically has a visual indicator that shows whether the breaker is in the “on” or “off” position.
- **Auxiliary contacts:** Some MCBs have additional contacts that can be used to switch auxiliary loads or provide signaling functions.
- **Trip spring:** This is the spring mechanism that holds the MCB contacts in the “on” position. When the trip unit operates, the trip spring releases, allowing the contacts to separate and break the circuit.

MCB - Working

- When the current overflow occurs through MCB, the bimetallic strip gets heated and deflects by bending.
- The deflection of the bi-metallic strip releases a latch.
- The latch causes the MCB to turn off by stopping the current flow in the circuit.
- This process helps safeguard the appliances or devices from the hazards of overload or over current.





MCB - Working

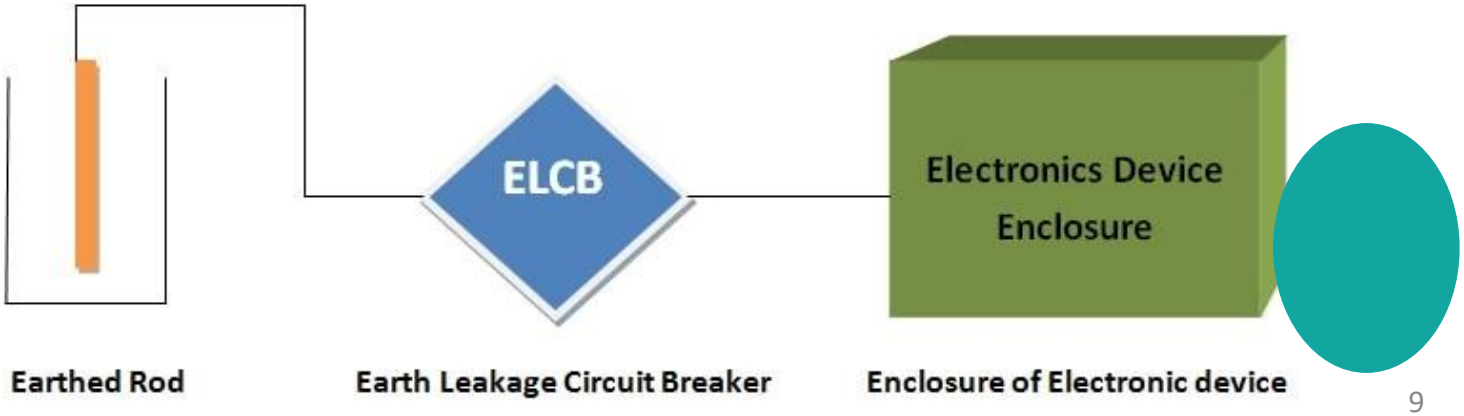
- To restart the current flow, MCB must be turned ON manually.
- In the case of short circuit conditions, the current rises suddenly in an unpredictable way, leading to the electromechanical displacement of the plunger associated with a solenoid.
- The plunger hits the trip lever, which causes the automatic release of the latch mechanism by opening the circuit breaker contacts.
- An MCB is a simple, easily operable device and is maintenance-free too.
- MCB can be easily replaced.
- The trip unit is the key part of the MCB on which the unit operates.
- The bi-metal present in the MCB circuit protects against overload current, and the electromagnet in the circuit protects against short-circuit current.

ELCB (Earth Leakage Circuit Breaker)

- It is used for protecting a person from electric shock and injury.
- The needs of these devices arise because of the number increasing in injuries as well as deaths because of electric shock.
- As name suggest, its operated on earth leakage current.
- Line (Phase or Live), Neutral (N) and Earth Wire connected to the load points through ELCB.
- ELCB is also known as RCD (Residual Current Device)

ELCB Construction and Operation

- It is international standard that each electronics device enclosure should be earthed.
- For proper operation of ELCB, its need to bury a metallic rod deep in the soil and ELCB is connected between the wire coming from the rod to the wire attached to the external metallic body of the Electrical device.
- When the live wire (accidentally) touches the metallic body of the connected device or appliance, then there is potential generated between the earthed rod and the metallic enclosure of that device.
- The circuitry (inside the ELCB) senses the potential difference and when this potential difference reached at 50volt then ELCB cuts off the main supply from the connected device.



Electronic Fuses

- An electrical fuse is a safety device that operates to provide protection against the overflow of current in an electrical circuit.
- An important component of an electrical fuse is a metal wire or strip that melts when excess current flows through it.
- It helps to protect the device by stopping or interrupting the current.
- Apart from protecting equipment, they are also used as safety measures to prevent any safety hazards to humans.
- Under normal conditions, the fuse wire is a part of the circuitry, contributing to a complete loop for charges to flow through it.
- However, when an excessive amount of current flows through the fuse wire, the heating effect of the current causes the fuse wire to melt.

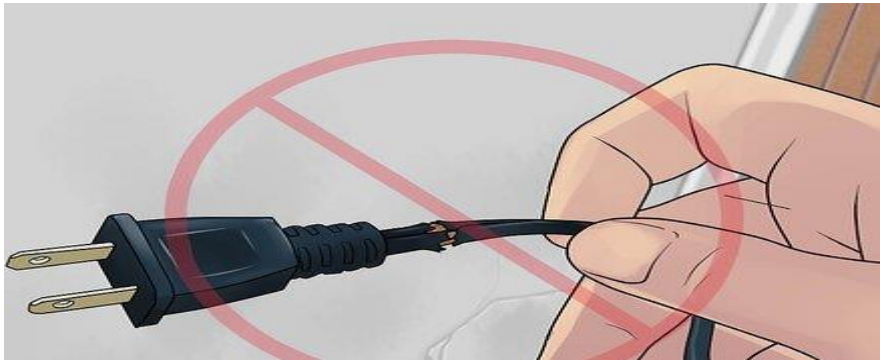

Symbol of Fuse

Safety: Causes of Accidents and Accident Prevention in Wiring and Grounding

- Accidents in electrical systems often occur due to a combination of human error, faulty equipment, poor maintenance, and unsafe environmental conditions.
- Human errors such as improper handling of electrical devices, lack of awareness, and negligence in following safety protocols are common causes.
- Additionally, the use of substandard or damaged equipment, along with improper wiring practices like loose connections or incorrect wire sizing, significantly increases the risk of accidents.
- Poor maintenance, such as failing to inspect and repair aging systems, and environmental factors like moisture or exposure to flammable materials, further contribute to hazardous situations.

Safety in Wiring and Grounding

- To prevent such accidents, proper wiring and grounding are essential. Grounding provides a safe path for excess electrical current to flow into the earth, reducing the risk of electric shock and equipment damage.
- Using high-quality materials, ensuring proper insulation, and selecting the correct wire gauge help maintain system integrity.
- Circuit protection devices like fuses, circuit breakers, and residual current devices (RCDs) play a crucial role in disconnecting power during faults.

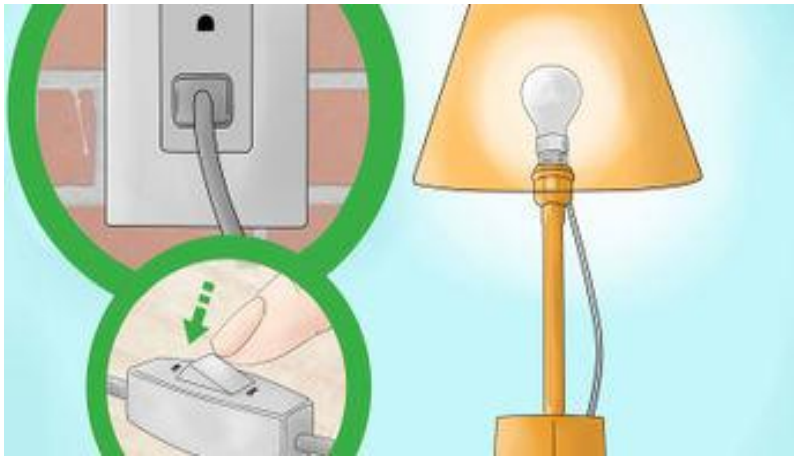


Safety in Wiring and Grounding

- Regular inspection, timely maintenance, and adequate training for personnel are vital for maintaining a safe electrical environment. Overloading of circuits should also be avoided by evenly distributing electrical loads.
- Implementing these safety measures can greatly reduce the chances of electrical accidents and ensure the protection of both people and equipment.

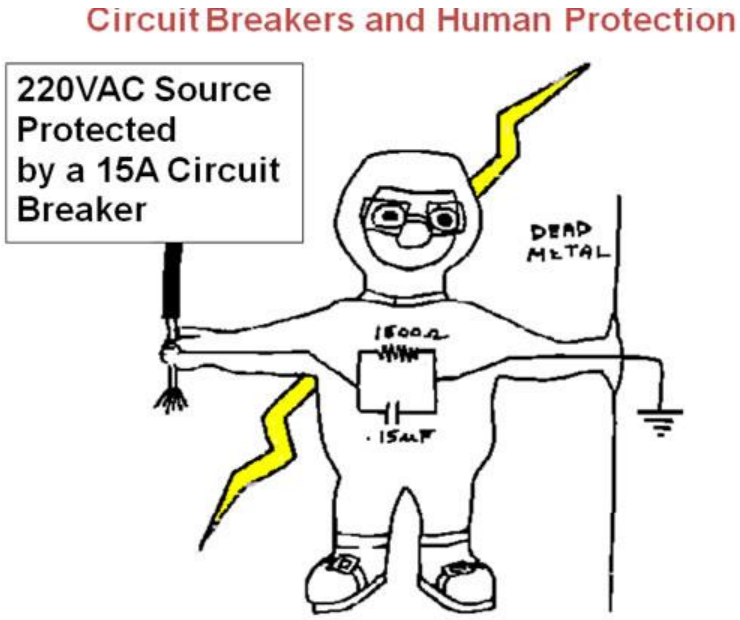
Accident Prevention in Wiring and Grounding

- Circuit breakers play a vital role in maintaining electrical safety and preventing accidents. They are designed to automatically interrupt the flow of electricity when a fault such as an overload, short circuit, or ground fault is detected.
- By cutting off the power supply instantly during such conditions, circuit breakers help prevent electrical fires, equipment damage, and electric shocks.



Accident Prevention in Wiring and Grounding

- Unlike fuses, which must be replaced after a fault, circuit breakers can be reset and reused, making them more convenient and reliable.
- Their quick response to abnormal electrical conditions ensures the protection of both people and property, making them an essential safety component in residential, commercial, and industrial wiring systems.



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