

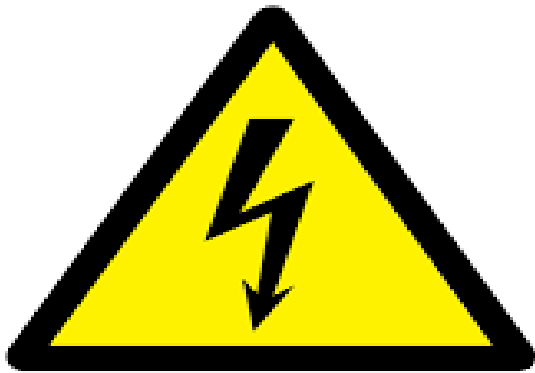
ELECTRICAL SAFETY DEVICES

Dr. H. K. Verma

Distinguished Professor (EEE)
Sharda University, Greater Noida

(Formerly: Deputy Director and Professor of Electrical Engg.
Indian Institute of Technology Roorkee)

Electricity Danger Signs



**Warning
electricity**



Electricity Danger Signs



Electrical Safety : Against What?

A. Safety against electric shocks

B. Safety against electric fire

A. Safety of equipment

Various Electrical Safety Devices

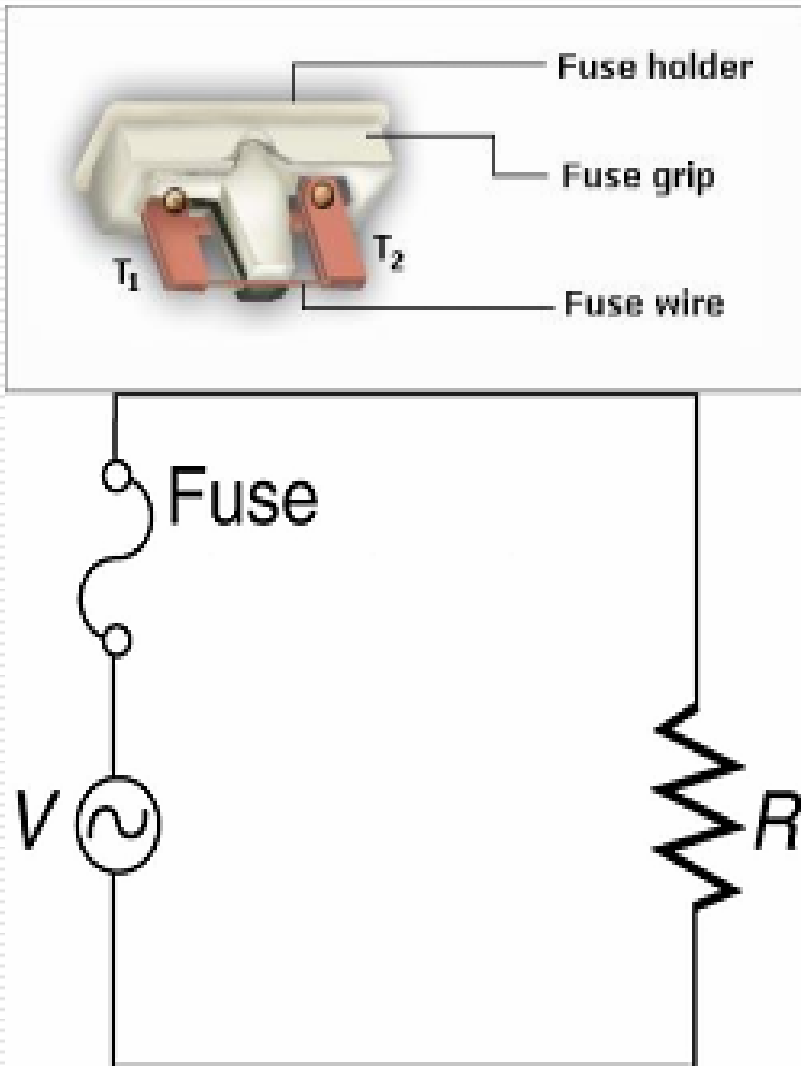
In Consumer's Premises

- Electric Fuse
- Miniature Circuit Breaker (MCB)
- Residual-Current Circuit Breaker (RCCB)

In Substations

- HRC Fuse
- Moulded-Case Circuit Breaker (MCCB)
- Relay plus Circuit Breaker (Relay + CB)

Electric Fuse



- Protects appliance or equipment when too much current flows due to
 - Overload, or
 - Fault
- Has a thin wire or strip of metal that melts when too much current flows through it.

Electric Fuse Types

1. Semi-Enclosed Fuse / Kit-Kat fuse:

- The fuses which can be opened and re-wired

2. Fully Enclosed Fuse/ Cartridge fuse:

- Enclosed in a glass tube or porcelain tube
- Whole unit is sealed off
- In case the fuse blows, needs to be replaced by new one
- It can not be rewired

Electric Fuse Types

Kit-Kat fuse



Cartridge Fuses



MCB

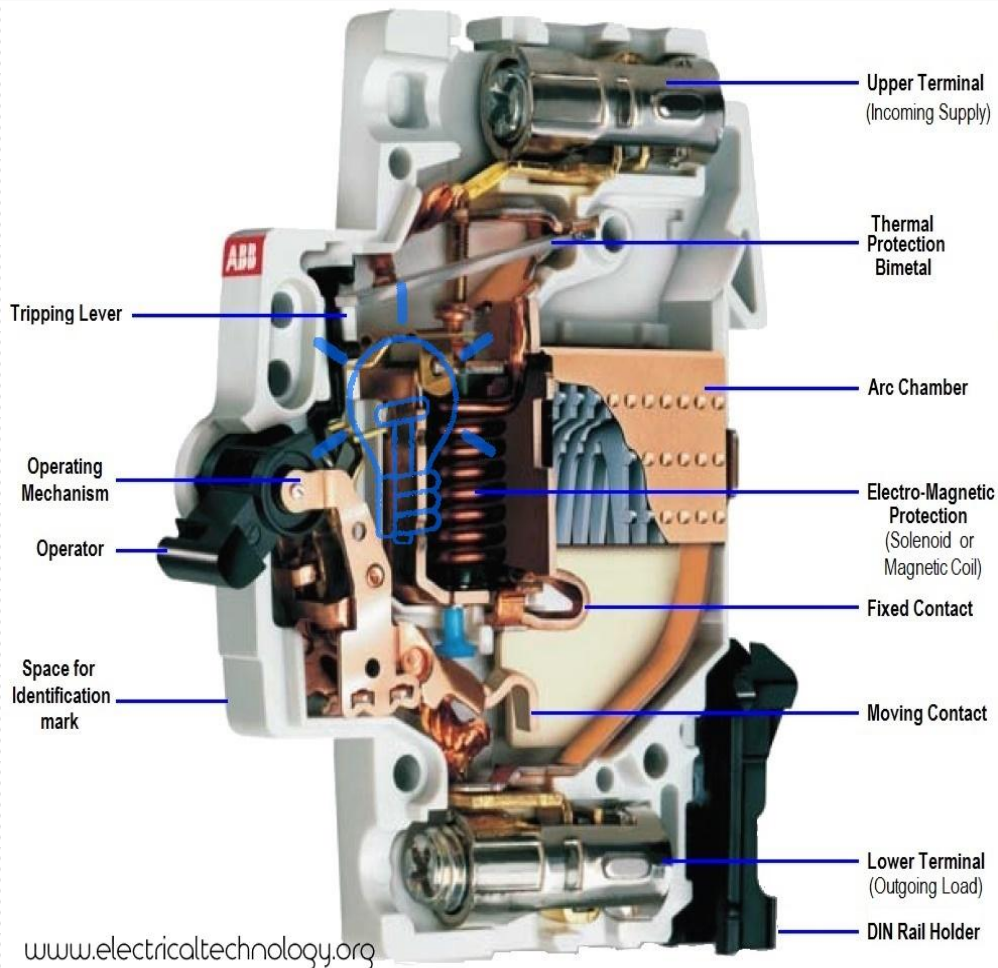


- ✓ Used as control switch with built-in fault and overload protection
- ✓ Single-pole, double-pole, 3-pole and 4-pole MCBs used as per need
- ✓ Rated at 220V for DC supply and 240/415 for AC supply (single and three-phase)
- ✓ Load current range up to 100A



Source : www.electricaltechnology.org

MCB: Operating Mechanism



✓ Operating mechanism consists of:

- Magnetic tripping arrangement
- Thermal tripping arrangement

Source : www.electricaltechnology.org

MCB Types

- ✓ Three major types according to their instantaneous tripping currents:
 - *Type B MCB*
 - *Type C MCB*
 - *Type D MCB*

MCB Type	Minimum Trip Current	Maximum Trip Current
Type B	3 Ir	5 Ir
Type C	5 Ir	10 Ir
Type D	10 Ir	20 Ir

Type B MCB



- ✓ This type of MCB will trip instantly at three to five times its rated current
- ✓ Normally used for resistive or small inductive loads where switching surges are very small
- ✓ Therefore, suitable for residential or light commercial installations

Type C MCB



- ✓ This type of MCB will trip instantly at five to ten times its rated current
- ✓ Normally used for high inductive loads where switching surges are high, such as small motors and florescent lighting
- ✓ Therefore, suitable for highly inductive commercial and industrial installations

Type D MCB



- ✓ This type of MCB will trip instantly at ten to twenty times its rated current
- ✓ Normally used for very high inductive loads, where high inrush current are very frequent
- ✓ Therefore, suitable for specific industrial and commercial applications
- ✓ Common examples are x-ray machines, industrial welding equipment, large winding motors, etc.

MCB Selection: Three Factors

1. *Nominal rating of MCB*

- This is the rated ampere current rating of MCB
- Must be \geq maximum full load current in the circuit

2. *KA rating or breaking capacity*

- This rating refers to the capability of MCB to trip or interrupt the circuit under short circuit conditions
- Must be \geq prospective short-circuit current in circuit

3. *Type of MCB as per application*

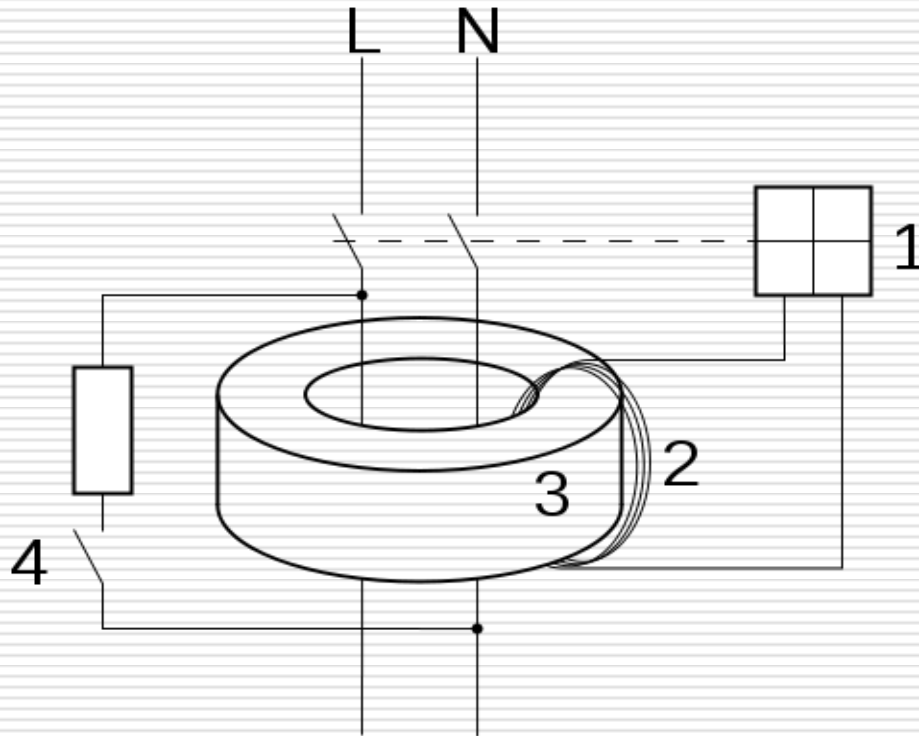
- *Type B*: residential or light commercial installations
- *Type C*: highly inductive commercial and industrial installations
- *Type D*: specific industrial and commercial applications, like x-ray machines, industrial welding equipment, etc.

RCCB : Example



- ✓ Two-pole Residual-Current Device (RCD) or Residual Current Circuit Breaker (RCCB)
- ✓ The test button and connect/disconnect switch are colored blue
- ✓ A fault will trigger the switch to its down (off) position, which in this device would disconnect both conductors.

RCCB : How does it work?



- 1: Electromagnet with help electronics
- 2: Current transformer secondary winding
- 3: Transformer core
- 4: Test push-button

L: Line conductor

N: Neutral conductor