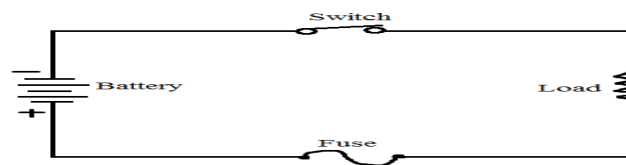


Fuses

Introduction:

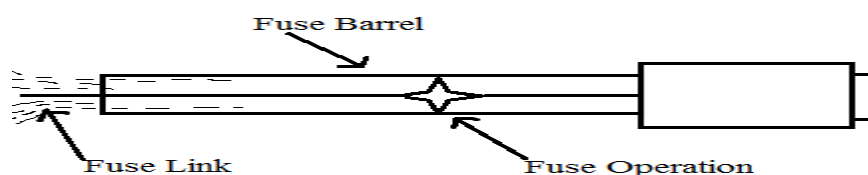
Fuses are the protectors, these are the safety devices which are used to protect the home appliances like televisions, refrigerators, computers with damage by high voltage.

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. Also, it works as a circuit breaker or stabilizer which protects the device from damage. In the market, many types, features, and design of fuses are available nowadays. Their strips are made up of aluminum, copper, zinc & it is always connected in series with the circuit to protect from overcurrent in the running cables. Here is the basic circuit diagram & symbol of the fuse.



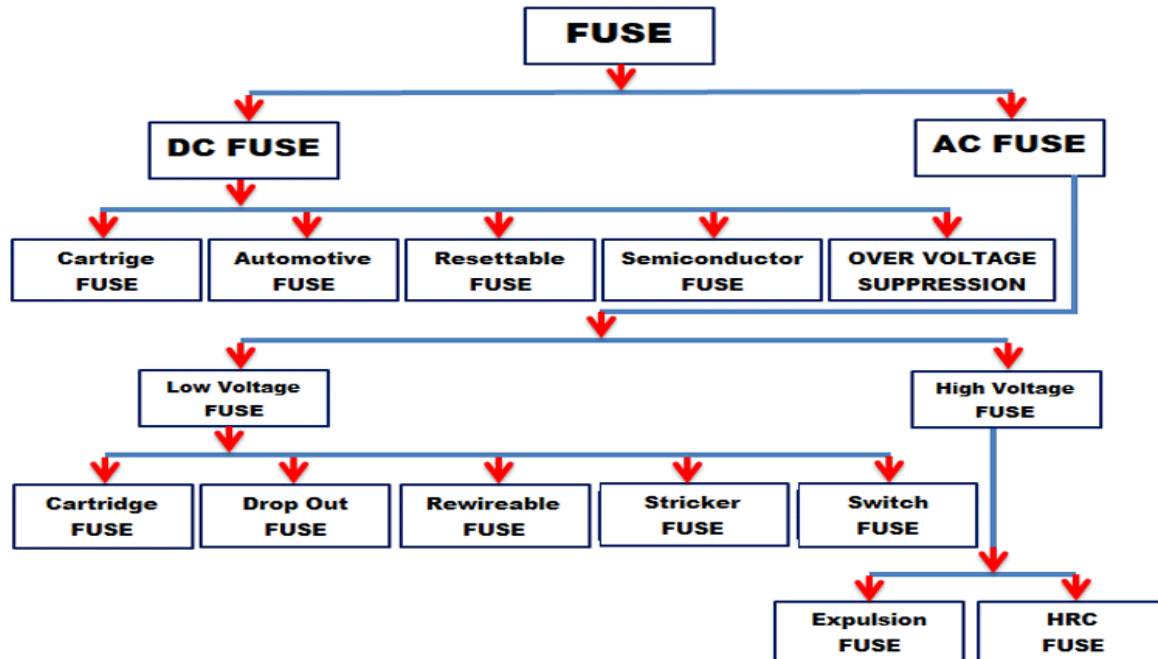
The theory of operation:

The fuses work on the principle of the heating effect of the current. It's made up of thin strip or strand of metallic wire with noncombustible material. This is connected between the ends of the terminals. Fuse is always connected in series with the electrical circuit. When the excessive current or heat is generated due to heavy current flows in the circuit, the fuse melts down due to the low melting point of the element and it opens the circuit. The excessive flow may lead to the breakdown of wire and stops the flow of current. The fuse can be replaced or changed with the new one with suitable ratings. The fuse can be made up of the element like zinc, copper, silver & aluminum.



Different types of fuses :

Fuses can be divided into two major categories, AC fuses, and DC fuses. The below block diagram illustrates the different types of the fuse under each category



Dc fuses:

1-CARTRIDGE fuses

This is the most common type of fuse. The fuse element is encased in a glass envelope that is terminated by metal caps. The fuse is placed in an appropriate holder. Since the glass envelope is clear, it is easy to visually determine if the fuse is blown.



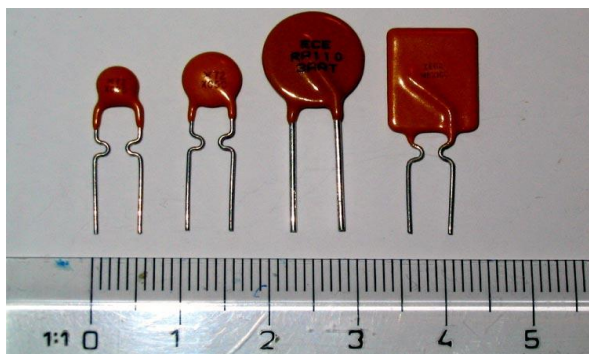
2-AUTOMOTIVE FUSES:

These fuses are specifically designed for automotive systems that run up to 32V and occasionally 42V. They come in 'blade' form (a transparent plastic envelope with flat contacts) and are colour coded according to rated current. Some of these types are also used in other high-power circuits.



3-RESETTABLE FUSES/POLYFUSE :

these fuses are self-resetting. They contain carbon black particles embedded in organic polymers. Normally, the carbon black makes the mixture conductive. When a large current flows, heat is generated which expands the organic polymer. The carbon black particles are forced apart, and conductivity decreases to the point where no current flows. Conductivity is restored as temperature decreases. Thus, the fuse does not have to be physically replaced. This kind of fuse is also called a PTC, meaning positive temperature coefficient, since resistance increases with temperature.



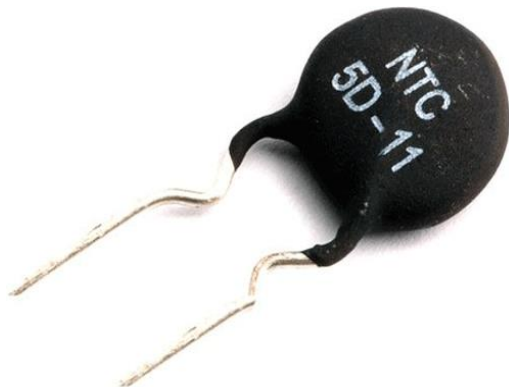
4-SEMICONDUCTOR FUSES

The power dissipated by a semiconductor increases exponentially with current flow, and hence semiconductors are used for ultrafast fuses. These fuses are usually used to protect semiconductor switching devices that are sensitive to even small current spikes.

5-OVERVOLTAGE SUPPRESSION

Sometimes voltage spikes can be harmful to circuits too, and often an overvoltage protection device is used with a fuse to protect against both voltage and current spikes.

NTCs (negative temperature coefficient) are placed in parallel with the supply. When the supply voltage spikes, NTC Fuses decrease resistance due to higher current flow and 'absorb' spikes.



AC FUSES:

1-Cartridge fuses

They are very similar to cartridge DC fuses. They consist of a transparent envelope surrounding the fuse element. They can be plugged in (blade type) or screwed into a fixture (bolt type).

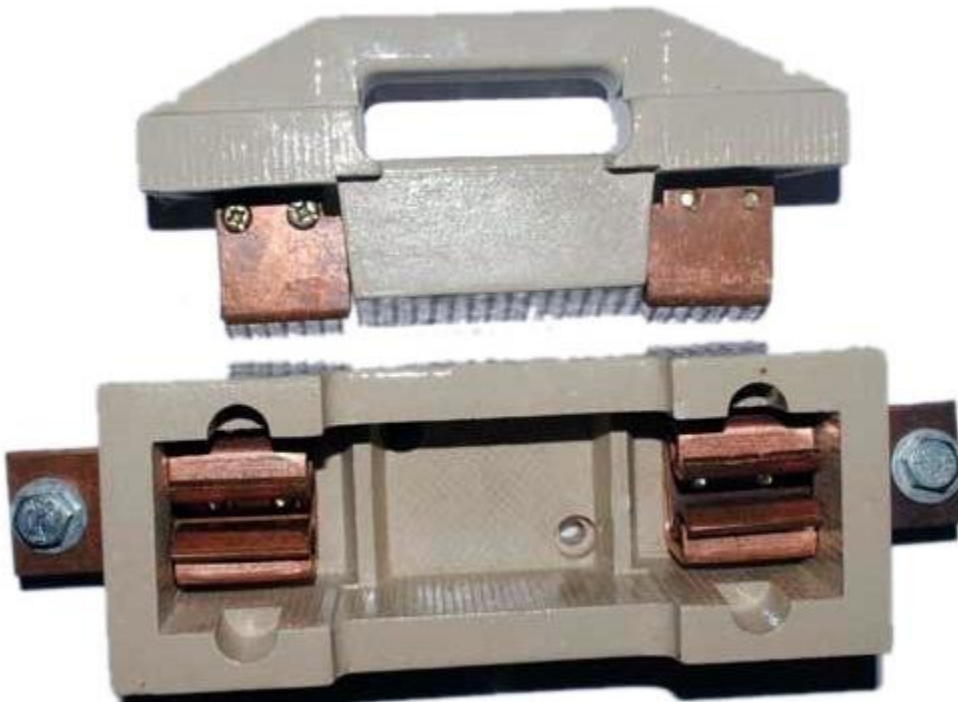
2-Drop out fuses

They contain a spring-loaded lever arm that retracts when a fault occurs and must be rewired and put back in place to resume normal operation. They are a type of expulsion fuse.



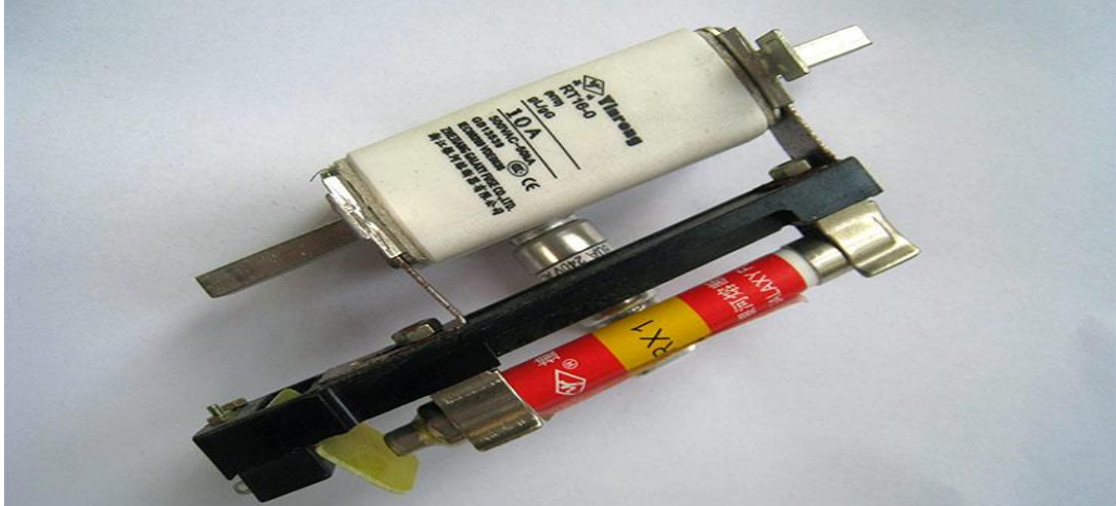
3-Rewireable fuses

They are a simple reusable fuse used in homes and offices. They consist of a carrier and a socket. When the fuse is blown, the carrier is taken out, rewired and put back in the socket to resume normal operation. They are somewhat less reliable than HRC fuses.



4-Striker fuse:

These fuses are provided with a spring-loaded striker that can act as a visual indicator that the fuse has blown and also activate other switchgear.



5-Switch fuse

A handle that is manually operated can connect or disconnect high current fuses.



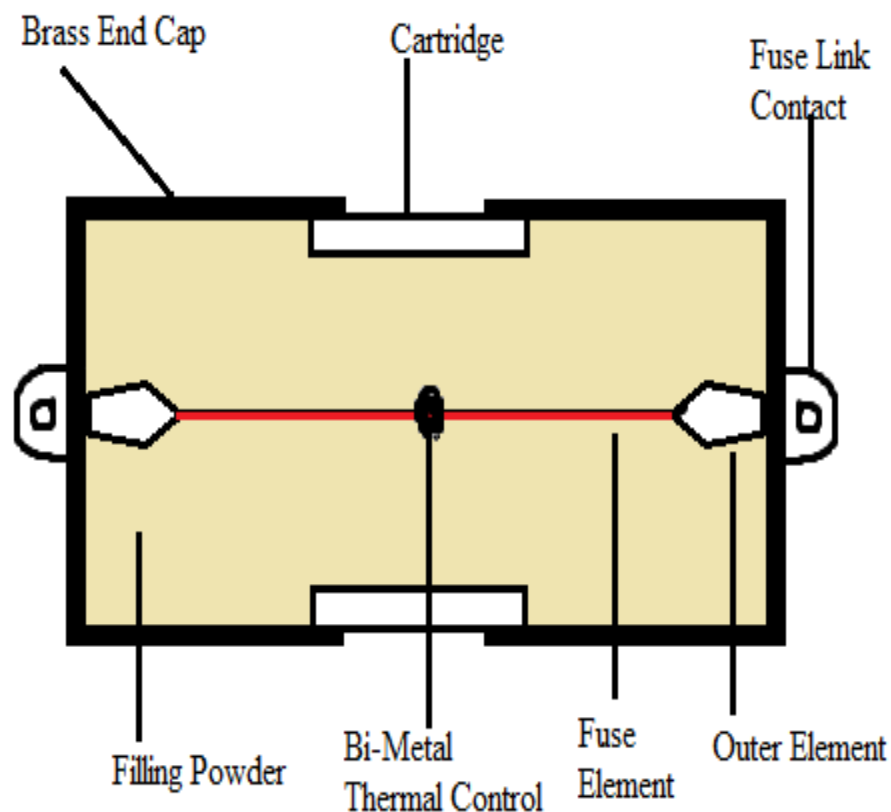
2. High Voltage Fuses (HV):

All types of high voltage fuses are used upon the rated voltage up to 1.5 Kv to 138 Kv. High voltage fuses are used to protect the instrument transformers & small transformers. It is made up of silver, copper & tin. When heat generated, the arc produces which causes the boric acid to evolve high amount of gases. That's why these are used in outdoor places.

These are of three types which are as follows:-

1-Cartridge Type HRC Fuses

:- It is similar to low voltage type, only some designing features are different.



2-Expulsion Type HRC Fuses:

It is the escapable fuse, in which expulsion effect of gases produced by internal arcing. In this, the fuse link chamber is filled with boric acid for expulsion of gases.

Features of a Fuse:

The important parameters that must be considered while selecting suitable Fuses are:

1-Current Rating

2- I^2T value

3-Voltage Rating

4-Operating Temperature

1-Current Rating:

This is the current carrying capacity of a fuse measured at normal conditions and temperature. Before adopting this technique, one must make sure that circuit components are able to withstand the overload of current before the fuse act its role.

With this whenever there is a sudden increase of current only the fuses will blow out. Make sure that the circuit's current is 75% (generally) of your fuse's current rating.

Current Circuit = 75% of Current Rating of Fuse

2- I^2T Value of Fuse:

This is also called as Melting Current. When the current increases in the circuit, the melting time of the element decreases. This is because the power dissipation and the temperature increase rapidly. In short, the product of square of the current in the circuit should be less than I^2T value of the device.

I^2T Circuit = I^2T Device

3-Voltage Rating

Voltage rating for the Fuses are mainly considered for safety reasons for the circuit as well as the environment. It is because an explosion may take place and might trigger fire if the open circuit voltage is higher than that of the device when fuses open up.

4-Temperature

Temperature affects the capacity of Fuses. When the operating temperature is high, the current capacity will decrease and it melts early. Hence, the current capacity in the fuse is directly proportional to the operating temperature

importance of fuses in electric circuit:

A fuse(s) is needed in any electrical system (AC or DC). These protection devices react to the amount of heat being produced by electricity passing through wires and/or components. They are used so as to protect wires and components from the extreme heat produced should there be an electrical overload or short circuit.

Applications :

The applications of Fuses include nearly all electrical/ electronic devices such as:

1-Electrical wiring at home.

2-Appliances like AC, Refrigerator, TV, Washing machine etc.

3-Laptops.

4-Mobile chargers.

5-Automobiles (Cars, Trucks, Buses, etc).