Electronic Valve: Diode

The electric valves are named according to the number of electrode the contain.

(i) Diode : Two electrodes

(ii) Triode : Three electrodes

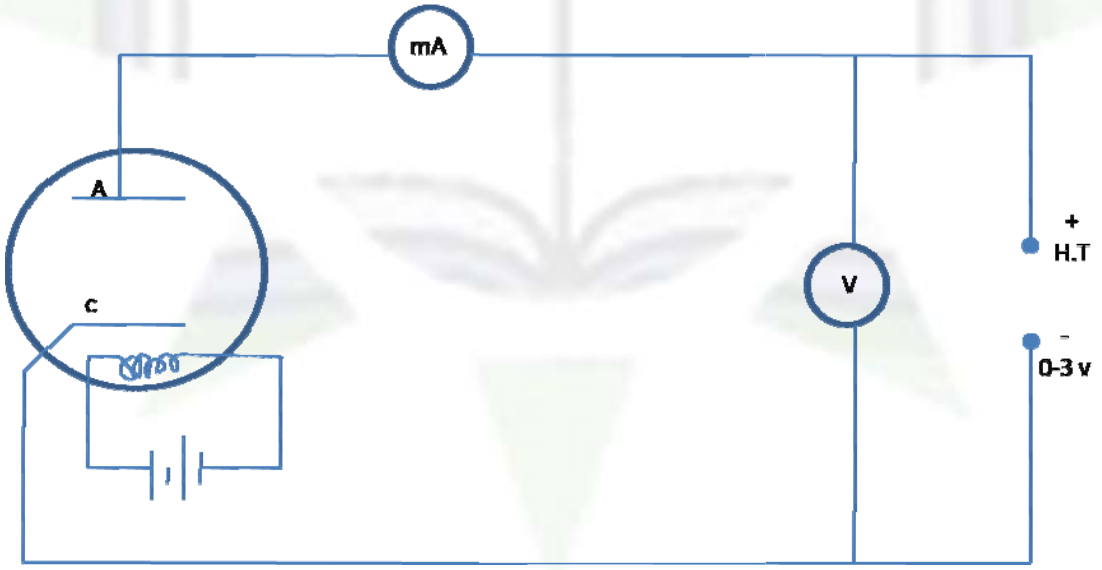
(iii) Tetrode: Four electrodes

(iv) Pentode: Five electrodes

The valves are based on the principle of thermionic emission (gas filled diode)

Construction:

It consists of cylindrical tube of the emitting electrode such as thoriated tungsten or thorium oxide, which can easily emit electrons when heated. Inside the cylindrical tube a filament is kept which is heated by passing a current through it using a D.C source (battery of 5 to 6 volt) when the filament is heated it indirectly heats the cathode and electrons are emitted. In order to collect the electrons surrounding the cathode a metallic plate of iron oxide or copper oxide is kept and known as plate or anode. The whole thing is enclosed in a none conducting envelop, which is highly evacuated at a pressure as low as 10^{-7} mm of Hg.



Action of diode: On heating the filament the cathode is heated and the electrons are emitted. In order to collect the electrons by the plate the plate is to be kept at (+) ve potential with respect to the cathode. The electrons flow through the plate circuit giving plate current i_p or anode current i_a . The current is in mille ampere range and is measured by the millimetre.

For a given filament current the cathode emits a constant number of electrons per second. For a given plate voltage V_p (the potential difference applied between the plate and the cathode) the plate can collect a certain number of electrons per second, giving a certain plate current. If the plate voltage is increased the plate collects more and more electrons per second and hence the plate current increases. If we go on increasing plate voltage a time comes when the plate collects all the electrons emitted per second from the cathode. If the plate voltage is increased still further since number of emitted electrons per second is constant hence the plate cannot collect more electrons per second and the plate current becomes constant. This is known as saturation current I_S . A diode is generally not operated in the saturation region. The variation of i_p with V_p cannot be given by Ohm's law and is given by child-Lagmuir law.

$$I = KV^{3/2}$$

Below the saturation region i.e. when applied plate voltage is low the plate cannot collect all electrons that are emitted per second. The un collected electrons gather inside the bulb within very very short time the accumulated electrons becomes very large in number and the negative charge of these electrons in the space inside the bulb is known as space charge, within a very short time the accumulated space charge becomes so high that it repels back any fresh electron that are emitted from the cathode. Thus the space charge now takes the control of emission of electrons from the cathode. For the given plate voltage the plate collets the electrons from the space charge and the space charge allows as many electrons to be emitted from the cathode as are collected by the plate from the space charge so that the amount of space charge remains constant. The valve is then said to operate under space charge limitation. Generally the valves are operated in the space charge region.

What happens when the plate is kept at negative potential with respect to the cathode?

When the plate is kept at negative potential with respect to the cathode no plate current flows through the circuit electrons emitted from the cathode will not be attracted by the plate and hence no electron will be able to reach the plate, the plate current becomes zero. Thus diode allows current to flow in one direction only and due to this uni-directional flow it is known as valve.