Development in Electronics

Methods to generate/produce electrons.

1. Photoemission: when light of particular wavelength fall on specific materials, electrons are produced. These electrons are called photoelectron.
example:- Solar Cell, photodiode, alkali metals.
For this effect energy of light wave is equal to or exceeding the work function of photoelectric material.

2. Thermionic emission:-
when some materials are heated, then liberation of electrons by virtue of its temperature. This occurs because the energy given to the charge carriers (electrons) overcomes the work function of the material. Mathematically the equation which gives the current density of electrons is expressed as

$$J = AT^2 e^{-\phi_w / k_B T}$$

where T is absolute temperature.
k_B is Boltzman constant.
ϕ_w - work function
e - electron charge
A - is constant.

3. Cold Field emission:-

In this a very field is applied across the material, then electrons are ejected.

1st generation electronic device:

First electronic device is based upon the phenomen of thermionic emission. First device was Vacuum Tube diode. Diode means two electrodes. one electrode is used to produced electrons, known as cathode, and the other one collects the electron, called Anode or plate.

Both these electrodes are cylindrical in shape and enclosed by glass envelope. Vacuum is created in the glass envelope, as shown in figure below. (fig 1).

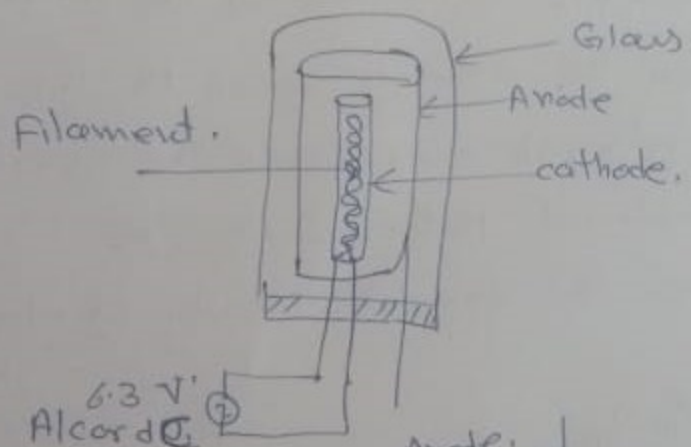
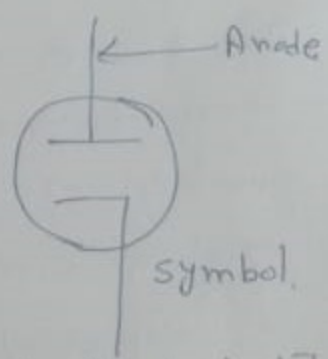
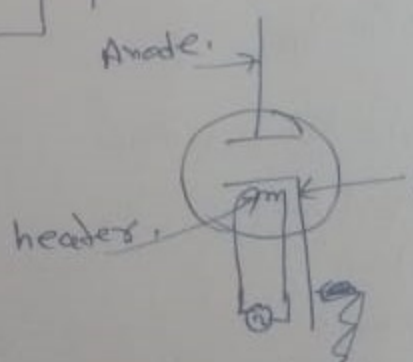


Fig (1).



[Directly heated cathode]
symbol of diode.

Fig 2(a).



[Indirectly heated cathode]

Fig (2b).

Cathode may be directly heated fig (2a) and indirectly heated fig (2b).

Other vacuum tube are.

Triode:- Means three electrode vacuum tube device as shown below in fig (3).

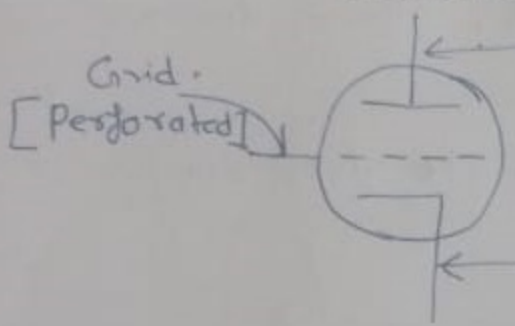


Fig (3).

1. Anode:- Collects electron.
2. Grid:- Controls the no. of electrons reaching to anode.
3. Cathode:- Produced electrons.

Tetrode: Four electrodes. This has two grids. as shown in fig (4).

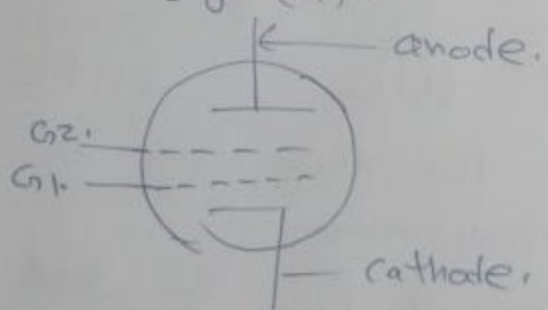


Fig (4).

Tube action.

A diode is connected to a voltage source as shown in fig. (5), in such a way that plate is at positive potential and cathode is connect to -ve terminal of ~~the~~ voltage source, or at -ve. potential.

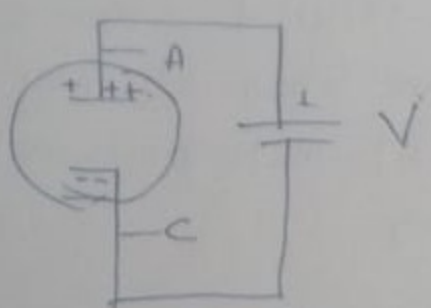


Fig (5).

when filament is heated electron are produced and collected by plate, because plate is at +ve potential, and current flows through the device.

Drawbacks:

Instruments made from vacuum tubes were bulky, heavy, and produce heat. These devices consume power in W or kW.

These can not be used at highe frequency operations, because anode and cathode also act as a capacitor, or tube has some capacitance.

Inpedance is given by

$$X_C = \frac{1}{2\pi C} = \frac{1}{2\pi f C}.$$

when f is the frequency of operation.

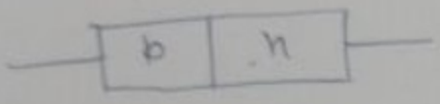
C → is capacitance.

For high value of f, X_C ~~dec~~ decreases,

$f \to \infty$, $X_C \to 0$. This means tube gets short circuited. Hence we can not use vacuum tubes at very high frequency. This is one of major drawbacks of vacuum tube devices.

II generation electronic devices:

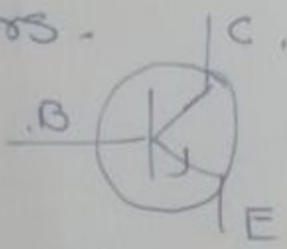
Semiconductor devices. 1 p-n junction diodes, Transistors.



(diode).

n-type - equivalent to cathod.
p-type → equivalent to anode

~~p-n junction~~



(Transistor). Three electrodes,
E → emitter, equivalent to cathode.
B → Base :- equivalent to Grid.
C → collector - equivalent to plate.

Light in weight, small size, low power consumption in (mw). high frequency operating range.

III - Generation electronic devices.

IC's :- Integrated circuits. It means all components in one chip. except Inductors.

① very small in size. ② very high frequency range.
③ low power consumption. ④ when ~~three~~ IC's are used, we have to use power supply pins, Input pins and output pin. what is inside the IC/ ~~use~~ components inside the IC, we don't know. So very ~~to~~ easy to use.