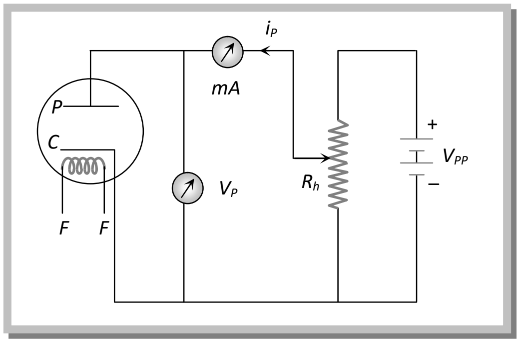
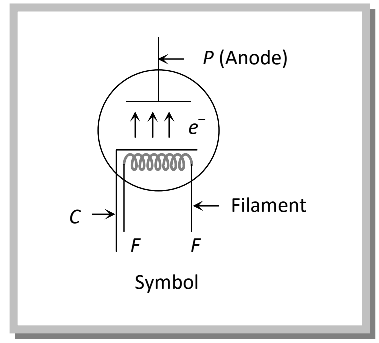
Diode Valve.





Inventor: Fleming

Principle: Thermionic emission

Number of electrodes: Two

Working: When plate potential (V_p) is positive, plate current (i_p) flows in the circuit (because some emitted electrons reaches to plate). If + V_p increases i_p also increases and finally becomes maximum (saturation).

Note: If $V_p \rightarrow$ Negative; No current will flow

If $V_p \rightarrow$ Zero; current flows due to very less number of highly energized electrons

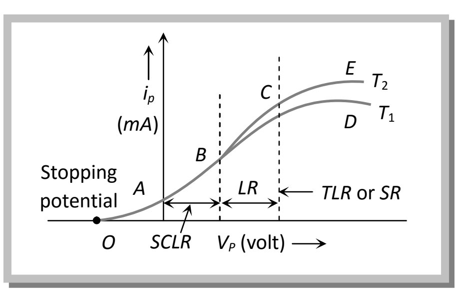
(1) **Space charge**

If V_p is zero or negative, then electrons collect around the plate as a cloud which is called space charge. space charge decreases the emission of electrons from the cathode.

(2) **Characteristic curve of a diode**

A graph represents the variation of i_p with V_p at a given filament current (i_f) is known as characteristic curve.

The curve is not linear hence diode valve is known as non-ohmic device.



(i) **Space charge limited region (SCLR)**: In this region current is space charge limited current. Also $i_p \propto V_p^{3/2} \Rightarrow i_p = kV_p^{3/2}$; where k is a constant depending on metal as well as on the shape and area of the cathode. This is called child's law.

(ii) **Linear region (LR)**: $i_p \propto V_p$

(iii) **Saturated region or temperature limited region**: In this part, the current is independent of potential difference applied between the cathode and anode.

$i_p \neq f(V_p)\ i_p = f$ (Temperature)

The saturation current follows Richardson Dushman equation i.e. $i = AT^2 e^{-\phi/kT}$

Note: The small increase in i_p after saturation stage due to field emission is known as Shottkey effect.

(iv) **Diode resistance**

(a) Static plate resistance or dc plate resistance: $R_p = \frac{V_p}{i_p}$.

(b) Dynamic or ac plate resistance : If at constant filament current, a small change ΔV_P in the plate potential produces a small change Δi_p in the plate current, then the ratio $\Delta V_p / \Delta i_p$ is called the dynamic resistance, or the 'plate resistance' of the diode $r_p = \frac{\Delta V_p}{\Delta i_p}$.

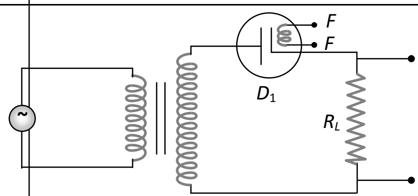
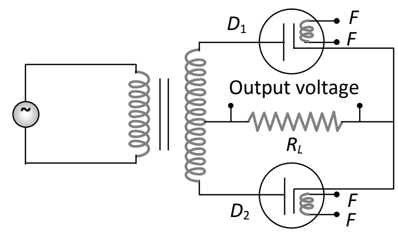
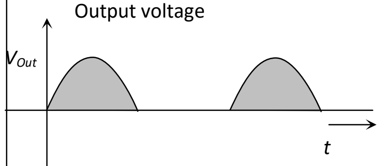
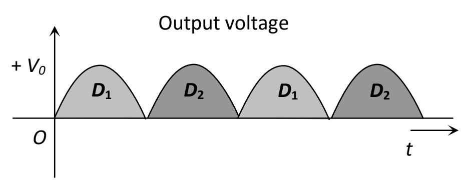
Note: In SCLR $r_p < R_p$, In TLR $R_p < r_p$ and $r_p = \infty$.

(3) **Uses of diode valve**

(i) As a rectifier
(ii) As a detector
(iii) As a transmitter
(iv) As a modulator

(4) **Diode valve as a rectifier**

Rectifier is a device which is used to convert ac into dc

S. No.	Half wave rectifier	Full wave rectifier
(i)		
(ii)		
(iii)	$I_{av} = I_{dc} = \frac{I_0}{\pi}$ and $E_{av} = E_{dc} = \frac{V_0}{\pi}$	$I_{av} = \frac{2I_0}{\pi}$ and $E_{av} = \frac{2V_0}{\pi}$
(iv)	Ripple factor $r = \sqrt{\left(\frac{i_{rms}}{i_{dc}}\right)^2 - 1} = 1.21$	r = 0.48
(v)	$i_{\text{rms}} = \frac{i_0}{2}$	$i_{\text{rms}} = \frac{i_0}{\sqrt{2}}$
(vi)	Value of peak load current $= \frac{V_0}{r_p + R_L}$	$\frac{V_0}{r_p + R_L}$
(vii)	dc component in output voltage as compared to input ac voltage – less	More
(viii)	Efficiency $\eta = \frac{0.406}{1 + \frac{r_p}{R_L}}$	$= \frac{0.812}{1 + \frac{r_p}{R_L}}$

(ix)	Form factor = 1.57	1.11
(x)	Ripple frequency – equal to the frequency of input ac	Double the frequency of input ac

(5) **Filter circuit**

Filter circuits smooth out the fluctuations in amplitude of ac ripple of the output voltage obtained from a rectifier.

(i) Filter circuit consists of capacitors or/ and choke coils.

(ii) A capacitor offers a high resistance to low frequency ac ripple (infinite resistance to dc) and a low resistance to high frequency ac ripple. Therefore, it is always used as a shunt to the load.

(iii) A choke coil offers high resistance to high frequency ac, and almost zero resistance to dc. It is used in series.

(iv) π – Filter is best for ripple control.

(v) For voltage regulation choke input filter (L-filter) is best.