RECTIFIER

A rectfier is an electronic device which is used to convert AC voltage into DC voltage. Rectified circuits are used in power supply (Power supply delivers DC voltage). Regulated power supply (constant output) Power supply Unregulated power supply (constant output)

Unregulator Power supply is

$$\rightarrow \boxed{\text{Re}\,ctifier} \rightarrow \boxed{filter}$$

Regulated Power supply is

$$\rightarrow \boxed{\text{Re}\,ctifier} \rightarrow \boxed{filter} \rightarrow \boxed{regulator} \rightarrow$$

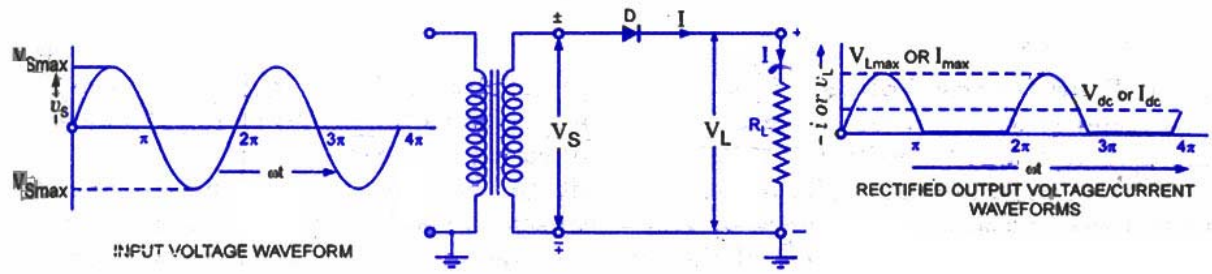
A.C. component on output of rectifier is pulsating D.C. filter filters the pulsating D.C. and gives pure D.C.

Rectifiers are classified based on period of conduction

1. Half wave rectifier
2. Full wave rectifier

Half-wave Rectifier :

It converts A.C. into pulsating D.C. using ony half of the applied AC voltage.



Half-Wave Rectifier

Two parallel lines indicates the core (except for air gap) v_s is secondary voltage of transfomrmer (AC)

$v_s = vl \sin \omega t = vm \sin \alpha$

$\alpha = \omega t$

v_m is peak value of voltage

$v_m >> v_\Gamma$

v_Γ is nothis but cut-in voltage of diode.

During the +ve half-cycle the voltage at point (Anode) A is positive w.r.t. point B (cathode). Then diode is forward biased and will conducts. Then this current flow through R_L. So current through R_L is given by

$$i = I_m \sin \alpha \qquad 0 \le \alpha \le \pi$$

$$\text{Im} = \frac{V_m}{R_f + R_s + R_L}$$

Where R_f is forward resistance

R_S is secondary winding resistance of transformer

R_L is load resistance

$i = 0 \qquad \pi \le \alpha \le \pi$

Average (value) current:

The average current is obtained by ratio of area under curve by time period.

$$I_{av} \text{ or } I_{dc} = \frac{Area\ under\ curve}{2\pi}$$

$$= \frac{1}{2\pi}\int_0^{2\pi} i dx$$

$$= \frac{1}{2\pi}\int_0^{\pi} I_m \sin\alpha dx$$

$$= \frac{I_m}{2\pi}\left[-\cos\alpha\right]_0^{\pi}$$

$$= \frac{I_m}{\pi}$$

$$= 0.318 I_m$$

$$V_{av} \text{ or } V_{dc} = \frac{1}{2\pi}\int_0^{2\pi} V d\alpha$$

$$= \frac{1}{2\pi}\int_0^{\pi} V_m \sin\alpha d\alpha$$

$$= \frac{V_m}{2\pi}\left[-\cos\alpha\right]_0^{\pi}$$

$$= \frac{V_m}{2\pi}(2)$$

$$V_{dc} = \frac{V_m}{\pi}$$

Rms current :

The a.c. current is generally specified by r.m.s. value. The root mean square current can be obtained by doing the following operations.

1. square
2. Mean value of squares of currents
3. Root of mean value

1. square : i^2
2. Mean : $\frac{Area\ under\ curve}{2\pi}$

$$= \int_0^{2\pi} i^2 d\alpha / 2\pi$$

3. Root : $\sqrt{\frac{1}{2\pi}\int_0^{2\pi} i^2 d\alpha}$

$$i_{rms} = \sqrt{\frac{1}{2\pi}\int_0^{\pi} \left(I_m{}^2 \sin^2 \alpha\right) d\alpha}$$

$$= \sqrt{\frac{I_m{}^2}{2\pi}\int_0^{\pi} \frac{1-\cos 2\alpha}{2} d\alpha}$$

$$= \sqrt{\frac{I_m{}^2}{2\pi}\left[\frac{\alpha}{2} - \frac{\sin 2\alpha}{4}\right]_0^{\pi}}$$

$$= \sqrt{\frac{I_m{}^2}{2\pi}\left[\frac{\pi}{2}\right]}$$

$$= \frac{I_m}{2}$$

Similarly $v_{rms} = \sqrt{\frac{1}{2\pi}\int_0^{\pi} v^2 d\alpha}$

$$= \sqrt{\frac{V_m{}^2}{2\pi}\int_0^{\pi} \frac{1-\cos 2\alpha}{2} d\alpha}$$

$$= \frac{V_m{}^2}{2\sqrt{\pi}}\left[\frac{\alpha}{2} - \frac{\sin 2\alpha}{4}\right]_0^{\pi}$$

$$= \frac{V_m}{2\sqrt{\pi}}\sqrt{\pi}$$

$$V_{rms} = \frac{V_m}{2}$$