Rectifier :-

Rectifier is an electronic device which converts alternating current into direct current.

Rectification :-

The process of converting alternating current into direct current is called rectification.

→ Rectifier is of two types.

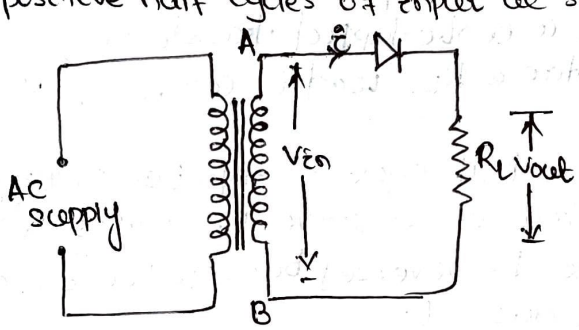
(i) Half wave Rectifier
(ii) Full wave Rectifier

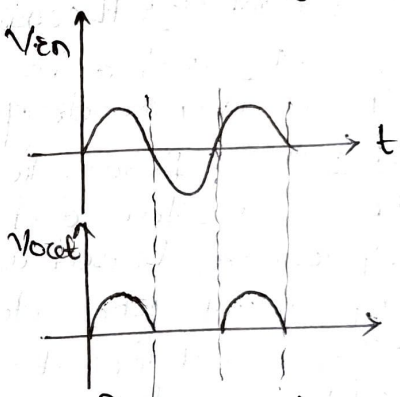
→ Again full wave rectifier is of two types.

(i) Centre-tap full wave Rectifier
(ii) Full wave Bridge Rectifier.

Half wave Rectifier

→ In half wave rectification the rectifier conducts current only during the positive half cycles of input ac supply.





Circuit details: It consists of a diode, a transformer and load resistance R_L. Generally ac supply is given through a transformer.

Operation: During positive half cycle of input ac voltage, end A becomes positive and end B becomes negative. This makes the diode forward biased and hence it conducts current. and the current flows through the load R_L.

→ During negative half cycle end A is negative and end B is positive. This makes diode reverse biased and does not conduct.

→ Therefore current flows through the diode during positive half cycles only.

→ The output obtained across R_L is pulsating in nature.

Advantage:

→ Easy to design.

→ Less costly.

Disadvantage

→ output is low.

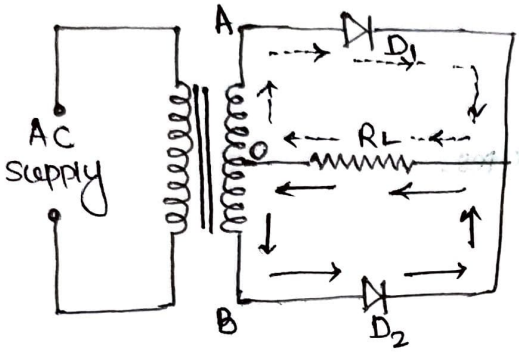
→ output is pulsating dc. so filter circuit is required to get pure dc.

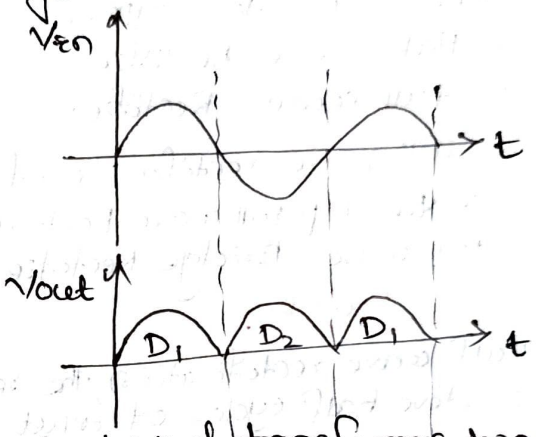
Rectifier efficiency $\eta = \frac{\text{dc power output}}{\text{Input ac power}}$

$\eta\% = 40.6\%$

Centre-Tap full wave Rectifier

In full-wave rectification, current flows through the load for both half cycles of input ac voltage.





circuit details: It consists of a centre tapped transformer, two diodes D_1 and D_2 and a Load resistance R_L. Load is connected at centre of secondary winding

operation: During the positive half cycle of input ac voltage, end A becomes positive and end B becomes negative. This makes the diodes D_1 forward biased and diode D_2 reversed biased. Therefore diode D_1 conducts while diode D_2 does not.

→ The current flows through ($A \rightarrow D_1 \rightarrow R_L \rightarrow O \rightarrow A$) the upper half of the secondary winding as shown by the dotted arrows.

→ During negative half cycle of input ac voltage, end A becomes negative and end B becomes positive. This makes the diodes D_1 reverse biased and diode D_2 forward biased. Therefore diode D_2 conducts while diode D_1 does not.

→ The current flows through ($B \rightarrow D_2 \rightarrow R_2 \rightarrow O \rightarrow B$) the lower half of the secondary winding as shown by the solid arrows.

→ The current in the Load R_L is in the same direction for both half cycles of input ac voltage. Therefore same output is obtained for both the half cycles.

Advantages

→ output is high than half wave rectifier.

Disadvantages

→ It is difficult to locate the centre tap on the Secondary winding

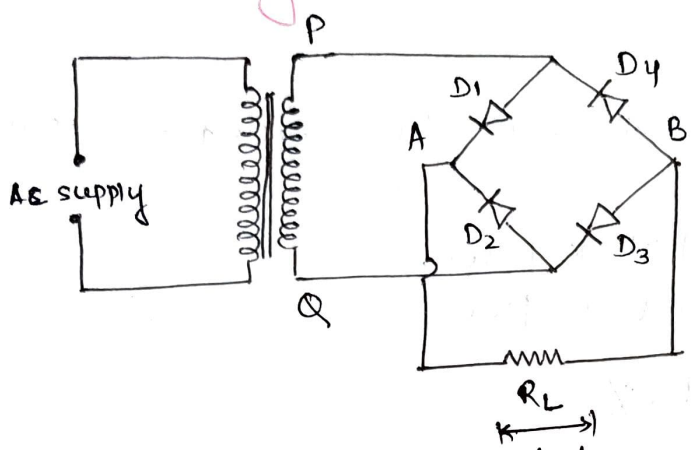
→ The diodes used must have high peak inverse voltage (PIV = $2V_m$)

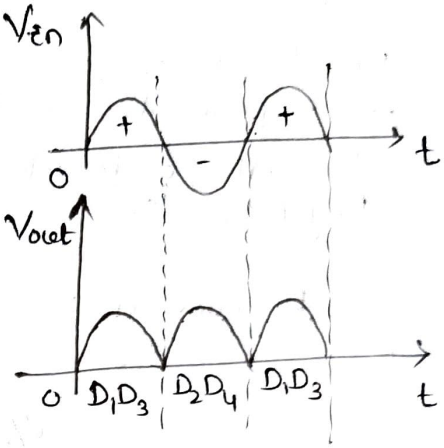
→ The dc output is smaller than full wave bridge rectifier.

Efficiency $\eta = \frac{\text{dc power output}}{\text{Input ac power}}$

$\eta\% = 81.2\%$

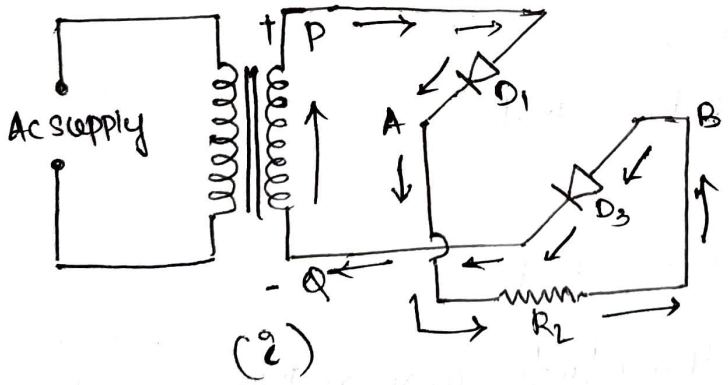
Full wave Bridge Rectifier :-

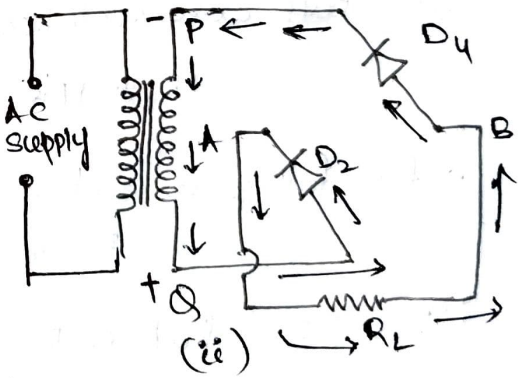




circuit details :- The full wave bridge rectifier contains four diodes D_1, D_2, D_3 and D_4 connected to form bridge as shown in fig. The a.c supply to be rectified is applied to the diagonally opposite ends of the bridge through the transformer. Between other two ends A and B the load resistance R_L is connected.

operation : During positive half cycle of secondary voltage, the end P becomes positive and end Q becomes negative. This makes diodes D_1 and D_3 forward biased while diodes D_2 and D_4 reverse biased. Therefore only diodes D_1 and D_3 conduct. The current flows through $P \rightarrow D_1 \rightarrow A \rightarrow R_L \rightarrow B \rightarrow D_3 \rightarrow Q \rightarrow P$ as shown in fig(i) below.





→ During negative half cycle of secondary voltage, the end p becomes negative and end Q becomes positive. This makes Diodes D_2 and D_4 forward biased and diodes D_1 and D_3 reverse biased. Therefore only diodes D_2 and D_4 conduct. The current flows through $Q \rightarrow D_2 \rightarrow A \rightarrow R_L \rightarrow B \rightarrow D_4 \rightarrow P \rightarrow Q$ as shown in fig (ii).

→ The current flows through the load R_L in the same direction for the positive half cycle and negative half cycle. Therefore same dc output is obtained across the load R_L.

Advantages:-

→ The need for centre tapped transformer is eliminated.

→ The output is twice that of centre tap full wave rectifier

→ The PIV is less than the centre tap full wave rectifier.

Disadvantage:-

→ It requires four diodes.

→ The output is pulsating in nature. So a filter circuit is required to get pure dc.

$$\text{Efficiency } \eta = \frac{\text{output dc power}}{\text{Input ac. power}}$$

$$\eta\% = 81.2\%$$

Ripple factor:-

The unwanted ac component present in the rectified dc output is known as ripple.

→ The ratio of r.m.s value of ac component to the dc component in the rectifier output is known as ripple factor.

$$\text{Ripple factor} = \frac{\text{r.m.s value of ac component}}{\text{value of dc component}} = \frac{I_{ac}}{I_{dc}}$$

→ for half wave rectification,

Ripple factor = 1.21

→ for full wave rectification,

Ripple factor = 0.48

This shows that in the output of a full wave rectifier, the dc component is more than ac component.

Filter circuit

→ A filter circuit is a device which removes the ac component of rectifier output but allows the dc component to reach the load.

→ A filter circuit is generally a combination of, inductors (L) and capacitors (C).

→ A capacitor passes ac but blocks the dc component.

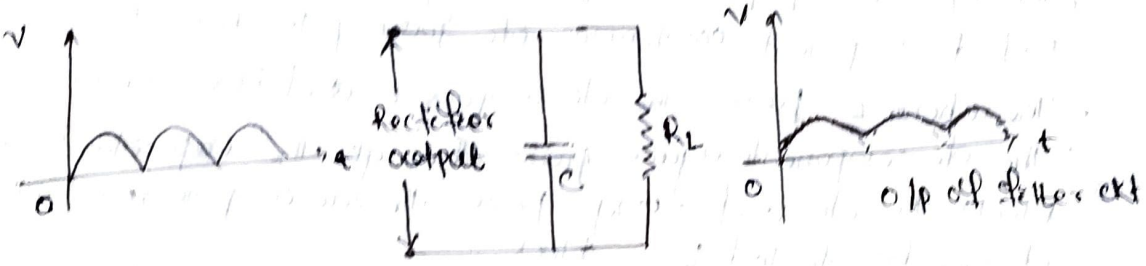
→ An inductor passes dc but blocks the ac component.

Types of filter circuit

The most commonly used filter circuits are.

(i) capacitor filter
(ii) choke input filter
(iii) capacitor input filter or π-filter.

Capacitor filter



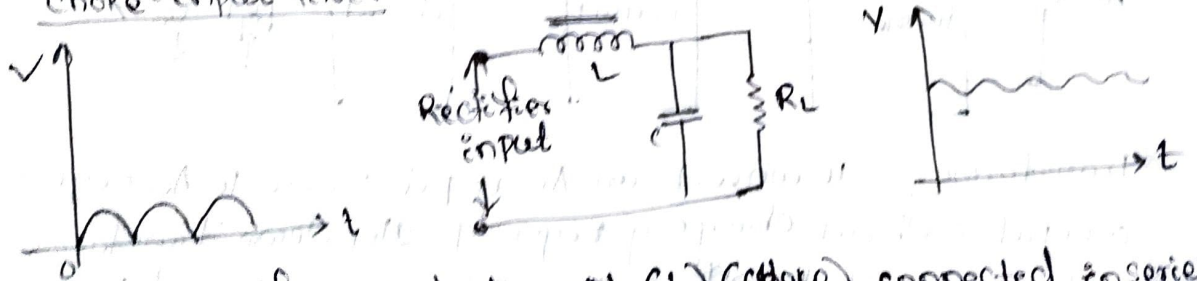
→ It consists of a capacitor C placed across the rectifier output in parallel with load R_L.

→ When the input is applied to the capacitor, it passes the ac components but blocks the dc components which again passes to the load R_L and the output is obtained.

→ The output contains very little ripple.

→ Because of low cost, small size it is used.

Choke input filter



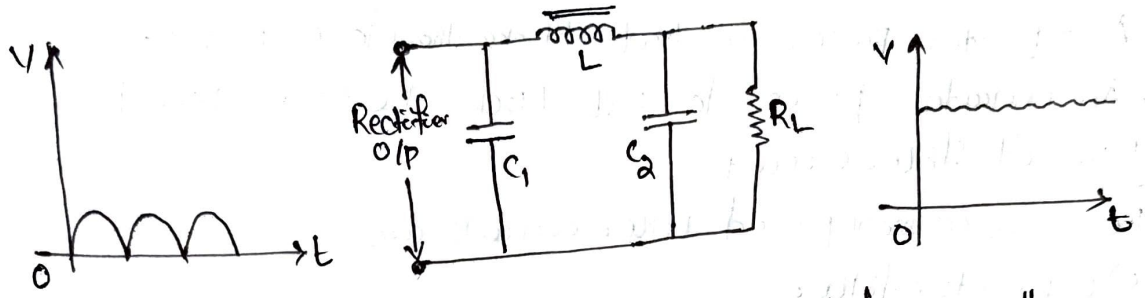
→ It consists of an inductor coil (L) (choke) connected in series with the rectifier output and a filter capacitor C across the load.

→ The pulsating dc is applied to the filter circuit. The choke allows dc component but blocks the ac component.

→ From the dc component passed to the capacitor. capacitor passes the ac components if any present in the dc. and only dc component

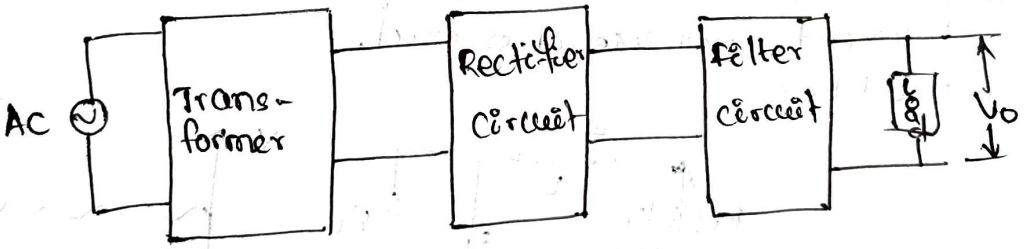
blocked by the capacitor to reach the load.
→ The dc output obtained at the load is more improved than the capacitor filter.

Capacitor input filter or π-filter



→ It consists of a filter capacitor C_1 connected across the rectifier output, a choke L in series and another filter capacitor C_2 connected across the load.
→ The capacitor C_1 passes the ac components and blocks the dc component and dc components continues its journey to choke L.
→ The choke L passes the dc component and blocks the ac component
→ The dc components again passes through the capacitor C_2. capacitor blocks the dc and only passes the ac components which the choke has failed to block.
→ Therefore only dc component appears across the load and that is what we desire.

DC power supply system (unregulated)



Transformer :- It converts an AC input source to Ac required output without changing frequency. Step down transformer reduces amplitude of ac voltage to required level.

Rectifier :-