2.4 Bridge Rectifier

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- The basic bridge rectifier circuit is shown in Fig. 2.4.1.
- The bridge rectifier circuit is essentially a **full-wave rectifier circuit, using four diodes,** forming the four arms of an electrical bridge.

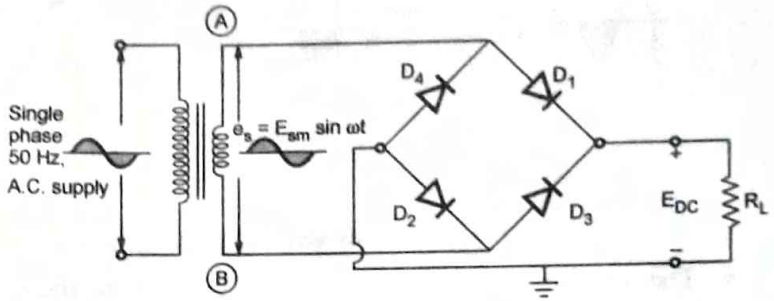

Fig. 2.4.1 Bridge rectifier circuit

- To one diagonal of the bridge, the ac voltage is applied through a transformer if necessary, and the rectified dc voltage is taken from the other diagonal of the bridge.
- The main advantage of this circuit is that it does not require a center tap on the secondary winding of the transformer.

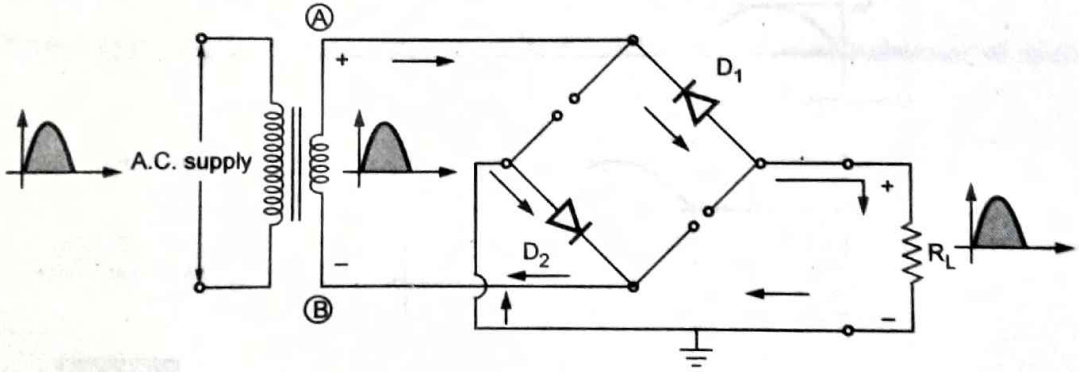

Fig. 2.4.2 Current flow during positive half cycle

Operation of the circuit : Consider the positive half of ac input voltage. The point A of secondary becomes positive. The diodes D_1 and D_2 will be forward biased, while D_3 and D_4 reverse biased. The two diodes D_1 and D_2 conduct in series with the load and the current flows as shown in Fig. 2.4.2.

- In the next half cycle, when the polarity of ac voltage reverses hence point B becomes positive diodes D_3 and D_4 are forward biased, while D_1 and D_2 reverse biased. Now the diodes D_3 and D_4 conduct is series with the load and the current flows as shown in Fig. 2.4.3.
- It is seen that in both cycles of ac, the load current is flowing in the same direction hence, we get a full-wave rectified output.

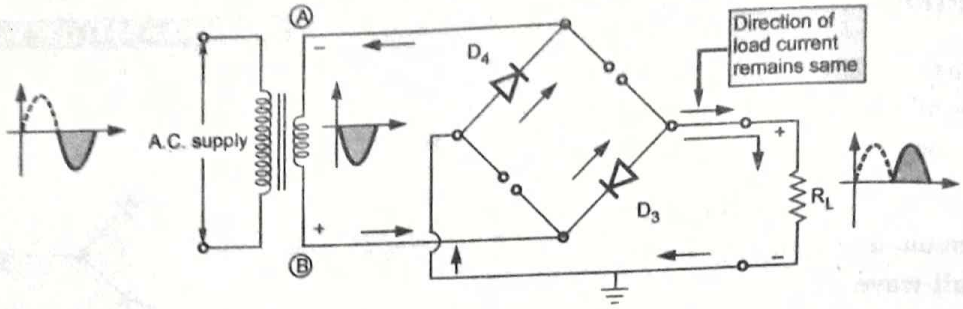

Fig. 2.4.3 Current flow during negative half cycle

- The waveforms of load current and voltage are shown in the Fig. 2.4.4.

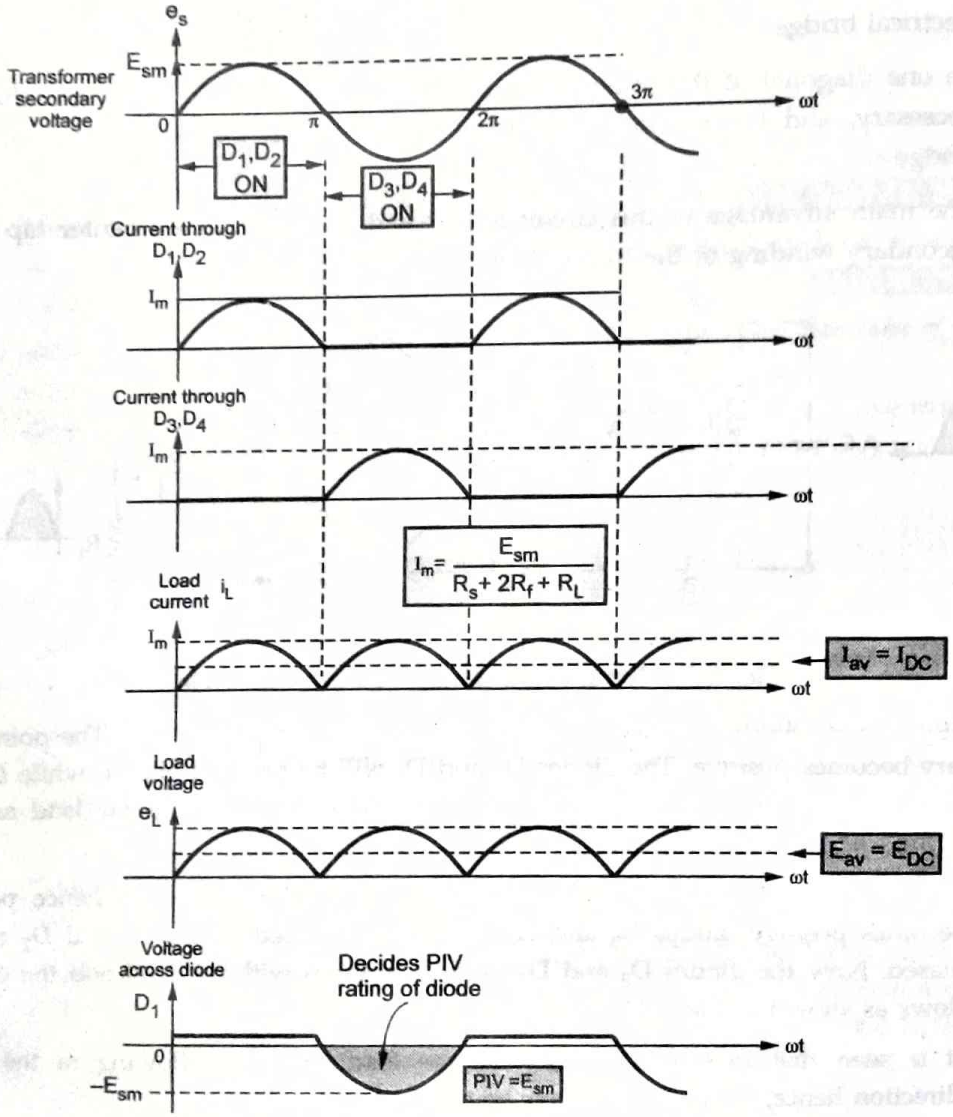

Fig. 2.4.4 Waveforms of bridge rectifier

2.4.1 Expressions for Various Parameters

- The bridge rectifier circuit, being basically a full wave rectifier circuit; all the derivations discussed previously for a full-wave circuit using two diodes are applicable for a bridge rectifier circuit.
- The expression for I_m will change slightly. This will be clear from the equivalent circuit shown in the Fig. 2.4.5.

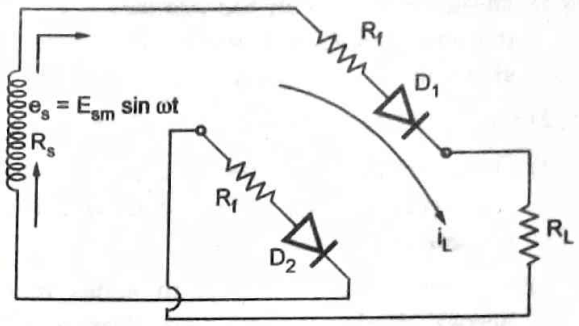

Fig. 2.4.5

- In each half cycle two diodes conduct simultaneously. Hence maximum value of load current is,

$$I_m = \frac{E_{sm}}{R_s + 2R_f + R_L}$$

- So the only modification is that instead of R_f, which is forward resistance of each diode, the term **$2R_f$ appears in the denominator.**
- The PIV rating of the diodes is E_{sm}, as 2 E_{sm} gets divided equally across two diodes.
- The remaining expressions are identical to those derived for two diode full wave rectifier and reproduced for the convenience of the reader.

$$E_{DC} = I_{DC} R_L = \frac{2E_{sm}}{\pi}, \quad E_{RMS} = \frac{I_m}{\sqrt{2}} R_L = \frac{E_{sm}}{\sqrt{2}(R_s + 2R_f + R_L)} R_L$$

$$P_{DC} = I_{DC}^2 R_L = \frac{4}{\pi^2} I_m^2 R_L$$

$$P_{AC} = I_{RMS}^2 (R_s + 2R_f + R_L) = \frac{I_m^2 (2R_f + R_s + R_L)}{2}$$

$$\eta = \frac{8R_L}{\pi^2 (R_s + 2R_f + R_L)}, \quad \% \eta_{max} = 81.2 \%$$

$$\gamma = 0.48, \quad \text{T.U.F.} = 0.812$$

The E_{sm} is the maximum value of a.c. voltage across full secondary winding of the transformer used.

2.4.2 Advantages

1) The current in both the primary and secondary of the power transformer flows for the entire cycle and hence for a given power output, power transformer of a small size and less cost may be used.
2) No center tap is required in the transformer secondary.
3) The currents in the secondary of the transformer are in opposite directions in two half cycles. Hence net d.c. component flowing is zero which reduces the losses and danger of saturation.
4) As two diodes conduct in series in each half cycle, inverse voltage appearing across diodes get shared. Hence the circuit can be used for high voltage applications.
5) The transformer gets utilized effectively.

2.4.3 Comparison with Two Diode Rectifier

Sr. No.	Full wave rectifier using two diodes	Full wave rectifier using four diodes
1.	It uses centre tapped transformer.	It does not use centre tapped transformer.
2.	One diode conducts in each half cycle of input.	Two diodes conduct in each half cycle of input.
3.	The voltage drop across the diode is due to R_f only.	The voltage drop across the diodes is due to $2R_f$.
4.	The output voltage is more.	The output voltage is less.
5.	The transformer is less effectively used.	The transformer is used more effectively.
6.	TUF is 0.693.	TUF is 0.812.
7.	The PIV rating of the diode is $2 E_{sm}$.	The PIV rating of the diode is E_{sm}.

2.4.4 Applications

1. Used as rectifier in power circuits to convert a.c. to d.c.
2. In rectifier type meters, to convert a.c. voltage to be measured to d.c.
3. In power supply circuits.