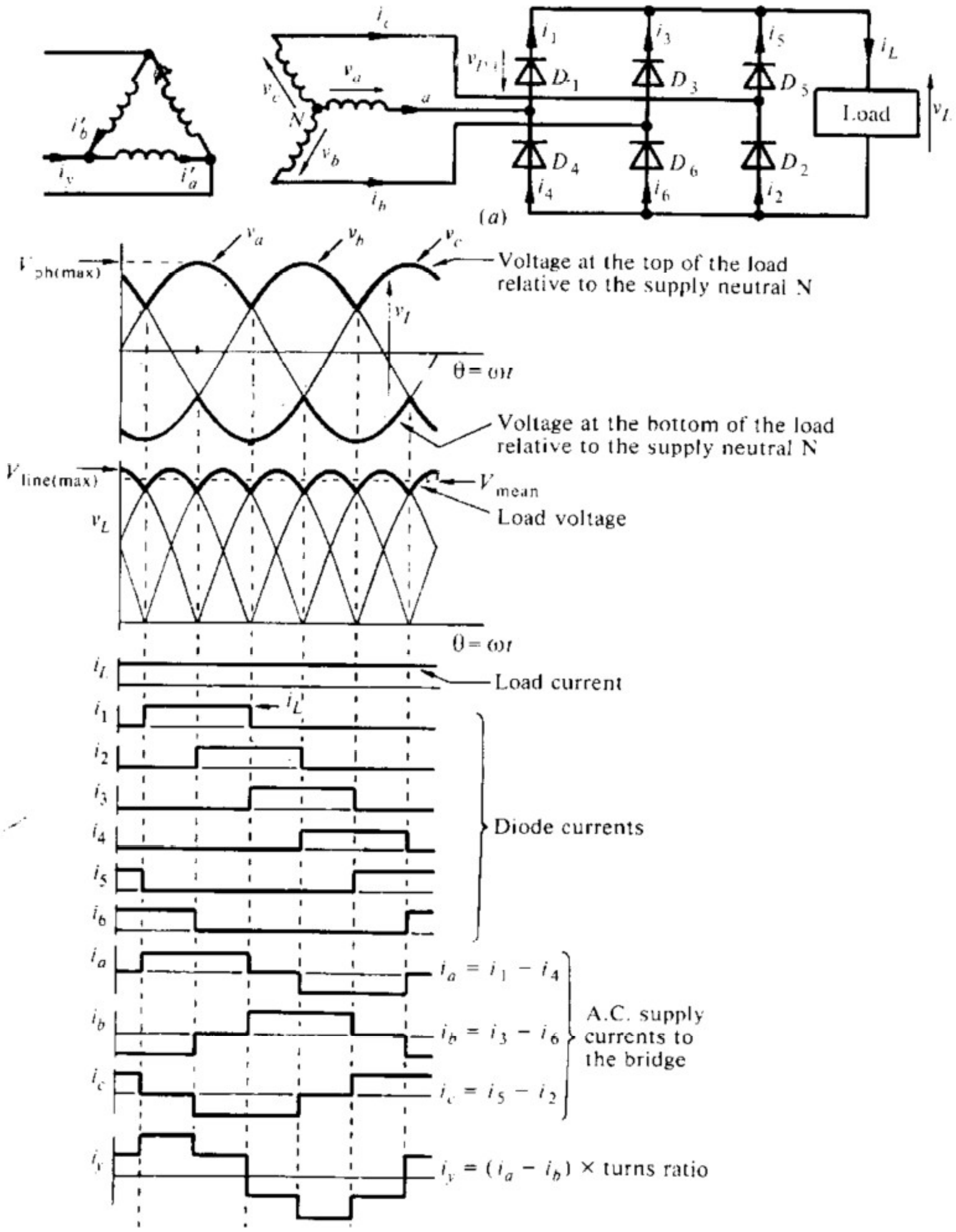
For usual case the load is inductive with L very high therefore it can be assumed to be continues level.

$$V_{mean} = \frac{1}{\frac{2\pi}{3}} \int_{\pi/6}^{5\pi/6} V_m \sin\theta \, d\theta = \frac{3\sqrt{3}}{2\pi} V_{m\,ph} \qquad \ldots(22)$$

$$I_{D_1\,rms} = \left[\frac{1}{2\pi} \int_{\pi/6}^{5\pi/6} I_{mean}^2 \, d\theta\right]^{1/2} = \frac{I_{mean}}{\sqrt{3}} \qquad \ldots(23)$$

2 -2 Three phase bridge uncontrolled rectifier



A three phase bridge rectifier is commonly used in high-power applications and it is shown in fig(9). This is a full wave rectifier .It can operate with or without a transformer and gives six-pulse ripples on the output voltage. The diodes are numbered in order of conduction sequences and each one conducts for (120^o).

The conduction sequence for diodes is 12, 23, 34, 45, 56 and 61. The pair of diodes which are connected between that pair of supply lines having the highest amount of instantaneous line-to-line voltage will conduct. When v_a is the most positive phase diode D_1 conducts and during this period first v_b is the most negative with diode D_6 conducting until v_c becomes more negative when the current in diode D_6 commutates to diode D_2.

The load voltage follows in turn six sinusoidal voltages during one cycle , these being (v_a−v_b), (v_a−v_c), (v_b−v_c), (v_b−v_a), (v_c−v_a), (v_c−v_b), all having the maximum value of the line voltage that is √3 times the phase voltage. The line voltage can be found by V_{XN}, V_{YN}.

$$V_o = V_{XN} - V_{YN} = V_{XN} - (-V_{YN}) = V_{XN} + V_{YN}$$

$$V_{mean} = \frac{1}{\frac{2\pi}{6}} \int_{\pi/3}^{2\pi/3} V_{m\ line} \sin\theta \, d\theta = \frac{3V_{m\ line}}{\pi} \qquad \ldots(24)$$

$$I_{a\ rms} = \left[\frac{2}{2\pi}\int_{\pi/6}^{5\pi/6} I_{mean}^2\, d\theta\right]^{1/2} \ or\ \left[\frac{2}{2\pi}\int_{0}^{2\pi/3} I_{mean}^2\, d\theta\right]^{1/2}$$

$$= \sqrt{\frac{2}{3}} I_{mean} \qquad \ldots(25)$$

$$V_{rms} = \left[\frac{1}{\frac{2\pi}{6}}\int_{\pi/3}^{2\pi/3} (V_{m\ line})^2\, (\sin\theta)^2 d\theta\right]^{1/2} = 1.6554\, V_m \qquad \ldots(26)$$

Example (4):

A three phase bridge rectifier has a purely resistive load of R. Determine a) the efficiency, b) the form factor, c) the ripple factor.

Solution:

$$V_{mean} = \frac{3V_{m\,line}}{\pi} = \frac{3\sqrt{3}\mathrm{V_m}}{\pi} = 1.654\ \mathrm{V}_m$$

$$I_{mean} = \frac{V_{mean}}{R} = \frac{1.654 V_m}{R}$$

$$\mathrm{P}_{mean} = \frac{(1.654\, V_m)^2}{R}$$

$$V_{rms} = 1.6554\, V_m$$

$$I_{rms} = \frac{V_{rms}}{R} = \frac{1.6554\, V_m}{R}$$

$$P_{rms} = \frac{(1.6554\, V_m)^2}{R}$$

a) $\eta = \dfrac{(1.654\ V_m)^2}{(1.6554\ V_m)^2} = 99.83\ \%$

b) $\mathrm{FF} = \dfrac{1.6554\ V_m}{1.654\ V_m} = 1.0008 = 100.08\ \%$

c) $\mathrm{RF} = \sqrt{(1.0008)^2 - 1} = 0.04 = 4\%$

	Single phase half wave rectifier	Single phase bridge rectifier	Three phase bridge rectifier
η	40.5%	81%	99.83%
FF	157%	111%	100.08%
RF	121%	48.2%	4%

3- Single phase thyristor rectifiers (controlled rectifier)

Controlled rectifiers are basically AC to DC converters. The power transferred to the load is controlled by controlling triggering angle of the devices. Fig.(10) shows this operation.

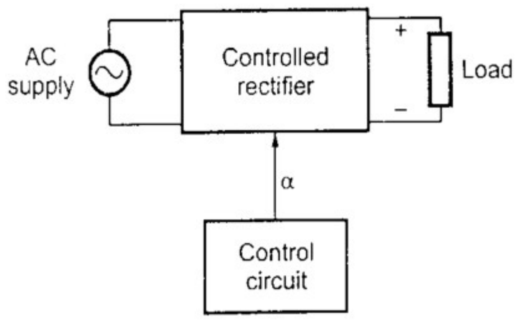


Fig. (10) Principle of operation of a controlled rectifier

The triggering angle (α) of the devices is controlled by control circuit.