2.2 Steady state analysis of three phase converter fed separately excited DC motor drive:

Three phase controlled rectifiers are used in large power DC motor drives. Three phase controlled rectifier gives more number of voltage per cycle of supply frequency. This makes motor current continuous and filter requirement also less.

The number of voltage pulses per cycle depends upon the number of thyristors and their connections for three phase controlled rectifiers. In three phase drives, the armature circuit is connected to the output of a three phase controlled rectifier.

Three phase drives are used for high power applications up to megawatts power level. The ripple frequency of armature voltage is greater than that of the single phase drives and its requires less inductance in the armature circuit to reduce the armature current ripple.Three phase full converter are used in industrial application up to 1500KW drives. It is a two quadrant converter.

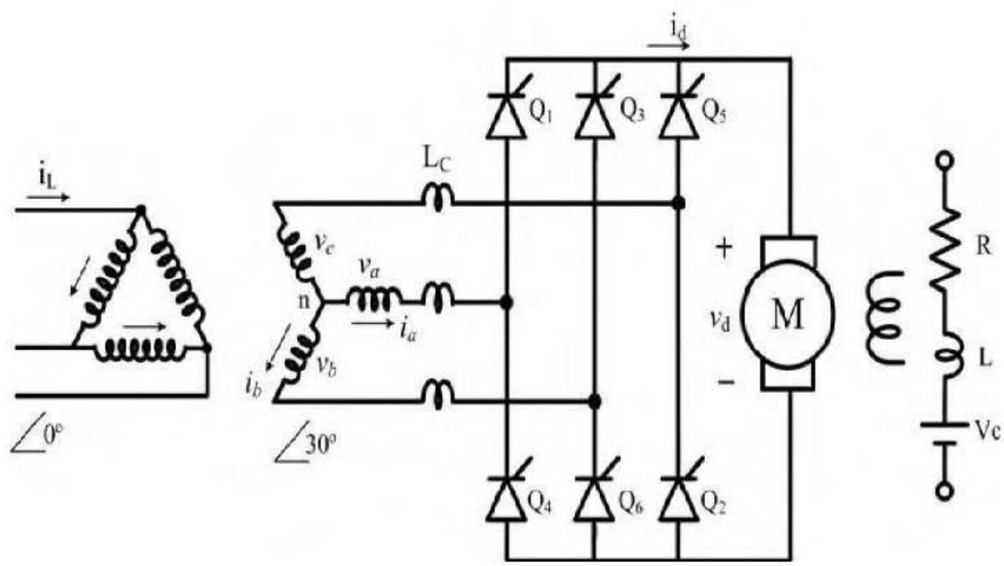

Figure 2.2.1 Three Phase rectifierfed DCmotor drive

(Source:"Fundamentals of Electrical Drives" by G.K.Dubey,page-111)

Three phase full converter bridge circuit connected across the armature terminals is shown fig. The voltage and current waveforms of the converter. The circuit works as a three AC to DC converter for firing angle delay $0^0 < \alpha < 90^0$ and as a line commutated inverter for $90^0 < \alpha < 180^0$. A three full converter fedDC motor is performed where generation of power is required.

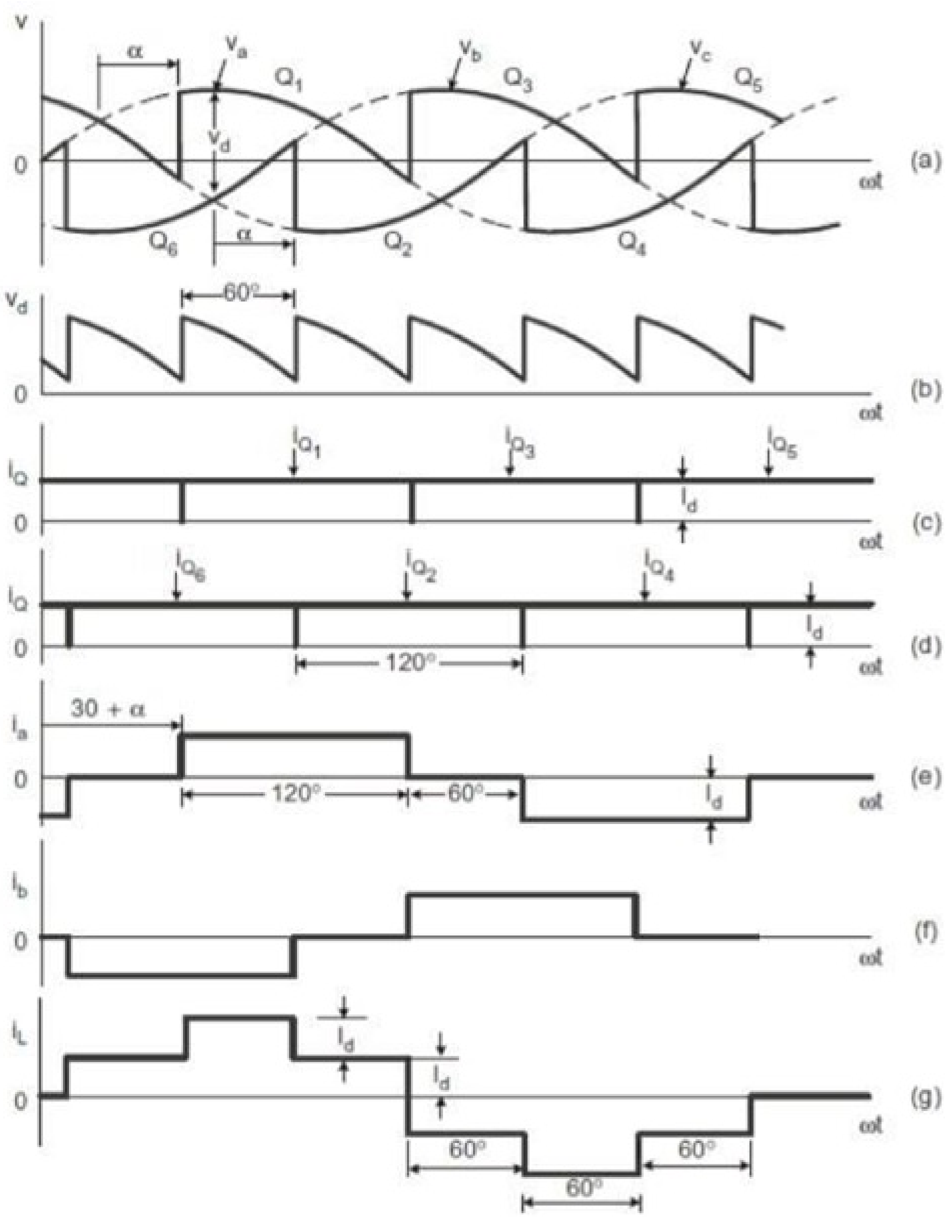

Figure 2.2.2 Three Phase rectifierwaveforms

(Source:"Fundamentals of Electrical Drives" by G.K.Dubey,page-111)

The average motor armature voltage is given by

$$V_a = \frac{3}{\pi}\int_{\frac{\pi}{6}+\alpha}^{\frac{\pi}{2}+\alpha} V_{ab}\, d(\omega t)$$

In the above substitute $V_{ab} = \sqrt{3}V_m \sin\left(\omega t + \frac{\pi}{6}\right) d(\omega t)$

We have $V_a = \frac{3\sqrt{3}}{\pi} V_m \cos\alpha$

Speed Torque Relations:

The drive speed is given by

$$V_a = E_b + I_a R_a \qquad \text{Where } E_b = K_a \phi \omega$$

Then $V_a = K_a \phi \omega_m + I_a R_a$

$$\omega_m = \frac{V_a - I_a R_a}{K_a \phi}$$

In separately excited DC motor $K_a \phi I_a = T$ therefore (2.52) becomes

$$\omega_m = \frac{V_a}{K_a \phi} - \frac{R_a}{(K_a \phi)^2} T$$