2.2 DIESEL CYCLE

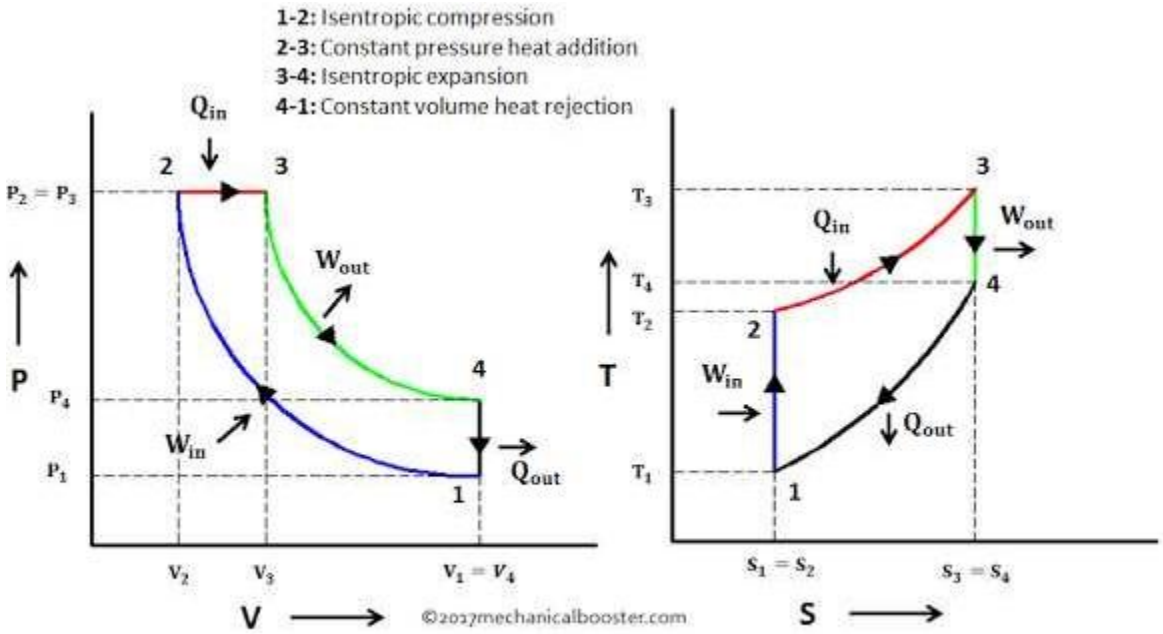
Diesel cycle was invented by Rudolph Diesel in 1893. He put forward an idea by which we can attain higher thermal efficiency, with a high compression ratio. All diesel engine works on this cycle. Diesel is used as fuel in this cycle as it can be compressed at higher compression ratio. It is also known as constant pressure cycle because heat is added in it at constant pressure. It has high thermal efficiency and compression ratio (11:1 to 22:1) as compared with Otto cycle.

The engine that is put forward by Rudolph consists of an enclosed air in the cylinder. The cylinder walls are perfectly non-conductors of heat, but the bottom is a perfect conductor of heat. It has a hot body, cold body and an insulating cap, which are alternately brought in contact with the cylinder.

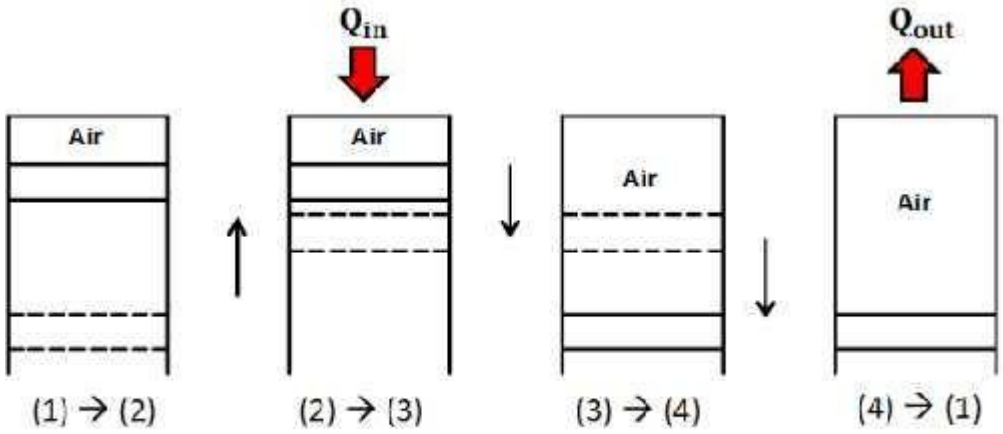
The ideal Diesel cycle consist of 4 process, two isentropic processes, one constant pressure and one constant volume process.

The 4 process are as follows

1. Isentropic (reversible adiabatic) Compression
2. Constant pressure heat addition
3. Isentropic Expansion
4. Constant volume heat rejection.



P-V and T-S Diagram of Diesel Cycle



Piston Position in Diesel Cycle Process

$$\eta_{th} = 1 - \frac{1}{r^{\gamma-1}} \left(\frac{\alpha^{\gamma} - 1}{\gamma(\alpha - 1)} \right)$$

where

η_{th} is thermal efficiency

α is the cut-off ratio $\frac{V_3}{V_2}$ (ratio between the end and start volume for the combustion phase)

r is the compression ratio $\frac{V_1}{V_2}$

γ is ratio of specific heats (C_p/C_v)

The cut-off ratio can be expressed in terms of temperature as shown below:

$$\frac{T_2}{T_1} = \left(\frac{V_1}{V_2} \right)^{\gamma-1} = r^{\gamma-1}$$

$$T_2 = T_1 r^{\gamma-1}$$

$$\frac{V_3}{V_2} = \frac{T_3}{T_2}$$

$$\alpha = \left(\frac{T_3}{T_1} \right) \left(\frac{1}{r^{\gamma-1}} \right)$$