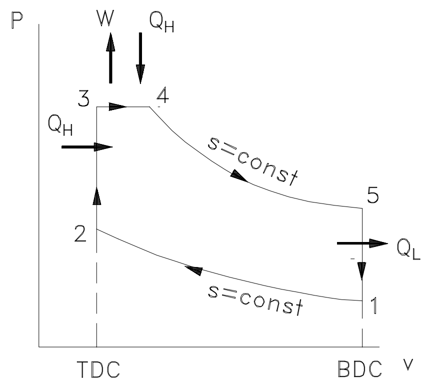
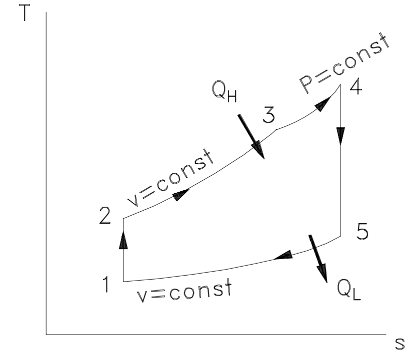
Week 7: Lecture 3

Dual Cycle

- this is a better representation of the combustion process in both the gasoline and the diesel engines
- in a compression ignition engine, combustion occurs at TDC and the piston moves down to maintain a constant pressure





1 - 2	isentropic compression
2 - 3	constant volume fuel injection and initial combustion
	→ modelled as a reversible, constant volume heat addition
3 - 4	isobaric expansion as the fuel burns
	→ modelled as a reversible, isobaric heat addition
4 - 5	isentropic expansion
5 - 1	exhausting of spent gases
	→ modelled as a constant volume heat rejection process

- $\eta_{dual} = 1 - \dfrac{r_p r_v^k - 1}{\left[(r_p - 1) + k r_p (r_v - 1)\right] r^{k-1}}$

  where

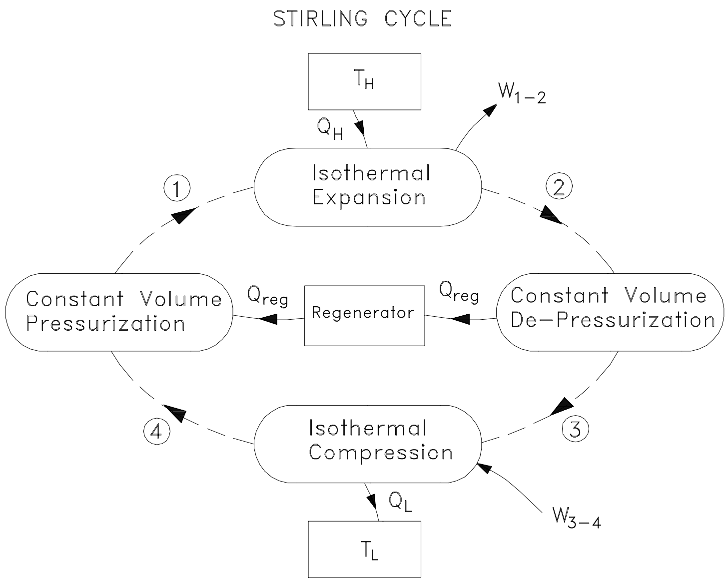
$$r = \frac{V_1}{V_2} \quad \text{(compression ratio)}$$

$$r_v = \frac{V_4}{V_3} \quad \text{(volume ratio)}$$

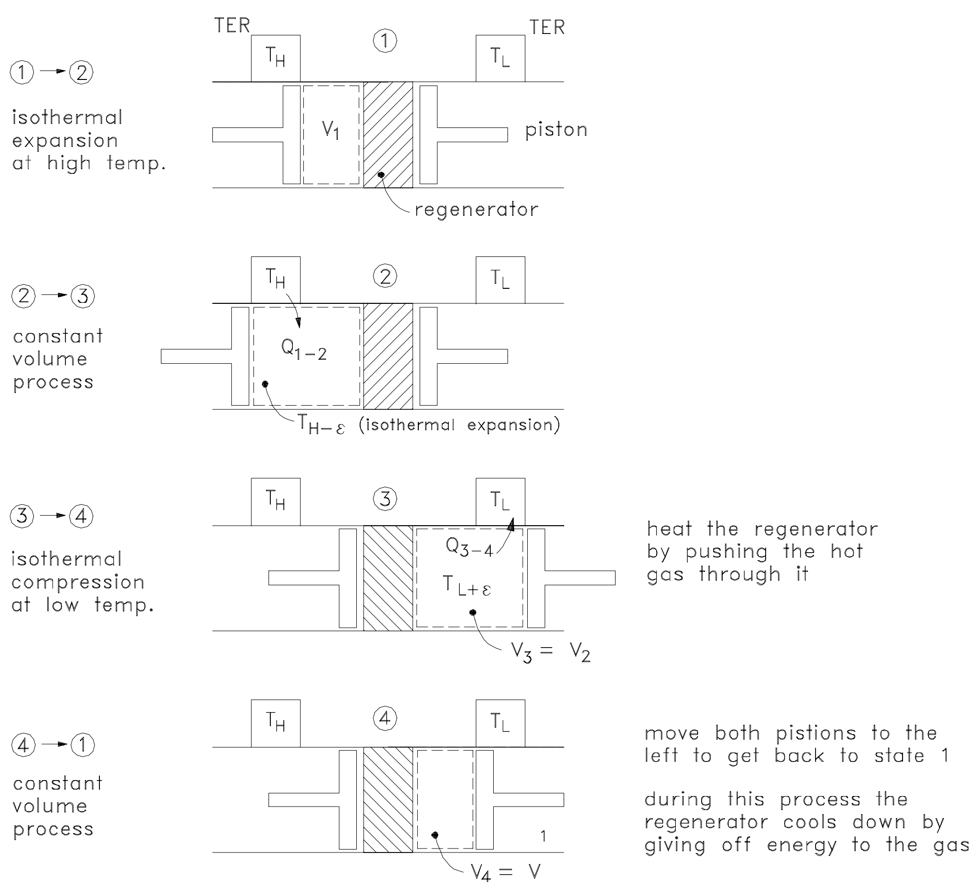
$$r_p = \frac{P_3}{P_2} \quad \text{(pressure ratio)}$$

Week 7: Lecture 3

Stirling Cycle

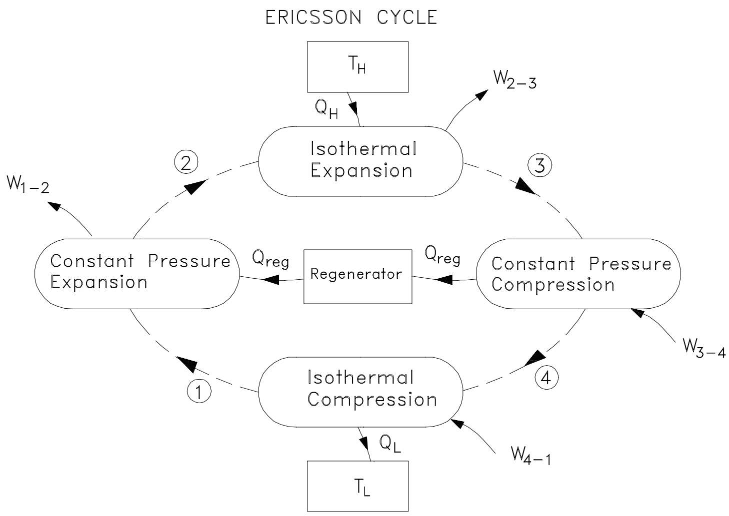


- reversible regenerator used as an energy storage device
- possible to recover all heat given up by the working fluid in the constant volume cooling process
- all the heat received by the cycle is at T_H and all heat rejected at T_L
- $\eta_{Stirling} = 1 - T_L/T_H$ (Carnot efficiency)



Week 7: Lecture 3

Ericsson Cycle



- hardware is not complicated
- but it is very difficult to operate turbines and compressors isothermally
- can approach isothermal conditions by repeated intercooling (compressor) and repeated reheating (turbines)
- $\eta_{Stirling} = 1 - T_L/T_H$ (Carnot efficiency)