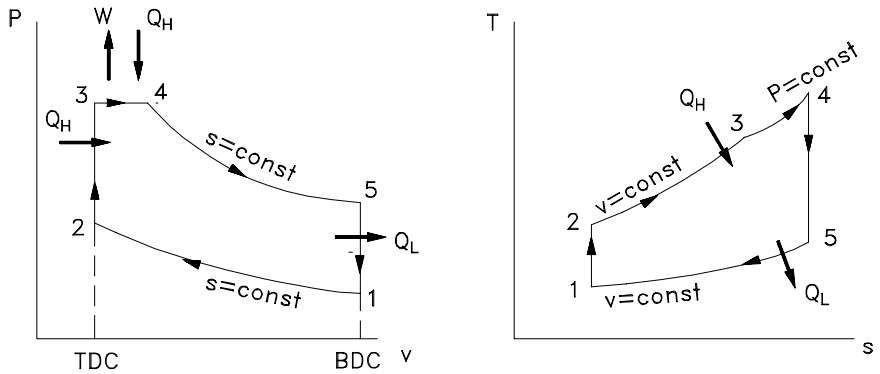
Week 7: Lecture 3

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

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

where

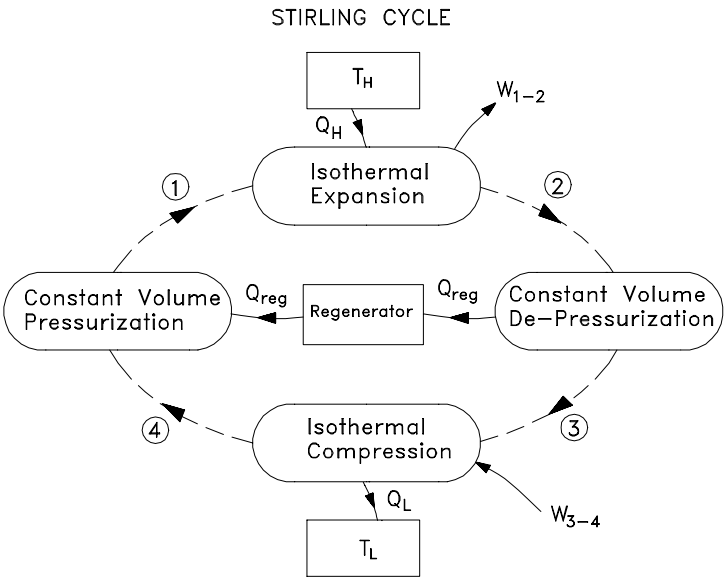
$r = \dfrac{V_1}{V_2}$ (compression ratio)

$r_v = \dfrac{V_4}{V_3}$ (volume ratio)

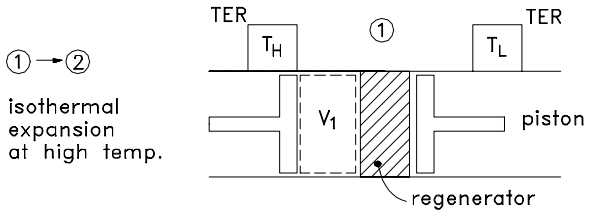
$r_p = \dfrac{P_3}{P_2}$ (pressure ratio)

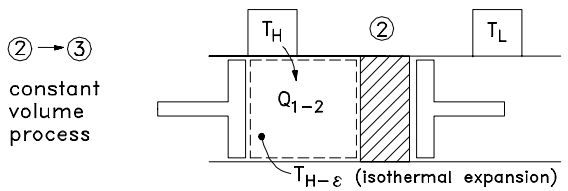
Week 7: Lecture 3

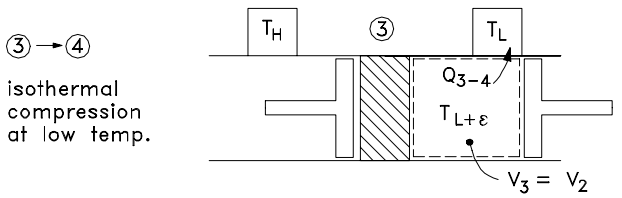
Stirling Cycle



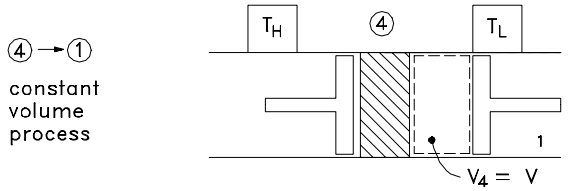
- reversible regenerator used as an energy storage device
- possible to recover all heat given up by the working fluid in the constant volume cooling process
- all the heat received by the cycle is at T_H and all heat rejected at T_L
- $\eta_{Stirling} = 1 - T_L/T_H$ (Carnot efficiency)







heat the regenerator by pushing the hot gas through it

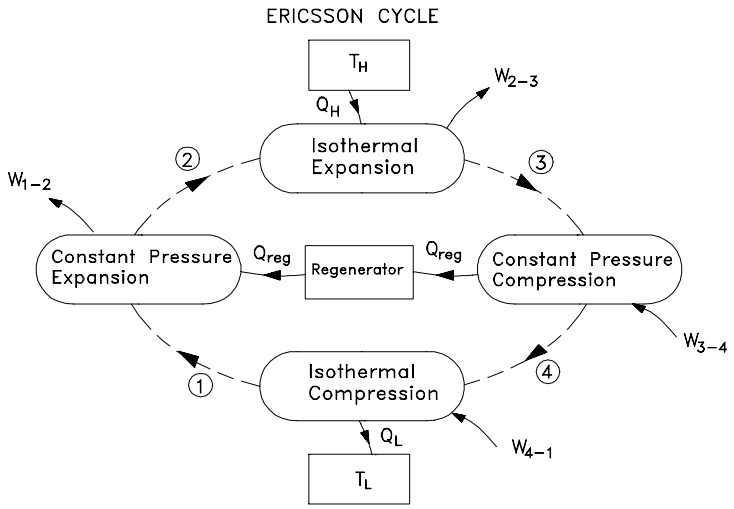
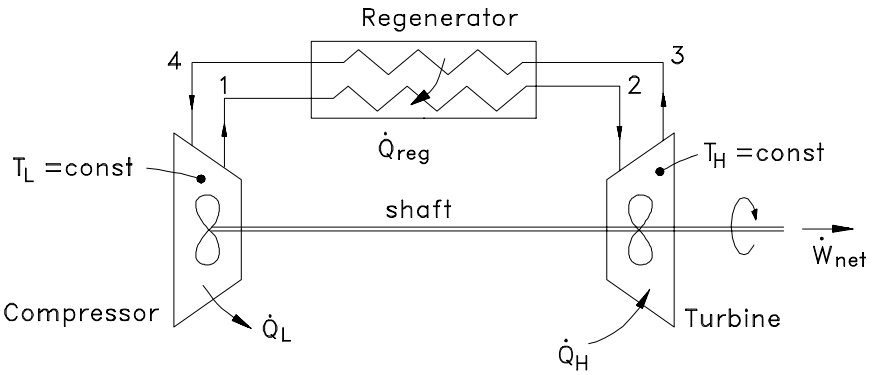


move both pistions to the left to get back to state 1

during this process the regenerator cools down by giving off energy to the gas

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)