RANKINE CYCLE

- DEFINE
- PRINCIPLE
- CONSTRUCTION
- WORKING
- ENERGY ANALYSIS
- EFFICIENCY
- IDEAL RANKINE CYCLE
- MORE COMPLICATED CYCLE
- COMBINED CYCLE

❖ *Define*

- *The rankine cycle is modification of carnot cycle.*
- *When the carnot cycle had been issued it had some mistakes so Mr.Rankine get the solution and give the updated cycle.*
- *So, this cycle is called the rankine cycle.*

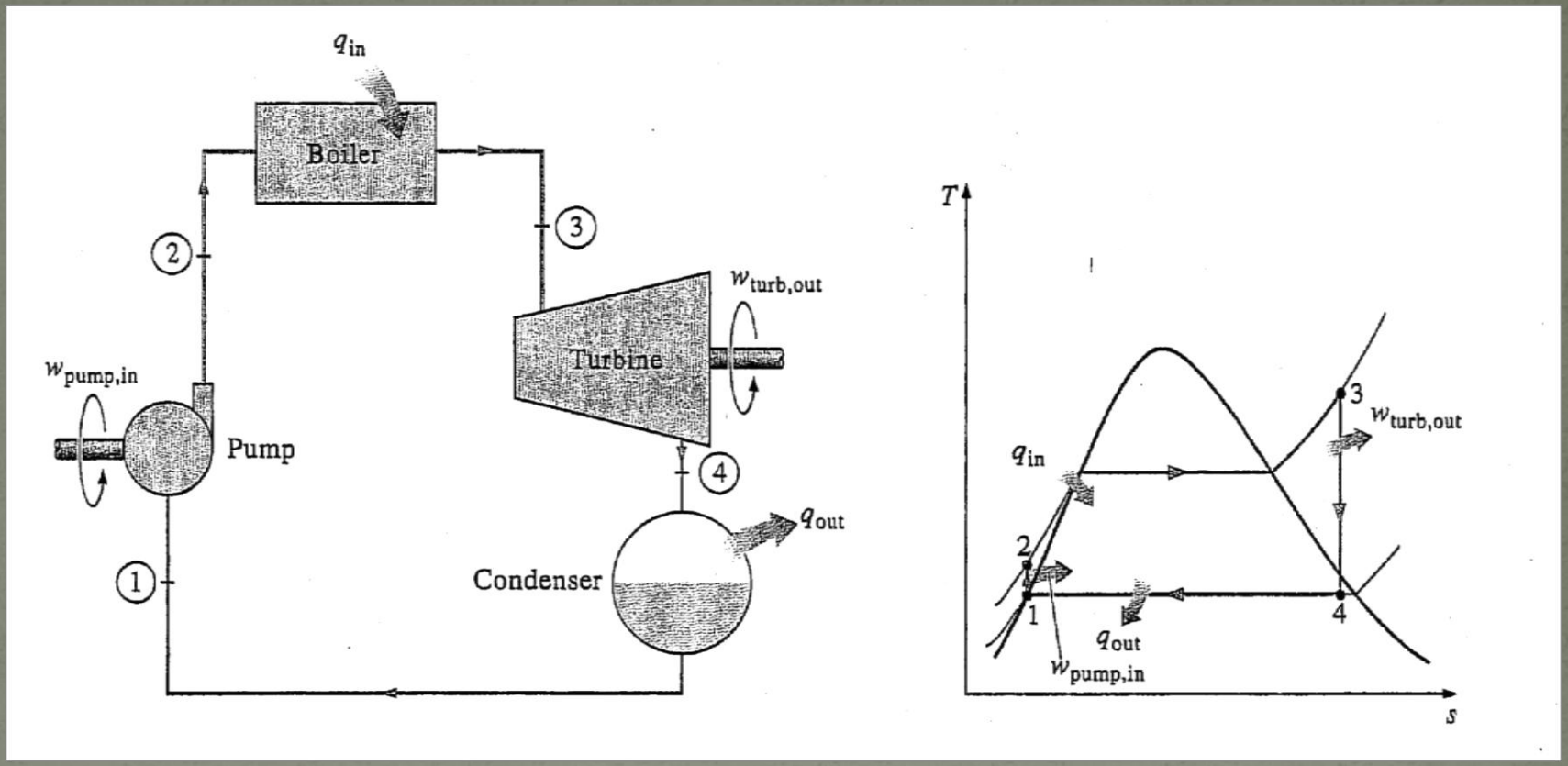
❖ *Principle*

- ❑ *It works on the principle of heat engines which converts chemical energy of fuel in thermal energy for the generation of steam.*

❖Construction

- *There are main 4 components of this cycle:*

1) *Steam boiler*
2) *Steam turbine*
3) *Steam condenser*
4) *Feed pump*



- *1-2 isentropic pump*
- *2-3 constant pressure heat addition*
- *3-4 isentropic turbine*
- *4-1 constant pressure heat rejection*

❖ *Working*

- *This process is starts with feed pump. Feed pump supplies the water in necessary amount to the steam boiler.*
- *In this device, heat is supplied for the generation of steam from supplied water.*
- *When the steam is generated, it is transferred to the steam turbine and turbine starts to rotate and give the work done.*
- *After this the steam is transferred to the steam condenser, where the heat is rejected and steam is converted into hot water and it is converted into cool water which is supplied to the pump.*
- *And cycle repeats again……*

❖ Energy Analysis

- $h_1=h_f$ low pressure (saturated liquid)
- $W_{pump\ (ideal)}=h_2-h_1=v_f(P_{high}-P_{low})$
  - v_f=specific volume of saturated liquid at low pressure
- $Q_{in}=h_3-h_2$ heat added in boiler (positive value)
  - Rate of heat transfer = Q*mass flow rate
  - Usually either Q_{in} will be specified or else the high temperature and pressure (so you can find h_3)
- $Q_{out}=h_4-h_1$ heat removed from condenser (here h_4 and h_1 signs have been switched to keep this a positive value)
- $W_{turbine}=h_3-h_4$ turbine work
  - Power = work * mass flow rate
- h_4@ low pressure and $s_4=s_3$

❖ Efficiency

- $W_{net}=W_{turbine}-W_{pump}$
- Heat supplied = $Q_{in}-Q_{out}$
- Thermal efficiency,

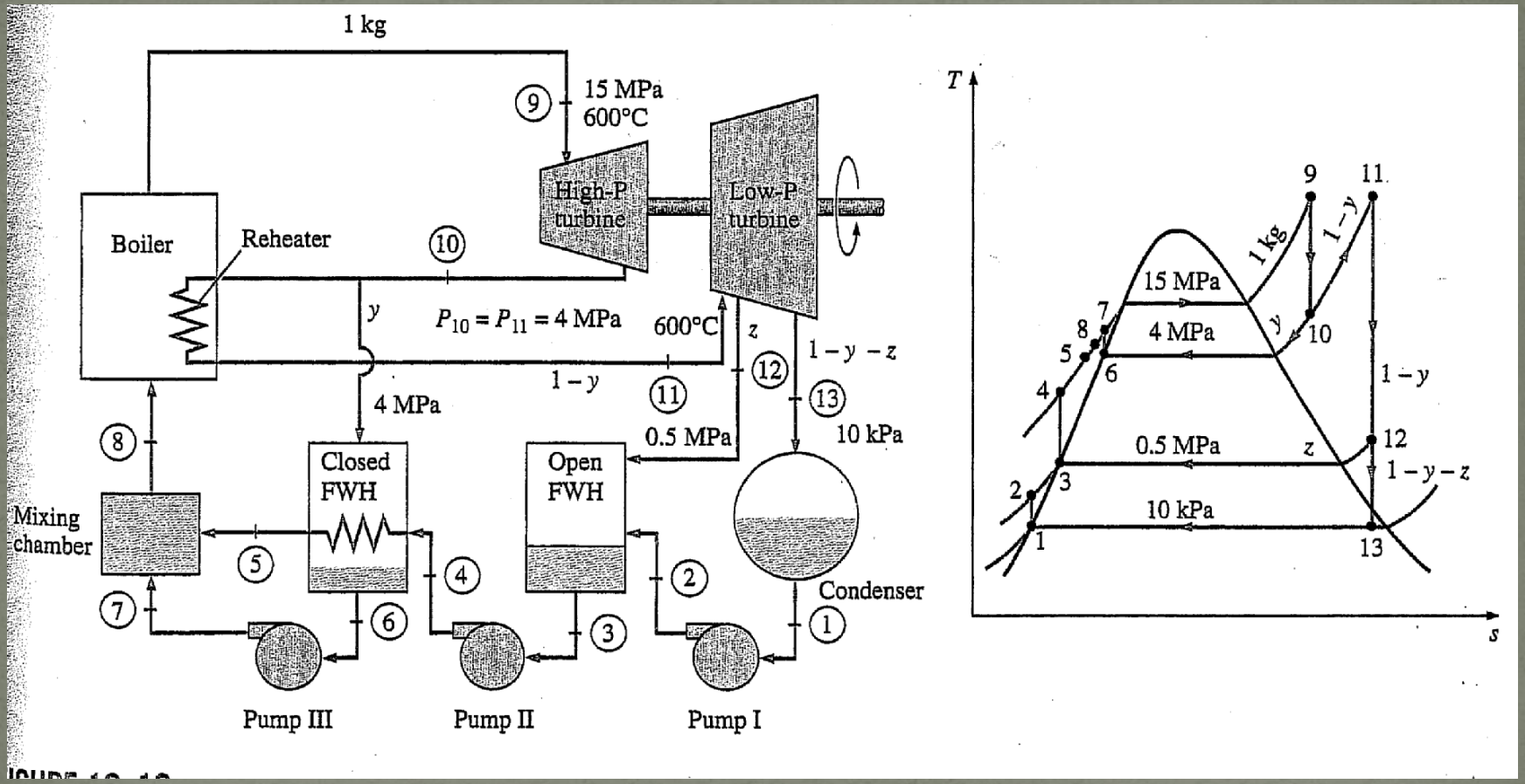
$$\text{thermal efficiency} = \frac{\text{work done}}{\text{heat suppiled}}$$

$$h_{th}=W_{net}/Q_{in}$$

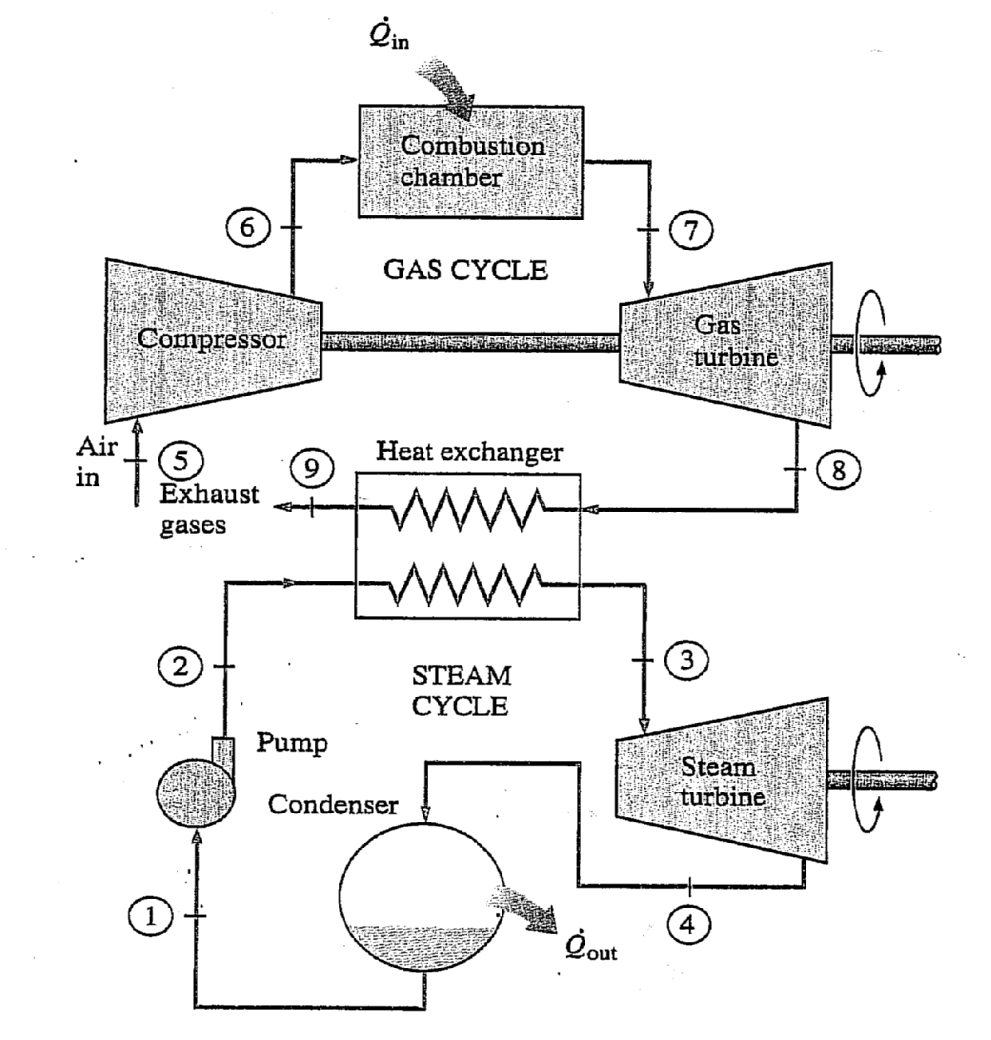
Ideal Rankine Cycle

- *This cycle follows the idea of the Carnot cycle but can be practically implemented.*
- *1-2 isentropic pump*
- *2-3 constant pressure heat addition*
- *3-4 isentropic turbine*
- *4-1 constant pressure heat rejection*

❖A more complicated cycle…



❖ Combined Cycle



Thank You