Kelvin Plank Statement (Deal with)

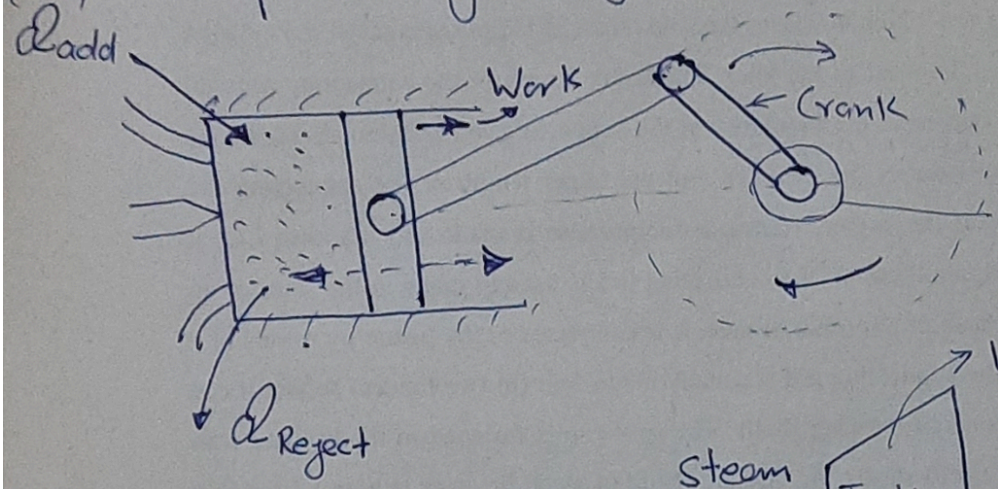
→ Cyclic heat engine

① Reciprocating engine

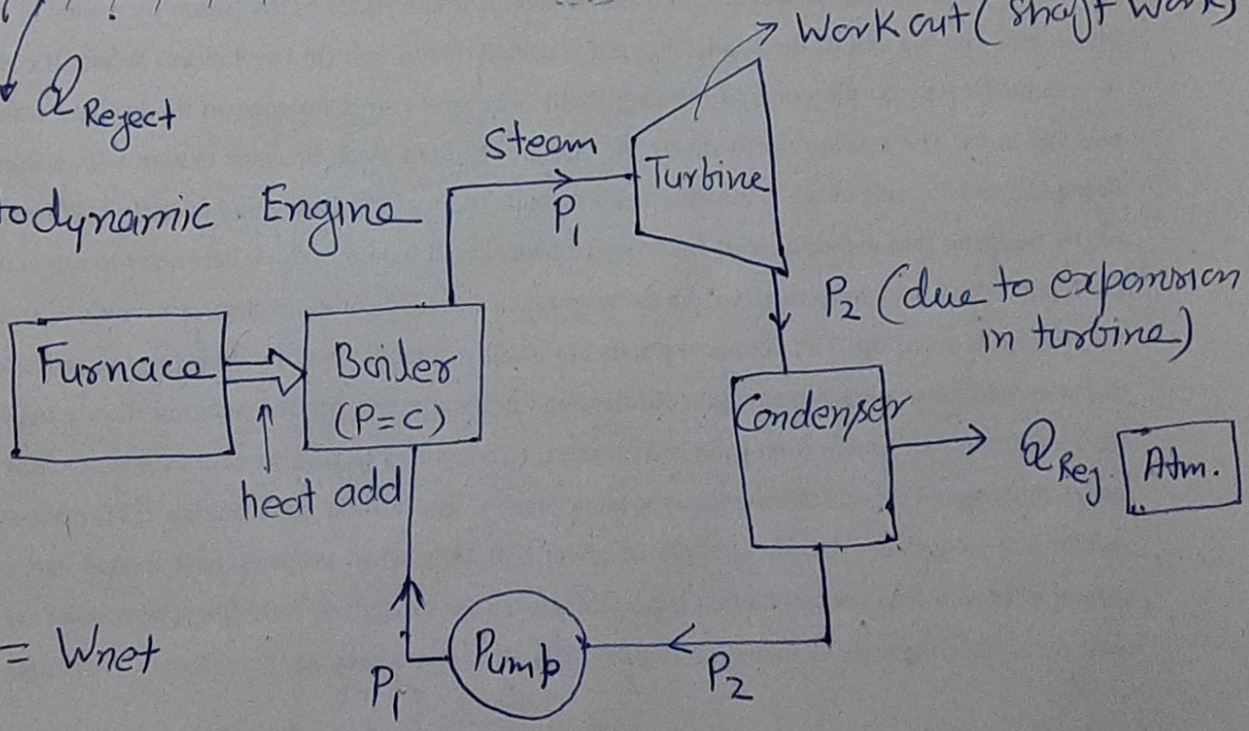
② Rotary (Rotodynamics)

(Note):- Heat engine is a device which convert heat into work]

① Reciprocating engine



② Rotodynamic Engine



$Q_{net} = W_{net}$

$Q_{add} - Q_{rej} = (W_{out} - W_{in}) \rightarrow W_{net}$

$$\boxed{Q_{add} = Q_{rej} + W_{net}}$$

[means W_{net} is less than heat added]

The term arrises that is thermal efficiency.

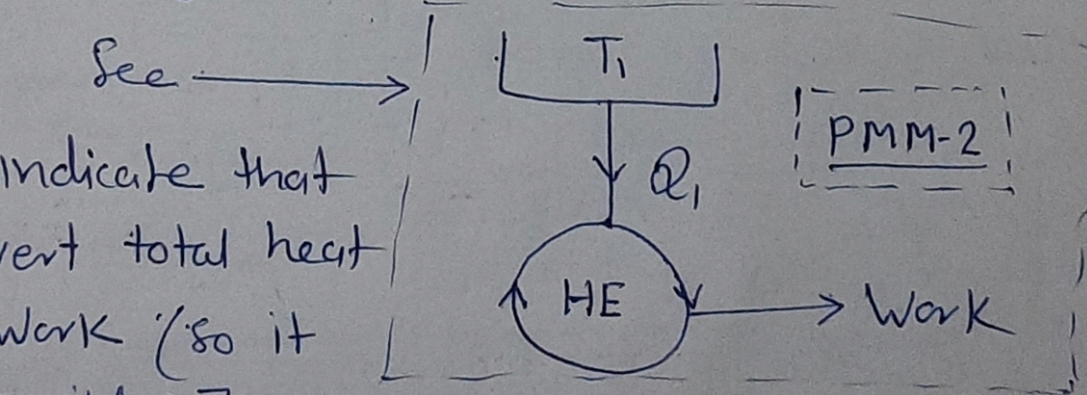
$$\eta_{Th.} = \frac{W_{net}}{Q_{add}}$$

$Q_{add} > W_{net}$ Always.

So the thermal η of is Always less than 1 or 100%. ($\eta < 100\%$)

Kelvin Plank Statement

It is impossible for a heat engine to Produce net work in a complete cycle if it exchange heat only with bodies at a single temperature (or no heat rejected)



[It indicate that it Convert total heat into Work (so it is impossible)]

[↳ so if any one Can Construct such a device which Convert 100% so such a device is Known as PMM-2]

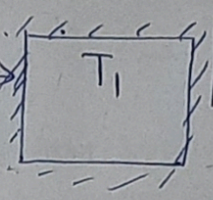
means $Q_{rej} = 0$ [So thermal efficiency will equal to 100%]

(So PMM-2 is Completely Hypothetical Concept)

TER (Thermal Energy Reservoir)

A device which have infinite capacity of heat, means from such a device if we extract a finite quantity of heat, but we can't change the initial condition of TER

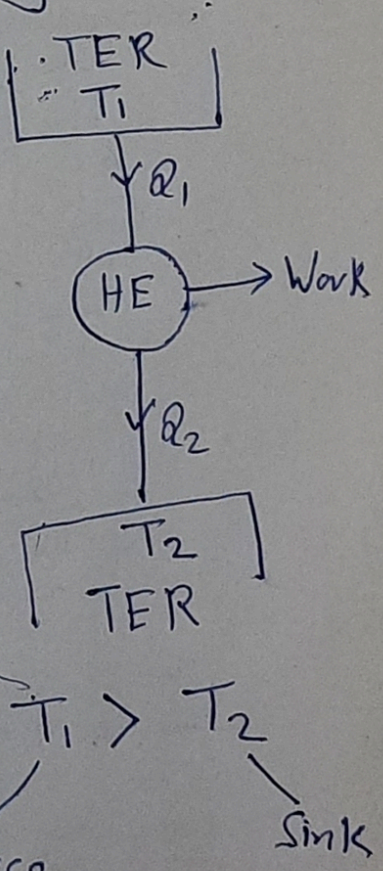
Like furnace



[it maintain a constant temp. ~~if we~~ and No matter how much energy you extract]

TER

- Source (Reject any Quantity of heat temp. will not change)
- Sink (Add any Quantity of heat temp will not change)

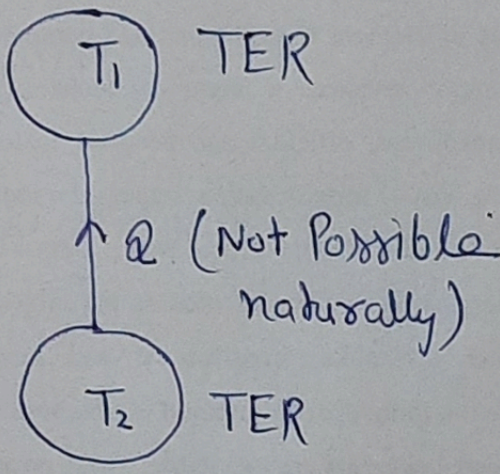


So Th. efficiency.

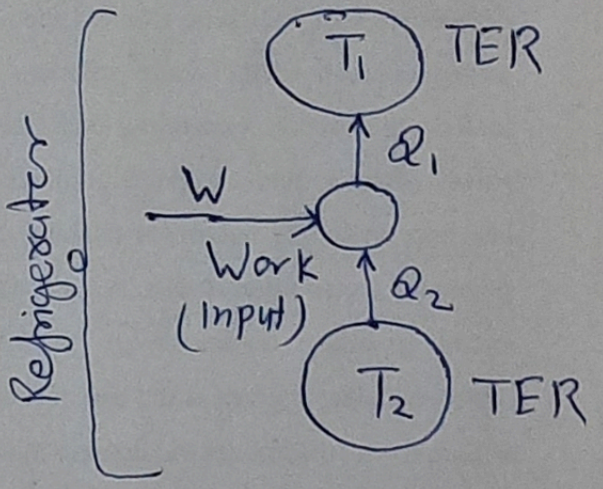
$$\eta_{th} = \frac{W_{net}}{Q_1} = \frac{Q_1 - Q_2}{Q_1}$$

CLAUSIUS " Statement

[It is impossible to construct a device which, while operating in a cycle; will produce no other effect other than the transfer of heat from cooler body to Hotter body] "means heat will not flow from cooler to hotter body by it sely"



$T_2 < T_1$



$T_2 < T_1$

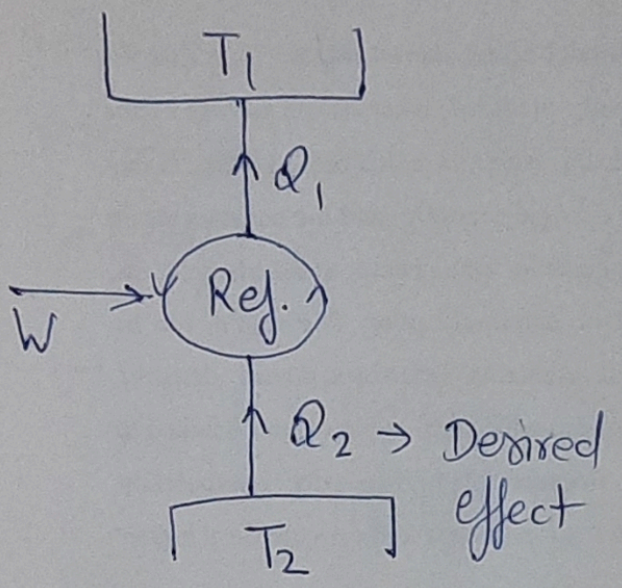
(means have to do some work for this type of transfer) like refrigerator

Continuously reject heat from cooler body like AC or refrigerator.

The functioning of Refrigerator is reverse of heat Pump.

In refrigerator we use COP (Coefficient of Performance) instead of efficiency.

$$COP = \frac{\text{Desired effect}}{\text{Work input}}$$



$T_1 > T_2$

$W + Q_2 = Q_1$

$W = Q_1 - Q_2$

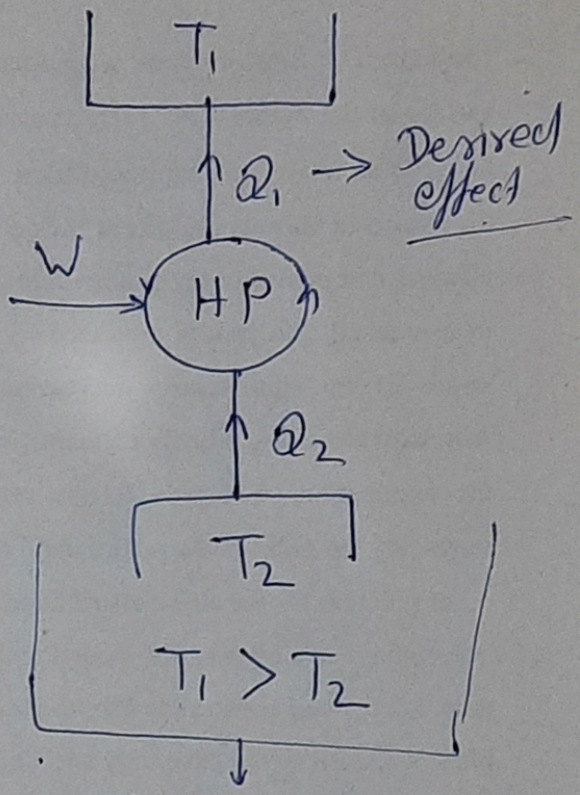
$$[COP]_{Ref} = \frac{Q_2}{W} = \frac{Q_2}{Q_1 - Q_2}$$

So

$$[COP]_{H.P} = \frac{Q_2}{Q_1 - Q_2} + 1$$

$$\frac{Q_2 + Q_1 - Q_2}{Q_1 - Q_2}$$

$$[COP]_{H.P} = \frac{Q_1}{Q_1 - Q_2}$$



If you want to heat up your Bromises that is extremly cold so the desired effect is Q_1

$Q_2 + W = Q_1$

$W = Q_1 - Q_2$

$$[COP]_{H.P} = \frac{Q_1}{Q_1 - Q_2}$$

$$[COP]_{HP} = [COP]_{Ref} + 1$$