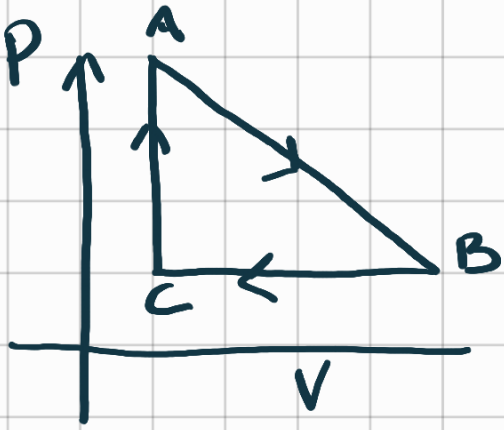
$$dU = dQ - dL$$

in un ciclo $dU = 0$

per ogni ciclo di uno stato e ritorno allo stesso stato



AB ISOTERMA
CA ISOCORA

Q_{AB} e $Q_{CA} > 0$

$Q_{BC} < 0$

$$Q = L$$

$$L = Q_{AB} + Q_{BC} + Q_{CA}$$

$$L = \underbrace{Q_{AB} + Q_{CA}}_{Q_{ASS}} + \underbrace{Q_{BC}}_{Q_{CED}}$$

$$L = Q_{ASS} - |Q_{CED}|$$

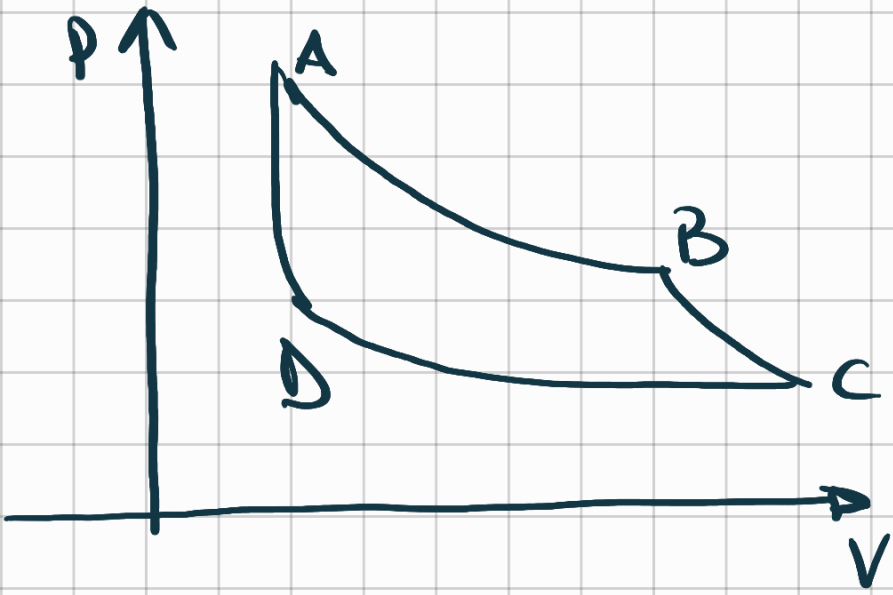
Una macchina termica

prevede per forza una perdita di CALORE

NON POSSO CONVERTIRE TUTTO Q in L

$$\eta = \frac{L}{Q_{ASS}}$$

rendimento macchine termica



AB ISOTERMA
CD ISOTERMA

BC } ADIABATICHE
DA }

$$Q_{AB} = nRT_1 \ln \frac{V_B}{V_A}$$

$$V_B > V_A \Rightarrow Q > 0$$

$$Q_{CD} = nRT_2 \ln \frac{V_D}{V_C}$$

$$V_C > V_D \Rightarrow Q < 0$$

$$\eta = \frac{L}{Q_{ASS}} = \frac{Q_{ASS} - |Q_{CEDI}|}{Q_{ASS}} =$$

$$= 1 - \frac{|Q_{CEDI}|}{Q_{ASS}}$$

$$\eta = 1 - \frac{nRT_2 \ln \frac{V_D}{V_C}}{nRT_1 \ln \frac{V_B}{V_A}}$$

$$= 1 - \frac{|T_2 \ln \frac{V_D}{V_C}|}{T_1 \ln \frac{V_B}{V_A}}$$

ADIABATICHE $BC = DA$

nella formula del rendimento ho un rapporto tra volumi e so che l'adiabatica è legata col un'isoterma => T costante

Uso perciò la formula di adiabatica che mette in relazione V e T

$$TV^{\gamma-1} = COST$$

$$T_A = T_B = T_1$$

$$T_C = T_D = T_2$$

$$T_B V_B^{\gamma-1} = T_C V_C^{\gamma-1}$$

$$T_A V_A^{\gamma-1} = T_D V_D^{\gamma-1}$$

da cui

$$T_1 V_B^{\gamma-1} = T_2 V_C^{\gamma-1}$$

$$T_1 V_A^{\gamma-1} = T_2 V_D^{\gamma-1}$$

$$\left(\frac{V_B}{V_A}\right)^{\gamma-1} = \left(\frac{V_C}{V_D}\right)^{\gamma-1}$$

ciò significa che

$$\frac{V_B}{V_A} = \frac{V_C}{V_D}$$

$$\eta = 1 - \frac{|T_2 \ln \frac{V_D}{V_C}|}{T_1 \ln \frac{V_B}{V_A}}$$

$$= 1 - \frac{|-T_2 \ln \frac{V_C}{V_D}|}{T_1 \ln \frac{V_B}{V_A}}$$

$$= 1 - \frac{T_2 \ln \frac{V_C}{V_D}}{}$$

$$T_1 \ln \frac{V_B}{V_A}$$

me $\frac{V_C}{V_D} = \frac{V_B}{V_A}$ dunque si elidono

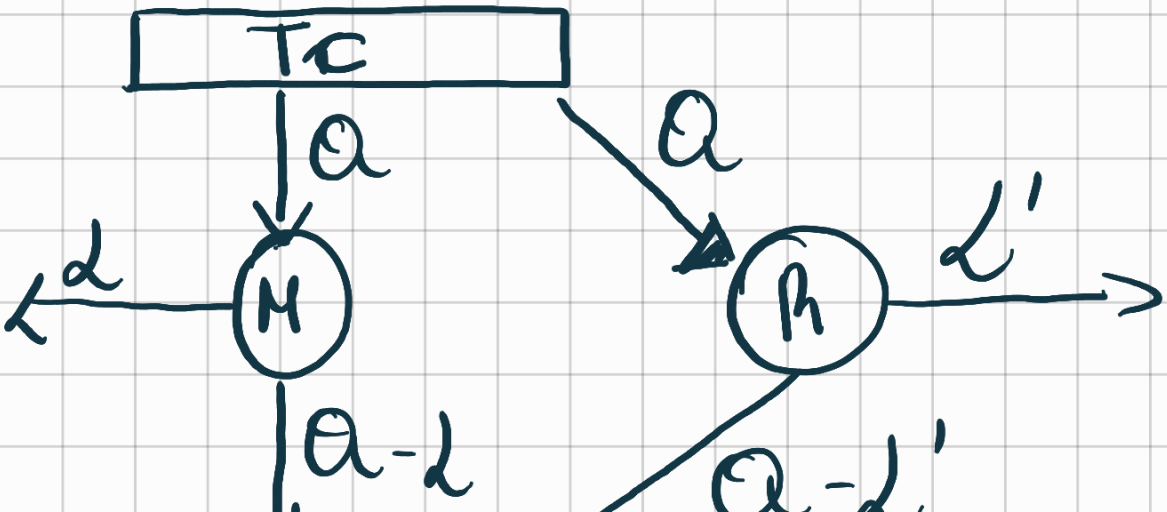
$$\eta = 1 - \frac{T_2}{T_1}$$

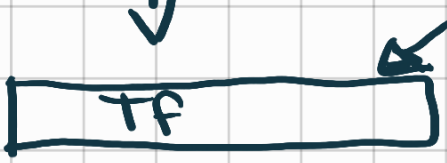
$$\frac{|Q_{CED}|}{Q_{ASS}} = \frac{T_2}{T_1}$$

TUTTE Q SONO PRELEVATE

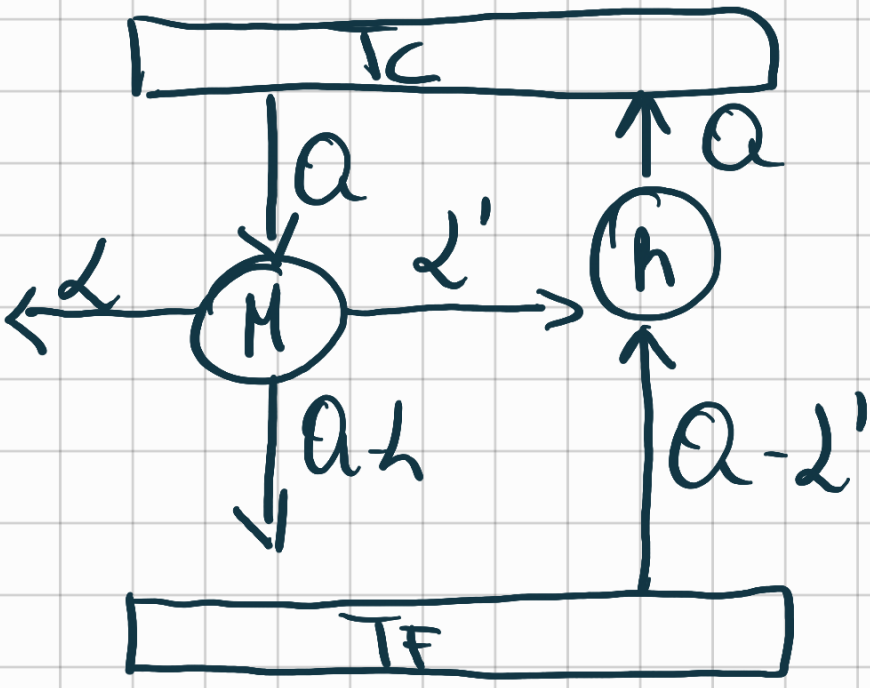
$$\frac{Q_1}{T_1} + \frac{Q_2}{T_2} = 0$$

TH CARNOT





$$\eta_m > \eta_R \Rightarrow \lambda_m > \lambda_R$$



$$Tc \Rightarrow Q - Q = 0$$

$$Tf \Rightarrow Q - \lambda - (Q - \lambda')$$

$$= Q - \lambda - Q + \lambda'$$

$$= \lambda' - \lambda \quad \Rightarrow \lambda > 0$$

CALCOLO SEMPRE QCEDUTO SORGENTI (QCED - QASS) $\Rightarrow \lambda < 0 \rightarrow \lambda - \lambda'$

$\downarrow$

lavoro di M

me significa che ho trasformato tutto Q in L scambiando calore con una solo sorgente
$\Rightarrow$ Violo Kelvin

Perciò $\eta_M \leq \eta_R$

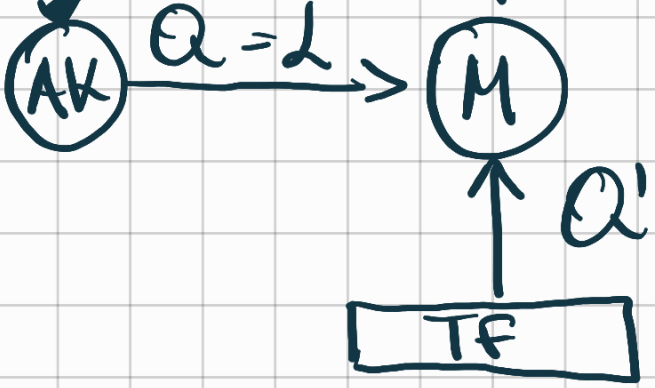
II PARTE $\eta_M \leq \eta_R$

$\eta_R \leq \eta_M$

$\eta_R = \eta_M$

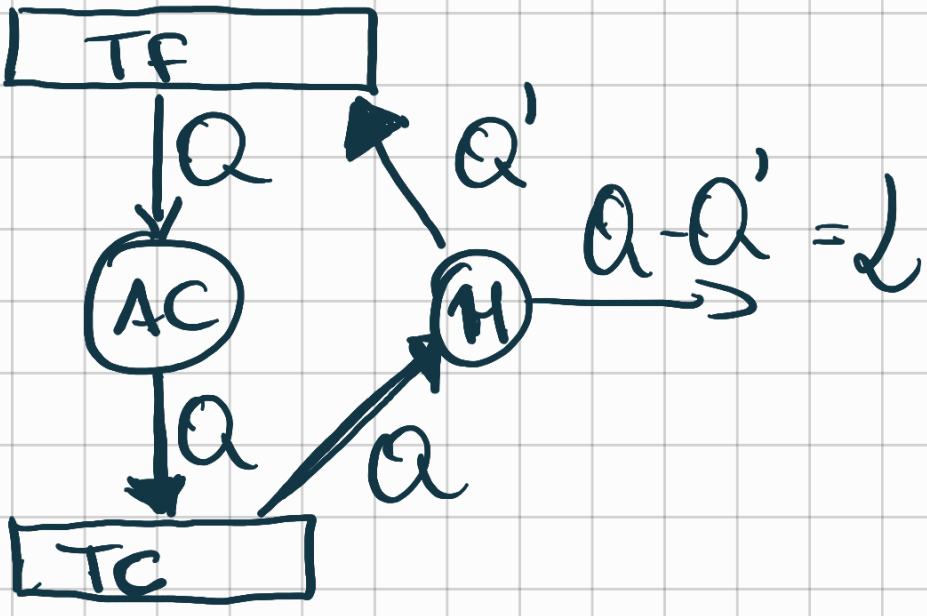
$$\frac{Q_1}{T_1} + \frac{Q_2}{T_2} \leq 0$$

PRINCIPIO K. PLANK $\Rightarrow$ CLAUSIUS



TRASFERISCO CALORE DA UNA FREDDA AD UNA CALDA

⇒ Vedo CLAUSIUS



Q_{CED} = CEDUTO - ASSORBITO

$Q_{CED} = Q - Q' = L$

Vedo Kelvin