T. Carnot

Tutte le macchine rev. (R) hanno lo stesso rendimento η_R.

Ogni altra macchina (M) non può avere rendimento maggiore.

$$T_2 > T_1$$

$$\Downarrow Q_2 > 0 \qquad \Downarrow Q_2' > 0$$

$$(X) \Rightarrow W > 0 \qquad (R) \Rightarrow W > 0$$

$$\Downarrow Q_1 < 0 \qquad \Downarrow Q_1' < 0$$

$$T_1$$

$$Q_1 + Q_2 = W$$

$$Q_1' + Q_2' = W$$

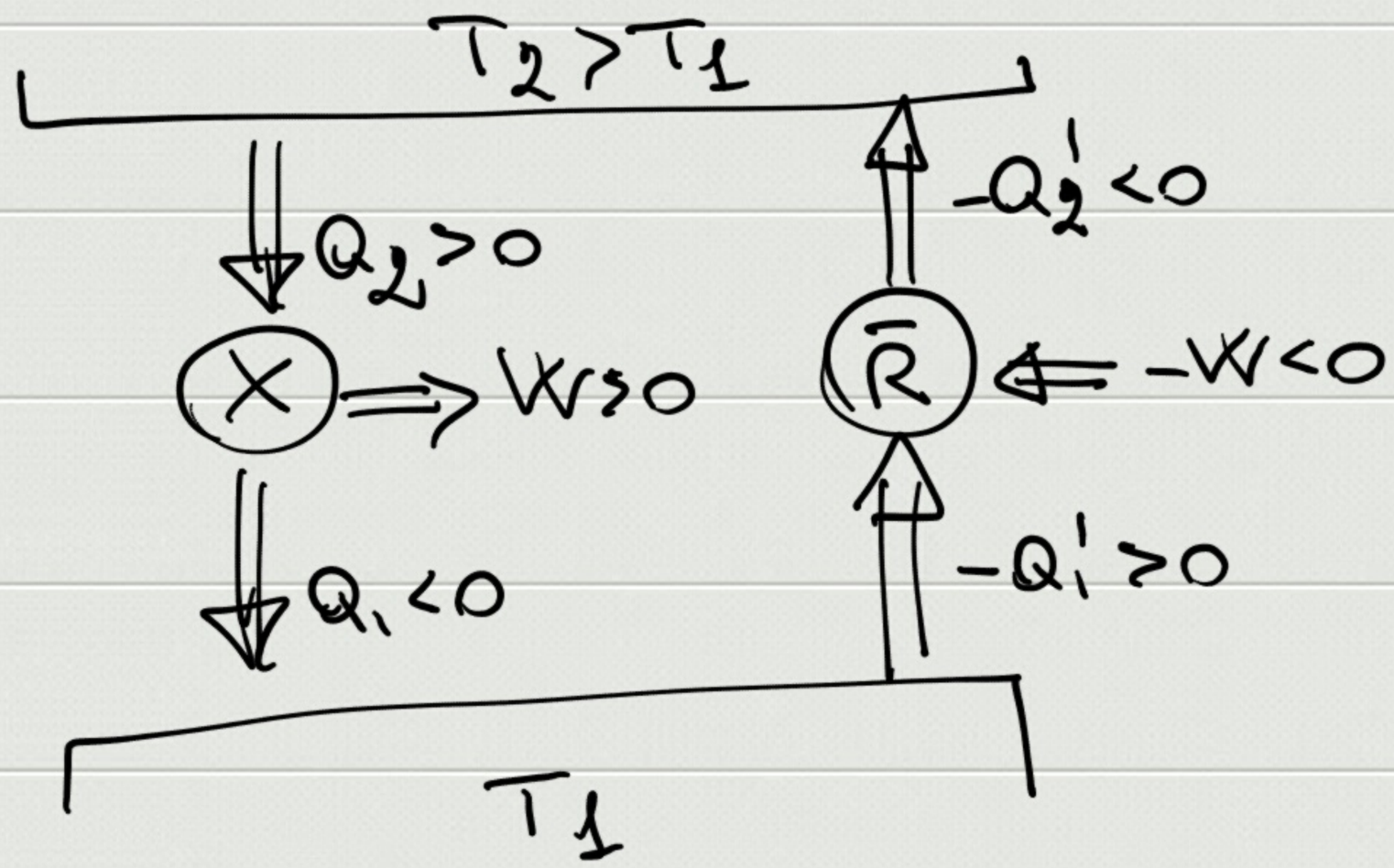
$$\Rightarrow Q_1 + Q_2 = Q_1' + Q_2'$$

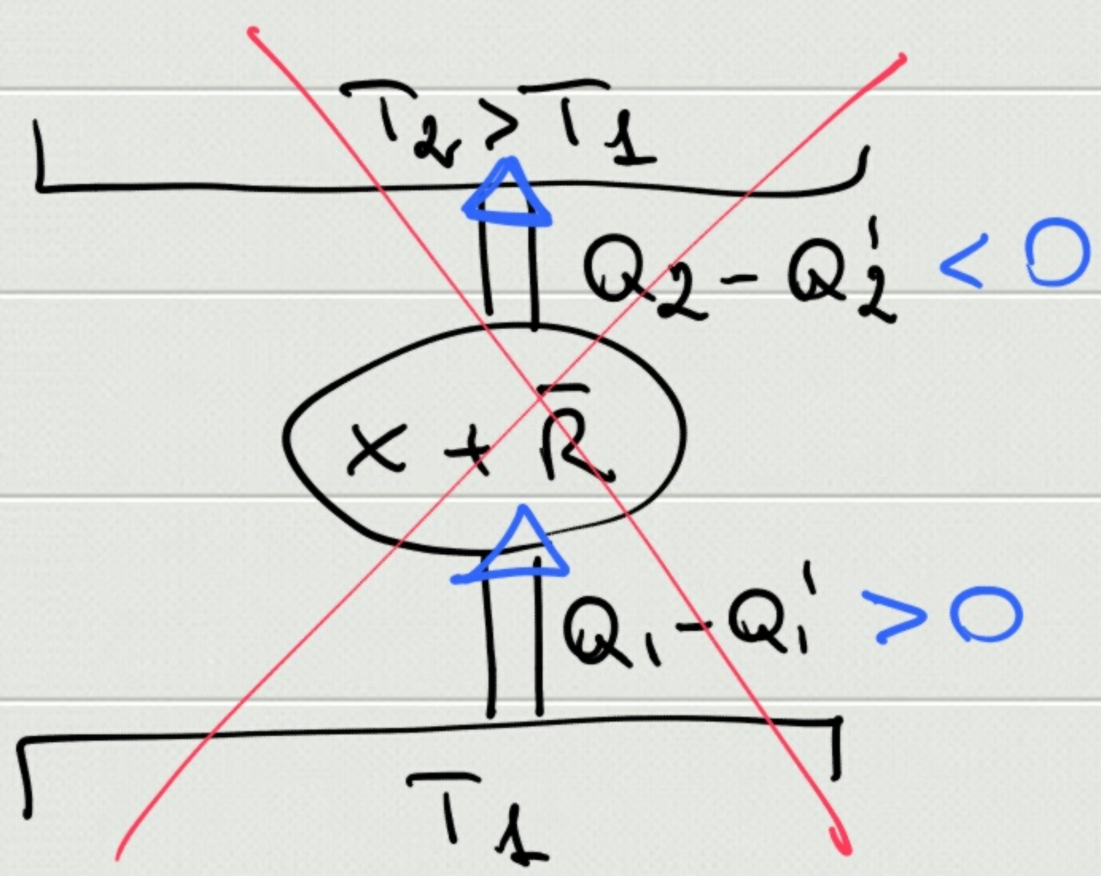
$$\boxed{\eta_X \leq \eta_R}$$

Per assurdo $\Rightarrow$ $\eta_X > \eta_R$

$$\underbrace{\eta_x > \eta_R} \Rightarrow \frac{W}{Q_2} > \frac{W}{Q_2'} \Rightarrow Q_2' > Q_2$$

$$\Rightarrow \underbrace{Q_2' - Q_2 > 0}$$





$$Q_1 + Q_2 = Q_1' + Q_2' \Rightarrow Q_1 - Q_1' = Q_2' - Q_2 > 0$$

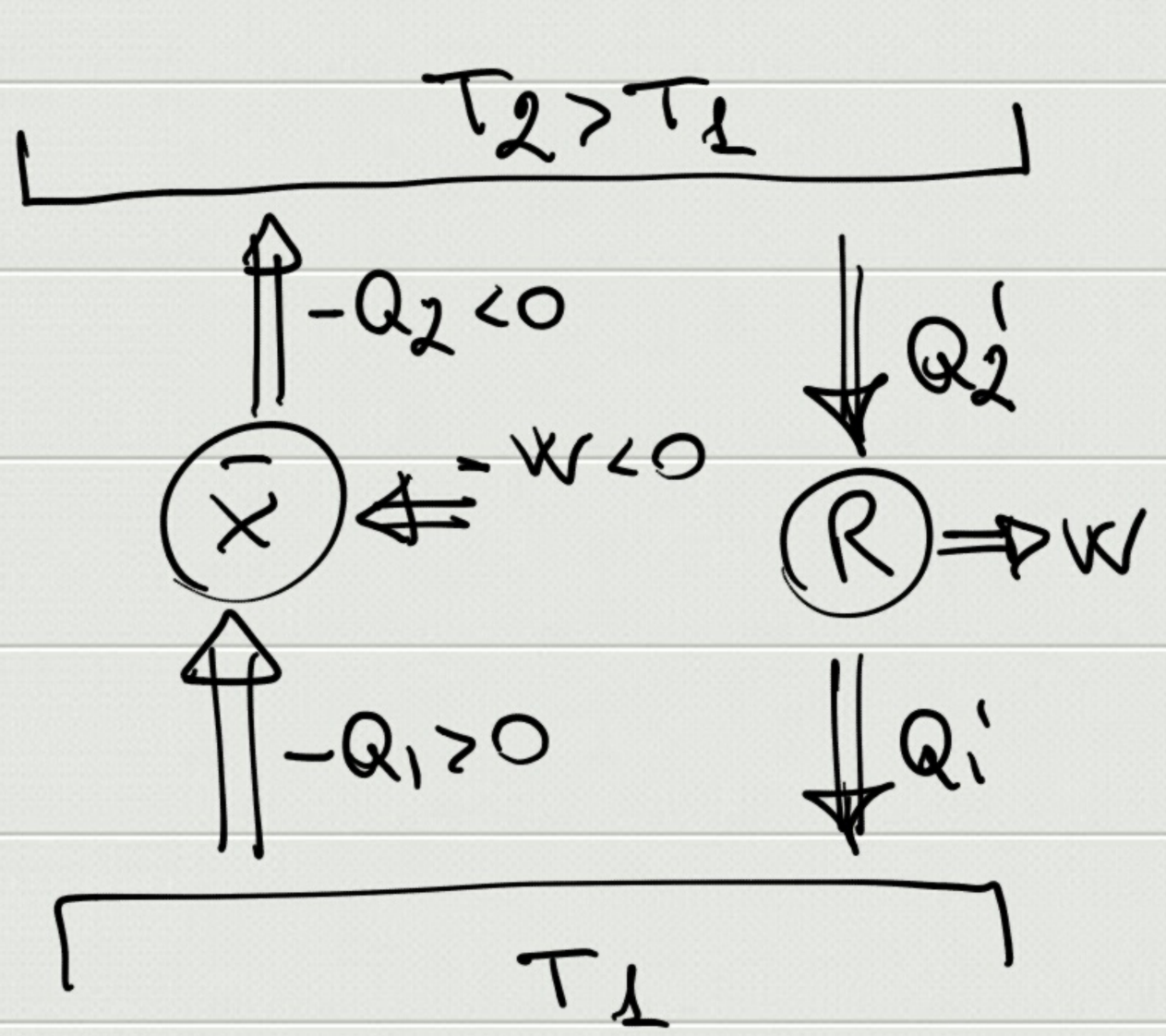
$$\Rightarrow \boxed{\eta_x \leq \eta_R}$$

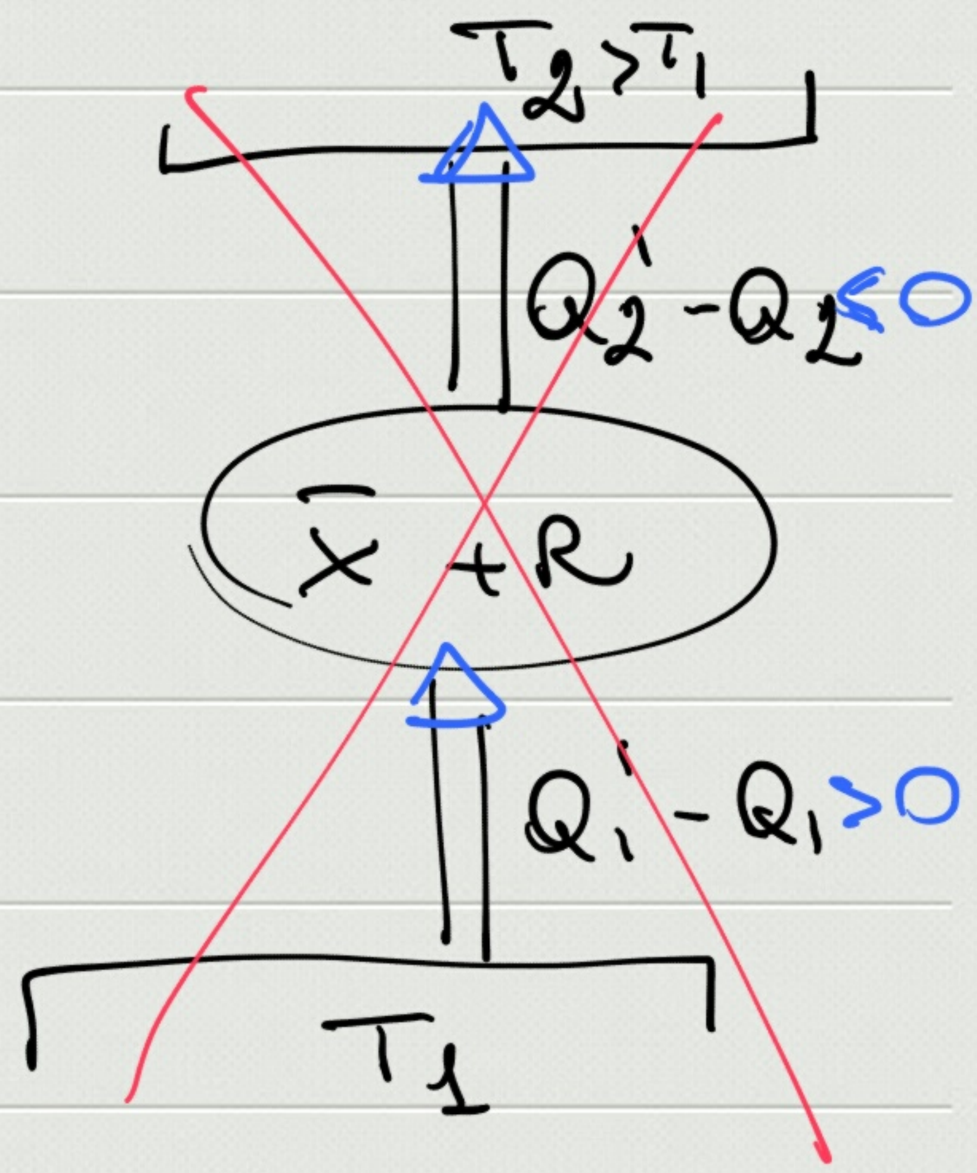
X : reversibile

$\eta_X \leq \eta_R$ per assurdo $\underbrace{\eta_X < \eta_R}$

$$\frac{W}{Q_2} < \frac{W}{Q_2'} \Longrightarrow Q_2' < Q_2 \Longrightarrow \underbrace{Q_2' - Q_2 < 0}$$

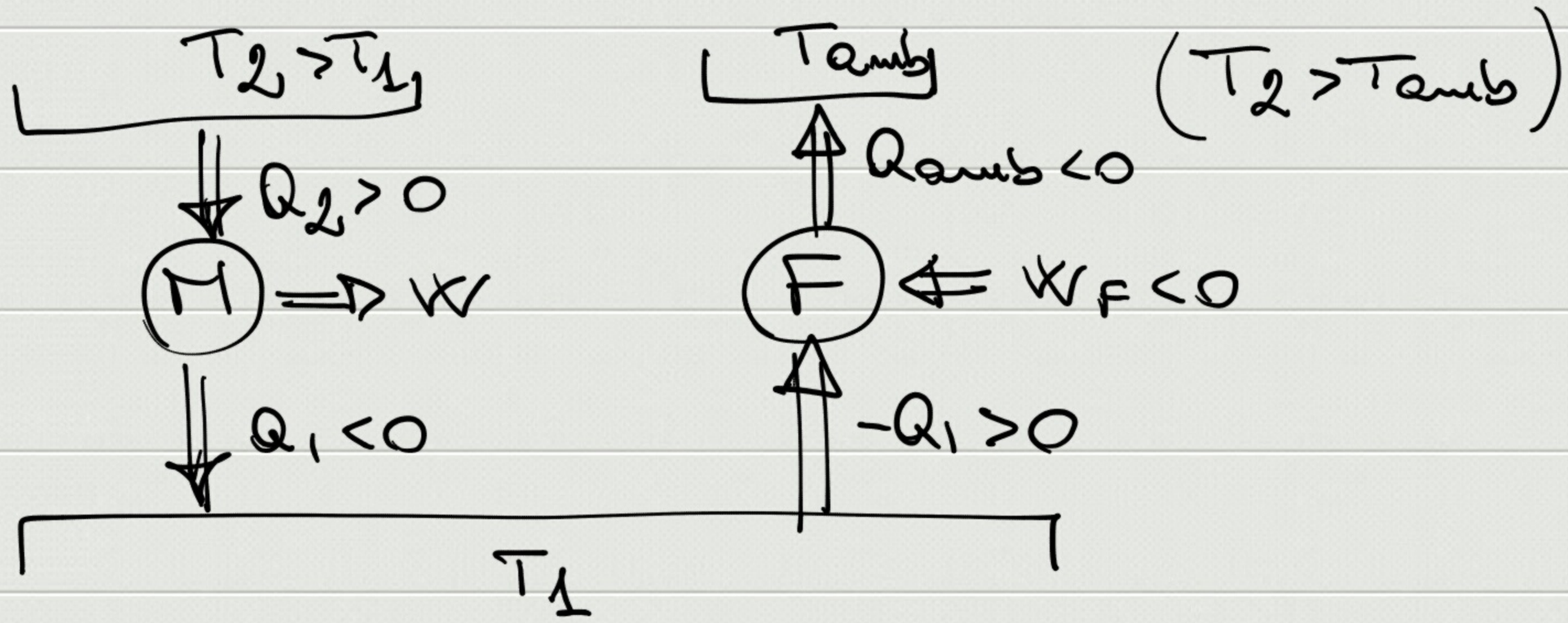
$$Q_1 + Q_2 = Q_1' + Q_2' \Longrightarrow Q_2' - Q_2 = Q_1 - Q_1' < 0$$

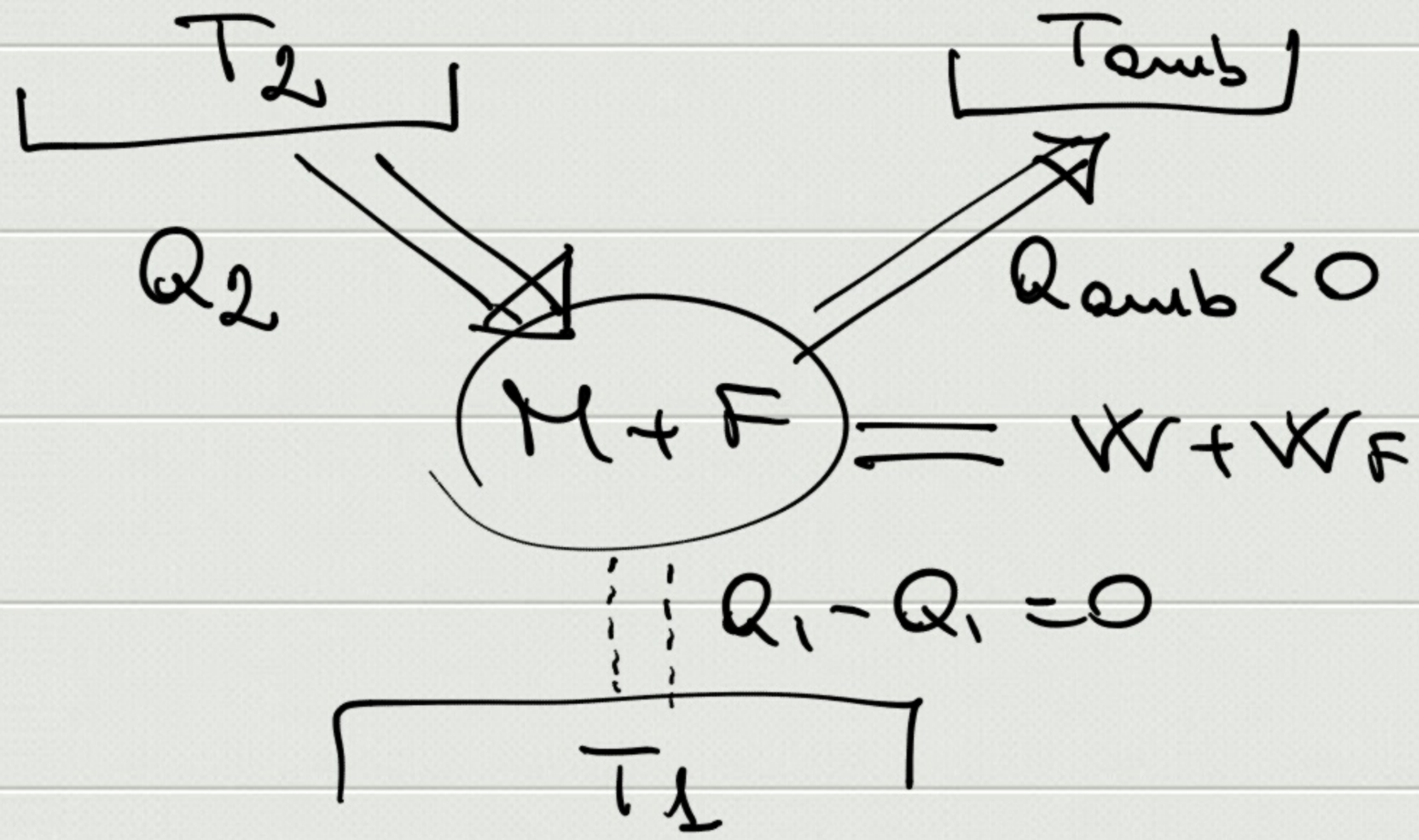




$\eta_X \geq \eta_R$ $\quad \eta_X \leq \eta_R \Longrightarrow \boxed{\eta_X = \eta_R}$

$$\boxed{\eta_R = 1 - \frac{T_1}{T_2}} = \eta_{max}$$

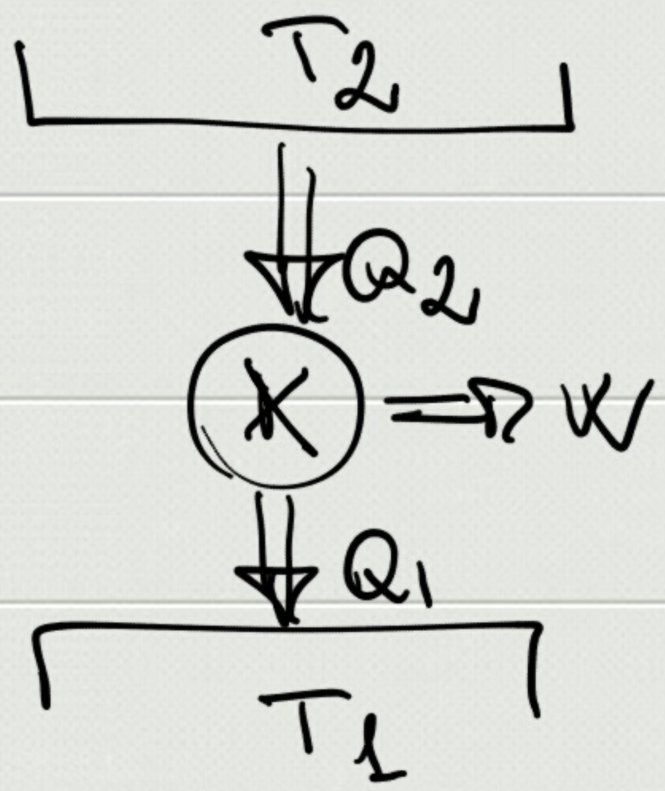




$$\eta_{M+F} = \frac{W + W_F}{Q_2} = \frac{(\cancel{Q_1} + Q_2) + (Q_{amb} - \cancel{Q_1})}{Q_2} =$$

$$= 1 + \frac{Q_{amb}}{Q_2}$$

$$\eta_x \leq \eta_R \Rightarrow \eta_x = 1 + \frac{Q_1}{Q_2} \leq \eta_R = 1 - \frac{T_1}{T_2}$$



$$\frac{Q_1}{Q_2} \leq -\frac{T_1}{T_2}$$

$$\Rightarrow \frac{Q_1}{T_1} \leq -\frac{Q_2}{T_2}$$

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

$$\begin{cases} < 0 & \text{irreversibile} \\ = 0 & \underline{\text{reversibile}} \end{cases}$$

$$\eta_x = \frac{W}{Q_{ASS}} \leq \eta_{Rev} = \eta_{max} = 1 - \frac{T_1}{T_2}$$

Dato Q_{ASS} : $\Rightarrow W = \eta Q_{ASS} \leq \underset{\substack{\shortparallel \\ W_{max}}}{\eta_{max}} Q_{ASS}$

$$\boxed{W_{max} = Q_{ASS}\left(1 - \frac{T_1}{T_2}\right)}$$

Dato W : $\Rightarrow Q_{ASS} = \frac{W}{\eta} \geq \frac{W}{\eta_{max}} = Q_{ASS,min}$

$$\boxed{Q_{ASS,min} = \frac{W}{1 - \frac{T_1}{T_2}}}$$