Exercício 4.121

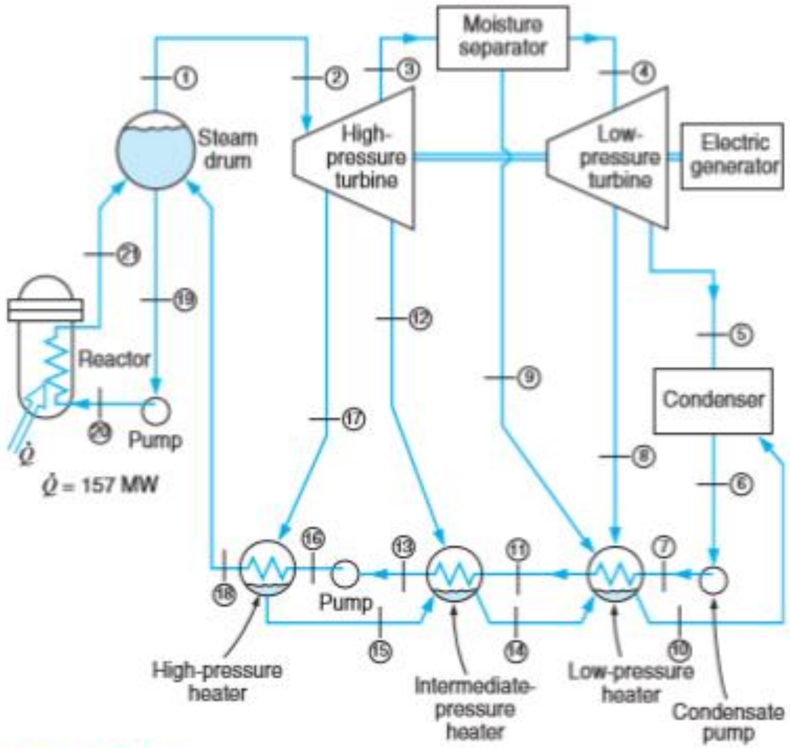
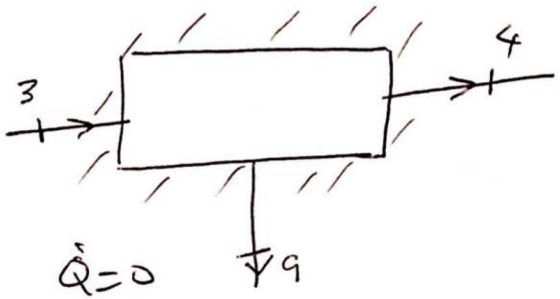


FIGURE P4.121

4.121

a) SEPARADOR



REG. PERM.

V.C.

$\dot{Q} = 0$

$\dot{W} = 0$

MASSA $\quad \dot{m}_3 = \dot{m}_4 + \dot{m}_9 \Longrightarrow \dot{m}_4 = 58{,}212$ kg/s

ENERGIA $\quad \dot{m}_3 h_3 = \dot{m}_4 h_4 + \dot{m}_9 h_9$

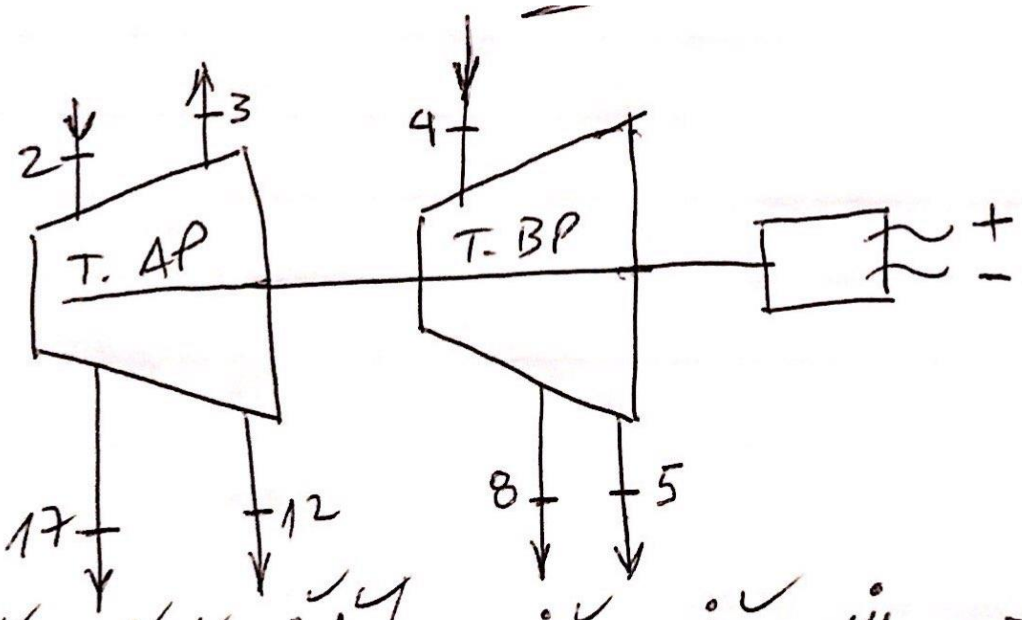
$h_4 = 2673{,}9 = h_{l,4} + x_4 h_{lv,4}$ $(P = 310$ kPa$)$

$h_{l,4} \rightarrow 566{,}18$

$h_{lv,4} \rightarrow 2160{,}6$

$x_4 = 0{,}9755$

5)



$$\dot{W}_{vc} = \dot{m}_2 h_2 - \dot{m}_{17} h_{17} - \dot{m}_{12} h_{12} - \dot{m}_3 h_3$$

$$\dot{W}_{vc} = 18394 \text{ kW}$$

$$\dot{m}_4 = \dot{m}_8 + \dot{m}_5 \Rightarrow \dot{m}_5 = 55{,}44 \text{ kg/s}$$

$$\dot{W}_{v.c.} = \dot{m}_4 h_4 - \dot{m}_5 h_5 - \dot{m}_8 h_8$$

$$\dot{W}_{vc} = 22489 \text{ kW}$$

Exercício 4.125

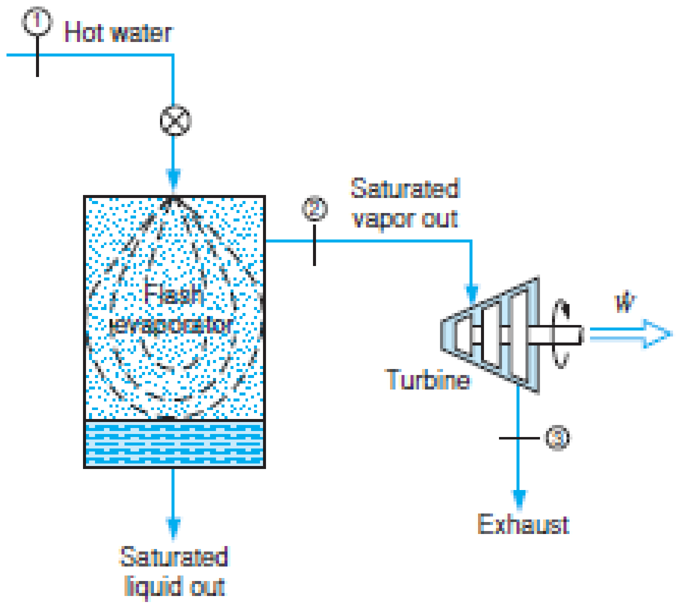
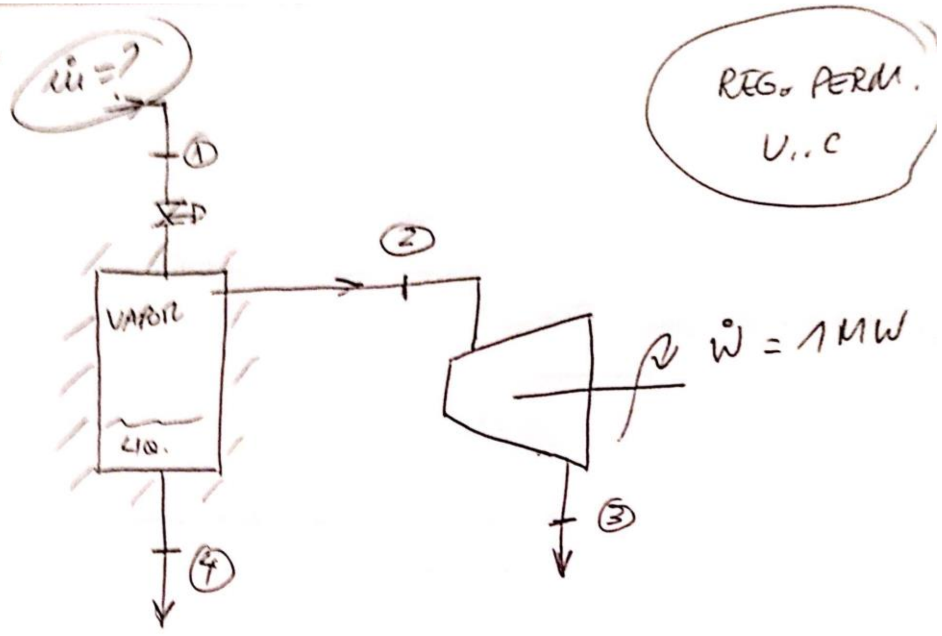


FIGURE P4.125

125



① : $P = 1{,}5\ MPa$
$T = 180\,°C$

$h_1 = 763{,}5\ kJ/kg$

② : $P = 400\ kPa$
$x = 1{,}0$
$h_g = 2738{,}6\ kJ/kg$

④ : $P = 400\ kPa$
$x = 0{,}0$
$h_l = 604{,}74\ kJ/kg$

① : $P = 1{,}5\ MPa$
$T = 180°C$

$h_1 = 763{,}5\ kJ/kg$

② : $P = 400\ kPa$
$x = 1{,}0$
$h_g = 2738{,}6\ kJ/kg$

③ $h_3 = 191{,}83 + 0.9 \times 2392{,}8$
$= 2345{,}4$
$P = 10\ kPa$, $x = 0.9$

④ : $P = 400\ kPa$
$x = 0.0$
$h_l = 604{,}74\ kJ/kg$

Na turbina : $\dot{W} = \dot{m}_2 (h_2 - h_3)$

$$\dot{m}_2 = \frac{1000\ kW}{(2738{,}6 - 2345{,}4)} = 2{,}543\ kg/s$$

No evaporador:

$$\dot{m}_1 h_1 = \dot{m}_2 h_2 + \dot{m}_4 h_4$$

$$h_1 = \frac{\dot{m}_2}{\dot{m}_1} h_2 + \frac{\dot{m}_4}{\dot{m}_1} h_4 \Rightarrow x_{EVAP} = \frac{(h_1 - h_4)}{(h_2 - h_4)} = 0{,}074$$

$\frac{\dot{m}_2}{\dot{m}_1} = x_{EVAP}$, $\frac{\dot{m}_4}{\dot{m}_1} = 1 - x_{EVAP}$

$$\Rightarrow \dot{m}_1 = 2{,}543 / 0{,}074 = 34{,}2\ kg/s$$

Exercício 4.153

4.153 An insulated spring-loaded piston/cylinder device, shown in Fig. P4.153, is connected to an air line flowing air at 600 kPa and 700 K by a valve. Initially, the cylinder is empty and the spring force is zero. The valve is then opened until the cylinder pressure reaches 300 kPa. Noting that $u_2 = u_{line} + C_v(T_2 - T_{line})$ and $h_{line} - u_{line} = RT_{line}$, find an expression for T_2 as a function of P_2, P_0, and T_{line}. With $P_0 = 100$ kPa, find T_2. 4.1

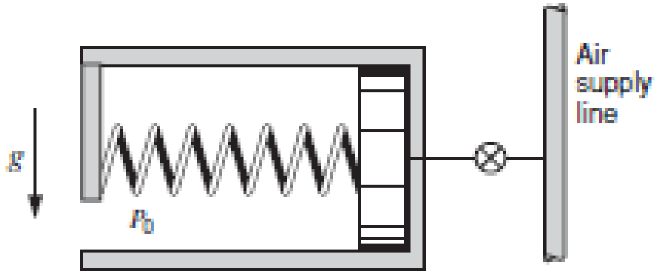
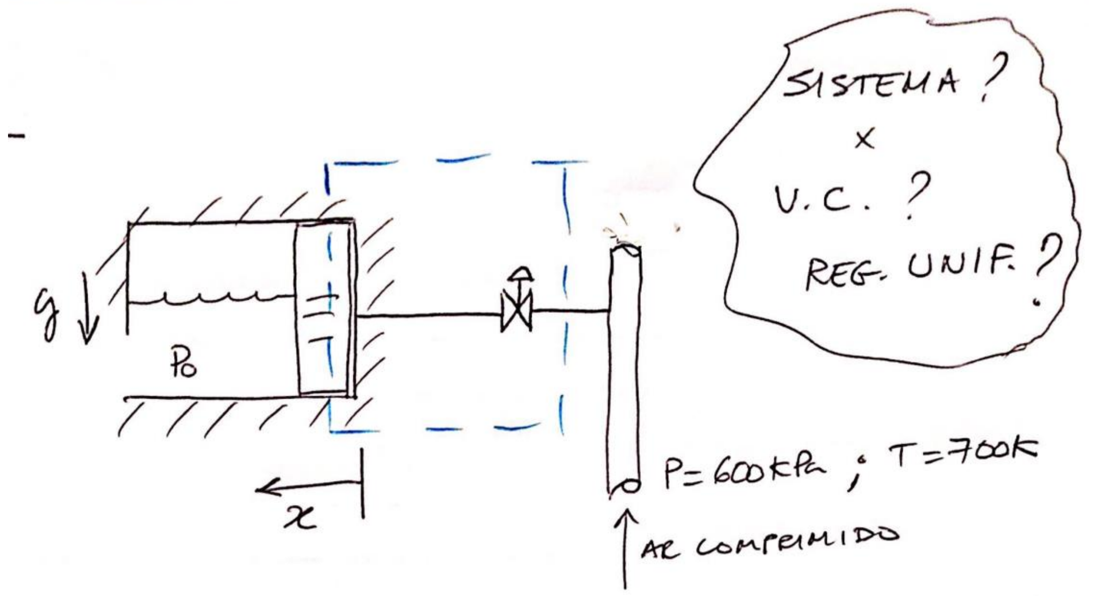


FIGURE P4.153



.C. → MASSA DE AR ENTRE O PISTÃO E A ENTRADA DA VÁLVULA

→ REGIME UNIFORME? HIPÓTESE FUNDAM.??

OK

MASSA : $m_2 - m_1 = m_e$ (1)

ENERGIA : $m_2 u_2 - m_1 u_1 = m_e h_e - \int P dV$ (2)

→ REGIME UNIFORME? HIPÓTESE FUNDAM.??

OK

MASSA : $m_2 - \cancel{m_1}^{0} = m_e \quad (1)$

ENERGIA : $m_2 u_2 - \cancel{m_1}^{0} u_1 = m_e h_e - \int P dV \quad (2)$

$m_2 = m_e \quad (1')$

$m_2 u_2 = m_2 h_e - \int P dV \quad (2')$

mas $\int_1^2 P dV = \frac{1}{2}(P_1 + P_2)(V_2 - V_1)$

→ Pressão na fronteira

Sabemos que $P_1 = P_0$, $V_1 = 0$,

então $\int_1^2 P\,dV = \frac{1}{2}(P_2 + P_0)V_2$

em (2'):

$m_2 u_2 = m_2 h_e - \frac{1}{2}(P_2 + P_0)V_2$

$$m_2 u_2 = m_2 h_e - \frac{1}{2}(P_2 + P_0)V_2 \qquad (2'')$$

HIPÓTESE: Ar Comprimido → GÁS PERFEITO

$$pv = RT \quad (4a) \quad e \quad dh = c_p\,dT \quad (4b)$$
$$du = c_p\,dT \quad (4c)$$

em (2''):

$$m_2(u_2 - h_e) = -\frac{1}{2}(P_2 + P_0)V_2$$

$$m_2\big(u_2 - (u_e + \underbrace{P_e v_e}_{RT_e})\big) = -\frac{1}{2}(P_2 + P_0)V_2$$

$$m_2(\underbrace{u_2 - u_e}_{c_v(T_2 - T_e)} - RT_e) = -\frac{1}{2}(P_2 + P_0)V_2$$

$$(c_v(T_2 - T_e) - RT_e) = -\frac{1}{2}(P_2 + P_0)\frac{V_2}{m_2} \qquad \frac{V_2}{m_2} = v_2 = \frac{RT_2}{P_2}$$

$$c_v(T_2 - T_e) - RT_e = -\frac{1}{2}(P_2 + P_0)\frac{RT_2}{P_2}$$

$$0.7165(T_2 - 700) - 0{,}2870 \times 700 = -\frac{1}{2}(300 + 100) \times \frac{0{,}287 \times T_2}{300}$$

$$T_2 = 773{,}7\ K$$