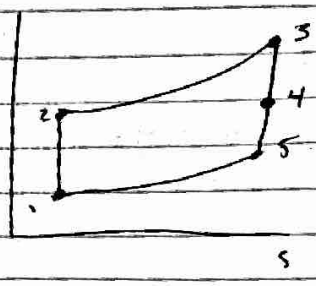
135



① A-17 7°C 280°K

$h_1 = 280.13 \text{ kJ/kg}$

$P_{r_1} = 1.0889$

$\frac{P_2}{P_1} = \frac{P_{r_2}}{P_{r_1}} \qquad P_{r_2} = P_{r_1}\left(\frac{P_2}{P_1}\right) \qquad P_{r_2} = 1.0889(9)$

$P_{r_2} = 9.8001$

Enthalpy @ P_{r_2} A-17

$$h_2 = \frac{(9.8001 - 9.684)(533.98 - 523.63)}{(10.37 - 9.684)} + 523.63$$

$$= 525.38 \text{ kJ/kg}$$

$\dot{Q}_{in} = .5(427000)$

$= 21350 \text{ kW}$

$$q_{in} = \frac{\dot{Q}_{in}}{\dot{m}_a} = \frac{21350}{20} = 1067.5 \text{ kJ/kg}$$

$q_{in_{2-3}} = h_3 - h_2 \quad = 1067.5 = h_3 - 525.38$

$h_3 = 1592.8$

T_3 Relative pressure @ h_3

$$T_3 = \frac{(1592.8 - 1587.63)(1480-1460)}{1611.79 - 1587.63} + 1460$$

$$= 1464.34^\circ K$$

$$Pr_3 = \frac{(1592.8 - 1587.63)(568.8 - 537.1)}{1611.79 - 1587.63} + 537.1$$

$$= 543.9$$

W by turbo

$$W_t = W_c$$

$$h_3 - h_4 = h_2 - h_1$$

$$1592.8 - h_4 = 525.38 - 280.13$$

$$h_4 = 1347.63 \text{ kJ/kg}$$

$$\frac{Pr_3}{Pr_5} = \frac{P_3}{P_5} \qquad \frac{543.9}{Pr_5} = 9 \qquad Pr_5 = 60.4$$

Find Enthalpy A-17 @ Pr_5

$h_5 = 897.57 \text{ kJ/kg}$

Apply SFEE Equation

$$h_4 + \tfrac{1}{2}V_i^2 = h_5 + \tfrac{1}{2}V_E^2$$

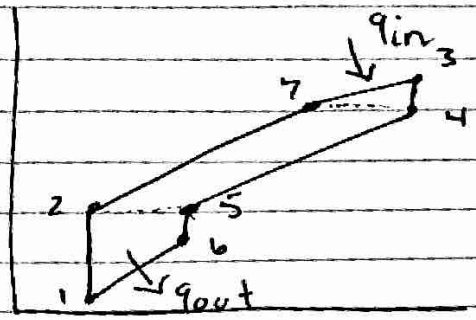
$$V_E^2 = \sqrt{2(h_4 - h_5)} = 969.59 \text{ m/s}$$

$$F = \dot{m}_a(V_e - V_I)$$

$$20(969.59)$$

$$= 19391.95 N$$

167



① $T_5 = T_2$

$T_1 = r_p^{k-1/k}$

② $T_7 = T_4$

$T_3 = r_p^{1-k/2k}$

③ $T_6 = T_5\left(\frac{P_6}{P_5}\right)^{\frac{k-1}{k}}$

④ $T_5 = \frac{1}{\sqrt{r_p}}$

⑤ $T_6 = T_5 r_p^{\frac{1-k}{2k}}$

$= T_2 r_p^{\frac{1-k}{2k}}$

$= T_1 r_p^{\frac{k-1}{k}} \cdot r_p^{1-k/2k}$

$= T_1 r_p^{\frac{k-1}{2k}}$

⑥ $q_{in} = h_3 - h_7$

$= c_p(T_3 - T_7)$

$= c_p T_3\left(1 - r_p^{\frac{1-k}{2k}}\right)$

⑦ $q_{out} = h_6 - h_1$

$c_p(T_6 - T_1)$

$q_{out} = c_p\left(T_1 r_p^{\frac{k-1}{2k}} - T_1\right)$

$\eta_{th} = 1 - \frac{c_p T_1\left(r_p^{\frac{k-1}{2k}} - 1\right)}{c_p T_3\left(1 - r_p^{\frac{1-k}{2k}}\right)}$

$= 1 - \frac{T_1\left(r_p^{\frac{k-1}{2k}} - 1\right)\left(r_p^{k-1/2k}\right)}{T_3\left(r_p^{\frac{k-1}{2k}} - 1\right)}$

⑧ $\eta = 1 - \frac{T_1}{T_3} r_p^{\frac{k-1}{2k}}$