PROBLEM 6.86

Figure P6.86 provides steady-state operating data for a well-insulated device having steam entering at one location and exiting at another. Neglecting kinetic and potential energy effects, determine (a) the direction of flow and (b) the power output or input, as appropriate, in kJ per kg of steam flowing.

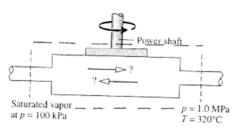


Fig. P6.86

ENGR. MODEL:

- 1. The control volume shown in the statch is at steady state.
- 2. For the control volume, Qcv=0 and kinetic and potential energy effects con ke neglected.

ANALYSIS: As discussed in Secs. 5.1 and 6.8, directionality normally can be established using the Indlaw. Here, a direction is assumed and the associated entropy production is evaluated. To begin, property data are found:

Table A-4: Saturated vapor at 100 KPa: h=2675.5 EJ/Eg, 5=7.3594 KJ/Eg.K
p=1.0MPa, 320°C: h= 3093.9 EJ/Eg, 5=7.1962 KJ/Eg.K

Taking the inlet as the saturated voyen at 100 kPa, an entropy note balance gives

$$\frac{dS^{0}}{dt} = \sum_{i=1}^{\infty} \frac{1}{2} + \sin(\sin - 5\cos t) + \cot t$$

$$\Rightarrow \frac{dz}{dt} = 5\cos t - 5\sin t$$

$$= (7.1962 - 7.3794) = -0.1632 = \frac{167}{150} = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632 = -0.1632$$

I OM Pa = 10 bur

320°C

100KPa
= 1 bar

As Jev/m must be = 0, the direct on of flow must be opposite to that assumed: from 1.0MPa, 320°C to saturated vapor at 100EPa.

Then, an energy nate balance needs,

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