**PROBLEM 5.34**

**KNOWN:** Steady-state data are provided for a power cycle developed by an inventor.

**FIND:** Evaluate the inventor's performance claim.

**ANALYSIS:** The inventor claims the power cycle will develop $W_{\text{cycle}} = 100\text{hp}$ for $Q_H = 5.1 \times 10^8 \text{ Btu/h}$, while operating between hot and cold reservoirs at $1000\text{K}$ and $500\text{K}$. Any such cycle must satisfy:

$$\eta \leq \eta_{\text{max}} = 1 - \frac{T_C}{T_H} = 1 - \frac{500}{1000} = 0.5$$

where:

$$\eta = \frac{W_{\text{cycle}}}{Q_H}$$

Then:

$$\frac{W_{\text{cycle}}}{Q_H} = \frac{100\text{hp}}{5.1 \times 10^8 \text{ Btu/h}} \leq 0.5$$

$$= 0.499$$

Accordingly, the inventor's claim corresponds to nearly reversible operation. While such operation is not impossible, it is highly unlikely.

**PROBLEM 5.35**

**KNOWN:** Steady-state data are provided for a power cycle developed by an inventor.

**FIND:** Evaluate the inventor's performance claim.

**ANALYSIS:** The inventor claims the power cycle will develop $W_{\text{cycle}} = 32\text{ kW}$ for $Q_H = 150,000\text{kJ/h}$, while operating between hot and cold reservoirs at $1735\text{K}$ and $295\text{K}$. Any such cycle must satisfy:

$$\eta \leq \eta_{\text{max}} = 1 - \frac{T_C}{T_H} = 1 - \frac{295}{1735} = 0.749$$

Using the given power and heat transfer rate data, we get:

$$\eta = \frac{W_{\text{cycle}}}{Q_H} = \frac{32\text{ kW}}{(150,000\text{kJ/h})\frac{1\text{ kJ}}{3600\text{s}}} = 0.768$$

The claim cannot be correct, for the thermal efficiency exceeds the maximum theoretical value.