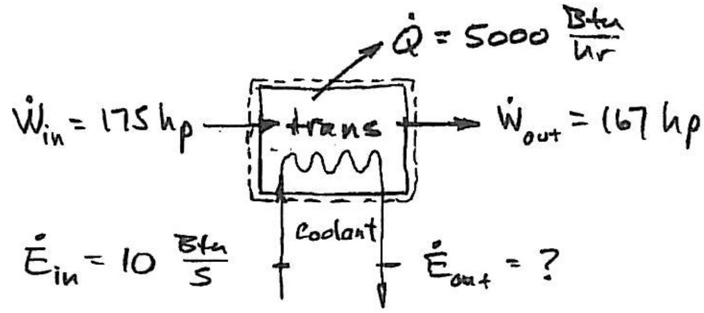
Given: An automobile transmission being cooled.



Find: $\dot{E}_{out}$

Solution: If the coolant keeps the transmission from overheating, $\dot{E}_G = 0$

Therefore,

$$\dot{E}_T = \dot{E}_G = 0$$

The energy transport rate for the system is,

$$\dot{E}_T = \dot{Q} - \dot{W} + \dot{E} = \dot{Q} - \dot{W} + (\dot{E}_{in} - \dot{E}_{out})$$

Then,

$$\dot{E}_T = \left(-5000 \frac{Btu}{hr}\right)\left|\frac{hr}{3600\ s}\right.$$

$$-\ (167 - 175)\ hp \left|\left(\frac{2545\ Btu}{hp \cdot hr}\right)\left(\frac{hr}{3600\ s}\right)\right.$$

$$+\ \left(10 - \dot{E}_{out}\right)\frac{Btu}{s} = 0$$

Solving for $\dot{E}_{out}$ ...

$$\dot{E}_{out} = \underline{\underline{14.26}}\ \frac{Btu}{s} \leftarrow$$

Reflection: There is LOTS of stuff in this problem

- The +/- signs can drive you insane ... unless you remember what the terms represent!

  $\dot{Q} \rightarrow$ the <u>net</u> heat transfer rate <u>into</u> the system

  $\dot{W} \rightarrow$ the <u>net</u> work transfer rate <u>out</u> of the system

  $\dot{E} \rightarrow$ the <u>net</u> energy transfer rate <u>in</u> due to flow

Following these definitions, you can see,

1) Why $\dot{Q}$ is negative

2) Why $\dot{W} = \dot{W}_{out} - \dot{W}_{in}$

3) Why $\dot{E} = \dot{E}_{in} - \dot{E}_{out}$

- Unit conversions! - Very important! All terms MUST be dimensionally homogeneous
- If the coolant is keeping the transmission from overheating, you would expect $\dot{E}_{out} > \dot{E}_{in}$. This is exactly what you found!!
- This is such an important and pivotal concept in ME 322 that I will <u>guarantee</u> that there will be a problem similar to this on your first exam.