Heat Engines

Work can be easily converted to other forms of energy, but converting other forms of energy to work is not that easy. A device which is converting heat to work is called heat engines.

Heat engines characterizedby the following;

- They recieve heat from a source.
- They convert part of this heat to work (with the aid of shaft or something else).
- They reject excess heat to sink.
- They operate on cycle.

Heat engines and other cyclic devices usually involve a fluid and from which heat is transferred while undergoing a cycle. The fluid is called the working fluid.

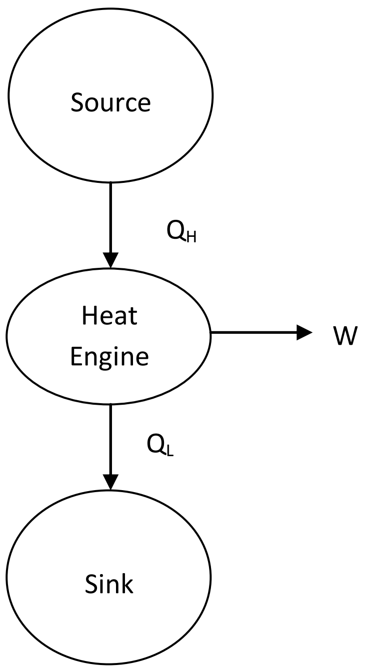

Fig 1. Schematic representation of heat engine

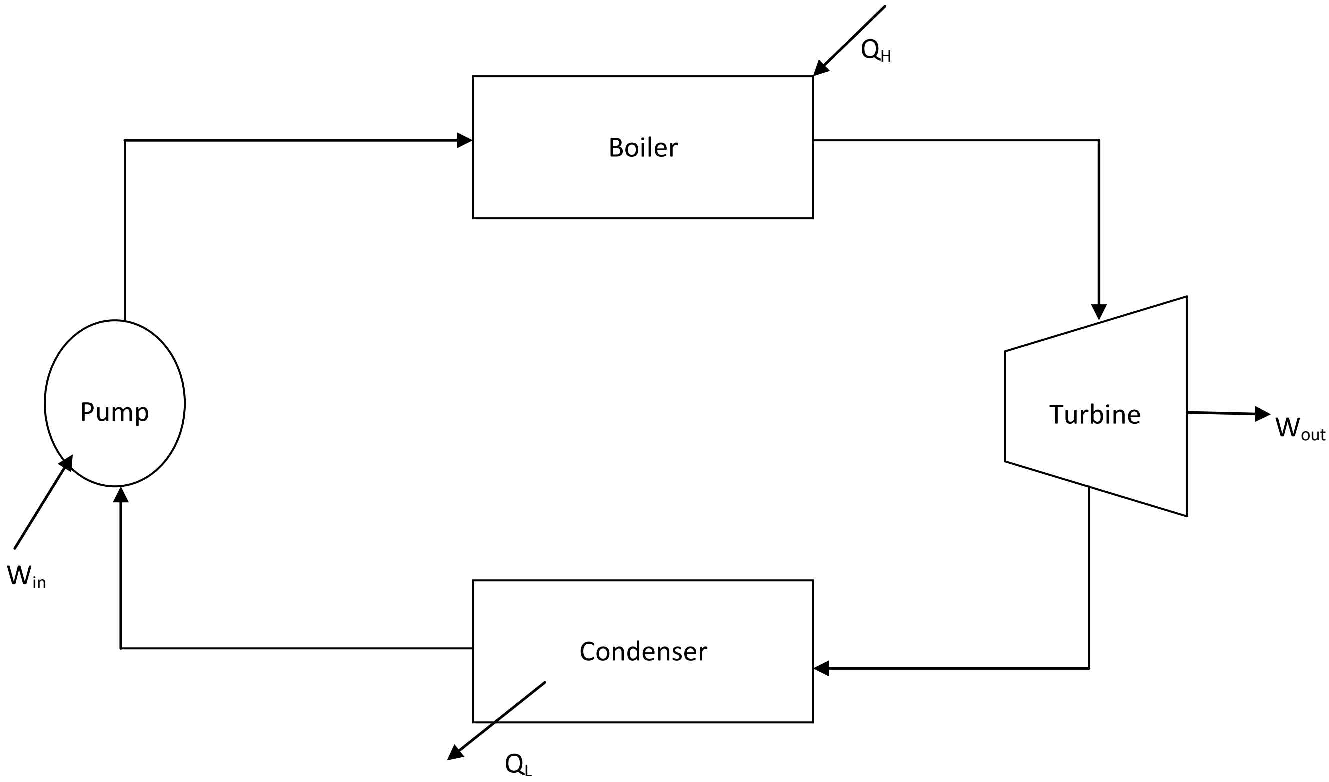

Fig. 2 Schematic representation of steam power plant

Here;

Q_{in} : Amount of heat supplied to steam in boiler from high-temperature source.

Q_{out} : Amount of heat rejected from steam in condenser from to a low-temperature sink.

W_{out} : Amount of work delivered by steam as it expands in turbine.

W_{in} : Amout of work required to compress water to boiler pressure.

$$Wnet,out = Wout – Win$$

In general energy balance around heat engine;

$$W_{net,out} = Q_H – Q_L$$

Thermal Efficiency

The fraction of the heat input that is converted to net work output is a measure of the performance of a heat engine and is called the thermal efficiency. Thermal efficiency denoted by "τ_{th}".

$$\text{Performance} = \frac{}{}$$

For heat engines, the desired output is the net work output and the required input is the amount of heat supplied to the working fluid. Then the thermal efficiency of a heat engine can be expressed as;

$$\text{Thermal efficiency} = \frac{\quad}{\quad}$$

$$\tau_{th} = \frac{\quad}{\quad}$$

It can also expressed as;

$$\tau_{th} = \quad \frac{\quad}{\quad}$$

Q_H : Magnitude of heat transfer between the cyclic device and the high-temperature medium at temperature T_H.

Q_L : Magnitude of heat transfer between the cyclic device and the low-temperature medium at temperature T_L.

$$W_{net,\, out} = Q_H - Q_L$$

$$\tau_{th} = \frac{\quad}{\quad}$$

$$\tau_{th} = \quad \frac{\quad}{\quad}$$