Senior Design Team 20
Solar Powered Phase-Change Compressor

Conceptual Design Review
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PROJECT DEFINITION

- Need Statement: Design a compressor for a refrigeration system that is powered by solar energy.
- Objective: 5,000 BTU/hr of cooling (1465 W)
- Solar-Thermal Driven
- Project Budget: $2000

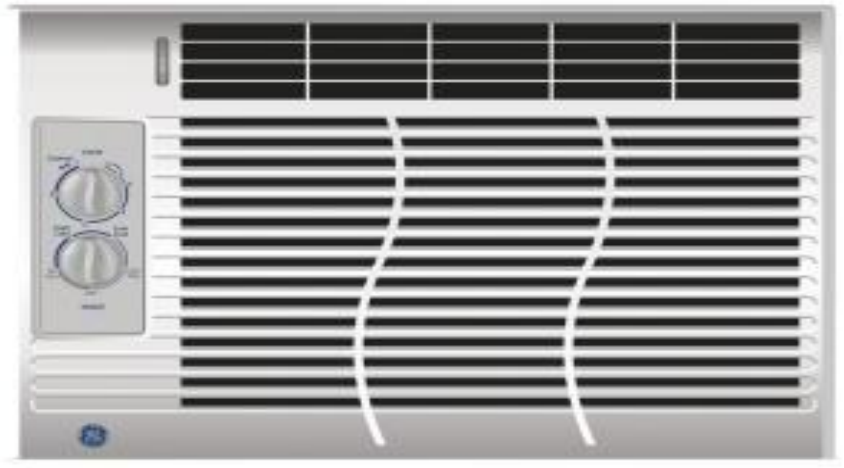
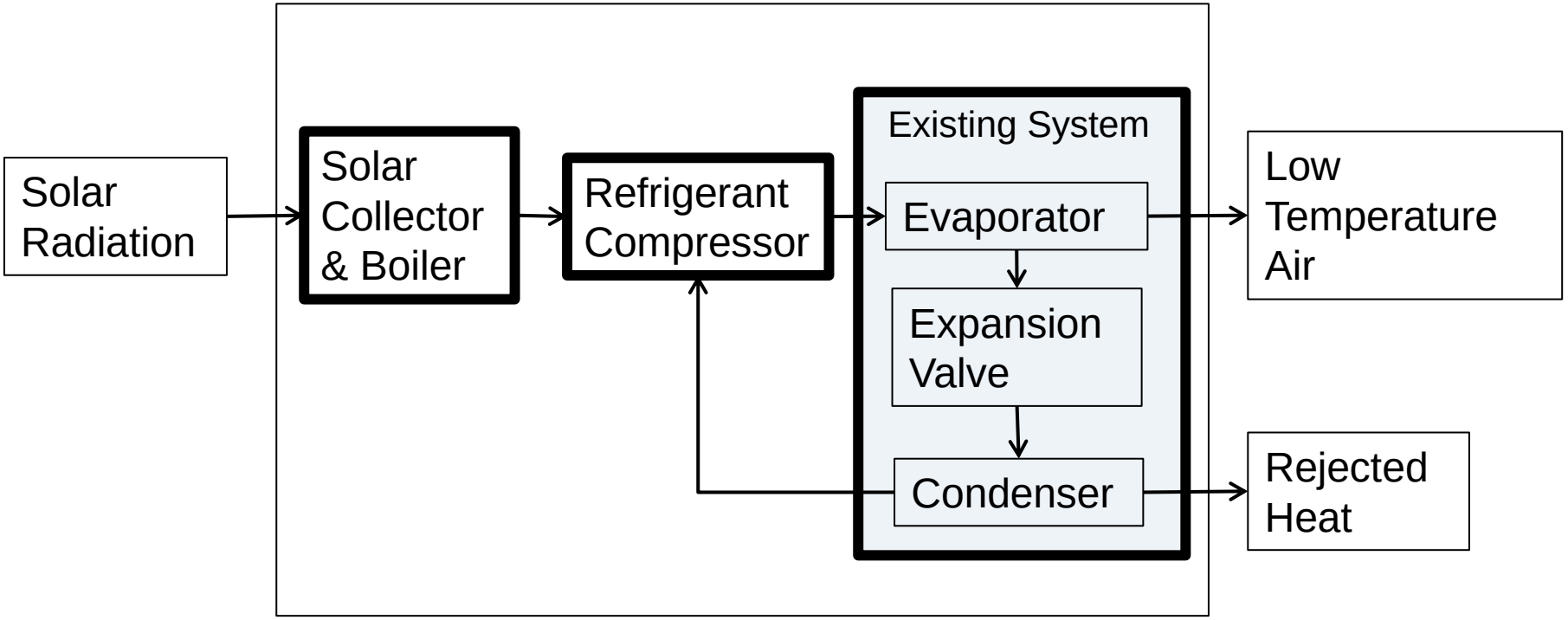
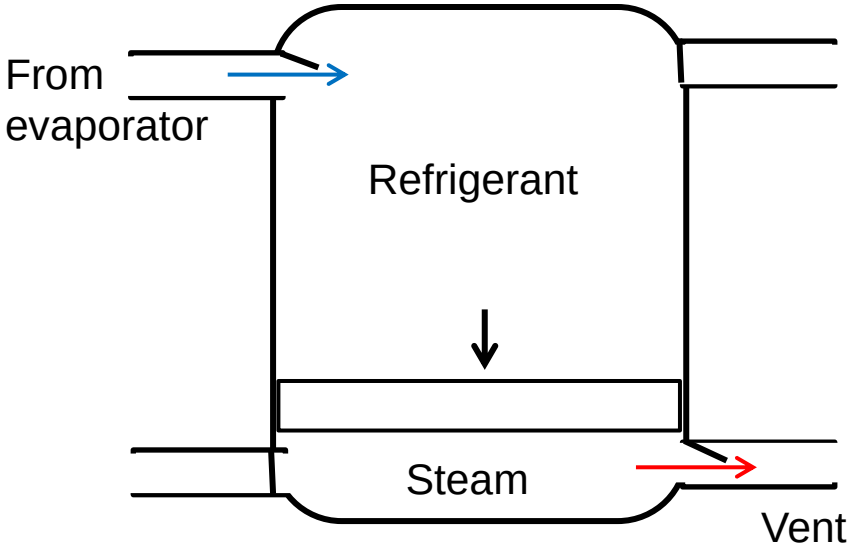


Figure 1: GE 115 Volt 5,000 BTU A/C

PROJECT SCOPE



COMPRESSOR CONCEPT

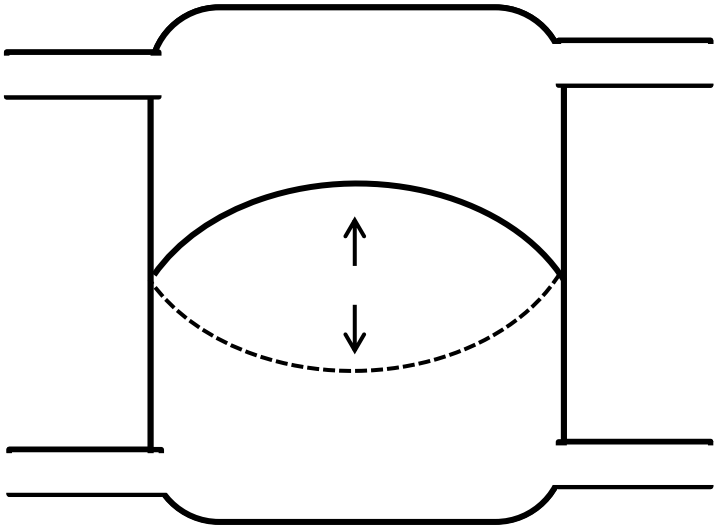


- Pressure from boiler raises the piston and compresses refrigerant.
- Steam is vented and refrigerant is drawn into compressor.
- Vent is closed, cycle repeats.

- What frequency could such a system achieve?
- Design displacement will depend on the frequency the system is capable of.

- How can valves be controlled?

COMPRESSOR DESIGN: PISTON VERSUS MEMBRANE



Elastic Membrane

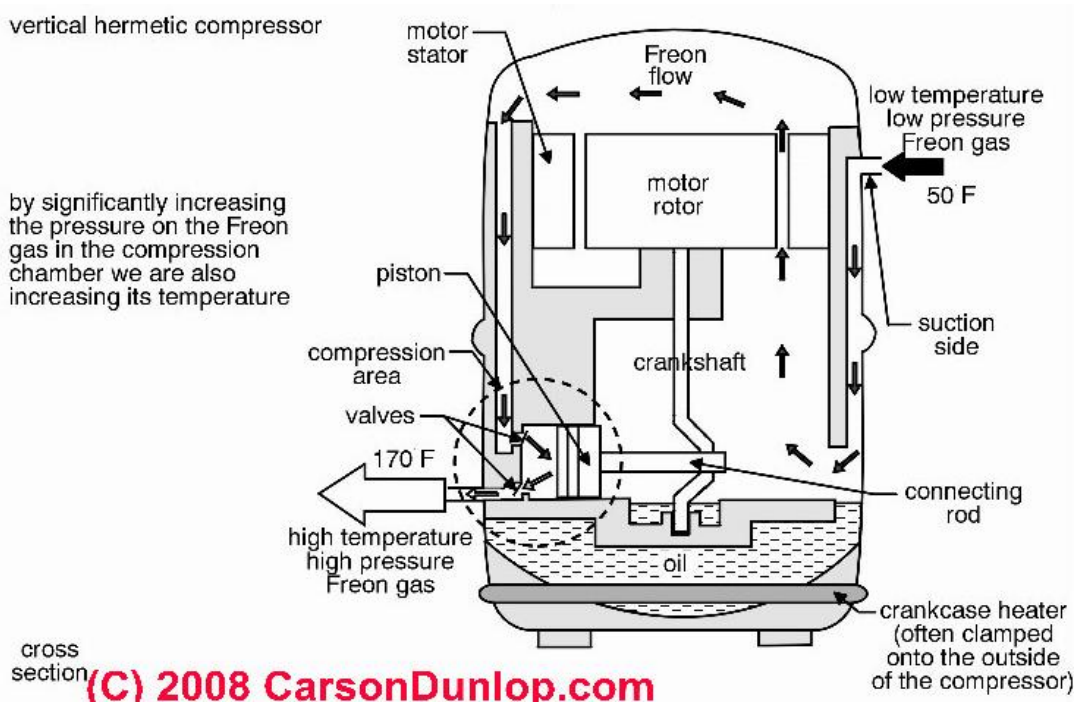
Pros:

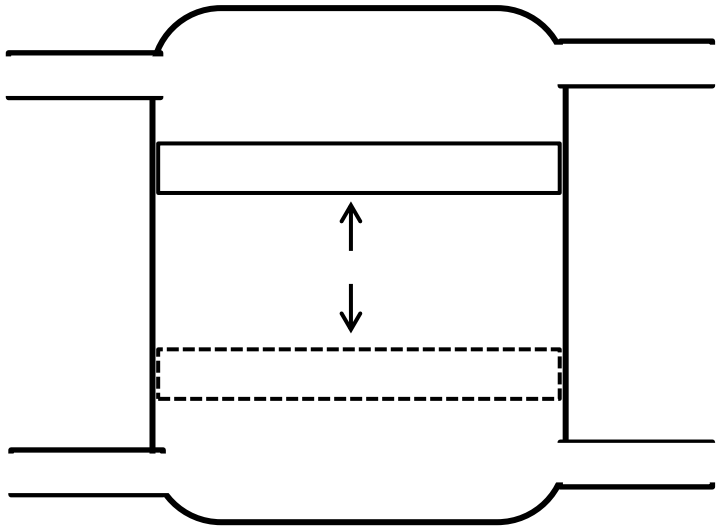
- Tolerance not critical
- Each side is sealed from the other

Cons:

- Must be resistant to high temperature
- Strength must not degrade after multiple cycles
- Smaller displacement than piston

Compressor Design: Piston versus Membrane

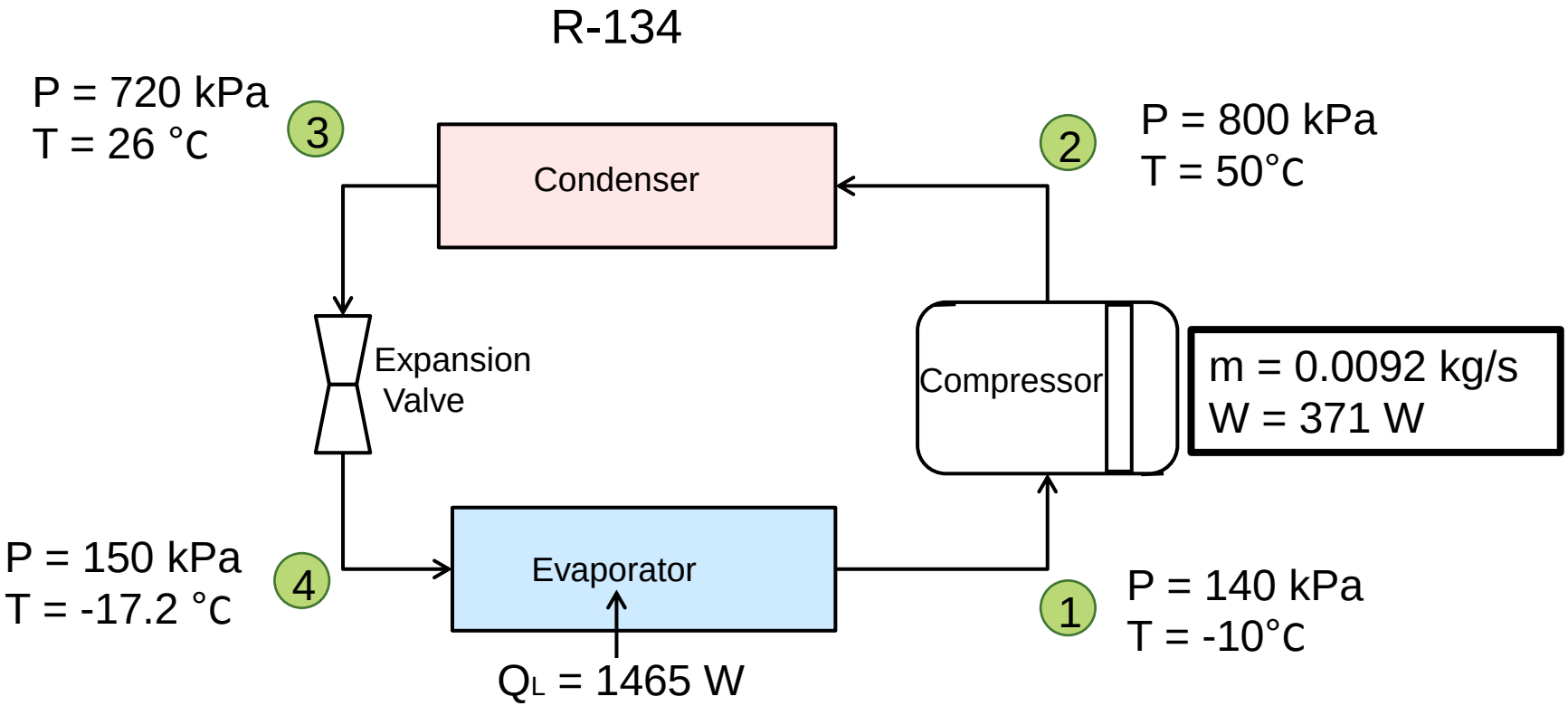




- Typical AC compressor uses crank-driven piston.

- Is there a device available that has the components of our proposed concept?

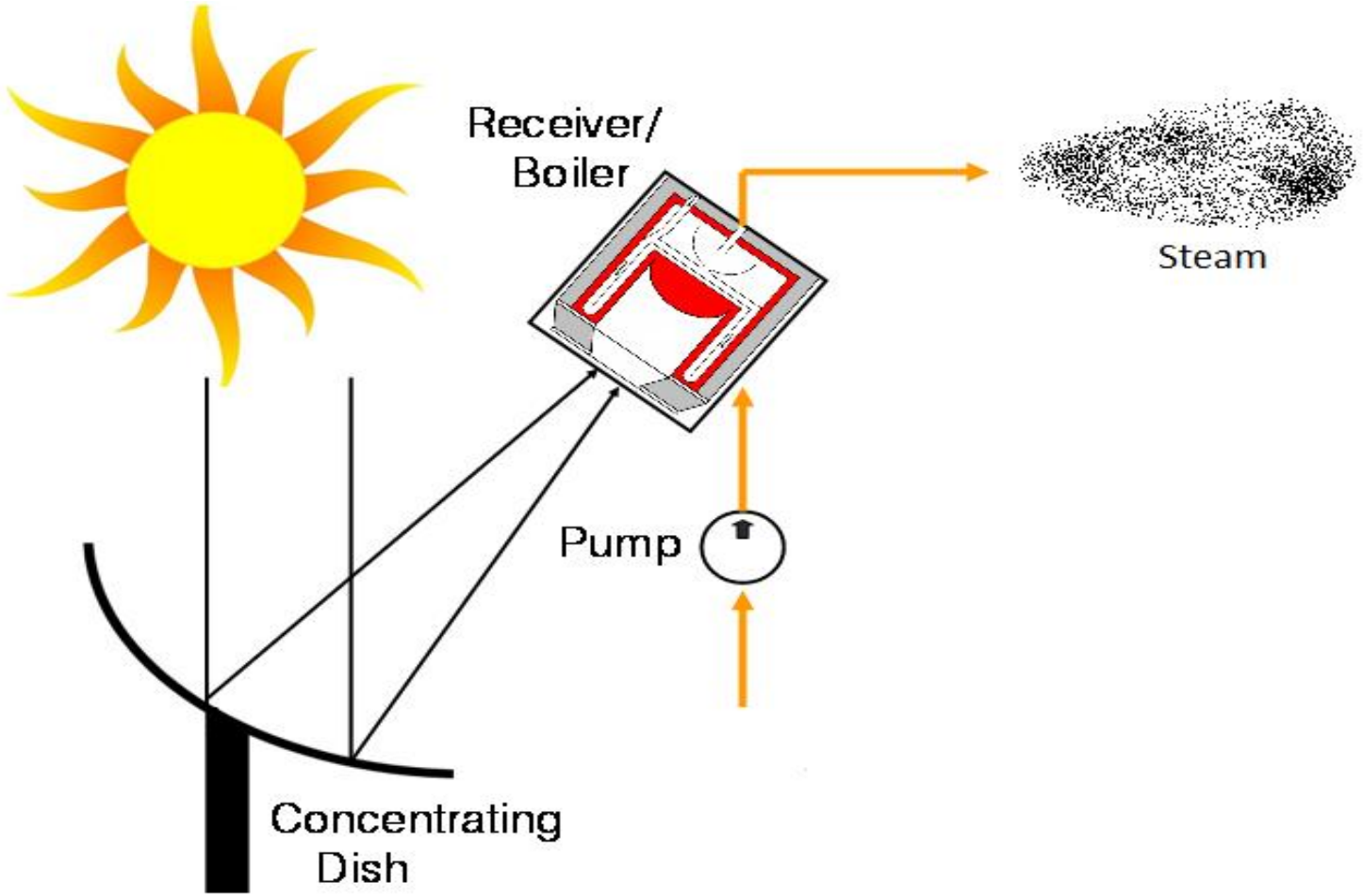
VAPOR-COMPRESSION CYCLE MODEL



- Plan to consult AC technician to determine the Temperature limits and Pressure in a real system.

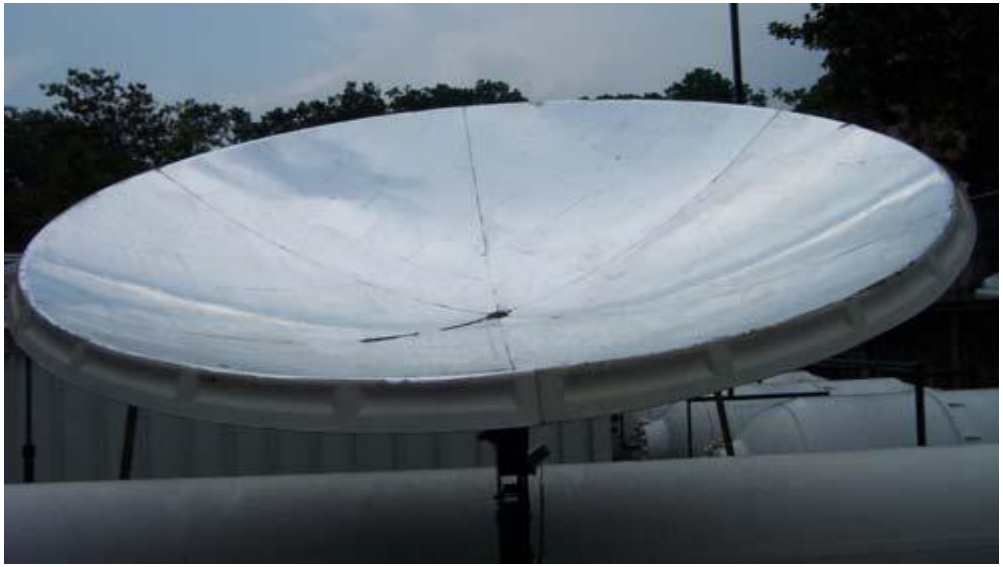
From Cengel p.397

STEAM GENERATION



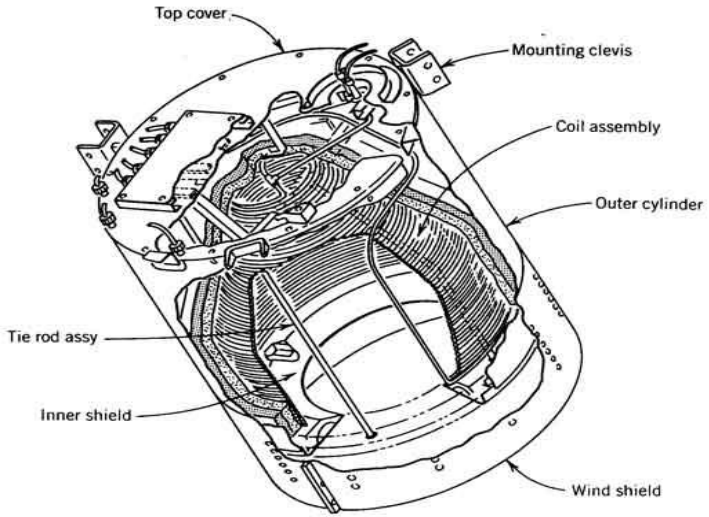
PARABOLIC DISH

- Constructed from fiberglass
- Coated with adhesive ReflecTech (94% reflective)
- Withstand various weather conditions



RECEIVER/BOILER

- Cavity receiver
- Has an aperture through which the reflected solar radiation passes through
- Absorbed through inner walls in working fluid (sodium nitrate)



STEAM GENERATION

Achievements

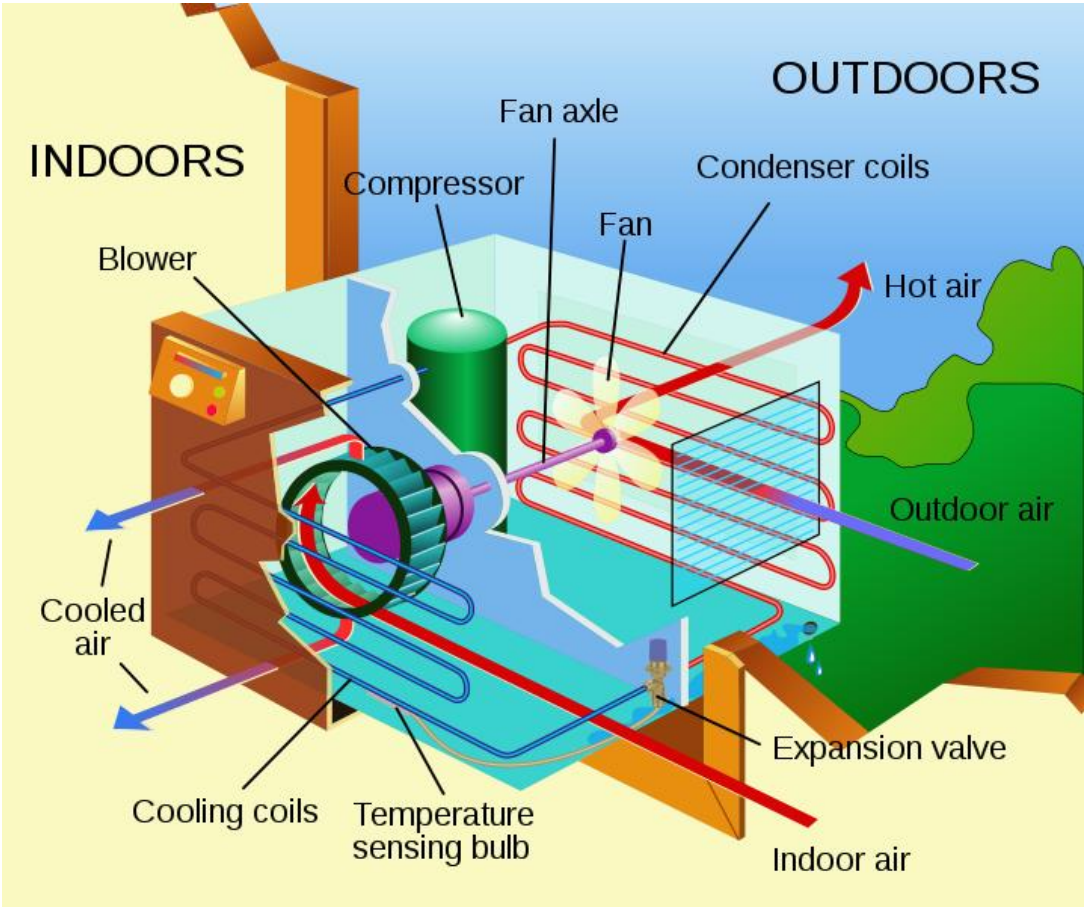
- Temp ≈ 325 C
- Pressure ≈ 80 psi

Issues

- Thermal loss due to connection
- Availability of Dascomb's system

AIR CONDITIONER UNIT

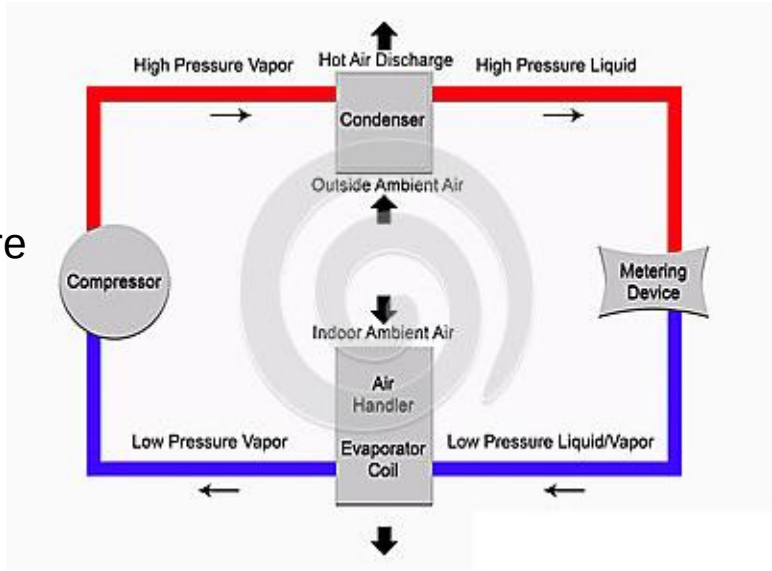
- Refrigerant cycle
- Electrical system
- Coupled Systems



REFRIGERANT CYCLE

- Recap
  - Low Pressure Refrigerant
    - High Refrigerant Pressure < Steam Pressure
  - Mass Flow must be carefully calibrated

- Questions
  - Banned / Toxic / Unusable refrigerants
  - Changing Refrigerant types in a system
    - Piping change?
    - Dangers
  - Mass flow Calibration
    - Skewedness allowed?



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- 2. Dascomb, John. 2009. *Low-cost concentrating solar collector for steam generation*. Thesis (M.S.)--Florida State University, 2009. http://etd.lib.fsu.edu/theses/available/etd-04142009-100533/
- 3.Google Patent of Sponsor's Design: http://www.google.com/patents/US20100192568?pg=PA1&dq=grant+peacock&hl=en&sa=X&ei=jVilUOT4H4PY8gT2i4CoBQ&ved=0CDEQ6AEwAQ#v=onepage&q=grant%20peacock&f=false
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ANY QUESTIONS?