

Solar Refrigerator/Freezer

Senior Design Project

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Project overview

Problem Statement

- ▶ Developing countries without access to electricity
- ▶ Natural disaster that damages electrical infrastructure
 - Either situation creates the need to keep temperature sensitive items cold, such as food and medicine
 - General need for micro-economic growth

Problem Solution

- ▶ Refrigerator/Freezer that uses solar power to provide the heat in the absorption refrigeration cycle
- ▶ This unit can be used in a developing world community as a tool for small business growth

Design Concept

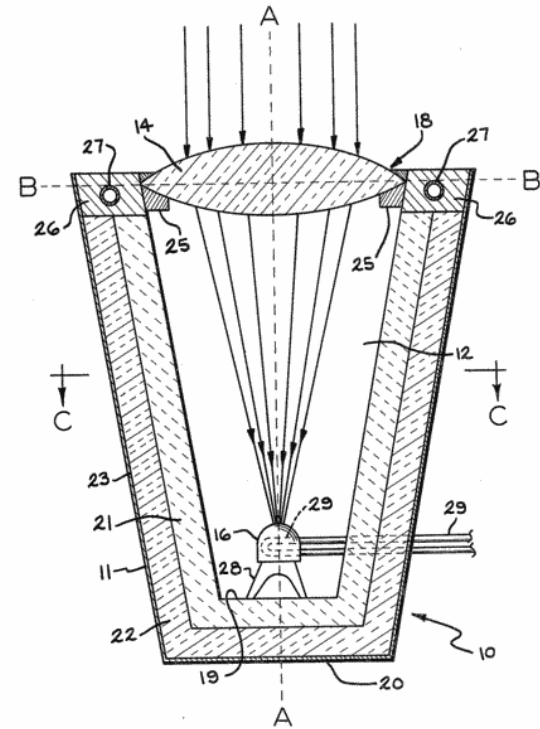
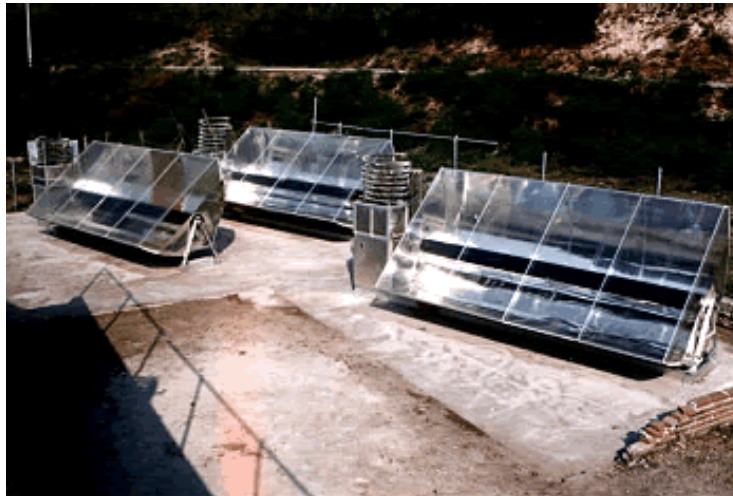
- ▶ The basic concept for the solar refrigerator/freezer (SRF) is to use solar power for the heat addition process in an absorption refrigeration cycle. The purpose for the ice is a cooling method when there is little or no sunlight available, as well as keeping items cold. There are three main parts to our design:
 1. Solar Consolidator/Collector
 2. Absorption Cycle
 3. Cooler (insulated chest)

Solar Consolidator

- ▶ **Goals for the solar consolidator**
 - Provide needed heat generation for absorption cycle
 - Develop a design that is more efficient than the commonly used parabolic mirror/trough design
 - Have the ability to use a single solar consolidator in conjunction with multiple refrigeration/freezer units
- ▶ **Initial design ideas**
 - Use of multiple small lenses to concentrate sun radiation
 - Concept similar to Julich Solar Power Plant
 - Multiple mirrors direct sunlight towards single “solar tower” that then continuously heats a circulating salt solution
 - Heat exchanger used to transfer heat to absorption cycle
 - Use of KaoWool to insulate solar consolidator and minimize heat loss

Solar Consolidator

U.S. Patent Apr. 10, 1979 Sheet 1 of 4 4,148,300



—FIG. 1

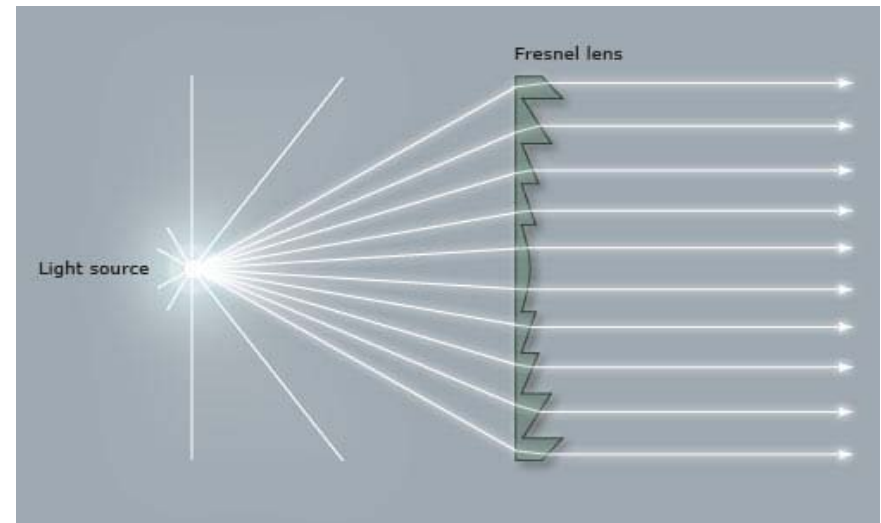
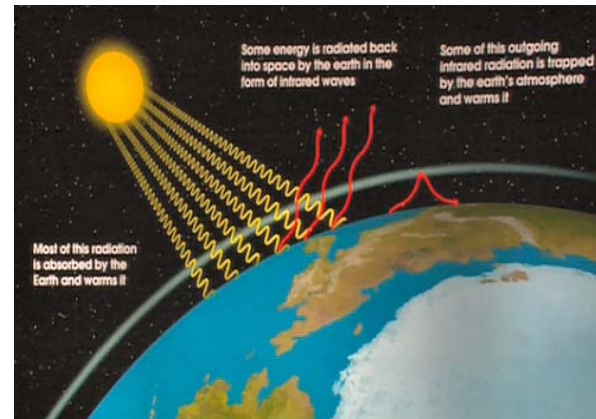
Solar Collector

- ▶ Current solar collectors being tested
 - Fresnel Lens
 - Original concept used in lighthouses
 - Possibility to use recycled big screen TV lenses
 - Satellite dish
 - Standard satellite dish covered with reflective surface
 - Scheffler Reflector
 - Similar to satellite dish concept, only with very specific shape taken from a part of the parabolic curve
 - Currently used for solar cooking in many developing countries

Solar Collector



Scheffler Reflector



Fresnel Lens

Absorption Cycle

- ▶ Possible cycles that could be used
 - Intermittent
 - Double Intermittent
 - Continuous cycle
 - Double Continuous
- ▶ Possible chemical combinations for the cycle
 - Ammonia/Calcium Chloride
 - Ammonia/Water
 - Water/Lithium Bromide

Cooler



54qt / \$225



48qt / \$40

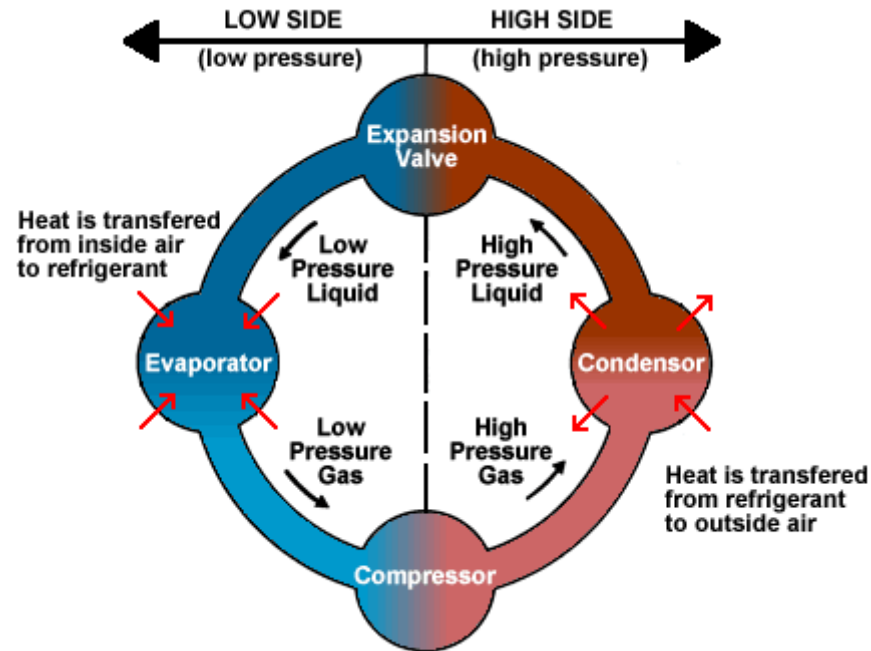


150qt / \$100 – \$300

Market Research

- ▶ Research shows that there are solar refrigerator/freezer units that have already been developed. The following goals involving our project will differentiate us from these:
 - Smaller solar collector to aid in portability
 - Simple design to keep cost low and keep the product available to those in need
 - Develop an open-source design to allow further development and wide spread use

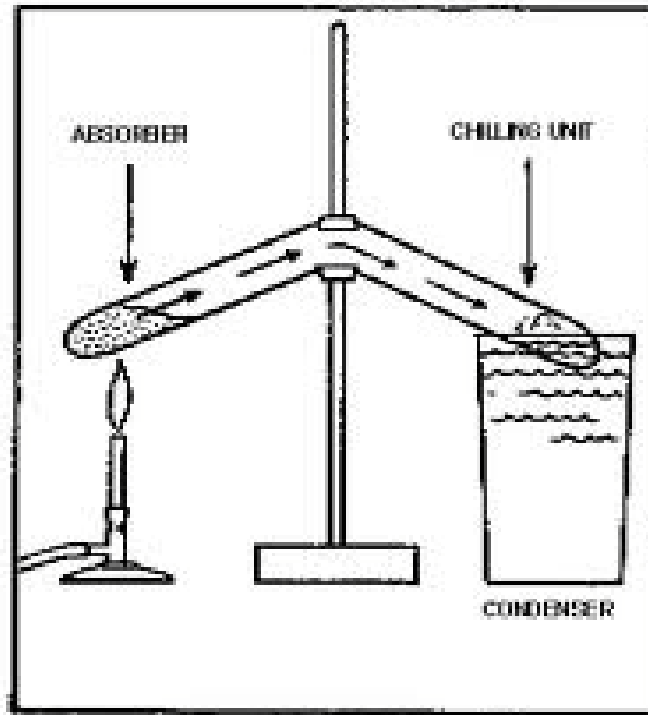
Basic Refrigeration Cycle 100



Principles of Refrigeration

- Liquids absorb heat when changed from liquid to gas
- Gases give off heat when changed from gas to liquid.

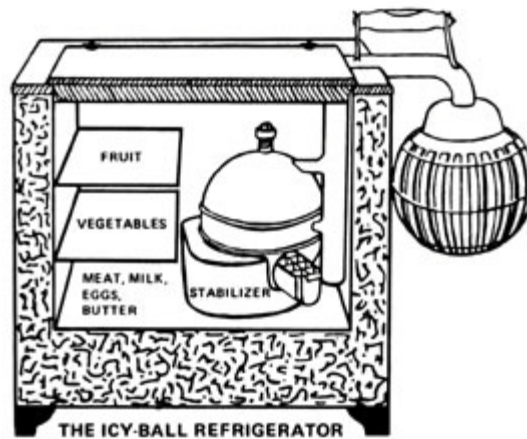
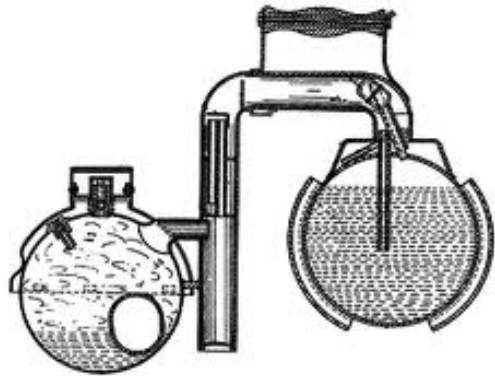
Absorption Cycle 101



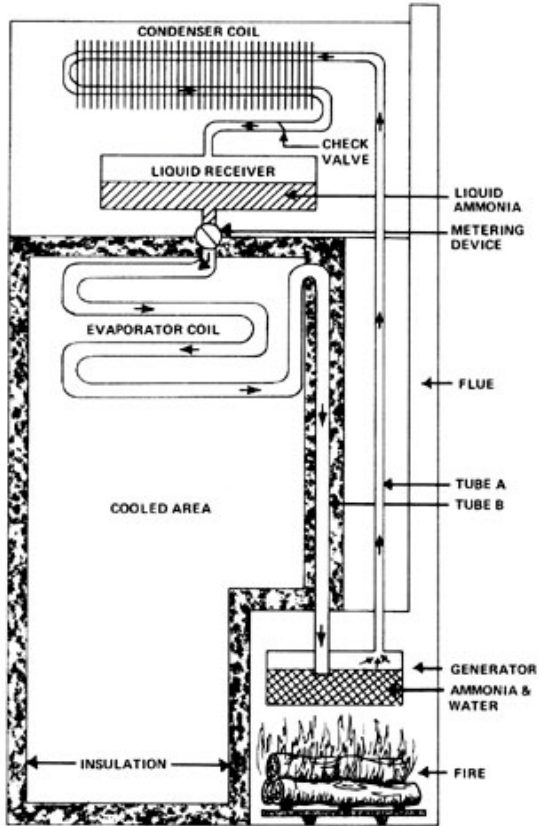
Principles of Absorption Refrigeration

- Heat is applied to change/boil refrigerant from liquid to gas.
- Intermediate condensing of refrigerant from gas back to liquid.
- Heat is absorbed as refrigerant is changed/evaporated from liquid to gas.

Ice Ball Refrigerator

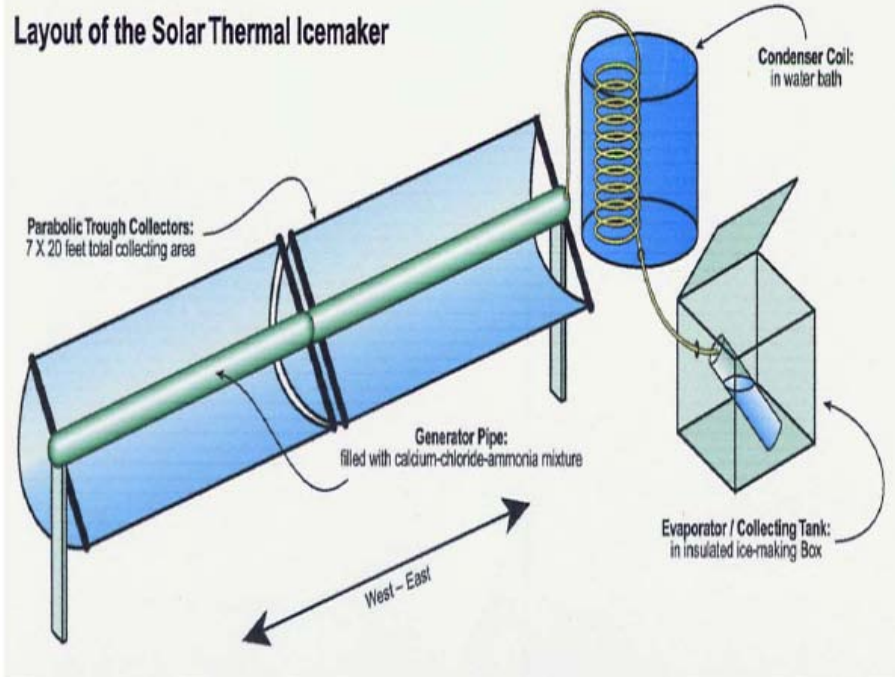


Vapor Absorption Diagram



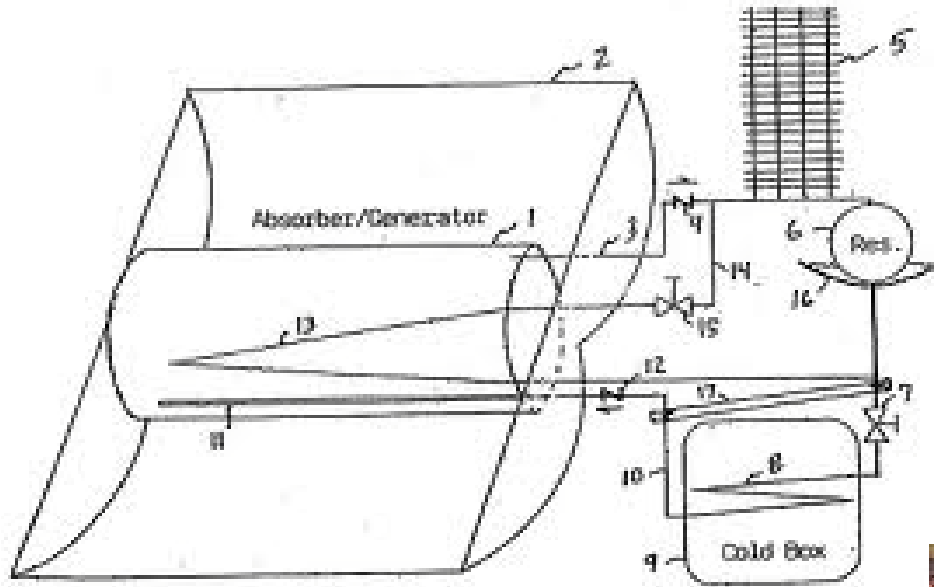
THE INTERMITTENT ABSORPTION REFRIGERATOR

Layout of the Solar Thermal Icemaker



Intermittent Absorption Diagram

Systems In Use Today



Technical Counsel

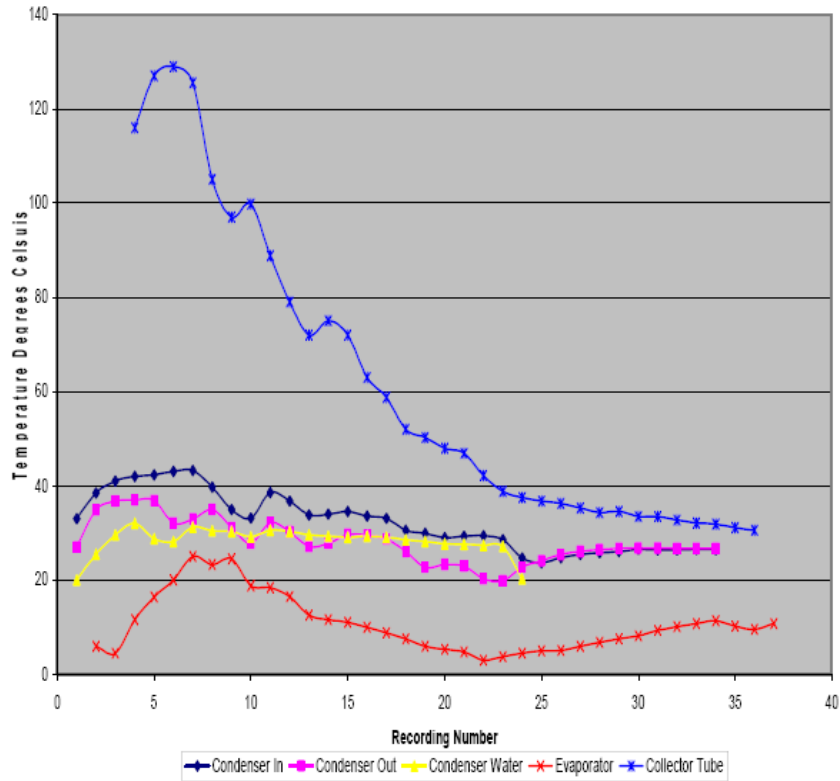
We would like to thank the following people for their assistance with this project:

- ▶ Dr. Robin Podmore (IncSys)
- ▶ Dr. Issac Hansoo Jung (Faculty SMU ME)
- ▶ Phil Lou (WSU Energy Olympia)
- ▶ Will Howson (Bremerton Mechanical A.C.)
- ▶ Sunset Air Olympia
- ▶ Alfred Villanueva (P.W. Point Mugu NAS)

Thank You

We will now take any questions or comments!

System Temperatures T1



System Temperatures T2

