

Date: January 24, 2008

To: Dr. Stephen Batill and Dr. Michael Stanisc

From: Rachel Paietta

Subject: Individual Concept Memo

The market for the compact solar power generator is envisioned as one comprised of customers in natural disaster areas, third world countries and remote locations where the electrical infrastructure is not established. In all of these situations low cost, versatility, simplicity and reliability are essential features for the product to truly serve its purpose as an aid to people in need.

Low cost was incorporated into the design through the use of a home-made stirling engine, which can be made from materials as simple as soda cans, pipes and water. Although the prototype and product will use materials that will result in higher performance, the ability to make this type of engine out of easily obtained materials makes it an ideal candidate for helping the product meet a low cost requirement. The parabolic trough design is inherently simpler than other heat concentrating technologies currently implemented in solar plants because it consists of a single mirror that tracks the sun along one axis. One possible solution for tracking the sun without use of some driving motors to move the structure is the use of a fluid filled tube with canisters on each side of the trough, and these would balance to equilibrium from the radiation in the sun and would properly orient the trough to optimize sunlight collection. Because the reliability of the product to provide a continuous supply of electricity at all hours is important, the storage of solar energy converted during the day is another important factor. Keeping the resources of the intended customers in mind, batteries are the most appropriate technology to choose for storing energy. Any intelligent technology added to this product will draw from the electricity that will be generated by the collector and detract from the simplicity of the system and from the efficiency of the end product (electricity). One possible location for embedded intelligence is in the power distribution system between the battery and the constantly running light bulb.

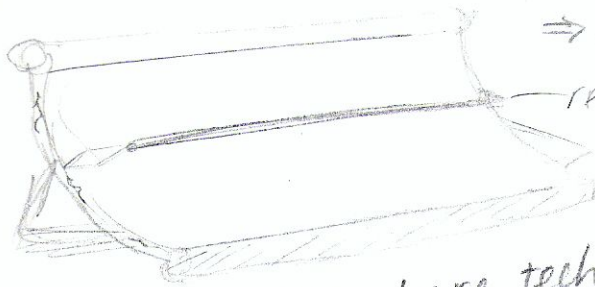
The essential design requirements to continuously provide 20W at 12V through a 40 hour period will be largely obtained effectively using the energy storage capabilities of the battery by charging the battery with any excess energy collected during the day. To meet the other essential design requirement for assembly, complex components such as the engine and trough could be packaged into a kit that would be easy to assemble into a complete solar collector.

The operation of the solar power unit will operate following the drawing of the complete system attached on the next page. First, the parabolic collector will concentrate the sunlight off its highly reflective surface to a tube filled with water (because water is easily obtained) located at the parabola's focal point. The heated water will turn to steam and flow through the tube to the base where the heat-to-electrical conversion system is housed. The stirling engine will use a thermal difference to operate where the ground side is a heat sink and the top side is heated. The pistons will turn moving the flywheel which is in place to maintain generation when the solar radiation is not constant. This powers a generator, which charges the battery and powers the light after passing through an intelligent power distribution system.

Solar collector Individual Design

collection

- parabolic trough collector system



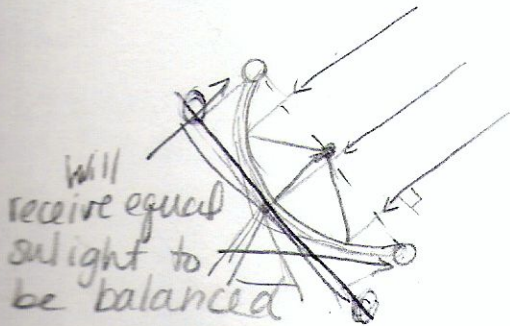
⇒ one degree of tracking (simple)

retractable collector tube

⇒ one mirror / reflective surface

⇒ mature technology

Tracking system based on thermodynamics to minimize internal use of the power collected ⇒ maximize energy generation



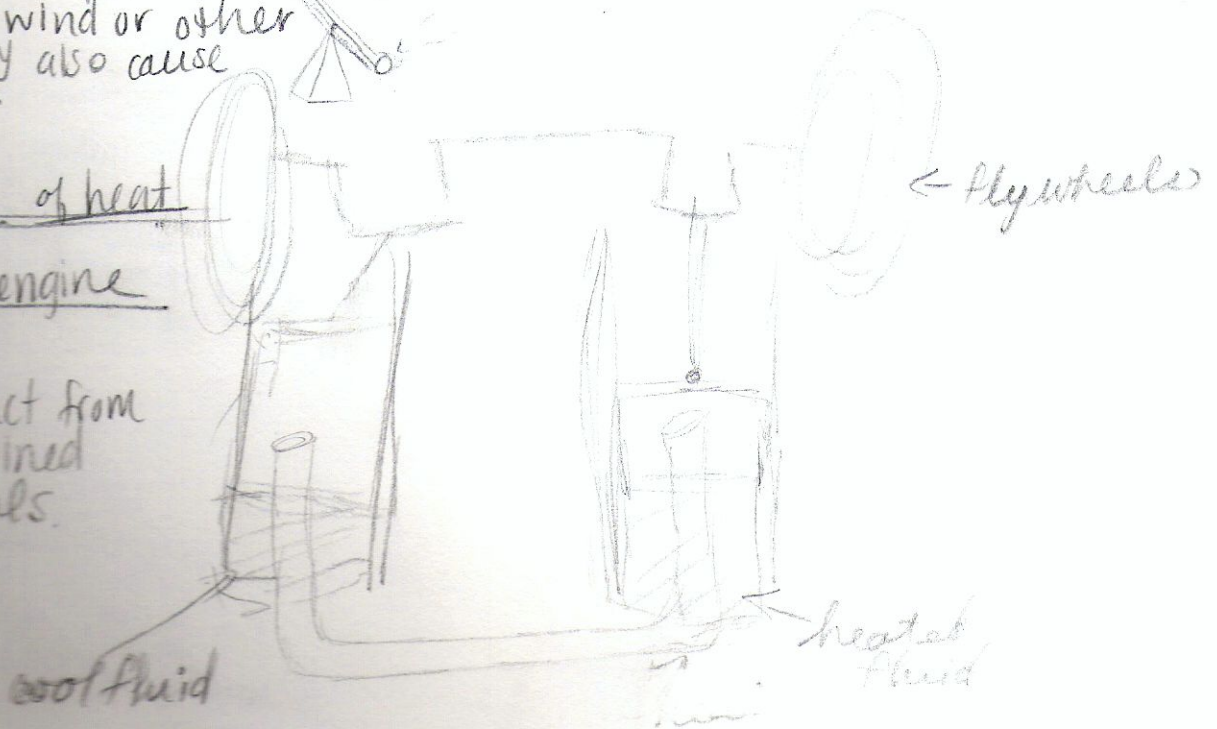
⇒ as one tube receives more solar radiation, it will heat more and liquid will evaporate and as the system equilibrates the dish will follow the sun

• unsure if this system will work effectively for a parabolic shape, would work if flat, but may require movement hinges to be too sensitive so wind or other weather may also cause movement.

Conversion of heat

stirling engine

→ can construct from easily obtained materials.



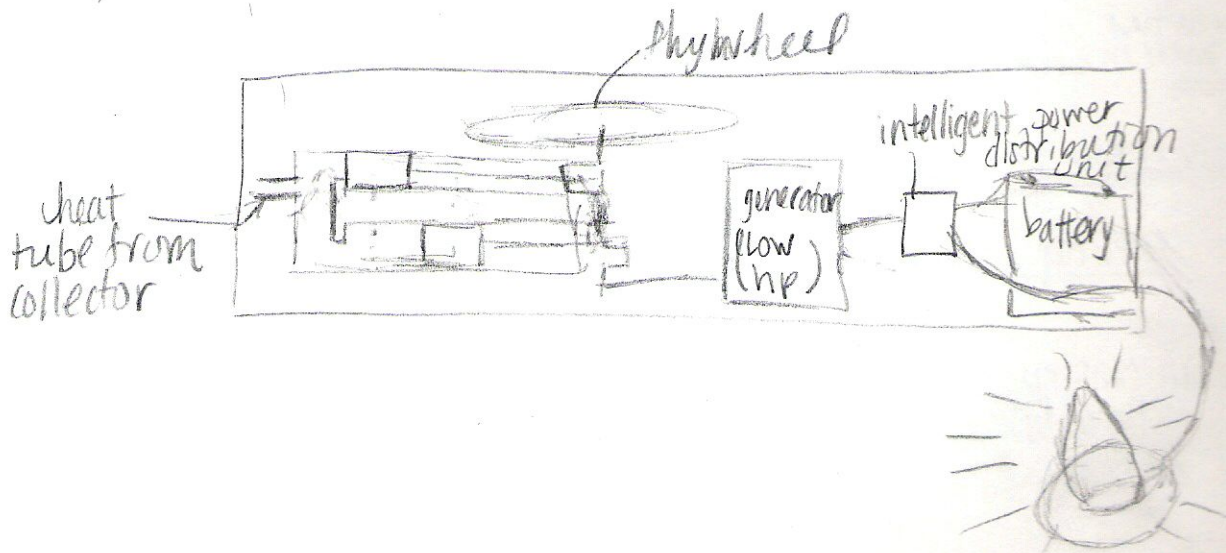
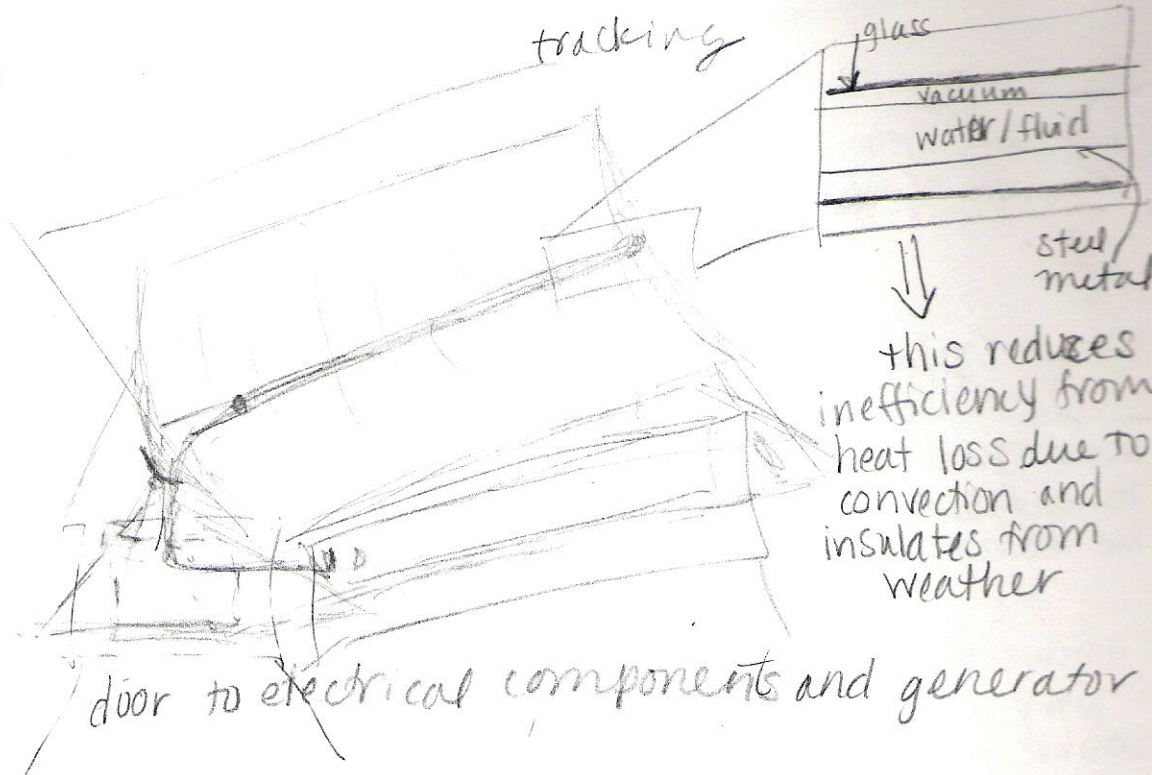
storage

Battery \Rightarrow easily accessible in most areas, doesn't require building an energy storage system

heat storage = large scale solar plants / not practical for small scale applications.



System



structure for trough

