Group D1
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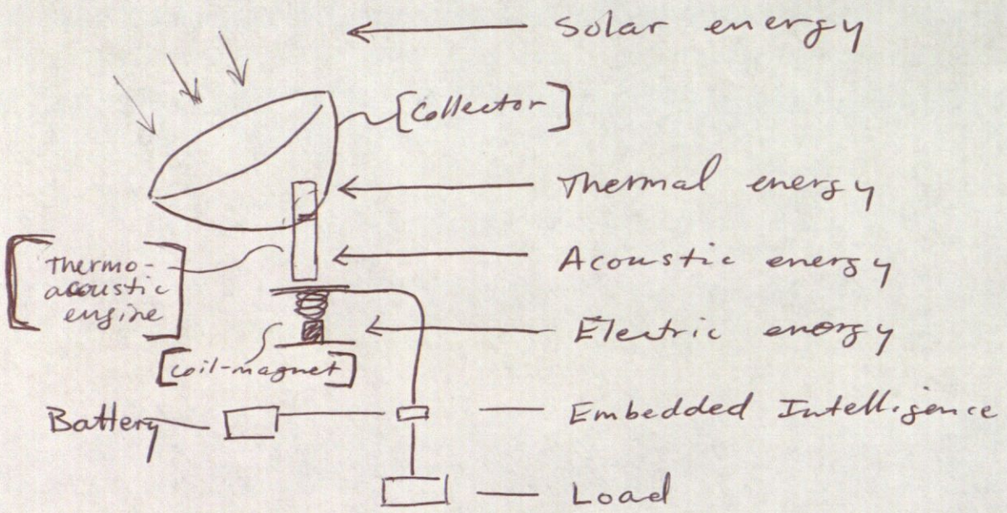
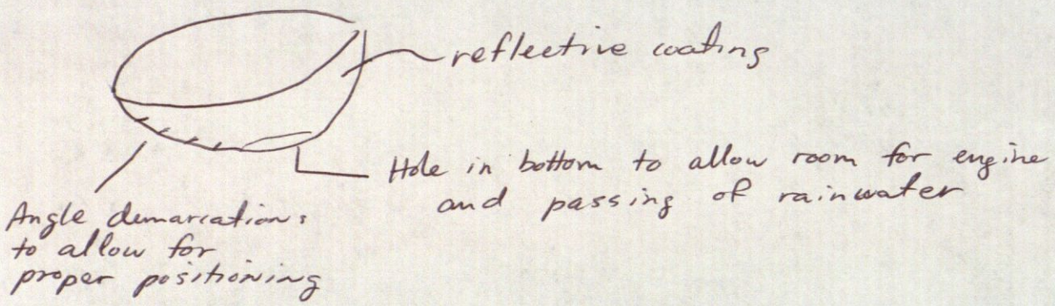
Concept Memo

The critical design requirements addressed in this memo are the same as those outlined for the overall project. Namely, the product must be low cost, simple, versatile, and reliable. In particular, the product must meet the electrical specifications of delivering 20 W at 12 VDC. Since this is a relatively low power requirement, it ought to be achieved with the proposed design. That is, the solar collector would be a large reused bowl, for example a metal salad bowl, with a hole cut out of the bottom. Reflective material would be placed on the bowl to increase the intensity of light incident on the hot side (top) of the engine. A thermo-acoustic Stirling engine would be placed in the hole, as noted in the following pages, to convert the thermal energy to acoustic energy, which would then be converted to electricity with the coil-magnet-diaphragm setup. Another key requirement is that the product be capable of storing the electricity, which would be accomplished with the battery in the system. The embedded intelligence would serve to control the usage/storage of the generated electricity. That is, it would determine the amount of electric power required by the load and deliver the rest to the battery for storage. To accomplish this, the embedded intelligence would be in the form of a simple chip located in the circuit between the generator and the load/battery, as shown in the energy flow schematic on the following page. Another critical design requirement is that the product be simple and capable of being assembled and maintained by two high-school-educated individuals. The only complicated aspect of the assembly would be the engine, which could be pre-fabricated and included in the kit. The base structure which houses all the components could also be pre-fabricated to reduce assembly complication. The rest of the parts would simply need to be connected. The only maintenance required is to periodically change the position of the solar-collecting bowl in order to maximize the incident radiation. With markings denoting the angle on the side of the bowl and a set of instructions this could be accomplished easily. Another requirement is that the product be low-cost and utilize recycled parts. Both are accomplished by the fact that at least the bowl and battery could be reused parts. Finally, another requirement is that the product continue to function in the rain. Although the solar collector would likely be ineffective in that situation, at least the battery would still be operable. In order to protect the electrical components, the would be housed inside the box that forms the base, and any rain incident on the structure would be gathered in the bowl and flow through the hole in the bottom, into the center of the box and out the spout as shown in the second page of figures. All main components would be housed in the box in such a way that they could be easily replaced if necessary.

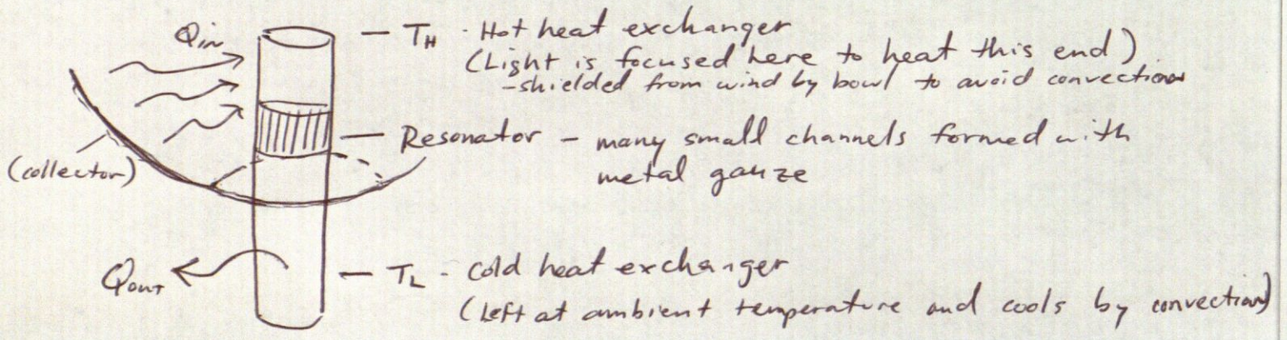
Energy Flow Schematic



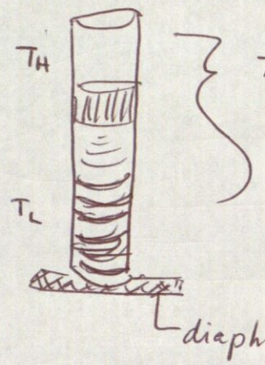
Collector (large recycled metal bowl)



Thermo-acoustic engine

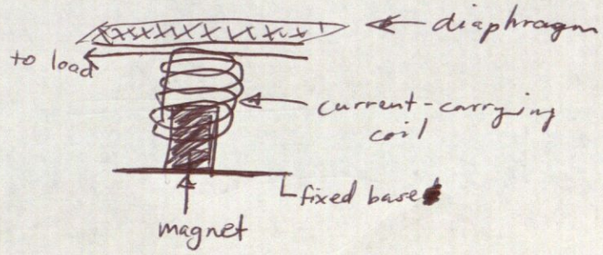


Thermo-acoustic engine (continued)



Temperature difference across resonator sets up acoustic waves, which travel down tube to vibrate the diaphragm, which has electric coil attached

Generator (magnet-coil)



Electricity generated through movement (relative) of magnet through coil.

Overall setup