Solar Cavity Receiver for a Stirling Engine

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In this Bachelor thesis a solar cavity receiver together with a parabolic concentrating mirror has been designed for a Stirling engine, which traditionally runs on gas or bio-fuels. These design changes make it possible to run the engine on solar energy. This Dish-Stirling system has been designed with cost in mind, so it could be used in third world countries, thus cheap materials and production methods have generally been preferred over high performance and efficiency.

In this thesis, a thorough analysis of the concentrator, the receiver, and the cavity is made. The analyses was based on heat transfer, thermodynamics, and geometry calculations. These analyses resulted in a final design, which was compared to the existing gas-fired engine. An analysis of storage options was carried out, along with an economic analysis, in order to determine whether it is economically justifiable to invest in a Dish-Stirling system.

The final design of the receiver is seen in Figure 1. The tubes have been designed to capture all the incoming radiation from the sun.

Figure 1: The final receiver design

An economic analysis where the Dish-Stirling technology is compared to the photovoltaic technology was carried out. It was found that both technologies require subsidies to be economically justifiable, and that they are very similar with respect to pay-back period. In this relation examples of possible buyers was given and the perspectives of the Dish-Stirling technology were investigated. The analysis showed that the technology has great potential in small-scale decentralized energy production, for example in rural villages in third world countries.