AN ELECTRIC GENERATOR USING ONE HEAT DRIVEN THERMOACOUSTIC AMPLIFIER

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Electric generator using thermoacoustic conversion could be a very good candidate for space applications. Indeed thermoacoustic systems are efficient and reliable. The only moving parts appear in the electroacoustic system and works at ambient temperature, contrary to the Stirling systems. A first prototype has been built to test the feasibility of matching one thermoacoustic amplification cell between two linear alternators from Chart Industries. The first one (1s132d) provides acoustic power which is amplified by thermoacoustic before being converted into electricity by the second linear alternator (1s175d). On this first prototype, an electric resistance provides the heat power to the thermoacoustic amplification cell. As the feedback electric loop between the two linear alternators to get a self-sufficient system is not set up, the electric power is dissipated into a RC load.

The system is working with 30 bars helium and with a frequency of 60 Hz. The system is built with two enclosures: one corresponding to the thermoacoustic wave guide and the second surrounded insulation placed around the wave guide. This insulation is supposed to be filled with argon or nitrogen gas in order to improve the insulation efficiency.

Some results concerning the sizing and the experimental analysis of the prototype will be presented at the conference. The system was design being able to accept heat source at temperature up to 950°C. Runs were performed varying acoustic input energy up to 200W for various hot source temperature scaling from 500°C to 900°C. They show that the system is very stable without nonlinear effects even for high temperature gradient in the buffer tube. As an example, the thermoacoustic cell (Heat exchangers, regenerator and buffer tube) reaches about 55% of Carnot with a hot temperature of 700°C taken into account the heat losses. By reducing them, the system can achieve near 70% of Carnot.

By improving the thermal insulation of our setup, it could be shown that the global efficiency could be greater than 25% with one thermoacoustic amplifier and 40% with 2 amplifiers using heat sources at 950°C.