

## Difference between working gases in thermoacoustic engine

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**Abstract.** Presented paper includes description of design and assemblage of experimental device for evaluating difference between thermoacoustic device in which was used as working gas air and device in which was used as working gas helium.

### 1 Introduction

The interaction of heat and sound has been a subject of interest to scientists since 1816, when Laplace [1] corrected Newton's first theoretical calculation of the speed of sound in air. [2] Newton assumed that the acoustic expansions and compressions of the gas occurred isothermally, without any associated variations in the temperature of the gas.

Laplace included the effects of the changes in gas temperature that accompany the adiabatic expansions and compressions of the sound wave and derived the correct result for the adiabatic sound speed that was 18% faster than Newton's isothermal result. These thermal effects, which accompany sound waves, are essential to the operation of thermoacoustic engines and refrigerators. [3]

The term "thermoacoustics" was introduced by Nikolaus Rott. In the literal sense, Rott's claim is entirely justified, since the field is concerned with transformations between thermal and acoustical energy.

A detailed theoretical analysis of standing wave systems, based on the linear acoustics model was performed by Swift [4], who also provided some examples of the early developments at Los Alamos National Laboratory. He also provided a detailed analysis of a practical standing-wave engine where 7000W of thermal energy was converted to 630W of acoustic power [5].

Currently is engaged in thermoacoustic Los Alamos National Laboratory, University of Utah, University of Manchester, National Taiwan University and many other universities and research centres around the world.

### 2 Theory of thermoacoustic engines

Thermoacoustic devices are using simple design and reliable device, which are using interaction between heat and acoustics for energy conversion [4].

Between advantages of thermoacoustic devices belongs simple design. Thermoacoustic devices do not contains any moving parts, like are shafts, bearings, etc.

For operation that devices are not necessary any special, expensive or dangerous component materials, refills or lubricants. Hence are thermoacoustic devices therefrom view more nature friendly and cheaper for production, than other refrigerators or electric generators.

In view of possibility operation with low temperature gradient, is possible utilize waste heat from a lot of industrial and energetic processes.

Between disadvantages of thermoacoustic devices belongs fact, that currently the majority of thermoacoustic devices have low efficiency. Reason of this is that thermoacoustic phenomena is currently still in research stage.

But it is possible assume that efficiency will increase and thermoacoustic engines and prime movers start be more often used in practical applications.

#### 2.1 Schematic and description of a thermoacoustic device

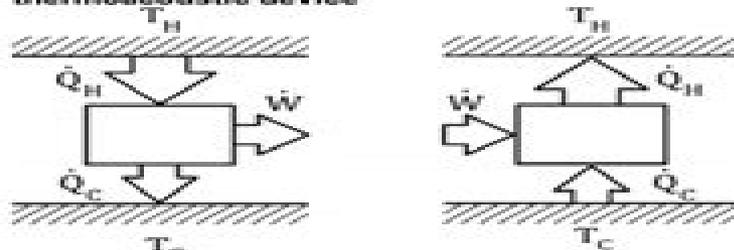


Figure 1. Schematic of function of thermoacoustic engine (left) and thermoacoustic heat pump (right)

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