STUDY ON A LOOPED 2-STAGE THERMOACOUSTIC ENGINE

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Multi-stage looped thermoacoustic engines have attracted much attention in recent years[1]. This paper presents the looped 2-stage thermoacoustic prime movers schematically shown in Figure 1, which are composed of 2 thermoacoustic cores (including hot heat exchangers, regenerators and main cold heat exchangers) connected by resonators, thermal buffer tubes and secondary cold heat exchangers in series. The two thermoacoustic cores can be arranged in asymmetric or symmetric configuration. The total loop length is about 8 m. Main dimensions of the thermoacoustic core are listed in Table 1. A funnel-shaped fluid director is inserted between the thermoacoustic core and resonator to reduce the flowing loss.

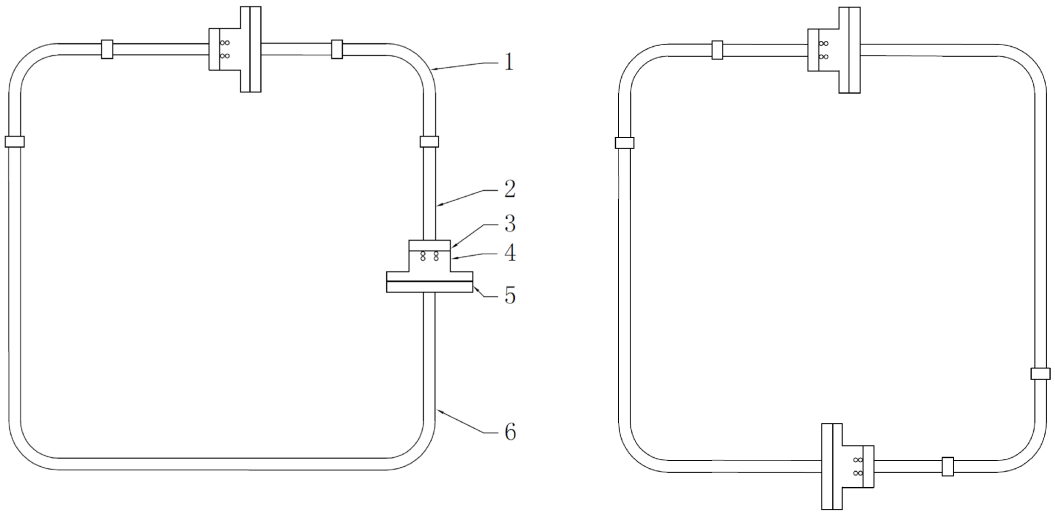

Figure 1: *Schematic of the looped 2-stage thermoacoustic prime movers: 1. Secondary cold heat exchanger; 2. Thermal buffer tube; 3. Hot heat exchanger; 4. Regenerator; 5. Main cold heat exchanger; 6. Resonator.*

Table 1: *Dimensions of the thermoacoustic core*

Components	Hot heat exchanger	Regenerator	Main cold heat exchanger
Length (mm)	30	30	30
Diameter (mm)	99	99	99

Numerical simulations with the DeltaEC program[2] and systematic experiments on the looped 2-stage thermoacoustic engine with an asymmetric configuration (see Figure 1 on the left) have been conducted with helium as the working fluid. Figure 2 presents the relation between pressure amplitude and heating temperature with the filling pressure of 2 MPa, containing the results from both experiments and simulations. Figure 3 shows the onset temperatures under different filling pressures in our experiments. A lowest onset temperature of 64°C (under a cooling temperature of 13°C) was achieved with the filling pressure of 2.3 MPa.

A symmetric configuration of the thermoacoustic prime mover (see Figure 1 on the right), in which the two thermoacoustic cores are placed with a distance of half-wavelength, has also been tested, but failed to oscillate even at 600 °C with helium as working fluid.

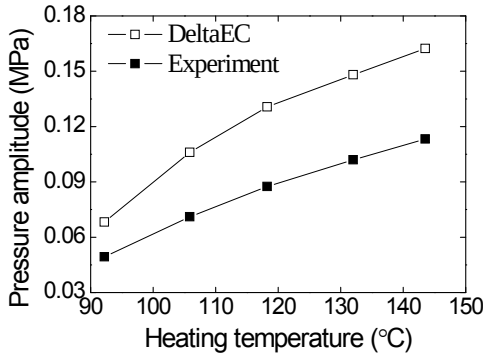

Figure 2: *Pressure amplitude versus heating temperature*

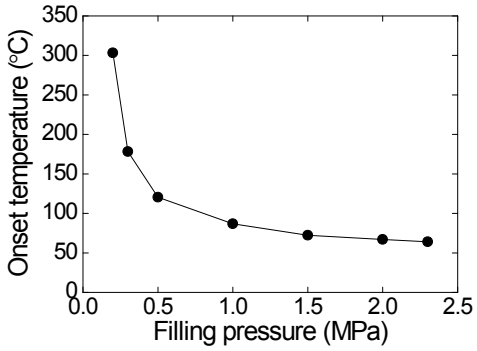

Figure 3: *Onset temperature versus filling pressure*

In summary, the results show that the looped 2-stage thermoacoustic prime mover with an asymmetric configuration can oscillate under a quite low heating temperature, showing the promising usability of low-grade heat source.

Acknowledgements

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