PROSPECTIVE AIR-BREATHING PULSE DETONATION ENGINE

V. Golub, A. Kotelnikov[1], V. Volodin, S. Golovastov

Joint Institute for High Temperatures of Russian Academy of Sciences (JIHT RAS)
Moscow, Russia

In 1940 Y.B. Zel'dovich showed that thermodynamic efficiency of fuel combustion at detonation regime is greater than at other regimes [1]. This theoretical result gave rise to numerous studies of possibility of creation and utilization of a detonation engine for aviation applications [2]. Advantages of detonation engines can be listed as follows: design simplicity, low fuel consumption, operation range from zero up to supersonic velocities, high specific impulse [3].

The idea to use the direct air intake from the atmosphere is attractive for future employment of pulse detonation engine (PDE) in aviation. In particular, it has been proposed to use a turbine compressor for air intake like in the case of turbojet engines [4]. Due to complexity of the turbine compressor the system requires employment of high-precision equipment and modern manufacturing materials.

In this paper, a new PDE architecture is primarily proposed. According to this concept, the compression of oxidizer at Mach number close to zero is performed without involving a turbine compressor. It was investigated the possibility of performing the oxidizer compression by means of a piston that is driven by detonation and shock waves. For this purpose according to the new concept the numerical simulation of the piston motion and of the PDE was performed.

In particular it has been demonstrated that the oxidizer compression ratio of ten can be atained for the piston mass of 25 g. The obtained results are indicative that show the possibility of development an engine according to the proposed concept. The parameters such as the piston mass of 25 g, the engine length of 2000 mm, and the working frequency of 100 Hz with the compression ratio of ten are acceptable for the realization and utilization of PDE.

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[1] E-mail: andrei@ihed.ras.ru