Numerical and experimental study of model valveless pulsejet operation

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The process of energy supply to the gas during burning may be attended by self-exciting oscillations. This phenomenon has been known for a long time and was investigated by Rayleigh. With the aviation and space technology advancement, the problem of the engine destruction due to the occurrence of combustion instability has arisen. However, there is a class of chambers with a benefit of combustion instability – pulsejets. Because the simplicity of its design, engines of this type have been used in aircraft modeling for quite a long time. With the development of pilotless vehicles, a need for simple and cheap jet engines occurs. An experimental model was manufactured to study the working process in pulsejet. It consisted of an air inlet, a combustion chamber, an exhaust pipe and a fuel supply and ignition systems. The diameter of the combustion chamber was 235 mm, the total length of the model was 1750 mm. Propane was used as the fuel. During the operation of the model engine, 57 Hz pressure fluctuations in the combustion chamber were recorded. This frequency was almost independent of fuel consumption. Numerical modeling was performed for the problem both in two-dimensional axisymmetric and three-dimensional formulations. A model of a compressible chemically reactive mixture of ideal gases was used as the medium. During the solution process, a self-oscillation mode was obtained. The frequency was the same as experimental one. Propulsion performance characteristics were also calculated.