INVESTIGATION OF DYNAMIC CHARACTERISTICS OF HEXAFLY-INT FACILITY MODULE IN HIGH-ALTITUDE TESTING CONDITIONS

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In the project HEXAFLY a large-scale model of a high-speed civil aircraft on hydrogen fuel was proposed [1-2]. The concept of this model formed the basis of the HEXAFLY-INT project [3]. This project involves the Central Institute of Aviation Motors (CIAM), Moscow, Russia, in the part of preparing, conducting and analyzing the ground tests of the facility module. The geometry of the facility module (Fig. 1) differs from the original one in that the facility module has the intake of a simplified configuration. The facility module has two fuel supply zones, one at the entrance to the inner flow path, the other in the middle of the expanding combustion chamber.

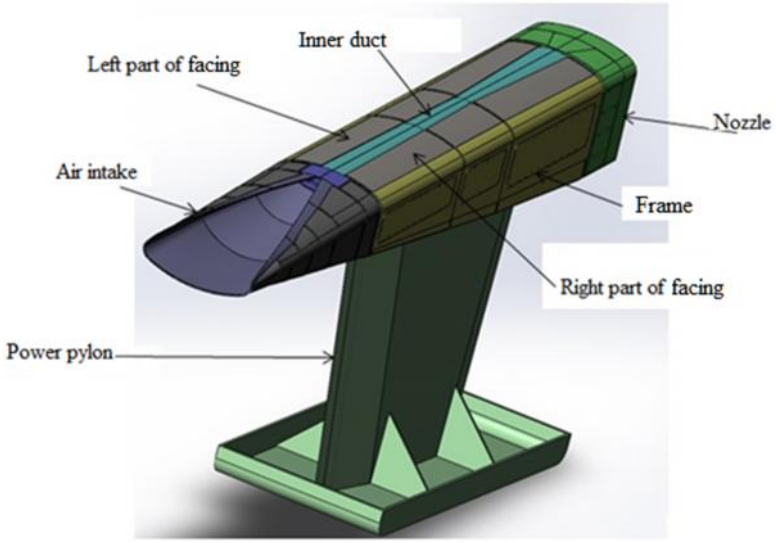

Fig. 1. HEXAFLY-INT facility module

Determination of the dynamic characteristics of the scramjet facility modules of the at ground-based high-altitude tests allows to obtain useful data that can be used to estimate the vibration flight loads. When pressure pulsations are applied to all streamlined surfaces of the structure, the vibration acceleration spectrum measured at any point in the structure can reach maxima at the same frequencies that correspond to either the maximum of the impact spectrum or the amplitude-frequency characteristic of the structural elements. The sharp maxima of the modulus of the amplitude-frequency characteristic of a weakly damped mechanical system are close to those corresponding to the proper modes of oscillations. Therefore the problem of determining the frequencies and proper vibrational modes of oscillation of a structure is one of the main for determining its dynamic characteristics. As a rule near these frequencies there can be maxima of the spectral amplitudes of the spectra of vibration acceleration and the stresses or deformations caused by them, which can exceed the admissible value for a given structure which will lead to its destruction.

In the paper the proper frequencies of the facility module were determined by the shock load method. A spectral analysis of the dynamic force signals acting on the test module during the testing was carried out. The analysis of high-frequency pressure signals and their spectra recorded in the combustion chambers of the vitiation heater and the facility module was performed. It is shown that

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the spectrum of the pressure pulsation signal in the combustion chamber of the facility module has a continuous form of the distribution of the spectral amplitudes of the pressure pulsations characteristic for the developed turbulent flow with combustion in the low-frequency region.
The obtained experimental data can be used to diagnose the working process in the scramjets combustion chambers.

Acknowledgments

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