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DYNANIC INSTABILITY OF STIFFENED CONIC FAIRINGS FOR LAUNCH VEHICLES IN SUPERSONIC GAS FLOW

Vibrations of launch vehicle conical fairings stiffened by rings in the gas flow are investigated. Fairings are simulated using thin conic shells stiffened by inner rings. Losses in a dynamic structural stability corresponding to the Hopf bifurcation are analyzed. Using the method of given forms, one can study a dynamic instability of conic shells with rings in a supersonic gas flow. The pressure acting on the shell is described by the piston theory. Kinetic and potential energies of the structure are intended to be dependent on the component of the shell displacement vector. To study a dynamic instability of ribbed shells in a supersonic gas flow, models with the finite number of freedom degrees are developed. Aeroelastic vibrations of the shell are presented in the form of a shorten series on natural modes of vibrations, which are determined by the Rayleigh–Ritz method. The analysis of free vibrations of conic shells with the different number of rings demonstrated that ribbing increases values of natural frequencies more than by a factor of two. An increase in the number of rings from five to seven does not effect on the first three natural frequencies of structural vibrations. The number of assemblies of the first natural mode of vibrations of the structure with rings is 1.5 times greater than the number of the same mode of vibrations of the structure without rings. A critical frequency of self-excited vibrations is basically well above the first natural frequency of the structure. Those frequencies are closely related for a conic shell with three rings. The frequency of self- excited vibrations is less than the first natural frequency of the structure with five and seven rings. Frequencies of self-excited vibrations and the first natural frequency of the structure do not change, if the number of rings increases from five to seven.

Keywords: conical shell with rings, supersonic gas flow, method of given forms, 3D form of losses in stability.

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