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CONSTRAINED DAMPING LAYER FOR DYNAMIC LOADING ATTENUATION OF LIQUID ROCKET ENGINE FRAME

Abstract

Shock and random loads which were induced during liquid rocket engine working transmitted to the next rocket structures in form of stress wave in acoustic velocity. In order to improve the safety of important equipments, satellites or astronauts, many necessary facilities and technologies for reducing the vibration loading were introduced which caused the launch costs increasing sharply. For reducing the effects of the dynamic loading on the launched equipments quickly as well as obtaining an economical launching activity, constrained damping layer was introduced to dissipate the dynamic energy of the stress wave in liquid rocket engine frame in this paper. Two kinds of constrained damping structures were applied in the frame respectively. Both of the damping layers which were affixed to inner wall of the rocket structure consisted of rubber layer and inertia body with different geometrical dimensions. Finite element method (FEM) was used to investigate dynamic loading transmitting in the frame with the constrained damping. The results showed that a part of kinetic energy of the particle in the frame would transfer to the damping structure as the stress wave transmitting throughout the damper. In the following process, shear loads in the damping material were caused by the particle velocity differences between the outer and inner surfaces while the dynamic energy was quickly dissipated by the dampers. By comparing with the frame without damping layer, the dynamic loading in the frame was able to be reduced sharply by the both dampers. In essence, the dynamic loads depending on the changes of the particle velocity in the frame were reduced by the kinetic energy decreasing of the frame particle. Furthermore, the influences of the dampers position on the transverse vibration responses of the frame were investigated; and the optimal position for the damper dissipating dynamic energy was found.