Complex decreasing of vibroacoustical loadings in aircraft systems

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Operational capability, durability and quality of aerospace constructions largely depend on the intensity of vibrational and acoustic processes which have overwhelmingly negative destabilizing impact on durability of aircrafts. It should be noted that the increase of specific power, size and weight decrease exacerbates this negative impact. The thesis is devoted to complex approach to analysis and control of vibrational and acoustic processes intensity in aircraft hydromechanical systems. In this way the processes are considered as an interactive set of fluid (gas) pulsations, mechanical vibration and noise produced by the vibration. The thesis describes the methods for reduction of hydromechanical systems vibration loading which can be classified into methods of affecting the source of vibration, methods of detuning resonant frequencies, systems dynamic characteristics correction methods.

Pipes are important elements of hydromechanical systems and their reliability largely depends on vibration and acoustic loading. Under this research there was developed a mathematical model describing vibration, acoustic and strength properties of pipes operating under interacting vibration loadings and pulsating fluid flow loading. Within the research the usage of special devices for correction of dynamic characteristics like vibration isolators, vibration dampers and fluid dampers is considered to be an effective method for decreasing the vibration and acoustic loading. There were presented the experimental results of studying the effectiveness of using the developed correctional devices for reducing the vibrational and acoustic loading of pipe systems.

Also in the thesis there are presented the results of study of erratic valves and pressure controllers operation affecting the vibrational loading. There is the description and examples of the developed methods for decreasing the vibrational and acoustic loading of pneumo-hydro mechanical systems by ensuring the stable operation of the units by either increasing the damping of the moving elements of aggregates, or by changing the dynamic characteristics of the associated pneumo-hydraulic chain.

There are developed methods for decreasing the vibration and acoustic loading of the mechanical systems which have the pumping units as a main source of dynamic loading. Under the research there are presented effective methods of affecting the pump construction which allow reducing pump pulsating activity.

All the developed methods and mathematical models are presented along with the experimental results which prove the validity of the research.