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С.В. Філіпковський, В.С. Чигрін, О.О. Соболєв,
Є.Т. Василевський, М.С. Топал, Л.О. Філіпковська
(S.V. Filipkovskij, V.S. Chigrin, O.O. Soboliev,
Ye.T. Vasilevskij, M.S. Topal, L.O. Filipkovska)

СТІЙКІСТЬ АВТОРОТАЦІЇ ТУРБОВЕНТИЛЯТОРНОГО ДВИГУНА З ВІДІРВАНОЮ ЛОПАТКОЮ ВЕНТИЛЯТОРА (STABILITY OF AUTO-ROTATION OF A TURBOFAN ENGINE WITH A BREAKED FAN BLADE)

One of the requirements for the aircraft being designed is the ability to continue flying and landing if one of the engines fails. One of the calculated cases of engine failure is the separation of the fan blade. This phenomenon causes large vibrations, both of the engine itself and of the aircraft structure.

Calculation model and method for studying engine oscillations with damage in the form of blade separation have been developed. Numerical studies of oscillations of the engine suspended on a pylon were carried out. The operation of an engine with an unbalance of the fan after switching off during the transition to autorotation is considered. Numerical simulation was performed using the ANSYS Workbench package.

The front supports of the rotors are ball bearings installed in the elastic elements of the "squirrel cage". Ball bearing are modeled as a rigid hinge. There are two thin-walled shells, which are intermediate power elements outside the elastic element. With an increase in the imbalance of the fan rotor, the gap in the oil damper closes, the damper housing sits on the shells, switching on their rigidity to work. Thus, the support stiffness characteristic is bilinear. The stiffness coefficients of the elastic element "squirrel cage" and the shells of the front support are determined by numerical simulation.

The fan rotor is modeled as a rigid body on bearings. The motor stator is modeled by a rigid body on an elastic suspension. The pylon and elements of the elastic suspension of the engine are modeled by beams of variable section, working simultaneously in tension, torsion and bending.

A numerical analysis of the transient oscillations of the D-436-148FM engine mounted on the pylon of the AN-178 aircraft was performed. The amplitude-frequency response of oscillations is obtained in the frequency range below the fan speed in cruising mode. The stability of engine oscillations at a resonant frequency close to the autorotation frequency has been studied.

The results of numerical simulation are presented in the form of diagrams. Orbits of the centers of gravity of the fan rotor and the motor casing in the resonant mode are constructed. Poincaré mappings of oscillations of the same points of the structure are also constructed.