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Analysis of the Operating Load of Gas Bearings in the Gas Generator of the Turbine Engine during a Deceleration to Dash Maneuver

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Abstract : The paper discusses the status of loads acting on the drive unit of the unmanned helicopter during deceleration to dash maneuver. Special attention was given for the loads of bearings in the gas generator turbine engine, in which will be equipped a helicopter. The analysis was based on the speed changes as a function of time for manned flight of helicopter PZL W3-Falcon. The dependence of speed change during the flight was approximated by the least squares method and then determined for its changes in acceleration. This enabled us to specify the forces acting on the bearing of the gas generator in static and dynamic conditions. Deceleration to dash maneuvers occurs in steady flight at a speed of 222 km/h by horizontal braking and acceleration. When the speed reaches 92 km/h, it dynamically changes an inclination of the helicopter to the maximum acceleration and power to almost maximum and holds it until it reaches its initial speed. This type of maneuvers are used due to ineffective shots at significant cruising speeds. It is, therefore, important to reduce speed to the optimum as soon as possible and after giving a shot to return to the initial speed (cruising). In deceleration to dash maneuvers, we have to deal with the force of gravity of the rotor assembly, gas aerodynamics forces and the forces caused by axial acceleration during this maneuver. While we can assume that the working components of the gas generator are designed so that axial gas forces they create could balance the aerodynamic effects, the remaining ones operate with a value that results from the motion profile of the aircraft. Based on the analysis, we can make a compilation of the results. For this maneuver, the force of gravity (referring to statistical calculations) respectively equals for bearing A = 5.638 N and bearing B = 1.631 N. As overload coefficient k in this direction is 1, this force results solely from the weight of the rotor assembly. For this maneuver, the acceleration in the longitudinal direction achieved value a_max = 4.36 m/s2. Overload coefficient k is, therefore, 0.44. When we multiply overload coefficient k by the weight of all gas generator components that act on the axial bearing, the force caused by axial acceleration during deceleration to dash maneuver equals only 3.15 N. The results of the calculations are compared with other maneuvers such as acceleration and deceleration and jump up and jump down maneuvers. This work has been financed by the Polish Ministry of Science and Higher Education.

Keywords : gas bearings, helicopters, helicopter maneuvers, turbine engines
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