

915. Experimental investigation of dynamics of bearings with adaptive hydrodynamic elements under external effects

A. Čereška¹, R. Maskeliūnas²

Vilnius Gediminas Technical University, Basanavičiaus str. 28, LT – 03224 Vilnius, Lithuania

E-mail: ¹audrius.cereska@vgtu.lt, ²rimas.maskeliunas@vgtu.lt

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Abstract. Operation of mechanical dynamic systems with adaptive hydrodynamic elements is investigated in this paper. Experimental research is performed taking the change of clearance between the rotors and bearing into account and investigating the effects of change of temperature and frequency of rotation of the rotor. Principle scheme of measurement is proposed. Matrix of planning of the proposed experiment is described. Principal system of measurement and method of analysis together with the proposed pattern of changes of searching parameters are presented and the obtained results of investigations are described in detail. Recommendations for the design of dynamic vibrating systems with adaptive hydrodynamic elements are provided and they are used in industrial applications.

Keywords: dynamic system, vibrating system, adaptive hydrodynamic elements, bearings, clearance, frequency of rotation, rotor, effect of temperature.

Introduction

Hydrodynamic bearings are among the most important dynamical systems of different mechanical devices with rotary engines. They are widely used in various mechanical vibrating systems, in dynamic technological machines, high power steam turbines, turbo generators, turbo compressors, pumps, generators, etc. Sliding bearing failures account for 23 % of all causes of system failure according to EEI (Edison Electrical Institute) statistics data. Similar thermal power studies performed in EPRI (Electrical Power Research Institute) have shown that the most common failures occur due to problems caused by such bearings [1, 2].

Research work in the field of diagnosis, development and analysis of mechanical dynamic rotor systems with sliding elements with hydrodynamic friction bearings has been performed much less extensively than for systems with rolling bearings. This is due to many reasons. One of them is that the process of degradation of those bearings is diagnosed with some problems. Waning hydrodynamic sliding friction bearings increase the gap between the rotor and the bearing pin. When the gap is significant, exploiting the system forward, operation of the oil wedge is snarled, this increases friction, effect of vibration, temperature, and also other parameters of the system are changed [3, 4, 5].

In particular conditions of operation the temperature in the zone of bearing operation reaches critical values, then the viscosity of lubricating film and the thickness of oil film are reduced [6, 7, 8]. After this the semi-bearing fluid lubrication regime takes place. As a result, this shortens the operating time of equipment and may result in a crash. In such events the process of operation of the system is affected and substantial losses are experienced. In order to avoid large damages, tests in rotating systems with adaptive hydrodynamic bearings with sliding friction have been performed [9, 10].

Object of research

Dynamic parameters are among the most informative parameters characterizing not only the individual unit of the device, but also the state of the whole system. Changing internal and