

BEHAVIOUR STUDY OF RADIAL BEARINGS WITH HYDRODYNAMIC LUBRIFICATION UNDER CONDITIONS OF SHOCK AND VIBRATION RUNNING

ABSTRACT OF THESIS

Bearings with hydrodynamic sliding are complex machine parts that enable the fixing and rotation of shafts and axles used in modern machines and mechanisms. They have developed in parallel and competition with bearings, compared to which they are superior in applications with dynamic loading, high temperatures and peripheral velocity, non-conventional lubricants.

The behaviour study of radial bearings with hydrodynamic lubrication, functioning under conditions of shocks and vibrations, is carried out from a tribological point of view, observing under the aspect of friction and lubrication, the lubricant film, by which the shock is damped.

Research regarding the behavior of radial bearings with hydrodynamic lubrication, under the conditions of functioning with shocks and vibrations, have at their basis important Romanian literature, as well as numerous foreign publications, some of these being only bibliographical references.

After reviewing the literature in the field, it can be outlined that, from a phenomenological point of view, the determining of the lubricant stratum thickness that separates the two moving surfaces, with bearings exposed to shocks and vibrations, the value of pressure in the lubricant film, as well as the analogy of EHD lubrication, in the case of sliding radial bearings with EHD lubrication encountered at rolling bearings, and at gearings as well, are still in the phase of theoretical and experimental analysis.

The study of sliding radial bearings in a transitory regime, due to the complexity of phenomena that are to be considered, has slowly developed, having a relatively short history, and this fact has occurred only since the appearance of computers.

In the case of bearings exposed to heavy loading (shocks) the difficulty occurring stays in the solution to Reynolds' equation, the equation of energy, the equation of elastic deformations of the axle and bushing surfaces, and the equation of lubricant viscosity and

density variation with pressure, and all these together form a non-linear integral and differential system.

That is why I consider useful a systemic approach to these problems, with the conviction that the results obtained will contribute to the finding of new solutions, in the qualitative understanding of the phenomena that occur in the functioning of sliding bearings.

The objective of this paper is the analysis of hazardous situations, that occurs in the functioning of the sliding radial bearings, due to heavy loading (shocks) through the change of one or more important parameters of radial bearing functioning, with impact on the pressure in the lubricant film and lubricant film thickness, that endanger the correct functioning of hydrodynamic radial bearings. Also, through the research topic chosen within the framework of this doctoral thesis, I propose the carrying out of theoretical and experimental studies, that should clarify the phenomena that occur at the lubrication of sliding radial bearings exposed to heavy shocks, and the contributing to the modeling of the contact between the axle and bushing, in the case of HD radial bearings, that function under conditions of shocks and vibrations.

The paper is structured on six chapters, being a synthesis of theoretical research and experiments carried out by the author with the outlining of personal contributions brought through:

- ✚ the perfecting of the mathematical model regarding the lubrication of sliding radial bearings exposed to heavy loading (shocks)
- ✚ the perfecting of an experimental data processing methodology, as well as the instrumentation of the stand and experimental procedures
- ✚ the establishment of the correlation between acceleration of shock-pressure-resistance of lubricant film
- ✚ correlation of electrical properties of lubricant with the minimum thickness of the lubricant film between axle and bushing.

The synthesis study in Chapter 2 shows the present status of research in the field of sliding radial bearings with hydrodynamic lubrication, outlining the functioning of bearings under the regime of static loading, the determination of geometrical and functional

parameters for these, as well as the specific tribological aspects that occur at the functioning of radial bearings exposed to heavy loading (shocks) . The finality of the bibliographical study led to the establishment of the directions for research and objectives proposed for the thesis.

In Chapter 3, basing on information provided by technical literature, I propose the mathematical modeling of radial bearing lubrication, by stating the lubrication equations, the establishment of the limit and initial conditions for the case of radial bearings exposed to heavy loading (shocks). The manner of achieving the bearing lifter has been outlined, that function under a regime of shocks and vibrations, in the case of the closing motion between the surfaces of the axle and bushing, through the effect of expulsion of the squeeze film.

Chapter 4 presents the experimental program and the data processing methodology , it presents the experimental stand for the testing of sliding radial bearings under shocks, along with the necessary tooling, it also presents the measurement chains conceived for the determining of bushing acceleration, of pressure in the lubricant film as well as for the determination of the electrical resistance of the lubricant film.

Chapter 5 presents the experimental results obtained. It presents the experimental data regarding the acceleration under shock of the bushing, under conditions of dynamic loading of the bearing, the pressure in the lubricant film, under conditions of static and dynamic loading of the bearing, the flow of lateral leak of the lubricant and the resistance of the lubricant film under conditions of static and dynamic loading of the bearing.

Chapter 6 presents the validity of the computing method regarding the lifter/carrier of the lubricant film, and the theoretical and experimental correlations regarding the minimum thickness of the lubricant film.

Chapter 7 presents the final conclusions, the main contributions of the author and the perspectives for subsequent research in the field of sliding radial bearings, that function under conditions of heavy loading (shocks).

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