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REGULAR THERMAL REGIME OF A SYSTEM OF BODIES

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Rolling bearings are widely used in machines. Good bearing performance depends on the correct calculation of the maximum load. There is a lot of research in the field of vibration and acoustic diagnostics. But the thermal control method remains very effective in detecting faults [1].

Works [2, 3, 4] are devoted to the study of heat transfer in rolling bearings. However, studies on the regular thermal conditions of rolling bearings are not enough.

Consider a rolling bearing as a composite body, consisting of several parts, the materials of which differ significantly in thermal properties. For brevity, such a composite body will be called a system. Let the heat exchange on the outer side S of the system obey Newton's law:

$$\lambda_i = \left(\frac{\partial(t_i - t_o)}{\partial n_i}\right)\Big|_s + \alpha_i(t_i - t_o)|_s = 0, \quad (1)$$

where i – is the number of the part of the system that is in contact with the external environment.

We will assume that the λ_i, α_i parameters do not depend on temperature. This will make it possible to apply the first theorem of Kondrat'ev [5] to this system and assume that the temperature field is regularized in the system.

In a system of bodies that is cooled or heated in a thermostated convective medium, as in a homogeneous body, over time, the temperature field inevitably occurs. This means that the rate of change of the logarithm of the excess temperature $\partial(\ln \vartheta_{reg})$ from time to time remains the same for all points of the system.

Graphically, the temperature field of the system $\vartheta = f(\tau)$ is depicted in semilogarithmic coordinates by a family of parallel straight lines (Fig. 1), that is, it remains similar to itself, as in the case of a simple body.

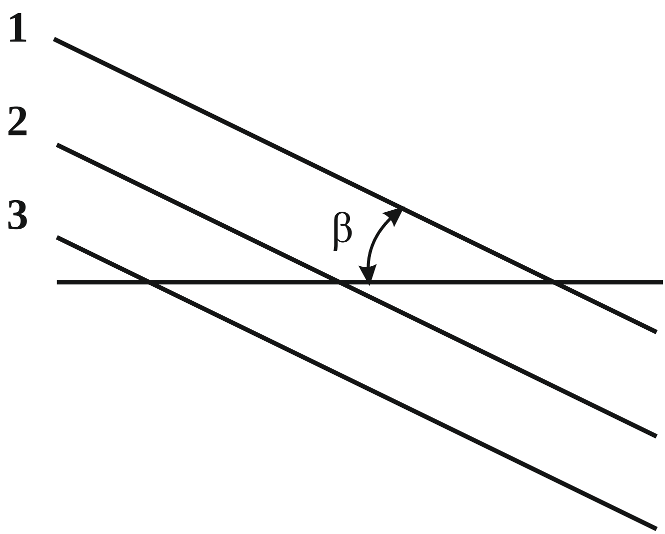

Fig. 1. System temperature field

Regular heating mode characterizes the heating rate [6]:

$$m = \frac{\ln \vartheta - \ln \vartheta_e}{\Delta \tau} = const \quad (2)$$

where ϑ – object temperature, °C; $\ln \vartheta_e$ – ambient temperature, °C; $\Delta\tau$ – time, minutes.

For the system, the heating rate m depends on a large number of parameters:

– on the shape and size of the system and the relative position of its parts;

– on the thermophysical properties of the materials that make up the system;

– on the conditions of heat transfer on the outer surfaces of the system;

– on the conditions at the interfaces between adjacent parts of the system.

For the system, as well as for a simple body, the law of asymptotic increase of m with increasing α is fulfilled, and the limit $\lim_{\alpha\to\infty} m = m_\infty$ a finite quantity.

Thus, in a rolling bearing, a regularization of the temperature field inevitably occurs over time. The heating rate of the rolling bearing is not constant and depends on the shape, size, material properties of the elements, heat transfer conditions and the conditions of the element boundaries.

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SIMULATION OF PROCESSING WITH ABRASIVE SUBSTANCE OF ANGULAR RECTANGULAR WAVEGUIDE CHANNEL

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Rectangular waveguides with numerous bends and twists are applied in the S-range radars. There are two types of waveguide bends: smooth curves, which are made by bending the waveguide tube, and angular bends, which are made by welding or brazing sections of the waveguide tube. Angular ones are used more often, as they are more compact (Fig. 1). Waveguides are made from a thin-walled (2.5 mm) rectangular pipe, the material is aluminum or brass.