EVALUATION OF FOUR-POINT CONTACT BALL BEARINGS EFFICIENCY IN HIGH-SPEED SPINDLES

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Modern high-speed spindles operating at rotational frequencies exceeding 100,000 RPM require innovative solutions to ensure rotor position stability and improve operational efficiency. This research examines the potential application of four-point contact bearings to achieve high axial and radial stiffness in a single compact unit instead of using two angular contact ball bearings, which is particularly important for spindles operating at frequencies up to 120,000 RPM.

The proposed design includes a ball bearing in which both the outer and inner rings are divided into left and right halves. This simplifies the process of mounting the separator with balls and allows varying the number of balls to adapt the load-carrying capacity of the entire bearing.

The structural division of rings into halves creates a zone between them that can be utilized for placing an improved separator with enhanced rigidity. This also allows for implementing radial holes in the spindle housing for supplying air or oil mist directly to the center of the bearing working zone, significantly improving cooling and lubrication under high-speed conditions.

The main advantages of the proposed design include: increased axial and radial stiffness, reduced mass and inertia of rotating parts, improved dynamic stability, the possibility of effective cooling and lubrication, as well as increased efficiency due to reduced friction.

The implementation of four-point contact bearings with divided rings represents a promising direction for the development of next-generation high-speed spindles, particularly for applications requiring simultaneous high precision, stiffness, and extended service life at extreme rotational speeds.

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