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MODELLING OF THE CONTACTING UNILATERAL CONSTRAINTS INCLUDING WEAR, HEAT AND IMPACTS

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In this work the model of a contact system with heat and wear generated by friction and possible impacts is studied. The methods and mathematical models of such systems applied so far contribute only partially to the description of complex dynamics. First, the analysis of contacting dynamic models omit tribological processes on a contact body surface. Second, the mentioned models do not include either the body inertia or impact phenomena usually appearing within the body clearance. We contribute to the problem by matching both phenomena, which improves modeling of dynamic behavior of contacting bodies. Analysis of both stick-slip and slip-slip motion exhibited by the system is performed.

Attention is focused on modeling of non-linear dynamics of two bodies consisting of a stiff bush with clearance $2\Delta_\varphi$ (see Fig. 1). The bush is coupled with housing by springs with stiffness k_2 and is mounted on the rotating thermoelastic shaft 1. The following assumptions are taken: (i) the shaft rotates with such angular velocity Ω that centrifugal forces can be omitted; (ii) non-linear kinetic friction occurs between the bush and the shaft; (iii) heat is generated on the contacting surface $R = R_1$ due to friction; (iv) heat transfer between contacting bodies is governed by Newton's law.

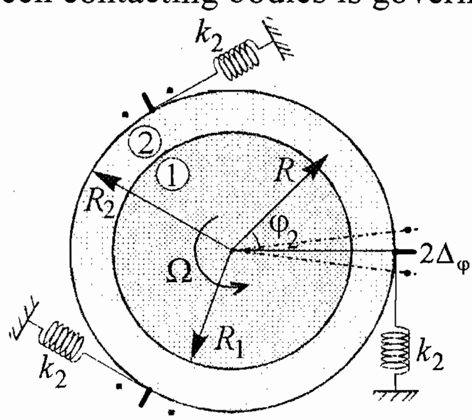

Figure 1. Analyzed system

Applying the Laplace transformation, our problem has been reduced to that of the system of one non-linear differential equation and one second-order Volterra integral equation with respect to the contact pressure. A kernel of the latter equation is the function of the sliding velocity. We have estimated analytically the restitution coefficient for which a periodic motion occur assuming small slope of friction characteristics. We have shown, among the others, various periodic motions exhibited by the analyzed system and we have verified numerically the theoretical considerations.