Chapter 5
Features of Dynamic States in Mechanical Oscillatory Systems With Linkage

ABSTRACT

Peculiarities of dynamics of systems with lever mechanisms are considered, which relate to actual directions of modern dynamics of machines and theory of mechanisms and machines. Particular attention is paid to systems consisting of two solids with rotation points. Expressions are given for kinetic and potential energy, as well as equations of motion for such systems. Then we consider analogues of these systems with two degrees of freedom, which have partial blocks that make only translational movements. It is shown that these systems can be converted to equivalent schemes with material points. Methods for constructing structural and computational schemes for such systems are described, as well as expressions for transfer functions and coefficients of equations of motion. Peculiarities of dynamics of systems with lever mechanisms and their connection with systems having partial units performing only translational movements are discussed.

The issues of equivalent transformations of mechanical oscillatory systems were considered in sufficient detail in works related to the development of modern dynamics of machines and the theory of mechanisms and machines. In recent years, a number of publications have appeared in which much attention is paid to the formation of mechanical linkage systems in structures and their corresponding display using structural mathematical models.

In this regard, the study of the features of the dynamics of systems with lever mechanisms can be attributed to the current directions of modern machine dynamics. Assessment of the possibilities of structural transformations of mechanical

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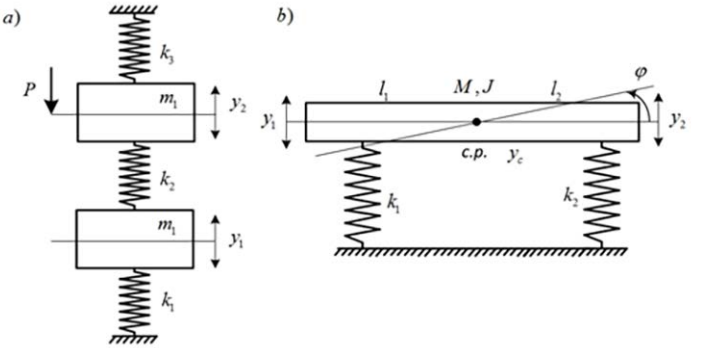
systems in which partial formations make reciprocating movements; there are still certain difficulties and requires the development of a methodological basis.

Possibilities of conversion of rotary forms of motion in their relation with structures of mechanisms having partial blocks of translational type are studied.

STRUCTURAL MATHEMATICAL MODELS OF SYSTEMS WITH CONSTITUENT ELEMENTS IN THE FORM OF SOLID BODIES HAVING ROTATION POINTS

Consider a mechanical oscillatory system consisting of two solid bodies with each fixed point of rotation (pp. O_1, O_2), in the presence of connections realized by elastic elements (Figure 1).

Figure 1. Design diagram of the system with rotary partial units (levers of the second kind)



We write down the expressions for kinetic energy for kinetic and potential energies:

$$T = \frac{1}{2}J_1 \cdot \left(\dot{\phi}_1\right)^2 + \frac{1}{2}J_2 \cdot \left(\dot{\phi}_2\right)^2 \tag{1}$$

$$\Pi = \frac{1}{2}k_1 \cdot \left(\phi_1 l_1\right)^2 + \frac{1}{2}k_2 \cdot \left(-\phi_1 l_2\right)^2 + \frac{1}{2}k_3 \cdot \left(\phi_2 l_3 - \phi_1 l_1\right)^2 + \frac{1}{2}k_4 \cdot \left(-\phi_2 l_4 - \phi_1 l_2\right)^2 \tag{2}$$

After the usual transformations for Lagrange formalism, we write the equations of motion:

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