Movement of a Particle on the Inner Surface with a Preset Meridian

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The particle movement on a surface which rotates around a vertical axis is considered in the article. The surface's meridian is the parabola's branch, offset from the axis of symmetry by a given value. When a particle hits the surface in the lower part of the segment, it accelerates with a simultaneous upward movement. Such movement is characterized by a change in relative (sliding) speed and absolute speed. The relative velocity firstly increases and then decreases to zero when the "sticking" of the particle. The absolute velocity of the particle increases all the time and becomes constant after its "sticking". For the surface of a sieve with parabola meridian,, the "sticking" of the particle occurs in a narrow range of changes in the meridian rise angle. As the angular velocity of the sieve rotation increases, this range increases very slowly. Differential equations of relative particle displacement are compiled and solved. Graphs of particle movement trajectories and velocity change are constructed. The regularity of the particle movement during it rises along the surface is found out. The obtained analytical dependencies allow determining the influence of structural and technological parameters on the movement process.

Neutralization of the Destabilization Effect Caused by Small Damping Force in Non-Conservative System

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For the first time, the destabilizing effect of small dissipative forces was marked by Thomson and Tait in 1879. They showed that a statically unstable conservative system stabilized by gyroscopic forces could be destabilized again by introducing small damping forces. Later on, in 1924, Kimball noticed the paradoxical effect of damping on dynamic stability for rotor systems that have stable steady motions for a certain range of speed but become unstable when the speed is changed to a value outside the range. Further progress in engineering and technology has witnessed that such phenomenon arises in numerous mechanical applications and may cause equipment malfunction. In the present article, this problem is studied by comparing the stability conditions for undamped and weakly damped systems. The aim is to find the interrelation between the matrix elements characterizing the damping force (assuming that the stiffness matrix is known), which allows to avoid or minimize the negative effect of small damping in the presence of non-conservative positional forces. For the case study of two Degrees-of-Freedom system, a simple analytical technique is suggested for this purpose. This technique is demonstrated on two mechanical systems: a system with friction-induced vibrations and a double pendulum under the action of the follower force.