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Konfiguracja i walidacja wytrzymałościowa stosów zaworowych amortyzatorów z użyciem modeli numerycznych

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Summary

The configuration and validation of the strength of disc valve stacks of shock absorbers using numerical models

In this thesis, a mathematical non-linear model of valve system was devised, which has allowed, using the method of a numerical simulation, to verify the valve systems of hydraulic shock absorber in terms of required damping forces and fatigue strength.

The model of valve system was formulated, applying finite element method and considering spatial and shell solid elements, which has enabled to optimize the time of simulation and the accuracy of its results.

To determine the damping force produced by a shock absorber, a basic model of double-tube hydraulic shock absorbers was used, whose validation was performed at a universal servo-hydraulic station.

The paper demonstrates the use of the devised models to support the process of designing the structure of hydraulic shock absorber for railway vehicles.

The utilitarian achievement of the dissertation is the implementation of the approach to construct new series of types of shock absorbers supported by the numerical model on the basis of the sensitivity of the design criteria (damping force and fatigue strength) to the change of structure parameters, considering material tolerance and components, of which valve system is produced, as well as attainable technological tolerance in assembly process of shock absorber subassembly.

As part of the thesis, a configural spatial model of disc valve system, employed in hydraulic shock absorbers for railway vehicles, was developed, using computer-aided design CAD. Taking advantage of the ANSYS program, a model of mechanical elements of disc valve system was built with the use of spatial shell and solid elements, and then the optimal size of the finite element in terms of the criterion for invariability of the analysis results and its time was determined. In the dissertation, a mathematical model of volumetric flow through the valve and a model of fatigue strength of the valve pile was formulated. Using the model of valve system and of hydraulic shock absorber, a complex and multi – option analysis was carried out, regarding the sensitivity of fatigue strength of elastic discs and damping forces of hydraulic shock absorber VG50 to upper and lower tolerance limits of selected geometrical and physical parameters of the valve.