Doctoral dissertation summary

Design method of the branch type spiral damper for reduction of pressure pulsation in hydraulic systems

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This doctoral dissertation focuses on reduction of pressure pulsation in specific hydraulic systems based on essential hydraulic components. One of the main sources of noise in hydraulic systems is mechanical vibration of hydraulic components triggered by pressure pulsation. On the other hand, external mechanical vibrations transmitted to hydraulic elements also cause pressure pulsation, among others, by excitation of the control elements of the lift micro valves. Such pressure pulsation has a wide spectrum of frequency which produces a negative impact on the environment. In order to reduce the negative impact of the external mechanical vibration, a dedicated holder for use of vibration isolation materials has been created as a part of the initial research. Moreover, it was proposed to change the design of the lift valves using viscous damping.. Nevertheless, use of a pulsation damper is the most effective way of reduction of pressure pulsation. Due to this, the dissertation has suggested introduction of the passive branch type spiral damper characterised by reduced sizes (compact structure) in comparison to already known axial dampers of significant length. Damper's curvature allows its adjustment to free space of the hydraulic power supply outside or inside the oil tank, depending on the position of hydraulic pump and current building conditions of the machine or device. An original, modified impedance model for a spiral damper has been created which allows determination of its length in order to obtain high effectiveness of pulsation reduction generated by a pump for certain force frequencies. This dissertation presents the model analysis depending on changeable hydraulic systems operation parameters, i.e. rotational speed of the pump shaft, average pressure and liquid temperature. Frequency of pressure pulsation depends on the pump's rotational speed generated by productivity pulsation of the pump, whereas the volumetric elasticity alternative module of liquid and damper pipe depends on average pressure and its viscosity and friction loss depend on liquid's temperature. These are the main parameters influencing the spiral damper impedance which determines its length. For certain parameters described above, experimental measurements have been taken, confirming the model analysis obtained on the basis of the created model spiral damper. In the course of the dissertation analysis, it has been proven that use of the suggested modified (spiral) damper shows its increased effectiveness in comparison to so far used model of the axial dumper.