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Error estimate at magnetorheological transformer calculation tests by flooding methods

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Abstract

The article reviews the issues of error estimate at measuring deformations in magnetorheological transformers in which the choking channels are replaced by a cylindrical gaping between the two coaxial cylinders.
The cylindrical gaping as well as the main and compensation chambers volumes are filled with magnetorheological fluid. Such construction of magnetorheological transformers is preferable for impact loads damping. At impact loads the measurement of flooding methods displacements is connected to a number of features, reviewed in this article.
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Keywords: magnetorheological transformer; flooding method

1. Introduction

The article analyses the reasons for phase measurement error, caused by sounding signal speeds and the researched object deformations ratio – damper with a magnetorheological transformer (MRT).

The actions of shock loads on MRT cavitation processes are significantly increased. Therefore, improving the accuracy of measurements of deformations MRT by wave method becomes relevant.

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2. Main Results

The process of the damper deformations (displacements) measurement with a magnetorheological transformer by flooding methods is the following (Fig. 1) [1, 7, 8].

Longitudinal displacements radiated by an ultrasonic wave source U_{tt} of a sounding signal are determined by the following equation

$$U_{tt} - c^2 U_{xx} = 0 \,,$$

where U_{xx} – is the initial sounding signal displacement, $c = \sqrt{E/\rho}$ - the speed of sound in a rheological environment which could be represented by gases and liquids, E – the environment elasticity module, ρ – the environment relative density.

The boundary line between the media is supposed to be influenced by ultrasonics from the radiating source and, being reflected by the surface of the researched object they are caught by the correspondent receiver. Thus the condition of continuity at the boundary line between the media is the following

$$Z_0 U_t(0,t) - EU_x(0,t) = \mu(t) \,,$$

where $Z_0 = \sqrt{E\rho}$ - flood medium resistance, $\mu(t)$ – the given functional displacement.

Considering the moving boundary impenetrable for a sounding signal, the second boundary condition at $x = L + l(t)$ is

$$U[L + l(ty)] = l(t) \,,$$

where L – the distance from the source to a fixed boundary, $l(t)$ – boundary displacement law.

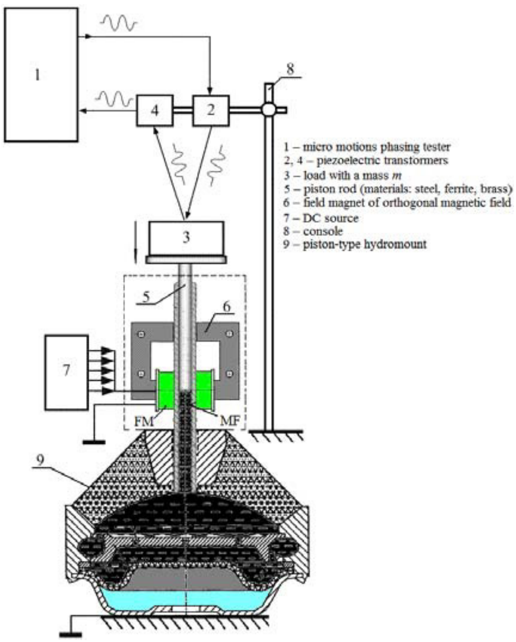

Fig. 1. Experimental unit schematic diagram to identify MRT vibration displacements.

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