REDUCTION OF THE GAS TURBINE ROTOR FORCED VIBRATION PARAMETERS BY CONSTRUCTIONAL DAMPING

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The research object is the turbine rotor blades forced vibration frequency spectrum. Turbine rotor is considered as a system of blades of the same shape spaced on the surface of impellers. The gas flow passing through the rotor blades causes their vibration, that should be decreased by means of damping. The aim of the study is to develop a refined mathematical model that describes the influence of constructional damping between the blades bandages on the impellers forced vibration frequencies. Internal damping in the material of the impellers is not taken into consideration due to the lack of an established method for determining intermolecular bonds in the material and the discrepancy between its real crystal structure and the theoretical one due to the presence of impurity inclusions and the graininess of the material structure.

As the stationary coordinate system, the Cartesian right-handed *xyz* coordinate system with the center at point *O* is taken [1]. This coordinate system rotates together with the turbine rotor at a constant angular velocity ω equal to the angular velocity of rotor. The blades are mounted on the disks of the same radius *R*.

For this case, the exciting force is the periodic gas-dynamic force F(φ). It depends on the angle of the rotor rotation φ and the pressure of the working fluid flow on the impeller. The force F(φ) can be specified as an infinite sum of the terms of the trigonometric Fourier row [1, 2]:

$$F(\varphi) = F_0 + F_1\cos\varphi + F_2\cos(2\varphi) + \cdots + F_k\cos(k\varphi) + \cdots + P_1\sin\varphi + P_2\sin(2\varphi) + \cdots + P_k\sin(k\varphi) = F_0 + \sum_{k=1}^{\infty}(F_k\cos(k\varphi) + P_k\sin(k\varphi)) \quad (1)$$

$$(\varphi = 0\ldots360^0; \qquad k = 1\ldots g)$$

where k - is the harmonic number of the exciting force;

F_0, F_k, P_k – are the coefficients of the Fourier row.

The Fourier row coefficients from the dependence (1) can be found by this way:

$$F_0 = \frac{1}{2\pi}\int_0^{2\pi} F(\varphi)d\varphi \qquad F_0 = \frac{1}{\pi}\int_0^{2\pi} F(\varphi)\cos(k\varphi)\,d\varphi \quad (2)$$

$$P_k = \frac{1}{\pi}\int_0^{2\pi} F(\varphi)\sin(k\varphi)\,d\varphi$$

$$(\varphi = 0\ldots360^0; \qquad k = 1\ldots g)$$

References:

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