EXPERIMENTAL DETERMINATION OF GAS TURBINE ENGINE BLADES FATIGUE STRENGTH PARAMETERS

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In most cases gas turbine rotors operate under variable conditions cyclic loads, and the stresses arising in them during operation are variable in time in magnitude and sign. Therefore, one of the main types of operational failures is fatigue failure, that is, under the influence of variable loads, impellers are destroyed at significantly lower stresses than under the action of static loads. Practice has established that if a blade is repeatedly subjected to variable loading of a certain level, then after some number of stress changes, a crack will appear in it, which will gradually develop. In the end, the blade will collapse without causing noticeable residual deformations, even in the case when its material is highly plastic [1, 2].

Experimental investigation was held to determine the endurance limit of the blades. It was carried out by excitation of resonant mechanical vibrations of the research object along the first bending mode with a symmetrical loading cycle with cantilever clamping of the research object. All experimental tests were carried out while maintaining vibration at a constant level of alternating stresses from the lowest stress level. Then we reach the level of alternating stresses at which the research object accumulated the base number of cycles, required by technical recommendation and then we reach the endurance limit after which the blades or disks destroy.

The process of the mechanical stresses measuring is based on the conversion of electrical voltage, received from the sensors into the mechanical stresses, according to the following dependence:

$$U_i = 0{,}708 I_i S m \frac{q_i R_k R_i}{E(R_k + R_i)} \tag{1}$$

where U_i is the electrical resistance on the i-th sensor, mV; I_i – current strength at the input terminal of the i-th sensor; S – strain sensitivity coefficient; m – current amplification factor on sensor; q_i – the desired vibration stress at the installation site of the i-th sensor; E – Young's modulus of the material of the blade or disk under study; R_k – input electrical resistance of the measuring channel of sensor; R_i – electrical resistance of the sensor.

References:

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