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EXPERIMENT-AND-CALCULATION DETERMINATION OF THE COEFFICIENTS APPEARING IN A MATHEMATICAL MODEL OF CAVITATING PUMPS OF LIQUID-PROPELLANT ROCKET ENGINES

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Cavitation phenomena in liquid-propellant rocket engine (LPRE) pumps not only affect the power performance characteristics of the pumps, but they also affect the pump dynamics and pogo vibrations. The theoretical characterization of cavitation phenomena in LPRE pumps is not a widely used practice because theoretical and experimental data are in unsatisfactory agreement. Because of this, use is made of approaches that employ experimental data. The goal of this work is to determine the coefficients of a hydrodynamic model of cavitating LPRE pumps throughout the cavity existence region based on the experimental frequencies of cavitation oscillations and cavitation self-oscillation boundaries. In determining the cavity elasticity and negative resistance, use was made of the experimental cavitation oscillation frequencies of 26 LPRE pumps differing in dimensions and capacity. In determining the cavitation resistance distribution coefficient and the cavity-due disturbance transfer time, the experimental cavitation self-oscillation boundaries of 14 more pumps were used. To extend the cavity elasticity determination region, the extrapolation dependence of the cavity elasticity in cavitation stall regimes was updated. To make the stratification of the cavity resistance dependence more uniform in the range of large discharge coefficients, incipient cavitation numbers were refined. Using he qualitative dependence of the cavitation resistance distribution coefficient obtained from theoretical transfer matrices of cavitating pumps and its lower estimate (at zero disturbance transfer time) and upper estimate (for a uniform stratification of pump transfer matrix determinants), its analytical dependence was found. Using it and the coefficients of a mathematical model of cavitation oscillations on the cavitation-self oscillation boundary, disturbance transfer times were found and approximated.

Keywords: *liquid-propellant rocket engine, inducer-equipped centrifugal pump, cavitation, hydrodynamic model, experimental cavitation self-oscillation frequencies and regions*.

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