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INVESTIGATION ON FLOW-TYPE COUPLING OSCILLATIONS OF THE PREBURNER SUB-SYSTEM OF THE STAGED COMBUSTION CYCLE ENGINE

Abstract

Preburner is an important component of the staged combustion cycle engine. It provides a source of energy for the turbo pump. The operating characteristics of the preburner have a significant impact on the gas line and supply system, and its working state feedback effects by the supply system. The pressure oscillation of the preburner chamber acts on the supply system, which can cause the flow oscillation of the supply system. The flow oscillation of the supply system can generate pressure oscillation through the combustion and flow process in the preburner. Coupling oscillation may be appeared when the amplitude and phase are appropriate. The research object of this paper is the preburner sub-system of 180KN LOX kerosene staged combustion cycle engine. Firstly, a one-dimensional dynamic model of preburner and supply pipeline is established, and the amplitude-frequency response characteristics of preburner and pipeline are studied by numerical simulation. Secondly, the stability of the sub-system is judged according to the amplitude and phase relations of the stability criterion, and the test results are compared as a validation of the method. Finally, the influencing factors are analyzed, and the results show that the response amplitude of supply system can be reduced by increasing the flow resistance of nozzle, decreasing the volume of head cavity and decreasing the temperature rise of the propellant flowing through pump. Furthermore, the coupling stability of preburner and supply system is improved through these measures. The stability of the sub-system under rated and low working conditions is studied. The results show that the stability margin of the system under low working conditions is worse and more unstable.