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JET INDUCER FOR A TURBO PUMP OF A LIQUID ROCKET ENGINE

Abstract

Liquid rocket propulsion systems are able to provide thrust at high specific impulse. One requirement to achieve this objective is a high combustion pressure which again requires a strong and efficient feed system. In large propulsion systems turbo pumps are used to obtain a high combustion pressure. In order to keep the mass of the pumps low the pumps or operated at very high rotational speed. Despite this a high suction performance without cavitation is required. The state of the art designs use a so called inducer to guarantee good suction performance at high rotational speed. This publication proposes a non-rotating jet inducer which promises a higher performance and higher efficiency than the conventional inducer. The inducer is a helix shaped rotating turbomachine component for mainly axial flow. It is resistant to cavitation at its intake and increases the total pressure toward the inducer outlet. In doing so the inducer turns the gas fraction in the fluid back to liquid state. The spin of the fluid at the outlet of the inducer is normally reduced by guide vanes before the fluid enters the impeller. Compared to other pump components the efficiency of the inducer is poor respectively when we consider the loss in the subsequent guide vanes. The here proposed jet inducer completely replaces the conventional inducer. It works on the principle of the jet pump, a suction jet is injected before the inlet of the turbo pump and increases the total pressure of the fluid before it enters the impeller. The flow for the jet is taken from the pressure side of the pump itself and can be adjusted by a control valve depending on the operational point of the pump and on the operation phase (steady state or transient). The main component of the jet inducer is a set of aerodynamic profiles with nozzles at the trailing edge. The profiles have a star-like arrangement. The advantage of the jet inducer is the capability to increase the pressure without applying spin on the fluid and hence promising a higher efficiency of the complete turbomachine. Due to the regulation of the jet flow we can also expect a higher suction performance of the impeller. In operational points where the tendency to cavitation increases (transient, low inlet pressure, over speed) we apply high mass flow on the jet inducer in normal condition we reduce or stop the flow of the jet.