CALCULATED-EXPERIMENTAL INVESTIGATION OF THE FLOW IN THE GASDYNAMIC THROTTLE

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In the experimental development of air-jet engines, autonomous tests of the most heat-stressed structural elements, for example, diffusers, combustion chambers, nozzles, etc., take a special place. Such tests are carried out in installations with a connected air duct. The main task in this case is the creation of the required parameters of a high-enthalpy gas flow (pressure, temperature and velocity), which are varied during the test. In the event that the experimental setup is a channel of constant cross section with a critical section, the flow velocity is determined primarily by the ratio of the cross-sectional area of the channel to the critical area. The change in such a parameter as speed by mechanical change in the area of the critical section presents certain design difficulties due to high flow temperatures. The present work is devoted to the study of gas-dynamic control of the output constant section channel compression degree with the purpose of varying the velocity and density of a high-enthalpy gas stream. Figure 1 shows the schemes of two variants of the experimental setup, 1 - the main high-enthalpy flow, 2 - the throttling gas. This method of regulation is easy to implement, but has the drawback that it depends on the effective area of the critical section on the parameters of the main flow. Using numerical simulation, the effective area of the critical section was determined as a function of the main parameters and properties of the gas-the pressure of the main and throttling gas, the temperature of the main gas, the adiabatic exponents, and also the shape of the throttle and the direction of injection. The simulation was carried out both in an axisymmetric setting and in a three-dimensional design to take into account the design features. Figures 2 - 4 show the fields of the axial velocity of the gas. The figures show a significant effect of the feeding method on the flow parameters in the channel, while parameters such as pressure, temperature, and properties of the main and throttling gas remain unchanged. The problems of choosing a model of turbulence and grid convergence were considered. To confirm theoretical dependencies, an experimental setup was developed and manufactured. Air was used as the working medium of both the main and throttling gas. During the tests, the following parameters were measured: flow and temperature of the main flow, pressure on the walls of the channel and in the collector of throttling air.

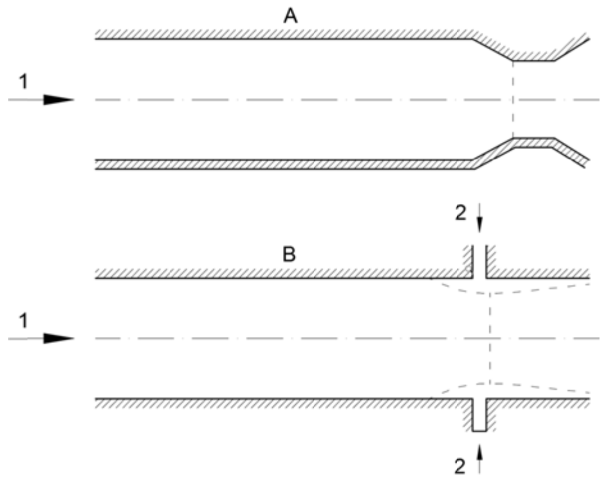

Figure 1 - Experimental installation schemes

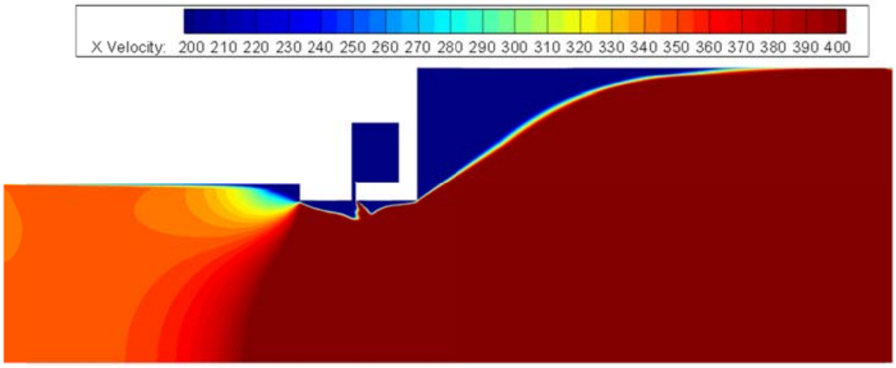

Figure 2-Axis speed field, configuration 1

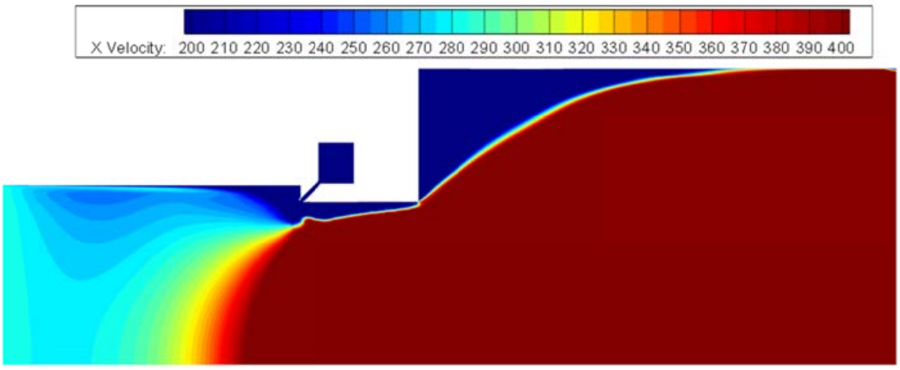

Figure 3 - Axis speed field, configuration 2

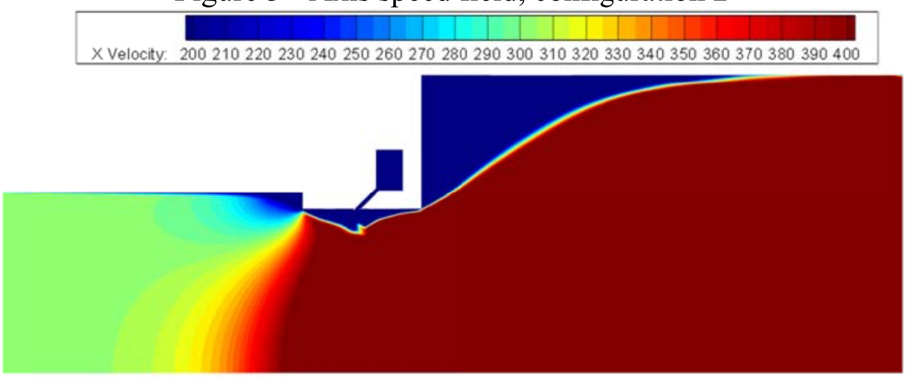

Figure 4 - Axial speed field, configuration 3