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Letter

Study on the characteristics of interaction flowfields induced by supersonic jet on a revolution body

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HIGHLIGHTS

- The paper focuses on the triple jets interaction with a hypersonic external flow on a revolution body.
- The experimental model is a ogive-cylinder body with three supersonic nozzles, which are aligned along the flow direction.
- The spatial and surface flow characteristics were illustrated by the schlieren photographs near nozzles and the typical pressure distribution.

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ABSTRACT

The paper focuses on the triple jets interaction with a hypersonic external flow on a revolution body. The experimental model is a ogive-cylinder body with three supersonic nozzles, which are aligned along the flow direction. The freestream Mach number are 5 and 6. The spatial and surface flow characteristics were illustrated by the schlieren photographs and the typical pressure distribution. The results show that there are multi-wave system, separation, reattachment, multi-peak pressure, high-pressure and low-pressure zone boundaries obvious distinction in tri-jets interference flowfield. The present paper also analyzes how do the pressure ratio, the angle of attack, and Mach number effect on tri-jets interaction characteristics.

When a sonic or supersonic jet is injected laterally into supersonic or hypersonic free stream, the complex jet interactive flowfield is generated which involves highly complicated flow phenomena such as shock/boundary layer interaction, shock/shock interaction, jet/jet interaction, flow separation, and flow reattachment, complex spatial vortices, etc. [1-6]. Zukoski and Spaid [5] experimentally studied the supersonic interaction flowfield on a flat plate induced by a single sonic transverse jet. The single sonic jet/lifting surfaces interaction on a revolution body was investigated by Brandeis and Gill [6]. They mainly studied the single jet on a flat plate or revolution body by experiments, but the multiple jets interaction was studied mainly through numerical simulation [7], hardly by experiments. Furthermore, many engineering applications often use multiple jets and simultaneously start multiple jets for control.

The present paper focuses on the multiple jets interaction with a hypersonic external flow on a revolution body. The region near nozzles is turbulent boundary layer. The experiment was performed in FD-07 hypersonic wind tunnel of China Academy of Aerospace Aerodynamics (CAAA). Mach number is designed from 5 to 8. The experimental model is a ogive-cylinder body with three supersonic nozzles, which are aligned along the flow direction. The freestream Mach number are 5, 6. The spatial and surface flow characteristics were illustrated by the schlieren photography near nozzles and the pressure distribution on the typical position. The complex interference flowfield structure is given, such as multi-wave system, separation, reattachment, multi-peak pressure, high-pressure and low-pressure zone boundaries obvious distinction. The present paper also analyzes how do the pressure ratio, the angle of attack, and Mach number effect on multi-jet interaction characteristics. The experiment result also provides a reliable basis for numerical simulation methods.

The experiment was performed in FD-07 hypersonic wind tunnel in CAAA. FD-07 hypersonic wind tunnel is a blowdown wind tunnel, as shown in Fig. 1. The diameter of axis symmetrical nozzle exit is Φ500 mm. Mach number is designed from 5 to 8. There is a Φ350 mm optical glass window at the side wall of the test section for colour schlieren apparatus. The test was under

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