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EFFECT OF THE LENGTH OF A TRUNCATED NOZZLE WITH A TIP ON ITS THRUST CHARACTERISTICS

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Nowadays, for solving new problems, rocket engine nozzle developers are increasingly turning to non-traditional nozzle configurations that differ from the classic Laval one. A relatively new line in the design of supersonic nozzles is the development of the so-called bell-shaped nozzle, which, unlike the classical Laval nozzle, has a larger angle of entry into the supersonic part of the nozzle. In this case, dual bell nozzles, which have two flow expansion sections in their supersonic part, are considered. However, the effect of the length ratio of the two flow expansion sections of a truncated nozzle on its characteristics has not yet been studied. The goal of this work is to determine the effect of the length of the upstream conical supersonic section on the static pressure distribution in the nozzle and its thrust characteristics with the shape of the bell-shaped tip kept unchanged. .

The nozzle characteristics were studied using the ANSYS Fluent computing package. It was shown that the flow patterns in the nozzle (velocity fields) change with the length of the conical part upstream of the tip and the underexpansion degree. Under terrestrial conditions ($P_н$ = 1 bar), all variants show a developed separation zone that starts from the corner point where the tip is connected to the conical part. In this case, the pressure on the nozzle wall is nearly equal to the ambient pressure. At a large flow underexpansion degree (P_0 = 300 bar) and in low-pressure conditions conditions ($P_н$ =0.1 bar), the flow in the tip is adjacent to the wall. At a large flow underexpansion degree, the pressure in the nozzle increases from the corner point to the tip exit, and the pressure at the tip exit increases with decreasing tip length. The nozzle thrust coefficient decreases with increasing flow underexpansion degree, and it reaches a constant value after the flow becomes adjacent to the tip wall downstream of the corner point where the tip is connected to the nozzle. At high flow underexpansion degrees, the nozzle thrust coefficient is higher for a nozzle with a longer conical part. The calculated results are in good agreement with experimental data on nozzles of this type.

Keywords:*. truncated supersonic nozzle, bell-shaped tip, static pressure distribution in nozzle, flow velocity distribution, nozzle thrust coefficient.*

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