DESIGNING OF OPTIMAL NOZZLES OF PULSED DETONATION ENGINES OF VARIOUS TYPES

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The problems of design of two-dimensional (symmetrical and asymmetrical) and axisymmetrical supersonic parts of nonadjustable nozzles were solved for some types of pulsed detonation engines. These nozzles realize the maximum of impulse and thrust (integral of thrust on time during the period) at a fixed size and depending on time parameters of detonation products in the initial section of the nozzle. The pulsed detonation engines with supersonic flow in the detonation chamber (DC) exit section, i.e. in the nozzle entrance section (SPDRE – Supersonic Pulsed Detonation Ramjet Engine) and engines with subsonic flow in the detonation chamber exit section were considered. During designing of the second-type engines (further – PDE) nozzles apart with optimal supersonic nozzle part shaping the optimal compression ratio – the ratio of the minimal nozzle cross section area to the cross section area of DC was found. The detonation in PDE can be initiated both in entrance and in exit section of DC. The non-stationary flow in DC of regarded pulsed detonation engines was calculated by using the one-dimensional approach (up to the minimal nozzle cross section area of PDE). The non-stationary supersonic (for SPDRE) and sonic (for PDE) flows supposed to be uniform in initial sections of designing nozzle parts. The optimal design contours were constructed by using the previously developed approach based on solving some 2D (two-dimensional or axisymmetrical) stationary problems by the method of characteristic. The thrust impulses realized by designed nozzles were determined by numerical integration of 2D non-stationary flow equations.