TRANSITION TO AVALANCHE COMBUSTION ACTIVATION AS A METHOD FOR ENHANCING AN EJECTOR PULSEJET ENGINE

G. A. Glebov[1], K. K. Migalin[2], and I. P. Boychuk[3]

[1]Kazan National Research Technical University named after A. N. Tupolev, 10 K. Marx Str., Kazan 420111, Tatarstan, Russian Federation
[2]Enterprise LLC Scientific Production Company "Rotor," 25-145 Pobedy Str., Togliatti, Samara Region 445002, Russian Federation
[3]"Sigmatek" LLC, 33 A Dnepropetrovsk Str., Saint Petersburg 191119, Russian Federation

Abstract: In the 1970s, E. M. Glukharev developed an ejector pulsejet engine designed to drive a helicopter rotor. Taking this engine design as a basis, the authors developed it further. As a result, a two-circuit ejector pulsejet engine was made, capable of operating in the high-speed flight regime. The article describes combustion boosting methods based on partial fuel conversion performed during the engine operating cycle and avalanche flame activation. These studies were carried out to increase the specific characteristics of the engine.

Keywords: vavleless bypass pulsejet engine; avalanche combustion activation; gasoline pyrolysis; fuel conversion; Glukharev engine

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Figure Captions

Figure 1 Dependence of the combustion chamber pressure pulsation amplitude on the fuel flow rate in the Offord–Miller engine at steady fuel supply (*1*) and unsteady fuel injection with various cycle lead angels: *2* — $\psi = 80°$; *3* — 95°; *4* — 115°; and *5* — $\psi = 125°$

Figure 2 Schematic of the experimental bypass ejector pulsejet engine

Figure 3 Variations in the mean indicated cycle pressure P_i (*1*) and the thrust pulsation amplitude (A) (*2*) at a freestream velocity of 60 m/s. Fuel — AI-92 automotive gasoline

Figure 4 Pressure pulsations in the deflagration combustion regime

Figure 5 Pressure pulsations in the enhanced combustion regime at an inlet air velocity of 200 m/s (all pressures are gauge)

Figure 6 Planar slot reactor. Dimensions are in millimeters

Figure 7 Gas temperature fields in the reactor at different cycle phases

Figure 8 Gas temperature variation at the reactor inlet during a single cycle

Figure 9 Prechamber. Dimensions are in millimeters

Figure 10 Calculated pressure pulsation profile on the combustion chamber back wall near the prechamber inlet

Figure 11 Experimental pressure pulsation profile at the inlet of the second mixer at an inlet air velocity of 60 m/s

Figure 12 Gas mass flow rate variation through the prechamber during a single pulsation cycle at an inlet air velocity of 200 m/s: *1* — three negative flow rate peaks at the initial stage of the heat addition phase where gas was forced into the prechamber tube in three successive waves; *2* — predominantly negative flow rate where gas was forced into the prechamber; *3* — positive flow rate where gas from the prechamber entered the engine cavity during the second stage of heat addition; and *4* — final stage with a slight negative flow rate where gas started to flow back from the engine into the prechamber

Figure 13 Throttle characteristics of the engines: *1* — baseline engine; *2* — engine with a reactor; and *3* — engine with a Helmholtz resonator prechamber; solid lines — net thrust variations; and dashed curves — fuel consumption. Net thrust values are based on strain gauge measurements, excluding wind load

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Contributors

Glebov Gennady A. (b. 1947) — Doctor of Science in technology, Kazan National Research Technical University named after A. N. Tupolev, 10 K. Marx Str., Kazan 420111, Tatarstan, Russian Federation; glebov_g_a82@mail.ru

Migalin Kirill K. (b. 1983) — engineer, Enterprise LLC Scientific Production Company "Rotor," 25-145 Pobedy Str., Togliatti, Samara Region 445002, Russian Federation; rotor.skb82@mail.ru

Boychuk Igor P. (b. 1976) — Candidate of Science in technology, general director, "Sigmatek" LLC, 33 A Dnepropetrovsk Str., Saint Petersburg 191119, Russian Federation; boychuk@ieee.org