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3D MODELLING OF PULSED JET INJECTION AND COMBUSTION

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ABSTRACT

The concept of Pulsed Jet Combustion (PJC), proposed by Oppenehim (1) as an alternative mode of energy release in stratified charge internal combustion engines, shows a number of practical advantages. Based on the fundamental ideas of Gussak, Semenov and Zeldovich concerning the role of active radicals in the torch mechanism of ignition and flame propagation, the PJC concept implies a staged combustion process:

- the flame generated in a prechamber is extinguished by shear at efflux from the orifice between the prechamber and the main chamber;
- combustion is spontaneously reinitiated in the main chamber in the core of the hot turbulent jet.

Further chemical transformations in the main chamber occur in a fireball, i.e. via distributed combustion sustained by multiple pockets of high concentration of active radicals. Of prime importance are the entrainment processes providing fireball growth.

It should be emphasized that the fireball mode of combustion differs in principle from turbulent propagating flame mode. The latter is characterized by laminar-like average structure with certain characteristic thickness of the turbulent reaction zone. The turbulent propagating flame mode is assumed to exist in the majority of stratified charge concepts.

In this work, 3D computer modelling of the PJC system behaviour in internal combustion engine was made. Two PJC generators were located on the opposite cylinder walls. Standard k-ε model was used to solve turbulent combustion with the assumption that combustion is determined by molecular mixing of the eddies containing reactors with those containing hot products. The FIRE code developed by AVL was used to solve the governing equations in 3-D coordinates.

As a result of 3D numerical simulation of PJC system, it has been found that turbulent combustion in the main chamber exhibits two distinct modes, i.e. the fireball mode is characteristic of the initial stage of the process, while the turbulent flame dominates at later stages.