DETONATION FORMATION IN DEVICES WITHOUT PRELIMINARY COMPONENTS MIXING

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In detonation devices using for practical purposes (evaporation, cleaning of heat-receiving surfaces, crashing of scrap tires, pulse detonation engines) by the reason of safety it is necessary to mix the fuel components directly in the detonation combustion chamber (DCC). Pulsed fuel components supply in DCC provided by fast acting valves or a valveless system (so-called gas dynamics valves. In comparison with valve systems the valveless system has a number of advantages, the main of them are the increase of reliability and operation resource of the device. The peculiar property of gas dynamics valve operation is unsteady flows in it. This may cause the components mass flow variation with DCC filling. As a result, the real detonable mixture composition and flow turbulence in the spark plug location varied. These factors can substantially affect the DDT process. The fuel components mass flow may be varied at the conventional valves using because of the pressure variation in pressure accumulators and DCC. This allows investigating both the influence of valveless system operation and real fuel components supply pressure variation on the formation and parameters of detonation.

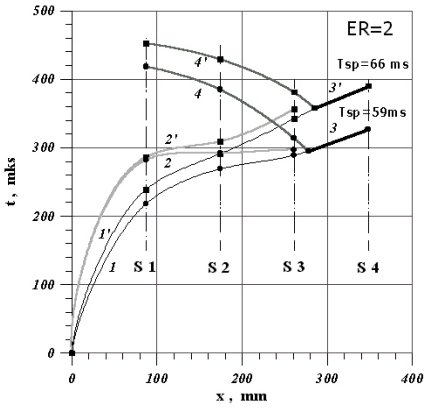

Fig. 1. The deflagration to detonation transition process. 1, 1' – shock waves, 2, 2' – flame fronts, 3, 3' – detonation, 4, 4' – retonation, S1, S2, S3, S4 – section of DCC with consequently gauges

Detonation formation was studied in the case of detonation devices without preliminary components mixing both with valve and valveless supply systems. The unsteady processes affecting the detonation formation are found. The optimal ignition delay times T_{sp} of DCC operation when DDT is shortest are found [1, 2]. The detonation forms are faster at less T_{sp} (Fig. 1).

The turbulence and ignition location influence on the detonation formation in flow of nonpremixed fuel components was investigated [3] (Fig. 2). The minimal time of DCC filling (6 ms) with fuel components was determined by means of the numerical simulation.

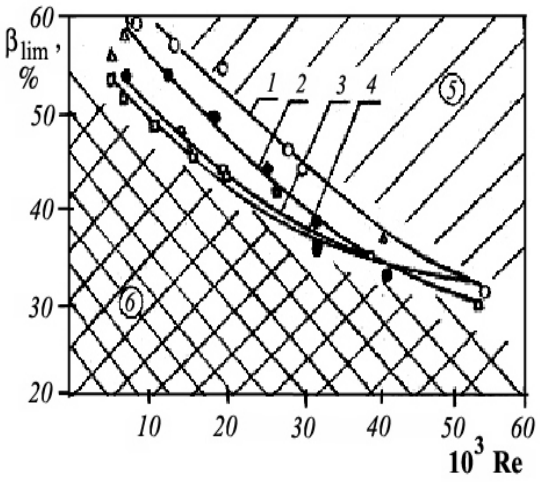

Fig.2. Limited values of β as a function of Re: 1 – ER = 0.625, 2 – ER = 0.71, 3 – ER = 1, 4 – ER = 1.2. Region 5 – detonation go, 6 – no go

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References

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