Generation of vortex structures by perturbed converging shock waves

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The flowfield in symmetric (cylinrical or spherical) converging shock wave is known to be vortex free. At the same time, converging shock waves are unstable with respect to symmetry preservation. Small disturbances of cylindrical or spherical flow symmetry tend to increase. This is accompanied by vorticity production, which increases rapidly in the vicinity of the focus. In the present work the vorticity production by spherical converging shock wave is investigated in the framework of the initial value problem for 3D Euler equations of gas dynamics formulated in converging frame. Carnahan-Starling equation of state is applied to take into account the influence of thermodynamic non-ideality due to the particle interactions. Moving (converging) grids allow to obtain an accurate solution to the problem in a wide range of the shock wave radius. Converging spherical shock wave is considered, which is perturbed by an asymmetric π-periodic disturbance with respect to rotation around an axis passing through the focus. The shock wave generates vortex surfaces (tangential discontinuities) outgoing from the lines of triple-shock configurations on the shock wave surface. Interactions of the vortex surfaces produce intence vortex formation within the structures of double Mach reflection. The calculations has shown turbulent nature of the flow near the focus at scale of the front pressure growth termination due to transition from Mach to regular interaction of the shock wave segments. The turbulent character of flow near the focus may be important for applications of converging shock waves for the purposes of initiating reactions (detonation, controlled thermonuclear fusion). The work was supported by the Russian Foundation for Scientific Research (No. 24-29-00659).