On neutral stability of shock waves with the first-order phase transition

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It is shown that the Kontorovich criterion for the neutral stability of relativistic shock waves (the relativistic analogue of the Dyakov–Kontorovich criterion in classical hydrodynamics), after eliminating the derivative along the Taub shock adiabat using relations on the relativistic shock-wave discontinuity, reduces to a restriction on the isenthalpy derivative of the internal energy (ε) with respect to specific volume (v) in the rest frame: $p > -(\partial\varepsilon/\partial v)_w > p_0$. Here, p and p_0 are the post shock and pre shock states, respectively. The resulting formulation is also valid in classical hydrodynamics. The consequences of this formulation are derived for shock waves with a single-phase and two-phase final state in a medium with a first-order phase transition. The influence of the Riedel parameter and isochoric heat capacity on the feasibility of neutrally stable shock waves is shown. In a model formulation of the problem, the influence of local thermodynamic nonequilibrium on the damping of disturbances of a neutrally stable shock wave is studied. The classical linear theory of shock wave stability, within the framework of which criteria for instability and neutral stability were obtained for media with an arbitrary equation of state, assumes that states of local thermodynamic equilibrium are realized behind the shock wave front. However, the study showed that the mode of neutral stability of the shock wave is realized primarily in cases where behind the front of the shock wave there is an extended zone of relaxation to a state of thermodynamic equilibrium. To study the influence of this factor, as part of the research carried out, within the framework of a model two-dimensional formulation of the problem, the influence of local thermodynamic nonequilibrium on the attenuation of disturbances of a neutrally stable shock wave was numerically studied.