Shock Wave Reflection under Suddenly Applied Transversal Magnetic Field

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The author reports here the shock wave reflection by suddenly applied transversal magnetic field. This Lorenz force ($F=J\times B$) is induced by the current J produced by the shock ionized gas (velocity V) and by the applied magnetic field B. Because F is inverse to the initial flow direction, this force acts as a "piston" and pushes the flow inversely. The "piston" reflects the initial shock or retards it.

The author gives here a theory of counteraction of a shock and magnetic field mainly by the methods of P-V (pressure-velocity) diagram and experimental verifications of this theory.

The theory is based mainly on the Riemann equation and the Rankine-Hugoniot equations. Since these equations can not be solved easily, they are transfered to non-dimentionalized P-V diagram. This P-V diagram clarifies qualitative structure of the shock refraction or reflection processes. Under special conditions, the systems of equations can be solved schematically and we get a critical magnetic field strength of shock reflection and also a velocity of retarded shock wave.

Experiments are performed by a conical electromagnetic shock tube. This shock tube is equipped with a pulsed magnetic field transversal to the tube axis. Magnetic field is maintained in about 100 μ sec in 1700 Gauss at peak. Luminous fronts of shock waves proceeding in the tube are imaged on a commercial high speed camera with writing speed 1 mm/μ sec.

The author concludes this P-V diagram theory has good coincidence with the experiments.

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