PREFACE

The thesis is an outcome of the researches carried out by the author under the supervision of Professor J. P. Vishwakarma, Department of Mathematics, D. D. U. Gorakhpur University, Gorakhpur. The thesis has been divided into five chapters and each chapter has been subdivided into a number of sections.

The first chapter is introductory. It gives, in brief, an idea about shock waves, shock waves in magnetogasdynamics, detonation waves, fundamental equations of a non-ideal gas, fundamental equations of mixture of a gas and small solid particles, the concept of self-similarity and Whitham’s method, as used in the thesis.

In the chapter II, we studied a self-similar solution for the propagation of a cylindrical shock wave in a weakly conducting mixture of a perfect gas and small solid particles in presence of a variable axial magnetic field. The shock is assumed to be driven out by a piston moving with the velocity obeying a power law. The density of the ambient medium is assumed to be constant. The presence of magnetic field fixes the value of the piston velocity index $n$ as $n = -1/2$. Similarity solutions are obtained, and the effects of variation of the mass concentration of solid particles ($k_p$), the ratio of the density of the solid particles and the initial density of the perfect gas in the mixture ($G_0$) and the strength of initial magnetic field on the strength of shock and on the flow-field behind it are investigated. It is shown that the effect of magnetic field becomes somewhat significant due to presence of small solid particles in the gas.

In the chapter III, we studied the propagation of diverging cylindrical shock waves in a weakly conducting dusty gas (mixture of a perfect gas and small solid
particles) under the influence of a spatially variable axial magnetic induction. The initial density of the medium obeys a power law. The total energy of the flow-field behind the shock is not constant, but assumed to be increasing due to time dependent energy input. The effects of variation of initial density, the mass concentration of solid particles \( k_p \), the ratio of the density of the solid particles and the density of perfect gas in the undisturbed mixture \( G_0 \), and the presence of magnetic induction, on the propagation of the shock and the flow-field behind it are investigated.

In chapter IV, we studied the propagation of converging cylindrical detonation waves in an ideal gas with varying initial density and varying azimuthal magnetic field. The Chester-Chisnell-Whitham (CCW) method was employed to determine the detonation front velocity and the other flow-variables just behind the shock in the case when (i) the gas is weakly ionized before and behind the detonation front, (ii) the gas is strongly ionized before and behind the detonation front and (iii) non-ionized (or weakly ionized) gas undergoes intense ionization as a result of the passage of the detonation front. It is investigated that in case (i) an increase in the value of the strength of initial magnetic field \( M_{cj}^{-2} \) shows almost negligible effect on the convergence of the detonation front and the pressure behind it, while an increase in the value of ratio of specific heats of the gas \( \gamma \), increases the velocity of detonation front and the pressure behind it near the axis. A decrease in the value of index for variable density \( \alpha \), accelerates the convergence of front and increases pressure behind it. In the case (ii) on increasing \( M_{cj}^{-2} \), when \( \alpha = 0 \), the front velocity near the axis and the pressure behind it decrease. A decrease in the value of \( \alpha \) increases the velocity of the detonation front and the pressure behind it. An increase in the value of \( \gamma \) in non-magnetic case, rapidly increases the velocity of detonation front and the
pressure behind it. In the case (iii), the variation of $M_{cj}^{-2}$ and $\alpha$, show similar behaviour as in case (ii), but an increase in the value of $\gamma$ rapidly increases the pressure behind the detonation front.

In chapter V, we studied the convergence of cylindrical detonation waves in a non-ideal gas with an azimuthal magnetic field. The Chester-Chisnell-Whitham (CCW) method is used to solve the problem. The front velocity and the other flow variables just behind the shock are determined in the case when (i) the gas is weakly ionized before and behind the detonation front, (ii) the gas is strongly ionized before and behind the detonation front and (iii) non-ionized (or weakly ionized) gas undergoes intense ionization as a result of the passage of the detonation front. It is investigated that in case (i) an increase in the value of the strength of initial magnetic field has no effect on the convergence of the front and on the pressure behind it, while a change in the value of the parameter of non-idealness of the gas $\delta$ shows small effects on these variables. When the initial density increases towards the axis, then the front velocity and the pressure behind it remains almost constant. When density is constant, the front velocity and the pressure behind it increases as axis is approached. In the case (ii) on increasing the strength of initial magnetic field, the velocity of detonation front and the pressure behind it decrease. A change in the value of non-idealness of the gas $\delta$, shows small effects on these variables. When the initial density increases towards the axis, the front velocity and the pressure behind it increase as the axis is approached. In the case (iii) the front velocity and the pressure show similar behaviour as in the case (ii).
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