Chapter-VII

Self Similar Model of Radiative Shock Waves in Magnetohydrodynamics with Magnetic Effect

INTRODUCTION

In this chapter we consider propagation of shock wave under the effect of radiation taking magnetic effect in to account of an instantaneous release of energy in a non-uniform equilibrium conditions. The disturbance are headed by a shock of variable strength. This model is of considerable physical interest in sonic booms.

The medium ahead of the shock is assumed to be inhomogeneous and at rest the shock position in this problem is given by

The theory of shock waves and related flows has attracted a renewed interest in connection with the phenomena associated with laser production of plasma, nuclear detonation and astrophysical situations. Ray [1] obtained an analytic solution in the case of a central explosion in a gravitating mass of equilibrium in which the disturbance was headed by a shock surface of variable strength. Ojha [2] considered the propagation of explosion waves in a steller model in the shock strength does not remain constant in general and mach number of the shock is a function of time. Ojha and onkar [3] studied the propagation of shock in inhomogeneous self gravitating gaseous mass are headed. Tayar [4], Carrusetal [5], Klynch [6], Sedov [7] have accumulated and extensive to literature on self similar model of phenomena for the propagation of shock wave in gas dynamics and in the formation of stars and super nova explosions. Summers and whitham [8] have discussed qualitative analysis of self similar solution to the problem of unsteady spherical symmetric motion of self gravitating gas Sakurai [9] has considered the problem of shock wave arriving at the edge of a gas in a medium in which density varying as power law. The flare generating shock waves has been studied by Hundhances [10]. Deb Ray and Bhownik [11] have obtained the self similar solution for central explosion in stars with radiation flux when the shock is isothermal & transparent.

\[ R = A t^\alpha \] (7.01)
where $\mu$ and $A$ are constant & $\mu < 1$

We assume that the density disturbance is given by

$$\rho_o = br^0$$  \hspace{1cm} (7.02)

where $b$ & $\beta$ are constants.

The magnetic field disturbance the magnetic field distribution is taken cc & Rosenate  & Frankenthal [12] as

$$h_o = cr^c$$  \hspace{1cm} (7.03)

directed tangentially to the advancing shock front where $c$ & $\delta$ are constants.

**EQUATIONS OF MOTION**

$$\frac{\partial \rho}{\partial t} + u \frac{\partial \rho}{\partial r} + \rho \frac{\partial u}{\partial r} = 0$$ \hspace{1cm} (7.04)

$$\frac{\partial P}{\partial t} + u \frac{\partial P}{\partial r} - \frac{\gamma P}{\rho} \left( \frac{\partial \rho}{\partial t} + u \frac{\partial \rho}{\partial r} \right) = 0$$ \hspace{1cm} (7.05)

$$\frac{\partial u}{\partial t} + u \frac{\partial u}{\partial r} + \frac{1}{\rho} \frac{\partial P}{\partial r} + \left( h_o + h_z \right) \frac{\partial}{\partial r} \left( h_o r + h_z r \right) = 0$$ \hspace{1cm} (7.06)

$$\frac{\partial h_o}{\partial t} + u \frac{\partial h_o}{\partial r} + h_o \frac{\partial u}{\partial r} = 0$$ \hspace{1cm} (7.07)

$$\frac{\partial h_z}{\partial t} + u \frac{\partial h_z}{\partial r} + h_z \frac{\partial u}{\partial r} = 0$$ \hspace{1cm} (7.08)

Where $\rho$, $u$, $p$, $h_o$, $h_z$, $\gamma$, $m$ are the density, velocity, pressure, azimuthal magnetic field, transverse magnetic field and ratio of specific heats of the gas, mass respectively.

We introduce the similarity variable $\eta = \frac{r}{R(t)}$ and take the solution of fundamental equation in the form

$$u = \dot{R} V (\eta)$$ \hspace{1cm} (7.09)

$$\rho = \rho_o D (\eta)$$ \hspace{1cm} (7.10)

$$p = \rho_o \dot{R}^2 P (\eta)$$ \hspace{1cm} (7.11)
\[ h_\theta = \sqrt{\rho_0} \hat{R} H_\theta (\eta) \]  \hspace{1cm} (7.12)

\[ h_z = \sqrt{\rho_0} \hat{R} H_z (\eta) \]  \hspace{1cm} (7.13)

where \( V, D, P, H_\theta, H_z \) are functions of \( \eta \) only and \( \dot{R} = \frac{dR}{dt} \) the shock velocity.

The jump condition for a shock wave (cf summer & Whitworth [13]) are

\[ u_1 = \frac{2\dot{R}}{(\gamma + 1)} \]  \hspace{1cm} (7.14)

\[ p_1 = \frac{2\rho_0 \dot{R}^2}{(\gamma + 1)} \]  \hspace{1cm} (7.15)

\[ \rho_1 = \frac{(\gamma + 1)\rho_0}{(\gamma - 1)} \]  \hspace{1cm} (7.16)

\[ h_{\theta 1} = \frac{(\gamma + 1)}{(\gamma - 1)} h_{\theta 0} \]  \hspace{1cm} (7.17)

\[ h_{z 1} = \frac{(\gamma + 1)}{(\gamma - 1)} h_{z 0} \]  \hspace{1cm} (7.18)

where suffix 1 denotes the volumes of flow variables immediately behind the shock front.

**SOLUTION OF EQUATION OF MOTION**

By Equation (7.01)

\[ \frac{\partial p}{\partial t} + u \frac{\partial p}{\partial r} + \rho \frac{\partial u}{\partial r} = 0 \]  \hspace{1cm} (7.01)

By condition (7.09)

\[ u = \dot{R} V(\eta) \]

\[ \frac{\partial u}{\partial r} = \dot{R} V \frac{\partial \eta}{\partial r} \]

\[ \therefore \eta = \frac{r}{R(t)} \]

\[ \frac{\partial \eta}{\partial r} = \frac{1}{R} \]
\[ \frac{\partial \eta}{\partial r} = \frac{\eta}{r} \]

\[ \frac{\partial u}{\partial r} = \dot{R} \nu' \frac{\eta}{r} \]

\[ \eta = \frac{r}{R(t)} \]

\[ \frac{\partial \eta}{\partial t} = -\frac{\eta}{R} \dot{R} \]

By condition (7.10)

\[ \frac{\partial \rho}{\partial t} = \rho_0 D' \frac{\partial \eta}{\partial t} \]

\[ \frac{\partial \rho}{\partial t} = -\rho_0 D' \frac{\eta}{R} \dot{R} \]

By condition (7.10)

\[ \rho = \rho_0 D'(\eta) \]

\[ \frac{\partial \rho}{\partial r} = \rho_0 D' \frac{\partial \eta}{\partial r} + D \frac{\partial \rho_0}{\partial r} \]

\[ \frac{\partial \rho}{\partial r} = \frac{\rho_0}{R} \left[ \frac{D' + \frac{D\beta}{\eta}}{\eta} \right] \]

By condition (7.02)

\[ \rho_0 = b r^{d'} \]

\[ \frac{\partial \rho_0}{\partial r} = \frac{\beta (b r^d)}{r} \]

\[ \frac{\partial \rho_0}{\partial r} = \frac{\beta \rho_0}{r} \]

\[ \frac{\partial \rho_0}{\partial r} = \frac{\beta \rho_0 \eta}{R} \]

Substituting these values in equation (7.01)

\[ -\rho_0 D' \frac{\eta}{R} \dot{R} + V \dot{R} \frac{\rho_0}{R} \left[ D' + \frac{D\beta}{\eta} \right] + \rho_0 \dot{R} \nu' \frac{\eta}{r} = 0 \]
\[-\rho_0 \frac{D' \eta}{R} + \frac{V}{R} \left[ D' + \frac{D\beta}{\eta} \right] + \frac{DV'}{\eta R} = 0 \]

\[-D' \eta + V \left[ D' + \frac{D\beta}{\eta} \right] + DV' = 0 \]

\[-\eta + V \right] D' \left[ \frac{V\beta}{\eta} + V' \right] D = 0 \quad (7.19) \]

By equation (7.05)

\[\frac{\partial p}{\partial t} + u \frac{\partial p}{\partial r} - \frac{\gamma p}{\rho} \left( \frac{\partial p}{\partial t} + u \frac{\partial p}{\partial r} \right) = 0 \]

By Condition (7.11)

\[p = \rho_0 \hat{R}^2 \left( \eta \right) \]

\[\frac{\partial p}{\partial r} = \frac{\rho_0}{R} \left[ D' + \frac{D\beta}{\eta} \right] \]

Substituting these values in equation (7.05), we get

\[\frac{\hat{R}^2 \rho_0}{R} \left[ -p_0 + 2 \frac{\mu - 1}{\mu} \right] + \frac{\hat{R} V \rho_0 \hat{R}^2}{R} \left[ -p_0 + \frac{P' \beta}{\eta} \right] - \frac{\gamma \rho_0 \hat{R}^2 p}{\rho_0 \hat{R}^2} - \frac{\rho_0 \hat{R}^2 \eta}{R} + \frac{V \hat{R} \rho_0}{R} \left[ D' + \frac{D\beta}{\eta} \right] = 0 \]

\[(V - \eta) P' + 2 \frac{\mu - 1}{\mu} \left[ \frac{\beta V}{\eta} + \frac{2(\mu - 1)}{\mu} \right] p - \frac{\gamma p}{D} \left[ (V - \eta) D' + \frac{\beta D V'}{\eta} \right] = 0 \quad (7.20) \]

Now, taking equation (7.06)

\[\frac{\partial u}{\partial t} + u \frac{\partial u}{\partial r} + \frac{1}{\rho} \frac{\partial p}{\partial r} + \left( h_0 + h_2 \right) \frac{\partial}{\partial r} \left( h_0 r + h_2 r \right) = 0 \]

By condition (7.09)

\[u = \hat{R} V \left( \eta \right) \]

\[\frac{\partial u}{\partial r} = \hat{R} V' \]

\[\frac{\partial \rho}{\partial t} = \sqrt{\rho_0} \left[ p' \frac{\partial \eta}{\partial t} \hat{R}^2 + 2 \hat{R} \hat{R} p \right] \]

\[= \sqrt{\rho_0} \left[ p' \left( -\frac{\eta \hat{R}}{R} \right) \hat{R}^2 + 2 \hat{R} \hat{R} p \right] \]

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By condition (7.01)
$$\mathbb{R} = A t^\mu$$
$$\dot{\mathbb{R}} = \mu A t^{\mu-1}$$
$$\ddot{\mathbb{R}} = \mu (\mu - 1) A t^{\mu-2}$$
$$\dddot{\mathbb{R}} = \frac{\mu - 1}{\mu} \dddot{\mathbb{R}} \mathbb{R}^2$$

Then
$$\frac{\partial P}{\partial t} = \sqrt{\rho_0} \left[ - \frac{P' \sqrt{\mathbb{R}}}{\mathbb{R}} \mathbb{R}^2 + 2 \mathbb{R} \frac{(\mu - 1)}{\mu} \mathbb{R}^2 P \right]$$
$$\frac{\partial P}{\partial t} = \frac{\dot{\mathbb{R}}^2 \rho_0}{R} \left[ - P' \eta + 2 P \frac{(\mu - 1)}{\mu} \right]$$

again, by condition (7.11)
$$P = \rho_0 \dot{\mathbb{R}} \mathbb{R}^2 P$$

$$\frac{\partial P}{\partial \tau} = \dot{\mathbb{R}} \left[ P \frac{\partial \rho_0}{\partial \tau} + P' \frac{\partial \eta}{\partial \tau} \rho_0 \right]$$

$$\frac{\partial P}{\partial \tau} = \frac{\dot{\mathbb{R}}^2 \rho_0}{R} \left[ \frac{P \beta}{\eta} + P' \right]$$

$$\frac{\partial P}{\partial t} = \rho_0 D' \frac{\eta}{R} \dot{\mathbb{R}}$$

$$\frac{\partial u}{\partial \tau} = \left[ \dot{\mathbb{R}} V' \frac{\partial \eta}{\partial \tau} + V \frac{\partial \dot{\mathbb{R}}}{\partial \tau} \right]$$

$$\frac{\partial u}{\partial t} = \left[ \dot{\mathbb{R}} V \left( - \frac{\eta}{R} \right) + V \frac{(\mu - 1)}{\mu} \dddot{\mathbb{R}} \mathbb{R}^2 \right]$$

$$\frac{\partial u}{\partial t} = \frac{\dot{\mathbb{R}}^2}{R} \left[ - \eta V' + V \frac{(\mu - 1)}{\mu} \right]$$

By condition (7.12)
$$h_\theta = \sqrt{\rho_0} \dot{\mathbb{R}} H_\theta (\eta)$$

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\[
\frac{\partial h_0}{\partial r} = \hat{R} \left[ H_0 \frac{\partial \rho}{\partial r} \sqrt{\rho_o} + H_0 \frac{\partial \rho_o^{1/2}}{\partial r} \right]
\]

\[
= \hat{R} \left[ H_0 \frac{\sqrt{\rho_o}}{R} + \frac{H_0 \beta}{2\eta} \sqrt{\rho_o} \right]
\]

\[
\frac{\partial h_u}{\partial r} = \frac{\hat{R} \sqrt{\rho_o}}{R} \left( H'_0 + \frac{H_0 \beta}{2\eta} \right)
\]

again, by condition (7.13)

\[
h_z = \sqrt{\rho_u} \hat{R} H_z (\eta)
\]

\[
\frac{\partial h_z}{\partial r} = \hat{R} \left[ \sqrt{\rho_u} H'_z + H_z \frac{\partial}{\partial r} \frac{\rho_o^i}{\rho} \right]
\]

\[
\frac{\partial h_z}{\partial r} = \frac{\hat{R} \sqrt{\rho_o}}{R} \left[ H'_z + \frac{H_z \beta}{2\eta} \right]
\]

By condition (7.11)

\[
\hat{R} = \frac{\rho_o}{\rho} \hat{R}^2 \hat{P} (\eta)
\]

\[
\frac{\partial \hat{P}}{\partial r} = \frac{\rho_o \hat{R}^2}{R} \left[ \hat{P}' + \frac{\hat{P} \beta}{\eta} \right]
\]

substituting these values in this equation

\[
\frac{\partial u}{\partial t} + u \frac{\partial u}{\partial r} + \frac{1}{\rho} \frac{\partial P}{\partial r} + \left( \frac{h_0 + h_z}{\rho} \right) \left( \frac{\partial h_0}{\partial r} + \frac{\partial h_z}{\partial r} \right) + \frac{(h_o + h_z)^2}{\rho r} = 0
\]

so, we get

\[
\frac{\hat{R}^2}{R} \left[ -\eta \hat{V}^2 + \frac{V}{\mu} \left( \frac{\mu - 1}{\mu} \right) \right] + \frac{\hat{R} \hat{V} \cdot \hat{V}'}{R} + \frac{\rho_o \hat{R}^2}{\rho_o D R} \left[ \hat{P}' + \frac{\hat{P} \beta}{\eta} \right]
\]

\[
+ \frac{\sqrt{\rho_o} \hat{R} \left[ H_0 + H_z \right]}{\rho_o D} \left[ \frac{(H_0 + H_z) \beta}{2\eta} + \frac{(H'_0 + H'_z) \beta}{2\eta} \right] \frac{\hat{R} \sqrt{\rho_o}}{R} + \frac{(H_0 + H_z)^2}{\rho_o D \eta R} \rho_o \hat{R}^2 = 0
\]

\[
-\eta \hat{V}^2 + \frac{V}{\mu} \left( \frac{\mu - 1}{\mu} \right) + \frac{1}{D} \left[ \hat{P}' + \frac{\hat{P} \beta}{\eta} \right] + \left( \frac{H_0 + H_z}{\rho} \right) \left[ \frac{(H'_0 + H'_z) \beta}{2\eta} \right] + \frac{(H_0 + H_z)^2}{D \eta} = 0
\]

(7.21)

Using equation (7.07)
\[
\frac{\partial h_0}{\partial t} + u \frac{\partial h_0}{\partial r} + h_0 \frac{\partial u}{\partial r} = 0
\]  
(7.7)

By condition (7.12)

\[
h_0 = \sqrt{\rho_0} \hat{R} H_0 (\eta)
\]

\[
\frac{\partial h_0}{\partial t} = \sqrt{\rho_0} \left[ H'_0 \frac{\partial \eta}{\partial t} \hat{R} + H_0 \hat{R} \right]
\]

\[
= \sqrt{\rho_0} \left[ H'_0 \frac{-\eta}{R} \hat{R} + H_0 \frac{(\mu - 1) \hat{R}^2}{\mu R} \right]
\]

\[
\frac{\partial H_0}{\partial t} = \sqrt{\rho_0} \frac{\hat{R}^2}{R} \left[ -\eta H'_0 + \frac{(\mu - 1)}{\mu} H_0 \right]
\]

again, \( h_0 = \sqrt{\rho_0} \hat{R} \overline{H}_0 (\eta) \)

\[
\frac{\partial h_0}{\partial r} = \hat{R} \left[ H'_0 \frac{\partial \eta}{\partial r} \sqrt{\rho_0} + H_0 \frac{\partial \rho_0}{\partial r} \right]
\]

\[
\hat{R} \left[ H'_0 \frac{\rho_0}{R} + \frac{H_0 \beta}{2 \eta R} \sqrt{\rho_0} \right]
\]

\[
\frac{\partial h_0}{\partial r} = \hat{R} \sqrt{\rho_0} \left[ H'_0 + \frac{H_0 \beta}{2 \eta} \right]
\]

By condition (7.09)

\[
u = \hat{R} V(\eta)
\]

\[
\frac{\partial u}{\partial r} = \hat{R} V' \frac{\partial \eta}{\partial r}
\]

\[
\frac{\partial u}{\partial r} = \frac{\hat{R} V'}{R}
\]

substituting these values in eq. (7.07) we get

\[
\sqrt{\rho_0} \frac{\hat{R}^2}{R} \left[ -\eta H'_0 + \frac{(\mu - 1)}{\mu} H_0 + \frac{\hat{R} V \hat{R} \sqrt{\rho_0}}{R} \left[ H'_0 + \frac{H_0 \beta}{2 \eta} \right] + \sqrt{\rho_0} \hat{R} H_0 \frac{\hat{R} V'}{R} = 0
\]

\[-\eta H'_0 + \frac{(\mu - 1)}{\mu} H_0 + H'_0 V + \frac{V H_0 \beta}{2 \eta} + V' H_0 = 0
\]
\[(\nu - \eta) H_\nu' + \left[ \frac{(\eta - 1)}{\mu} + \frac{V\beta}{2\eta} + V' \right] H_\nu = 0 \]  

(7.22)

By equation (7.08)

\[
\frac{\partial h_z}{\partial t} + u \frac{\partial h_z}{\partial \tau} + h_z \frac{\partial u}{\partial \tau} = 0
\]

By condition (7.13)

\[h_z = \sqrt{\rho_0} \, \hat{R} \, H_z (\eta)\]

\[\frac{\partial h_z}{\partial t} = \sqrt{\rho_0} \left[ H_z' \frac{\partial \eta}{\partial \tau} \hat{R} + H_z \frac{\partial \eta}{\partial \tau} \hat{R} \right] \]

\[= \sqrt{\rho_0} \left[ H_z' \frac{\partial \eta}{\partial \tau} \hat{R} + H_z \frac{(\eta - 1) \hat{R}^2}{\mu \hat{R}} \right] \]

\[\frac{\partial h_z}{\partial \tau} = \sqrt{\rho_0} \frac{\hat{R}^2}{\hat{R}} \left[ -\eta H_z' + \frac{(\eta - 1)}{\mu} H_z \right] \]

again \[h_z = \sqrt{\rho_0} \, \hat{R} \, H_z (\eta)\]

\[\frac{\partial h_z}{\partial \tau} = \hat{R} \left[ H_z' \frac{\partial \eta}{\partial \tau} \sqrt{\rho_0} + H_z \frac{\partial \eta}{\partial \tau} \rho_0' \right] \]

\[= \hat{R} \left[ H_z' \sqrt{\rho_0} + H_z \beta \sqrt{\rho_0} \right] \]

\[\frac{\partial h_z}{\partial \tau} = \frac{\hat{R} \sqrt{\rho_0}}{\hat{R}} \left[ H_z' + H_z \beta \frac{\partial \rho_0}{\partial \tau} \right] \]

By equation (7.09)

\[u = \hat{R} \, V (\eta)\]

\[\frac{\partial u}{\partial \tau} = \hat{R} \, V' \frac{\partial \eta}{\partial \tau} \]

\[\frac{\partial u}{\partial \tau} = \frac{\hat{R} V'}{\hat{R}} \]

Substituting these values in equation (7.08)
\[ \sqrt{\rho_0} \frac{\dot{R}^2}{R} \left[ -\eta H_z + \frac{(\mu - 1)}{\mu} H_z \right] + \frac{\dot{R}V \sqrt{\rho_0}}{R} \left[ (H_z + \frac{H_z \beta}{2\eta}) \right] + \sqrt{\rho_0} \frac{\dot{R}}{R} H_z \frac{\dot{R}V'}{R} = 0 \]

\[-\eta H_z + \frac{(\mu - 1)}{\mu} H_z + H_z V + \frac{VH_z \beta}{2\eta} + V' H_z = 0 \]

\[(V - \eta) H_z' + \left[ \frac{(\mu - 1)}{\mu} + \frac{V\beta}{2\eta} + V' \right] H_z = 0 \quad (7.23)\]

Equation (7.19-7.22) can be reduced in new form

\[ D' = \frac{1}{(V - \eta)} \left[ \frac{V\beta}{\eta} + V' \right] D \quad (7.24) \]

\[ P' = \frac{1}{(V - \eta)} \left[ \frac{\beta V}{\eta} + \frac{2(\mu - 1)}{\mu} \right] P + \gamma PV' \quad (7.25) \]

\[ H_z' = \frac{-1}{(V - \eta)} \left[ H_z V' + H_z \frac{(\mu - 1)}{\mu} + \frac{VH_z \beta}{2\eta} \right] \quad (7.26) \]

\[ H_o' = \frac{-1}{(V - \eta)} \left[ H_o V' + \left[ \frac{(\mu - 1)}{\mu} + \frac{V\beta}{2\eta} \right] H_o \right] \quad (7.27) \]

\[ V' = \left[ \beta \left( P + \frac{(H_o + H_z)^2}{2} \right) \frac{V}{\eta} - \frac{(\mu - 1)}{\mu} (V D (V - \eta) - 2P) - (H_o + H_z)^2 \right] \]

\[ - \frac{P}{\frac{\beta (V - \eta)}{\eta} - \frac{\gamma (2+\beta) V}{2} + \frac{V}{\eta}} \left( H_o + H_z \right)^2 \left( \frac{V}{\eta} - \frac{\beta (V - \eta)}{2\eta} - \frac{V - \eta}{\eta} \right) \]

\[ \left[ D (V - \eta)^2 - \gamma P + (H_o + H_z)^2 \right]^{-1} \quad (7.28) \]

Now shock condition 7.14-7.18 are transformed into following form by condition (7.09) and (7.14)

\[ u = \frac{2\dot{R}}{\gamma+1} \]

\[ \dot{R} V(\eta) = \frac{2\dot{R}}{\gamma+1} \]

at \( \eta = 1 \)
\[ V(1) = \frac{2}{(\gamma + 1)} \quad (7.29) \]

By condition (7.11) & (7.15)

\[ P_1 = \frac{2\rho_\eta \, \hat{R}^2}{(\gamma + 1)} \]

\[ \rho_\eta \, R^2 \, P(\eta) = \frac{2\rho_\eta \, \hat{R}^2}{(\gamma + 1)} \]

at \( \eta = 1 \)

\[ P(1) = \frac{2}{(\gamma + 1)} \quad (7.30) \]

When the magnetic field is weak J.B. Singh and S.K. Pandey [13].

\[ \frac{\rho_1}{\rho_\eta} = \frac{(\gamma + 1)}{(\gamma - 1)} \quad (7.31) \]

Which is purely non magnetic By condition (7.10), (7.16) and (7.31)

\[ \rho_1 = \frac{(\gamma + 1)}{(\gamma - 1)} \rho_\eta \]

\[ \rho_\eta \, D(\eta) = \frac{(\gamma + 1)}{(\gamma - 1)} \rho_\eta \]

at \( \eta = 1 \)

\[ D(1) = 1 \quad (7.32) \]

By condition (7.12) and (7.17), (7.31)

\[ h_{w1} = \frac{(\gamma + 1)}{(\gamma - 1)} h_{w\eta} \]

at \( \eta = 1 \)

\[ H_0(1) = 1 \quad (7.33) \]

By condition (7.13), (7.18) & (7.31)

\[ h_{11} = \frac{(\gamma + 1)}{(\gamma - 1)} h_{22} \]

\( \eta = 1 \)

\[ H_z(1) = 1 \quad (7.34) \]
And appropriate shock condition are

\[ V(t) = \frac{2}{(\gamma+1)} \]  \hspace{1cm} (7.29)

\[ P(t) = \frac{2}{(\gamma+1)} \]  \hspace{1cm} (7.31)

\[ D(t) = 1 \]  \hspace{1cm} (7.32)

\[ H_x(t) = 1 \]  \hspace{1cm} (7.33)

\[ H_0(t) = 1 \]  \hspace{1cm} (7.34)

RESULT AND DISCUSSION

The numerical result for certain choice of parameters are in tabular form. The nature of field variables is illustrated through tables for following sets of parameter. \( \gamma = 4/3, 7/5, b = 3, \mu = 0.7, \beta = 0.4. \) It is obvious from table that velocity, density, and magnetic fields increase as we move towards the point of explosion while the pressure decrease as we approach towards the centre. The variation in flow variable is negligible for different value of \( \gamma. \)
### Table 7.1

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<th>( D )</th>
<th>( P )</th>
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References