Mach number! -

$$M = \frac{V}{C} = \frac{\text{velocity at a point in a fluid}}{\text{velocity of sound at that point at a given instant of time}}$$

For - $M < 0.3$ — incompressible.

$.3 < M < .8 \rightarrow$ Subsonic flow

$.8 < M < 1.2$ — transonic [infact $M = 1$ - sonic flow].

$1.2 < M < 5$ — Supersonic flow

$5 < M < 11$ — hypersonic flow

$M > 11$ — hyper velocity flow.

1) $M < 1$ $(V < C)$ — subsonic.

ii) $M = 1$ $(V = C)$ - Sonic.

iii) $M > 1$ $(V > C)$ - supersonic

Mach Cone :- when the point source moves with a velocity greater than sound speed, It will move ahead of the disturbance. The wave front in such case form a conical surface tangential to wavefronts known as Mach cone.

The half angle of the mach cone is known as mach angle.

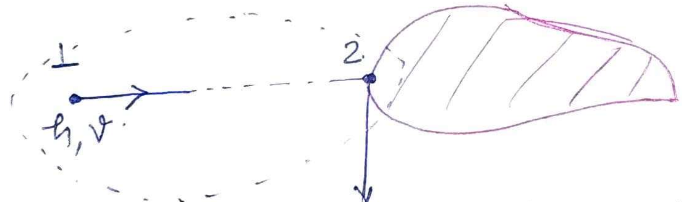
$$\sin\alpha = \frac{ct}{vt} = \frac{c}{v} = \frac{1}{M}.$$

The region inside the mach cone is known as Zone of action, whereas the region outside is termed as Zone of silence.

Stagnation properties! The point on a immersed body, where the velocity is zero is called stagnation point. The value of pressure, temp., density at stagnation point are called stagnation properties.

no heat interaction

no work interaction



$v=0$ Stationary body.

$h_1 = h,\ v_1 = v,\ z_1 = z$, $h_2 = h_0,\ v_2 = 0,\ z_2 = z.$

According to S.F.E.E.

$$\overset{0}{q} = \overset{0}{w_{cv}} + \Delta ke + \overset{0}{\Delta pe} + \Delta h$$

$$\Delta h + \Delta K.E. = 0.$$

$$h_0 = h + \frac{V^2}{2}$$ adiabatic flow

$\uparrow$ Stagnation enthalpy (SP.)

Stagnation temp.

$$h_0 = h + \frac{V^2}{2} \Rightarrow \underline{h_0 - h} = \frac{V^2}{2}.$$

For perfect gas - $\Delta h = C_p . \Delta T.$

$$C_p (T_0 - T) = \frac{V^2}{2}.$$

$$C_p = \frac{R \gamma}{\gamma - 1}$$

$$\frac{R . \gamma}{(\gamma - 1)} (T_0 - T) = \frac{V^2}{2}.$$

$$C_V = \frac{R}{\gamma - 1}$$

$$\frac{R . \gamma . T}{(\gamma - 1)} \left(\frac{T_0}{T} - 1 \right) = \frac{V^2}{2}$$

$$c = \sqrt{\gamma . RT}$$

$$c^2 = \gamma . RT.$$

$$\frac{c^2}{(\gamma - 1)} \left(\frac{T_0}{T} - 1 \right) = \frac{V^2}{2}$$

$$\left(\frac{T_0}{T} - 1 \right) = \frac{\gamma - 1}{c^2} . \frac{V^2}{2}.$$

$$M = \frac{V}{c}$$

$$\frac{T_0}{T} - 1 = \frac{\gamma - 1}{2} . M^2$$

$$\frac{T_0}{T} = 1 + \frac{\gamma - 1}{2} M^2 \quad (x)$$

$$\boxed{T_0 = T \left[1 + \frac{\gamma - 1}{2} M^2 \right].}$$