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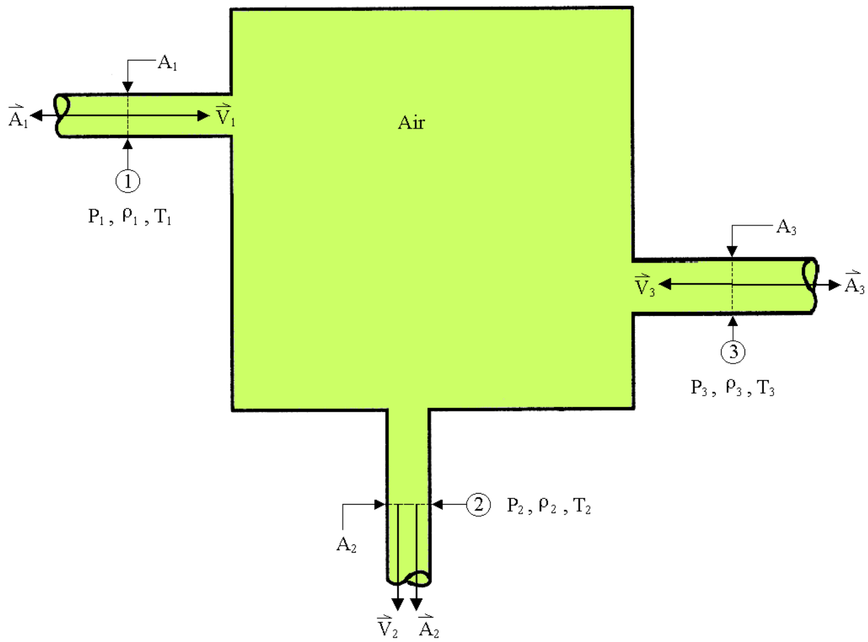
Case 6: **Multiple Entries, Compressible, Unsteady Flow**

Now consider case 5 but with air instead of water. One obvious difference between this flow and the one in the previous two cases is that air (as well as any other gas) will fill out the entire volume of the tank regardless of its mass, adjusting its density in the process.



We can use eq.(1) in case 5 again as our starting point:

$$\dot{m}_{in} - \dot{m}_{out} = \frac{d\left(m_{cv}\right)}{dt} \qquad (1)$$

but we must now keep the density as a variable:

$$- r_1 V_1 A_1 - r_2 V_2 A_2 + r_3 V_3 A_3 = \frac{d\left(m_{air-in-\tan k}\right)}{dt} = \forall_{\tan k} \frac{dr_{air-in-\tan k}}{dt} \qquad (2)$$

allowing for the fact that each stream may have a different density as a result of differences in temperature and / or pressure.
Generalizing eq.(2) as before we get:

Continuity eq. for **unsteady**, **compressible, 1-D** (or **quasi 1-D**) flow for a control volume with **multiple entries**

$$\boxed{\sum_{C.S.} r\vec{V}\cdot\vec{A} = -\frac{d\left(r\forall_{cv}\right)}{dt}} \quad (3)$$