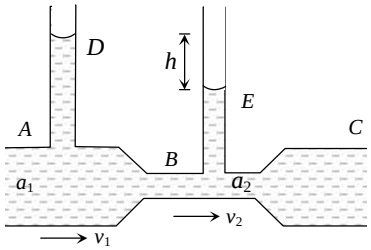
Venturimeter

It is a device based on Bernoulli's theorem used for measuring the rate of flow of liquid through pipes.

It consists of two identical coaxial tubes *A* and *C* connected by a narrow co-axial tube *B*. Two vertical tubes *D* and *E* are mounted on the tubes *A* and *B* to measure the pressure of the flowing liquid.



When the liquid flows in the tube *ABC*, the velocity of flow in part *B* will be larger than in the tube *A* or *C*. So the pressure in part *B* will be less than that in tube *A* or *C*. By measuring the pressure difference between *A* and *B*, the rate of flow of the liquid in the tube can be calculated.

Let a_1 and a_2 are area of cross section of tube A and B respectively

$v_1, v_2 =$ Velocity of flow of liquid through A and B respectively

$P_1, P_2 =$ Liquid pressure at A and B respectively

$\therefore \; P_1 - P_2 = h\rho g$ …(i) [ρ = density of flowing liquid]

From Bernoulli's theorem for horizontal flow of liquid

$$P_1 + \frac{1}{2}\rho v_1^2 = P_2 + \frac{1}{2}\rho v_2^2$$

$$P_1 - P_2 = \frac{1}{2}\rho(v_2^2 - v_1^2) \quad \ldots(ii)$$

From (i) and (ii) $h\rho g = \frac{1}{2}\rho(v_2^2 - v_1^2) = \frac{1}{2}\rho\left[\frac{V^2}{a_2^2} - \frac{V^2}{a_1^2}\right]$ [As $V = a_1v_1 = a_2v_2$]

$\therefore \quad V^2 = \frac{2a_1^2a_2^2hg}{a_1^2 - a_2^2}$ or $V = a_1a_2\sqrt{\frac{2hg}{a_1^2 - a_2^2}}$