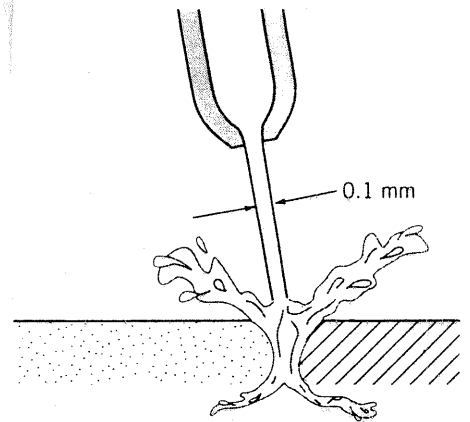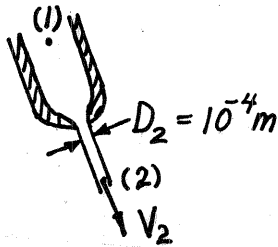3.26   Small-diameter, high-pressure liquid jets can be used to cut various materials as shown in Fig. P3.26. If viscous effects are negligible, estimate the pressure needed to produce a 0.10-mm-diameter water jet with a speed of 700 m/s. Determine the flowrate.

■ FIGURE P3.26

$$\frac{p_1}{\gamma} + \frac{V_1^2}{2g} + z_1 = \frac{p_2}{\gamma} + \frac{V_2^2}{2g} + z_2 \quad \text{where } V_1 \approx 0, \ z_1 \approx z_2, \text{ and } p_2 = 0$$

$$\text{Thus} \quad p_1 = \frac{1}{2}\frac{\gamma}{g}V_2^2 = \frac{1}{2}\rho V_2^2 = \frac{1}{2}\left(999 \frac{kg}{m^3}\right)\left(700 \frac{m}{s}\right)^2 = \underline{\underline{2.45 \times 10^5 \frac{kN}{m^2}}}$$

Also,

$$Q = V_2 A_2 = 700 \frac{m}{s}\left[\frac{\pi}{4}\left(10^{-4} m\right)^2\right] = \underline{\underline{5.50 \times 10^{-6} \frac{m^3}{s}}}$$