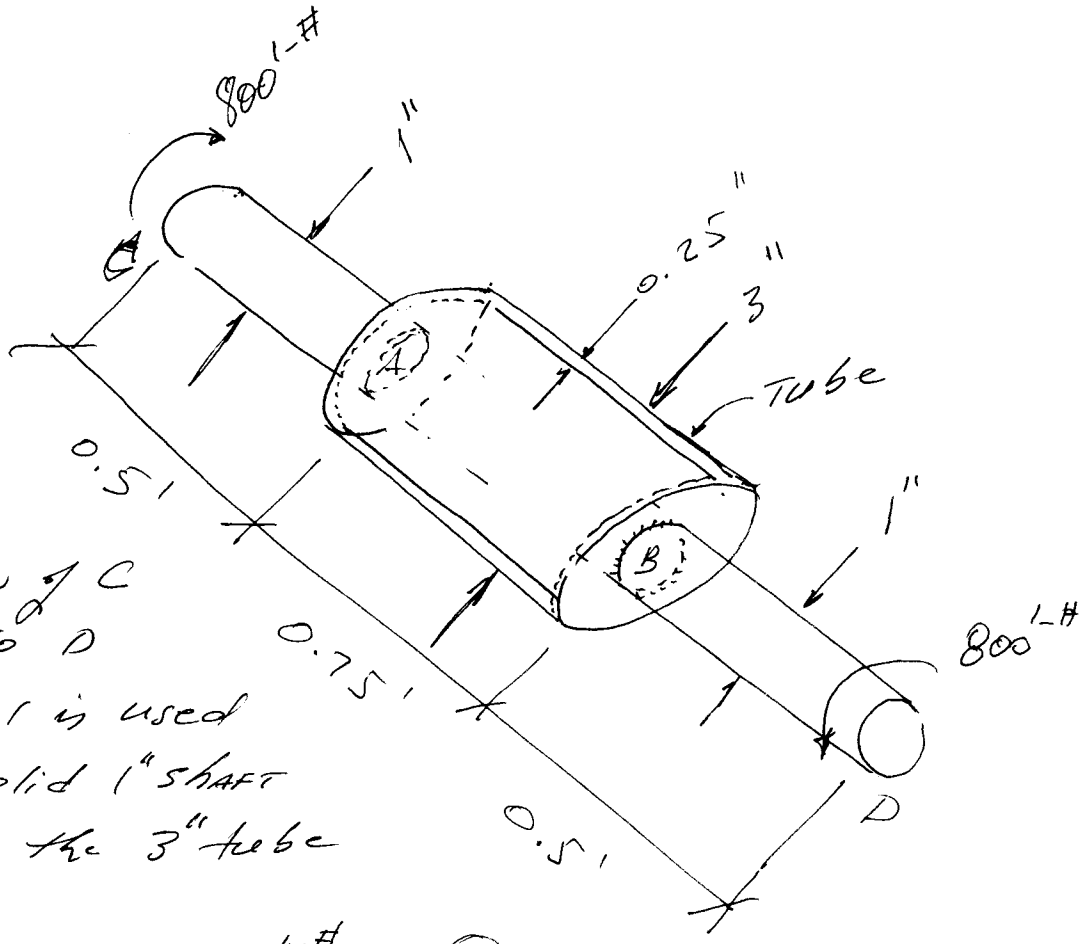


Determine
The Rotation of C
Relative to D
A-36 steel is used
for the solid 1" shaft
as well as the 3" tube

$$T_{BAR} + T_{Tube} = 800^{l-\#} \quad (1)$$

$$\left(\phi_{A/B}\right)_{BAR} = \left(\phi_{A/B}\right)_{Tube}$$

$$\frac{T_{BAR} \cdot (0.75)(12)}{G\left(\frac{\pi}{2}\right)(.5)^4} = \frac{T_{Tube} \times 0.75 \times 12}{G \cdot \frac{\pi}{2}(1.5^4 - 1.25^4)}$$

$$\therefore T_{BAR} = 0.238\, T_{Tube} \quad (2)$$

Substitute (2) into (1) and solve

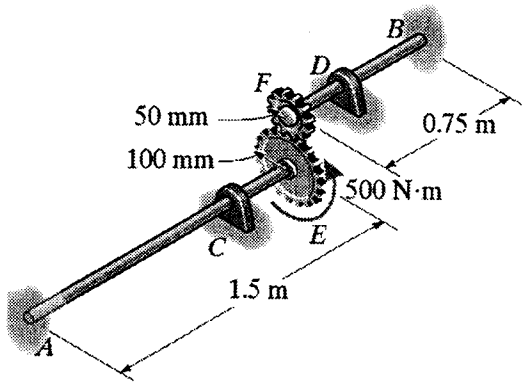
$$T_{BAR} = 18.6^{l-\#} \qquad T_{Tube} = 781.4^{l-\#}$$

$$\phi_{C/D} = +\frac{800 \times 12 \times 0.5 \times 12}{G\left(\frac{\pi}{2}\right)(.5^4)} + \frac{18.6 \times 12 \times .75 \times 12}{G \cdot \frac{\pi}{2}(.5)^4} + \frac{800 \times 12 \times .5 \times 12}{G \times \frac{\pi}{2} \times 0.5^4}$$

$G = 11 \times 10^6$ psi

$$\therefore \phi_{C/D} = 0.1085 \text{ Rad} \text{ or } 6.2^{\circ}$$

5–81. The two shafts are made of A-36 steel. Each has a diameter of 25 mm and they are connected using the gears fixed to their ends. Their other ends are attached to fixed supports at A and B. They are also supported by journal bearings at C and D, which allow free rotation of the shafts along their axes. If a torque of $500\ \text{N}\cdot\text{m}$ is applied to the gear at E as shown, determine the reactions at A and B.



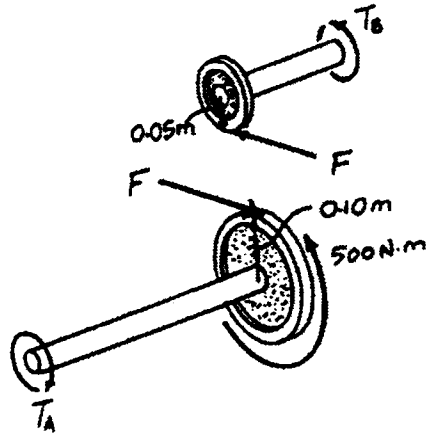
Equilibrium :

$$T_A + F(0.1) - 500 = 0 \qquad [1]$$

$$T_B - F(0.05) = 0 \qquad [2]$$

From Eqs. [1] and [2]

$$T_A + 2T_B - 500 = 0 \qquad [3]$$



Compatibility :

$$0.1\phi_E = 0.05\phi_F$$

$$\phi_E = 0.5\phi_F$$

$$\frac{T_A(1.5)}{JG} = 0.5\left[\frac{T_B(0.75)}{JG}\right]$$

$$T_A = 0.250T_B \qquad [4]$$

Solving Eqs. [3] and [4] yields :

$$T_B = 222\ \text{N}\cdot\text{m} \qquad \textbf{Ans}$$

$$T_A = 55.6\ \text{N}\cdot\text{m} \qquad \textbf{Ans}$$