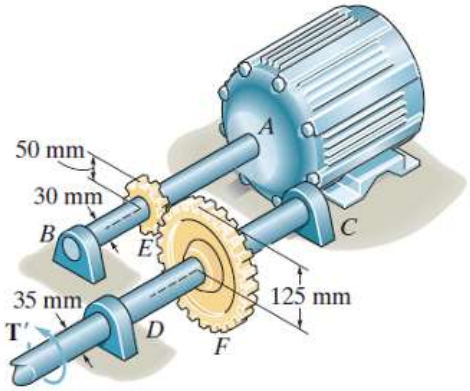
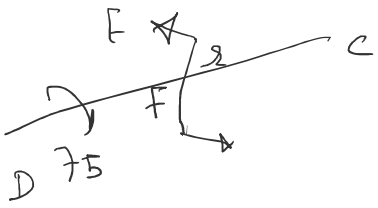
•5–13. If the applied torque on shaft CD is $T' = 75\ \text{N}\cdot\text{m}$, determine the absolute maximum shear stress in each shaft. The bearings B, C, and D allow free rotation of the shafts, and the motor holds the shafts fixed from rotating.

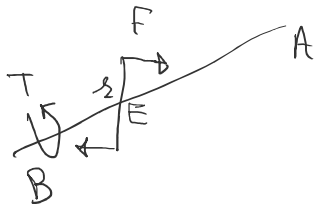




$\curvearrowleft \Sigma T = 0;\quad 75 - (F \times 2) = 0$

$$F = \frac{75}{2} = \frac{75\ \text{Nm}}{0.125\text{m}}$$

$$\Rightarrow F = 600\ \text{N}$$



$\curvearrowleft \Sigma T = 0$

$\Rightarrow F \times 2 - T = 0$

$2 = 0.05\ \text{m}$

$F = 600\ \text{N}$

$\Rightarrow 600 \times 0.05 = T$

$\Rightarrow T = 30\ \text{N}\cdot\text{m}$

Max Shear Stresses on AE & CD;

We know:

$$\frac{\tau_{max}}{R} = \frac{T_{max}}{J} \quad [\text{Torsion formula}]$$

$$\Rightarrow \tau_{AE,max} = \frac{T_{max,AE} \times R_{AE}}{J_{AE}} = \frac{30 \times 0.015}{\frac{\pi}{2} \times 0.015^4} = 5.66 \text{ MPa}$$

similarly:

$$\tau_{CD,max} = \frac{75 \times 0.0175}{\frac{\pi}{2} \times 0.0175^4} = 8.91 \text{ MPa}$$

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