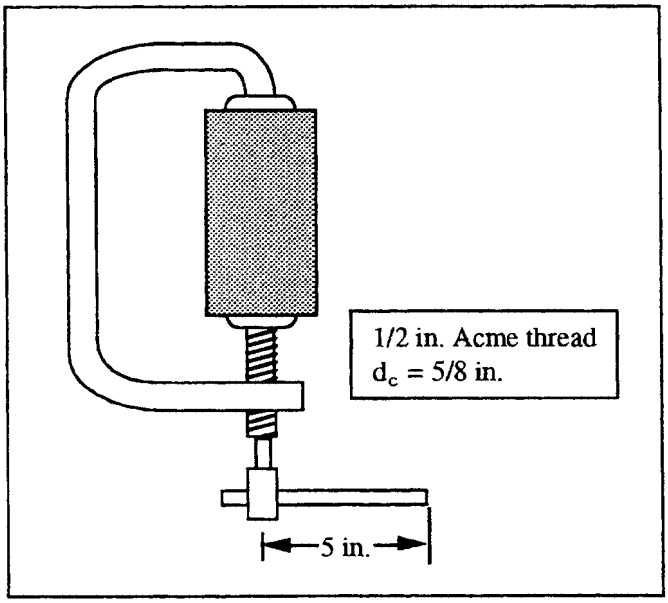
SOLUTION (10.9)

Known: An ordinary C-clamp uses a 1/2 in. Acme thread and a collar of 5/8 in. mean diameter.

Find: Estimate the force required at the end of a 5-in. handle to develop a 200 lb clamping force.

Schematic and Given Data:



Assumptions:

1. Coefficients of running friction are estimated as 0.15 for both the collar and the screw.
2. The screw has a single thread.

Analysis:

1. From section 10.3.1, and considering that service conditions may be conducive to relatively high friction, estimate $f = f_c \approx 0.15$ (for running friction).
2. From Table 10.3, p = 0.1 in., and with a single thread, L = 0.1 in.
3. From Fig. 10.4(a),

$$d_m = d - \frac{p}{2} = 0.5 - 0.05 = 0.45 \text{ in.}$$

$$\alpha = 14.5^\circ$$

From Eq. (10.1),

$$\lambda = \tan^{-1} \frac{L}{\pi d_m} = \tan^{-1} \frac{0.1}{\pi(0.45)} = 4.05^\circ$$

From Eq. (10.6),

$$\alpha_n = \tan^{-1} (\tan \alpha \cos \lambda) = \tan^{-1} (\tan 14.5^\circ \cos 4.05^\circ)$$
$$= 14.47^\circ$$

(Note: with $\lambda \approx 4^\circ$, it is obvious that $\alpha_n \approx \alpha$ and well within the accuracy of assumed friction coefficients)

4. From Eq. (10.4),

$$T = \frac{W d_m}{2}\left(\frac{f \pi d_m + L\cos \alpha_n}{\pi d_m \cos \alpha_n - f L}\right) + \frac{W f_c d_c}{2}$$

$$= \frac{(200)(0.45)}{2}\left(\frac{(0.15)\pi(0.45) + 0.1(\cos 14.47^\circ)}{\pi(0.45)(\cos 14.47^\circ) - (0.15)(0.1)}\right) + \frac{(200)(0.15)(0.625)}{2}$$

$$= 10.27 + 9.37 = 19.64 \text{ lb in.} \quad \text{Use } T \approx 20 \text{ lb in.}$$

At the end of a 5-in. handle, the clamping force required $\approx \frac{20}{5} = 4$ lb ■