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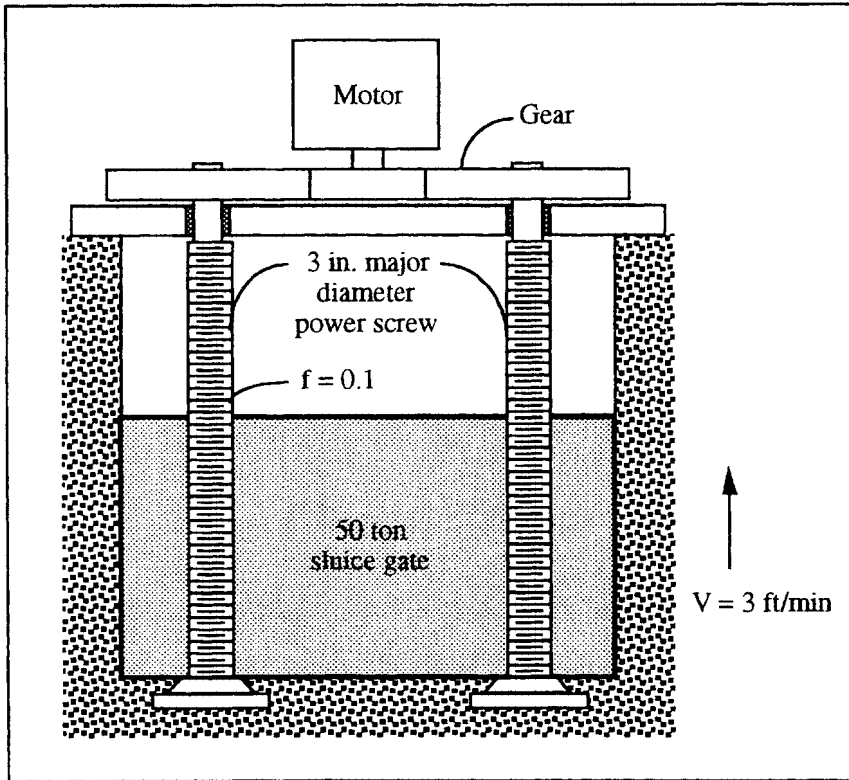
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**SOLUTION (10.10)**

**Known:** Two identical 3 in. major diameter screws (single threaded) with modified square threads are used to raise and lower a 50-ton sluice gate of a dam. An estimated friction coefficient is only 0.1 for the screw. Because of gate friction, each screw must provide a lifting force of 26 tons.

**Find:** Determine the power required to drive each screw when the gate is being raised at the rate of 3 ft/min. Also calculate the corresponding rotating speed of the screws.

**Schematic and Given Data:**



**Assumption:** Collar friction can be neglected.

**Analysis:**

1. From Table 10.3,  
 $p = L = 1/(1.75) = 0.571$  in.
2. From Fig. 10.4(d),

$$d_m = d - \frac{p}{2} = 3 - \frac{0.571}{2} = 2.71 \text{ in.}$$

and  $\alpha = 2.5^\circ$

3. Since  $\cos \alpha = 0.999$ , use Eq. (10.4a):

$$T = \frac{Wd_m}{2} \left( \frac{f\pi d_m + L}{\pi d_m - fL} \right) + \frac{Wf_c d_c}{2}$$

$$= \frac{(52,000)(2.71)}{2} \left( \frac{(0.1)\pi(2.71) + 0.571}{\pi(2.71) - (0.1)(0.571)} \right) + 0$$

$$= 11,851 \text{ lb in.} = 988 \text{ lb ft (during load raising)}$$

4. To raise the gate 36 in./min with  $L = 0.571$  in.  
 requires  $36/0.571 = 63.05 \approx 63$  rpm
5. From Fig. (1.3),

$$\dot{W} = \frac{(63.05)(988)}{5252} = 11.9 \text{ hp say 12 hp}$$

Therefore, 12 hp are required to drive each screw. ■

6. Check:

$$\begin{aligned}\text{Work output per gate} &= 52,000 \text{ lb (3 ft/min)} \\ &= 156,000 \text{ lb ft/min} = 4.73 \text{ hp}\end{aligned}$$

$$\lambda = \tan^{-1} \frac{L}{\pi d_m} = \tan^{-1} \frac{0.571}{\pi(2.71)} = 3.84^\circ$$

From Fig. 10.8,

$$\text{Efficiency} \approx 40 \%$$

$$\text{Thus, } \dot{W}_{\text{required}} \approx \frac{4.73}{0.4} = 11.83 \text{ hp}$$