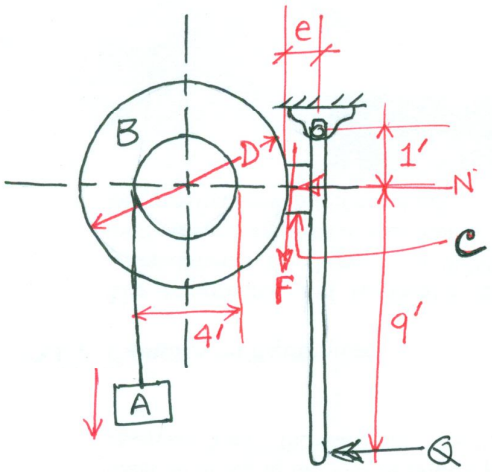
1420/P. 419



$W_B = 1288$ lb

$\bar{k}_B = 2.5$ ft

$\omega_{B0} = 120$ rpm $= \frac{120 \times 2\pi}{60}$

$= 4\pi$ rad/sec.

$S_A = 80$ ft

$v_{Af} = 0$

$W_A = 278$ lb

$Q = ?$

$D = 8'$

$f = \frac{1}{3}$

$e = 0$

Soln Let S_B be the distance that a point on the outer circle moved while A moved 80 ft downward.

$\therefore$ Angle travarsed, $\theta = \frac{S_A}{r_A} = \frac{S_B}{r_B}$

$\Rightarrow \frac{80}{2} = \frac{S_B}{4}$

$\therefore S_B = 160$ ft

For the entire system,

$U_{net} = W_A S_A - F \cdot S_B = 278 \times 80 - F \times 160 = 22240 - 160F$

$\Delta KE = \frac{1}{2} \cdot \frac{W_A}{g} \left(v_{Af}^2 - v_{A0}^2 \right) + \frac{1}{2} \bar{I}_B \left(\omega_{Bf}^2 - \omega_{B0}^2 \right)$

$= \frac{1}{2} \times \frac{278}{32.2} \left(0 - 64\pi^2 \right) + \frac{1}{2} \times 250 \left(0 - 16\pi^2 \right)$

$= -2726.71 - 19739.21$

$= -22465.92$ lb-ft

$v_{A0} = r_A \omega_{B0}$

$= 2 \times 4\pi$

$= 8\pi$ fps

$\bar{I}_B = m_B \bar{k}_B^2$

$= \frac{1288}{32.2} \times 2.5^2$

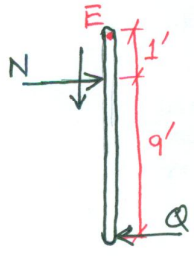
$= 250$ slug-ft^2

According to the principle of work and kinetic energy

$U_{net} = \Delta KE$

$\Rightarrow 22240 - 160F = -22465.92$

i.e. $F = 279.41$ lb



$N = \frac{F}{f} = \frac{279.41}{1/3} = 838.24$ lb

Taking $\sum M_E = 0$ $\circlearrowright$ +ve

$Q \times 10 - N \times 1 = 0$

$\Rightarrow Q \times 10 - 838.24 \times 1 = 0$

$\therefore Q = \boxed{83.82 \text{ lb}}$