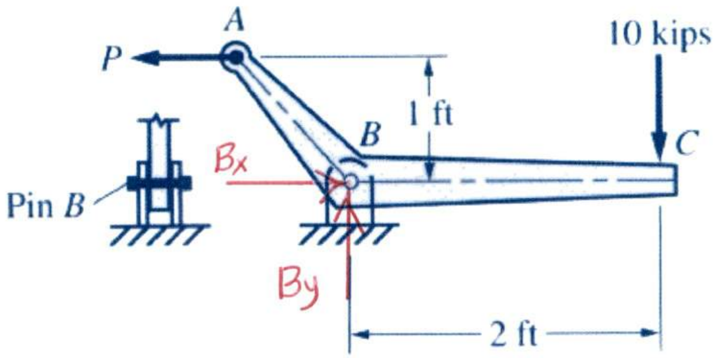
9-25

The bell crank mechanism in Fig. P9-25 is subjected to a vertical force of 10 kips applied at C. The force is resisted by a horizontal force P at A and a reaction at B. If the mechanism is in equilibrium and the allowable shear stress of the pin is 15 ksi, select the size of the pin at B.



FBD

Solution.

ccw +M ↺
cw −M ↻

Equilibrium Equations

$[\Sigma M_B = 0]$ $-10 \text{ kips } (2 \text{ ft}) + P(1 \text{ ft}) = 0$

$$P = \frac{20 \text{ kips} \cdot \text{ft}}{1 \text{ ft}} = 20 \text{ kips} \leftarrow$$

$[\Sigma F_x = 0]$ $B_x - P = 0$

$B_x - 20 \text{ kips} = 0$

$B_x = 20 \text{ kips} \rightarrow$

$$R_B = \sqrt{10 \text{ kips}^2 + 20 \text{ kips}^2} = 22.4 \text{ kips}$$

$[\Sigma F_y = 0]$ $B_y - 10 \text{ kips} = 0$

$B_y = 10 \text{ kips} \uparrow$

The pin at B is in double shear. Each area carries one-half of the load.

$$A_s = \frac{P}{\tau_{allow}} = \frac{22.4 \text{ kips}/2}{15 \text{ kips/in}^2} = 0.747 \text{ in}^2 \text{ (area of pin)}$$

$$A = \frac{\pi d^2}{4} = 0.7854\, d^2 = 0.747 \text{ in}^2$$

$$d = \sqrt{\frac{0.747 \text{ in}^2}{0.7854}} = 0.975 \text{ in.}$$

use $\underline{d = 1 \text{ in}}$