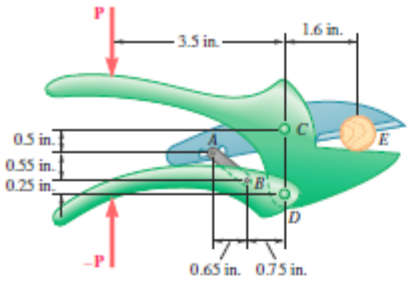
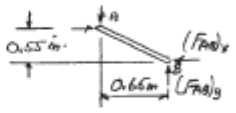


PROBLEM 6.175

The compound-lever pruning shears shown can be adjusted by placing pin A at various ratchet positions on blade ACE. Knowing that 300-lb vertical forces are required to complete the pruning of a small branch, determine the magnitude P of the forces that must be applied to the handles when the shears are adjusted as shown.

SOLUTION

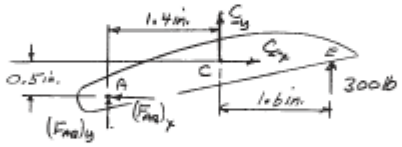
We note that AB is a two-force member.



$$\frac{(F_{AB})_x}{0.65\text{ in.}} = \frac{(F_{AB})_y}{0.55\text{ in}}$$

$$(F_{AB})_y = \frac{11}{13}(F_{AB})_x \qquad (1)$$

Free body: Blade ACE:



$$+\circlearrowleft \Sigma M_C = 0: \quad (300\text{ lb})(1.6\text{ in.}) - (F_{AB})_x(0.5\text{ in.}) - (F_{AB})_y(1.4\text{ in.}) = 0$$

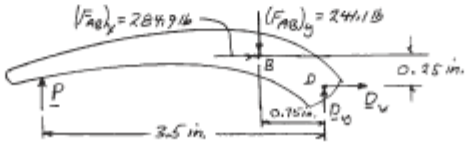
Use Eq. (1):

$$(F_{AB})_x(0.5\text{ in.}) + \frac{11}{13}(F_{AB})_x(1.4\text{ in.}) = 480\text{ lb}\cdot\text{in.}$$

$$1.6846(F_{AB})_x = 480 \qquad (F_{AB})_x = 284.9\text{ lb}$$

$$(F_{AB})_y = \frac{11}{13}(284.9\text{ lb}) \qquad (F_{AB})_y = 241.1\text{ lb}$$

Free body: Lower handle:



$$+\circlearrowleft \Sigma M_D = 0: \quad (241.1\text{ lb})(0.75\text{ in.}) - (284.9\text{ lb})(0.25\text{ in.}) - P(3.5\text{ in.}) = 0$$

$$P = 31.3\text{ lb} \blacktriangleleft$$