7-87* A pin-connected system of levers and bars is used as a toggle for a press as shown in Fig. P7-87. Determine the force $\vec{F}$ exerted on the can at A when a force $\vec{P}$ = 100 lb is applied to the lever at G.

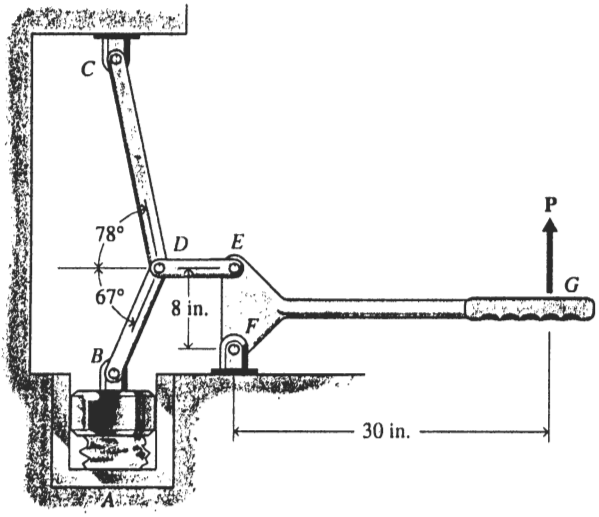
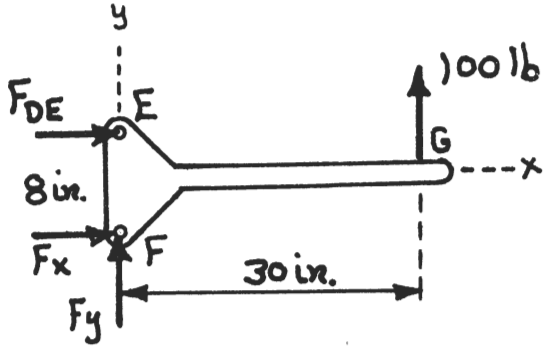


Fig. P7-87

SOLUTION

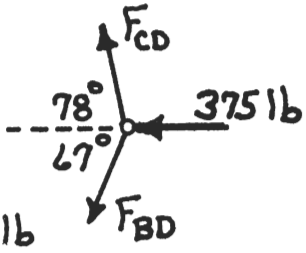
From a free-body diagram for the lever:



$$+ \circlearrowleft \Sigma M_F = 100(30) - F_{DE}(8) = 0$$

$$F_{DE} = 375 \text{ lb}$$

From a free-body diagram for the pin at D:



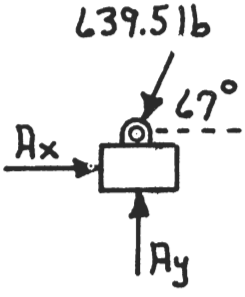
$$+ \rightarrow \Sigma F_x = -F_{BD} \cos 67^\circ - F_{CD} \cos 78^\circ - 375 = 0$$

$$+ \uparrow \Sigma F_y = -F_{BD} \sin 67^\circ + F_{CD} \sin 78^\circ = 0$$

$$F_{BD} = -639.5 \text{ lb}$$

$$F_{CD} = -601.8 \text{ lb}$$

From a free-body diagram for the piston at B:



$$+ \uparrow \Sigma F_y = A_y - 639.5 \sin 67^\circ = 0$$

$$A_y = 588.7 \text{ lb} = 588.7 \text{ lb} \uparrow$$

Force on the can: $\vec{F} \cong 589 \text{ lb} \downarrow$ Ans.

7-95* Forces of 25 lb are applied to the handles of the pipe pliers shown in Fig. P7-95. Determine the force exerted on the pipe at D and the force exerted on handle DAB by the pin at A.

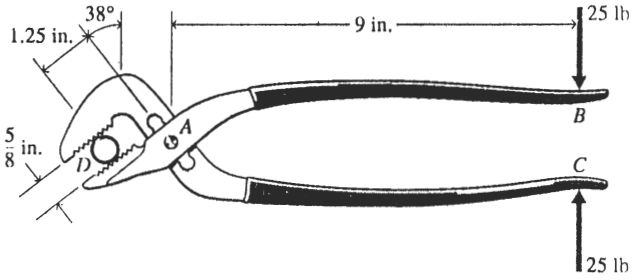
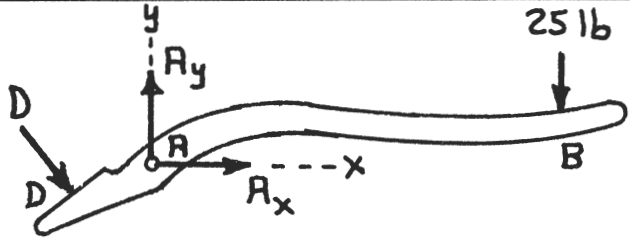


Fig. P7-95

SOLUTION

From a free-body diagram for member DAB:



$$+ \circlearrowleft \Sigma M_A = D(1.25) - 25(9) = 0$$

$$D = 180.0 \text{ lb} \qquad \text{Ans.}$$

$$+ \rightarrow \Sigma F_x = D \sin 38^\circ + A_x = 0$$

$$A_x = -D \sin 38^\circ$$

$$= -180.0 \sin 38^\circ$$

$$= -110.82 \text{ lb} = 110.82 \text{ lb} \leftarrow$$

$$+ \uparrow \Sigma F_y = A_y - D \cos 38^\circ - 25 = 0$$

$$A_y = D \cos 38^\circ + 25$$

$$= 180.0 \cos 38^\circ + 25$$

$$= 166.84 \text{ lb} = 166.84 \text{ lb} \uparrow$$

$$A = \sqrt{(A_x)^2 + (A_y)^2} = \sqrt{(-110.82)^2 + (166.84)^2} = 200.29 \text{ lb} \cong 200 \text{ lb}$$

$$\theta_A = \tan^{-1} \frac{166.84}{-110.82} = 123.59^\circ$$

$$\vec{A} = 200 \text{ lb} \measuredangle 56.4^\circ \qquad \text{Ans.}$$

7-96* Forces of 5 N are applied to the handles of the paper punch shown in Fig. P7-96. Determine the force exerted on the paper at D and the force exerted on the pin at B by handle ABC.

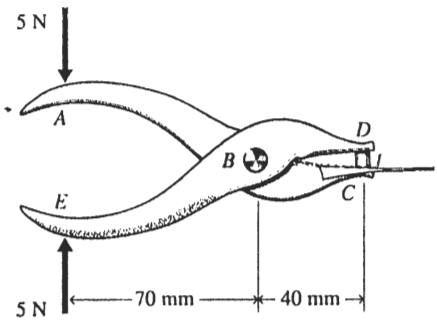
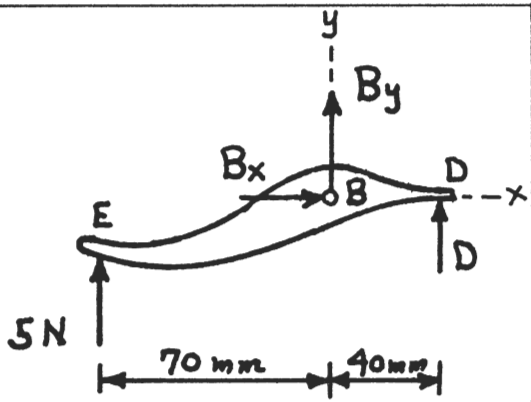


Fig. P7-96

SOLUTION

From a free-body diagram for handle EBD:



$$+ \circlearrowleft \Sigma M_B = D(40) - 5(70) = 0$$

$$D = 8.75 \text{ N} \uparrow$$

$$+ \rightarrow \Sigma F_x = B_x = 0$$

$$B_x = 0$$

$$+ \uparrow \Sigma F_y = B_y + 5 + 8.75 = 0$$

$$B_y = -13.75 \text{ lb} = 13.75 \text{ lb} \downarrow$$

Force exerted on the paper by handle EBD: $\vec{D} = 8.75$ N $\downarrow$ Ans.

Force exerted on the pin at B by handle ABC: $\vec{B} = 13.75$ lb $\downarrow$ Ans.