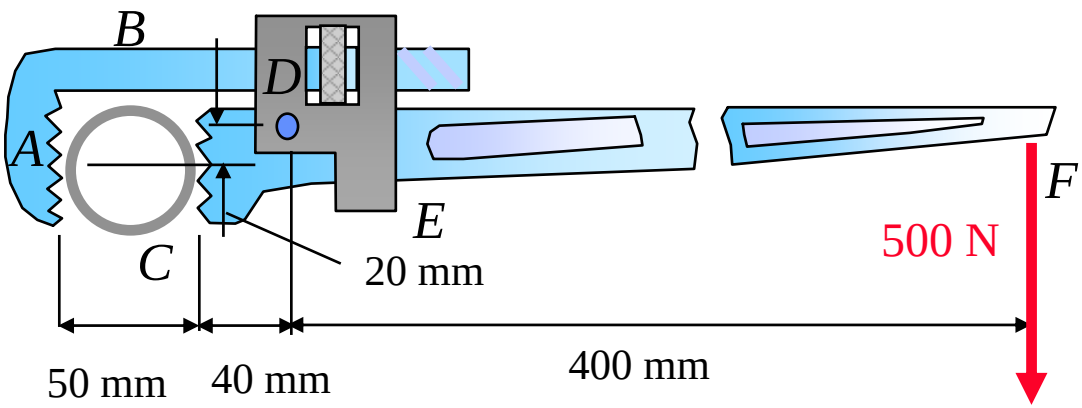
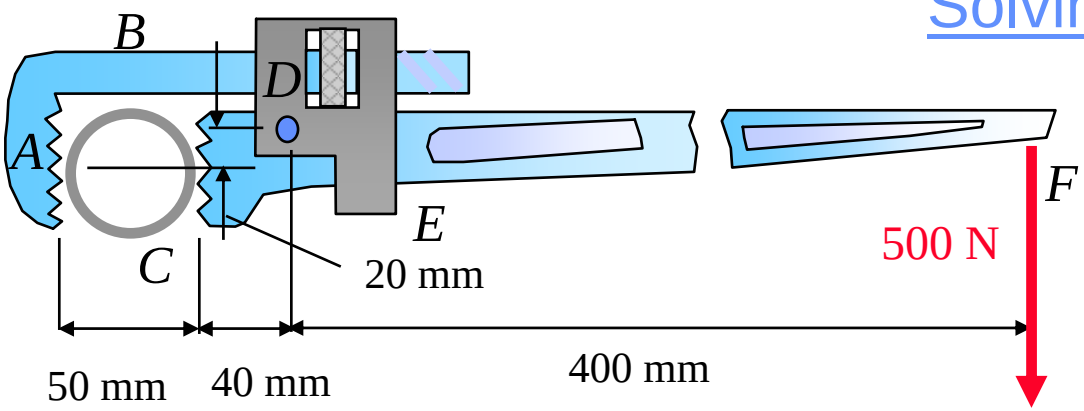
Problem 6.173



A pipe of diameter 50 mm is gripped by the Stillson wrench shown. Portions *AB* and *DE* of the wrench are rigidly attached to each other and portion *CF* is connected by a pin at *D*. Assuming that no slipping occurs between the pipe and the wrench, determine the components of the forces exerted on the pipe at *A* and at *C*.

Solving Problems on Your Own



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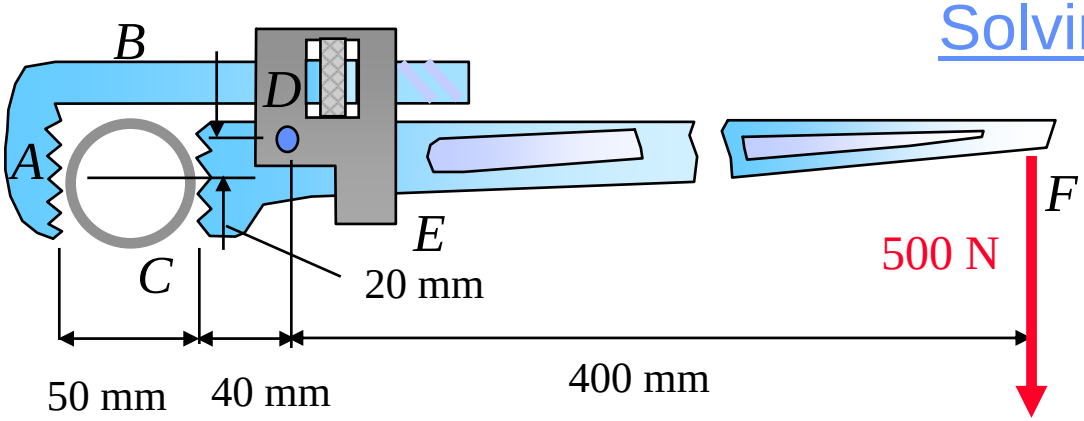
1. *Dismember the machine, and draw a free-body diagram of each member.*

2. *First consider the two-force members.* Apply equal and opposite forces to each two-force member where it is connected to another member.

Solving Problems on Your Own



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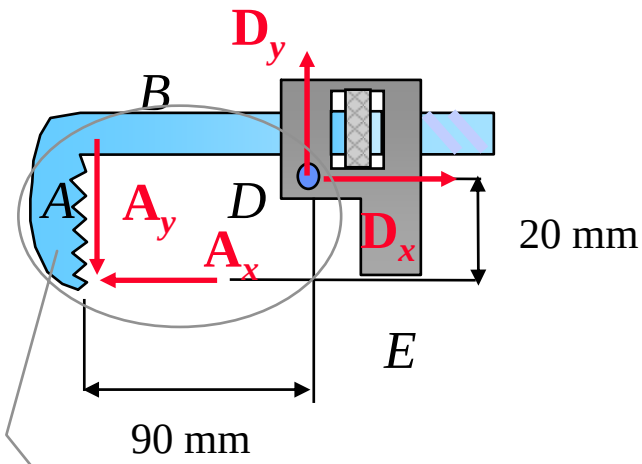
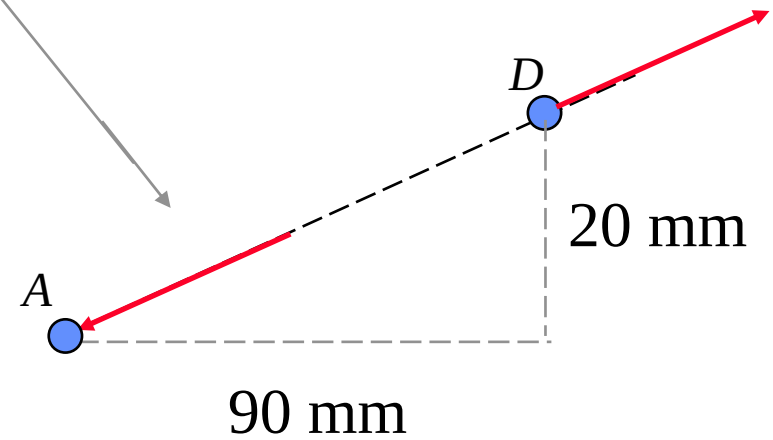
3. *Next consider the multi force members.*

4. *Equilibrium equations can be written after completing each free-body.*



Dismember the machine, and draw a free-body diagram of each member.

First consider the two-force members.



Free Body : Portion *ABDE*

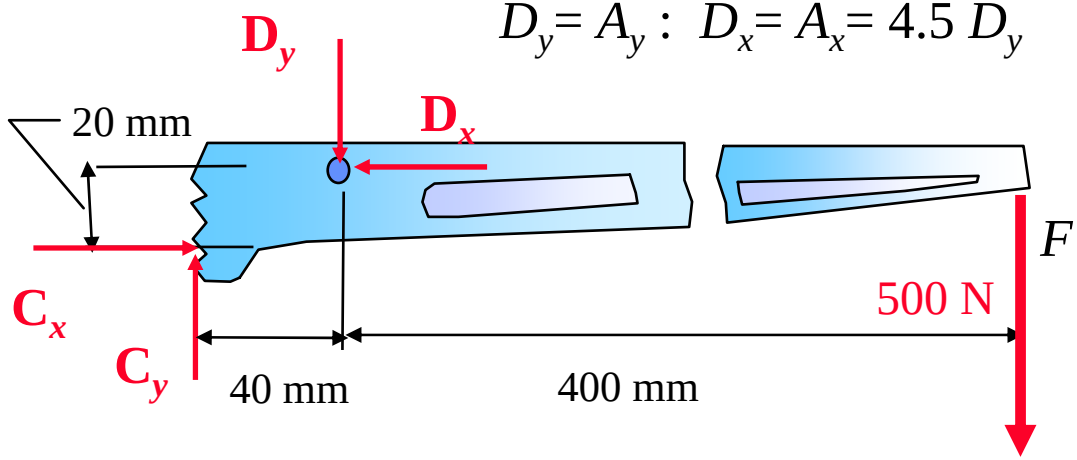
$$\frac{A_y}{20\text{ mm}} = \frac{A_x}{90\text{ mm}};$$

$$A_x = 4.5\,A_y$$

$$D_y = A_y: \quad D_x = A_x = 4.5\,D_y \qquad (1)$$

Problem 6.173 Solution

$D_y = A_y$: $D_x = A_x = 4.5\, D_y$ (1)



Next consider the multi force members.

Equilibrium equations can be written after completing each free-body.

Free Body : Portion *CF*

$$+\circlearrowleft \Sigma M_C = 0: \quad D_x(20\text{ mm}) - D_y(40\text{ mm}) - (500\text{ N})(440\text{ mm}) = 0$$

Substitute from (1) $\quad 4.5D_y(20) - D_y(40) - 220 \times 10^3 = 0$

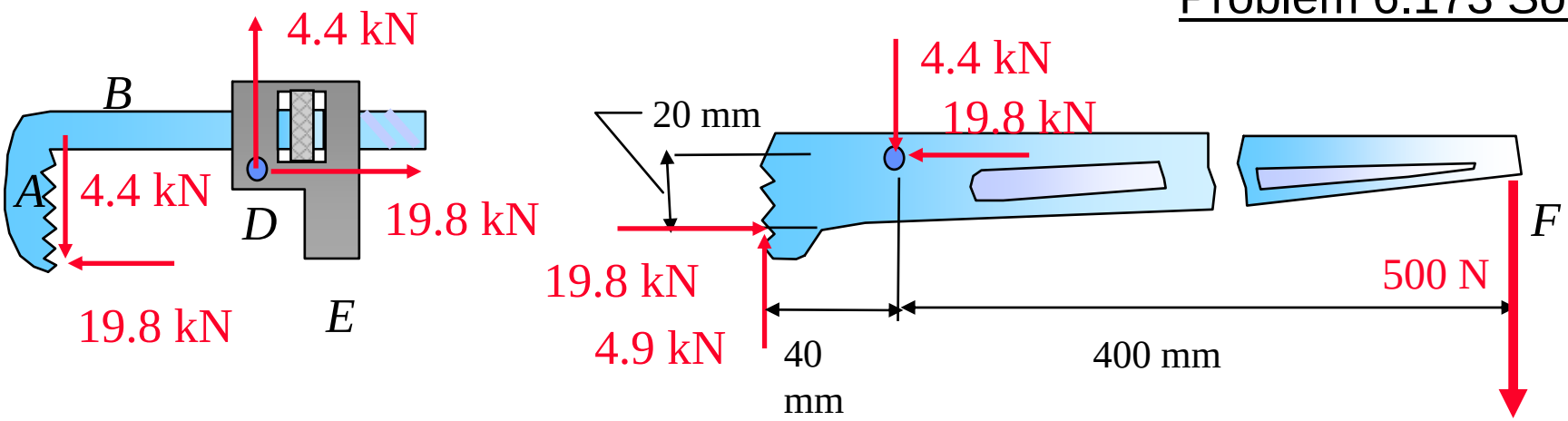
$$D_y = 4400\text{ N} = 4.4\text{ kN} \qquad D_x = 4.5\, D_y = 19.8\text{ kN}$$

$$\xrightarrow{+} \Sigma F_x = 0: \quad C_x - 19.8\text{ kN} = 0 \qquad C_x = 19.8\text{ kN}$$

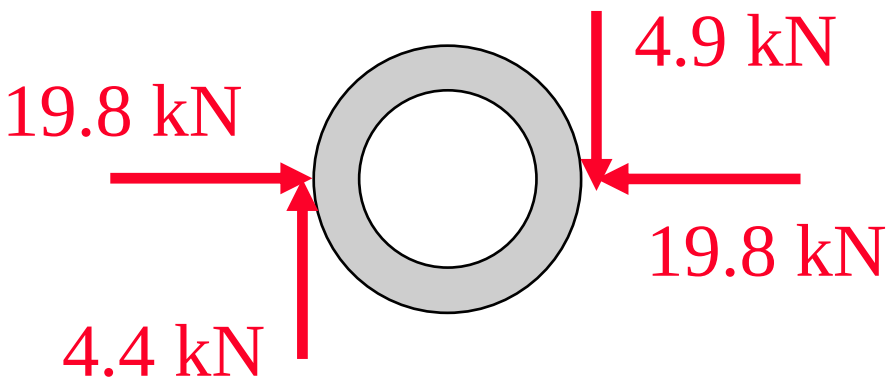
$$+\uparrow \Sigma F_y = 0: \quad C_y - 4.4\text{ kN} - 0.5\text{ kN} = 0 \qquad C_y = 4.9\text{ kN}$$

Using (1) $\quad A_x = D_x = 19.8\text{ kN} \qquad A_y = D_y = 4.4\text{ kN}$

Problem 6.173 Solution



All components act in the directions shown. Components on the pipe are equal and opposite to those on the wrench.



$\mathbf{A}_x = 19.8\ \text{kN} \rightarrow$

$\mathbf{A}_y = 4.4\ \text{kN} \uparrow$

$\mathbf{C}_x = 19.8\ \text{kN} \leftarrow$

$\mathbf{C}_y = 4.9\ \text{kN} \downarrow$