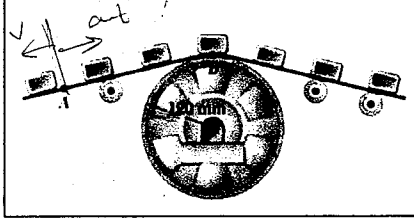
PROBLEM 15.21



A series of small machine components being moved by a conveyor belt passes over a 120-mm-radius idler pulley. At the instant shown, the velocity of point A is 300 mm/s to the left and its acceleration is 180 mm/s^2 to the right. Determine (a) the angular velocity and angular acceleration of the idler pulley, (b) the total acceleration of the machine component at B.

SOLUTION

$$v_B = v_A = 300 \text{ mm/s} \leftarrow \qquad r_B = 120 \text{ mm}$$

$$(a_B)_t = a_A = 180 \text{ mm/s} \rightarrow$$

(a) $v_B = \omega r_B, \qquad \omega = \dfrac{v_B}{r_B} = \dfrac{300}{120} = 2.5 \text{ rad/s}$ ↻ $\qquad \omega = 2.50 \text{ rad/s}$ ↻ ◀

$(a_B)_t = \alpha r_B, \qquad \alpha = \dfrac{(a_B)_t}{r_B} = \dfrac{180}{120} = 1.5 \text{ rad/s}^2$ ↻ $\qquad \alpha = 1.500 \text{ rad/s}^2$ ↻ ◀

(b) $(a_B)_n = r_B\omega^2 = (120)(2.5)^2 = 750 \text{ mm/s}^2$ ↓

$$a_B = \sqrt{(a_B)_t^2 + (a_B)_n^2} = \sqrt{(180)^2 + (750)^2} = 771 \text{ mm/s}^2$$

$\tan\beta = \dfrac{750}{180}, \qquad \beta = 76.5°$ $\qquad \mathbf{a}_B = 771 \text{ mm/s}^2$ ↖ 76.5° ◀

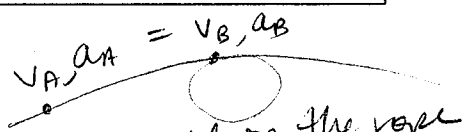
Find α, ω of pulley.

$V_B = V_{0,A} + at$

$V_B = V_A = 300 \text{mm/s}$

$V = \omega r \rightarrow \omega = \frac{300}{120} = 2.5 \text{ rad/s}$

$a = r\alpha \rightarrow \alpha = \frac{a}{r} = \frac{180}{120} = 1.5 \text{ rad/s}^2$



equal on the rope

Total acceleration at B = $a_t = 1.5 \text{ rad/s}^2$.

$a_n = \omega \times (\omega \times r)$

$= 2.5 \times (2.5 \times 120) = 750 \text{ rad/s}^2$

$a = \sqrt{180^2 + 750^2} = 771.3 \text{ rad/s}^2$ at 13.49°.

direction?