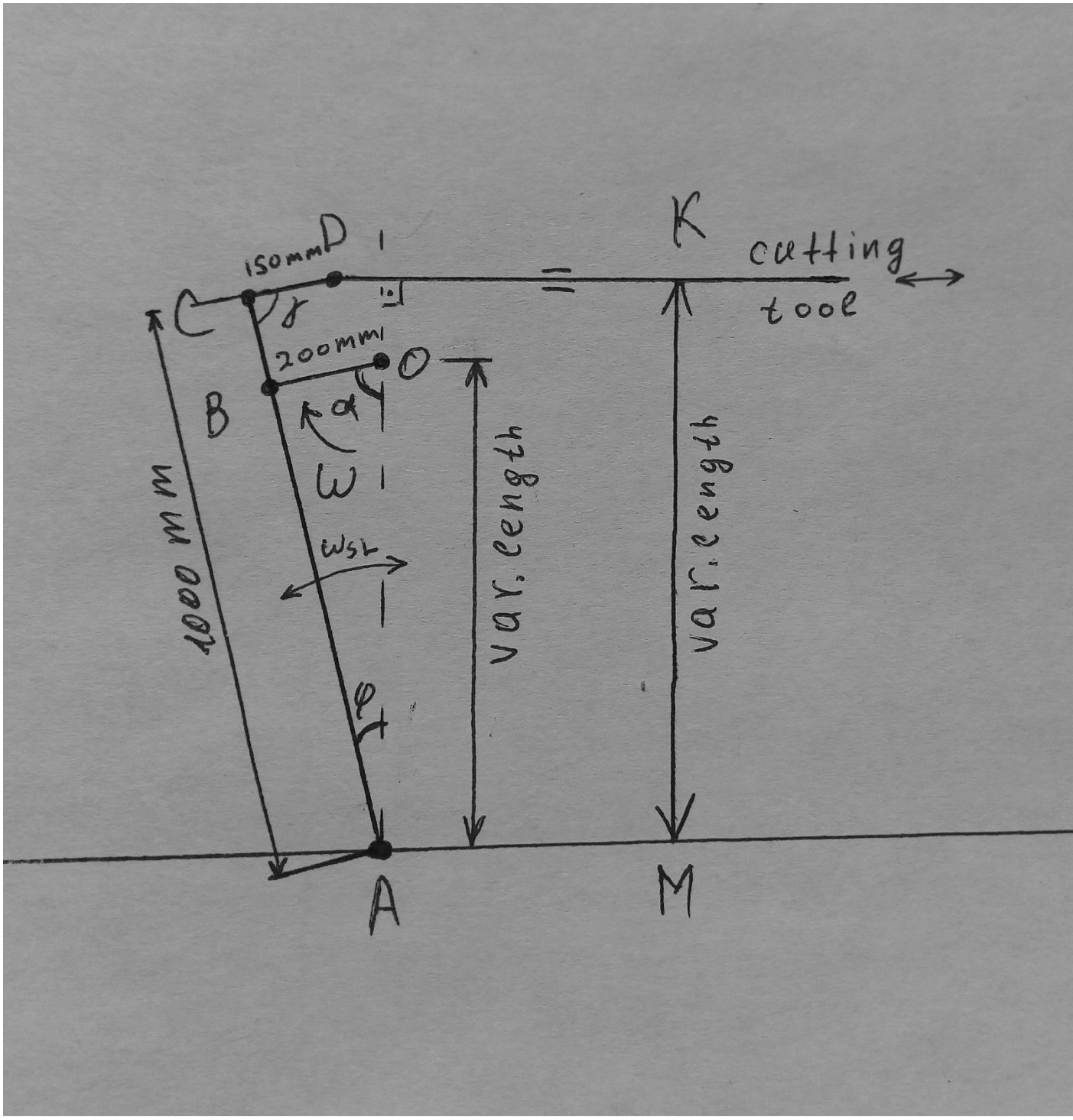
Answer on Question #79618, Physics / Mechanics | Relativity

The slotted link mechanism shown in Figure 4 provides slow forward quick-return motion to the cutting tool of a shaping machine. The slotted link AC is 1 m in length and the connecting link CD is 150 mm in length. The sliding block, B, is set at a radius of 200 mm from the center O of the driving wheel. Determine the angular velocity of the slotted link and the velocity of the cutting tool at the instant shown.

Solution

Since there is no figure given, draw it and agree that MK is variable given value as well as AO, angular velocity of the driving wheel is ω.



1) Find slotted link's angular velocity. Consider triangle ABO:

$$\frac{OB}{sin\varphi} = \frac{OA}{\sin(\omega t)}$$

$$\varphi = sin^{-1}\frac{OBsin(\omega t)}{OA}$$

$$\omega_{SL} = \frac{d\varphi}{dt} = \frac{OB \cdot \omega}{OA\sqrt{1 - \frac{OB^2 \sin(\omega t)}{OA^2}}}$$

2) Find velocity of the cutting tool:

$$\gamma = sin^{-1}\frac{\mathrm{MK} - \mathrm{AC} \cdot cos\left(sin^{-1}\frac{OB \cdot sin(\omega t)}{OA}\right)}{CD} + 90° - sin^{-1}\frac{OB \cdot \sin(\omega t)}{OA},$$

$$v_{ct} = \frac{d\gamma}{dt}CD = \frac{0.04 \cdot \omega \cdot \sin(\omega t) \cdot \cos(\omega t))}{\sqrt{1 - 0.04 \cdot \sin^2(\omega t)} \cdot \sqrt{1 - 44.44 \cdot (\mathrm{MK} - \sqrt{1 - 0.04 \cdot \sin^2(\omega t)})^2}} - \frac{0.03 \cdot \omega \cdot \cos(\omega t)}{\sqrt{1 - 0.04 \cdot \sin^2(\omega t)}}$$

Answer

$$\omega_{SL} = \frac{OB \cdot \omega}{OA\sqrt{1 - \frac{OB^2 \sin(\omega t)}{OA^2}}}$$

$$v_{ct} = \frac{0.04 \cdot \omega \cdot \sin(\omega t) \cdot \cos(\omega t))}{\sqrt{1 - 0.04 \cdot \sin^2(\omega t)} \cdot \sqrt{1 - 44.44 \cdot (\mathrm{MK} - \sqrt{1 - 0.04 \cdot \sin^2(\omega t)})^2}} - \frac{0.03 \cdot \omega \cdot \cos(\omega t)}{\sqrt{1 - 0.04 \cdot \sin^2(\omega t)}}$$