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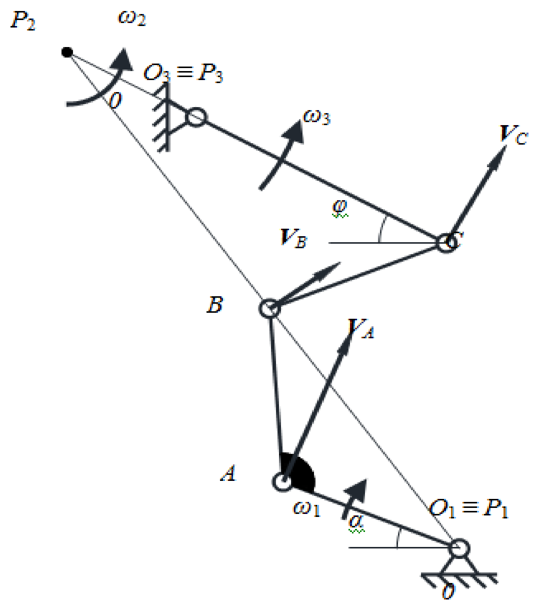
CALCULATION OF TRANSMISSION OF TRANSMISSION MECHANISM BETWEEN COUNTER-ROTATING DRUMS

Andijan mechine building institute, Andijon city, Uzbekistan
Faculty of "Transport and Logistics".
Assistant: ***Tursunboyev Lochnbek Erkinjon o'g'li***

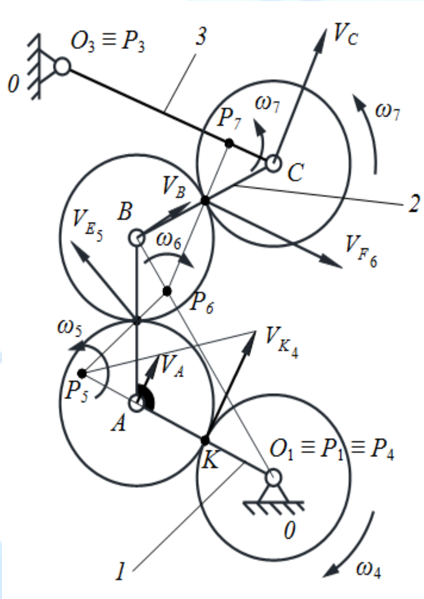
Annotation: In this article, the calculation of the transmission mechanism between counter-rotating drums is made. Analytical analysis of the existing working shafts on reciprocating shaft machines and the inter-shaft transmission mechanisms used in them was performed[1-3].

Key words: Differential transmission mechanism with gear lever, shaft machine, kinematics, link, lever, theorem of sines, instantaneous rotation, contour with lever.

In the kinematic inspection of the differential gear transmission mechanism, we first check the kinematics of the gear circuit and determine the angular and linear velocities of its points[4-5]:



1-picture. diagram of the construction of the 4-stage lever circuit of the gear differential transmission mechanism



2-picture. diagram of the construction of the 4-stage lever circuit of the gear differential transmission mechanism

Given: d_4=d_7= 270mm. d_5=d_6 $= 90mm.\ \omega_3 = 0.1\ \omega_4$; α= 60°; β= 45

We need to determine the linear speed of the point S, for this we can determine the angular speed of the 3rd link by multiplying it by the length of the lever O_3S.

$$V_C = \omega_3 \cdot O_3C$$

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Here O_3C is the length of the lever.

From the course of theoretical mechanics, we know that if we know the direction of the velocity vectors of two points of a rigid body and the speed of one of them, we can determine the velocity and acceleration of any point of the rigid body. To determine the angular velocity of the 2nd link, we need to determine the instantaneous center of rotation of the link[6-8].

To do this, we draw a straight line perpendicular to the velocity vectors and mark the point where they intersect as P_2, and this point will be the instantaneous center of rotation of the 2nd link. Now we can determine the angular velocity of link 2.

$$\omega_2 = \frac{V_C}{P_2C} = \frac{25}{307{,}54} = 0{,}081\ 1/s$$

By putting the value of V_C in formula 1 into formula 2, we can get the following equation[4].

$$\omega_2 = \frac{\omega_3 \cdot O_3C}{P_2C} = \frac{0{,}1 \cdot 250}{307{,}54} = 0{,}081 \quad 1/s$$

We can find the length of the distance P_2 C (P_2CO_3) by solving the triangle. In this we use the theorem of cosines[9].

After determining the angular velocity of link 2, we determine the linear velocity of point B.

$$V_B = \omega_2 \cdot P_2B = 0{,}081 \cdot 283{,}19 = 23{,}02\ mm/s$$

$$\omega_1 = \frac{V_B}{BO_1} = \frac{23{,}02}{416{,}19} = 0{,}055 \quad 1/s$$

Using the value of V_B, we can determine the angular velocity of link 1.

After determining the speeds of the points of the lever contour, we determine the speed accelerations of all points of the mechanism.

The center of rotation and angular velocity of the 4th link are known, so we can find the instantaneous center of rotation of the 5th link. For this, the speed of the point K in the coupling (V_K) of the 4-5 gear wheels and the linear speed of A of the center of the 5th gear wheel AND the speed vector heads are in a straight line, so they are straight from their ends. The point of intersection of the straight line passing through the curve and the vectors through the origin will be the instantaneous center of rotation of the 5th link P_5 [10-11]

$$V_K = \omega_1 \cdot R_4 = 10 \cdot 150 = 1500\ mm/c$$

After finding the instantaneous center of rotation of link 5, we find its angular velocity.

$$\omega_5 = \frac{V_A}{P_5A} = \frac{V_K}{P_5K}$$

Here $P_5K = P_5A + r_5;$

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$$\frac{V_A}{P_5A} = \frac{V_K}{P_5A + r_5}$$

$$\frac{13.82}{P_5A} = \frac{1500}{P_5A + 100}$$

From the given formula, we can find the unknown P_5A

$$P_5A = \frac{V_A \cdot r_5}{V_K - V_A} = \frac{13.82 \cdot 100}{1500 - 13.82} = 0.93 \text{ mm}$$

$$\omega_5 = \frac{V_A}{P_5A} = \frac{13.82}{0.93} = 14.86\ 1/c$$

We can determine the value of ω_5 *by the ratio of* V_A *to* P_5A

After determining ω_5, we can find the speed of the point of engagement of the 5th and 6th gears.

$$V_E = \omega_5 \cdot P_5E = 14.86 \cdot 99.34 = 1476.2\ mm/s$$

P_5E We can find the distance ΔP_5AE by solving the triangle.

After finding the speed of point F_6, we determine the angular speed of the 7th gear wheel. For this, we find the instantaneous center of rotation of the 7-toothed wheel[12].

We use the theorem of sines to solve this triangle.

$$\frac{\sin 60°}{P_7F} = \frac{\sin \alpha_7}{P_7C} = \frac{\sin \beta_7}{r_7}$$

From this we can determine the values of P_7F and P_7C,

$$\omega_7 = \frac{V_F}{P_7F} = \frac{1514.9}{148.78} = 10.18\ \ 1/s$$

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