UDC 621.924.7

DEVELOPMENT OF A DRIVE THAT PROVIDES THE TORQUE TRANSMISSION TO THE DRIVE SHAFT OF THE MACHINE, PERFORMING ADDITIONAL RECIPROCATING MOVEMENT

M.G. Zalyubovskiy, Candidate of Technical Sciences, Doctoral Student
Kyiv National University of Technologies and Design
I.V. Panasyuk, Doctor of Technical Sciences, Professor
Kyiv National University of Technologies and Design

Keywords: spatial mechanism, kinematic pair, connecting rod, slider.

Represent the hinge component of the drive of the machine at the two extreme positions of the slider [1], which is shown in Figure 1, for further synthesis.

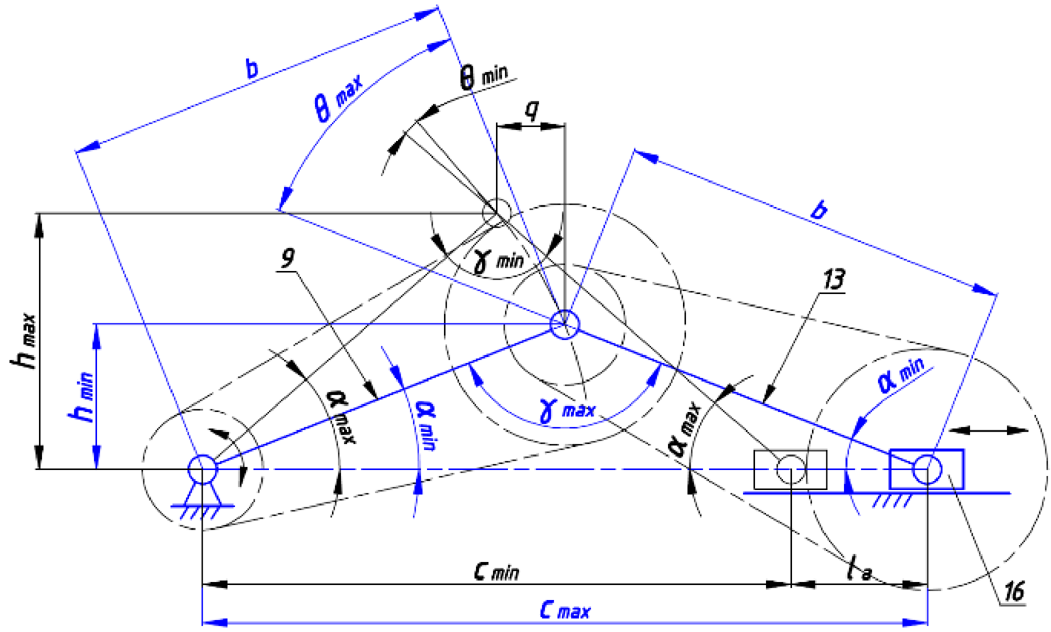

Figure 1. Kinematic scheme of the four-hinged hinge mechanism

In fact, the operation of this actuator is provided by a flat four-link hinged mechanism [2], which is part of it and consists of the leading link – the slider 16, the connecting rod 13 and the driven link – the rocker arm 9 and the fixed link – the frame 1. With reciprocating movement of the slider 16, there will be a cyclic change in the distance between the center of rotation of the rocker arm 9 and the rotary kinematic pair "connecting rod-slider" from the maximum c_{max} to the minimum c_{min} value.

Based on geometric considerations, we write an expression to determine the length b of the rocker arm and connecting rod:

$$b = \frac{c_{\max} \cdot \sin(45^{\circ} - 0{,}5 \cdot \Theta_{\max})}{\sin(90^{\circ} + \Theta_{\max})}. \qquad (1)$$

Based on geometric considerations, we write down the expressions for determining hmax:

$$h_{\max} = \sqrt{\left(\frac{c_{\max}\cdot\sin(45^\circ - 0{,}5\cdot\Theta_{\max})}{\sin(90^\circ+\Theta_{\max})}\right)^2 - 0{,}25\cdot\left(c_{\max} - \sqrt{l_{PЄ}(2l_B + l_{PЄ})} + \sqrt{l_{PЄ}^2 - 4(l_B\cos 45^\circ)^2}\right)^2}, \quad (2)$$

where lB – the axial distance of the driving and drived forks is, lPЄ – the axial distance of the working capacity/

Write the expression to calculate the horizontal component of the displacement amplitude q of the kinematic pair "rocker arm-connecting rod":

$$q = 0{,}5\sqrt{l_{PЄ}(2l_B + l_{PЄ})} + \sqrt{l_{PЄ}^2 - 4(l_B\cos 45^\circ)^2}. \quad (3)$$

On the basis of the previously obtained expressions, it is possible to derive an equation for calculating the distance cmax, which will provide in the kinematic pairs of the mechanism the maximum values of the pressure angles θmax and αmax within acceptable limits:

$$c_{\min} = c_{\max} - \sqrt{l_{PЄ}(2l_B + l_{PЄ})} + \sqrt{l_{PЄ}^2 - 4(l_B\cos 45^\circ)^2}. \quad (4)$$

$$c_{\max} = \frac{\sqrt{l_{PЄ}(2l_B + l_{PЄ})} + \sqrt{l_{PЄ}^2 - 4(l_B\cos 45^\circ)^2}}{1 - \dfrac{2\cdot\sin(45^\circ - 0{,}5\cdot\Theta_{\max})}{\sin(90^\circ + \Theta_{\max})}}. \quad (5)$$

Thus, using the dimensions of the lengths of the links of the spatial mechanism of the machine, providing the corresponding amplitude of reciprocating movement of the slider, as well as previously adopting within the acceptable limits the maximum values of the angles of pressure θmax and αmax in kinematic pairs of the mechanism, using equation (5) it is possible to calculate the rational maximum distance cmax between the center of rotation of the rocker arm and the rotary kinematic pair "connecting rod-slider", which will become the basic geometric parameter of the mechanism during its further synthesis.

The drive design for this machine is developed, which allows to realize the rotation of the drive shaft of the machine with simultaneous reciprocating movement, synthesized four-links hinge mechanism that is part of the drive. Mathematical dependences were obtained for the calculation of the basic geometric ratios of the lengths of the links of the four-link hinged mechanism in order to ensure the angles of pressure in the kinematic pairs of the mechanism within acceptable limits.

References

1. Zaliubovskyi M. G. Synthesis and research of the tumbling machine spatial mechanism / M. G. Zaliubovskyi, I. V. Panasiuk, Yu. I. Smirnov, V. V. Malyshev // Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu, – 2020. – 178, issue 4, 69-75.

2. Zalyubovskii M. G. On the study of the basic design parameters of a seven-link Spatial mechanism of a part processing machine / M. G. Zalyubovskii, I. V. Panasyuk // International Applied Mechanics, 56, issue 1, April 2020, 54 – 64.