

KINEMATIC ANALYSIS OF RICE SORTING MACHINE FIST MECHANISM

A. Djurayev,
d.t.sc., Professor

V. M. Turdaliyev,
d.t.sc., Professor

M. A. Mamashayev
Basic Doctoral Student
Namangan Engineering-Construction Institute
mmamashayev89@gmail.com, tel: +99893-945-69-89

Abstract

The article presents the results of the kinematic analysis of the belt element fist mechanism of the modernized rice sorting machine. The kinematic characteristics of the belt element fist mechanism of the rice sorting machine are presented. In this case, taking into account the limit deformations of the belt element, a formula expressing the vibration of the coromislo was obtained.

Keywords. Brass sorter, punch mechanism, belt element, eccentric, radius, deformation, vibration, angle, kinematic couple, coefficient, law of motion.

We present the scheme of the mechanism for performing kinematic analysis (Fig. 1). From the calculation scheme, we distinguish ABD and BCD from closed contours [1, 2]. Closed circuit vector equations in it:

For ABD outline:

$$\bar{q} + \bar{l}_4 - \bar{e} = 0 \quad (1)$$

For BCD outline:

$$\begin{aligned} \bar{q} + \bar{l}_3 - \Delta l_3 - \bar{r} - \Delta r &= 0; \\ \bar{q} + \bar{l}_3 - r &= 0 \\ \bar{q} + \bar{l}_3 + \Delta \bar{l}_3 - \bar{r} + \Delta r &= 0 \end{aligned} \quad (2)$$

Received We project the vector equation (1) onto the axis AX

$$l_4 - q \cos \varphi_q - e \cos \varphi_r = 0$$

$$q \sin \varphi_q + e \sin \varphi_r = 0 \quad (3)$$

From the account scheme:

$$\operatorname{tg} \varphi_q = \frac{e \sin \varphi_1}{l_4 - e \cos \varphi_1}; \quad q = -e \frac{\sin \varphi_1}{\sin \varphi_q} \quad (4)$$

ΔBCD , $\Delta BC_1 D$, taking into account the deformations of the strap element in the first and $\Delta BC_2 D$ from triangles based on the theorem of cosines [3];

$$\begin{aligned} r^2 &= q^2 + l_3^2 - 2ql_3 \cos \alpha; \\ l_3^2 &= q^2 + r^2 - 2qr \cos \varphi_{qr}; \\ (r + \Delta r)^2 &= q^2 + (l_3 - \Delta l_3)^2 - 2q(l_3 - \Delta l_3) \cdot \cos(\alpha + \Delta \alpha); \\ (l_3 + \Delta l_3)^2 &= q^2 + (r - \Delta r)^2 - 2q(r - \Delta r) \cdot \cos(\varphi_{qr} - \Delta \varphi_{qr}); \\ (r - \Delta r)^2 &= q^2 + (l_3 + \Delta l_3)^2 - 2q(l_3 + \Delta l_3) \cdot \cos(\alpha - \Delta \alpha); \\ (l_3 - \Delta l_3)^2 &= q^2 + (r + \Delta r)^2 - 2q(r + \Delta r) \cdot \cos(\varphi_{qr} + \Delta \varphi_{qr}); \end{aligned} \quad (5)$$

From the derived expression in (5), we get the following:

$$\begin{aligned} \alpha &= \arccos \frac{q^2 + l_3^2 - r^2}{2ql_3}; \\ \varphi_{qr} &= \arccos \frac{q^2 + r^2 - l_3^2}{2qr}; \\ \alpha + \Delta \alpha &= \arccos \frac{q^2 + (l_3 - \Delta l_3)^2 - (r + \Delta r)^2}{2q(l_3 - \Delta l_3)}; \\ \varphi_{qr} - \Delta \varphi_{qr} &= \arccos \frac{q^2 + (r - \Delta r)^2 - (l_3 + \Delta l_3)^2}{2q(r - \Delta r)}; \\ \alpha - \Delta \alpha &= \arccos \frac{q^2 + (l_3 + \Delta l_3)^2 - (r - \Delta r)^2}{2q(l_3 + \Delta l_3)}; \\ \varphi_{qr} + \Delta \varphi_{qr} &= \arccos \frac{q^2 + (r + \Delta r)^2 - (l_3 - \Delta l_3)^2}{2q(r + \Delta r)}; \end{aligned} \quad (6)$$



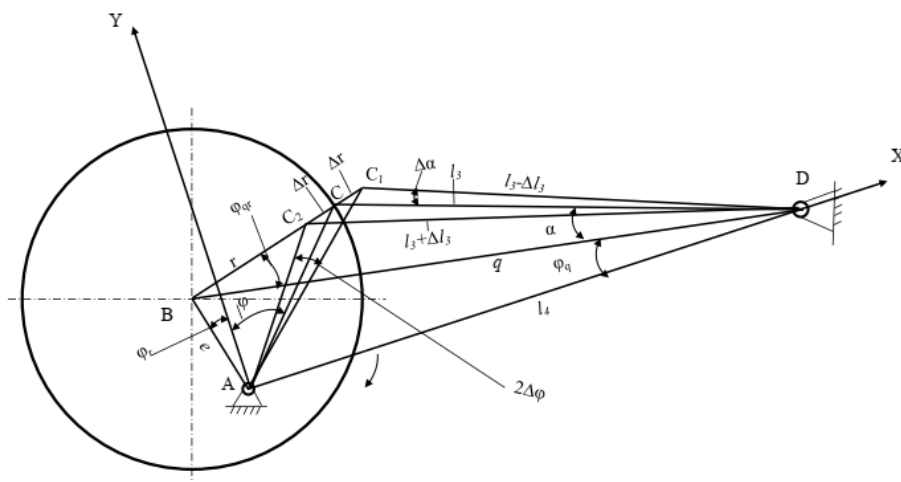


Figure 1. Calculation scheme of a fist mechanism with an eccentric belt element

Taking into account the option of its assembly when preparing the punching mechanism α and φ_{qr} values can have positive and negative signs [4]. In that case

$$\varphi_{qr} = \varphi_r \pm \varphi_q; \alpha = \varphi_3 \pm \varphi_q \quad (7)$$

In that case

$$\alpha = \arccos \frac{e^2 - r^2 + l_3^2 + l_4^2 - 2el_4 \cos \varphi_1}{2l_3 \sqrt{e^2 + l_4^2 - 2el_4 \cos \varphi_1}} + \arctg \frac{e \sin \varphi_1}{l_4 - e \cos \varphi_1}; \quad (8)$$

$$\varphi_2 = \arccos \frac{e^2 + r^2 - l_3^2 + l_4^2 - 2el_4 \cos \varphi_1}{2r \sqrt{e^2 + l_4^2 - 2el_4 \cos \varphi_1}} + \arctg \frac{e \sin \varphi_1}{l_4 - e \cos \varphi_1};$$

It is important to determine the values of α and $\Delta\varphi$, respectively, depending on the length of the rod and the rod of the punched rice sorter mechanism. $\Delta\alpha$ Therefore, by subtracting the third equation from the first equation of the given system of equations (8) and dividing it by two, as well as by subtracting the fourth equation from the second equation and dividing it by two, the following expressions are formed:

$$\Delta\alpha = \frac{1}{2} \begin{cases} \arccos \frac{e^2 + l_4^2 - 2el_4 \cos \varphi_1 + (l_3 - \Delta l_3)^2 - (r + \Delta r)^2}{2(l_3 - \Delta l_3)\sqrt{e^2 + l_4^2 - 2el_4 \cos \varphi_1}}; \\ - \arccos \frac{e^2 + l_4^2 - 2el_4 \cos \varphi_1 + (l_3 + \Delta l_3)^2 - (r - \Delta r)^2}{2(l_3 - \Delta l_3)\sqrt{e^2 + l_4^2 - 2el_4 \cos \varphi_1}} \end{cases}$$

$$\Delta\varphi_3 = \begin{cases} \arccos \frac{e^2 + l_4^2 - 2el_4 \cos \varphi_1 + (r - \Delta r)^2 - (l_3 + \Delta l_3)^2}{2(l_3 + \Delta l_3)\sqrt{e^2 + l_4^2 - 2el_4 \cos \varphi_1}}; \\ - \arccos \frac{e^2 + l_4^2 - 2el_4 \cos \varphi_1 + (r + \Delta r)^2 - (l_3 - \Delta l_3)^2}{2(l_3 - \Delta l_3)\sqrt{e^2 + l_4^2 - 2el_4 \cos \varphi_1}} \end{cases} \quad (9)$$

Accordingly, according to the calculation scheme, the maximum and minimum turning angles of the connecting rod r and l_3 are determined from the following expression:

$$\varphi_{\max} = \varphi_3 + \Delta\varphi_3; \quad \varphi_{\min} = \varphi_3 - \Delta\varphi_3;$$

$$\alpha_{\max} = \alpha + \Delta\alpha; \quad \alpha_{\min} = \alpha - \Delta\alpha; \quad (10)$$

It is possible to determine the laws of motion by implementing the numerical solutions of the obtained expressions for the specific fist mechanisms in the rice sorting machine, but it is necessary to determine the uniformity of the fist belt element according to the experimental results and to determine Δr and Δl_3 [5, 6, 7].

Summary

On the basis of theoretical studies, the kinematic analysis of the belt-element fist mechanism was carried out. Taking into account the deformation of the belt element, the expressions defining the laws of motion of the connecting rod and the crankshaft have been determined.

List of references

1. Тимофеева Г.А. теория механизмов и механика машин. –М.: Экзамен. 2008. -256 с.
2. Артоболевский И.И. теория механизмов и машин. –М.: Наука. 1988. -640 с.

3. Kenjaboyev Sh., Djuraev A. Kinematic analysis of the crank-beam mechanism with compound hinges with fixed changes in the length of the links. European science review, Vienna, 2017. -№9-10. –p. 96-101.

4. Левитский Н.И. Теория механизмов и машин. Изд. «Наука», М.: 1997. -574 с.

5. Джураев А. и др. Теория механизм машин. –Ташкент: Г.Гулом, 2004. -582 с.

6. Djuraev A., Madrahimov Sh., Urinova S. Ways of reducing superfluous communications in battant mechanism of weaving looms. European science review, №1-2 2016 January-February, –p. 142-145.

7. A.D.Djurayev., V.M.Turdaliyev., M.T.Mansurov ,M.A.Mamashayev // Structural and kinematic analysis of elastic element with fist mechanism of rice sorting machine. Journal of Mechanical and Production Engineering (JMPE) ISSN (Print): 2278-3512; ISSN (Online): 2278-3520 Vol. 14, Issue 2; Dec 2024, 7-1 6.

