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# KINEMATIC MECHANISM WITH ADJUSTABLE OSCILLATION WITH ROD OF VARIABLE LENGTH

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***Abstract:*** *In this paper it has been determined the variations of the velocities and of the angular accelerations for different lengths of the mechanism with adjustable oscillation used in impulse drive Gusa. There fare it was been made a program allowing graphical display of these.* ***Key words:*** *kinematic, mechanism with adjustable oscillation.*

## 1. INTRODUCTION

The mechanism with adjustable oscillation used in the impulse drive, for which is determined kinematics is a mechanism with rod of variable length.

Kinematic analysis consists in the studying of elements movement in terms of geometry without taking into account the causes determining the movement in the kinematic analysis we aim to solve the following problems [1], [3]:

- determination of the angular velocity of the elements;
- determination of the angular acceleration of the elements.

## 2. RELATIONS CALCULATION FOR THE KINEMATICS ANALYSIS OF THE MECHANISM

In the figure 1 it's represented the kinematic scheme of the mechanism with adjustable oscillation from a impulse drive rod of variable length, a mechanism with five mobile elements obtained by binding to motor element, of one group of third grade. Is a mechanism with cylinder moving parallel plan and variable length rod.

The impulse drive studied has three identical mechanisms with adjustable oscillations in parallel, and for driven shaft speed control is varying the length $\ell_6$ of bearing pedestal [4].

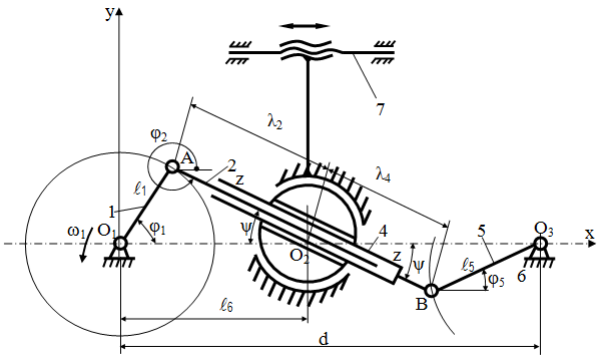


**Fig. 1** Mechanism with adjustable oscillation

$$\omega_5 = \frac{1}{\ell_5 \cdot \cos(\varphi_5 + \psi)} \cdot$$

$$\cdot \left[ \omega_1 \frac{\ell_1 \lambda_4}{\lambda_2} \cdot \cos(\varphi_1 + \psi) + \dot{\ell}_6 \cdot \sin(1 - \lambda_4) \cdot \sin\psi \right]; \quad (1)$$

ware : $$\varphi_2 = 360° - \psi; \quad (2)$$

$$\psi = \arctan\left( \frac{\ell_1 \cdot \sin\varphi_1}{\ell_6 - \ell_1 \cdot \cos\varphi_1} \right); \quad (3)$$

$$\omega_1 = \frac{\pi \cdot n_1}{30}; \quad (4)$$

$$\lambda_2 = \ell_6 \cdot \cos\psi - \ell_1 \cdot \cos(\varphi_1 + \psi); \quad (5)$$

$$tg\psi = \frac{\ell_1 \cdot \sin\varphi_1}{\ell_6 - \ell_1 \cdot \cos\varphi}; \quad (6)$$

$$\lambda_4 = (d - \ell_6)\cdot \cos\psi - \ell_5 \cdot \cos(\varphi_5 + \psi); \quad (7)$$

$$\varphi_5 = \arcsin \frac{\frac{d-\ell_6}{\ell_5}\cdot \mathrm{ctg}\psi \pm \sqrt{1 - \frac{(d-\ell_6)^2}{l_5^2} + \mathrm{ctg}^2\psi}}{1 + \mathrm{ctg}^2\psi}. \quad (8)$$

## 3. THE KINEMATICS OF MECHANISM WITH VARIABLE LENGTH ROD

Based on this relations (1) - (8) it has been developed a calculation program that allows a graphical display of angular velocity and angular acceleration of the mechanism.

The dimensions of the elements of mechanism are: $\ell_1$=$O_1A$=30 [mm]; $\ell_5$=$O_3B$=80 [mm]; d=$O_1O_3$=260 [mm]; $\ell_6$ = 120…165 [mm], and the speed shaft conductor $n_1$=1420 [rot/min].

The calculation program for graphics representation has been realized in the programming language C + +. In figure 2 it's presented the interface of the calculation program.

1. includes input data and calculated values based on the equations presented above;
2. includes the graphic display of angular velocities $\omega_5$ for a single mechanism;
3. includes the graphic display of angular accelerations $\varepsilon_5$ for a single mechanism.

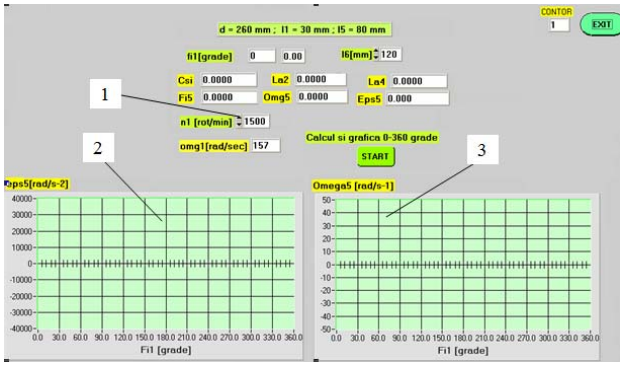


**Fig. 2** Interface of the calculation program.

In figure 3 are represented the graphs of velocity and acceleration angular for the following input data : speed $n_1$=1420 [rot/min], $\ell_6$=120[mm], $\ell_1$=120[mm], $\ell_5$=80[mm] and d = 260 [mm].

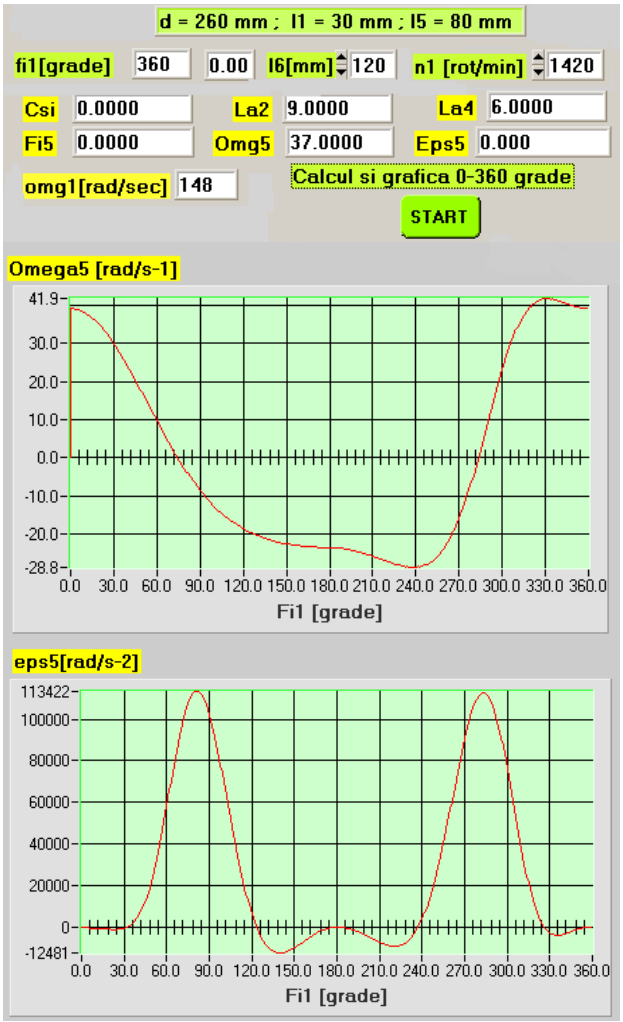


**Fig. 3** Variation of the angular velocity and acceleration

In figures 4, 5 are represented the graphs velocity and acceleration angular for the length $\ell_6$=135[mm].

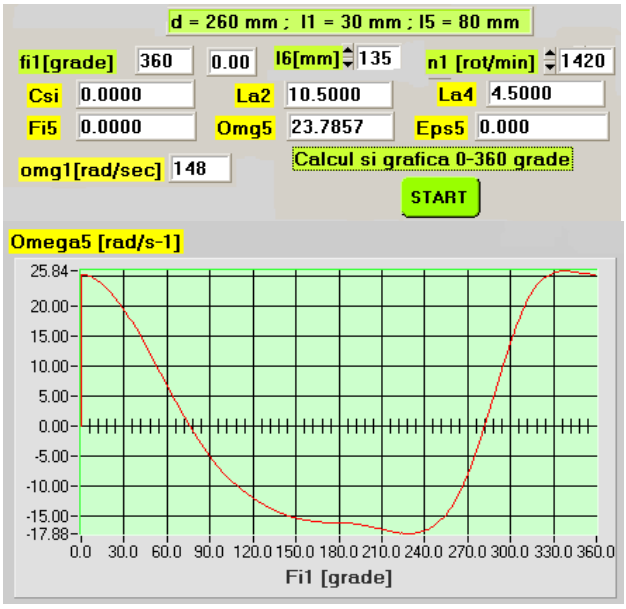

**Fig. 4** Variation of the angular velocity

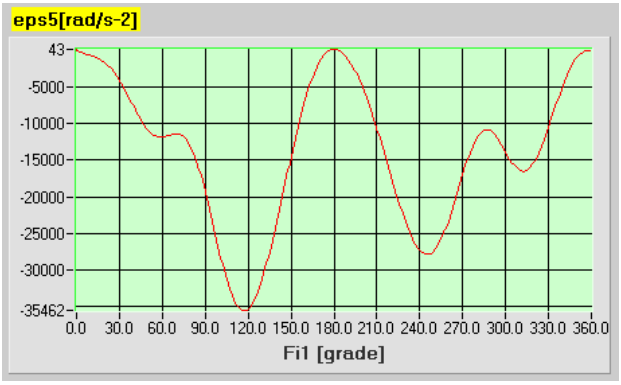


**Fig. 5** Variation of the angular acceleration

In figure 6 are represented the graphs velocity and acceleration angular for the length $\ell_6$=150 [mm].

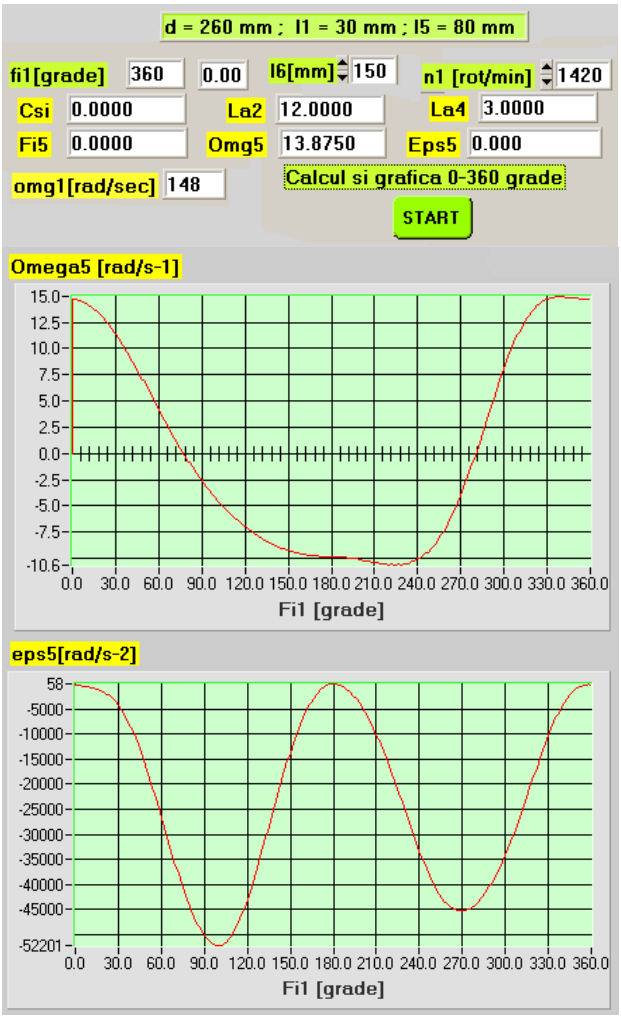


**Fig. 6** Variation of the angular velocity and acceleration

In figure 7 are represented the graphs velocity and acceleration angular for the length $\ell_6$=165 [mm].

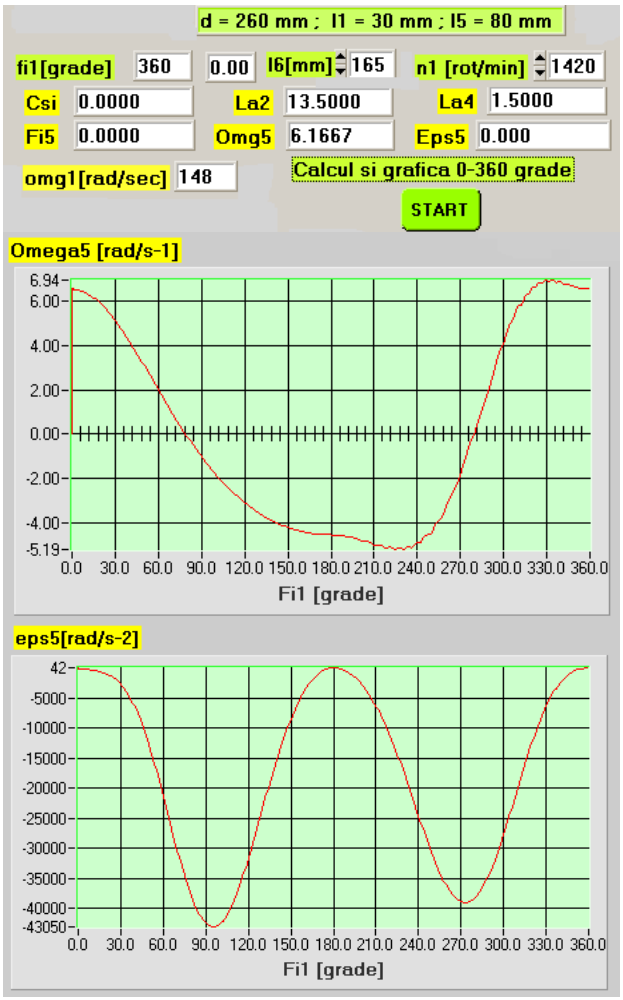


**Fig. 7**

The values of the angular velocity obtained from the calculations made for four values of length $\ell_6$ are given in table 1.

*Table 1*

| $\varphi_1$ [°] | $\ell_6$[mm] | | | |
|---|---|---|---|---|
| | **120** | **135** | **150** | **165** |
| | $\omega_5$ | $\omega_5$ | $\omega_5$ | $\omega_5$ |
| 0 | 39,269 | 25,232 | 14,718 | 6,541 |
| 30 | 30,660 | 19,754 | 11,580 | 5,176 |
| 60 | 10,538 | 7,254 | 4,468 | 2,079 |
| 90 | -8,085 | -4,598 | -2,417 | -0,983 |
| 120 | - 18,421 | -11,845 | -6,922 | -3,085 |
| 150 | -22,546 | -15,152 | -9,162 | -4,193 |
| 180 | -23,561 | -16,056 | -9,812 | -4,528 |
| 210 | -22,546 | -15,152 | -9,162 | -4,193 |
| 240 | -18,421 | -11,845 | -6,922 | -3,085 |

| | | | | |
|---|---|---|---|---|
| 270 | -8,085 | -4,598 | -2,417 | -0,983 |
| 300 | 10,538 | 7,254 | 4,468 | 2,079 |
| 330 | 30,660 | 19,754 | 11,580 | 5,176 |
| 360 | 39,269 | 25,232 | 14,718 | 6,541 |

## 4. CONCLUSION

After analysing the rod mechanism with the variable length we can observe that the speed and angular acceleration decreases along with increased adjustable lengths $\ell_6$ of the mechanism with adjustable oscillations on the impulse drive construction.

## 5. REFERENCES

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## CINEMATICA MECANISMULUI CU OSCILATII REGLABILE CU BIELA DE LUNGIME VARIABILA

**Rezumat:** În cadrul acestei lucrări s-au determinat variațiile vitezelor şi acceleraţiilor unghiulare pentru diferite lungimi ale mecanismului cu oscilații reglabile utilizat în variatorul cu impulsuri Gusa. Pentru aceasta s-a realizat un program care să permită afişarea grafică a acestora.

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