SYNTHESIS AND ANALYSIS OF A MECHANISM WITH THREE DYADS AND TWO DRIVING ELEMENTS

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ABSTRACT: In the paper it is designed the synthesis of a mechanism with two driving elements and three dyads. It started from a mechanism with an oscillating slider connected to a slider- crank mechanism through an RPP type dyad. In this way, the resulting mechanism is of type RR-PRR-RRP-RPP. The equations for the analysis of the mechanism are written, using the closed-loop method, and based on a computer program numerous curves are obtained. A first set of curves were obtained by changing some dimensions of the mechanism, and the second set of curves resulted from the changing of the correlation coefficient between the angles of the driving elements. The resulted curves are unknown in the theory of mechanisms, but they have interesting shapes.

KEY WORDS : curves of the RR-PRR-RRP-RPP mechanism, mechanisms for generating curves, special curves

1. INTRODUCTION

Academician Artobolevskii's research on the geometry of mechanisms is known, as well as many volumes with mechanisms that draw different curves [1, 2]. Numerous drawings of mechanisms for curves generating are given in [14]. In [13] is given the animation of a mechanism which generates different curves depending on the position of a joint of the mechanism. Our team has dealt a lot with mechanisms for generating mathematical curves [8, 9, 10]. In [12] we have also studied curves of slider-crank mechanism generated by mechanisms with two driving elements. An original mechanism for generating rare curves is studied below.

2.THE MECHANISM SYNTHESIS

We started from the oscillating slider mechanism ABG (fig. 1) which was connected with the slider-crank mechanism EFD, through the dyad BCC.

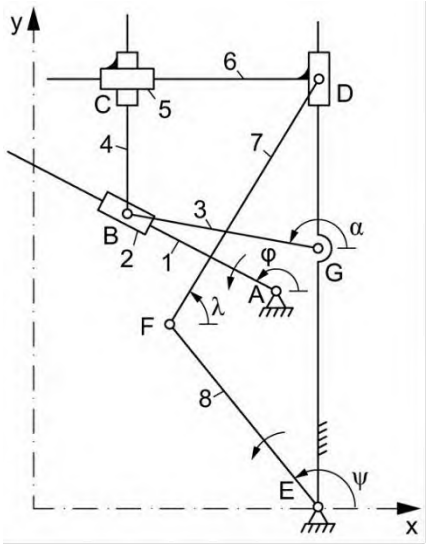

Figure 1. The generating mechanism

The purpose of creating this mechanism was to find out what possibilities it has to describe the interesting trajectories.The mechanism is decomposed into kinematic groups, the method being applied in other works that include structural analysis, such as [3, 6, 11] . Structurally, the mechanism has two driving elements, i.e. GB and EF (fig. 2) and three dyads: BBG, FDD, CCB, being a mechanism of type RR-PRR-RRP-RPP.

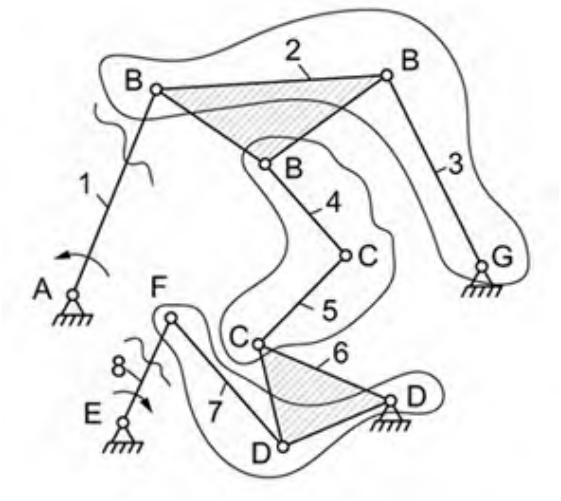

Figure 2. The structure of the mechanism

3.THE MECHANISM ANALYSIS

The dimensions of the mechanism were established by tests, so that the driving elements to rotate as much as possible and the resulting curves to be almost closed. The following dimensions were chosen: XE = 63; XA = 35; XG = XE; YG = 45; GB = 90: EF = 53; FD = 65; YA = 25 [mm]; q = 0.85.

To determine the curves described by a mechanism, mathematical equations of the coordinates of the different points of the mechanism are needed. For this, the closed-loop method can be applied. The closed-loop method is often used in the kinematic analysis of mechanisms, as it can be encountered in different scientific papers [4, 5, 7].

For the mechanism in Figure 1, based on the closed-loop method, the following equations result:

$$x_B = x_A + AB\cos\varphi = x_G + GB\cos\alpha \quad (1)$$

$$y_B = y_A + AB\sin\varphi = y_G + GB\sin\alpha \quad (2)$$

$$x_C = x_B \quad (3)$$

$$x_F = x_E + EF\cos\psi \quad (4)$$

$$y_F = Y_E + EF\sin\psi \quad (5)$$

$$x_D = x_F + FD\cos\lambda = const. \quad (6)$$

$$y_D = Y_F + FD\sin\lambda \quad (7)$$

$$y_C = y_D \quad (8)$$

$$\psi = q \cdot \varphi \quad (9)$$

From (1) and (2) result: α, AB, x_B, y_B, and from (3) x_C is obtained, the point C belonging to the right angle BCD. From (4) and (5) the coordinates of F are obtained, from (6) results λ and x_D, and from (7) results y_D, being equal to y_C, according to relation (8). The relation (9) allows to determinate the function ψ=f(φ), as linear relation (easily achievable by the current electromechanical systems), the coefficient q being introduced as the initial date.

4. CURVES OBTAINED BY CHANGING SOME DIMENSIONS OF THE MECHANISM

In fig. 3 it is shown the curve described by the point C for the initial values of the lengths of some elements, indicated below the figure. The curve is not closed, but has a special shape, different from the usual curves. Next are presented other curves

resulting from other values of some elements of the mecanism.

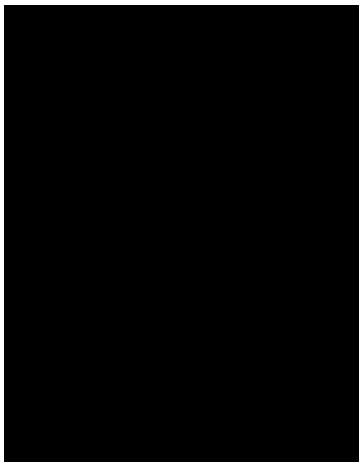

Figure 3. GB=90; XA=35; YA=25

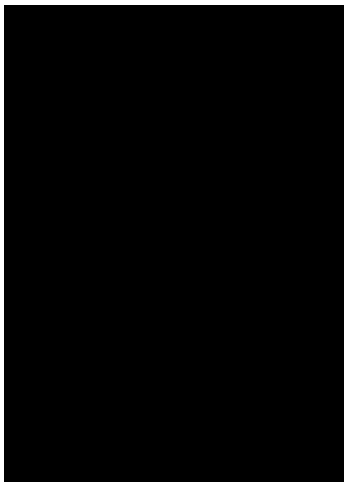

Figure 4. GB=65; XA=25; YA=80

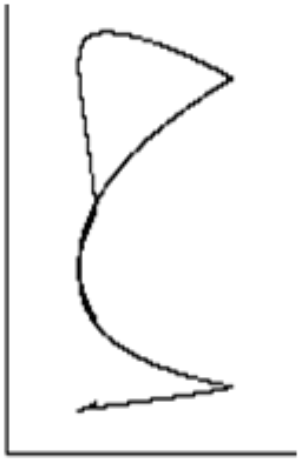

Figure 5. GB=90; XA=40; YA=25

The resulting curves are open, continuous, with shapes rarely encountered in mechanism.

5. CURVES OBTAINED BY MODIFYING "q" PARAMETER

To establish the values of ψ correlated with those of φ, the coefficient q was modified The same initial data for the elements lengths were used. The results are given below.

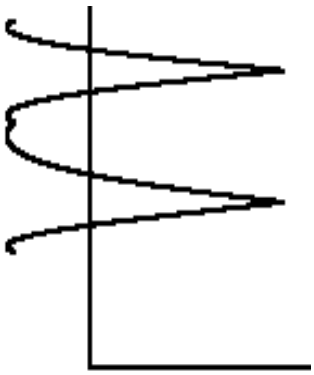

Figure 6. q=0,2

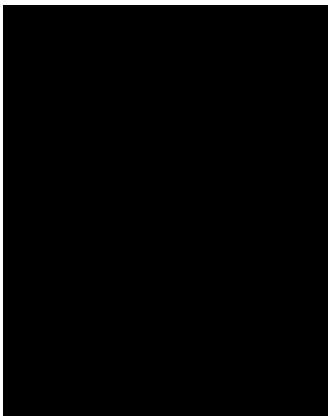

Figure 7. q=0,5

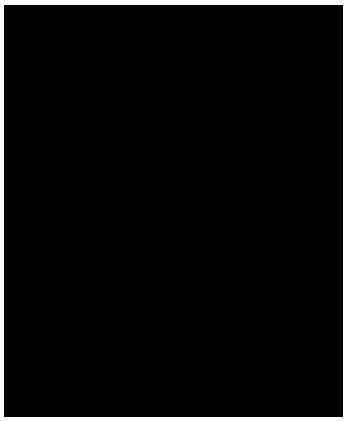

Figure 8. q=1

Figure 9. q=1,8

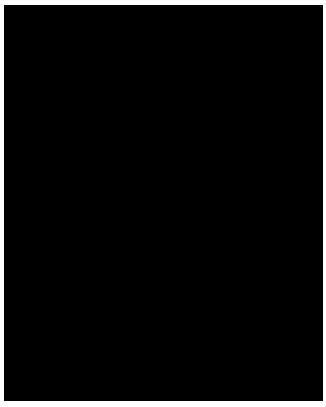

Figure 10. q=2

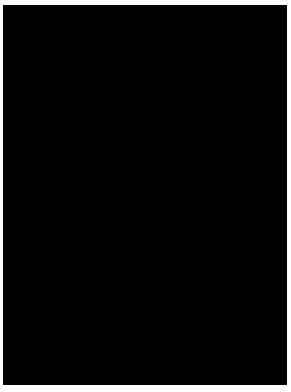

Figure 11. q=4

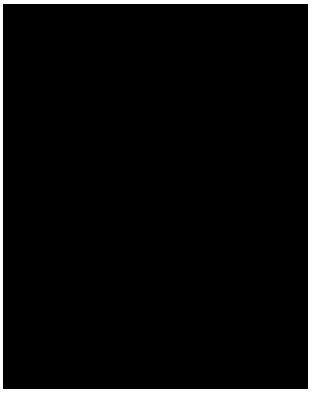

Figure 12. q=20

The negative values of q were also taken. At positive values of q, the element GB rotates trigonometrically like the element EF, and for the negative values of q, the element EF rotates clockwise. Below are the resulting curves for negative q.

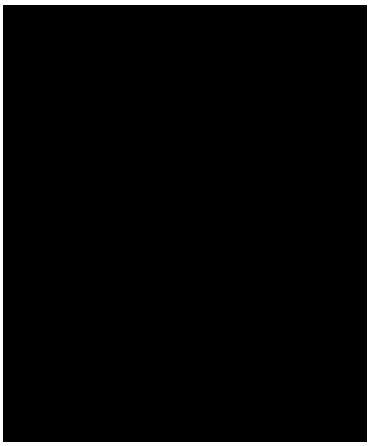

Figure 13. q = - 1,8

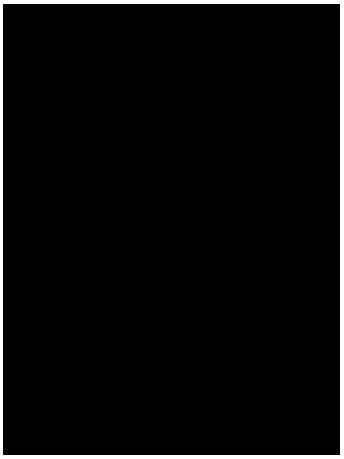

Figure 14. q= - 2

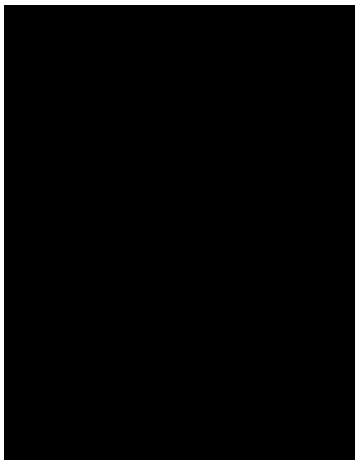

Figure 15. q= - 4

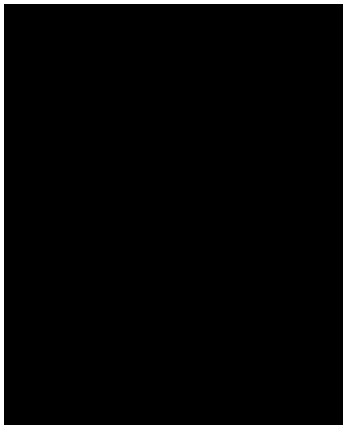

Figure 16. q= - 8

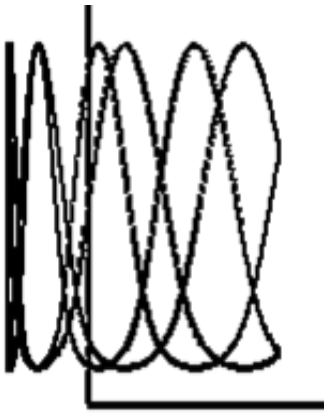

Figure 17. q= - 9

The mechanisms were also represented in one position and in successive positions for different values of q.

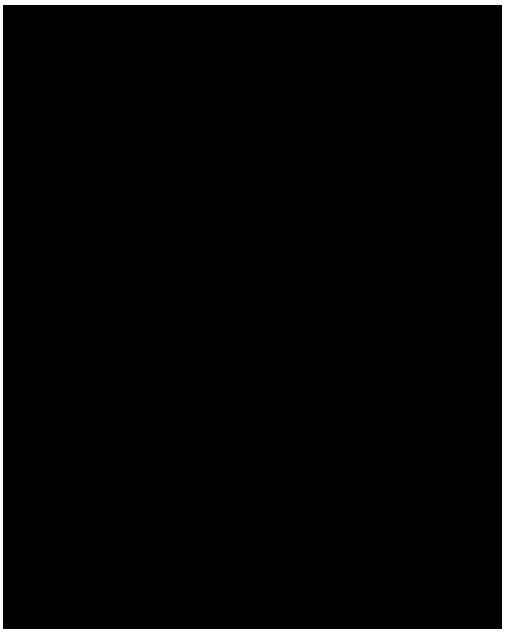

Figure 18. q= 1

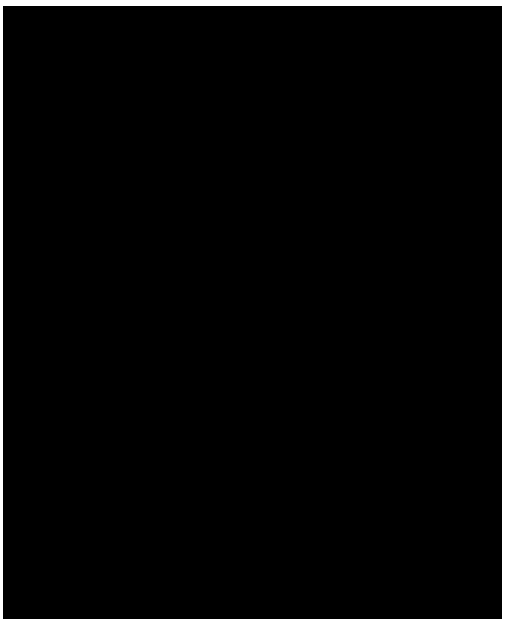

Figure 19. q= - 1,5

Other kinds of curves were obtained than those in the previous paragraph, finding that the q parameter has a significant influence on the shapes of the resulting curves .

6. CONCLUSIONS

The idea of the research started from the oscillating slider mechanism, which was connected with a slider-crank mechanism through an RPP type dyad. The result was an RR-PRR-RRP-RPP mechanism with two driving elements and three dyads. The purpose of the mechanism analysis was to determine the trajectories generated by a point on two welded sliders. These trajectories are new curves generated by mechanisms, obtained by changing the lengths of some elements of the mechanism. Another range of curves was obtained by changing the correlation coefficient between the angles of rotation of the driving elements. The curves are new compared to those generated by different mechanisms and studied so far.

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