ROCKER CURVES GENERATED BY POINTS FROM THE R-RRP-RPP-RPP MECHANISM

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Abstract: *In this paper we present the study of an R-RRP-RPP-RPP mechanism. It starts from the R-RRP mechanism, to which two RPP diade are added, which have the rotation pair at the same point on the driving element. The welded sliders have the generating points, one moving on the bar, and the other on a moving translation element. There are obtained many curves of interesting shapes, the most complicate with loops, where the welded sliders move on the rocker. The size of the mechanism has changed, increasing the range of generated rocker curves.*

Keywords: rocker curves, RPP diade, mechanism with three diades

1. Introduction

Rocker curves have a lot to do with mechanics designers, they are necessary for the machinery of machinery such as textiles, printing, excavators, presses and many other fields.

It is well-known the Hrones-Nelson atlas, of the rocker curves for the articulated quadrilateral mechanism, where the rocker curves are plotted with graphical methods, published in 1951 [1]. In [2] there is given an actual atlas, for the case of mechanisms that meet the Grashof conditions. The contouring method was used for analysis. There are many volumes of mechanisms used in the technique [3], many of them drawing different mathematical curves, especially ellipses, parables, hyperboles, but also other curves.

In [4, 5, 6, 7] there are presented many original mechanisms that generate mathematical curves or different rocker curves. In [8] there is animation of some mechanisms, some of which have only driving element R and one RPP diade, following the final translation movement of the last slider of the diade. A RPP diade is used in a stop mechanism [9], that is, on a subinterval of time, the end-driven element stays, although the leading element moves further. It is exemplified by a mechanism usable in a press. In [10] we start from the Burmester classical problem and synthesize a quadrilateral mechanism using also sliders, establishing a synthesis method using an invariant based on geometric considerations. A doctoral thesis [11] studies the kinematic errors of some mechanisms with or without diade, establishing the dimensional tolerances, observing the geometric conditions, using an iterative technique. Position, speeds and accelerations are taken into account.

This paper presents a study of the rocker curves generated by a new R-RRP-RPP-RPP mechanism.

2. The new mechanism- R-RRP-RPP-RPP.

Initially, the R-RRP mechanism was built, ie ABC (figure 1). Then, the first RPP diade was linked, ie DEE, a slider of E moving on the rocker BC. Next, the second RPP diade was linked, ie DF, in F being a straight line solidarized with slider 3.

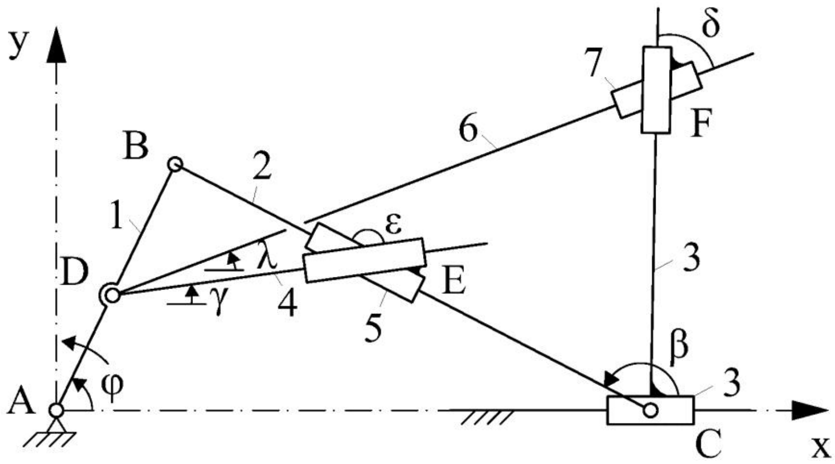

Fig. 1. The mechanism with three diades

The structural scheme of the mechanism is given in figure 2, resulting in an R-RRP-RPP-RPP type mechanism.

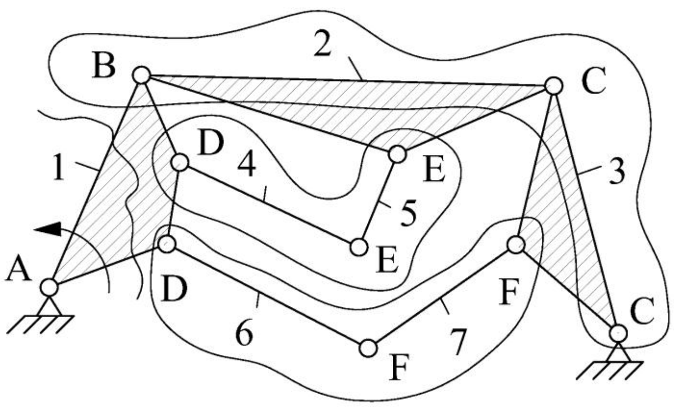

Fig. 2. The structural scheme

3. Relations and results

Based on fig. 1 are written the relations :

$$x_B = AB\cos\varphi; \quad y_B = AB\sin\varphi \tag{1}$$

$$x_D = AD\cos\varphi; \quad y_D = AD\sin\varphi \tag{2}$$

$$x_C + BC\cos\beta = x_B \tag{3}$$

$$BC\sin\beta = y_B \tag{4}$$

$$x_E = x_D + DE\cos\gamma = x_C + CE\cos\beta \tag{5}$$

$$y_E = y_D + DE\sin\gamma = CE\sin\beta \tag{6}$$

$$\gamma = \beta - \varepsilon \quad (7)$$

$$x_F = x_D + DF\cos\lambda = x_C \quad (8)$$

$$y_F = y_D + DF\sin\lambda \quad (9)$$

$$\lambda = 90 - \delta \quad (10)$$

From (1) the position of B is obtained, from (2) the position of D is obtained, from (3) and (4) result XC and β and from (5) and (6) result DE and CE. The angle results from (7) and the position of F results from relations (8) and (9). The λ angle, which is constant, is given by the relation (10).

Having as initial data: AB = 45; BC = 85; AD = 25; = 145; = 70 (lengths in mm and angles in degrees), based on a program, the mechanism was obtained at a position in figure 3 and the successive positions in figure 4.

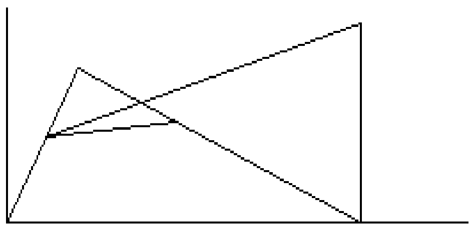

Fig. 3. The mechanism position for the initial data

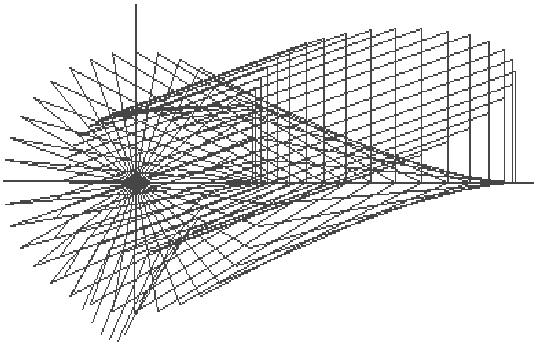

Fig. 4. Successive positions

Figure 5 shows that there are no breaks in the movement of the mechanism, the curves being continuous.

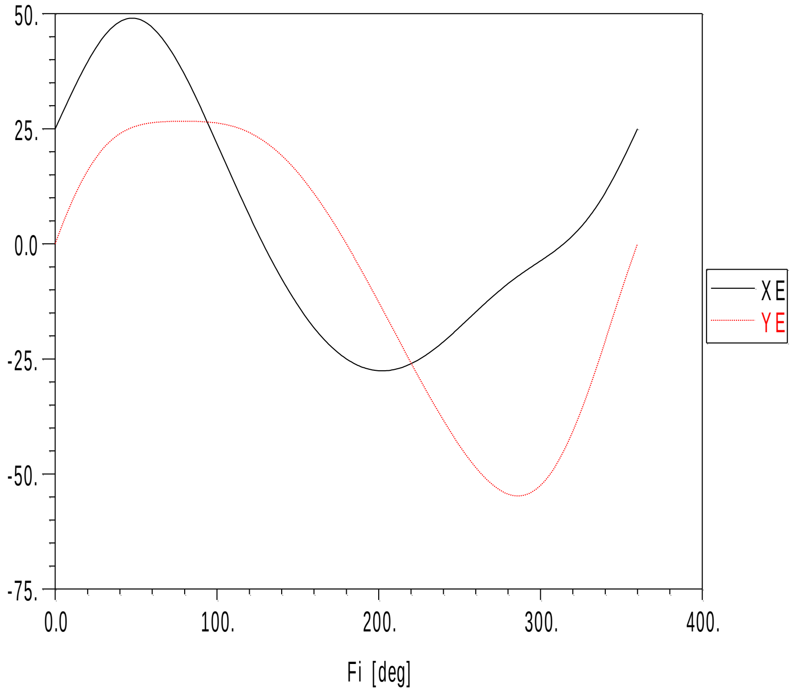

Fig. 5 . Variation of E coordinates

4. Rocker curves generated by E point

With the initial data we obtained the trajectory of point E (figure 6).

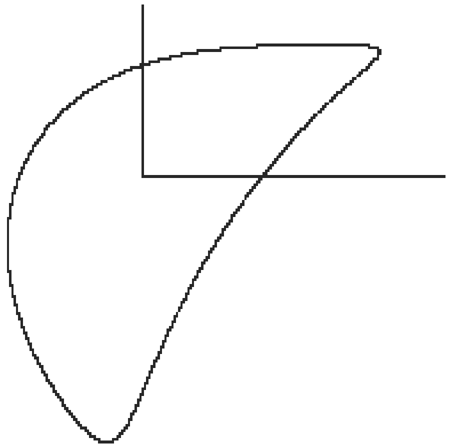

Fig. 6. The E trajectory for the initial data

In the following figures (figure 7, 8...18) are given the rocker curves resulting from the change in the ε angle between the welded sliders in E.

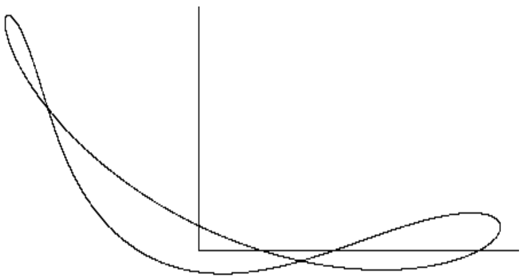

Fig. 7. The rocker curve, ε =10

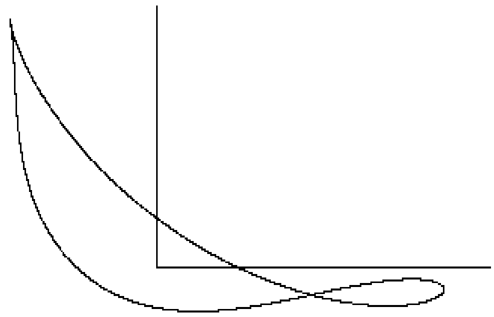

Fig. 8. The rocker curve, ε =15

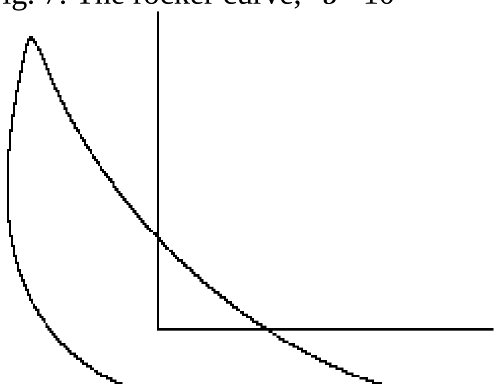

Fig. 9. The rocker curve, ε =20

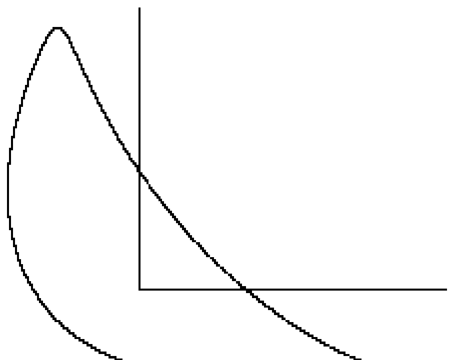

Fig. 10. The rocker curve, ε =25

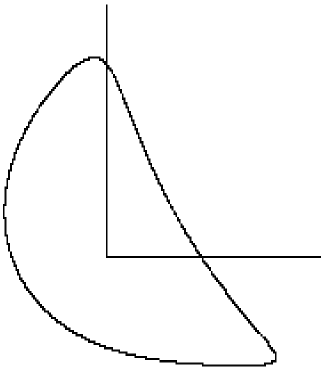

Fig. 11. The rocker curve, ε =40

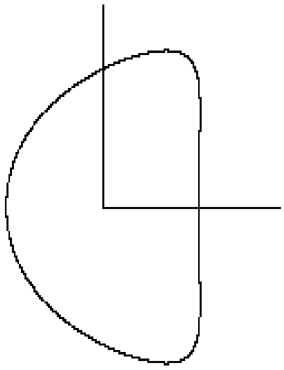

Fig. 12. The rocker curve, ε =90 şi 270

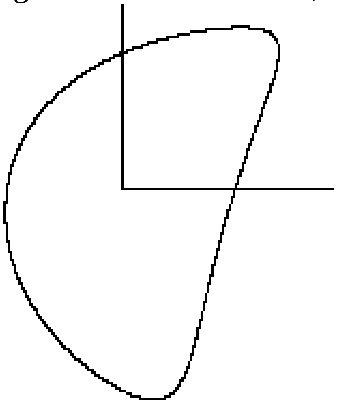

Fig. 13. The rocker curve, ε =120

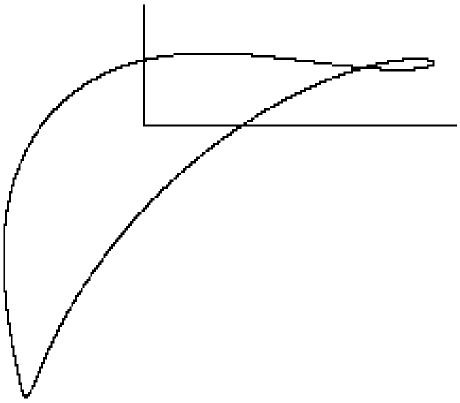

Fig. 14. The rocker curve, ε =160

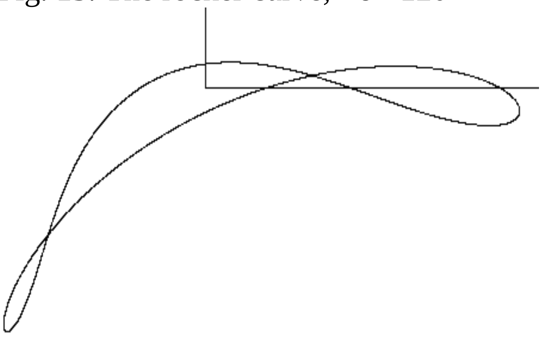

Fig. 15. The rocker curve, ε =170

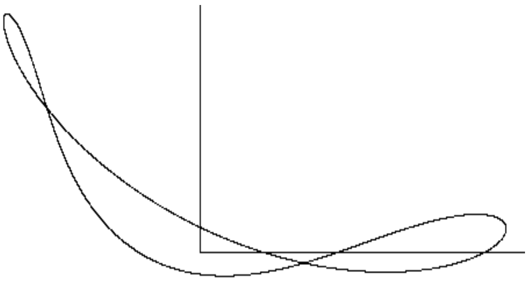

Fig. 16. The rocker curve, ε =190

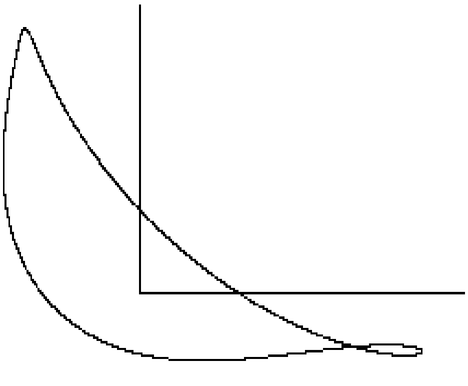

Fig. 17. The rocker curve, ε =200

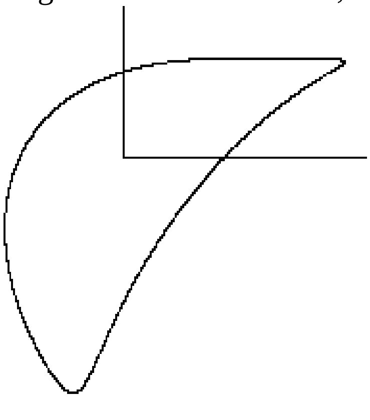

Fig. 18. The rocker curve, ε =330

For $\varepsilon = 90$ but with AD = 2AB, it resulted the rocker curve of figure 19, a symmetrical curve, also obtained with other mechanisms. If AD = - AB, the curves of figure 20 and 21 result.

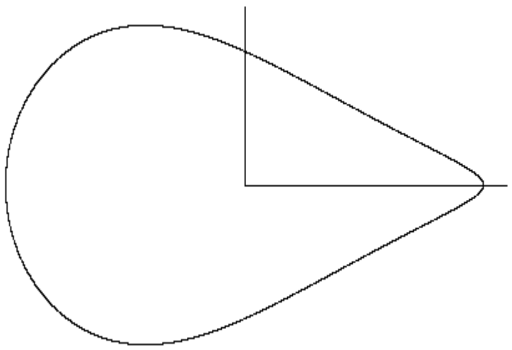

Fig. 19. The rocker curve, ε =90, AD=2AB

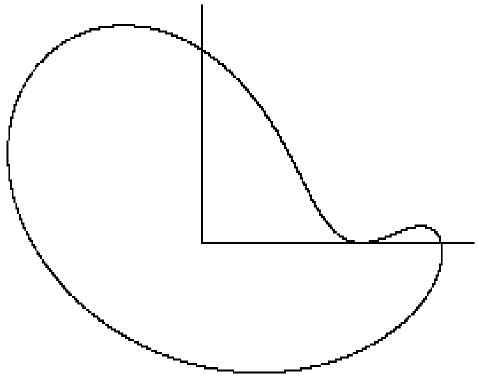

Fig. 20. The rocker curve, ε =70; AD= – AB

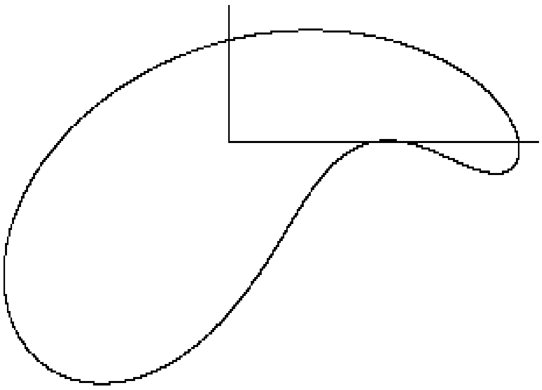

Fig. 21. The rocker curve, ε =120; AD= – AB

It is found that by altering some lengths, other curves are obtained.

5. Rocker curves generated by F point

With the initial data the F point generates the rocker curve of figure 22. From figure 23 it is found that both curves are symmetrical in relation to the ordinate, from $\varphi = 180$ degrees, the curves being continuous.

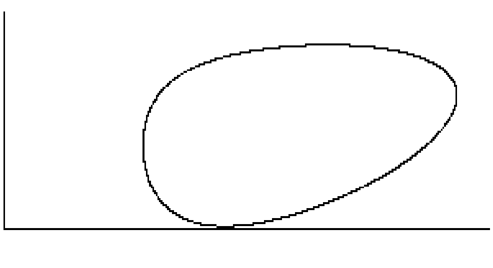

Fig. 22. The F trajectory for the initial data

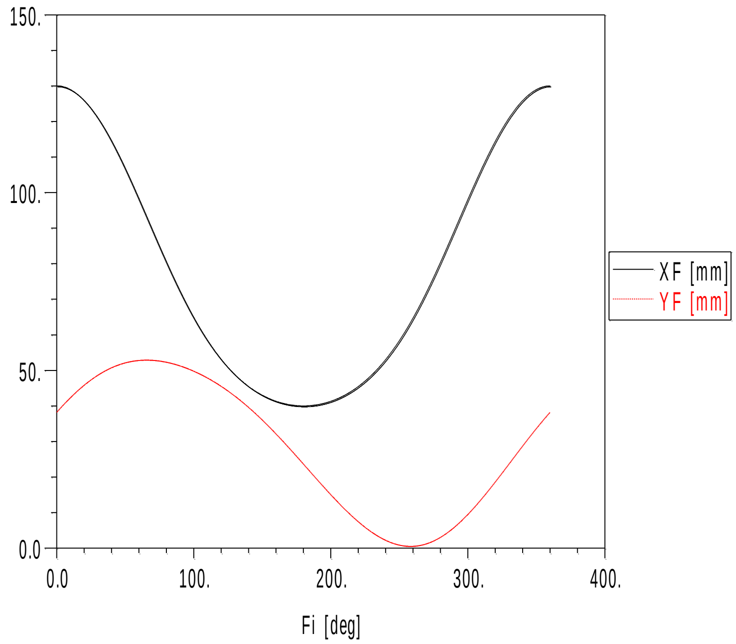

Fig. 23. Variation of F coordinates for the initial data

Next, the δ angular values from 0 to 90 degrees were cycled, with a 10 degree pitch, resulting in the rocker curves of figure 24 (for δ = 0 ... 90 and 180 ... 270), the sequence of curves being from the top down, to his growth δ. Similarly, it was obtained the figure 25 for δ = 90 ... 180 and 270 ... 360. Curves are the same, but with different dimensions and slopes for different δ values.

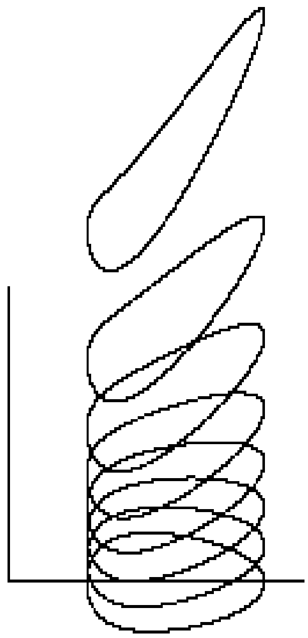

Fig. 24. The F trajectory for δ=0…90 and 180…270

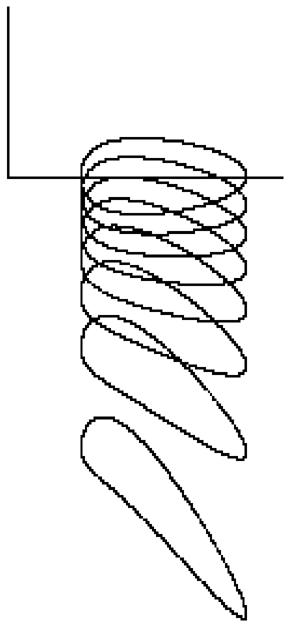

Fig. 25. The F trajectory for δ=90…180 şi 270…360

It is found that the point on a slider that moves on the rocker offers a larger range of rocker curves. The point that moves on a straight line related to an element in translation movement offers a smaller range of rocker curves.

6. Conclusions

A mechanism was built from the R-RRP mechanism, to which two RPP diades were added, one with the welded slider moving on the rocker and the other on a translation movement element. More special rocker curves have been generated in the case of the movement on the rocker. The mechanism is of the R-RRP-RPP-RPP type.

Curves found have special shapes, some of which are known to be generated by other mechanisms, other completely new curves. Some dimensions of the mechanism have been changed and a wide range of rocker curves were obtained.

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