THEORETICAL RESEARCHES REGARDING THE KINEMATIC POSSIBILITIES FOR THE THREE PLAN BARS MECHANISMS

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Abstract: *In this paper some results obtained using procedures and computational programmes for the drawing of coupler curve for three linked plan bars R-RTT mechanism are presented. There are showed some of the trajectories for a coupler point obtained with computational programmes applied to the three bar linkages. The programmes calculate and the perimeter of the obtained curves, variable that constitute the first indication in these curves identification.*

Because it is possible to modify both the element's dimensions and the position of the tracing point, the range of these trajectories can be extremely diverse. The programmes, allow the finding a numerous groups of solutions, which can be registered into bi-dimensional vectors, forming that way a base of data.
Key words: *mechanism, dyad, computational programmes, trajectories.*

1. INTRODUCTION

With the new codification [2] the symbol of the dyad represent the firs number is the aspect of the dyad (in the classical way) and the second number represents the variant of the dyad. It is showed how, by using the rules and principles of inventics, we can find many variants of mechanisms and for some précised criteria, it can be determined all possible mechanisms.

Usually the theory of mechanisms works with five dyads codified by the number of the translations couples and these ones positions. For an actuator element and a dyad we can obtain 38 variants from which only 25 are utilizable because, into a closed contour they must have minimum two rotation couples.

These variants were established from the principles of the inventics [2] by morphological analysis, where every possible variant was taking into consideration. For the structural synthesis it counts if the translation's couples is on the left or the right side or if the slideway belong to the dyad or not, because we can obtain different movements.

2. PREREQUISITES AND MEANS FOR SOLVING THE PROBLEM

We start from two kind of the same R-RTT mechanism category: the R-D50 mechanism (fig. 1), with trajectories equivalent with T-D23 mechanism, and the R-D52 mechanism (fig. 2), with trajectories equivalent with R-D55 mechanism.

Based on the fig. 1 we obtain the following relations:

$$\begin{cases} x_C = L_1\cos\varphi + S_2\cos\alpha = x_D + S\cos\lambda + L_3\cos(\lambda+\gamma_1) \\ y_C = L_1\sin\varphi + S_2\sin\alpha = S\sin\lambda + L_3\sin(\lambda+\gamma_1) \end{cases} \tag{1}$$

$$S_2 = \frac{L_1\sin\varphi - L_3\sin(\lambda+\gamma_1) - tg\lambda\left[L_1\cos\varphi - x_D - L_3\cos(\lambda+\gamma_1)\right]}{\cos\varphi\cdot tg\lambda - \sin\alpha} \tag{2}$$

$$S_1 = \frac{L_1\sin\varphi + S_2\sin\alpha - L_3\sin(\lambda+\gamma_1)}{\sin\lambda} \tag{3}$$

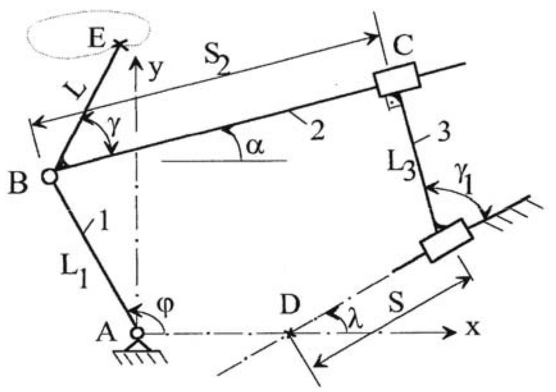

Fig. 1. The R-D50 mechanism

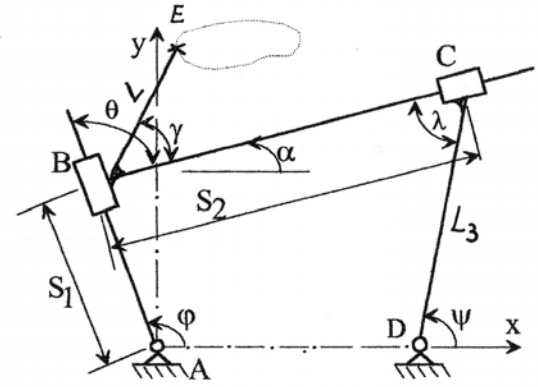

Fig. 2. The R-D52 mechanism

Based on the fig. 2 we obtain the following relations:

$$\begin{cases} x_C = S_1\cos\varphi + S_2\cos\alpha = x_D + L_3\cos\psi \\ y_C = S_1\sin\varphi + S_2\sin\alpha = L_3\sin\psi \end{cases} \tag{4}$$

$$S_2 = \frac{L_3\sin\psi - tg\varphi\left[x_D + L_3\cos\psi\right]}{\sin\alpha - tg\varphi\cdot\cos\alpha} \tag{5}$$

$$S = \frac{L_1\sin\varphi + S_2\sin\alpha - L_3\sin(\lambda+\gamma_1)}{\sin\lambda} \tag{6}$$

Based on the relations (1), (2), …,(6) there were elaborated procedures and programs that give the different kinds of trajectories and laws of movement for The R-RTT mechanisms.

3. **RESULTS – THE TRAJECTORIES**

Modifying the dimensions L, L_1 and L_2 of the elements, the position x_D for the fixed point and the values λ, γ and γ_1 for the fixed angles, we obtain for the R-D50 mechanism (and also for the T-D23 mechanism) only simple elliptic trajectories (fig. 3 and fig. 4) for the point E:

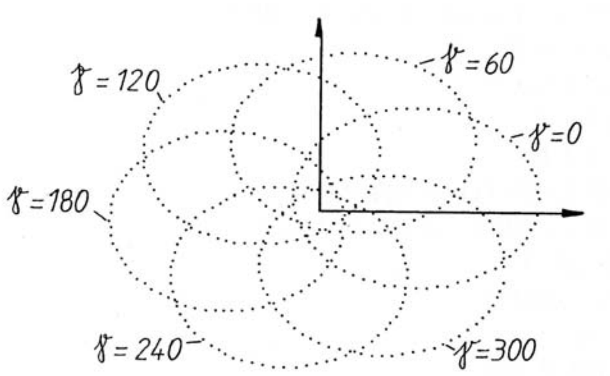

Fig. 3. Trajectories for R-D50 with L1=50, L=40, L3=25, xD=25, λ=60, γ1=40

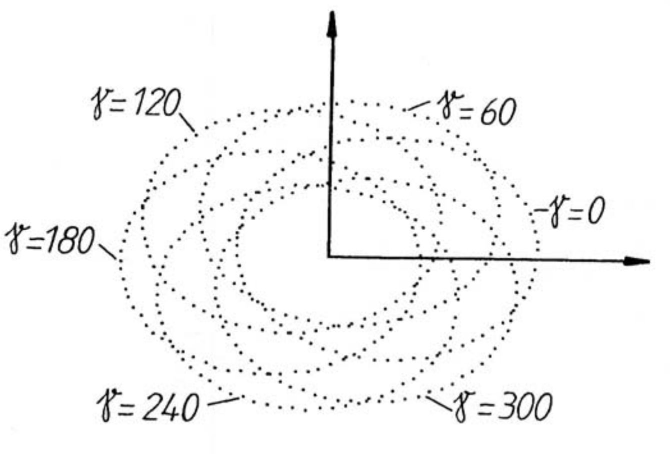

Fig. 4. Trajectories for R-D50 with L1=20, L=40, L3=25, xD=75, λ=60, γ1=40

Modifying the dimensions L and L_2 of the elements, the position x_D for the fixed point and the values λ, γ and θ for the fixed angles, we obtain for the R-D52 mechanism (and also for the T-D23 mechanism) much more complex trajectories as for R-D50 for the point E.

The mechanism from fig. 5 generates the same kind of ellipse for all the values of the γ angle, because $L_3 = 0$ and $x_D = 0$. For $L_3 \neq 0$ and $x_D = 0$ we obtain ellipses superposed two by two, as it is showed in fig. 6. For $L_3 = 0$ and $x_D \neq 0$ we obtain complex curves, as we can see in fig. 7, where we have cardiode curves, and in fig. 8, where we have limaçon curves.

The influence of the modification the L value can be observed in fig.10, where the value of the perimeter of the curves is lower than the case of mechanism from fig. 7.

The influence of the modification the x_D value is showed by comparison in fig. 10 and fig. 11.

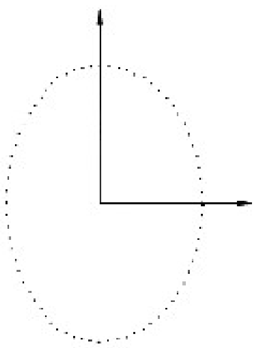

Fig. 5. Trajectories for R-D52 with L=40, L3=0, xD=0, λ=90, θ=90

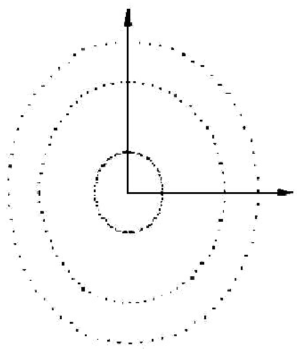

Fig. 6. Trajectories for R-D52 with L=20, L3=20, xD=0, λ=90, θ=90

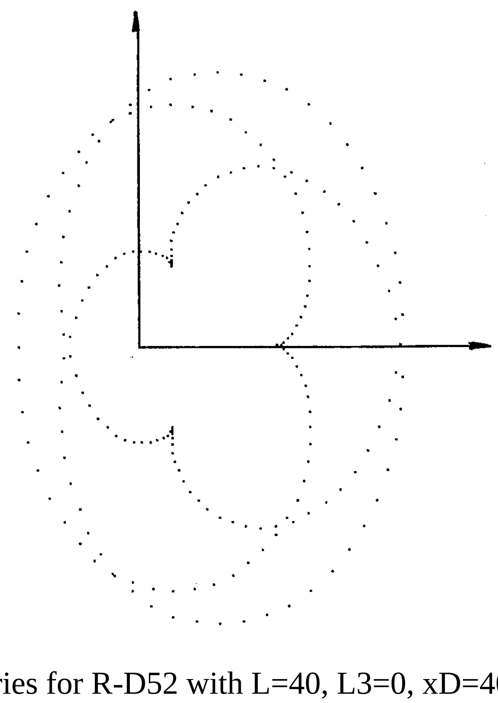

Fig. 7. Trajectories for R-D52 with L=40, L3=0, xD=40, λ=90, θ=90

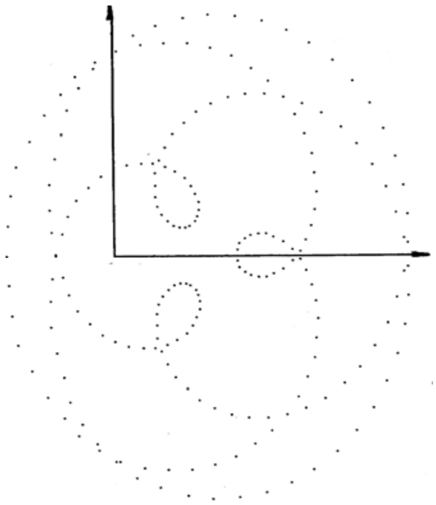

Fig. 8. Trajectories for R-D52 with L=40, L3=0, xD=60, λ=90, θ=90

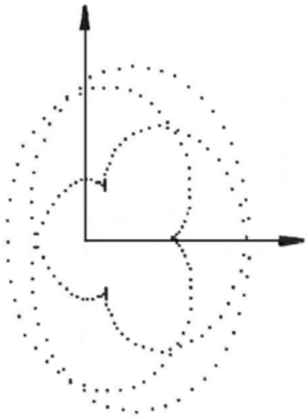

Fig. 9. Trajectories for R-D52 with L=20, L3=0, xD=20, λ=90, θ=90

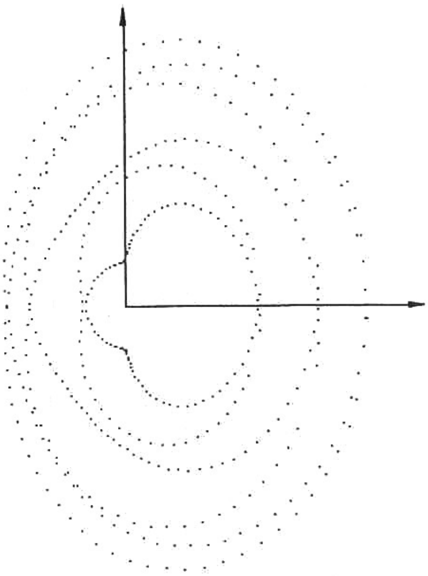

Fig. 10. Trajectories for R-D52 with L=20, L3=40, xD=20, λ=90, θ=90

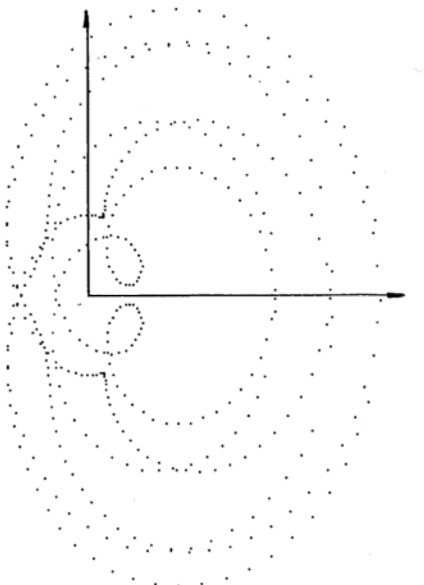

Fig. 11. Trajectories for R-D52 with L=20, L3=40, xD=40, λ=90, θ=90

4. CONCLUSIONS

The programmes calculate the joint’s positions for a complete rotation, but he also give the displacement of a tracing point E, marked on the element with plane movement. The programmes calculate also the perimeter of the obtained curves, variable that constitute the first indication in these curves identification

Because it is possible to modify both the element’s dimensions and the position of the tracing point, the range of these trajectories can be extremely diverse. The programmes, allow the finding a numerous groups of solutions, which can be registered into bi-dimensional vectors, forming this way a base of data.

In case of one imposed curve, the optimal solution for the R-RTT mechanism which can draw it, can be choose by picking the right one from the library of curves already done.

Some problems, regarding the means of comparing, the establishing of the origin’s position for the Cartesian frame and, also, regarding the numerical methods used for the error’s evaluation remain in study, together with the programmes improvement.

5. REFERENCES

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