A GEOMETRIC LOCUS PROBLEM AT A PATRULATER

Professor Liliana LUCA, PhD, University Constantinn Brancusi of Targu-Jiu
Professor Emeritus Iulian POPESCU, PhD, University of Craiova

Abstract: *A geometric locus problem is resolved by an equivalent mechanism of type R-R-RRP-RPP, with two conducting elements with correlated movements by a q coefficient. There are many curves for q> 0 and other completely different, for q <0, the direction of movement of the second leading element influencing the shape of the curve as a geometric place.*

Key words: geometric locus, equivalent mechanism, curves

1. Introduction

Problems of geometric locus are treated with geometry methods, which are limited, yet there are many problems solved, most of them being straight or circular arcs [4]. Some examples of obtaining geometric locus are given in [3]. In [5] there are other examples of geometric locus problems. In [1] and [2] there are other works in which many problems of geometric locus are solved by equivalent mechanisms.

Below, we analyze the ABCD quadrant (Figure 1), where point D moves on AD, and AB and BC have rotational movements. From A go right AE and ask for the geometric locus of E.

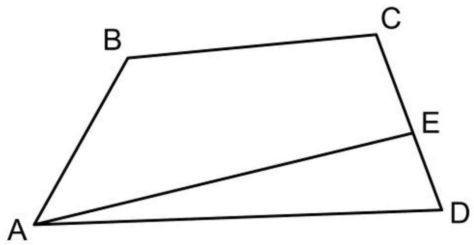

Fig. 1. The initial problem

2. Equivalent mechanism

In fig. 2 we show the equivalent mechanism constructed as follows: for D to move on AD it is mounted in D, and in order for E to slide on the CD, a slider is mounted in D, from which another slide has been welded allowing the passage of the AE element with variable length.

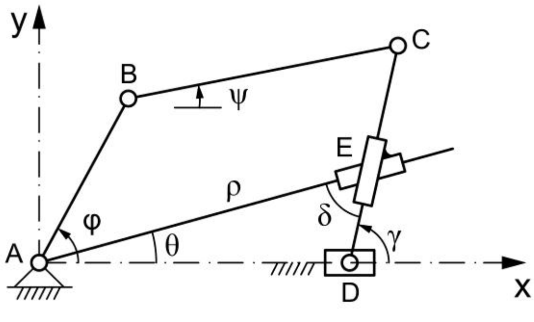

Fig. 2. Equivalent mechanism

The degree of mobility is M = 3.6-2.8 = 2, therefore they are two leading elements, adopting AB and BC, the mechanism being of the type: R-R-RRP-RPP.

3. Calculus relations

Based on fig. 2 the following are written:

$X_B = AB\cos\varphi; \quad Y_B = AB\sin\varphi$ (1)

$X_C = X_B + BC\cos\Psi = X_D + CD\cos\gamma$ (2)

$Y_C = Y_B + BC\sin\Psi = CD\sin\gamma$ (3)

$X_E = X_D + ED\cos\gamma = \rho\cos\theta$ (4)

$Y_E = ED\sin\gamma = \rho\sin\theta$ (5)

$\Psi = q\,\varphi$ (6)

$\theta = \gamma - \delta$ (7)

$ED = (-X_D\, tg\theta) / (\cos\gamma\, tg\theta - \sin\gamma)$ (8)

From (1) results the position of B; of 3 is obtained γ, and from (2) XD, so that the position of C is derived. From (4) and (5) the position of E is obtained, having the angles in (6) and (7). It was considered that the angle ψ is linearly correlated with the coefficient q. From (4) and (5) results the ED race given in (8).

4. Obtained results

The following initial data were taken: AB = 33; BC = 47; CD = 39 mm; δ = 60 degrees. The mechanism was obtained at a position given in fig. 3 and the successive positions of fig. 4 (q = 0.1333).

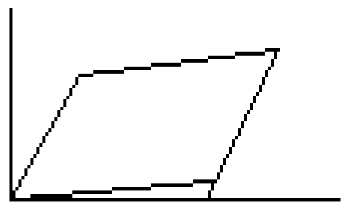

Fig. 3. The mechanism in a position

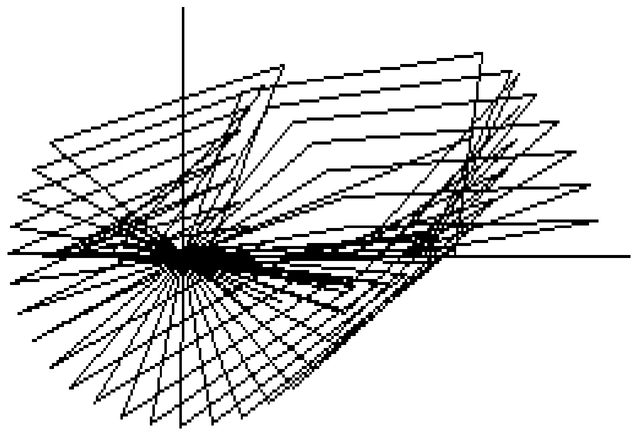

Fig. 4. Successive positions

From figure 5 it is noticed that the mechanism does not work in the area φ = 65 ... 120 degrees because of the lengths adopted for some elements.

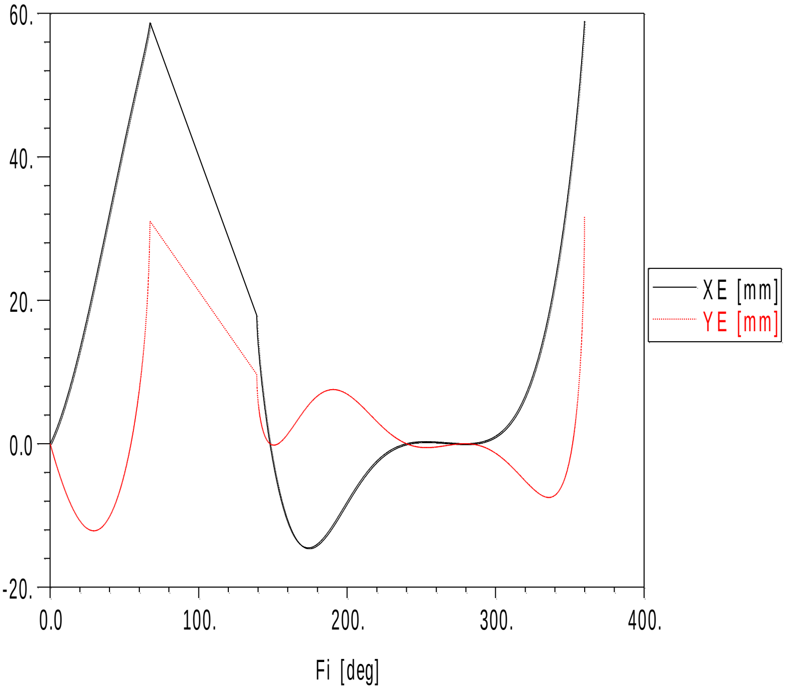

Fig. 5. Variation of E's coordinates

In fig. 6 ... 17 give the resulting geometric places for E at different values of q.

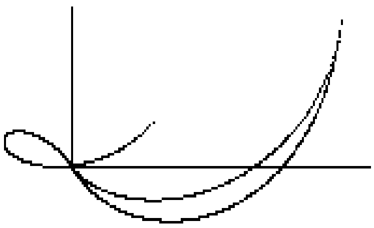

Fig. 6. q=0,156

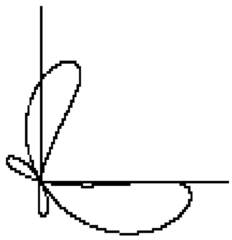

Fig. 7. q=0,01

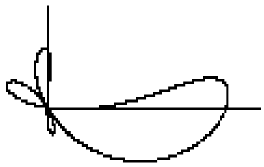

Fig. 8. q=0,05

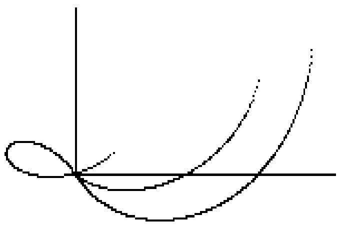

Fig. 9. q=0,2

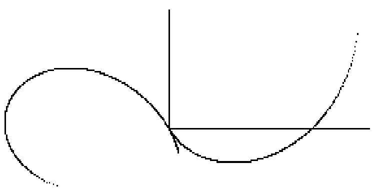

Fig. 10. q=0,5

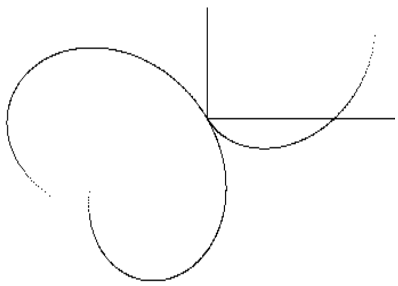

Fig. 11. q=0,7

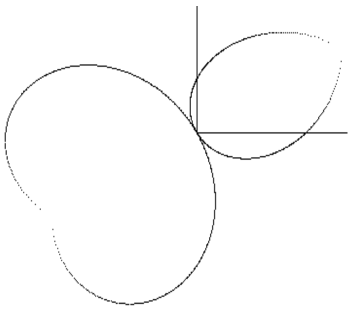

Fig. 12. q=1

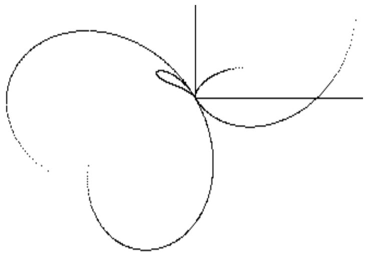

Fig. 13. q=1,5

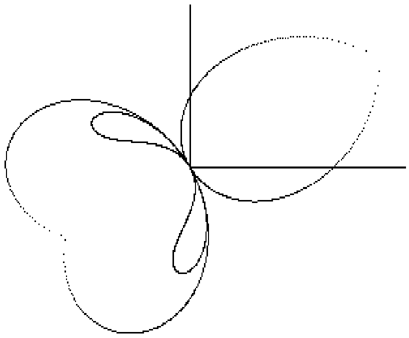

Fig. 14. q=2

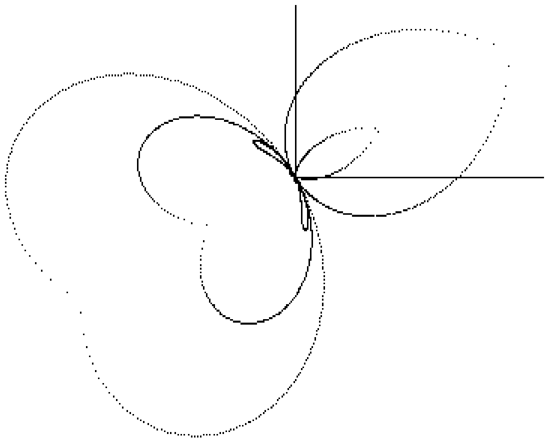

Fig. 15. q=3

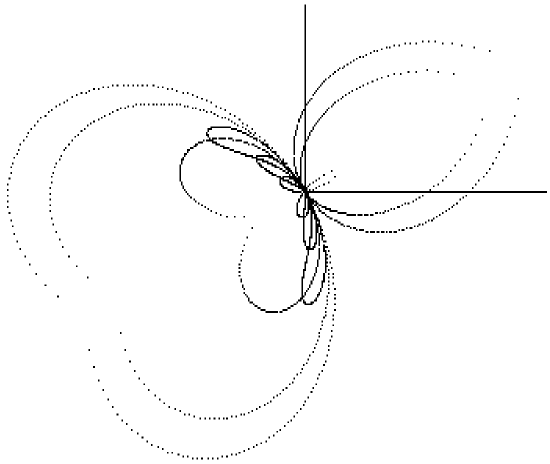

Fig. 16. q=5

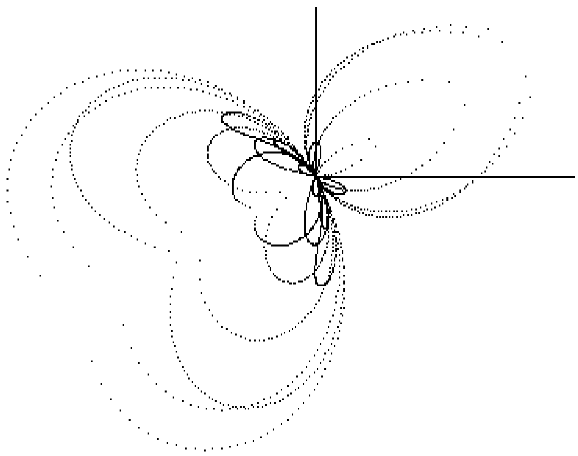

Fig. 17. q=8

Geometric locus are interesting curves, rarely found in mechanisms, with several branches when the coefficient q increases. Interesting and beautiful curves obtained with different plane mechanisms are presented in the works [6, 7, 8, 9, 10].

If q <0, i.e. the BC element rotates clockwise, while AB rotates in trigonometric sense, the geometric locations of fig. 18 ... 26.

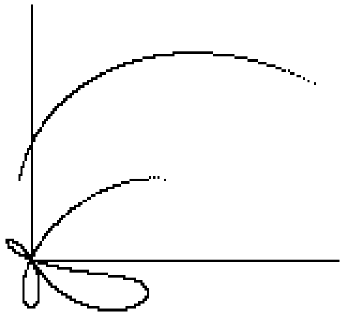

Fig. 18, q=–0,05

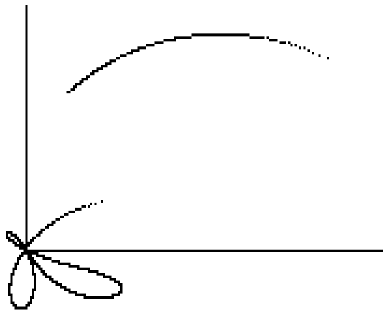

Fig. 19. q=–0,1

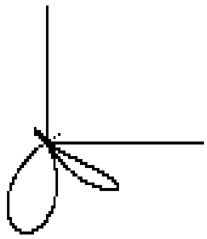

Fig. 20. q=–0,2

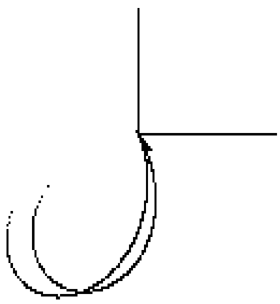

Fig. 21. q=–0,5

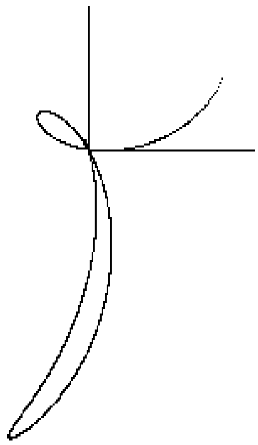

Fig. 22. q=–0,8

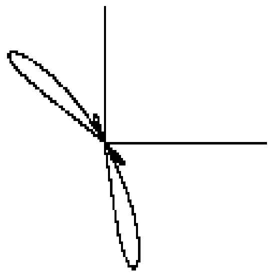

Fig. 23. q=–1

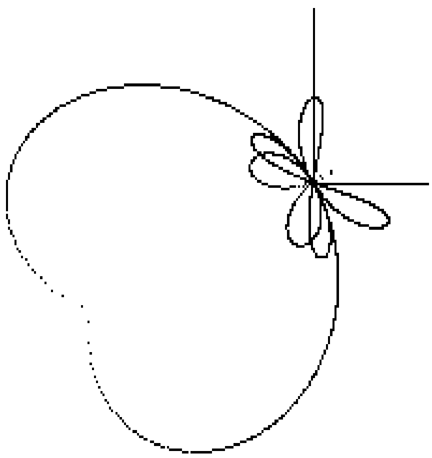

Fig. 24. q=–2

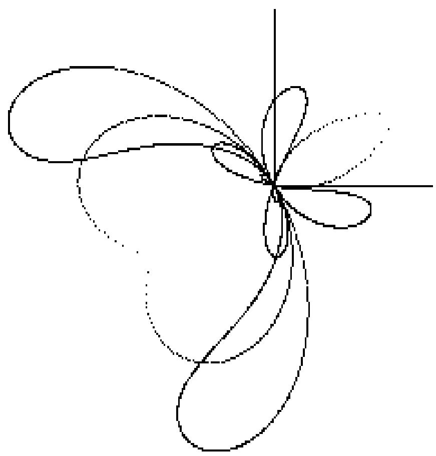

Fig. 25. q=–3

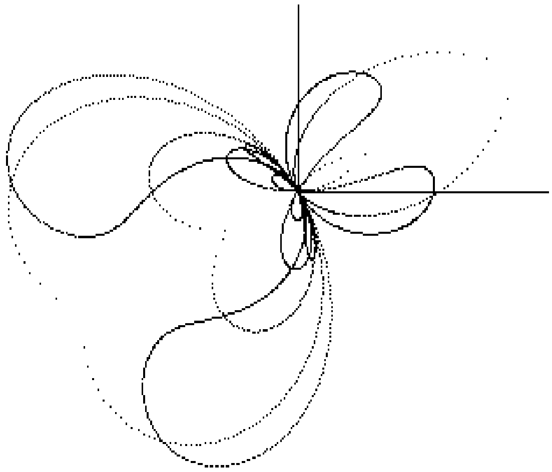

Fig. 26. q=–5

The curves resulting as geometric places are different from those of q> 0, with a wide variety of shapes.

5. Conclusions

The problem of geometric locus has been solved with an equivalent mechanism of type R-R-RRP-RPP. The mechanism having two leading elements has the movements of these elements correlated by a q coefficient. Depending on the value of q, many geometric locus were produced. Work with q> 0 and then with q <0 to obtain different curves when changing rotation directions.

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