KINEMATIC POSSIBILITIES FOR A MECHANISM WITH THREE RRR DYADS. PARTICULAR CASES

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Abstract. The paper deals with the kinematic possibilities of a mechanism with 7 elements, consisting of a leading element with rotating movement and 3 RRR dyads. Two particular cases are analyzed: the first one includes a short crank whilst the second includes a parallelogram and a quadrilater with the sides equal 2 by 2. Based on the projections method, analytical relations are obtained. Trajectories of some points are drawn, along with the diagrams depicting the variation of the co-ordinates of points which generate trajectories.

Key Words: mechanism, trajectories, dyad.

1. INTRODUCTION

Many papers from specialty literature revealed scientists' interest on the mechanisms with 3 dyads. The optimal design of a mechanism with 7 bars used by a press, through reversed Kinematics, is presented in [1]. In this paper, the method of contours is used and kinematical diagrams are provided.
A mechanism with 7 elements based on bars and gear wheels is studied in [3]. Various diagrams concerning the laws for movement are obtained and the resulting trajectories are provided as well.
Studies on the trajectories and movements-related laws for a mechanism with 7 elements, for various particular cases, are presented in the following sections.

2. MECHANISMS WITH THREE RRR DYADS

The first particular case: Fig. 1 depicts the studied mechanism. The mechanism is of type [2]: *R-RRR – 1+0 - RRR – 2+3 – RRR – 4+5.*
The following dimensions were adopted for mechanism's sides: AB_1=49; B_1C_1=81; D_1C_1=74; EF=67; GF=84; HK=46; LK=43; Y_D=0; EH=30; GL=39; HM=20; X_{D1}=106; D_1G=34; B_1E=43; X_A=11; Y_A=30. Unlike the case corresponding to this mechanism, the

crank has a smaller size and A is not placed into the origin.

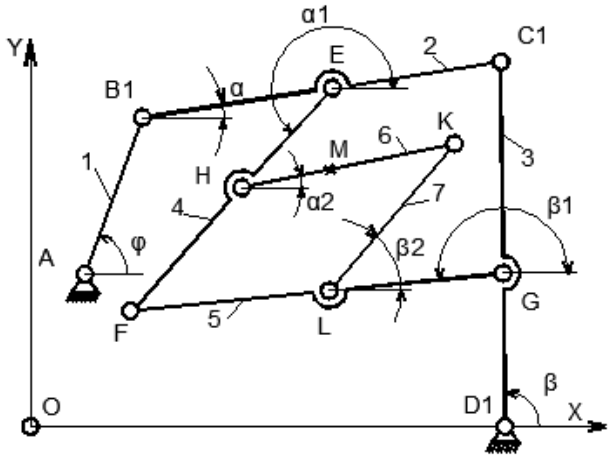

Fig. 1

Results: Fig. 2 depicts the mechanism obtained for φ=70º. It is similar to that from Fig. 1.

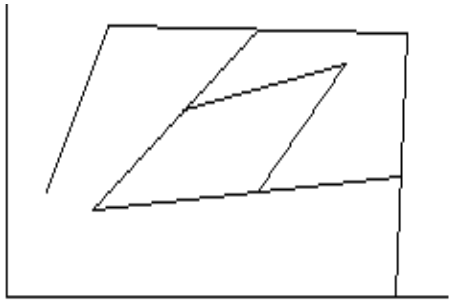

Fig. 2

Fig. 3 (which depicts the successive positions of the mechanism) reveals that the crank executes full rotations. So the mechanism is operational over the entire cycle, as certified by Fig. 4, where the coordinates of B_1 and C_1 are continuous curves.

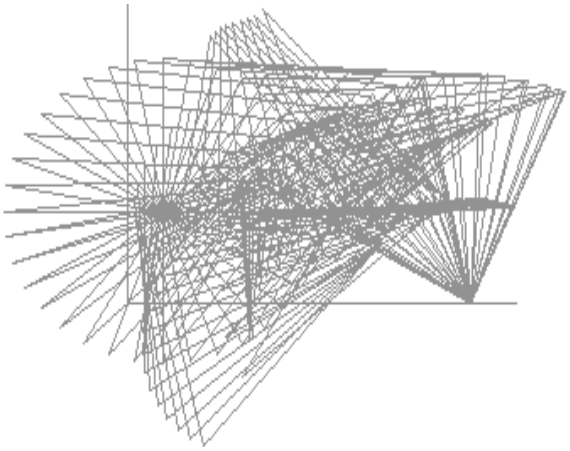

Fig. 3

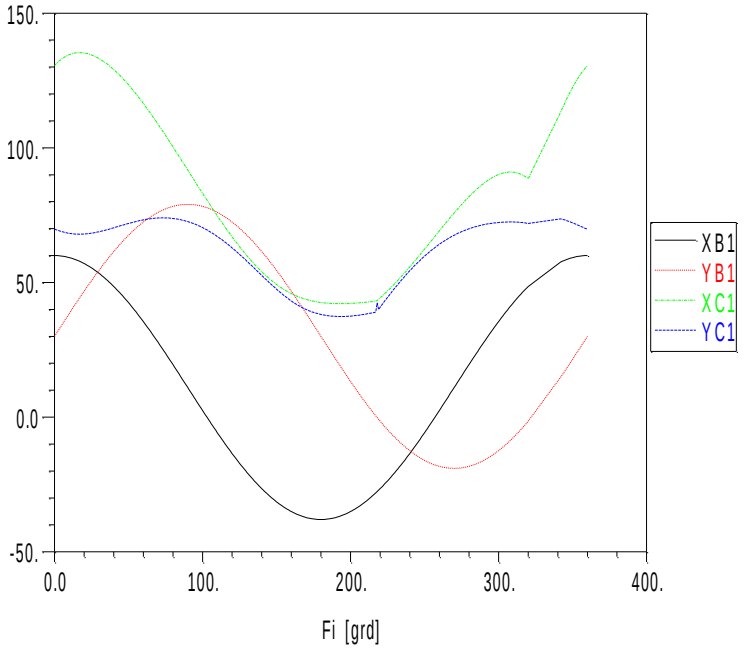

Fig. 4

Fig. 5 depicts the trajectories of points B_1 and C_1. As B_1 describes a full circle whilst to C_1 only a segment of circle is corresponding, one can deduce that C_1D_1 acts like a balance lever.

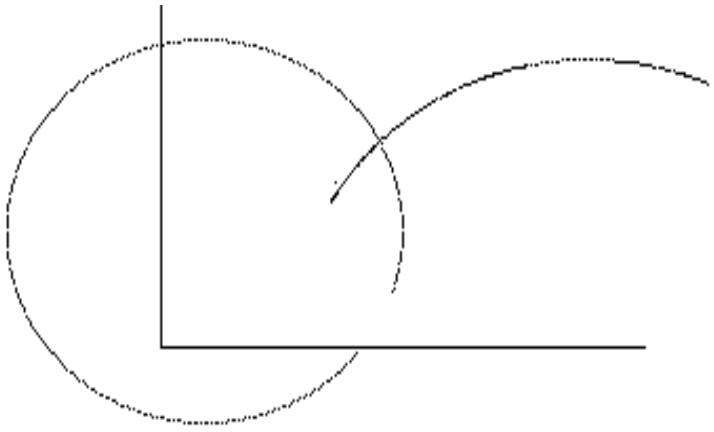

Fig. 5

Fig. 6 is used to represent the trajectories of the points E and G (inputs for the 2nd dyad). The trajectory of E is a closed loop whilst that corresponding to G is a segment of circle.

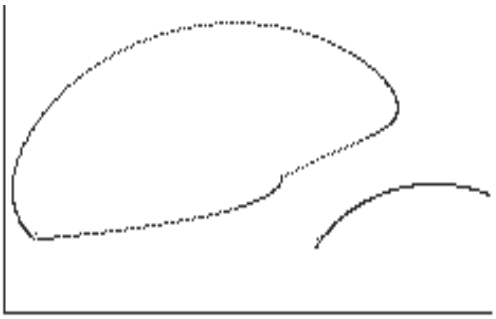

Fig. 6

Fig. 7 depicts the trajectory of H, shape. revealing a closed loop with an unusual

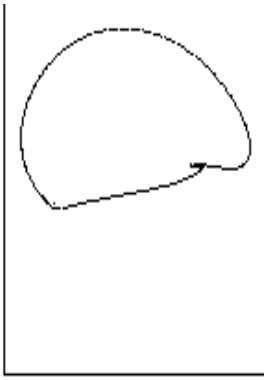

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Fig. 7

The coordinates of H vary as described by Fig. 8, with no discontinuities.

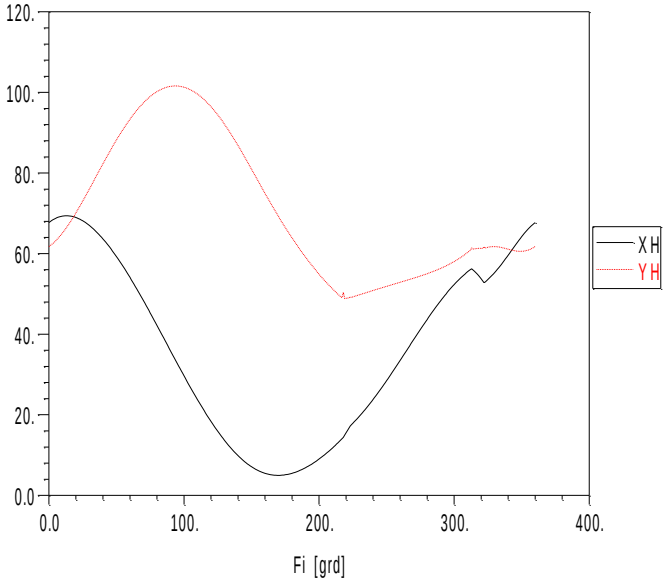

Fig. 8

Similar to Figs. 7 and 8, Figs. 9 and 10 are used for the study of point L.

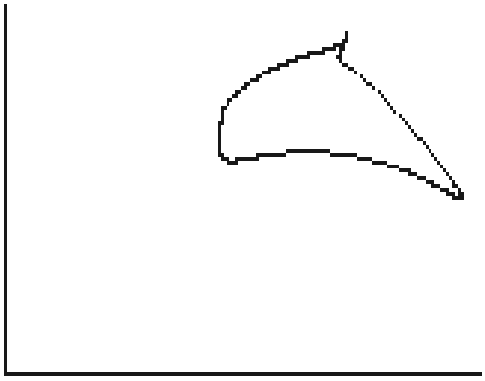

Fig. 9

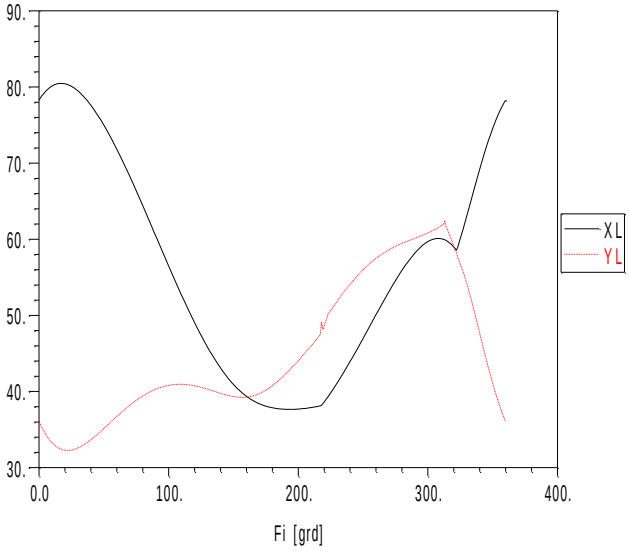

Fig. 10

The trajectories for the points F and K are depicted by Fig. 11 and 12 respectively. Interesting features, not encountered at other mechanisms, can be noticed.

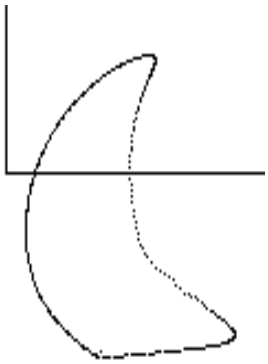

Fig. 11

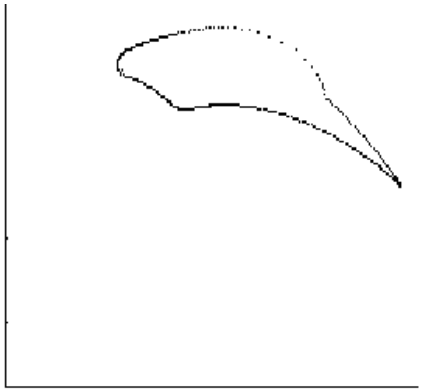

Fig. 12

The second particular *case* could be obtained by choosing mechanism's sized such as to include a parallelogram and a quadrilater with the sides equal 2 by 2. The following dimensions were used: AB_1=50; B_1C_1=70; D_1C_1=50; EF=50; GF=50; HK=40; LK=40; Y_D=0; GL=25; HM=15; X_{D1}=70; DG=25, X_A=0; Y_A=0. The chain $AB_1C_1D_1$ represents a parallelogram, and the chain HFLK represents a quadrilater with the sides equal 2 by 2: EF=GF, HK=LK, EH=GL=EF/2.

Results: Fig. 13 depicts the mechanism obtained. The successive positions are depicted by Fig. 14.

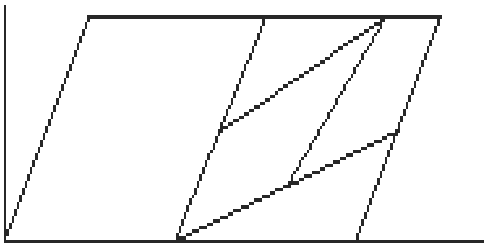

Fig. 13

Fig. 14 reveals that AB_1 executes full rotations, whilst C_1D_1 does not describe a full circle, as expected for an articulated parallelogram. This is caused by the next two dyads following it, which prevent C_1 from realizing a full rotation.

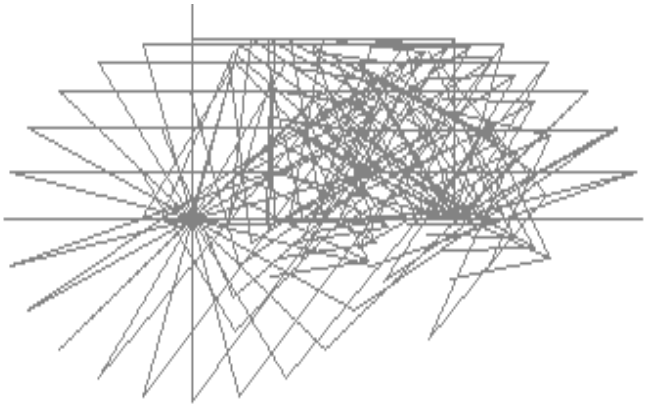

Fig. 14

Fig. 15 reveals that B_1 describes a full circle, whilst the points C_1, E and G can only describe semicircles.

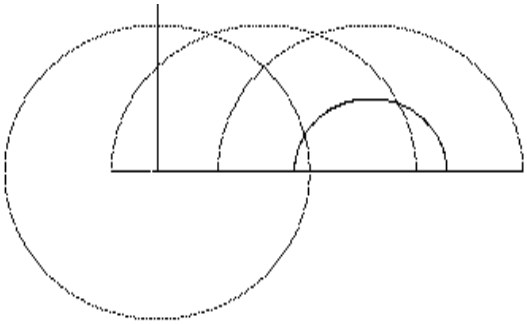

Fig. 15

In Fig. 16 there are represented two trajectories of F: one corresponds to the sign „+" in front of a square root, whilst the other corresponds to the sign „-„. The curves present interest, each of them having a couple of non-uniform loops.

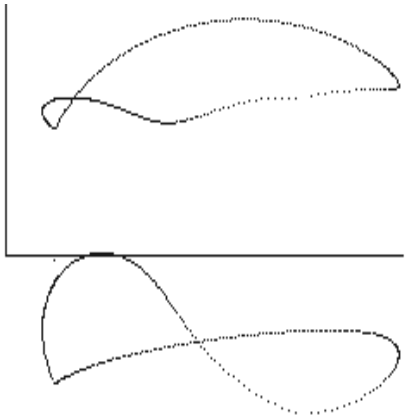

Fig. 16

Similar curves are also raised for the point K (Fig.17); but open loops are obtained for this point.

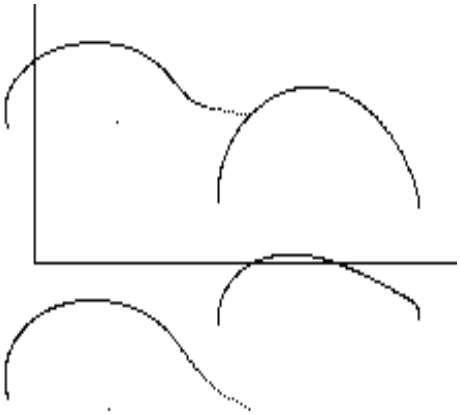

Fig. 17

3. CONCLUSIONS

- Two particular cases were treated: one corresponds to a short crank, the other to the case when a parallelogram and a quadrilater with the sides equal 2 by 2 appear in the mechanism structure.
- Interesting trajectories were obtained, specific for these mechanisms only;
- Many other trajectories can be obtained, through the modification of elements' lengths.

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