STRUCTURE AND KINEMATICS OF A MECHANISM WITH STOPS

Prof.PhD. Liliana LUCA, University Constantin Brancusi of Targu-Jiu, lylyanaluca@yahoo.com
Prof.PhD. Iulian POPESCU, University of Craiova, rodicaipopescu@yahoo.com
Lecturer PhD. Constanța RĂDULESCU, University Constantin Brancusi of Targu-Jiu, radulescu@utgjiu.ro

Abstract: *It is structurally and kinematical analyzed a mechanism that ensures the switching off of the final driven element, for a subinterval of the cycle in which the crank rotates further. Two variants are analyzed, leading to the conclusion that the first option is more convenient on accuracy. The mechanism serves the purpose, the errors being small.*

Keywords: mechanism with stops, precision of mechanisms.

INTRODUCTION

Mechanisms with stops are known for a long time. They have the property that in a subinterval of the cycle of movement of the crank, the movement of the final driven element stops, although leading element is still moving.

Cebâşev [1] also built many mechanisms based on geometrical considerations. Other researchers have also designed such mechanisms (Reuleauax, Evans, Silvester, Artobolevskii).

The best known mechanism of this type is the mechanism of Geneva (cross of Malta). In [2] it is shown, through animation, how this mechanism works. There are numerous gear mechanisms that meet this condition, based on alternating teeth with arcs on the periphery of the wheels; in [3] it is shown the animation of such a mechanism, which, at one time, from a simple gear, it becomes a planet gear.

[4] shows some mechanisms with stops used at textile machines.

In [5] there are some mechanisms with bars having breaks in operation.

Below, a mechanism from [6] is studied, which can be useful in textile and printing machinery and in other areas.

VERSION WITH CONSTANT α

It went from kinematical diagram of FIG. 1 [Kojevnikov, pg . 468], which states that at the rotation of element 1 in the subinterval given by the α angle, section C slides on guide 2, the vertical movement of 2 being stopped (with some approximation).The figure shows that AB is welded to the BC , i.e. AB and BC will tilt simultaneously.

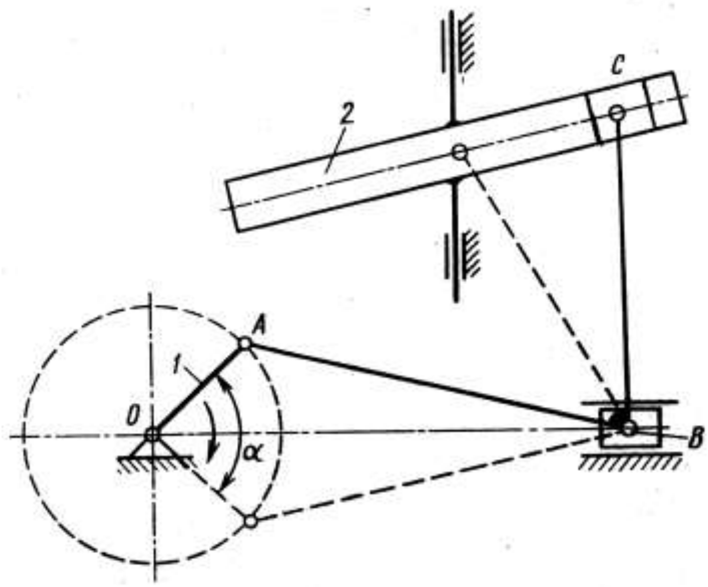

Fig. 1

The kinematical scheme of the mechanism is shown in FIG.2. Structurally (fig.3), the mechanism is composed of the leading element with rotating movement AB (R), BCC dyad type RRP and the DDE dyad type RPP, so it is R- RRP – RPP.

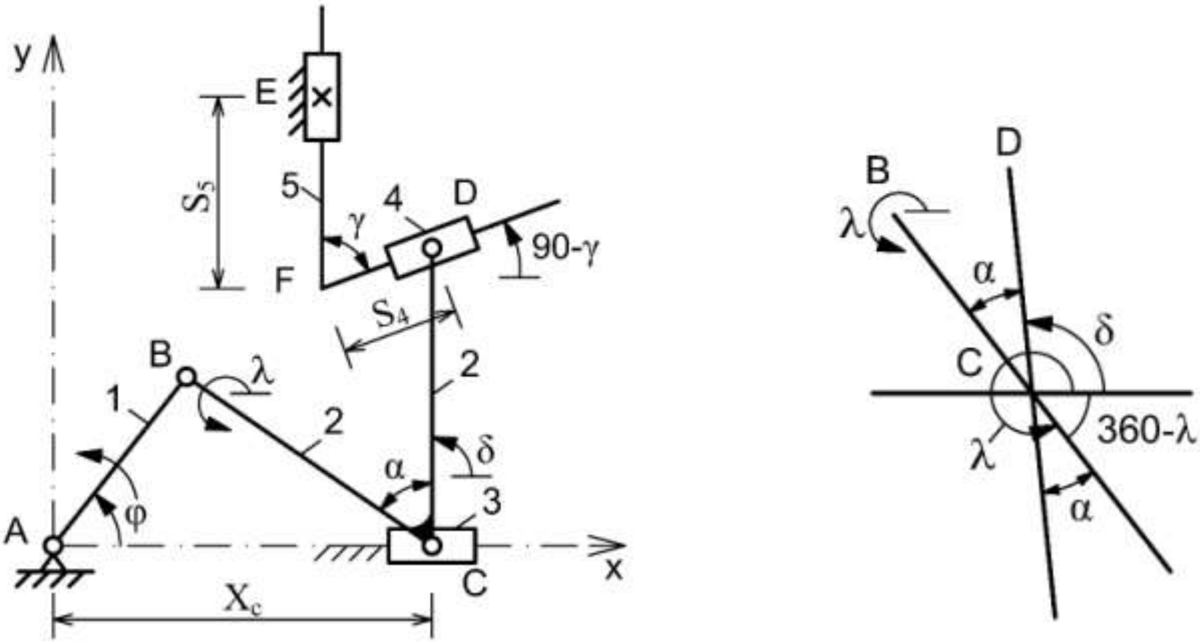

Fig. 2

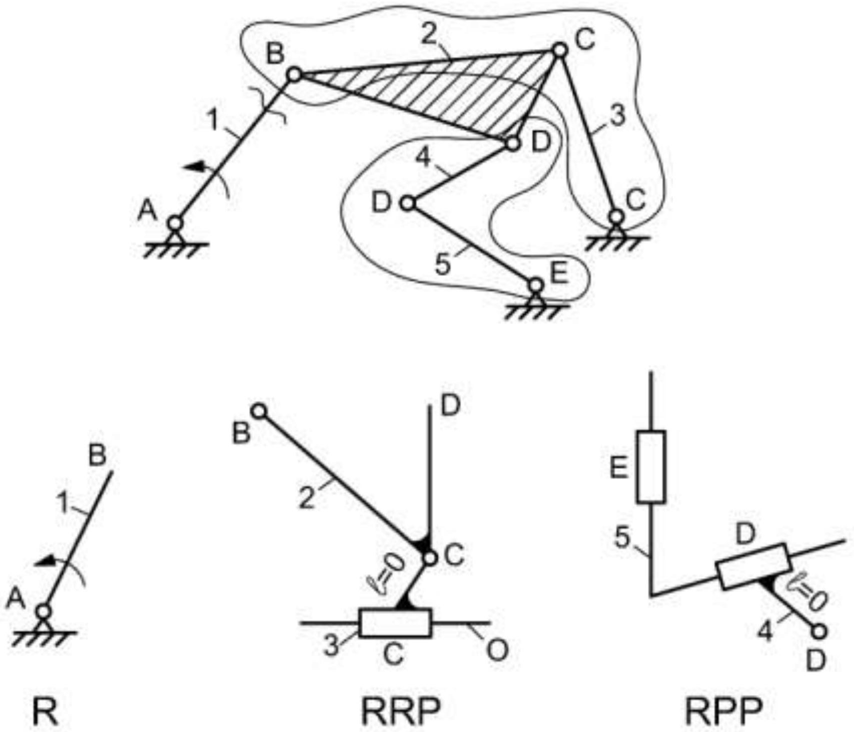

Fig. 3

For the kinematical analysis of the mechanism, the following relations are written:

$X_B=AB\cos\varphi$; $Y_B=AB\sin\varphi$

$X_C=X_B+BC\cos\lambda$; $Y_C=Y_B+BC\sin\lambda=0$

$\delta=\lambda-180-\alpha$

$X_D=X_C+CD\cos\delta$; $Y_D=CD\sin\delta$

$X_F=X_D+S_4\cos(90-\gamma+180)=const.$

$Y_F=Y_D+S4\sin(90-\gamma+180)$

$X_E=X_F=const.$

$Y_E=Y_F+S_5=const.$

The following initial values were taken:

AB=32: BC=43: CD=42: XE=40: YE=64: ALFA=66: GAMA=66: BC=100: AB=15. In Fig. 4 the mechanism is shown in a position.

In Fig. 5 the mechanism is shown in successive positions.

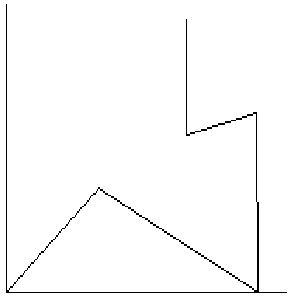

Fig. 4

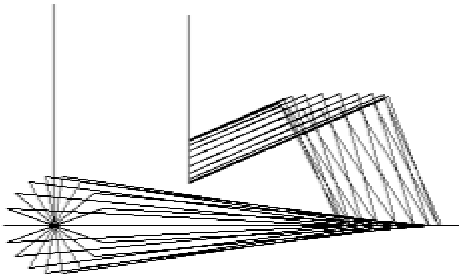

Fig. 5

Fig. 6 notes that all races: XC, S4 and S5 have symmetrical variations. It also notes that the curve of S5 has the smallest amplitudes.

Further, it has been made the crank angle variation as in Fig. 1, and it is determined that φ = - 45…+45, so that the successive positions have been obtained in Fig. 7. It is noticed that the FD segment positions are almost overlapping, which means that the variation of the S5 race on this subinterval is very small, that is exactly what is required in this mechanism.

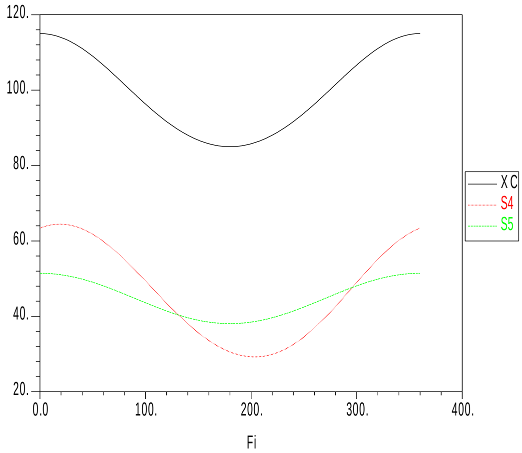

Fig. 6

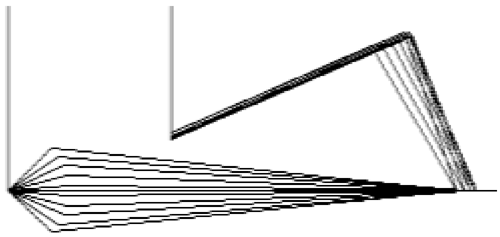

Fig. 7

In Fig. 8, the symmetry of the curve is seen and large variations. In reality, the ordinate data show small variations, up to 1.95 mm, which is considered admissible; there are low variations on the ordinate.

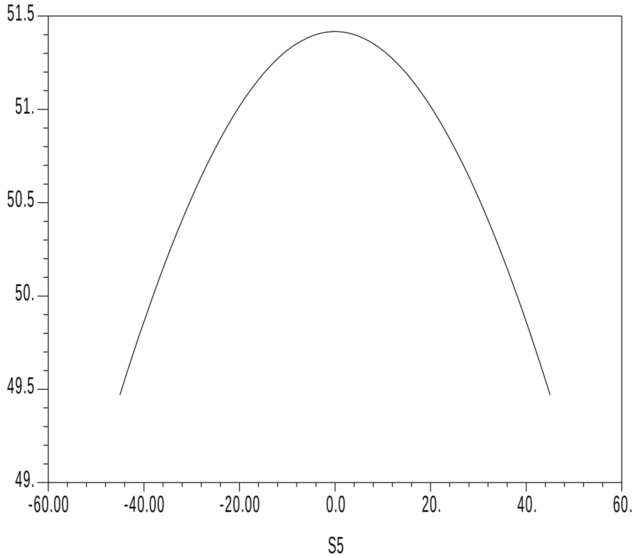

Fig. 8

The values obtained are given in Table 1.

Table 1

Fi	S5
-45	49.46939
-40	49.86157
-35	50.21485
-30	50.5266
-25	50.79444
-20	51.01639
-15	51.19076
-10	51.31625
-5	51.39193
0	51.41722
5	51.39192
10	51.31624
15	51.19074
20	51.01636
25	50.79441
30	50.52655
35	50.2148
40	49.86151
45	49.46932

VERSION WITH CD WELDED TO SLIDE 3

It was studied variant where the mechanism of fig. 2 is amended so that the CD is not welded to BC, but the slide 3. In this case the structure of the mechanism is the one of Fig. 9, the mechanism being R- RRP - RPP type, but the RPP dyad changes.

In this case, the successive positions of the mechanism are given in Fig. 10, ascertaining that, in contrast to Fig. 5, the CD tray always stays parallel to the ordinate.

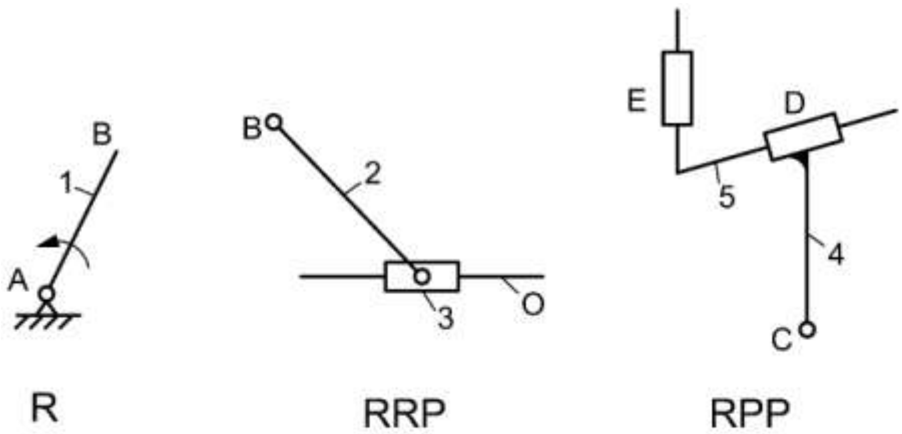

Fig. 9

In Fig. 11 are given only the positions for φ = - 45…+45, observing variations of the S5 race. In Fig. 12 the S5diagram (φ) is given, noticing the higher values of S5 for this subinterval, in comparison with the diagram of Fig. 8.

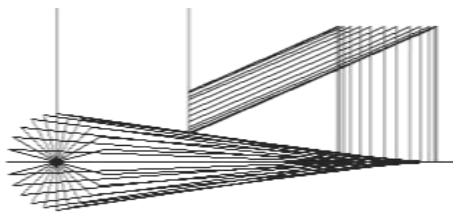

Fig. 10

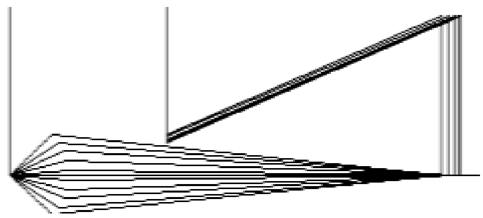

Fig. 11

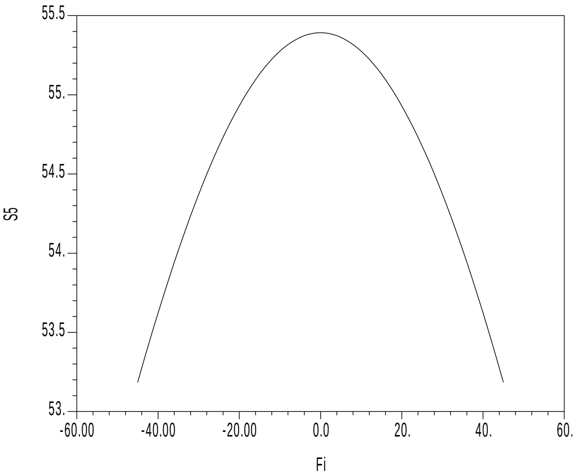

Fig. 12

Numeric values are given in Table 2. Here, the maximum difference is 2.21, as opposed to the previous case when it was 1.95, therefore the first mechanism is more convenient.

Table 2

Fi	S5
-45	53.1847
-40	53.62203
-35	54.01904
-30	54.37177
-25	54.67664
-20	54.93051
-15	55.13078
-10	55.27533
-5	55.36268
0	55.3919
5	55.36268
10	55.27533
15	55.13078
20	54.93051
25	54.67664
30	54.37177
35	54.01904
40	53.62203
45	53.1847

Referring to FIG. 13, it is noted that the solution to the results in Table 1 (first mechanism) provides lower values for S5 compared to the second mechanism, with the results given in Table 2.

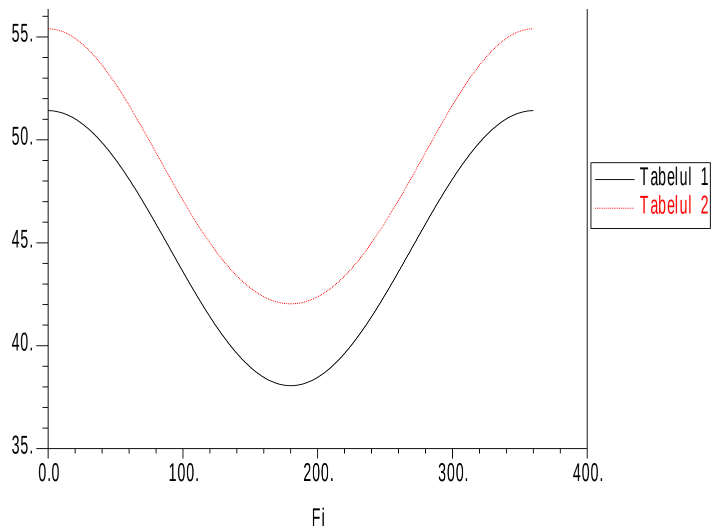

Fig. 13

CONCLUSION

- The structure of the mechanism from [6] was studied in two versions.
- S5's race variation was established for a particular subinterval of the crank rotation cycle for both structural variants.
- It appears that the more precise is the first structural variant.
- The mechanism serves the purpose, the errors being small.

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