Substantiation of Parameters of the Mechanism of Initial Orientation of the Package

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Abstract – The work is focused on solving the urgent problems of the packaging industry – the orientation of packaging. Structural and solid-state model of the mechanism of orientation is developed. The kinematic and force analysis of the primary orientation mechanism was carried out.

Keywords – kinematic analysis, force analysis, motion analysis, 3-D model, structural scheme.

I. Introduction

Increasingly popularity is gaining soft packaging, which is presented on the market to a wide range of products. According to its physical and mechanical characteristics, the materials used in the formation of soft containers are very different. In connection with this, one can not get a generalized scheme of forming a cargo unit when using this group of materials. Therefore, the work is focused on solving the problem of the initial orientation of soft packaging when leaving the working area of the machine.

The key factors that complicate the automation of the production process when using soft packaging is the change in its geometric parameters when the product is filled. It is this feature of soft packaging that requires the use of innovative approaches to orientation and stacking compared to products, parts and workpieces with a clearly expressed geometric shape.

Taking into account the sharp growth of the food industry in Ukraine, even when solving the above mentioned problem, the designed equipment can not be competitive. This is due to the flexible packaging system of food products, since several food products with different weight and geometric parameters of the package can be packed on the same equipment.

Solving this problem is possible with the modular design of the mechanism for the formation of group packaging. However, the most rational solution is to design modular units with a certain permission to change the geometric parameters of the package and its mass.

II. Description of the mechanism

The mechanism shown in Fig. 1 operates as follows: from the working zone of the machine 2 (shown schematically), the package 1 on the guide plane falls into the stop mounted on the guide plate 3. For the transfer of the package 1 from the detent 3, a directional lever mechanism is used that is a link 6, mounted on the hinge and vacuum holders 4. This link is attached to the stem of the pneumatic actuator 5, which is hingedly mounted to the support. The pneumatic drive 5 is mounted with the help of a hinge to realize the turn of the link itself at an angle necessary for moving the package to the working plane of the conveyor 10 in a circle radius R.

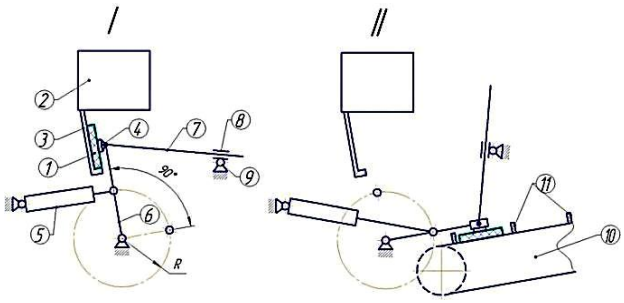

Fig.1 The basic scheme of the operation of the primary packing orientation node

In order to reorient the package in the process of moving the link 6, a link 7 is mounted to the end of the link that moves along the slider 8, which has the ability to rotate thanks to the hinge 9. The revolution of the packet is implemented gradually after the movement of the piston rod 5. This is done for that purpose. , so that when turning the package it does not stop the elements of the machine and does not deform during contact with the detent 3.

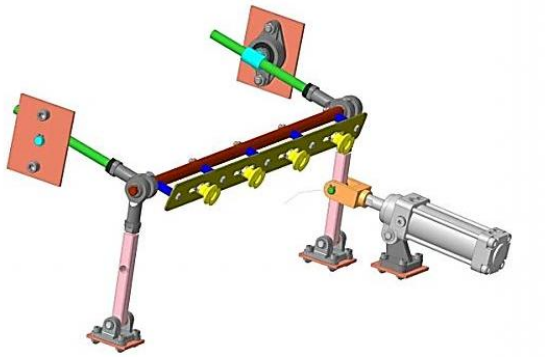

Fig.2 3-D model of the primary orientation mechanism

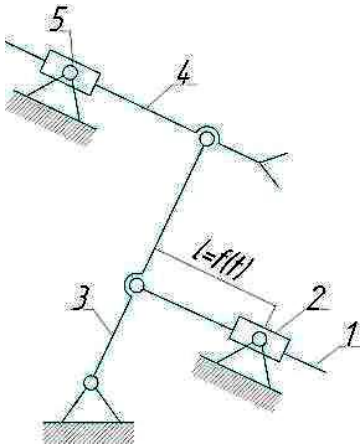

Fig.3 Structural scheme

Figure 2 shows the 3-D model of the mechanism used in determining the centre of mass of the constituent elements of the mechanism and on the basis of which the structural scheme of the mechanism is developed (Fig. 3).

Determine the degree of freedom of the mechanism by the formula of Chebyshev:

$$w = 3n - 2p_5 = 3 \cdot 5 - 2 \cdot 7 = 1. \quad (1)$$

According to formula (1), the degree of freedom of the mechanism is 1, which means that the position of all parts of the mechanism determined by changing the position of the stock.

III. Kinematic and force analysis

For power and kinematic analysis SolidWorks software was used. The initial parameters for modelling the mechanism of the mechanism were: the positioning time of 1.5 seconds and the displacement of the stem 80 mm. The simulation takes into account weight effort. SolidWorks Motion application is used for motion analysis.

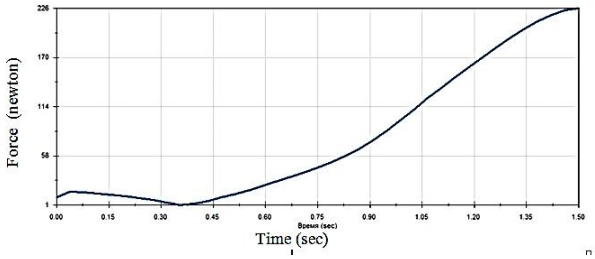

Fig. 4. The driving force

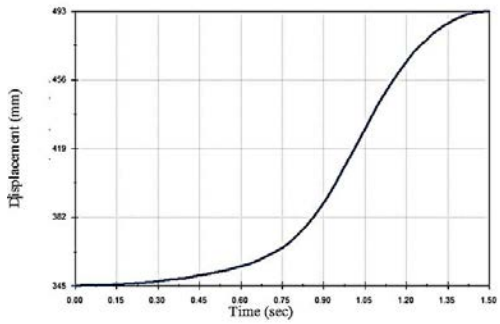

Fig. 5. Displacement of vacuum grips

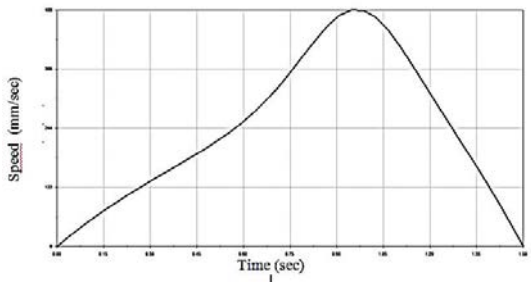

Fig. 6. Speed of vacuum grips

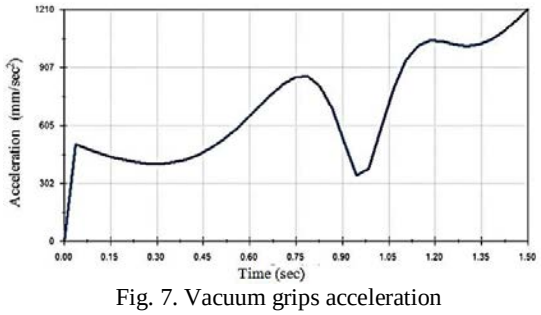

Fig. 7. Vacuum grips acceleration

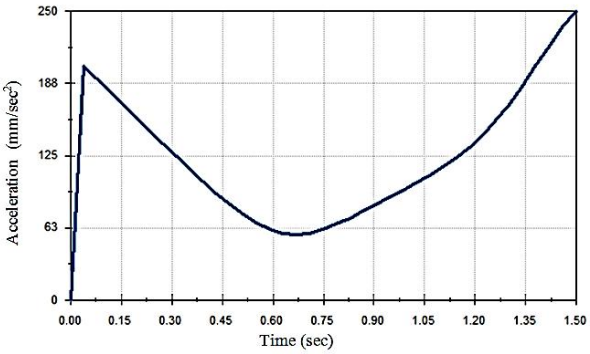

Fig. 8. Stock acceleration

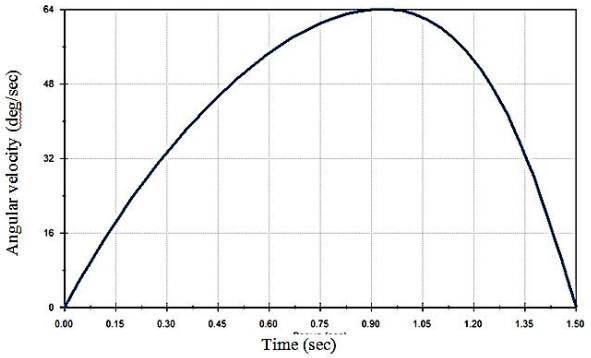

Fig. 9. Angular speed of the connecting rod

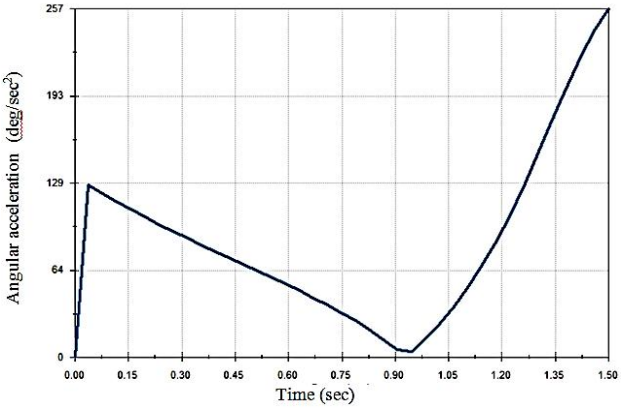

Fig. 10. Angular acceleration of the connecting rod

Conclusion

When developing the packaging orientation mechanism, a flexible system of production is taken into account. Using the computer simulation, the kinematic and power parameters of the mechanism are determined. The structure of the mechanism is analysed and the degree of freedom is determined

References

[1] O. M. Gavva, A. P. Bezpalko, A. I. Volchko, *Packing equipment. Equipment for packaging products in consumer and transport containers.* (in Ukrainian), Kyiv: Package, 2005.