SECTIONS 3. INDUSTRIAL ENGINEERING

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RESEARCH ON THE DRIVE FORCE LOAD OF A TWO-SECTION PRESSURE PLATE IN A DIE-CUTTING PRESS

ДОСЛІДЖЕННЯ СИЛОВОГО НАВАНТАЖЕННЯ ПРИВОДА ДВОСЕКЦІЙНОЇ НАТИСКНОЇ ПЛИТИ У ШТАНЦЮВАЛЬНОМУ ПРЕСІ

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Cardboard packaging plays a key role among the variety of packaging for food and industrial products. The reasons are the positive qualities of the cardboard-based material. Cardboard packaging is obtained from blanks that are manufactured on flat presses of a die-cutting equipment.

A die-cutting press consists of a stationary plate with a flat die-cutting form, a pressure plate, which is driven by lever-type wedging mechanisms [1, p. 61, 62]. Presses cyclically overcome large technological resistance, measured in hundreds of tons. This condition qualifies a die-cutting equipment as a heavily-loaded one. As a result, it is massive, energy- and metal-intensive.

To minimize significant peak loads, it is proposed to implement the cardboard blank die-cutting process *CB* (Fig. 1) alternately. For this, the monolithic design of the pressure plate is replaced by a sectional one: left 1_a and right 1_b. After feeding the blank *KZ* into the die-cutting zone, the sections alternately set in motion the wedging mechanisms of the left and right contours. At the contact moment of the left section 1_a of the pressure plate with the blank *CB*, the working surface of the right section 1_b is located below the left one by the cardboard thickness Δ.

Due to the sectional structure of a pressure plate, the cardboard blank *CB* is alternately die-cut by tools of the form 2, which is fixed to the plate 3 (Fig. 1).

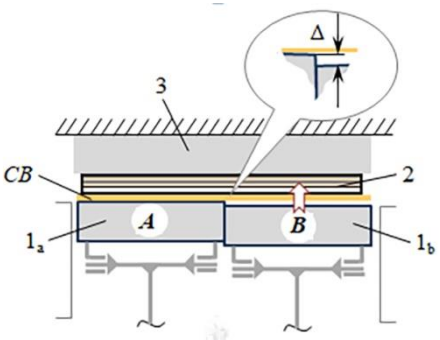

Fig.1. A scheme of sectional structure of a pressure plate in a die-cutting press

It is important to assess the impact of changing the design of pressure generator on the drive force load. For analytical studies of the drive force load of the pressure plate of the sectional structure, the relative parameters of the wedging mechanisms are taken into account [2, p. 39]. The relative geometric "unit" dimensional parameter is taken as the movement of sections 1_a and 1_b of the pressure plate, and the force "unit" is the value of the technological resistance due to die-cutting of the blank *CB*. According to the method [2, p. 42], calculations of the drive force load of the pressure plate sections are performed. The results of the calculations are graphically presented in Fig. 2.

As it can be seen from graphs 2, 3, the peak values of the relative moment of force (points A, B) are half the peak value of the moment of force (point C) in graph 1. The graphs confirm that the use of a sectional structure of the pressure plate halves the load on the drive. However, the crank rotation angle of the drive increases.

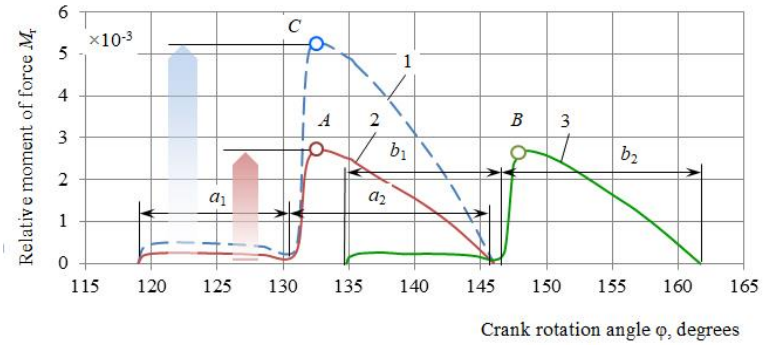

Fig. 2. Graphs of dependency of relative moment of force in a pressure plate drive of a die-cutting press on the crank rotation angle for: monolithic plate (1); sectional structure (2), (3)

Analysis of graphs 2, 3 shows that during phases a_1, b_1, a significantly lower value of M_r is observed than during phases a_2, b_2. The reason lies in the fact that in the first phase only the form elastic cushions are deformed. In the second phase, all the tools of the form 2 interact with the cardboard blank *CB*. The results of the interaction are die-cut blanks with creased folding lines.

The results of analytical studies reveal the nature of the drive load of a two-section pressure plate in the cardboard blank die-cutting process. The quantitative indicator of the drive load confirms the prospects of using a press with a two-section pressure plate in a die-cutting press.

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