INVESTIGATION OF THE MANUFACTURING PROCESS OF STAMP FORMS IN MECHANICAL ENGINEERING

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ABSTRACT

In modern mechanical engineering, the development of a technological process for processing stamping forms on shaped surfaces remains the most important task of today. Before processing the shaped surfaces, it will be necessary to study the working surfaces of the stamping molds. This article describes methods for determining the geometric parameters of the surface when processing stamping forms on shaped surfaces, in particular, the drawing structures of the cutting zone of shaped surfaces, the penetration of the cutter into the cutting zone and data on the conditions of editing in the cutting zone.

Key words: cutting area, consistency, durability, punching, punching design, cutting parameters.

As previously shown, when shaped surfaces are milled black using cylindrical milling cutters, untreated zones are formed in it. Unprocessed surfaces are made with spherical clean milling cutters, and the cutting force is not constant because the angle of the machined surface and the machining depth are constantly changing during full milling. This in turn leads to a change in the trajectory of the cutting edge of the cutting tool and the resulting machining error. Existing methods, including additional adaptive devices, do not allow for proper control of the processing of such cutting areas in clean machining. Therefore, the issue of determining the optimal cutting conditions in any part of the machined surface should be addressed at the stage of development of the control program.

In existing SAM systems (including high-level UNIGRAPHICS, CATIA, PRO / ENGINEER) based on object structure modeling (parasolid-format X_T), it is necessary to implement a step-by-step removal of the inserted part from the workpiece model to control the cutting modes. However, in SAM systems, the billet model is built through the edges (STL format) and therefore modern SAM systems cannot perform rotational operations around their own axis. Even if we assume that the detail and the format of the workpiece (from the previous operation) are compatible with each other, the system will have to perform a step-by-step determination of the cutting volume. This significantly increases the computational time of the control program.

When developing a control program, the SAM system itself calculates only the instrument trajectory. The technologist-programmer sets the following parameters:

- pushing workers;
- push of the first cutter;
- add cutting and pushing tools;
- accelerated thrust value;
- the number of revolutions of the spindle.

It should be noted that the values of these parameters do not change during the processing of the control program.

In this regard, it is necessary to develop a new method that allows to influence the forming process by controlling the cutting modes in any part of the machined surface in algorithms.

To do this, the RDB system must solve the following tasks.

- determine the change in the geometric parameters of the processing zone;
- Analysis of processing modes and optimization of their value, processing on any part of the surface.

The solution to these problems is to stabilize the strength parameters that affect the accuracy and quality of the machined surfaces machined during volumetric clean milling.

In volumetric milling of shaped surfaces with spherical milling cutters, the movement of the cutting tool is usually given in accordance with the norms in relation to the surface to be machined. This method reduces the number of working and idle movements and improves the accuracy and quality of processing. The trajectory of the cutting tool during bulk machining is the movement along a sloping path.

To determine the maximum possible placement value, it is necessary to know the depths of the machined surface, the trajectory of the cutting tool.

However, modern systems do not automatically perform such an analysis themselves. This requires the construction of surface sections that require additional costs. The upper part of the parabola is in the form of an ellipse and a hyperbola, the shape of which differs slightly from each other.

Based on this, the parameter of the maximum possible amount for any type of any cone is assumed to be the same, and the parabola parameters are more easily accepted by RDB systems, the maximum allowable parameters are generated for specific sections, and the maximum possible setting for the parabolic section is calculated.

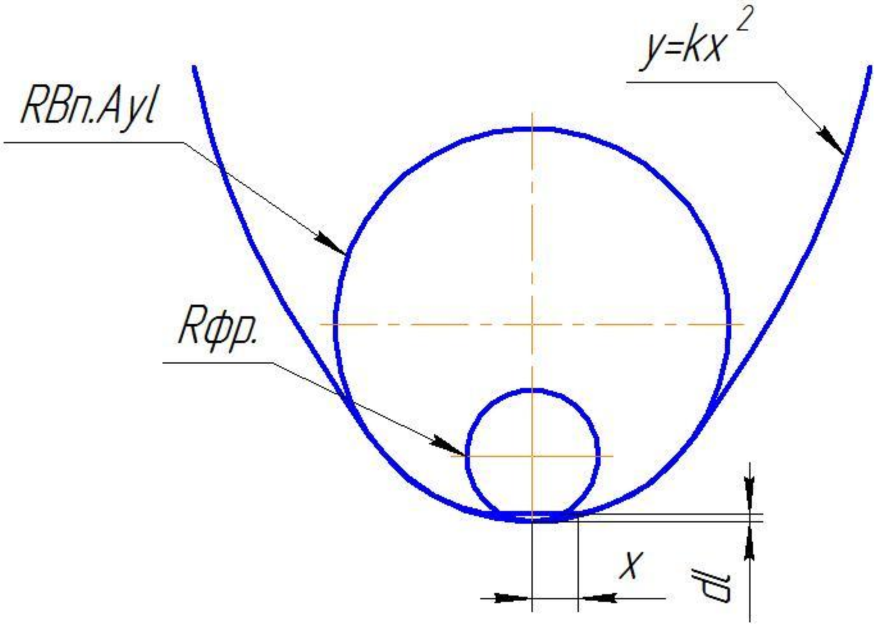

Figure 1. Scheme of calculation of parabola parameters

Parabola equation:

$y=kx^2$. (1)

In the part of the parabola that depends on the accuracy of the DT operation, it is possible to construct a circle with radius RVp.ayl. It is known from manufacturing experience that the maximum radius of the cutting tool should be 1.1 times less than the radius of the written circle to ensure no grinding during the cutting process. Therefore, according to Figure 1., the parabola coefficient k depends on the radius of the sphere of the instrument used.

$$x = \sqrt{(1{,}1R_{фр})^2 - \left(1{,}1R_{фр} - \Delta T\right)^2} =$$

$$\sqrt{(1{,}1R_{фр})^2 - \left(\left(1{,}1R_{фр}\right)^2 - 2{,}2R_{фр}\Delta T + \Delta T\right)^2} = \sqrt{\Delta T(2{,}2R_{фр} - \Delta T)} \qquad (2)$$

From the parabola equation:

$$y = \mathrm{k}x^2 \Rightarrow k = \frac{\mathrm{y}}{x^2} \qquad (3)$$

$$\Rightarrow k = \frac{1}{2{,}2R_{фр} - \Delta T} \qquad (4)$$

The final semi-clean transition process is performed with cylindrical milling cutters equal to the diameter of the cylindrical milling cutters. Therefore, the maximum value of the incremental rate for processing a symmetric parabola is determined by the following expression:

$$\mathrm{H}_{1\text{пар}} = \mathrm{y} = \mathrm{kx}^2 \approx \mathrm{k}\left(\mathrm{R}_{\text{фр}} + \mathrm{T}\right) + \mathrm{T}^2 = \frac{\left(\mathrm{R}_{\text{фр}} + \mathrm{T}\right)^2}{2{,}2\mathrm{R}_{\text{фр}} - \Delta\mathrm{T}} + \mathrm{T}^2 \qquad (5)$$

The expression calculates the maximum setting parameter that can be generated during black machining with a cylindrical cutter, provided that the diameter of the cylindrical cutter is equal to the spherical diameter.

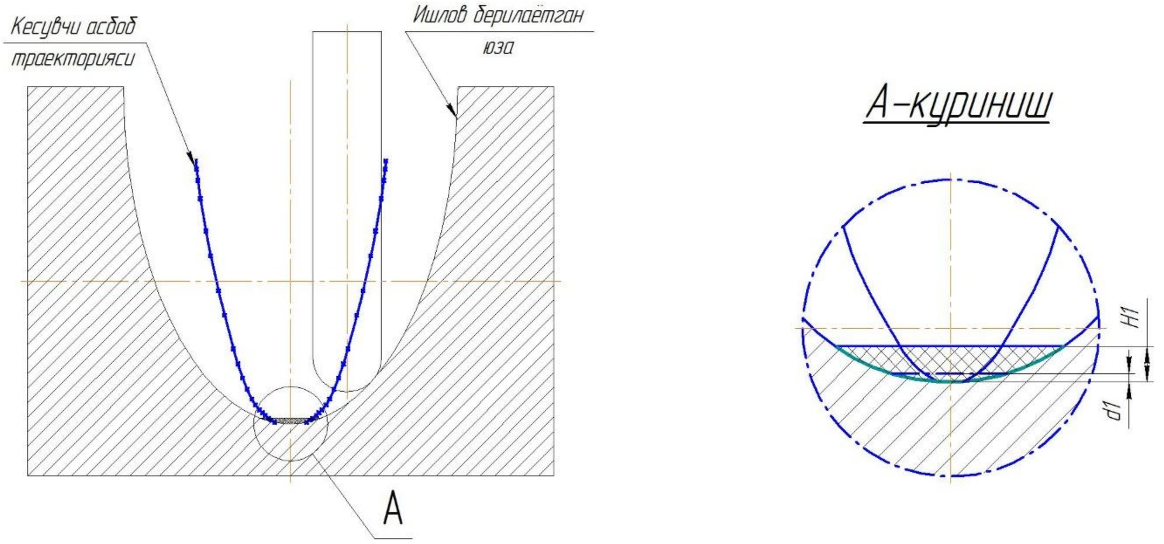

Figure 2. Scheme for calculating the maximum possible deposit.

Expression (5) calculates the random part of the cutting depth, for a parabolic cut. In practice, such a situation is very rare and requires replenishment.

The actual value of the deposit (Figure 3) depends on any part of the processed trajectory:

-Dfr is the diameter of the disposable cutting tool .;

-T Deposit in one-time processing;

-the part of the radius of the arc of the circular surface of the treated surface.

For machined surfaces, the movement of the cutting tool during machining is calculated according to the formula of the maximum depth of the untreated part:

$$H_{l\text{окр}} = H_2 + T, \qquad (6)$$

Where H_2 is the additional deposit, mm.

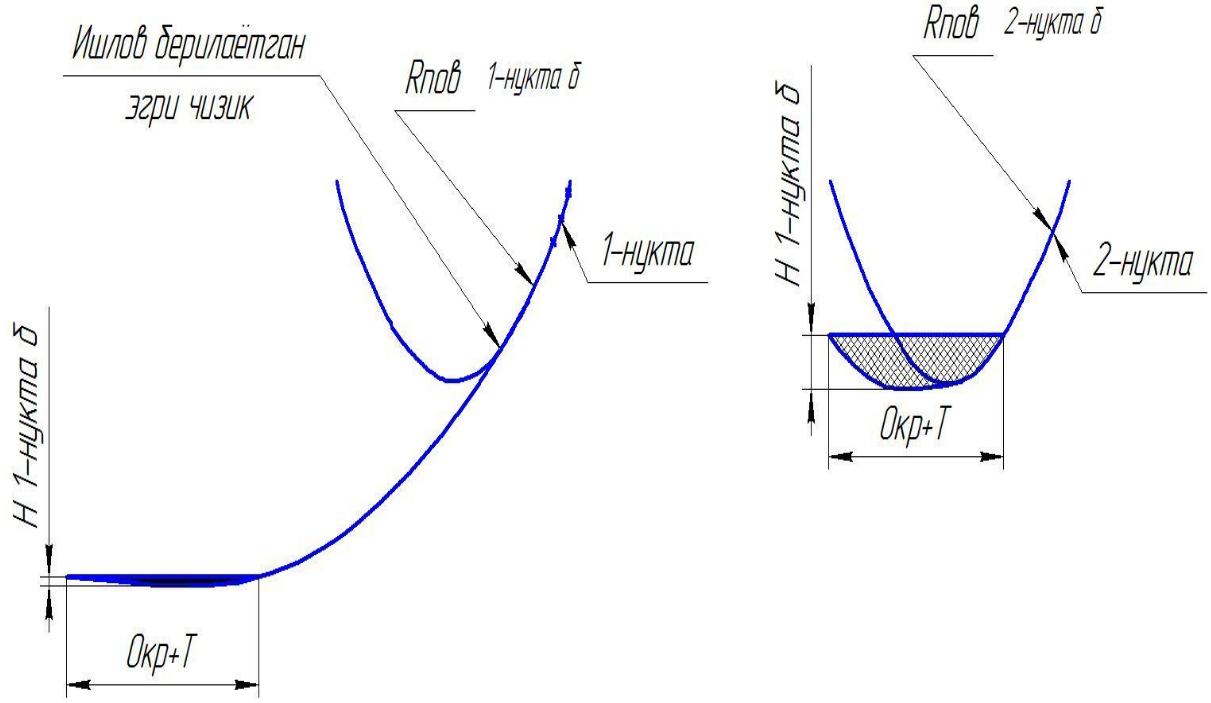

Figure 3. Dependence of the increasing deposit on the surface radius.

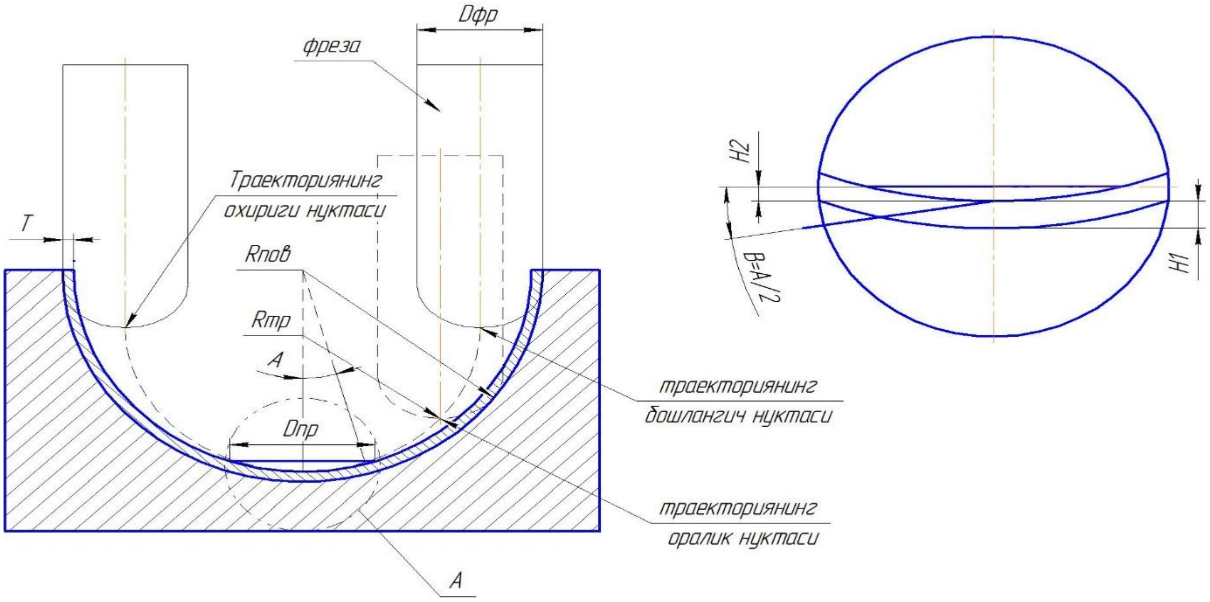

Figure 4. Calculation scheme of ascending deposit.

As can be seen in Figure 4

$$tg\alpha = \frac{2H_2}{R_{фр.}} \Rightarrow H_2 = \frac{R_{фр.}tg\alpha}{2}; \qquad (7)$$

$$sin\alpha = \frac{R_{фр.}}{R_{пов.}} \Rightarrow \alpha = arcsin\frac{R_{фр.}}{R_{пов.}}; \qquad (8)$$

In this case, Equation 2.6 takes the following value:

$$к. H_2 = \frac{R_{фр} \cdot tg(arcsin\frac{R_{фр}}{R_{пов}})}{2} \Rightarrow$$

$$\mathrm{H}_{1\mathrm{ayl}} = \frac{\mathrm{R}_{\mathrm{фр}} \cdot \mathrm{tg}\,(\arcsin \frac{\mathrm{R}_{\mathrm{фр}}}{\mathrm{R}_{\mathrm{пов}}})}{2} + \mathrm{T}, \qquad (9)$$

CONCLUSION.

Analysis of the obtained expression shows that the larger the diameter of the first insert and cutting tool, the higher the cutting depth parameter on the previously untreated surface, and the larger the radius of the machined surface, the lower the machining depth. The main task is to remove the deposit on the surface to be treated. In this case, the cutting parameters of the cutting tool and the thickness of the layer to be cut are important. When moving a cutting tool along a complex shaped surface, it is necessary to establish the optimal movement of the machining trajectory in SAD / CAM / CAE systems. Because the parameters of the cutting part of the cutting tool can be eaten, broken, the parameters of the cutting part can be changed during processing along the trajectory. This in turn affects the surface quality of the surface being cut. In this paper, the capabilities of SAD / CAM / CAE systems were used in machining the working part of stamp molds.

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