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THEORETICAL STUDIES OF THE TECHNOLOGICAL PROCESS OF MACHINING PARTS WITH CONCAVE SURFACES OF COMPLEX FORMS ON CNC MILLING MACHINES

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ABSTRACT

The master's dissertation on the topic "Conducting research on identification and elimination of errors arising when processing complex shaped parts on cnc machines" contains 138 pages of a text document.

The aim of the dissertation was to improve the existing manufacturing technology. As a result of the research, the technological process of machining was improved for a body part of high complexity "Housing" in conditions of mass production using technological equipment with numerical control.

Determination of geometric parameters of previously untreated zones .

As shown earlier, if Th rnovom concave milling F carotid cutters cylindrical surfaces formed untreated - nye zone. Finishing previously untreated zones produced sphere - symmetric with cutters, as well as in bulk processing slope portion Obra - batyvaemoy surface and the machining depth is constantly changing, the cutting force is not constant, which leads to a change in the trajectory of the cutting chrome - tool ki, and as a result, error handling ... Existing methods, including additional adaptive devices do not allow the armature - -posed manage the processing of such sites when performing Num - tovyh transitions.

For this reason, the question of the appointment of optimum modes of cutting - Nia in any part of the work surface should be resolved at the stage of development of the control program.

The existing CAM systems (including higher level UNIGRAPHICS , of CATIA , the PRO / ENGINEER) kernel build objects based on solid modeling (of pa rasolid - the format of the X _ T), and to osuschest - vit control cutting conditions, must be carried out step by step the subtraction model of the workpiece on the model blanks. But the systems work model is based facets (the format of the STL), and this at - the rank of modern CAM system is not able to produce the Boolean operators - radio. Even if we assume that the details of the formats and the workpiece (from the previous - conductive operation) will be the same, the system will have to perform stepop - -determination of the shear volume, which will significantly increase the time of calculation of the control program.

When developing the control program, the CAM systems calculate only the trajectory of the tool movement . The technologist-programmer sets the following parameters:

- working feed;
- feed of the first cut;
- infeed and retraction of the tool;
- accelerated feeds;
- spindle rotation frequency.

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

In this regard, it becomes necessary to develop a new method that will allow to influence the shaping process by frame-by-frame control of cutting modes on any part of the surface to be machined .

To do this, it is necessary that the CNC system solves the following tasks:

- determined the change in the geometric parameters of the processing zone;
- adjusted the treatment regimens in leading them to a value optimal nym on an arbitrary portion of the machined surface.

Solving these problems will ensure the stabilization of the power of steam - meters, affecting the accuracy and quality of machined concave style - GOVERNMENTAL surfaces for finishing milling volume.

When volumetric milling of concave shaped surfaces with ball milling cutters, the movement of the tool is usually assigned normal to the machined surface. This method reduces the number of workers and idle movements and also increases the accuracy and quality of fur - nical processing. Tool path at a volumetric Obra - Botko is a spline.

In order to determine the value of the maximum possible when starting, which is formed near the depression of the machined surface, it is necessary to know the path along which the tool moves. However, over - time CAM system, such an analysis does not automatically produce, it is necessary to build an additional section of the surface, which requires extra cost. From [28], the near vertex na - Rabolu, ellipse and hyperbola shaped differ little from each other. Based on this, we assume that the parameter is the maximum possible allowance is the same for any type of conic section, as well as mathematical transformation a parabola easier perceived CNC systems and setting the maximum allowance is formed specifically for the type of a pair of sections - bolas, then the calculation of the maximum possible allowance we make for paraboloid - -crystal portion.

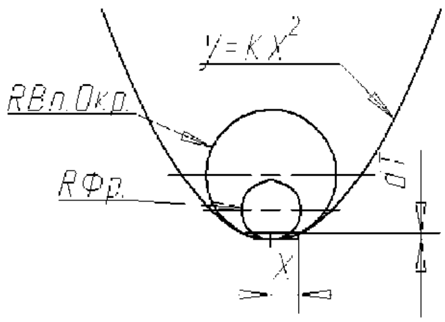

Figure 2.1. Parabola parameters calculation scheme

Parabola equation:

$$y = kx^2. \qquad (2.1)$$

On the site of the parabola, which depends on the processing accuracy AT mozh to construct a circle with a radius R в n - OKp .- From industrial experience of - known that the maximum radius of the tool for maintenance of process D - zaniya without crushing, must be less than the radius of the inscribed circle of 1.1 times. Consequently, according to the construction of Fig.2.1, the parabola coefficient k - depends on the radius of the sphere of the tool used.

$$x = \sqrt{(1{,}1R_{фр.})^2 - (1{,}1R_{фр.} - \Delta T)^2} =$$
$$= \sqrt{(1{,}1R_{фр.})^2 - ((1{,}1R_{фр.})^2 - 2{,}2R_{фр.}\Delta T + \Delta T^2)} = \sqrt{\Delta T(2{,}2R_{фр.} - \Delta T)}. \qquad (2.2)$$

From the parabola equation:

$$y = kx^2 \Rightarrow k = \frac{y}{x^2}; \qquad (2.3)$$

$$\Rightarrow k = \frac{1}{2{,}2R_{фр.} - \Delta T}. \qquad (2.4)$$

The final semi-finish transition is made with a cylindrical cutter with a diameter equal to that of a ball-shaped finishing cutter. Consequently , the maximum value of the increasing allowance when processing a symmetric parabola is determined by the expression [42] (Fig.2.2):

$$H_{1нар} = y = kx^2 \approx k(R_{фр.} + T) + T^2 = \frac{(R_{фр.} + T)^2}{2{,}2R_{фр.} - \Delta T} + T^2. \qquad (2.5)$$

Expression (2.5) calculates the parameter of the maximum possible allowance that can be formed during roughing with a cylindrical cutter, provided that the diameter of the cylindrical cutter is equal to the diameter of the spherical cutter.

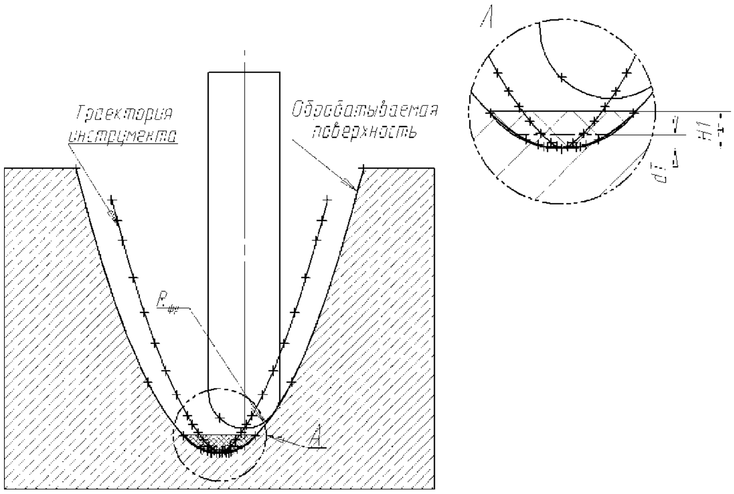

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Figure 2.2. Scheme for calculating the maximum possible allowance

Expression (2.5) calculates the depth of cut for a particular case, for a parabolic section. In practice, such a case is extremely rare, and tre - buet additions.

The actual value of the allowance (Fig. 2.3) at any part of the machined path depends on:
- the diameter of the previously used tool *O* f r .;
- pretreatment allowance *T;*
- the area of the radius of the arc of the circumference of the processed surface I_p.

For a concave shaped surface, during the processing of which the movement of the tool is carried out in a circle , the maximum depth of the unprocessed zone is calculated by the formula [43]:

$$H_{1окр.} = H_2 + T, \tag{2.6}$$

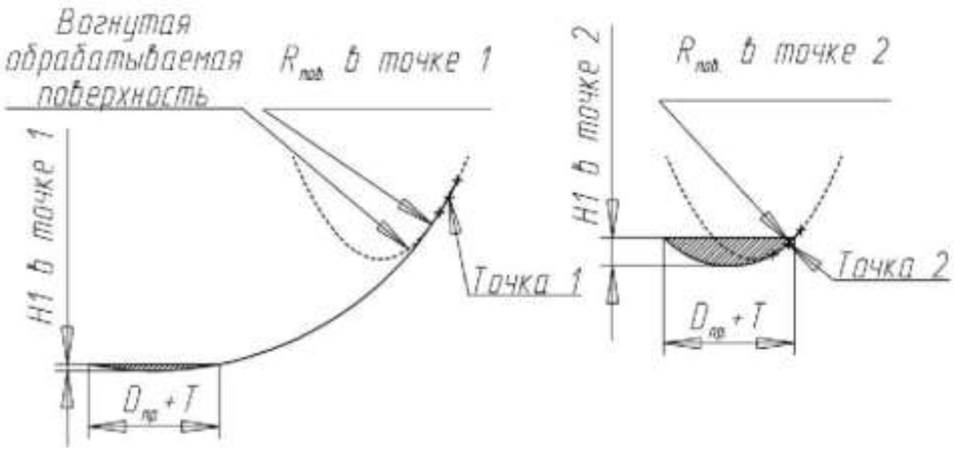

Figure 2.3. Dependence of the growing stock on the surface radius .

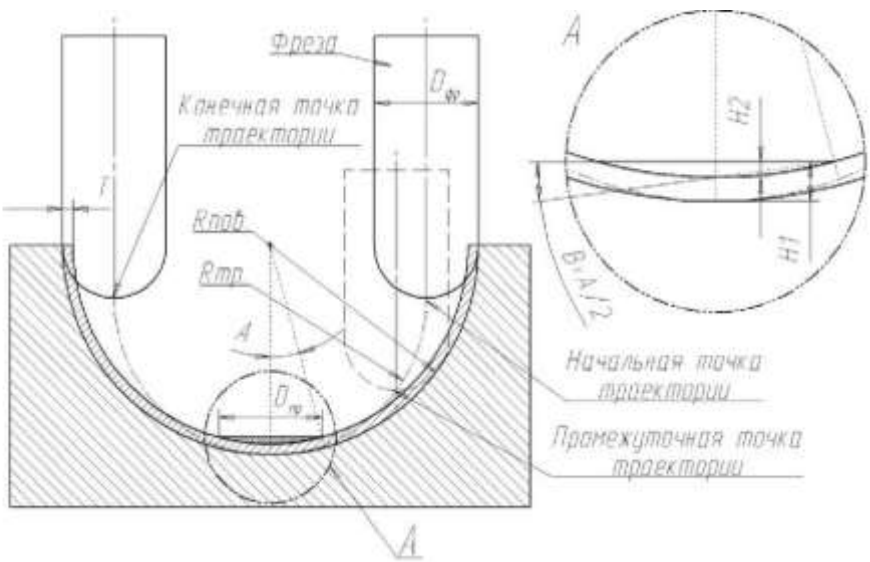

Figure 2.4. Calculated scheme of the increasing stock .

From figure 2.4 it follows

$$tg\alpha = \frac{2H_2}{R_{фр.}} \Rightarrow H_2 = \frac{R_{фр.}tg\alpha}{2}; \qquad (2.7)$$

$$\sin\alpha = \frac{R_{фр.}}{R_{пов.}} \Rightarrow \alpha = \arcsin\frac{R_{фр.}}{R_{пов.}}. \qquad (2.8)$$

Then Equation 2.6 will take the following value

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

$$H_{1окр} = \frac{R_{фр.}\cdot tg\left(\arcsin\frac{R_{фр.}}{R_{пов.}}\right)}{2} + T, \qquad (2.9)$$

Analysis of the obtained expression shows that the larger the preliminary allowance and the diameter of the preliminary tool, the higher the parameter of the depth of cut in the previously untreated zone, and the larger the radius of the machined surface, the smaller the depth of processing.

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