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DEVICES FOR DIMENSIONAL ADJUSTMENT OF THE CUTTING OF LATHE MACHINES

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ABSTRACT: - In this paper, the factors affecting the processing accuracy of lathes are examined. The paper highlights their environments, the dominant factors that have the greatest influence on the processing accuracy. The possibilities of increasing the processing accuracy on existing lathes by eliminating the influence of dominant factors on the processing accuracy is analyzed. The authors describes the place and value of the dimensional adjustment of the cutting edge of lathes while ensuring the accuracy of processing of parts such as a body of revolution, a method and a schematic diagram of a device for precision adjustment of the cutters of a lathe to the size to be machined are proposed in this paper.

KEYWORDS: Tools adjustment (setting), tool wear monitoring, measuring device, precision adjustment

INTRODUCTION

The most common type of machining of parts on metal-cutting machines is machining to size. Adjusting a tool to a size means setting its cutting edge to a predetermined position relative to the base (the origin of the dimensions). The shape of the machined surface is determined by the nature of the working movements of the machine and the position of the cutting edge of the tool installed on the machine.

One of the reserves for increasing the productivity of machine tools is to reduce their downtime associated with setting up and setting up a tool by a given size. During machining, it is necessary not only to set the cutting edge to a given size, but also to maintain it within the established tolerance field of the corresponding quality. The position of the cutting edge is not kept constant. The reasons for the occurrence of deviations are: dimensional wear of the cutting tool, blunting of the cutting edge, thermal and force deformations that occur during cutting, etc.

The dimensional stability of a tool is understood as the duration of its operation, which ensures the preservation of the machined dimensions of the parts. Dimensional tool life is usually less than the overall tool life of the cutting tool, and its greatest value can be achieved by compensating for a systematic dimensional error and increasing the tool setting accuracy by size.

The loss of time on the machine, associated with the wear of the tool and the need to replace it, consists of the time spent on initial setup for a given size, for setup (dimensional regulation), and changing a worn tool. They make up from 8 to 20% of the time of the machine, during this time the machine is idle and does not participate in the production.

The quality of parts processing both in terms of accuracy and surface quality will depend on the type and characteristics of the selected finishing. Depending on the requirements for the quality of the surfaces of various parts, at present, the following are used as finishing: reaming, broaching, grinding, fine turning and milling, etc.

Traditionally, if the main factor in evaluating the effectiveness of various pre-treatment methods was productivity and cost, as well as the complexity of the equipment, in contrast to this, for finishing operations, the surface quality factor came first in their comparative evaluation. At the same time, only methods that provide a given surface quality and processing accuracy were compared in terms of productivity and cost of the process, taking into account the complexity and cost of equipment.

Currently, the development of mechanical engineering requires finishing methods to provide a given surface quality and machining accuracy while meeting the requirements for productivity and cost of the process, taking into account the complexity and cost of equipment. At the same time, the task of finishing consists not only in resolving the issues of obtaining parts of the correct shape and exact dimensions within tolerances, but also in resolving the problem of obtaining a wear-resistant surface when working in machines. To do this, the roughness must be minimal, these surfaces must be obtained under such physical cutting conditions in which the surface layer must be wear-resistant, therefore, it is necessary to eliminate: unfavorable changes in the surface layer that occur during roughing; deformation reduction and associated temperature rises during finishing, etc.

One of the most common types of processing is turning. When finishing on lathes, there are a number of problems in ensuring high machining accuracy. In order to ensure high accuracy of turning, first of all, it is necessary to ensure the minimum depth of the cut layer, and the stability of the cutting process. Since in this case, due to the small cross sections of the chip and the small values of contact between the cutter and the workpiece, the cutting forces and heating of the part at a minimum depth of cut turn out to be very insignificant, as a result of which there are no significant changes in the crystal structure and work hardening of the surface layer of the metal, which ensures high wear resistance of the surfaces. processed parts. Small cutting forces at the same time allow it to be limited to very small forces when clamping parts. Due to the low forces, deformations during installation and processing of parts are also insignificant, which ensures high accuracy and correct microgeometry for fine turning. As a result of these factors, it is possible to confidently predict the accuracy of the dimensions of parts processed under the above conditions, which corresponds to 7-6 qualities of accuracy, and it is possible to maintain tolerances of the order of 5-8 microns, for a diameter of 15-100 mm, the values of ellipticity and taper within 3 microns.

The characteristics of the main parameters of various processing methods are known in the literature [1]:

- the maximum economic accuracy in the processing of raw materials for the processes of reaming and pulling lies within the 7th grade of accuracy;

- the limits of economically achievable accuracy in turning is the 9th grade of accuracy, which is much less than the accuracy in deployment and broaching.

An analysis of various literature data shows that the accuracy of processing methods depends on the minimum depth of a possible removed metal layer. When deployed and pulled, it is 0.03 mm. When turning, such a layer of metal is 0.06 mm. It is obvious that by turning in serial and mass production types, by machining on tuned equipment, it is practically impossible to obtain an accuracy of diametrical dimensions higher than the 9th accuracy class.

Taking into account a significant percentage of the use of turning in mechanical engineering, it must be considered that the problem of improving the quality and accuracy in turning is very relevant.

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The quality of turning, including accuracy, is influenced by many factors. These factors include: the original structure and the type of material being processed; the state of the technological system machine-tool-tool-products, including the presence of vibration and forced vibrations in the process of work; cutting mode - cutting speed, feed, depth of cut; cutting tool geometry; condition and material of the cutting edge; lubrication and cooling during cutting.

All of these factors can be combined into two main groups:

1) geometric factors, these include the amount of feed, the radius of curvature of the cutting blade tip, the auxiliary and main cutting angles in the plan;

2) physical factors: material of the part and tool, cutting speed and angle, deformation and vibrations of the machine tool, tool and product, coolant and lubricant, etc.

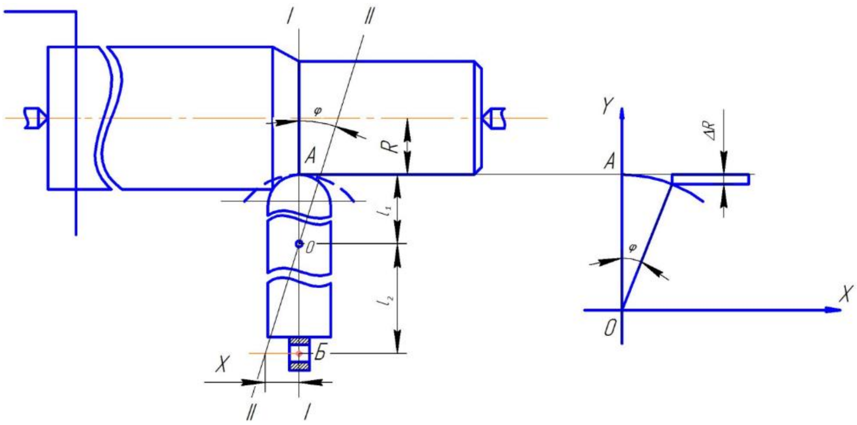
If the first group of factors mainly affects the formation of roughness, then the second group of factors mainly determines the stability of chip formation.

When processing cylindrical surfaces with a blade tool, the accuracy of diametrical dimensions depends both on the processing methods and on the equipment used, the tool and the cutting pattern. Thus, we can say that the accuracy of turning is influenced by a large number of different technological factors, and in order to find ways to improve the accuracy of machining, it is necessary to pay attention mainly to the dominant factors.

If the shape accuracy is mainly determined by the operation of the machine, then the dimensional accuracy depends on the setting, i.e. the error of setting the cutter on the size does not affect the change in the shape of the workpiece, but only affects the change in size. The error of setting the cutter to the size refers to random errors and, as shown by the conducted studies, obeys the law of normal distribution.

The development of production technologies leads to an increase in the requirements for the quality and accuracy of manufactured products, which leads to the introduction of new machine tools at enterprises with new devices for setting up equipment for processing a manufactured part. Setting up the equipment is reduced to the use of devices that allow you to set the tool to a given size with the required accuracy in a short time. There are several methods and devices that provide cutting tool settings for size with a certain accuracy. However, the cutting tool included in the technological system has a limited service life, determined by the period of its durability. Therefore, the cutting tool is each time re-adjusted to the size. In this case, it is not possible to install the tool absolutely exactly in its previous position. There is a setting error, as well as the whole range of physical and chemical processes when cutting metals (chip friction on the front surface, friction of the machined surface on the back; high temperatures and high pressures in the cutting zone, oxidation of the material of the front surface, etc.) leads to wear of the cutting tool. Therefore, to ensure the specified accuracy of processing products, it will be necessary to have a device that allows you to periodically introduce additional correction. Due to the large range of manufactured products, it is difficult to calculate this correction value in each specific case. Thus, there is a need to create and use special devices in the systems of adjustment and re-adjustment of machine tools that allow to take into account and compensate for a number of errors in setting and wear of the cutting tool and enter the required correction value.

Rice. 3. Scheme for determining the change in the depth of cut Δt when the cutter is rotated about the O axis



According to the scheme, the change in the depth of cut Δt (change in the position of the cutting edge of the tool) when the cutter is rotated by an angle ϕ can be determined by the following formula:

$$\Delta t = (l_1 - l_1 \cos\varphi) \cdot \frac{l_1}{l_2} \qquad (1)$$

Where l_1 is the distance from the axis of rotation of the cutter to the cutting edge, l2 is the distance from the axis of rotation of the cutter to the tail of the cutter, ϕ is the angle of rotation of the cutter.

$$tg\varphi = \frac{X}{OБ} \qquad (2)$$

For the design scheme shown in Fig. 1, we determine the change in the cutting depth Δt when the end of the cutter is moved by X as a result of turning the cutter through an angle ϕ (Fig. 3).

From equation (1) we get that,

$$l_1 = \frac{\Delta t}{1 - \cos\varphi} \qquad (3)$$

If we take into account that OB = l_2 and $l_2 = 2l_1$, then we can write equation (2) in the form

$$tg\varphi = \frac{X}{2l_2} \qquad (4)$$

Having jointly solved equation (3) and (4) for Δt, we obtain the following expressions

$$\Delta t = \frac{X(1 - \cos\varphi)}{2tg\varphi} \qquad (5)$$

If we keep in mind that according to the design of turning cutters, l2 = 100 mm can be taken, then moving the end of the cutter to X = 0.1 mm can give a change in the cutting depth even by Δt ≈ 0.2 µm.

Thus, the creation of a device for dimensional setting of the cutter of lathes based on the considered setting scheme allows the implementation of precision adjustment of the cutter to a given size and precise correction of its position.

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