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DEVELOPMENT OF THE DESIGN OF A PEAKLESS ROTARY CUTTING TOOL

Processing of external surfaces with turning tools is the most common in the total mass of tools, and occupies a special place in the technological process of manufacturing machine parts. The issues of increasing productivity, accuracy and reliability of the technological process have always been and remain relevant and effective for metalworking.

The aim of the study is to improve the quality of processing of external cylindrical surfaces with the development of a new processing method and the design of a peakless turning through-hole cutter.

The idea of the work is to develop a new design of a lathe cutter for finishing and a new processing method.

The analysis of methods and methods of processing external cylindrical surfaces, parameters of the cut layer during cutting, geometry and designs of turning cutting tools, led to the development of a new metal-cutting tool – a peakless turning cutting tool for finishing. The new design improves cutting conditions and minimizes the impact of adverse factors accompanying the cutting process.

Thus, a pass-through peakless cutter has one cutting edge, is simpler due to the absence of an auxiliary back surface and top, has less complexity of manufacturing and sharpening, and therefore requires less operating costs.

Keywords: processing, surface, construction, cutter, peakless, quality.

Introduction

The strategy of industrial and innovative development of the Republic of Kazakhstan is aimed at creating a high-tech structure of the economy through an active state policy in the field of science and innovation. The strategy outlines the main directions in the development of science: in the energy, chemical, oil and gas, mining industries, mechanical engineering and metalworking – increasing the competitiveness of manufactured products [1]. One of the most important elements that ensure the quality of machine parts processing and labor productivity is the cutting tool. With its help, the workpiece is given the desired shape and size by cutting off relatively thin layers of material. The performance of the cutting tool has a significant impact on the economic efficiency of the production process [2, 3].

In modern mechanical engineering, a large range of metal-cutting tools of various purposes and designs is used for processing external, internal and flat surfaces. At the same time, the processing of external cylindrical surfaces with cutters with the presence of a tip on the cutting plate is associated with a number of difficulties due to abrasive

mechanical effects on the material being processed, resulting in reduced tool life. These circumstances necessitate a reduction in cutting conditions, as well as the introduction of additional operations into the technological process.

The processing of external surfaces with turning tools is the most common in the total mass of tools, and occupies a special place in the technological process of manufacturing machine parts. The issues of increasing productivity, accuracy and reliability of the machining process have always been and remain relevant and effective for metalworking [4–7].

Methods and materials

Theoretical research was carried out using the basic provisions of mechanical engineering technology, cutting theory, tool design and mechanics.

Cutters are the most common type of metal cutting tool. They are used on turning, boring, carousel, revolving, planing machines, semi-automatic machines.

Depending on the type of machine and the work performed, various cutters are used, which are classified according to the following criteria:

- by type of processing (through, thrust, cutting, boring, cutting, shaped)
- by the nature of processing (roughing, finishing);
- by installation relative to the part (radial, angular, tangential);
- in the direction of feed (right, left)
- according to the design of the head (straight, bent, curved, drawn);
- according to the section of the body (rectangular, square, round);
- by design (solid, composite, prefabricated);
- according to the material of the working part (from tool steel, hard alloy, from ceramic materials, diamond, from superhard synthetic materials) [8].

The main geometric characteristics of the cutter are the main and auxiliary angles, the angles in the plan and the angle of inclination of the main cutting edge.

The main cutter angles (front γ, main back α, cutting δ, sharpening β) are measured in the main cutting plane perpendicular to the projection of the main cutting edge onto the main plane.

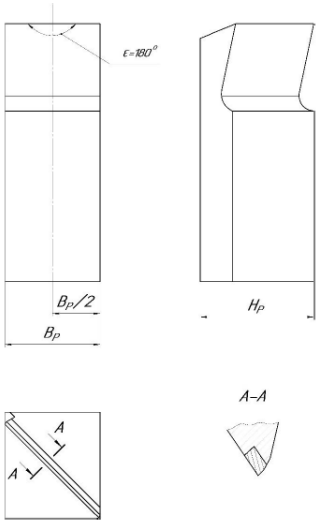
The disadvantage of turning cutters is that the tip of the cutter is the weakest point on the cutting part and is more exposed to mechanical, abrasive effects of the material being processed and temperature effects, i.e. it works in the most unfavorable cutting conditions, as a result of which the cutter resistance is reduced.

Results and discussions

An analysis of the methods and methods for processing external cylindrical surfaces, the parameters of the cut layer during cutting, the geometry and designs of turning through cutters led to the development of a new metal cutting tool – a peakless turning through cut for finishing [9]. The new design improves cutting conditions and minimizes the impact of adverse factors that accompany the cutting process [10–13].

The cutter has one rear surface and one rear corner (Figure 1). To create more favorable cutting conditions, the working part is made without a vertex and therefore the cutter is called vertexless (the main and auxiliary cutting edges of a traditional turning cutter are deployed in one line by reducing the main and auxiliary angles in the plan

to zero, therefore they are located on the same straight line and form a single cutting an edge with a lead angle at the top of 180°); the conditional location of the excluded vertex is at the point of intersection of the cutting edge with the longitudinal plane of symmetry of the holder.



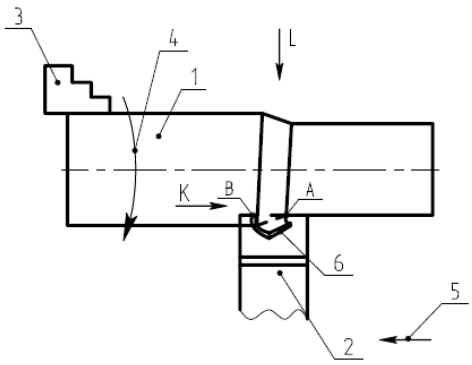
Bp – cutter width; Bp/2 – distance to the longitudinal plane of symmetry of the cutter holder; Hp – cutter height; ε – cutting edge with a 180° apex angle, A – A – section normal to the cutting edge for identifying the geometrical parameters of the cutter.

Picture 1 – Peakless turning cutter

The only cutting edge is located perpendicular to the longitudinal axis of the cutter and during operation is in the working plane, perpendicular to the main plane and tangent to the machined surface. The theoretical point of contact of the cutter and the machined surface at the moment of contact at zero depth of cut is on the generatrix in the section of the horizontal plane passing through the axis of the workpiece. At the theoretical point of contact (which is located in the middle of the line of contact between the cutter and the cut layer), the cutting edge actually divides into a main and a secondary cutting edge in kinematics, due to the curvature of the machined surface in cross section.

Thus, in the kinematics, equal in magnitude main and auxiliary angles appear in the plan. Therefore, the cutter has variables (converging to zero at the theoretical central point of contact with the machined surface, which creates the effect of the presence of a smoothing edge on the real contact line) the main and auxiliary kinematic angles in the plan, the angle of inclination of the cutting edge, one clearance angle. The division of the cutting edge into the main and auxiliary (due to the appearance of real main and auxiliary kinematic angles in the plan outside the real line of contact with the machined surface) is conditional, since the position of the mentioned theoretical contact point depends on the unregulated position of the cutter in height in the tool holder for use the entire length of the cutting edge and the full resource of the cutter; the back angle on the cutter remains unchanged. A safety undercut is made on the upper and lower parts of the cutting edge.

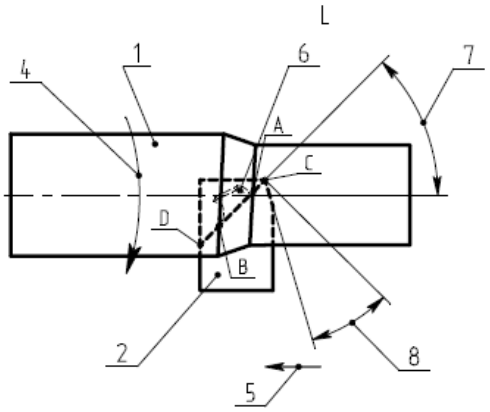
Figure 2 shows a diagram of the operation of a vertexless turning cutter when turning a part such as a body of revolution installed in a lathe chuck.



1 - the workpiece, 2 - the peakless turning tool, 3 - the machine chuck, 4 - the rotational movement of the chuck with the workpiece, 5 - the longitudinal movement of the cutter, 6 - chips, A and B – points limiting the contact of the workpiece and the cutter, K and L - views in the horizontal plane

Figure 2 – Diagram of the operation of a peakless lathe through-hole cutter

Figures 3 and 4 show the views along the arrow L and K in the horizontal plane.



7 – the angle of inclination of the main cutting edge (λ = 10 – 90 °); 8 – the angle of the upper safety edge; A and B – the points limiting the contact of the workpiece and the cutter; 9 – the safety edge; the lower safety edge is conditionally not shown; C – D – projection of the cutting edge; points C and D are respectively the upper and lower limits of the cutting edge

Figure 3 – Processing scheme (front view)

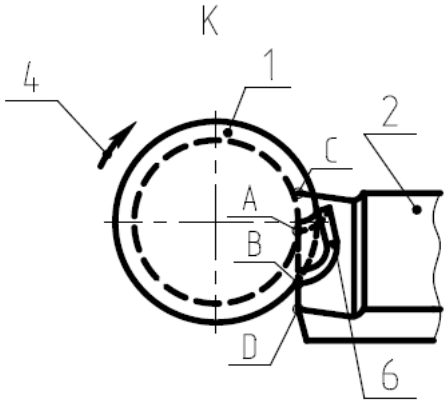


Figure 4 – Processing scheme (right view)

When working, the cutter is installed in the tool holder in height with the help of special adjustment plates for installing and including new sections of the cutting edge in operation. Based on the distinctive features described above, the claimed cutter (in kinematics) has five geometric parameters (angles) instead of six for a traditional through-pass turning cutter (in statics) due to the exclusion of the auxiliary rear angle: front angle, rear angle, angle of inclination of the cutting edge; main and auxiliary kinematic angles in plan (not measured, but calculated); main and auxiliary angles in plan in statics are zero. In statics, the cutter has only three geometric parameters: the front angle, the rear angle, the angle of inclination of the cutting edge. The scheme and method of processing with this cutter do not differ from traditional ones.

Conclusions

Thus, a pass-through peakless cutter has one cutting edge, is simpler due to the absence of an auxiliary back surface and top, has less complexity of manufacturing and sharpening, and therefore requires less operating costs. Its design provides upper and lower safety edges, although they may rarely be needed. The cutter can be made of high-speed steel or equipped with plates made of hard alloy and other tool materials.

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ТӨБЕСІЗ ЖОНУ ӨТПЕЛІ КЕСКІШТІҢ КОНСТРУКЦИЯСЫН ӘЗІРЛЕУ

Сыртқы беттерді бұрау арқылы өңдеу құралдардың жалпы санында ең көп таралған және машина бөлшектерін өндірудің технологиялық үрдісінде ерекше орын алады. Өңдеу процесінің өнімділігі, дәлдігі мен сенімділігі мәселелері әрдайым металл өңдеу үшін өзекті және тиімді болып қала береді.

Зерттеудің мақсаты – сыртқы цилиндрлік беттерді өңдеудің жаңа әдісін және төбесыз жону өтпелі кескішінің конструкциясынын жасау арқылы өңдеу сапасын арттыру.

Жұмыстың идеясы – түпкілікті өңдеуге арналған жону кескіштің жаңа конструкциясынын және өңдеудің жаңа әдісін жасау.

Сыртқы цилиндрлік беттерді өңдеу әдістері мен әдістерін, кесу кезінде кесілген қабаттың параметрлерін, геометрия мен жону кескіш конструкцияларын талдау жаңа металл кескіш құралдың – төбесіз жону өтпелі кескішінің дамуына әкелді. Жаңа конструкцияда кесу жағдайлары жақсарып, кесу үрдісін сүйемелдейтін қолайсыз факторлардың әсерін азайтады.

Осылайша, айналмалы біліксіз кескіш бір кесу жиегіне ие, көмекші артқы беті мен үстіңгі жағының болмауына байланысты қарапайым, өндіріс пен қайраудың аз еңбек сыйымдылығына ие, сондықтан пайдалану шығындарын аз талап етеді.

Кілтті сөздер: өңдеу, беті, құрылымы, кескіш, төбесіз, сапасы.

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РАЗРАБОТКА КОНСТРУКЦИИ БЕЗВЕРШИННОГО ТОКАРНОГО ПРОХОДНОГО РЕЗЦА

Обработка наружных поверхностей токарными резцами является наиболее распространенным в общей массе инструментов, и занимает особое место в технологическом процессе изготовления деталей машин. Вопросы повышения производительности, точности и надёжности процесса обработки всегда были и остаются актуальными и эффективными для металлообработки.

Целью исследования является повышение качества обработки наружных цилиндрических поверхностей с разработкой нового способа обработки и конструкции безвершинного токарного проходного резца.

Идея работы заключается в разработке новой конструкции токарного резца для чистовой обработки и нового способа обработки.

Анализ методов и способов обработки наружных цилиндрических поверхностей, параметров срезаемого слоя при резании, геометрии и конструкций токарных проходных резцов, привёл к разработке нового металлорежущего инструмента – безвершинного токарного проходного резца для чистовой обработки. В новой конструкции улучшены условия резания и сведены к минимуму воздействия неблагоприятных факторов, сопровождающих процесс резания.

Таким образом, проходной безвершинный резец имеет одну режущую кромку, является более простым из-за отсутствия вспомогательной задней поверхности и вершины, имеет меньшую трудоёмкость изготовления и заточки и потому требует меньше затрат на эксплуатацию.

Ключевые слова: обработка, поверхность, конструкция, резец, безвершинный, качество.

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