NOVATEUR PUBLICATIONS
INTERNATIONAL JOURNAL OF INNOVATIONS IN ENGINEERING RESEARCH AND TECHNOLOGY
[IJIERT] ISSN: 2394-3696 Website: ijiert.org
VOLUME 10, ISSUE 10, Oct. -2023

HIGH-PERFORMANCE ACCESSORIES FOR CNC MACHINES

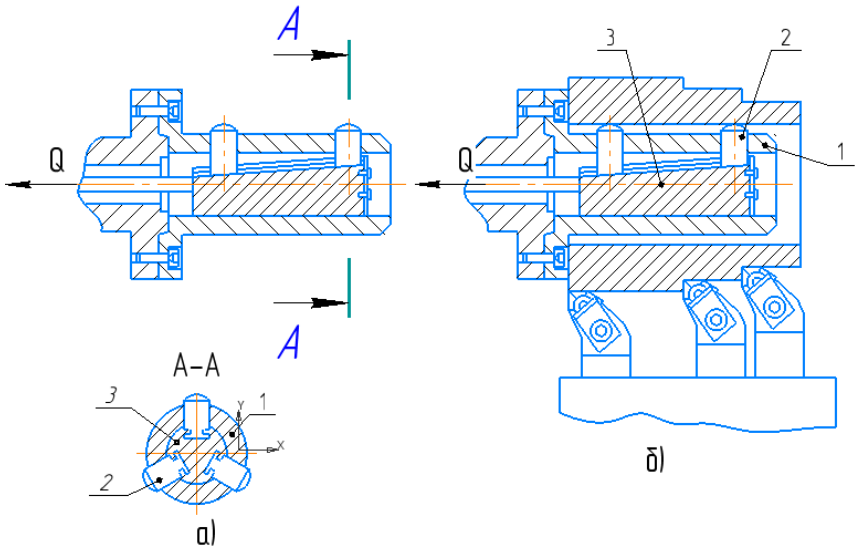
Mamajonov Alisher Mamadzhonovich[1],
Khomidov Ibrokhimbek[2]
Olimjon ugli,
Matkarimov Bekhzod[3]
Bakhtiyor ugli
[1]Tashkent State Technical University
E-mail:alisher.mamadjanov@tdtu.uzPhone:+998-94-608-82-35; E-mail:Xomidov_1949@mail.ruPhone:+998-97-763-17-67,
matkarimov.behzod@gmail.com, Phone:+99897-433-40-32.

Abstract

The article examines the high-performance tooling for CNC machine tools. The new constructions expanding mandrel and gang-tools are proposed. The deflected mode analyzes of proposed gang-tool constructions are performed by the final element method.

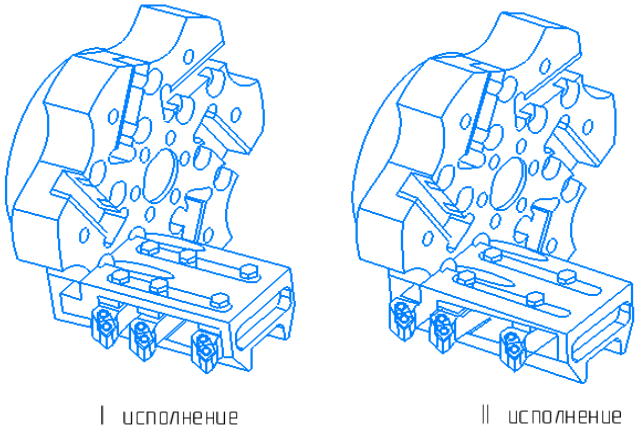
Tool turret heads of CNC lathes are an important factor in increasing processing productivity by reducing the time spent changing cutting tools. Thus, a consistent concentration of technological transitions is realized, since there is one tool in the cutting zone. Further increase in processing productivity on such machines is possible by implementing a parallel concentration of technological transitions, which is carried out using special multi-tool holders [1, 2].

The expanding mandrel and the technological diagram of multi-cutter processing on a CNC lathe are shown in Fig. 1. A workpiece with a large diameter axial hole is mounted on an expanding mandrel [3]. Under the action of the clamping force, the wedge 3 moves in the direction of its action, forcing the plungers 2 to carry out centrifugal axial movement in the holes of the housing 1, securing the workpiece. Release occurs during the reverse stroke of the wedge, when the plungers return to their original position due to the T-shaped connection of the clamping wedge and the plungers. The proposed mandrel allows one to significantly expand the range of diameters of the base holes of the workpieces.



Rice. 1. Expanding mandrel (a) and technological scheme of multi-cutter processing (b)

Multi-tool holders with pre-sized tools are installed and secured in the slots of the turret (Fig. 2). Improved design of a multi-cutter holder (II version) Progressive Technologies System and Machine Building, 2008, VIP. 36 72 is distinguished by wider technological capabilities and increased rigidity.



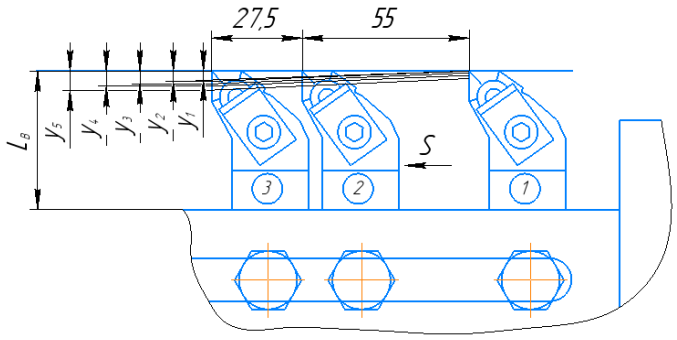
Rice. 2. Multi-tool holders

The stress-strain state of multi-tool holders was studied by the finite element method in order to evaluate the accuracy characteristics of multi-tool machining. To compare the magnitudes of elastic displacements, an analytical study of two- and three-cutter adjustments of multi-cutter holders of both designs was carried out. In this case, cutting forces corresponding to the processing of a steel shaft with a diameter of 80 mm with a cutting depth of t = 4 mm were applied to each of the cutters. The longitudinal overhang of the incisors LP, which is estimated by the distance between the incisors, varied from 27.5 mm to 110 mm. The transverse overhang of the cutters LB, measured from the tip to the point of overturning the cutter, is 50 mm. The values of elastic displacements of cutters along the Y and Z axes for the multi-cutter holders under study are given in Table. 1. The results of the analytical study showed a decrease in the magnitude of elastic displacements of cutters on a multi-cutter holder of type II both along the Y axis and along the Z axis, which increases the accuracy of the machined surfaces and makes it possible to increase cutting modes. For three-cutter adjustment of a multi-cutter holder, an analytical study of the influence of the transverse overhang of the cutters on the magnitude of elastic displacements was carried out. In graphical form in Fig. Figure 3 shows the elastic displacements of the cutters □y along the Y axis depending on the magnitude of the transverse overhang of the cutters of the multi-cutting head of the 1st design. The graphs shown in Fig. 4 and 5 characterize the dependence of the displacement of the cutters along the Y axis on the longitudinal and transverse overhang of the cutters.

Table 1 Elastic displacements of cutters fixed in a multi-cutter holder, mm

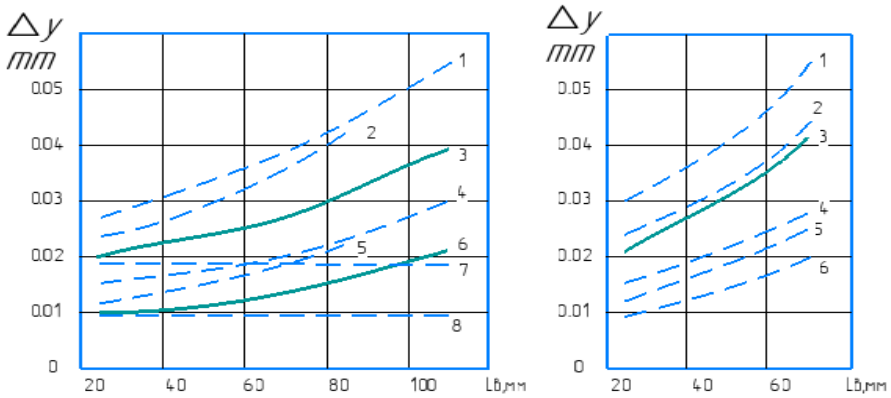
Number of cutters in adjustment, pcs.	Distance between cutters, mm	Multi-tool holder					
		I execution			II execution		
		Cutter number					
		1	2	3	1	2	3
		Displacement of cutters along the Z axis.					
2	55	0.051	0.071	-	0.011	0.0496	-
2	82.5	0.052	0.115	-	0.011	0.068	-
3	55-27.5	0.061	0.121	0.142	0.019	0.062	0.095
3	55-55	0.061	0.125	0.196	0.0196	0.073	0.103
		Displacement of cutters along the Y axis.					
2	55	0.014	0.017	-	0.001	0.013	-
2	82.5	0.014	0.022	-	0.0012	0.0156	-

3	55-27.5	0.014	0.022	0.028	0.0053	0.0148	0.023
3	55-55	0.014	0.022	0.038	0.0054	0.015	0.0254



Rice. 3. Elastic displacements of the cutters Δy in the direction of the Y axis when the cutters extend LB = 30; 40; 50; 60; 70 mm.

Analyzing the results of a theoretical study of the stress-strain state of multi-cutting setups, we come to the conclusion that the values of the longitudinal and transverse overhang of the cutters significantly influence the magnitude of elastic deformations of the technological system. At the same time, the elastic displacements of the cutters along the Y axis, which affect the accuracy of machining cylindrical surfaces, with the minimum possible transverse overhang of the tools do not exceed 0.03...0.035 mm, which is acceptable for rough turning. To assess the influence of multi-tool machining on the accuracy of parts and the reliability of analytical calculations on a computer to determine the elastic deformations of a multi-tool holder (I version), experimental studies of the accuracy of machining a smooth shaft were carried out on a CNC lathe model 16K20F3S2.



Rice. 4. Graphs of the displacement of cutters of two-cutters (——) and three-cutters (- - - -) adjustments along the Y axis from the longitudinal overhang:
1 – LB3 = 70 mm; 2 – LB2 = 70 mm; 3 – LB2 = 70 mm; 4 – LB3 = 30 mm; 5 – LB2 = 30 mm; 6 – LB2 = 30 mm; 7 – LB1 = 70 mm; 8 – LB1 = 30 mm.

Rice. 5. Graphs of the displacement of cutters of two-cutters (——) and three-cutters (- - - -) adjustments along the Y axis from the transverse overhang:

1 – LP3 = 110 мм; 2 – LP2 = 87,5 мм; 3 – LP2 = 110 мм; 4 – LP3 = 27,5 мм; 5 – LP2 = 27,5 мм; 6 – LP1 = 27,5...110 мм

Table 2 Machining parameters with two-cutter setup

Experiment series number	Diameter of treated surface, mm	Depth of cut, mm	LP, мм	LB, мм	SO, мм/об
1	41	1	110	50	0.5
2	39		110	50	0.3
3	37		110	50	0.1
4	35		55	50	0.5
5	33		110	50	0.5

As we see from table. 3, the results of analytical and experimental studies are close and confirm the good accuracy characteristics of multi-cutter machining on CNC lathes. We have performed a comparative analysis of the performance of rough machining of a stepped shaft on a screw-cutting lathe with a RU model 16K20, a CNC lathe model 16K20F3S2 and a CNC lathe model 16K20F3S2, equipped with Progressive Technologies and Machine Building Systems, 2008, Vip. 36 75 multi-tool holder.

Table 3 Results of experimental and analytical studies of cutter and holder deformation.

Series No. experiments	LP, мм	LB, мм	SO, мм/об	Average displacement of incisors, mm	
				Experiment	Modeling
1	55	50	0.5	0.04	0.03
2	110	50	0.5	0.04	0.04
3	110	50	0.3	0.04	0.03
4	110	50	0.1	0.05	0.02
5	110	70	0.5	0.07	0.06

The results of technical standardization for these turning operations are given in table. 4. Here tO is the main technological time; tCA – cycle time of automatic operation of the machine according to the program; tB – auxiliary time; TST – piece time.

Table 4. Time standards for turning a stepped shaft.

Machine type	Time, min			
	t_o	$t_{ЦА}$	$t_в$	$T_{шт}$
Screw-cutting lathe.	3.91	-	1.96	6.35
CNC lathe.	3.57	4.15	1.11	5.69
CNC lathe, equipped with multi-tool holders.	1.93	2.25	1.11	3.63

Thus, the use of a multi-tool holder when turning on CNC lathes can significantly increase not only productivity, but also the accuracy of shaft processing.

Conclusion. To increase the productivity of rough and semi-finish turning on CNC lathes equipped with turret heads, it is advisable to use the proposed designs of multi-tool holders and a high-speed expanding mandrel.

References

1. Decl. Pat. on vinakhid No. 67945 A Ukraine, MPK (2006), V23V 1/00, V23V 29/24. Methods of processing and devices for agricultural production / Karpus V.I., Milovsky B.V., Abdul Al Mohsen Ali Alameddin; applicant and patent holder of the National tech. University "KhPI". – No. 2003 076065; application 07/01/2003; publ. 07/15/2004. Bull. No. 7.
2. Pat. for Corisna model No. 24139 Ukraine, MPK (2006), B23V 29/24. Bagatoriztseviytrimach / Karpus V.Ye., Kotlyar O.V.; applicant and patent holder of the National tech. University "KhPI". – No. u 2006 13481; application 12/19/2006; publ. 06/25/2007, Bulletin. No. 9.
3. Pat. for Corisna model No. 30999 Ukraine, MPK (2006), B23Q 3/06. The mandrel is embossed / Karpus V.I., Ivanov V.O.; applicant and patent holder of the National tech. University "KhPI". – No. u 2007 11359; application 10/15/2007; publ. 03/25/2008, Bulletin. No. 6.
4. Fayzimatov S. N., Yakupov A. M., Gafurov A. M. THE GEOMETRY OF THE CONTACT SURFACE DURING PLASTIC DEFORMATION //Web of Scientist: International Scientific Research Journal. – 2022. – T. 3. – №. 12. – C. 231-239.
5. Fayzimatov, S. N., A. M. Yakupov, and A. M. Gafurov. "THE GEOMETRY OF THE CONTACT SURFACE DURING PLASTIC DEFORMATION." Web of Scientist: International Scientific Research Journal 3.12 (2022): 231-239.
6. Fayzimatov, S. N., Yakupov, A. M., & Gafurov, A. M. (2022). THE GEOMETRY OF THE CONTACT SURFACE DURING PLASTIC DEFORMATION. Web of Scientist: International Scientific Research Journal, 3(12), 231-239.
7. Gafurov A. M. et al. Study of the technological process of mechanical processing of parts with shaped surfaces in milling machines //Science and Education. – 2023. – T. 4. – №. 5. – C. 754-760.
8. Gafurov, Akmaljon Mavlonjonovich, and Abdumalik Khasanjon ogli Khamidjonov. "Study of the technological process of mechanical processing of parts with shaped surfaces in milling machines." Science and Education 4.5 (2023): 754-760.
9. Gafurov, A. M., & ogli Khamidjonov, A. K. (2023). Study of the technological process of mechanical processing of parts with shaped surfaces in milling machines. Science and Education, 4(5), 754-760.
10. Sh. N. Fayzimatov, A. M. Gafurov THE IMPORTANCE OF AUTOMATION IN THE DESIGN OF SHAPED SURFACES // Scientific progress. 2021. №6. URL: https://cyberleninka.ru/article/n/the-importance-of-automation-in-the-design-of-shaped-surfaces (дата обращения: 27.10.2023).
11. Sh. N. Fayzimatov, A. M. Gafurov THE IMPORTANCE OF AUTOMATION IN THE DESIGN OF SHAPED SURFACES // Scientific progress. 2021. №6. URL: https://cyberleninka.ru/article/n/the-importance-of-automation-in-
12. Sh. N. Fayzimatov, A. M.Yakupov, A. M. Gafurov DETERMINATION OF THE SHAPE AND DIMENSIONS OF DEFORMING ELEMENTS ACCORDING TO A GIVEN SHAPE AND DIMENSIONS OF THE CONTACT ZONE // Academic research in educational sciences. 2022. №12. URL: https://cyberleninka.ru/article/n/determination-of-the-shape-and-dimensions-of-deforming-elements-according-to-a-given-shape-and-dimensions-of-the-contact-zone (дата обращения: 27.10.2023).
13. Fayzimatov, S. N., A. M. Yakupov, and A. M. Gafurov. "THE GEOMETRY OF THE CONTACT SURFACE DURING PLASTIC DEFORMATION." Web of Scientist: International Scientific Research Journal 3.12 (2022): 231-239.

14. Fayzimatov, S. N., Yakupov, A. M., & Gafurov, A. M. (2022). THE GEOMETRY OF THE CONTACT SURFACE DURING PLASTIC DEFORMATION. Web of Scientist: International Scientific Research Journal, 3(12), 231-239.
15. Fayzimatov, S. N., A. M. Yakupov, and A. M. Gafurov. "THE GEOMETRY OF THE CONTACT SURFACE DURING PLASTIC DEFORMATION." Web of Scientist: International Scientific Research Journal 3, no. 12 (2022): 231-239.
16. Fayzimatov, S.N., Yakupov, A.M. and Gafurov, A.M., 2022. THE GEOMETRY OF THE CONTACT SURFACE DURING PLASTIC DEFORMATION. Web of Scientist: International Scientific Research Journal, 3(12), pp.231-239.
17. Fayzimatov SN, Yakupov AM, Gafurov AM. THE GEOMETRY OF THE CONTACT SURFACE DURING PLASTIC DEFORMATION. Web of Scientist: International Scientific Research Journal. 2022;3(12):231-9.