Trakia Journal of Sciences, Vol. 8, Suppl. 3, pp 37-40, 2010

Available online at:
http://www.uni-sz.bg

ISSN 1313-7069 (print)
ISSN 1313-3551 (online)

A NEW CONSTRUCTION OF A MOVABLE TWO-BLADE BLOCK FOR COMBINED MACHINING OF EXTERNAL TUBULAR SURFACE BY TURNING AND SURFACE PLASTIC DEFORMATION

N. Georgieva[1*], V. Grigorov[2], S. Kostadinov[2]

[1]Technical College – Jambol, Trakia University, Stara Zagora, Bulgaria
[2]Department Machine-building Technology and Metal Cutting Machines, Rousse University „Angel Kanchev", Rousse, Bulgaria

ABSTRACT
The disadvantages of the known scheme solutions for movable two-blade blocks used for cutting parts of tools for combined machining of external tubular surfaces by turning and surface plastic deformation (SPD) are analyzed. A variant of cutting block, creating conditions to reduce their disadvantages is presented.

Key words: combined machining, movable cutting block, cutting inserts, roll bearings, external tubular surfaces

INTRODUCTION

Cost-effectiveness of combination machining comprising the simultaneous implementation of cutting and SPD creates conditions for its wide application in engineering practice [1]. The evolution of this favorable circumstance is stimulated by the appropriate technical solutions based on the scheme and kinematical analogy of processes cutting and SPD [2]. Special feature of these technical solutions is the possibility of establishing a relative autonomy of the technical equipment for realization of both processes, which is reflected in applying of modular principle through differentiation of a cutting block and block of SPD within the combined tool [3, 4].

One of the solutions that received the most significant distribution in the practice of combined machining of external tubular surface is that based on using of a movable cutting block for carrying out the turning. The principal scheme of this block includes two cutting elements with diametrically opposed position, which are firmly linked to each other forming a common block. In the cutting process this block provides freedom for coordinated movement of the cutting elements in a direction forming a certain angle (usually 90°) with axis of the machining surface. A movable scheme of the cutting block is an effective means to prevent the consequences of the imbalance's emergence in the cutting process, which is commonplace in the machining of long shafts and axes resulting from the deflection and displacement of their mass centers. Also, through using tuning technology base with dimensions creation it provides high diametrically dimensions accuracy of the cylindrical surface.

EXPOSE

Regardless of the specified advantages, the used scheme variants of movable cutting blocks have shortcomings, too, which are result from the following reason - in the characteristic balance of the scheme the cutting forces' component in the direction of free movement of the cutting elements, the distribution of the cutting augmentation is such to ensure preservation of the power balance. In this regard, the variation of the augmentation and action of other random factors, occurring in the process of cutting a significant influence on the size accuracy and shape of machined surface, and also it is not possible to provide such distribution of augmentation, which

***Correspondence to:** *Nely Georgieva , Technical College – Jambol, Trakia University – Stara Zagora, "Graf Ignatiev" street №38, Jambol 8600; e-mail:ngeorgieva@tk.uni-sz.bg*

determines the differently and in the desired ratio preset cutting depth of for both knifes.

For example, increasing the cutting force component, acting on the one of the blades causes its driving back from machining surface and at the same time it is a reason for further inculcation of the other blade so that an increasing its cutting depth can lead to the achievement of the respective power balance. As a result of that, the rotation axis of the workpiece does not coincide with the axis of the other sections of the machining cylindrical surface. The reasons of violation of power balances are angular dislocation. Most often the described situation causes formation of vertebral-shaped form of treated surface in longitudinal section. Also, in the cases, when the value of removed augmentation exceeds twice the cutting depth of the smooth transition, due to inability to perform the required distribution of the augmentation, the cutting is implemented under conditions of dynamic loading with larger nominal value and scope of its dispersing. This circumstance makes reducing the accuracy of processing and the eventual compensation of that effect by increasing stability of the movable block or reduce its submission have negative consequences, too.

It is possible the listed shortcomings can be avoided or significantly limited by using improved scheme decision, which suggests removing of the fixed connection between the two cutting elements and its changing with such with roll elements, which roll on the machining surface. They are shown on **Fig. 1** where:
1 is cutting element removing an augmentation a_1;
2 - cutting element removing an augmentation a_2 ;
3 - roll element, which is solid connected with cutting element 1;
4 - roll element, which is solid connected with cutting element 2;
5 - guide standard surface with a diameter equal to that of machined, it is necessary till roll elements 3 and 4 pass on the machined;
6 - machined surface.

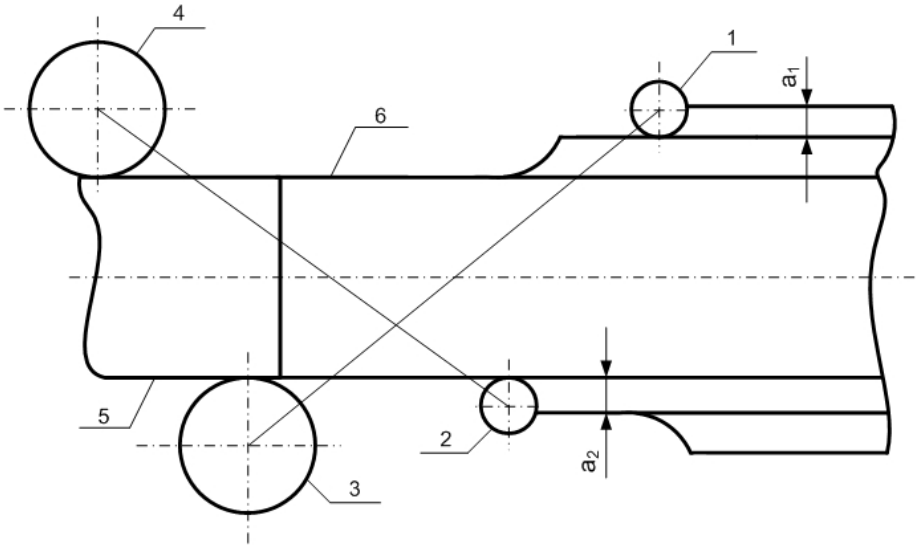

Fig. 1. Location scheme of the cutting and the bearing elements

The cutting and rolled elements, which are connected together, create two movable blocks. They can realize free movement each other in common direction, which coincides with this, created from the body's guidebars. The body of the construction is designed for fitting in the two blocks. It need to have possibility for angular turning around axis, which is perpendicular to the plane comprising the contact points of the elements 3 and 4 with 5 or 6 and of the cutting elements with the workpiece. This requirement is related to implementation of regulatory-dimensional functions and in order to free removal through the reverse moving of the block on the machined surface of the shaft.

A constructive solution of movable two-blade block, working according to the scheme on **Fig. 1** is shown on **Fig. 2**. The construction

contains two contours – external and internal, consisted of grinded steel plates. The external contour is built from plates 11, 13, 23 and 29 using screw fasteners 12 and pins 22. This contour gets into contact with the body's plane guidebars of the combined tool by means of ball bearings 20, centered by pins 21, which bear off the axes components of the cutting force. The fist cutting element is assembled on the external contour. It consists of round cutting insert 3 set firmly to movable holder 27, which is locked to the plate 29 by screws 2. Two-way screw 28 and support 1, which is immovably established by screws, serve for dimension adjusting of the insert. The radial component of the cutting force is balanced by rotating bearing fitting in the plate 13 (to 180^0 toward the insert 3) through an axis 15. The rotating bearing includes journal-bearing 16 and roller 17 with spherical external surface.

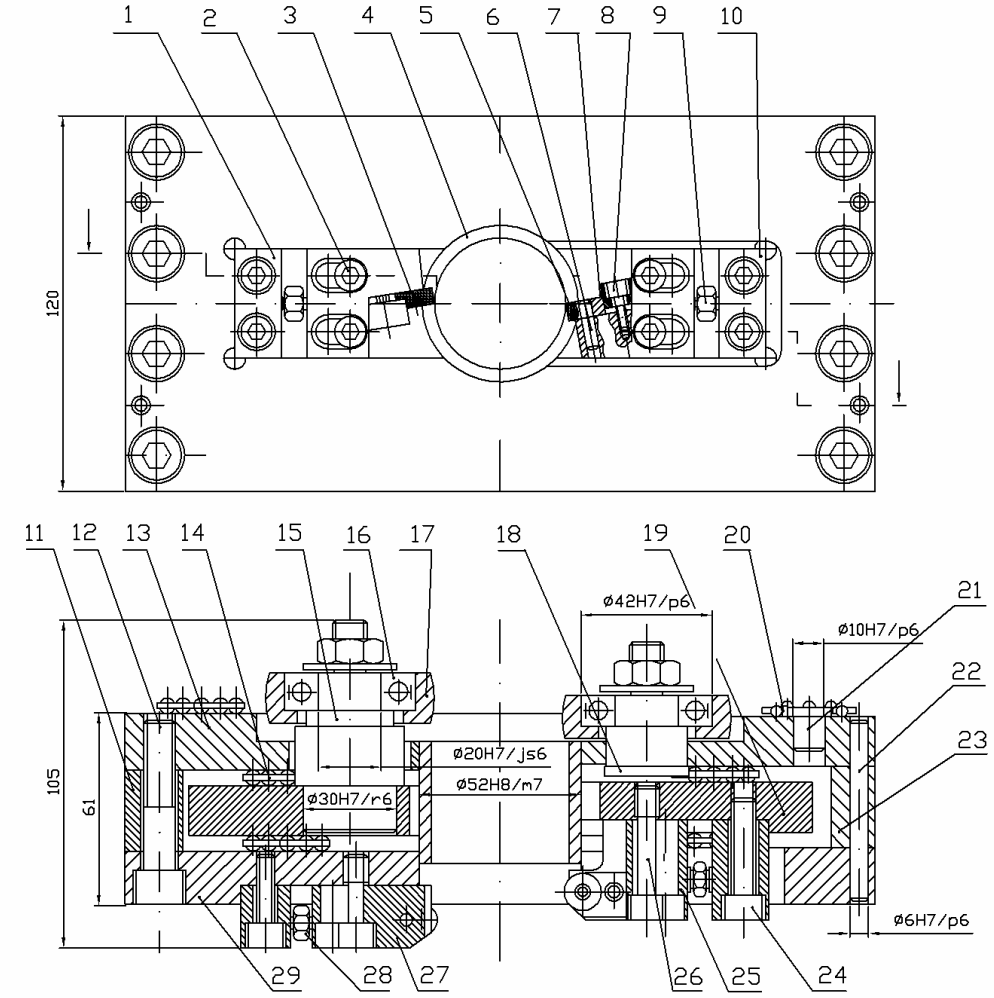

Fig. 2. Construction of movable cutting block with independent supports of the cutting part

The internal contour is built from plate 19 to which is established the second cutting element. It consists of insert 5, movable holder 25 and immovable bearing 10, which are fixed by screws 26 and 24. They perform functions analogous to the first cutting element. The inserts 3 and 5 are fixed by pressed wedges 7, screws 8 and pins 6. The radial bearing of the cutting insert 5 is analogous, too. It is assembled to the plate 19 by axis 15. The radial mobility of the internal contour toward the external is provided by using located bilaterally ball bearings 14. But in direction perpendicular to the plan plain it is limited by the plain guidebars of the body.

The possibility of getting shavings in the space between two contours is eliminated by housing 4, connecting plates 13 and 29 of the external contour.

Developed structure of movable two-blade block for machining smooth shaft is established on the parallels of universal lathe by a specially made holder. The set is shown in **Fig. 3.**

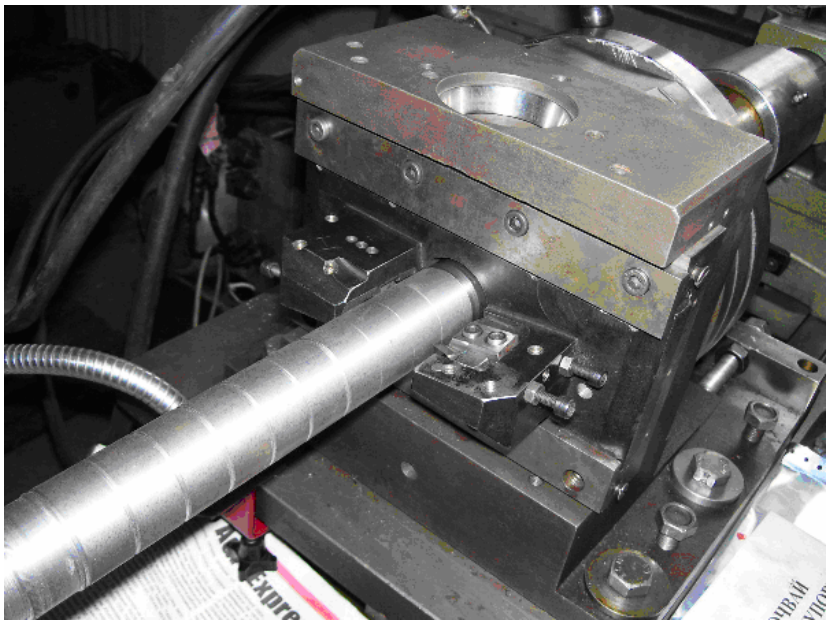

Fig. 3. Working scheme for machining smooth shaft with developed two-blade block

CONCLUSION

The chosen mutual disposition of the cutting and their respective rolling bearing elements creates a prerequisite for the partial elimination of the torques resulting from cutting forces and the reactions applied to rolling elements. The possibility of mutual displacement between the two movable blocks excludes the situation when the displacement of the one the blades toward rotation axis of detail would cause displacement to the other knife. At the same time, the obtaining of high accuracy of treated surface is ensured, in view of the fact that the radial position of the cutting elements at any moment is constant because it is determined by the radial position of the corresponding rolling elements. Because of there is possibility the diametric dimension of rolling elements to be selected by the required value, the variance of its contact deformation with the treated surface is practically negligible. Also in this way it surmounts the other of pointed shortcomings of used movable blocks, too, as the created independence between the two cutting elements is precondition for their participation in the proceeding with different cutting depth.

This allows first cutting knife works in a prior medium finishing cutting, and the second - a definitive cutting with minimal cutting depth according to the quality of surface and suitable for effective SPD. In this way it is creates circumstances for removing bigger augmentation and for neutralization of its variation over the dimension's dispersing after combined machining.

REFERENCES

1. Grigorov V.I., M.K.Karshakov, S.V.Kostadinov Peculiarities of scheme variants for combined machining of smooth shafts. Scientific papers of University of Rousse „Angel Kanchev", volume XXXXI, 2004, 139-146.
2. Kostadinov V.S. Scheme solutions for movable cutting blocks. Scientific papers of University of Rousse „Angel Kanchev", volume XXXII, 1989.
3. Kostadinov V.S. Combined machining by turning and surface plastic deformation. Abstract of the dissertation - doctor of technical sciences, S., 2005.
4. Kostadinov V.S. Peculiarities of surface plastic deformation accomplished by deformation module in combined instrument. AMO, Kranevo, 2008.