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Sliding Crank Mechanism Design for the Positioning Of a Lathe Cutting Tool

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ABSTRACT - *Now a days, In spite of fast evolving automation, some small companies are currently using conventional equipment for many finishing works. Current requirements in the manufacturing process place demands on the application of automation to the manufacturing process. Working with these devices is physically demanding and time-consuming, compared to working on CNC devices, especially from the machine parameters setup point of view. Previous methods of manual tool position settings are replaced by an automatic tool correction. In this paper, one of the solutions for an automatic turning tool position adjustment of a conventional device is described. The paper deals with the design of the sliding mechanism for the correction of the cutting tool and its automatic setting in the machining process.*
Keywords *- Sliding Mechanism, Conventional Devices, Tool Correction, Tool Setting.*

I. INTRODUCTION

Until now, the correction of the turning tool in conventional lathes has been performed manually with the aim of ensuring the highest precision of the tool setting. Machining produces great force effects which try to deflect the clamped tool from the preset position. Therefore, great care must be taken when determining the correct position of the clamping tool. By setting the tool position correctly, the required machining accuracy is ensured. The turning tool must have the smallest lining and must be clamped on the base by the entire base surface into the tool head by means of washers and clamping screws. On conventional lathes, turning knives are most often clamped into the tool head, which is rotatable, moves in front of the workpiece face and allows clamping several tools. The most common tool clamping errors occur by incorrect positioning of the clamping surface of the tool position in the lathe tool head, radial run-out, imprecision of the shape and position of individual machine parts and their mutual movements, and the like. [1]

The proposed sliding mechanism according to the technical solution published in patent application no. SK no. 50062-2015 provides a correction for the position of the turning tool moving on the basis of the floating bearing principle of the production tool with a precise correction feed [2]. The sliding mechanism consists of a housing located in the tool head of a conventional lathe, in which there is located a carrier with a small accurate thread pitch moving on the floating base principle. The carrier is connected to the clamp in which the turning tool is fixed. Through a precise threaded connection of the shaft pressed in two bearings located in the right cover and the pulley, a torque transmission is provided to adjust the displacement of the mechanism for correcting the position of the turning tool.

II. DEFINITION OF THE BASIC TERMS

The lathe is a machine where the main rotary motion is performed by a workpiece. It is mainly used for machining of both internal and external rotary surfaces, planar faces, for drilling holes, core-drilling, reaming and threading in the turning axis. Additional equipment can be used to grind both internal and external rotary surfaces, milling grooves and machining surfaces by superfinishing and the like. Turning creates cutting forces, the size of which is given mainly due to the cross section of the chips and the strength of the workpiece. For this reason, it is necessary to pay close attention to the correct clamping of the tool. The tool must be placed on the entire base surface and must be adjustable in the vertical direction.

A. Tolerance of dimensions

Tolerance of the dimensions and the quality of the tool surfaces must allow the cutting tool to be set to a certain position with the required precision. These requirements meet the basic shapes of the lathe cutting tool that are clamped in the holders. Knives with replaceable cutting plates are usually used for external machining. These tools do not change the position of the cutting edge with respect to the position of the blade body and thus allow rapid replacing of the blunted cutting edge. The tool body W x H is 20 x 20 mm, 25 x 25 mm, 32 x 25 mm and 32 x 32 mm. Similar requirements apply to the construction of cutting tools for internal machining and boring tools. Because most tools used for holes machining have a cylindrical or conical clamping part, an inner housing has cylindrical shape, too. This makes the internal cutting tool with the replaceable cutting plate similar to the drill bars. Axis tools, meaning drills, countersinks, reamers and taps are (with some exceptions) normalized.

B. Tool wear

Wear is the loss of the original geometric shape of the cutting wedge. It may also be associated with a change in mechanical properties. The resulting dimensional wear of the cutting tool can be reduced by the correction of the turning tool towards the workpiece by the wear value. The workpiece dimension is measured by the sensor and the measured values are gradually passed to the evaluation device. Further the data directs to the comparison device, where it compares with the data coming from the input device. The difference between these two data is the signal pointing to the power mechanism that performs automatic adjustment of the tool wear. The duration of the correction feed is a value whose size depends on several parameters and is calculated by using a simulation model. [3]

C. Cutting conditions for turning

Cutting speed is the main measure of the machine movement. When choosing its optimal value, it is necessary to take into account the properties of the workpiece material, its machinability and the type of cutting tool material. Further consideration must be given to the other components of the cutting conditions, that being the feed rate and depth, the cross-section and the optimum cutting edge durability. The cutting speed depends on the cutting edge geometry, type of lathe work, lathe stiffness and cooling. [4]

D. Clamping of cutting tools

For machines with higher automation, tools are clamped into tool heads of various designs. Toolhead types divided by the cutting tool clamping method are:

- The four-cutting toolhead is fitted with a larger number of tools and it moves in front of the workpiece face. The head is not suitable for machining shafts and the large machined diameters cause difficulties in spreading tools.
- The hexagonal toolhead is used mainly for clamping axis tools for turning holes. It is used in combination with the second toolhead on a cross support, on which are the tools for external turning.
- The circular head with the tools clamped in the holders placed on the face of the head. The head and tool positions in the work area make it possible to turn the flange, shaft and rod components.
- Circular head with knives clamped directly in the body of the head without cutting tool holders. It is intended for external turning. The head structure eliminates collisions with tailstock when turning the minimum diameter on the tip of the tailstock.

These tool clamping methods in toolheads, when used on automated machines, generally involve clamping tools in pre-set holders outside the machine. The position of the cutting edge relative to the holder is set on the adjusting device. Larger error is in the position of the clamping surfaces from the toolhead axis, in the radial turntable, and the like. Another error is in the deviation of the tool reference point from the beginning of the coordinate metering on the machine. The start position is adjustable and can be highly accurate for single-tool machines. [5]

III. DESIGN OF SLIDING MECHANISM

The overall design model of the technical solution is shown in Fig. 1. The design was created and simulated in the Creo Parametric software.

Fig. 1 Model of the proposed sliding mechanism

Fig. 2 shows more detail the arrangement of functional parts of the proposed sliding mechanism for correcting the position of the turning tool.

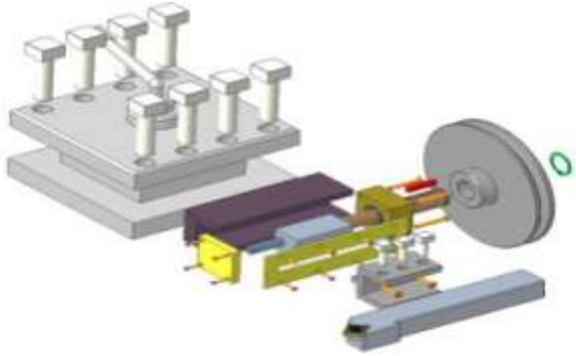

Fig. 2 Explode view of the proposed sliding mechanism

The sliding mechanism, which is shown in greater detail in Fig. 3, consists of a housing (3), which is firmly fixed in the toolhead (1) of a conventional lathe
by four adjusting screws (2). The housing (3) is closed by the left cover (4) and connected by the four screws
(5) of the left cover (4), the right cover (6) and the four connecting screws (7) connected by the eight screws
(15) of the front cover (14). To the housing (3) is inserted carrier (9) fixed to the clamp (16) with two screws (17) that performs a uniform linear micrometric displacement in both directions of the correction of the position of the lathe cutting tool (18) firmly established by three tightening screws (19). A carrier (9) with a very small and accurate thread pitch is threadedly connected to a shaft (10) mounted in two bearings (8) which are pressed in the right cover (6). The shaft (10) is rigidly connected to the pulley (11) by means of the key (12) and the locking ring (13). The torque will be caused by an engine with a designed gearbox and a control element generating a correction pulse to adjust the stroke of the mechanism to set the position of the lathe. [2]

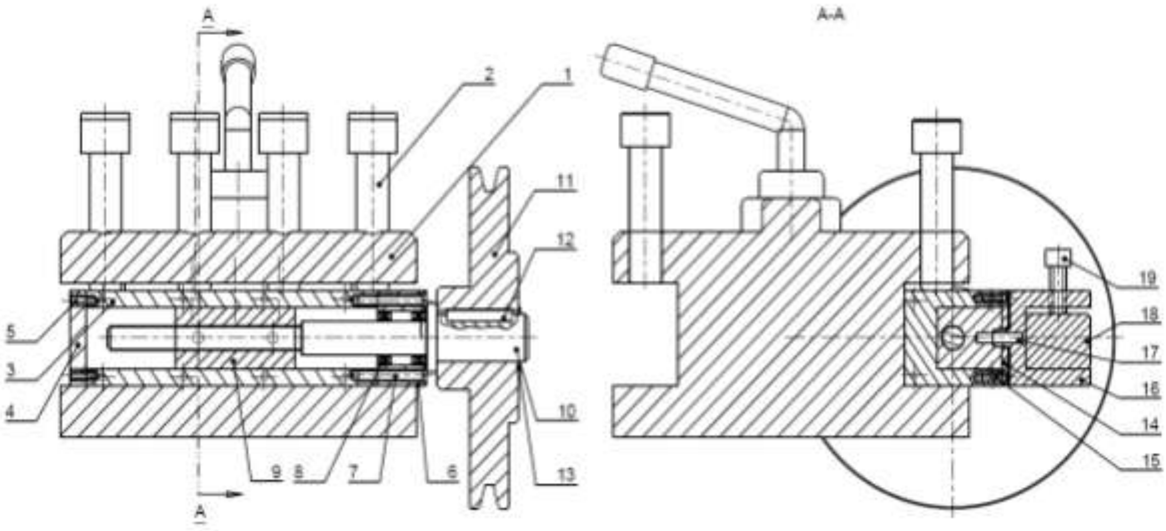

Fig. 3 Model of the proposed sliding mechanism in the section view

The design of a sliding mechanism operating on the basis of the floatation principle of the production tool must enable the correction feed of the tool at the moment of arrival of the correction signal. This mechanism must provide a high precision correction displacement (range micrometers) which corresponds to the correction of the dimensional wear of the tool. [6]

The automatic correction will be performed using a slider controlled by the control element, with the possibility of archiving data obtained from the machining process. By implementing the sliding mechanism of the production tool providing the correction feed in the event of exceeding the determined value of its dimensional wear, a higher efficiency in the production process is achieved.

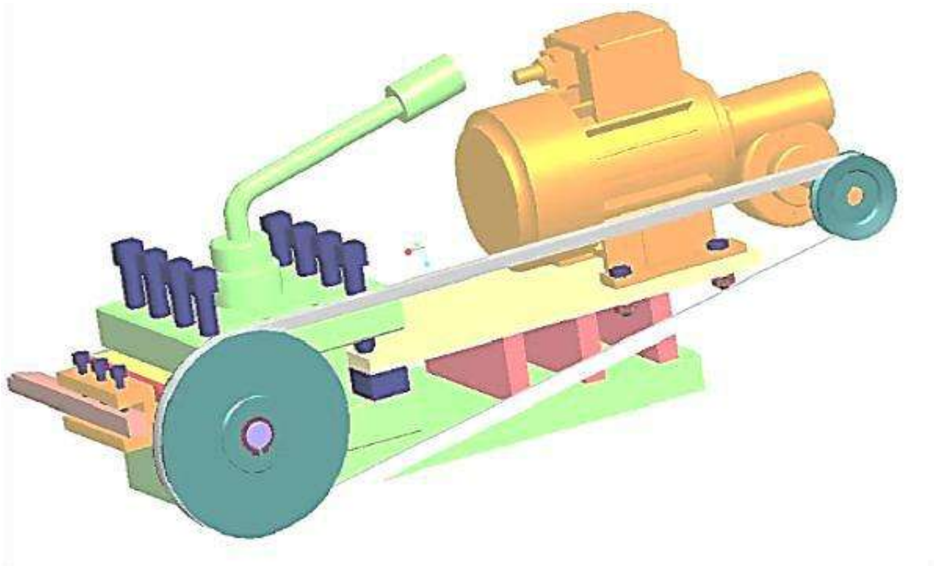

Fig. 4 Principle model of solutions

Fig. 4 illustrates a principle model of a sliding mechanism showing tool housing with a cutting tool in the toolhead. In the toolhead is also mounted base with the gearbox and engine.

IV. CONCLUSION

In spite of the development of CNC-oriented technologies, conventional machining facilities are still used in some small manufacturing companies. The current trend is to shorten the production time, that is, the machining time to meet the requirement for precision of the manufactured products, all with the full security of the processes. The paper describes the design of the device, the main task of which is to shorten the time required for clamping and setting of the cutting tool into the tool head of a conventional lathe as well as to increase the precision in the production of the components itself provided by the automatic tool correction in the proposed sliding mechanism.

The aim of the paper is to describe a sliding mechanism for correcting the position of a turning tool that is fixed by three tightening screws which is located in the clamp. The housing of the sliding mechanism is firmly fixed by four adjusting screws in the tool head of a conventional lathe in which a uniform straight micrometric feed of the clamp is effected by means of a shaft rigidly coupled to the pulley for adjusting the stroke of the mechanism for correcting the position of the lathe cutting tool. The sliding mechanism can be used for correct positioning of the tool in order to provide the required precision provide the required and when machining with a conventional lathe.

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