METHOD FOR PROVIDING AN EDGE PREPARATION ON A CUTTING EDGE OF A TOOL AND A CONTROL AND A PROCESSING MACHINE FOR CARRYING OUT THE METHOD

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ABSTRACT

A method for providing an edge preparation on a cutting edge of a tool by means of an edge processing operation includes clamping the tool in a processing machine for providing the edge preparation, recording as a reference value the position of the cutting edge to be processed by means of a sensor arranged on the processing machine, carrying out an edge processing operation by means of a preparation tool, recording the position of the cutting edge again by means of the sensor arranged on the processing machine and storing the position as an actual value, monitoring the edge processing operation on the basis of a comparison between the reference value and the actual value, and comparing the actual value with a desired value for material removed on the cutting edge.
METHOD FOR PROVIDING AN EDGE PREPARATION ON A CUTTING EDGE OF A TOOL AND A CONTROL AND A PROCESSING MACHINE FOR CARRYING OUT THE METHOD

BACKGROUND

[0001] 1. Field of the Invention

[0002] The invention relates to a method for providing a defined edge preparation on a cutting edge of a tool for machining metals by means of a rounding operation, in particular for providing a defined edge preparation on a drilling, reaming, threading and/or milling tool. The invention also relates to a control and to a processing machine for carrying out the method.

[0003] 2. Background Information

[0004] Both drilling and milling tools are produced, inter alia, in a plurality of production steps from a rough round bar. In this case, modern high performance tools are produced from solid carbide. In the process, the desired geometry with main cutting edges is normally formed at the end face by a special point grinding method. In continuation of the tool, flutes with secondary cutting edges are often provided. The selection of the special point grinding, the configuration of the cutting edge geometry and of the flutes depend on the respective requirements. The cutting properties of the tool are considerably influenced by the cutting edge geometry. After the grinding operation, the cutting edges are normally of very sharp design, and so the cutting edges are regularly rounded via “edge rounding”. This edge rounding, referred to below as rounding operation, is carried out using a suitable rounding tool, in particular by means of brushes. A high-precision rounding process is important here in order to achieve the desired cutting properties. The material removal is normally only within a range of a few um. A deviation from desired material removal leads to a deterioration in the cutting properties.

[0005] On account of the very hard material when using solid carbide drills, the brushes are subjected to high wear during the rounding operation, such that, during the processing of a multiplicity of tools, the result of the rounding operation often varies in an undesirable manner at the same machine settings.

[0006] A further conventional edge preparation in addition to such edge rounding is the provision of a bevel on a cutting edge. Here, too, reproducible high precision of the edge preparation is important.

[0007] Accordingly, a need exists for a simple, reliable method for producing a defined edge preparation, in particular during a multiplicity of successive edge processing operations, and for a processing machine for carrying out this method.

SUMMARY OF THE INVENTION

[0008] The present invention addresses such needs by providing a method for providing an edge preparation on a cutting edge of a tool by means of an edge processing operation, in particular for providing edge rounding or a bevel. Accordingly, for providing a defined edge preparation on a cutting edge of a tool, in particular a drilling, reaming, threading and/or milling tool, the tool is first of all clamped in place in a processing machine. The position of the cutting edge to be processed is then recorded by means of a sensor arranged on the processing machine and is stored as a reference value. In the next method step, the edge preparation operation is carried out by means of a preparation tool and the position, which has then changed, of the cutting edge is then recorded again by means of the sensor and stored as an actual value. Finally, the edge preparation operation is monitored on the basis of a comparison between the reference value and the actual value and is compared with a desired value for the material removal on the cutting edge. As a result, the edge preparation is controlled overall in a simple and efficient manner.

[0009] In previous methods, it was regularly necessary for this purpose to check the result of the edge preparation in a complicated manner in separate measuring devices. To this end, unclamping of the tool was necessary.

[0010] With the method now described herein, it is now possible to determine the result of the edge processing operation directly at the machine tool, and therefore no separate measuring operation in a separate measuring device has to be carried out. The recording of the relative change between the recorded reference value and the actual value recorded after the edge processing operation is especially important. It is therefore not important to determine the actual absolute situation and position of the cutting edge in the coordinate system of the processing machine. As a result of the recording of the relative change, the material removal actually effected can be determined in a highly precise manner.

[0011] In this way, in particular online process monitoring is made possible and provided by the simple measuring operation. Normally, a multiplicity of tools are processed one after the other on the processing machine and are subjected to the edge processing operation. The expression “online process monitoring” refers to the fact that, in the course of this process, that is to say the edge preparation of a multiplicity of tools, the result of a respective edge processing operation is regularly monitored. The expression “regularly” refers here to the fact that the edge processing operation itself is monitored by the described comparison in each case after a defined number of edge processing operations, for example after 3 to 5 rounding operations (tools). In principle, it is also possible, and provision is also made for this, to carry out the measurement and monitoring and also to log the data at each tool to be processed.

[0012] The edge preparation provided in particular a rounding operation. Alternatively, a bevel is provided using this method. The invention is explained in more detail below with reference to the rounding operation. The advantages and method features cited also likewise apply to the provision of a bevel.

[0013] According to an expedient configuration, wear of the preparation tool, designated below as a rounding tool, is deduced on the basis of the progression of the difference between actual value and reference value. Online monitoring of the wear of the rounding tool is therefore also made possible by this measuring method. When wear which exceeds an admissible tolerance value is detected, provision is accordingly also made for a desired control value for the rounding tool to be corrected in a control unit of the machine tool. The wear is therefore taken into account for the infeed movement of the rounding tool in order to ensure the desired result, that is to say the desired material removal, for subsequent rounding operations.

[0014] In an expedient configuration, the preparation tool is in this case a brush and furthermore provision is made in
particular for the sensor to be a probe. Such probes are present in modern processing machines, and therefore no additional measuring devices have to be attached to a conventional processing machine.

[0015] As an alternative to the brush, other preparation tools or preparation methods can also be provided, such as, for example, a grinding tool or a blasting method, in which the edge to be processed is processed in a wet blasting process, with abrasive particles if required.

[0016] The processing machine is preferably a multi-axis, for example 5- or 6-axis, CNC machine. Such machines are distinguished by universal use for the most varied tool processing operations. In particular, such machines are also used as universal machines for the further production processes, such as, for example, grinding, etc. It is therefore also possible to carry out a plurality of production steps, in particular all the production steps, such as the flute grinding or the end point grinding for producing the tool, without resetting the tool on the processing machine.

[0017] In a preferred development, in the event of an inadmissible deviation from the desired value being detected on account of wear of the rounding tool, a rounding operation is carried out again before the tool is unclamped. However, this is expediently avoided by a timely correction of the desired control value for the rounding tool.

[0018] The present invention further addresses such needs by providing a processing machine for carrying out the methods described herein. The machine includes a clamping unit for clamping the tool in place, a preparation tool for carrying out the edge processing operation, a sensor for recording the position of the cutting edge, and a control unit structured to monitor the edge processing operation on the basis of a comparison between the reference value and the actual value.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] An exemplary embodiment of the invention is explained in more detail below with reference to the drawings, in which:

[0020] FIG. 1 shows a greatly simplified illustration of a processing machine for carrying out edge rounding on a tool; and

[0021] FIG. 2 shows a greatly simplified schematic illustration of a cutting edge before and after the edge rounding.

[0022] Equivalent parts are provided with the same reference numerals in the figures.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0023] According to FIG. 1, a processing machine 2 has a clamping unit 4 which is designed for clamping a tool 6 in place. The processing machine 2 is shown in its entirety in FIG. 1 by the dot-dash line. Furthermore, the processing machine 2 comprises a tool unit 8 for the defined guidance of a tool, in particular a rounding tool, which in the exemplary embodiment is designed as a brush 10. Finally, the processing machine 2 comprises a control unit 12 which controls the individual components of the processing machine 2. A sensor designed in particular as a probe 14 is arranged on the tool unit 8. The individual components of the processing machine 2, which in particular is designed as a CNC machine tool, are adjustable in a controlled manner along various axes, as indicated by the arrows. In addition to linear adjustments in the direction of axes, rotary adjustments about axes of rotation are also possible. The individual adjusting movements can be superimposed in a suitable manner if required.

[0024] To carry out the actual rounding operation, first of all, in a first step, the probe 14 is brought up to a cutting edge 16 (shown in solid lines in FIG. 2), in particular a main cutting edge of the tool 6. In this initial state, the cutting edge 16, as shown, is still of extremely sharp design. As soon as the probe 14 touches the tip of the cutting edge 16, this position is established as a reference position. The corresponding measured values define reference values of the reference position.

[0025] The reference position is expediently recorded at an appropriate point on the main cutting edge or also on a secondary cutting edge of the tool 6. The position is preferably merely recorded at one point, since the rounding operation over the cutting edge length leads within sufficient tolerances to identical material removal d.

[0026] The probe 14 is then retracted again and the brush 10 for carrying out the rounding operation is advanced to the tool 6 in a manner known per se. A desired control value, up to which the brush 10 is advanced to the tool 6, is stored in the control unit 12.

[0027] After the rounding process is carried out, which is carried out according to a process sequence stored in the control unit 12, the probe 14 is again brought up to the then rounded cutting edge 16 (shown in dashed line in FIG. 2). The (rounded) position, then recorded by the probe 14, is evaluated as an actual position and the associated actual value is compared with the reference value recorded beforehand. The difference between the actual value and the reference value in this case determines the material removal d effected during the rounding operation. If material removal d is within a desired range, that is to say corresponding to a desired value with predetermined tolerances of, for example, ±5%, the rounding operation is all right. In a preferred configuration, if the material removal d effected is too little, a rounding operation is carried out once again by advancing the brush 10 again.

[0028] Preferably provided within the control unit 12 is a comparison module which continuously compares the recorded reference and actual values with one another and deduces the wear of the brush 10 on the basis of the progression of the difference between the reference values and actual values (during successive rounding operations on various tools 6). If the wear exceeds a predetermined tolerance value, the desired control value stored in the control unit is accordingly corrected. During the next rounding process, the brush 10 is then brought up to the tool in accordance with the new desired control value. As a result of this measure, online process monitoring is made possible and provided overall in a continuous manner during the rounding operation.

[0029] Instead of carrying out the rounding operation by means of a brush 10, other rounding tools, such as, for example, blasting methods, etc., can also be used. The rounding operation itself, with the online process monitoring described, can be carried out on a special processing machine 2 provided only for the rounding.

[0030] Further measures, such as, for example, coating measures, etc., can also be carried out if required.

[0031] The method described here and the processing machine 2 with the control algorithm stored in the control unit 12 in accordance with the method are distinguished by reliable edge rounding and online monitoring of the same during a multiplicity of successive edge rounding operations without
the need for a separate external measuring operation for recording the result of the respective edge rounding operation.

What is claimed is:

1. A method for providing an edge preparation on a cutting edge of a tool by means of an edge processing operation, the method comprising:
   - clamping the tool in a processing machine for providing the edge preparation;
   - recording as a reference value the position of the cutting edge to be processed by means of a sensor arranged on the processing machine;
   - carrying out an edge processing operation by means of a preparation tool;
   - recording the position of the cutting edge again by means of the sensor arranged on the processing machine and storing the position as an actual value;
   - monitoring the edge processing operation on the basis of a comparison between the reference value and the actual value; and
   - comparing the actual value with a desired value for material removed on the cutting edge.

2. The method of claim 1, wherein a plurality of tools are successively processed on the processing machine and wherein wear of the preparation tool is deduced on the basis of the progression of the difference between actual value and reference value.

3. The method of claim 2, wherein when wear of the preparation tool is detected, a desired control value for the preparation tool is corrected in a control unit of the processing machine.

4. The method of claim 1, wherein desired value for the material removal is within the range of 3 μm to 200 μm.

5. The method of claim 1, wherein the sensor is a probe.

6. The method of claim 1, wherein the preparation tool comprises a brush.

7. The method of claim 1, wherein the processing machine comprises a 5-axis CNC machine.

8. The method of claim 1, wherein an edge preparation is carried out again in the event of an inadmissible deviation from the desired value.

9. A processing machine for carrying out the method of claim 1, the processing machine comprising:
   - a clamping unit for clamping the tool in place;
   - a preparation tool for carrying out the edge processing operation;
   - a sensor for recording the position of the cutting edge; and
   - a control unit structured to monitor the edge processing operation on the basis of a comparison between the reference value and the actual value.