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THE WAY OF MACHINING OF FLAT SURFACES WITH A FACE MULTI-BLADE TOOL PROVIDING A FIXED CHIP THICKNESS

A large amount of scientific researches and engineering developments aimed at studying and analyzing the machining with blade tool proved that there are both benefits and drawbacks of this method that hinder the widespread implementation of mechanical milling.

The disadvantages of mechanical milling process includes:

- roughness irregularity of machined surface by its width due to the instability of cutting forces (variable depth of cut) caused by trochoidal trajectory of formative elements;
- the process of removing the machining allowance is intermittent;
- the amount of formative elements being simultaneously in the process of cutting changes while penetrating in the work surface and going out of it;
- the change of cutting forces during processing leads to instability of the roughness of the machined surface;
- at a symmetrical arrangement of mechanical instrument relative to the treated surface both counter and drive removal allowances take place that irreversibly leads to the formation of different roughness of the machined surface in width;
- deviation from the perpendicular to the axis of the spindle concerning the trajectory of the longitudinal movement of the machine table and the elastic deformation of the machined surface during removal allowance creates conditions for the formation of traces of re- touching of formative elements during their idle run on the surface that affects its roughness;

Having analyzed the problems above the new instrument with a variable radius of location of formative elements was developed (Fig. 1.). Design that includes the development of kinematic scheme, calculations and design of the tool construction was done.

A method of processing with the use of the developed tool gives possibility to eliminate the disadvantages typical for the process of mechanical milling. Application of the tools of new design requires the installation of adjustable high-moment engine on a tool. These high-speed engines have a discrete 0,001 rpm. The engine installed on the machine is used in the drive system and governed by CNC machine. Bevel drive with circular teeth is used in the transmission mechanism. Such transmissions are less sensitive to disruption of accuracy of the relative position of the wheels, have a higher carrying capacity compared to the wheels with straight teeth, operate smoothly and silently.

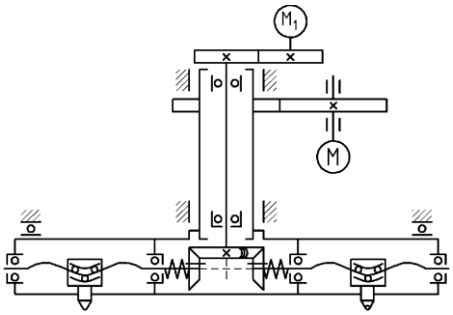

Fig. 1. The kinematics of the developed tool

Ballpoint screws are used for positioning of movable organs that allows you to create economical, highly reliable mechanisms due to its high capacity for loading, durability, high axial stiffness at high speeds of the ride.

To have more detailed description of the way of machining let's see one of the designed schemes of the instrument to be implemented (Fig. 2).

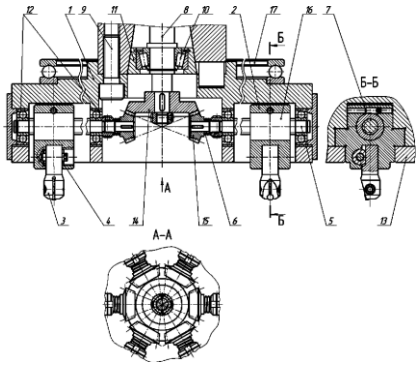

Fig. 2. Schematic diagram of the developed tool

Block 1 fixed by screws 9 is on the machine spindle centre, in which six sliders 2 with a minimum possible gap are moving along the guide rails, whose lower surface is a rectangular shape lid 13. Formative element 3 is fixed in each slider wedge clamp 4. In the fixed slider tangent screw 7 nut 16 pairs of ball screw transmission. Screws 5 helical gears placed on angular contact bearings 12. On the front ends of the screws 5 there are spring-loaded springs 6 conical toothed gear 15 transmission with a circular tooth. Spring-loaded performed for the purpose of automatic sampling gap in the transmission. All six gears 15 are in constant engagement with a conical toothed wheel 14 that is fixed to the front end of the shaft over 8 innings. Shaft passes through the spindle of the machine and installed it on two bearings 10 and the other end is connected to a with adjustable drive motor owing gears (not shown in figure). The outer ring of the bearing shaft 10 innings 8 is mounted in the sleeve 11 having a conical outer surface that serves as a hub for deployment in the inner conical hole of machine spindle. To increase rigidity and minimize bending elastic casing cutter on the top shell tool installed thrust ball bearing 17 centre on cylindrical projecting lower ring and rests on the upper body of the machine.

Principle of machining with a designed tool is in the following. At the beginning of machining formative elements are placed at the minimum radius. Work pieces or parts are installed so that the whole work surface area would fit into the ring that is limited to the minimum and maximum possible radius of the location of the cutting tool. When the engines work synchronized main motion and feed drive having the same frequency of rotation cause the milling cutter to rotate without moving of blades. Increasing of engine speed of the feed drive concerning frequency of rotation of a cutter at a certain amount Δ causes a feed motion.

A way of machining of flat surfaces has several advantages over the traditional one and allows to solve many drawbacks inherent in the process of face milling:

- The formative elements change their trajectory from trochoidal on the spiral one. Such trajectory provides a constant thickness of chip disposability.
- The detail being machined, is placed on one side of the center of the instrument. There is no idle running toward the work area in a designed tool that helps to avoid the conditions of formation of traces and worsening of machining quality.
- Efficiency growth of machining. The tool allows to machine several details simultaneously. Feed motion is provided by the designed tool.