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FEATURES OF END MILLS FOR HIGH-SPEED PROCESSING

The current level of industry development requires the improvement of the quality of manufacturing details, in particular, their geometric accuracy and surface quality. The frame of mechanisms, devices, apparatus, as well as supports, frames, beds make up more than 13% of all products of mechanical engineering and metalworking. In the technological processes of manufacturing parts from 10% to 50% of the parts must have a roughness of the treated surfaces not more than 1.6 microns.

Milling is the process of machining using rotary cutters to remove material by advancing a cutter into a workpiece. This may be done varying direction on one or several axes, cutter head speed, and pressure. Milling covers a wide variety of different operations and machines, on scales from small individual parts to large, heavy-duty gang milling operations. It is one of the most commonly used processes for machining custom parts to precise tolerances.

Milling is a cutting process that uses a milling cutter to remove material from the surface of a workpiece. The milling cutter is a rotary cutting tool, often with multiple cutting points.

There are two major classes of milling process:

– In face milling, the cutting action occurs primarily at the end corners of the milling cutter. Face milling is used to cut flat surfaces (faces) into the workpiece, or to cut flat-bottomed cavities.

– In peripheral milling, the cutting action occurs primarily along the circumference of the cutter, so that the cross section of the milled surface ends up receiving the shape of the cutter. In this case the blades of the cutter can be seen as scooping out material from the work piece. Peripheral milling is well suited to the cutting of deep slots, threads, and gear teeth.

Many different types of cutting tools are used in the milling process. Milling cutters such as endmills may have cutting surfaces across their entire end surface, so that they can be drilled into the workpiece (plunging). Milling cutters may also have extended cutting surfaces on their sides to allow for peripheral milling. Tools optimized for face milling tend to have only small cutters at their end corners.

The cutting surfaces of a milling cutter are generally made of a hard and temperature-resistant material, so that they wear slowly. A low cost cutter may have surfaces made of high speed steel. More expensive but slower-wearing materials include cemented carbide. Thin film coatings may be applied to decrease friction or further increase hardness.

Recently, the finishing of flat surfaces is increasingly executed by end milling, as a rule, standard end mills, which have a number of shortcomings. Removing these shortcomings is an important task that can be addressed in several areas. One of the directions of the solution of the task is to design more advanced designs of mills with combined cutting patterns that meet the requirements and take into account the

accumulated experience and results of modern scientific research, with the aim of further application of such mills in production.

When designing special end mills with combined cutting patterns, the main goal is to establish rational structural parameters of milling and operating modes. In addition, the use of cleaning end mills with combined cutting patterns makes it necessary to study the features of the kinematics of processing.

Expansion of the areas of use of a blade tool equipped with inserts of superhard materials is one of the main areas of increasing productivity and intensifying the processing of metals by cutting. One of these areas is the increase in the size of the dropping out, due to the use of progressive structures of cutting tools. Thus, with end milling, the use of spiral-step stages of cutting allows to cut up to 6-8 mm tolerance, in the processing of gray and high-strength cast iron.

End mills equipped with superhard materials allow:

– to realize the motion of the profile cutting knife on a straight line trajectory perpendicular to the feed vector of the workpiece and to align the roughness of the machining in the width of the milling;

– to cut the main part of the inclination with the cutting knives moving relative to the surface to be machined along the circular trajectories and fixed stationary in the mill cutter;

– due to the stepped arrangement of cutting blades, increase the maximum depth of cutting and combine roughing and finishing operations in one pass;

– to adjust the axial departure of the cutting knives, if necessary, to adjust the depth of cutting;

– significantly improve the quality of the treated surface, the tool's stability and processing performance;

– to provide oblique cutting, which makes it possible to reduce the specific loads per unit length of the cutting edges of knives, and thus greatly increase the stability of the cutting blades;

– to implement cutting schemes with the preliminary plastic deformation of the treated surface;

– to use mill cutters for processing flat surfaces on milling and grinding machines [1; 2; 3].

During high-speed milling, the main requirements for end mills are:

1) need to optimize the designs of end mills, the geometry of their cutting knives, as well as cutting modes;

2) creation of reliable means of control of the condition of face mills (with the possibility of replacing worn elements) and quality during processing;

3) determination of rational tool materials for processed materials with different physical and mechanical characteristics;

4) application of tool designs with the possibility of balancing;

5) use tools with minimal radial and axial beats;

6) during operation, the milling cutter must not exceed the maximum speed specified for this tool;

7) handle parts as much as possible with smaller outings of tools;

8) apply mill cutters with a minimum slip of cutting elements from the tool casing;

9) minimize the contact area of the edge with the part to reduce the risk of vibration;

10) apply symmetric tools if possible;

11) use a balanced auxiliary tool with a steep cone (power chamber cartridges, hydrophilic cartridges, cartridges for drills and cylindrical shaft mills) [2; 4; 5].

The main direction of mechanical processing development is the concentration of technological transitions, which allows to reduce the complexity of manufacturing parts, increase productivity, reduce the cost of processing. At the lowest cost, the concentration of technological transitions is carried out with the use of a combined cutting tool, the benefits of which are:

1) reduction of the number of technological transitions for the processing of the part;

2) the possibility of improving the accuracy of processing by reducing the error of the base, in connection with the decrease in the number of reinstalls;

3) reduction of energy costs;

4) reduction of the number of machine tools;

5) reduction of the number of required instrument [3].

Research and solving the questions of improving the productivity and quality of flat surfaces processing of parts is an actual task and is of great importance at the present stage of development of instrumental production and machine building in general.

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