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Issue Article

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RESEARCH OF THE PROCESS OF MACHINING OF LARGE MODULAR GEAR WHEELS ON CNC MACHINES

Abstract: *The article discusses the reliability of the process of processing large-module wheels on CNC machines and the requirements set for it. Research processes of new processing technologies are presented. The work presented shows that gears can be machined with straight gears as well as modified ones on a basic CNC machine.*

Key words: *gear mechanism, worm, composite disc carbide, operation.*
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Introduction

It is impossible to consider all aspects of modern gear processing technology in one work, so we will limit ourselves to considering the following issues:

• effectiveness of using different methods in milling the teeth of large module gears;

• the effectiveness of using various modern gear processing tools.

The main methods of tooth milling are profile milling (copy method with one division) and roll milling. In the first case, the tools are disk modular cutters (less finger modular cutters), and in the second - stove cutters.

Before using the plate milling method, the teeth were processed only by the profile milling method. In this case, the tool - a disc or finger modular cutter - has a cross section that corresponds to the profile of the given tooth cavity.

The tooth is processed by feeding along the axis of the part for the entire length of one cavity, after which the part is rotated at an angle corresponding to the angular step of the teeth, and the next cavity is processed. This process is repeated as many times as the teeth need to be processed. When processing the next tooth, the need to rotate the part with an angular step ("split") determines another name for this method - the method of single division

Spur gears can be cut using a dividing head on both horizontal and vertical milling machines. Disc modular cutters are produced in sets of 8 or 15 pieces per module. A set of 8 will allow you to get a gear wheel with 9 degrees of accuracy, but to produce more accurate wheels, a set of 15 or 26 is required. This number of cutters in each set is necessary because the dimensions of the grooves between the teeth are different for different teeth of the wheels. Each cutter is designed for a certain number of teeth.

Gears are one of the most complex and labor-intensive parts of machinery, and their quality mainly determines the performance and reliability of machines, devices and mechanisms in which they are used. Gear parts are used in heavy transport engineering, shipbuilding, nuclear and energy, mining and lifting and transportation machinery, as well as in wind energy, which has been developing rapidly in recent years. [1, p. 463-471]

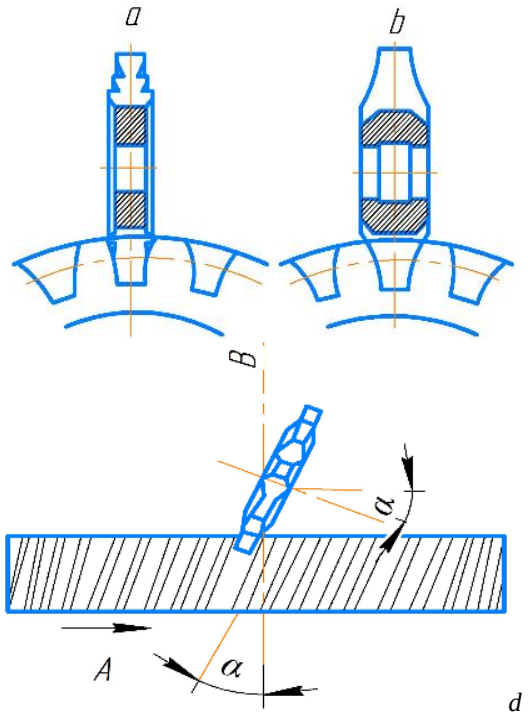

Figure 1. Dental treatment schemes

Cylindrical gears are the most common among wheels, because their cutting methods are universal and used in almost all types of production. Cylindrical wheels with a diameter of 250 - 12500 mm, with a module of at least 10 mm, can be considered typical for heavy engineering.

Finger (m = 50-75 mm), disk (m = 30-50 mm) and worm (m = 10-30 mm) module cutters are used in universal gear cutting equipment for cutting the teeth of large modular gear parts. Gear milling operations occupy a large part (about 70-80%) of the technological time spent on the complete processing of the part, so more attention should be paid to this process. [2, p. 25]

Today, the main direction in the development of metalworking is the use of multi-axis CNC equipment in combination with high-performance carbide tools. This combination in gear milling operations increases machining productivity, reduces costs and improves gear quality. [3, p.153-157]

The use of modern CNC machines allows for a sharp increase in cutting speed, which makes it possible to effectively use a gear cutting tool with a cutting part made of hard alloy. In addition, it became possible to electronically coordinate the movements of the tool and the workpiece, thanks to the replacement of the traditional kinematic chains of machine tools with electrical connections and individual drives controlled by a personal computer.[4, p.75]

However, in such equipment, the accuracies of the initialization and single-division methods are practically identical. Therefore, it seems that a significant benefit can be obtained from the introduction of developed innovative technologies and carbide tools, due to the possibility of simplifying the tool design and the complexity of the machining kinematics. The main characteristics of gear products were used as initial data to create the model, their combination together with the law of movement of the tool and the workpiece allowed to obtain the profile of the evolute. This paper attempted to use a composite disc carbide tool with flat cutting edges to finish high modulus wheels. To study the process, the design of the cutting tool and tooling was developed in the Compass 3D solid modeling system (Figure 2).

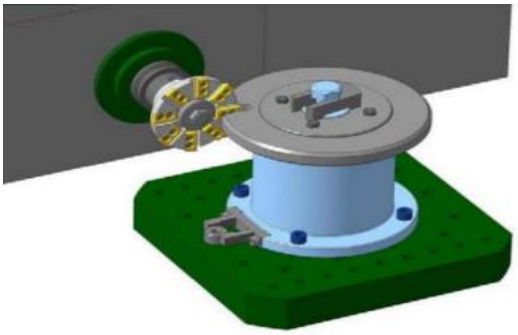

Figure 2. Experience simulation in the COMPASS 3D environment

Figure 3.

It should be noted that, despite its successful introduction in the industry, the new technology of gear processing requires more in-depth study in terms of improving both the constructions of special equipment and the tools used. This consolidates what has been achieved and expands the prospects for further application of the advanced technology of large-module wheel processing. Various designs of high-speed special calibers installed on gear cutting and vertical gear milling machines have been developed to finish gear cutting. New technological processes, tools and special equipment make it possible to obtain high-modulus hardened wheels that are not inferior to gear grinding in terms of accuracy and quality of the processed surface and exclude surface layer defects such as burns, micro-cracks and convenient compression. stresses are generated in the surface layer.

The introduction of new technologies into the industry for gear cutting of hardened teeth is 3-4 times more efficient than gear grinding, eliminating the need to buy expensive heavy gear grinding machines from cooperation or imports. The novelty and relevance of the developments proposed in this work are confirmed by copyright certificates for inventions and scientific publications

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