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GEAR CUTTING TOOLS DESIGN

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Abstract: The accuracy of the execution of the spiral bevel gear cutter tools is so high that the normal technology of relieving the gear cutting tools does not satisfy the demands of this special process. The spiral bevel gears cutting tools have a high number of cutters ranging from 8 to 28, placed at relatively large diameters, from 88.9 and 406.9mm. The high number of cutters on a cutting tool make that for the relief were necessary a large number of double strokes for a single rotation of the gear cutting tool. The aim of that paper is to demonstrate that the helical processing of the side and tip surfaces of the gear cutting tools, according to the same law of generation, can replace the radial and angular relieving with the cam, the processing being made on classical grinding machines or on thread grinding machines, and the deviations of the profile of the cutters being processed are comparable with those of companies manufacturing gear cutting tools.

1. INTRODUCTION

The most important element of the cutter holder support is the cutter or the cutters which represent the active part of the tool. Providing the geometrical shape for the cutting edges and for the proper profile, after the re-profiling of the cutters, represents the basic problem for the design and manufacture of the cutters. The construction of the gear cutting tools for different gear cutting systems is basically the same, the difference being the various different positioning of the cutting edges, as well the fixing of the cutters. The body of the cutter holder support passes through usual processing procedures, some of which are demanding, because they ensure the right positioning of the cutters. The technology for relieving, used by specialized companies, it is unknown, and the catalogues contain only the finished product presentation with a part of the geometrical elements. The technological processes for gear cutting tools processing, do not call special technological problems, but for the processing of the relieved surfaces. This paper addresses only the processing of the side and tip surfaces of the cutters, tasks being executed on classical or specialized machineries. The surface roughing is done by turning or milling, and finishing by grinding, in specially constructed devices.

2. PROFILE GRINDING TECHNOLOGY

The results of our numerical researches regarding the optimization of the profile relieving technology, demonstrates that the minimum deviation from a straight line of the cutting edge results from the processing with an abrasive stone – cylindrical disk.

Fig.1 Inner and outer axial relieving

By processing the seating surfaces of the cutters in the projected device, through grinding, the relieving technology is simplified having undeniable benefits:

-the simultaneous relieving of a high number of cutters

-with a single grip the cutters are processed on the left and on the right side

- elimination of errors due to shock and vibration
- adjustment of the part-device-tool assembly is simpler;

-removing the cams

-reduce processing time

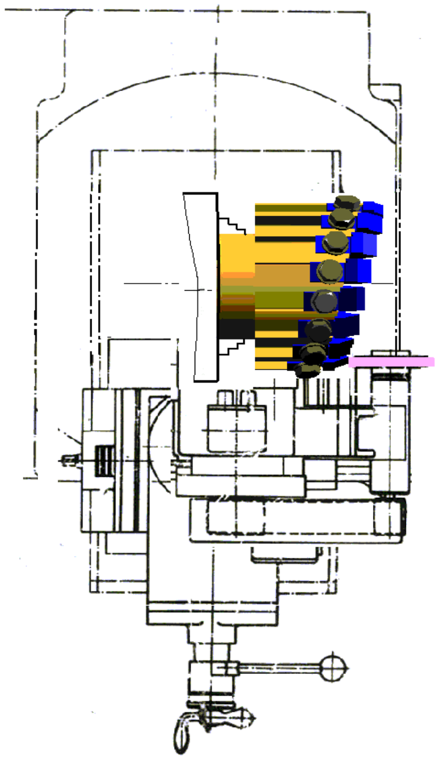

Fig. 2 Peak surface relieving after the cylindrical helix

The relieving is done on Nilles type worm milling machine for relieving equipped with the provided grinding device. By tilting the device in the horizontal plane with the φ [4] angle is obtained a surface with guidelines after the archimedical spiral or φ and β in vertical plane, the seating surface will result after an involute curve guideline. The grinding of the lateral surfaces of the cutters can be done on the thread grinding machines too. The diameter of the cylindrical grinding wheel results from the calculation program [4]. The advantages of the cylindrical grinding stone correction are:

-large number of grindings the stone;

-small variations of the cutting edge deviations at the decreasing of the diameter

Running the optimization program [4] for the gear cutting tools diameters starting with 3 ½'', size from which are executed with adjustable cutters it is possible to observe that the diameter of the stone results optimal, falling within the inner diameter of the processing gear cutting tool for inner surfaces.

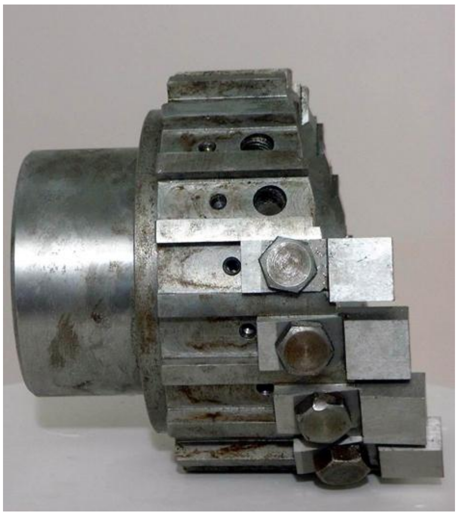

Fig.3 Technological device equipped with semifinished cutters

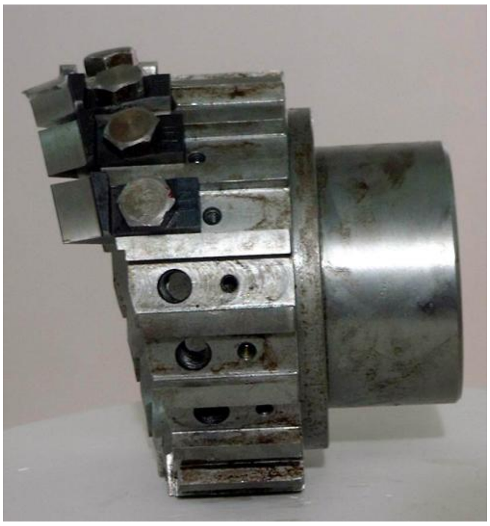

Fig.4 Technological device equipped with grinded cutters

To determine the elements of control of the gear cutting tools in parallel sections and in tangent to the base circle sections measurements were done on the co-ordinate measuring machine JCS – CLY 1086 at STIMIN Oradea, on which was mounted an electronic divider table CARL ZEISS JENA. The measurements were done for the cutters with the side positioning surface made after the archimedean spiral directory curve, involute and original Gleason cutters. With the aid of the program"*Software for determining the cutting edges deviations of the generated cutter*" were calculated the deviations of the cutting edges in five sections.

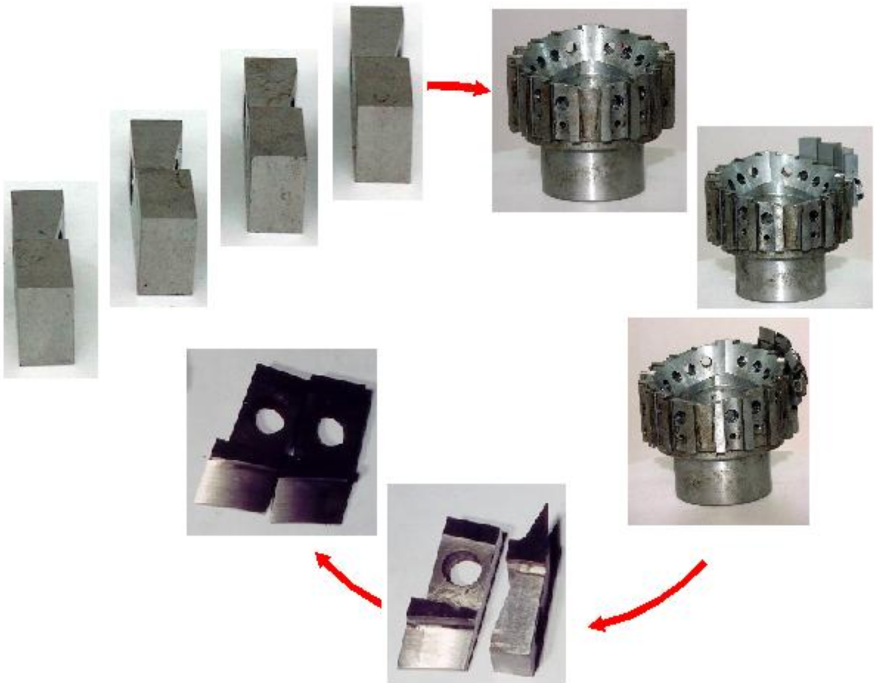

Fig.5 The itinerary of the experimental research

In the Mathcad program was drawn the diagram for the total cutting edges deviation fig.6.

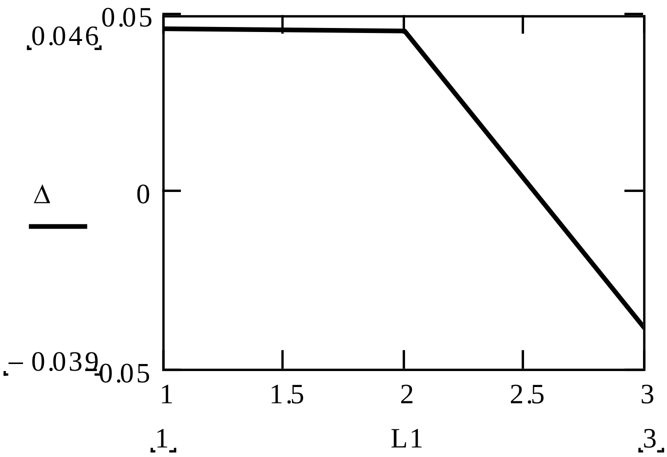

Fig.6 Total deviation

The comparative analysis of the measurements regarding the processed side seating surfaces coordinates, for the same conditions, but in different directrix curves, are shown in table 1.

Tab.1 Cutting edges deviations

Assesed section	**Deviation of the cutter's profile grinded after a Archimedean spiral directory curve δ [mm]**	**Maximum deviaton Δi [mm]**	**Gleason Cutter's profile deviation δ [mm]**	**Maximum deviation Δi [mm]**
0	0.012	0.071	-0.012	0.03
1	0.017		-0.025	
2	0.042		-0.039	
3	0.006		-0.023	
4	-0.025		-0.009	

4. CONCLUSIONS

The profile of these cutters is part of the helicoids, it cannot be wraped by cylindrical or conical grinding tools; under service conditions, is taking part in a complex manufacturing process through rolling or copying etc., as well as in a degradation process, which modifies the normal profile od the toothed wheel/gear tooth.

The technological process of the execution of the cutters requires special processing for the execution of the profiling. Under service conditions, appears the wearing of the profile at all the cutters, especially at the tip of them, where is concentrated the heat resulted from the cutting process. For the removal of that wearing, the re-sharpening/re-grinding of the whole set of cutters is done through grinding on the chip bearing surface.

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