

## ASPECTS REGARDING TENDENCIES IN TOOTHED GEARS MANUFACTURING AND CONTROLLING

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***Abstract:** The paper tackles a few aspects regarding the current international tendencies, in the field of toothed gears manufacturing and controlling. The major companies, that operate in the field of toothed gears manufacturing tools, that of tools for toothed gears and the one of control equipment, bring a new trend in the field, a based on the new technologies trend, that regards the materials for tools and the construction of tools, a based on the new concepts trend, that regards the centres of integrated processing and of course the IT, which manifests its presence in several forms.*

***Keywords:** gearing, technology, control, production*

### 1. INTRODUCTION

In the last few years the manufacturing technologies have evolved, both in the fields of machine tools and cutting tools, as well as in that of teeth control.

The toothed gears technology problem is set on new directions and new approaches. The new directions in this field will fundamentally change the directions of toothed gear manufacturing industrial systems, concerning both the manufacturing, as well as the field of investments, markets and value added to products that include toothed gears. If the advanced technologies in this field aim at high productivity and precision, in order to satisfy the highest demands in the field of environment protection (especially the noise produced by the toothed gears), they have reached high levels of complexity in fields of tunings, control product data archiving, but with high specific costs. Well, in the Eastern Europe, where the economic conditions are different from those in the rest of Europe, intermediate and adequate technologies are still applied.

### 2. GENERAL DIRECTIONS

The upcoming of new materials for cutting tools facilitated the structuring of tools that allow, in comparison with the current ones, much more intensive detachment of splinters. Besides assuring a high-speed cutting capacity, the tools used for cutting teeth (the hobs for different types of teeth, the pinion type cutter, the disk cutters etc.) haven't undergone significant changes from their geometry point of view, but their cutting performances have been significantly improved.

In approaching teething problems, new directions, with outstanding technological, but also economic effects have been developed:

a.) Deep and shallow tool geometry, with alternating gashes, increases tool life, feed rates, but reducing the hammering effect.

b.) The chamfering and the trimming on one operation tooth gears cutting machines; the chamfering doesn't require a secondary operation, thus reducing the manufacturing time.

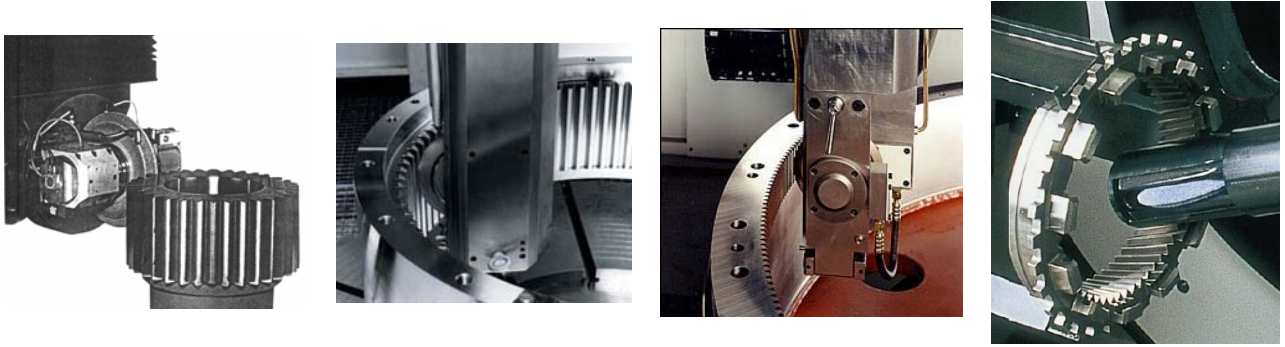
c.) In the case of finishing tools, new types of materials, used at the manufacturing of abrasive disks, offering super-abrasive properties have appeared. Among these abrasive tools, there are:

- Abrasive disks with high cutting capacity;
- Diamond dressed tools;
- The CBN (Cubic Boron Nitrate) tools, which are non-reshapeable tools. On a hardened steel body, a single layer of CBN is galvanized. In the case of grinding, the steel disk profile corresponds to the generator profile of the teeth tooth.

d.) Besides the changes underwent by the abrasive tools, the grinding machines have also suffered some changes and improvements. Thus, the new generation of grinding machines have:

- CNC command of the tool machine's movement
- Automatic CNC re-sharpening (profiling) of the abrasive disk command, assuring a constant cutting capacity of the tools as well as a constant generator profile.
- The possibility of working out teeth on the same machine via the copying or generating methods, using CBN tools or abrasive disks.

e.) Of an ultimate importance aspect among the technological novelties is the fact that interior teeth are being rectified. A remarkable fact is that interior teeth rectifying machines have appeared. This is a feedback to the request made by the wind generators producing industry, as well as by the heavy equipment producing one. In figure 1 there are presented the rectifying systems of some such machines. These have the possibility of working out both the interior and the exterior teeth.



**Fig.1.** *Rectifying systems of interior teeth*

These machines function on the principle of copying and working out the teeth gap-by-gap. The abrasive disk is either profiled with the help of CNC commands or is a CBN disk.

### **3. TENDENCIES IN THE FIELD OF TEETH GEAR CONTROL**

For high quality products, besides small working out (cutting) prices, a highly performing, fast and efficient quality control is needed.

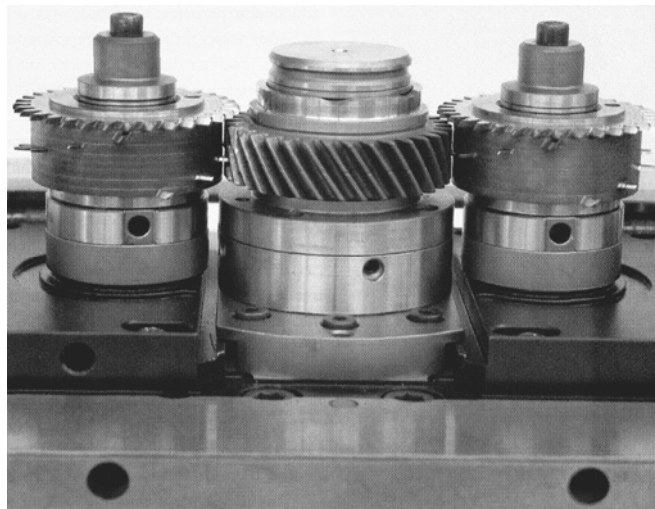
The methods and the functioning principle of the teeth controlling systems are unchanged, but from the constructional point of view these equipments have become more precise and easier to use. The inter-operational control equipment, such as the plate micrometer, the calibre for toothed gears have not changed, maybe at the most, reading has become digital.

In order to get numeric command and interfaces for the connection to computers, the classic methods of control and the equipments have been modified, so that diversion diagrams could be displayed on the computers screen, where the evaluations can be much more precise.

Besides the classic control equipment, new control equipments, such as the teeth scanners have appeared. They record, in a single positioning, a complete topology of both flanks of each toothed gear teeth, recording out of which the errors are obtained using a computerized system (figure 2).

Toothed gear high-speed control equipments, based on the cogging of the piece with a standard positioned toothed gear, have also been developed, the variations being recorded in comparison with the standard gear, through the reading system (figure 4).

In figure 2, there is presented the scanner for “RollScan” toothed gears, produced by Frenco GmbH Company, Germany, with the capacity of measuring 370 points in 2 minutes on a single toothed gear flank.



**Fig.2.** *Scanner for toothed gears*

In figure 3 there are presented pictures of the high speed toothed gear control equipment, produced by ITW Heartland Gears Company. These types of devices can perform the measurement and the control of both exterior (figure 3.a) and interior (figure 3.b) teeth.



**Fig.3.a.**



**Fig.3.b.**

An important aspect of the toothed gears control and of worked-out pieces stays in the automating and robotizing the operation, fact that determined a significant decrease in the time required by the control process and the elimination of the errors in reading and measuring, caused by the operators.

As an answer to the CNC command tools machines and centres of working-out, included in these equipments, where the entire process of fabrication is automated, the active control systems have

appeared. The active control has been spread, creating the possibility of occurrence, during the fabrication process, of the automatic intervention in the process of cutting, too.

In order to reduce the fabrication time, as well as of the control costs, the control equipments have become faster, which is not detrimental to their precision.

The existence of computer assisted control systems allow a thorough analysis of the worked out pieces and the tracking down of the cause that produces the error.

#### **4. TENDENCES IN THE TOOTHED GEARS FABRICATION SYSTEMS**

The tendencies aimed at by the manufacturers of the fabrication systems are to minimize the fabrication time, the increase in the quality of the manufactured toothed gears, the increase in the durability and maintenance of the equipments supplied by them. Major interest objectives in the field have been set towards:

a.) The automation of pieces loading and unloading on and from workstations of the tool machines.

b.) The tool machines of the CNC command

c.) The tool machines (the working-out centres) get high degrees of universality, thus being able to work out more types of teeth, impossible to obtain on classic tool machines, without their reconstruction and reequipping with new devices. The new tool machines combine in the same body classic machines, which work according to different teething principles, creating some flexible multifunctional units (module hob milling and pinion type cutter slotting; grinding through copying and rolling; etc.).

d.) The manufacturing of the working-out centres. These centres can be manufactured by adding diverse exterior modules to a tool machine (such as automatic control, ulterior trimming work-outs etc.), connected via systems of transport and automated manipulation of the piece or all these are mounted on and in the interior of a sole body. These concentrations lead towards the fabrication of complete manufacturing centres, in which the semi-product enters and the final product exits, with the testing done, ready to be delivered.

It is important to notice that today, in the production of toothed gears there is a tendency towards specialising certain companies exclusively on toothed gears production, companies that deliver toothed gears by catalogue or by special orders. Therefore, we can notice the concentration of toothed gear manufacturing in specialised companies, fact that facilitates investments and preoccupations with the technological development of a field that needs to be of high performance in machine construction.

#### **5. CONCLUSIONS**

The technical evolutions and innovations lead to a continuous modification of toothed gears manufacturing technology. New technologies are being developed, replacing the old

ones, providing the beneficiaries who invest in their implementation, with the growth of productivity and the quality of their products. The main displayed tendencies are:

- Achievement of automation for the tool machine command and service, as well as for the worked-out pieces control, which means high productivity;
- Increase in the flexibility and universality of the toothed gears manufacturing centres;
- Coming up of new computer assisted control systems (teeth scanners), which allow much more thorough analyses of the worked-out parts and the establishing of the error-generating causes;
- The CNC machine tools work both by teeth generation and teeth copying methods;
- The use of new cutting tools reduces the manufacturing time, the capital expenses and those of tools costs;
- The manufacturing system integrated control increases productivity;
- The achievement of grinded interior teeth;

All these lead to the manufacturing of high quality, low price products. No doubt, modern advanced technologies imply high capital investments. The issue stands also in the realm of semi-advanced or adapted technologies, which are still efficient to use in countries that do not dispose of enough cash, but where the working force is still cheap. One thing is sure: the companies that are not prepared to invest in the most recent technologies are doomed to disappear.

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