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Deformation and cutting process of interior surfaces

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Abstract. For going of the durability of the machining tools at the marking of mild steel is proposed the advanced straining, process which was applied in practice at the broaching the parts of holes valve rocker type. In this paper we propose to present some of specific aspects on the combined splinting and deforming process on internal surfaces.

Key words: durability, broach, straining, valve-rocker.

1. Introduction

In industrial machining the most part of pieces are processed by metal removing technology, to obtain a prescribed accuracy and quality of finished surfaces.
At the time of the splintering mechanical processing some materials have a low, good or very good machinability.
Materials with low machinability are those categories of processed materials whose put special problems, either under the aspect of wear for cutting tools, either from the point of view of mechanical stresses and energy that they generate during the splintering process.
Improve the machinability of steering materials is fundamental for scientists, who are looking for some new methods to increase productivity and quality of processed surfaces.
In the literature since researches have occurred communications regard to the splintering process of tough alloys (stainless steel with low carbon content, stainless steel weak allies, etc), from which it could be concluded that cutting tools had a much more pronounced wear than at the time of the processing steel with a hardness above [1, 3]. Scientists Baiev, Melamed, Enahoro have demonstrated that at the time of the processing of materials tenacious the cutting forces are higher

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than at the time of the processing of materials with higher hardness.
In the result of some papers Enahoro noted that "…material properties which was hardening before by cold deformation when approached to the ideal plastic-rigid material properties. Such material shall be processed easily, the process of chipping was characterized as is realized with reduced values for friction forces and with a large scale of cutting conditions where are formed flowing chip". This author has obtained in his research results lower cutting forces in machining alloy (HV 120) than on processing of copper (HV 89).
Problem statements. It is well known that the tenacious alloys (low carbon steels, low alloy steels etc.) are subjected to au intense wear while working with cutting tools. This phenomenon is evident enough in broaching the cavities into diecasted blanc. The structure of the surface superficial of the value-rocker layers that are casted with a depth to 0.2-0.3 mm is more ferritic then ferritic-perlitic (fig. 1). These superficial layers compared to the other payers of the basic alloy are very tenacious. The work obtainence of cavities in such blanc done with cylindrical broches, determines an intense wear for the first teeth. This decreases considerably the total hardness of the tool.

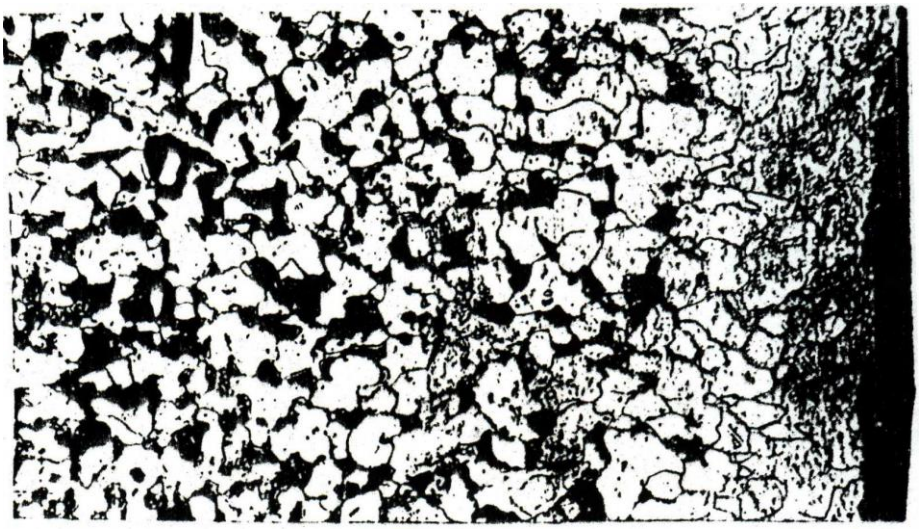

Fig. 1. Microstructure of the valve-rocker material, carbon steel C45.

2. The broaching process

The combined pushing broach was successfully experimented and implemented at machining of hole valve-rocker from internal combustion engines of cars ZIL (fig. 2).
The broaches made from rapid steel used to obtain this type of pieces as classic process method had a very limited durability (around 700 parts processed until the first regrinding), observation which conduct to the idea that it is necessary to improve this process.

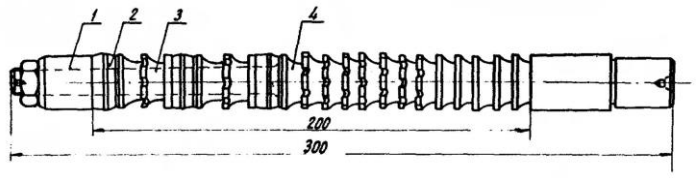

Fig. 2. Combined bushing pushing broach.

The wear tests for combined broach performed in laboratory from auto plant "IA Likhachev" from Moscow on processing valve-rocker have done sensational results (fig. 3).

The graph of dependency of tool wear in rapport with the number of machined parts shows that the combined broach cutting elements (curves 2,3) have a higher durability against cutting elements of classic broaching (curve 1). A combined broach calibration teeth wearing the compound (curve 3) is much lower than the wear of the cutting teeth.

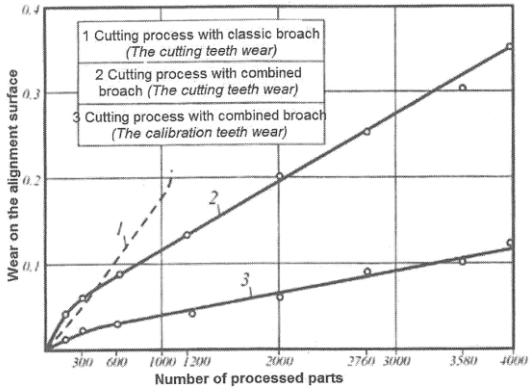

Fig. 3. The dependency of tool wear in rapport with the number of machined parts.

As a result, the dimensional durability which is determined by calibration tooth wear for the combined broaching is much higher than in conventional broaching.

Cutting forces decrease after preventive mechanical hardening of surface parts of tough material and effective increased the durability of combined broaches allowed us to come up with the hypothesis of this important phenomenon, using the basic theory of dislocations [4].

The main properties of dislocations, as crosslinking distortion are done because their mobility is high, causing a slight shear.

With increasing the degree of deformation the number of slip lines is sharply growing. On deforming of mono and policristal metal, the stress-strain curve is composed of three phases: 1-phase slip light; II-phase linear hardening; III-parabolic hardening stage. The average density of dislocations from one phase to another is essential increased. During the hardening phase parabolic are formed submicroscopic cracks in places where appear aggregation of dislocations at

barriers, which have as result a local stress unloading occurs, forming an additional possibility of plastic deformation developing [2].
Thus, as a result of the superficial hardening of the surfaces of the pieces, are created a substructure which is able to withstand static and cyclic considerable effort and is very sensitive to shear stresses.
The shear stresses, which occur in the cutting process, has affecting the accumulation of the dislocations creating favorable conditions to the formations of submicroscopic cracks, which are transformed into macroscopic cracks, accelerating the particles detach from the base metal.
This hypothesis can become compelling only after carrying out scientific research using modern election microscopes with high resolution.

3. Research course

In conclusion, it is proposed a new working scheme that can be used at the pusher broach construction (figure 2).
So, at a single pass of the broach, the working surface of the piece is plastically strained and cut.

4. Results

The scientificall researches have shown the superiority of the preventive plastically strained surfaces cutting process compared to the other similar processes. The most considerable advantages are:
1. The decrease of the broach's length, that offers the possibility of using pusher broaches.
2. The change of obtaining various surface qualities using different possibilities of placing the straining and cutting elements in the tool's construction.
3. The use of a simpler and cheaper pack of tools presses of various construction and forces in stead of broaches.
4. The volumetrical strain levels the working addition, decreases it and creates more favorable conditions to eliminate it.
5. Overharding, that determines the superficial layer destruction, is used as a positive factor in eliminating the cuttings (chips).
6. The possibility of using this scheme for working various shaped surfaces (slots etc.).
7. Dismountable construction combined broaches with deformable and cutting elements last 8-10 times more than the cutting broaches.

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