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NEW HOBS WITH INSERTED SEGMENTS

Summary : This contribution contains description of new principle of fixing cutting elements of cutting tools by means special expanding substance properties of which are depending on different parameters.

1. Introduction

General intensification trend of production tends to maximal valorization of metallurgical components in production process. This is pointed out in teeth production by development of heavy-duty hobbing cutters which require efficient and precision tools for their run. Introduction of monolithic tools in high-productive productions is not economical and also not realizable for some tools, for example for tools from cemented carbide.

Higher cutting speeds and feeds, longer tool life and higher accuracy of machined surfaces, there are requirements for which hobbing cutters which inserted segments are suitable.

Existing constructional solution of hobbing cutters with inserted segments have their basic body made from constructional high-quality steel in most of case. Cutting segments made from HSS, cemented carbide, or cutting ceramics are located and fixed in these basic bodies. Fixing elements then assure fixing of cutter segments in basic body of tool.

The above way of fixing cutter segments of hobbing cutter has many constructional variants, which are differents each other in dimensions, in form and in number of fixing elements. Dimensions, micro and macrogeometry of set fixing element contact surface must have been in accordance with accuracy class of tool, what results in increase of production costs. The question in this cases is in mechanical fixing by means of metal interelement.

2.Description solution

The above - mentioned defects have been solved by original way of fixing cutting blades of hobbing cutters.
The fact of the mater of this way resides in fixing of cutter segments in basic body through special expanding substance.
This substance expands in common cavities of basic body and cutter segment and so it forms necessary fixing expanding stress.
Essentially, ceramic expanding substance is powdered mixture, which together with water makes up the suspension suitable for application in fixing cavities.
Expansion pressure rises in consequence of crystal matrix formation of new mineral. Its volume is greater by comparison with original mineral. Thus the crystallizing pressure has been formed.
Its magnitude depends on choosing diameter, shape of cavity with suspension and on water contains in suspension.

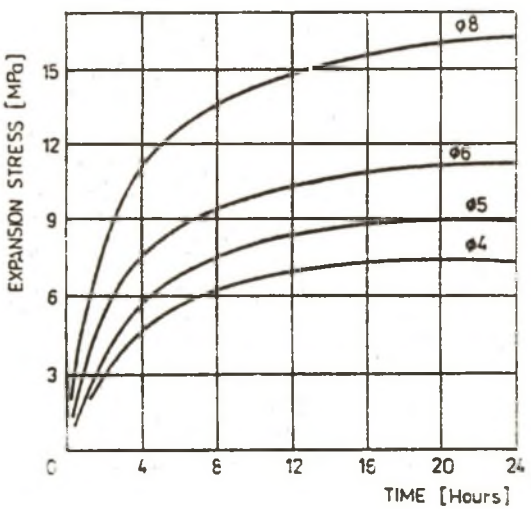

Fig. 1. Time functional dependence of fixing expansion stress (pressure) for differents diameters of fixing cavities ϕ [mm]

3.Description of experiment

There was made a model with the aim to get overall view about stress state in cross cut of hobbing cutter with inserted segments. (figures 2, 3).

Fig.2. Stress distribution in basic body of tool, fixing pressure 10 MPa

Fig.3. Stress distribution in basic body of tool, fixing pressure 20 MPa + cutting force Fz

The model on Fig.2 was loaded in separates fixing cavities with fixing pressure of 10 MPa by means of expanding substance. Stress distribution in basic body of tool as well as in separates cutting elements became visible owing to method photoelastic measuring.
Stress distribution is represented with isochromatic curves. This model is loaded only with pressure corresponding to fixing pressure of 10 MPa in real part.
The consequence of course and of isochromatics curves order is undesirable deformations of tool basic body and fixing hole have not been raised.

The model on Fig.3 is loaded with pressure corresponding to fixing pressure 20 MPa as well as with cutting force component corresponding as a matter of fact to force component of 1000 N in real part.

Stress field of fixing substance is symmetrical to tool axis, what is evident from figures 2 and 3.

The behavior of tool combined like this approaches during cutting to behavior of monolithic tool.

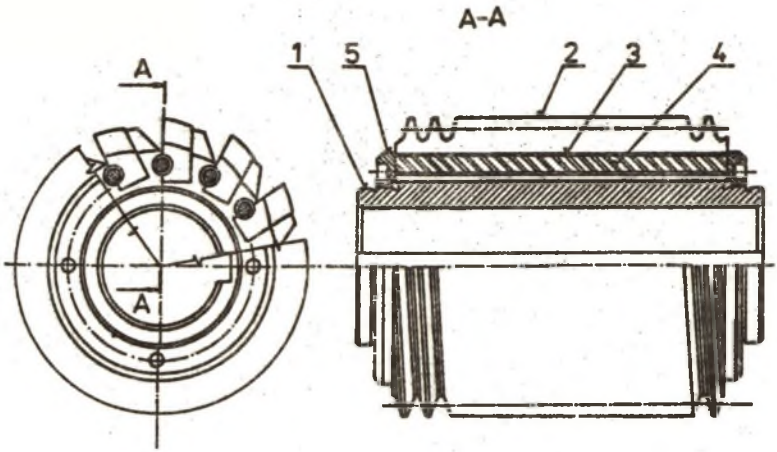

Fig. 5. Hobbing cutter with inserted segments, m = 2mm, Cemented carbide

There is possible to express following assumption on the basic of experiments made till now. Presented construction variants of hobbing cutters with inserted segments could include practically all over the modular scale of tools for spur gearing production.

5.Advantage a new solution

Proposed solution has following preferences in comparison with classical fixing of cutter segments with metal interelement, as well as mechanical fixing :

- there is the room made for location of greater number of cutter segments and the decrease in feed per tooth corresponds to the increase of machined surface accuracy and tool life,
- also repeated application of fixing expanding substance is cheaper than production of fixing elements with defined accuracy,
- cutter segments of tool are mounted in its body with certain prestress and so that the tool appears as monolithical,
- non-problem fixing of cutter segments with long and superlong tools, because fixing force is acting constantly the whole length of cutter segment, what increases fixing rigidity,
- total costs for manufacturing of tool are lower in comparison with classical construction of hobbing cutters with inserted segments.

Considering above-mentioned preferences and characteristic properties of hobbing cutters with inserted segments there is possible to express following conclusion.

Fixing substance is suitable as fixing medium first of all of long hobbing cutters with inserted segments. These cutters are very desired in the last time, because their application increases effectivity of teeth production.

4.Results of experiment

Following conclusions are the result of research experiments. Fixing expanding substance after achievement its expanding properties :

- developed expansion pressure sufficient for fixing cutting elements in basic body of tool,
- is resisting to the medium of machining process (cutting and cooling liquids),
- is resisting to static and dynamic stresses.

Figure 4 represents constructional solution of hobbing cutters with inserted segments, so-called hobbing cutters of long type with modul 3.

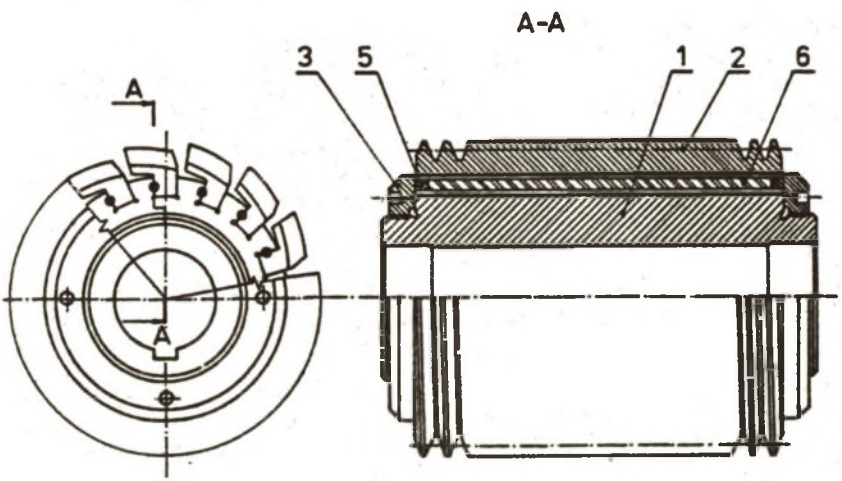

Fig. 4. Hobbing cutter with inserted segments, m = 3mm, HSS

The tool consists of these elements: cutting segments 2 are located in accordance with corresponding lead of helix in body 1. They are made from HSS. Axial location of separates is ensured by means of supporting flanges 3. Fixing expanding substance 6 is than applied inside corresponding cavities of tool located in this way.

Figure 5 represents constructional manufacturing of hobbing cutter with inserted segments. Cemented carbide was used in this case us cutting. Profile of this tool is finishing with grinding so as in case of classic monolithic milling tool.

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NEUE STOLLEN-WÄLZFRÄSER

Zusammenfasung

Der Vortrag enthält die Beschreibung des neuen Klemmprinzipes des Schnittwerkzeuges durch den speziällen Stoff, dessen Expansionscharakteris- tik von verschiedenen Parameter abhängt. In dem Beitrag wird weiter über die Spannung in dem Walzfräzer-Grundkörpers gesprochen die durch Wirkung des Klemmstoffes und der Modell-Schnitkraft verursacht wurde. Schliesslich sind die Aplikationen des Expansionsstoffes als Klemmediums behandelt.

NOWY FREZ Z WYMIENNYMI SEGMENTAMI

Streszczenie

Artykuł zawiera opis nowych zasad mocowania elementów skrawających narzędzi tnących za pomocą specjalnych rozszerzających się substancji, których własności zależą od różnych parametrów.

Wpłynęło do redakcji w styczniu 1992 r. Recenzent: Jan Darlewski