THE ANNALS "DUNĂREA DE JOS" OF GALAŢI
FASCICLE V, TECHOLOLOGIES IN MECANICAL ENGINEERING, ISSN 1221-4566
2004

Constructive-Functional Advances of Assembled Module Worm Cutter with Displaced Teeth

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ABSTRACT

The preliminary research in direction of the advances of the worm cutter constructive variants with individual teeth, fixed in taper holes, relived the possibility of teeth profiling by more productive sharpening methods and with a relative simple kinematics, whence avoid the relieving operation and the usage of the specialized machines.
The moderns variants of worm cutter profiled by continuous resharpening assure the needed machining precision for toothed wheel in condition of preservation of the advantages due of teeth displaced. The teeth's back edge generation is made directly on the tool's working body by continuous helical sharpening.
In paper are make specifications toward the constructive design on „Fredascon" module worm cutter, profiled by helical sharpening in assembled status.
***Keywords**:Fredascon, worm cutter, sharpening.*

1. Constructive Advance of Module Worm Cutter in Order of Cutting Moment Uniformization

The solution for cutting moment diminution, accomplished in case of module worm cutter with displaced sections, was completed and improved at „Fredarom" worm cutter, whereon all the teeth are displaced towards the conventional releasing channel, allowing the raising of the contact ratio and the diminution of the cutting uneveness by continuous work of tool's teeth [1], [2].

The „Fredarom" module worm cutter, regarding the cutting moment uniformization and the sure attachment on cone of each cutting tooth, allows the advance increment and the cutting speed incensement in case of some variants with blade carbide tipped teeth.

The worm's cutter individual teeth is centered on cone, oriented with a cylindrical pin which is guided in a flat channel, milled on the tool's body, assuring a complete location and a strong joining with tool's body.

The teeth of this type of worm cutter may have the cutting edges disposed in reference rack-gear's profile or in another modified profile, counted as profitable regarding the cutting conditions [3].

The main joining modalities of the individual teeth, placed in taper holes on the "Fredarom" worm's cutter body (see Figure 1) are the following:

- with nuts or screws, inland of the body;
- with external flanges, fastened with screws

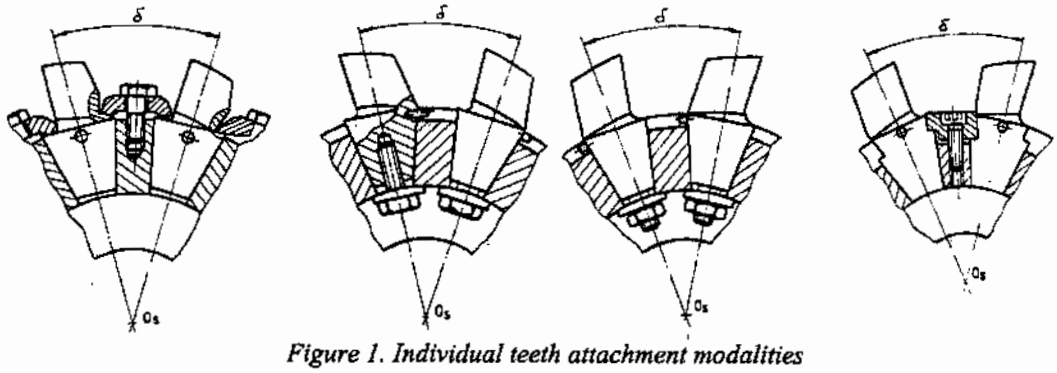

Figure 1. Individual teeth attachment modalities

2. The Module Worm Cutter Construction Advances in Order of Replacement of the Relieving Operation with Continuous Sharpening

The interests for this tool's construction lead to the replacement of the relieving operation, hard and dear, with a continuous sharpening of the back edges of the worm cutter's teeth.

The solution of the continuous sharpening of this type of worm cutter not only keeping the displaced teeth worm's cutter advantages, but also assure some major advantages in case of finishing operation: [2], [3], [4]

- the replacement of the relieving operation with a continuous sharpening of teeth's back edges;
- the improvement of the actives sharped surfaces;
- the teeth profiling precision improvement;
- the tool's total lastingness increase.

The moderns variants of the „Fredascon" worm cutter, with taper hole for teeth attachment offset toward the axial plane of the body, assure the sharpening and the re-sharpening of the back edges by helical continuous sharpening from one teeth positioning, directly on the tool's work body. After the continuous sharpening of helical back edges, revolving the teeth in working position, are obtained the back angle on top and lateral angles geometrically correlative (like the radial helical relieving of worm cutter), assuring the preservation of the cutting edges profiles on worm's cutter back edges sharpening.

Due of the offsetting of the taper holes toward the axial plane, the helical placed on working body worm's cutter teeth have the axis tangents to a cylinder with radius „a".

In order to increase the back edge resharpening reserve, the teeth's top is initial overhead toward their symmetry axis with „h" height.

Assumed as, in working position the back edge is radial oriented, at continuous sharpening, the worm's cutter teeth's top described a circular arc with radius:

$$R_a = \sqrt{R_{es}^2 - 4ah} \qquad (1)$$

The back angle of the tooth's top, which appear in working position of the worm cutter is:

$$\alpha_v = \arccos\frac{R_{es}^2 - 2a(a+h)}{R_{es}\sqrt{R_{es}^2 - 4ah}} \qquad (2)$$

The relieving depth, measured on radial direction between the external circle of worm cutter and the circle of the back edge sharpened by continuous cutting, at an teeth's angular pitch (see Figure 2), is equal with AB segment.

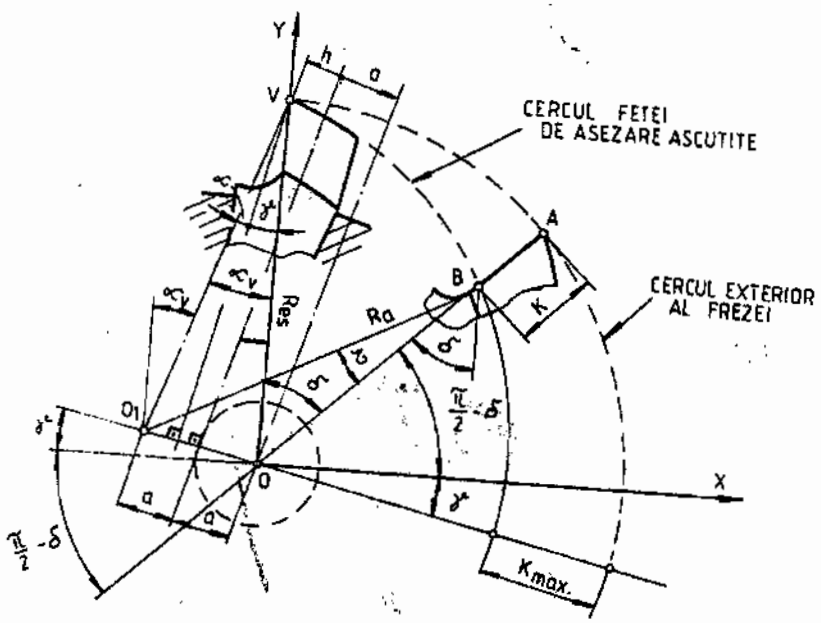

Figure 2. The relieving depth of worm cutter with continuous sharpening

$$K = R_{es} - \sqrt{R_{es}^2 - 4ah - 4a^2\cdot\cos^2(\delta-\gamma)} + 2a\cdot\sin(\delta-\gamma) \qquad (3)$$

where:

$\delta = 2\pi/z_K$ (rad) is the angular pitch of the worm cutter;

$\gamma = \arcsin(a+h)/R_{es}$ - apparent back angle.

For performances accomplishment of „Fredascon" worm cutter in necessary to appoint the

following:

- the accurate profile of the actives cutting edges;
- the displaced of the teeth in order to reduce the cutting uneveness at teething;
- the possibility of the lateral back edges sharpening and of top backs edges sharpening, directly on the body, by continuous helical sharpening;
- the needed position of teeth on the mill's body, which assure the optimum geometrical parameters on cutting.

3. Improved Constructive Solution of Module Worm Cutter Assembled with Displaced Teeth

For the experimental proof of the results of theoretically studies were designed and realized some constructive variants of „Fredarom" module worm cutter [2], [3], [4]. Next, we showed some constructive types of „Fredarom" worm cutter with individual assembled teeth, manufactured at „Dunarea de Jos" University of Galati.

4. Worm Cutter with Assembled Teeth Inland Fastened

For this type of worm cutter with assembled teeth, with 10÷20 mm modules, was used the same constructive principle above mentioned, with inland of tool teeth binding. In Figure 3 are showed a worm cutter with 12 mm module, which due of the dimension increasing, allow the teeth fastening with screw, by profiled bushing.

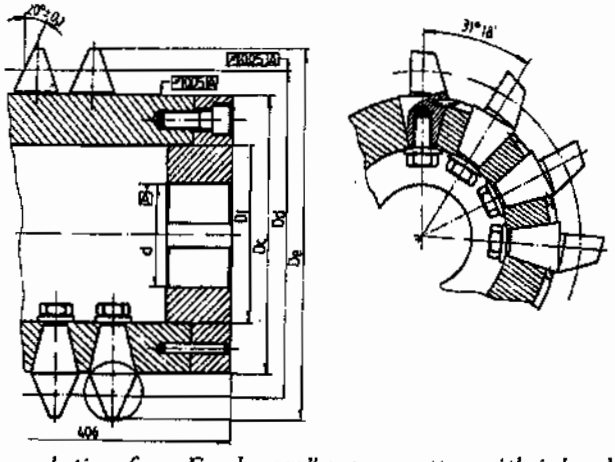

Figure 3. Constructive solution for „Fredarom" worm cutter with inland of tool's body teeth binding

For elders modules this constructive solution may be make in monobloc body variant, evident more rigid, whom are fastened the teeth on high-speed steel or armored with carbide insert plates. The displaced fastenings toward the worm's cutter radial direction allow the continuous sharpening of back edges directly on the tool's body.

In Figure 4 is showed the „Fredascon" module worm cutter prototype, with inland of tool's body teeth attachment.

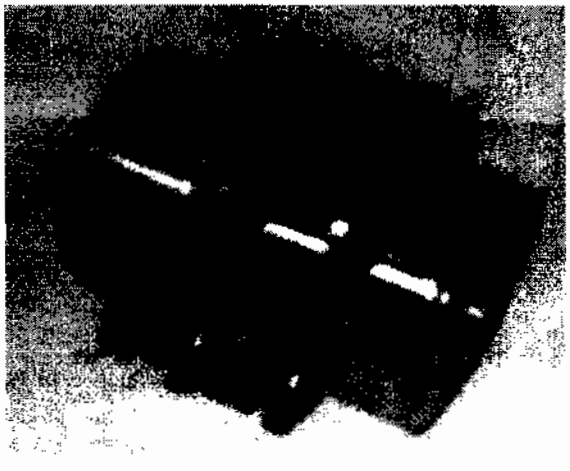

Figure 4. Fredascon worm cutter with inland of tool's body teeth attachment

5. Worm Cutter with Outside Fixed Assembled Teeth

The constructive solution for big modules, applied at a 24 mm module worm cutter, is showed in Figure 5.

The adopted solution, the attachment of teeth outside of mill, have the advantage that the body is more rigid, is unit cast and is possible an easy replacement of the teeth without strip down the tool from the bac of the teething machine.

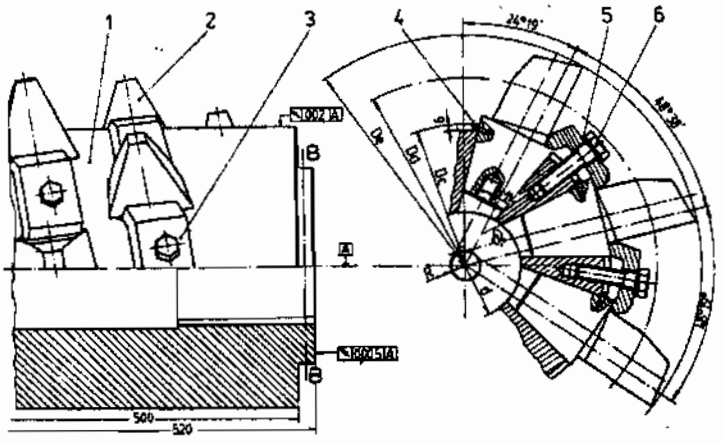

Figure 5. Constructive solution of „Fredarom" worm cutter with outside fixed teeth

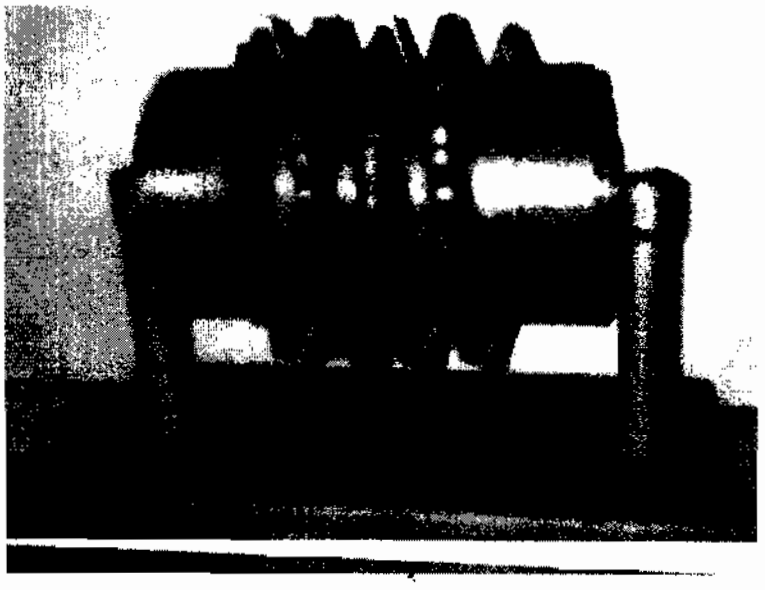

Figure 6. „Fredarom" module worm cutter with double number of teeth

6. Conclusions

Toward the worm cutter with comb fixed in same way, the individual teeth fixed in taper holes constructive solution is characterized by:

- allow the displaced location of the teeth toward the conventional position of gauge worms cutter, assuring the increase of the contact ratio and better cutting conditions;
- assure the tool's exterior diameter increasing and the increasing of the teeth number;
- allow the usage of a bac more rigid due of the worm's cutter hole's diameter;
- the teeth making is possible on universal machines, using simple devices.

Due of this special construction, the roughing tool have a profitable geometry of the cutting edges for better cutting conditions, making the teething in one cut, regardless the milling depth.

The change of teeth place along the generation rack-gear for tear uniformization, bring to the increase of tool's lastingness due to the increasing of time usage for an set of teeth.

The module worm cutter variants, profiled by continuous sharpening assure the cutting precision of toothed wheel in condition of preserved the advantages obtained by displacing the teeth.

Continuous resharpening of the back edges increases the total lastingness of the "Fredascon" worm cutter, where the teeth tear is smaller in depth.

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Perfecţionări constructiv-funcţionale ale frezelor melc modul asamblate cu dinţi decalaţi

Rezumat

Variantele constructive de freze melc modul cu dinţi individuali, fixaţi în alezaje conice, permit amplasarea decalată a dinţilor faţă de poziţia convenţională de la frezele standard, asigurând îmbunătăţirea condiţiilor de aşchiere şi a preciziei la danturare.

Cercetarile preliminare în direcţia perfecţionării sculelor de acest tip au evidenţiat posibilitatea profilării dinţilor prin procedee de ascuţire mai productive şi cu o cinematică relativ simplă, care să elimine operaţia de detalonare şi folosirea maşinilor-unelte speciale, provenite de regulă din import.

Variantele moderne de freze melc modul profilate prin ascuţire continuă asigură precizia de prelucrare necesară a roţilor dinţate în condiţiile păstrarii avantajelor rezultate prin decalarea dinţilor. Generarea suprafeţelor de aşezare ale dinţilor se face direct pe corpul de lucru al sculei prin ascuţire continuă elicoidală,

În lucrare se fac precizări importante privind proiectarea constructivă a frezelor melc modul „Fredascon", profilate prin rectificare elicoidală, în stare asamblată.

Perfectionnements constructiv-functionales, des fraises-mère assemblées aux dents décalées

Résumé

Les variantes constructives des fraises-mère aux dents individuelles, prisent dans des alésages coniques, permettent le positionnement décale des dents par rapport à la position conventionnelle des fraises standardisées, en assurent des meilleures conditions d'usinage et de précision.

Les recherches faites ont montré la possibilité de profilage des dents par des procédées plus productives, ayant une cinématique relativement simple qui permettent d'éliminer le processus de détalonnage et l'utilisation des machines-outils spéciales.

Les variantes modernes de fraises-mère, profilées par coupage continu, assurent la précision d'usinage nécessaire aux roux dentee en gardent aussi les avantages du décalage des dents. La génération des surfaces de dépouille des dents est faite directement sur le corps de l'outil, par coupage continu élicoidal.

Cet article présent des solutions de conception des fraises-mère „Fredascon", profilées par rectification élicoidale, en état assemble.