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TOOTHING HEAD FOR BEVEL GEARS WITH CURVED TEETH

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Abstract: The paper presents the theoretical and experimental research regarding the design of heads used for toothing conical gears with curved teeth and the sharpening of the knives that equip them, processed through relieving after a cylindrical helix. With the modification of the knife's profile, the clamping in the toothing head also changes. The advantages that result on processing with these heads and on sharpening the knives are also presented. Another objective of the paper is the obtaining of a calculus program for adjusting the Gleason 13A knife sharpening machine in relations to the parameters of the tool's profile.

1. Introduction

The knife-clip heads of the Hardac type are fitted with slots for fixing the knives that allow various radii of ordering of the tips of the knives on certain values, from the adjustment domain, with the help of certain sets of additions (wedges) with different widths.

This category includes the heads used for cogging and finishing processes called Hardac I, Hardac II and respectively Hardac III, destined for processing conical gears with teeth in a circle arc as well as gears.

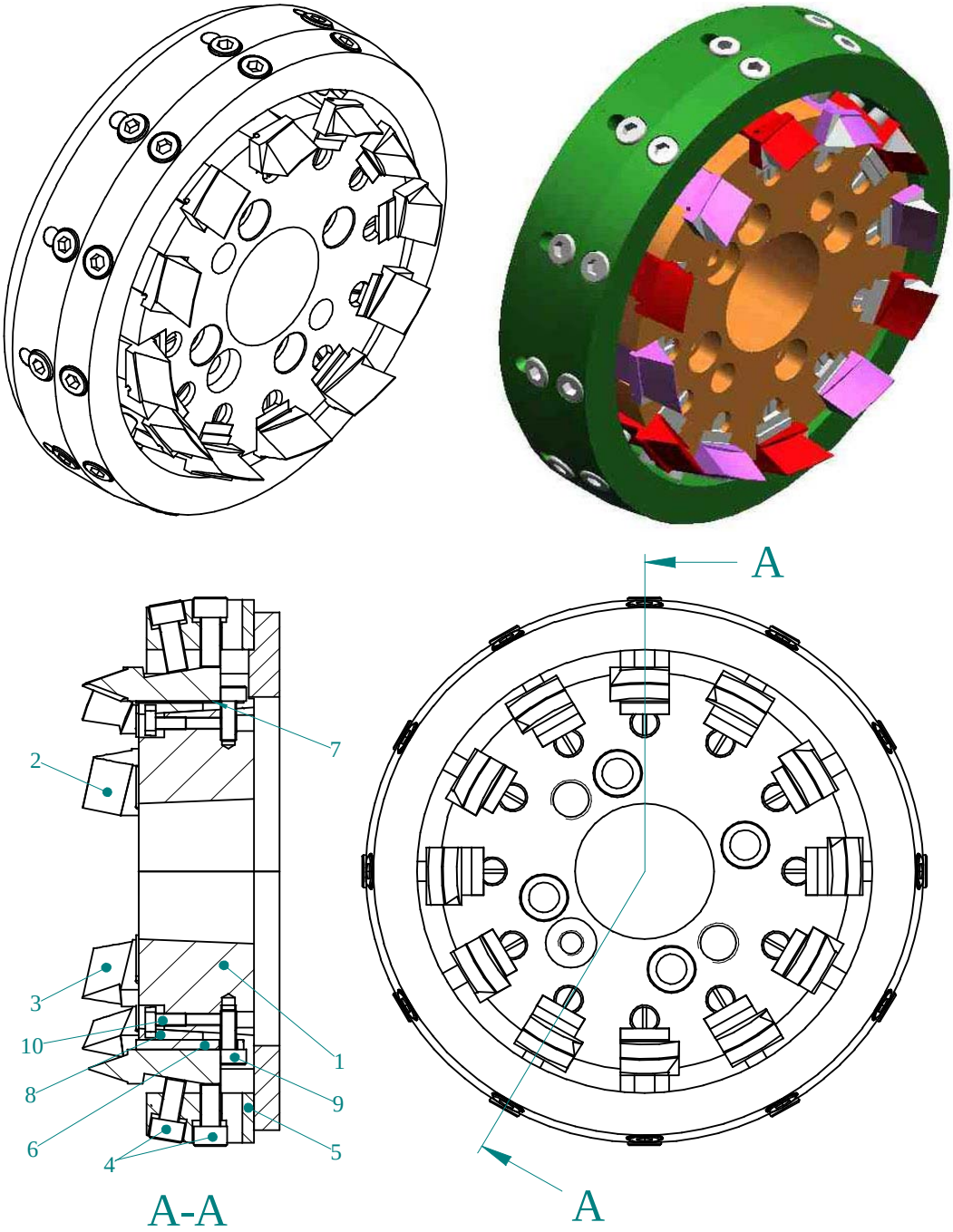
If cog milling is used both on the exterior knives and on the interior ones, on finishing the flanks only knives of the same sort, exterior ones for the processing of the concave flank and respectively interior ones for the convex flank are mounted on the knife-clip head following the unilateral system.

2. Designing toothing heads

Using the calculus methodology of the toothing heads [2, 3, 4] a toothing head (fig.1) was designed and generated in the SOLID EDGE 10 program.

Toothing heads can have fixed or mobile knives. In the case of heads with fixed knives, the knife does not require a supplementary adjustment after resharpening. These are inserted into the positioning slot and are buffered on the tip's surface. This solution is characteristic to the heads that work using the unilateral method. In the case of the bilateral method and the case of the finishing process, the knives are mounted on the toothing head so that they allow adjustments to be made on the diameters imposed on the exterior and interior knives with the help of wedges and blocks for all the knives.

The diameter of the knife that results from resharpening is the diameter on which the point of intersection of the lateral positioning surface with the tip positioning surface and the sharpening plane is situated. This point must be at a constant distance from the head's axis.



LEGENDA

1 – body;	6 – block I;
2 – exterior right knife;	7 -block II;
3 - exterior right knife;	8 – wedge
4 – clamping screws;	9 – eccentric head screw ;
5 – frame	10 – adjustment screw;

Fig. 1 Adjustable toothing head

If the knives are executed without a clamping hole and relieved following a cylindrical helix the second condition [4] is not fulfilled. The advantage of these knives is that on sharpening them, after wearing or chipping a knife, it is not necessary that they all be sharpened at the same height. One head there might have knives on their first sharpening

or on the last sharpening (not possible in the case of Hardac heads) because the knives do not maintain their height and diameter.

If individually sharpening the knives processed after a cylindrical helix and if on mounting them on the head they are buffered on the tip then the knives' height will be the same, the position of the chipping edge will be correct even if the exterior or interior diameters of the head are not maintained. Consequently the second condition will not correspond to these types of heads and can be modified to "the generating radii of the knives that equip the toothing head Re and Ri must remain constant"

3. The technology of sharpening knives

The calculus of the adjustment elements of the sharpening machine shown in the calculus chart, table 1, was done using the program *" Program de calcul pentru profilarea şi ascuțirea sculei" (Calculus program for profiling and sharpening the tool)* made in the C++ programming environment. The numeric example refers to the sharpening of knives used for toothing a conical gear with curved teeth and descending height of the tooth used in tram transmission.

Before fastening on the machine, the abrasive disk is mounted on a collar for static and dynamic equilibration. Between the body of the collar and the abrasive disk a gasket made from special paper will be fitted. The balancing of the collar-abrasive body will be achieved by utilizing a special plug. Together with other factors like: the diamond dressing of the abrasive disk, the cooling agent used, the chipping depth, the balancing, this will lead to improved quality of the sharpening surface of the knives.

On sharpening it is observed that due to the tilt angle of the chipping edge that is different for the interior and exterior knives the angular adjustments are different and the differences between them are big. The result of this big lag is a deeper processing of the interior knives. In order for the knives to remain at the same height and the number of sharpening to remain constant for both sets of knives, on designing and processing the active part of the interior knives, this must be heightened 1 mm in relation to the exterior knife.

Calculus program for profiling and sharpening the tool"

```
        m_fN1 = 0.0;
        m_sCloseN = _T("");
        m_fAr1 = 0.0;

        //-------------------------------------
        m_fN1 = ((m_iTeta1 + m_iTeta2) * sin(RadianDe(m_iBeta))) / 20;
        //verificam valoarea cea mai apropiata
        ((m_fN[0] - m_fN1 < 0) ? m_fMin = (-1) * (m_fN[0] - m_fN1) : m_fMin = m_fN[0] -
m_fN1);
        //-------------------------------------
float CProgram2Dlg::InvRadianDe(float Q)
{
        Q = Q * (180 / 3.141592654);
        return Q;
}
```

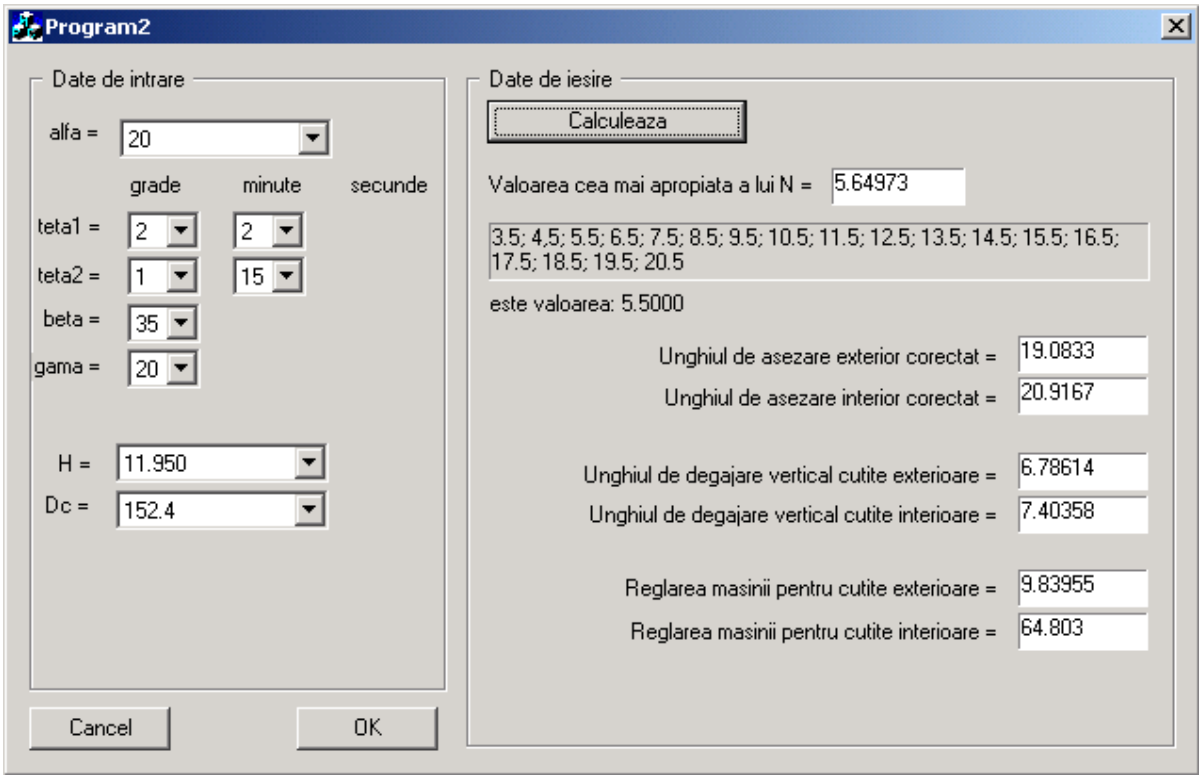


Fig. 2 Interface for determining the parameters on profiling and sharpening the tool

4. Conclusions

1. A head used for toothing conical gears with teeth in a circle arc was designed with a different knife-clipping system, adjusting the knives on the head in height being done by buffering the knives' tips in a horizontal plane.

2. The advantages of these types of heads consist in the fact that any knife can be resharpened separately and that the working side of the knife will occupy the same position without having to sharpen all of the knives equipping the head.

3. A program was created in the C++ programming environment for profiling and determining the adjustment parameters of the Gleason 13A machine for sharpening knives used for toothing conical gears with curved teeth.

4. An adjustment chart was drawn up in regard to the sharpening of knives for experimental research for the execution of the gear.

5. This research provides the engineer with a useful database in designing tools used for toothing conical gears with curved teeth.

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