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THE CINEMATIC CHAIN OF TWO CONTINUOUS AXES MILLING HEAD HD 320-2 CNC AT THE MACHINE "CPFPH 1000-5 axes"

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ABSTRACT

Keyword: ***Five axes machining.***

The Company Stimin Oradea is specialized in machine tools production, having a long tradition in Romania and produces machine tools for prismatic parts machining: milling, drilling, presses, and special machines, including here CNC machines, machining centers, flexible cells, and many others.

One representative machine is CPFPH 1000, as moving table bed type milling center with the table width of 1000 mm.

The actual machine is developed on owns forces by Stimin factory few years ago, as successfully machine in 3 CNC axes, ATC, and other special functions for the machining center level.

Now, Stimin factory want to extend the machine functions to the new level: that means to five axes machining, having the technical consulting of the University from Oradea.

INTRODUCTION

The machine CPFPH 1000 is a horizontal milling center with fixed bed and moving table machine type with the table width of 1000 mm. That means this is the ram type machine, having the following moving parts on the linear axes:

- Table movement on transversal direction as **X** axis, the table dimensions are 1000x4500 mm and **X** travel of 4000 mm;
- Vertical slide movement (knee forming) on vertical direction as **Y** axis, **Y** travel 1600 mm;
- Ram movement on longitudinal direction as **Z** axis, with **Z** travel of 1000 mm;
- Main spindle in horizontal position in the ram, with the ISO taper 50 and speed range of 30-3000 rpm;
- Automatic Tool Changer **ATC** chain type with CNC axis as chain rotation and ATC hydraulic double arm manipulator, fix tool gestion for 40 tools capacity;
- Automatic hydraulic indexing **H-V** milling head;
- Some options as: detachable rotary CNC table, with the diameter of 800 mm, as 4-th positioning axes, machine guarding, cooling installation, ram deflection compensation, telescopic way covers, CNC's pendant support, lubrication installation, hydraulic installation, etc.

The picture of the machine is showed in **fig. 1.**

THE FIVE AXES MACHNING EXTENSION

Stimin factory want to extend the machine functions to the new level: that means to five axes machining, having the technical consulting of the University from Oradea.

This machine will be equipped with the following modules and functions:

- two axes CNC tilting and swiveling milling head HD 320-2 CNC;
- two axes CNC rotary-tilting table MRI 500-2 CNC;
- ram deflection compensation;
- high CNC precision in accuracy class;
- automatic head changing;
- CNC equipment for 5 axes machining, full hard and soft for this scope;

- The other functions for machining center level remaining available.

Regard the new CNC milling head HD 320-2 CNC, the cinematic chain is described in the present paper work, using a new parallel synchronous and preloaded feed mechanisms for both movements (A and C axes), in order to assure the dynamic parameters and machine performing ***[1].***

Fig. 1- The machine CPHPH 1000, Stimin Oradea, [1].

About the new CNC milling Head HD 320-2CNC type, this head will be developed as five axes machining extension on the basic machine, in order to obtain a new machine level "CPFPH 1000-5 axes".

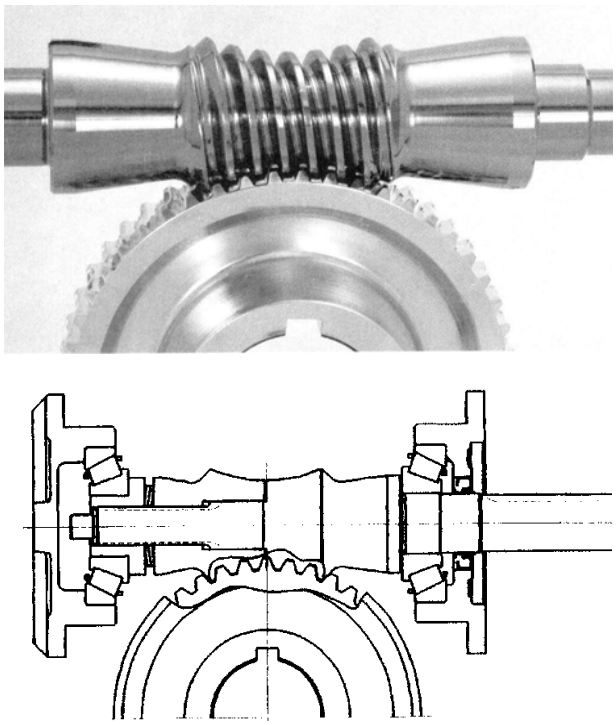
The cinematic chain solution for the rotary feed movements as continuous axes in the contouring milling conditions, has the following possibilities.

- using of globoid worm & gears CONE DRIVE (USA) type with backlash system, as in **fig. 2**, high precision hardened and grinded worm system, having two preloading variants: with two axial half worms and axial preloading, or one single worm with zero backlash;
- using of OTT (Germany) worm & gears (with small gear basic angle), as in **fig. 3**, with backlash system and axial preloading of two half worms;
- using of Duplex worm & gears (with different lead left and right), having the adjustment of the backlash by axial adjusted worm position against the gear teeth, as in **fig. 4**. Some of Duplex worm-gear pairs are manufactured by Stimin Oradea.

It is necessary to mention that the backlash system will be used at both head rotary movements: A and C axes (tilting and swiveling), from two separate servomotors.

The authors of the present paper work, are working at the new project of the mentioned head HD 320-2CNC, and the adopted solution is the combination between the globoid worm & gears CONE DRIVE (USA) and the principle of parallel feed mechanisms, on two parallel gear trains, without backlash and both preloaded, as in **fig. 5**. This solution assure the necessary stiffness of the feed mechanism, the backlash and preloading, the high energetic efficiency, in order to can working in contouring milling regime at maximal power.

In **fig. 6** it is showed the offer drawing of the head HD 320-2CNC with all the main parameters.



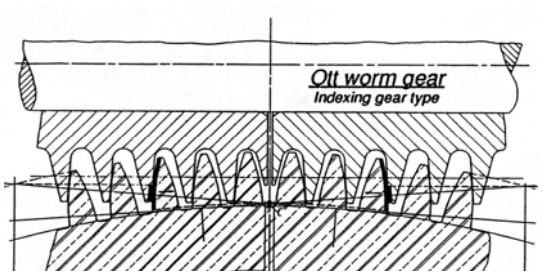


Fig. 2 – CONE DRIVE worm gear system [2], (top),

Fig. 3 – OTT worm gear system [3], (right)

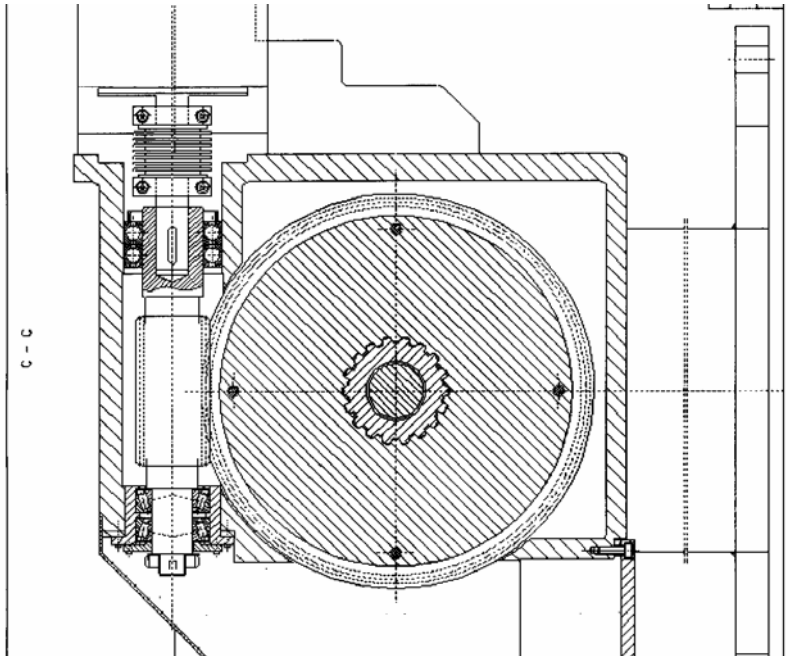


Fig. 4 – Duplex worm feed mechanism

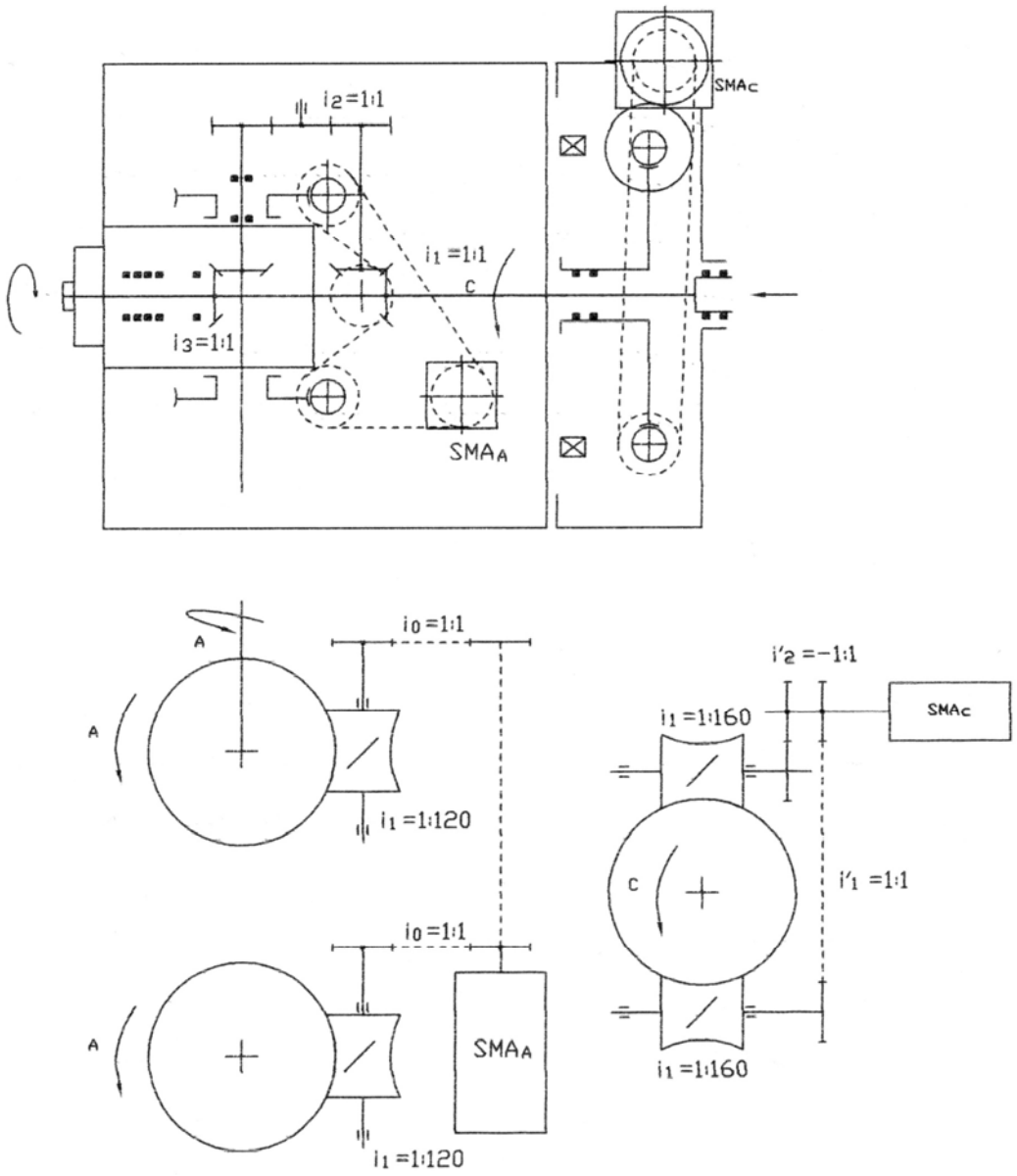


Fig. 5 – Parallel feed mechanism on two rotary axes head.

CONCLUSIONS

The authors of the present paper work are working at the machine modernization, in order to obtain the variant of "five axes machining" on the Stimin's representative machine CFPH 1000-5 axes". At this project will be applied innovative solutions as parallel feed mechanisms for the rotary CNC axes with globoid worm & gear pairs from US, in order to assure the quality head conditions.

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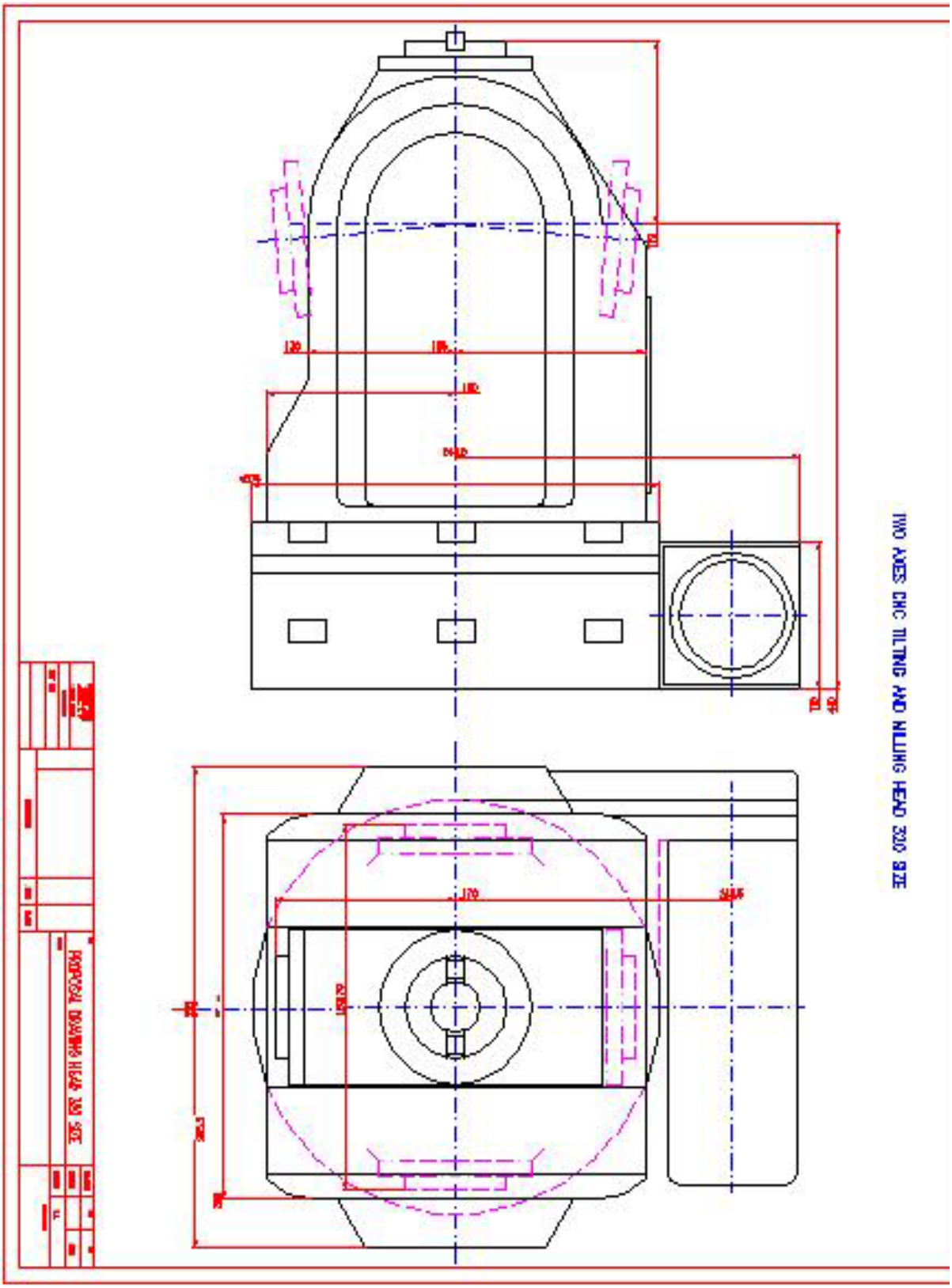
TWO AXES CNC TILTING AND MILLING HEAD 320 SIZE