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SOLUTIONS FOR THE RAM DEFLEXION COMPENSATION AT THE MACHINE CPFPH 1000-5 axes

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Abstract

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

The machining in five axes is a new technology, which need new machines, new tools, new software, and high precision level.

For this reason the machine-tools in five axes are expensive and sophisticated, the companies builders of these machines must respect carefully all the technical conditions specific of this field.

INTRODUCTION

The machine CPFPH 1000 manufactured by Stimin factory in Oradea town, Romania, is a new generation of horizontal spindle bed type with moving table machine in normal precision class, for heavy parts up to 10 tones, one representative machine for his class.

Now the machine need to be extended to five axes machining by the milling head with more two CNC rotary axes, and the head having the function of AHC (Automatic Head Changing).

The head is fixed on front face of the horizontal machine ram, having the movement on Z axis. The machine can be equipped with more heads, all with AHC function, with different weights. The head weight made the ram deflexion, having negative influence on the machine precision.

About the precision of the CNC axes and the precision class according to ISO 230-2 norm, these machines must be in high precision class not only for the positioning and the repeatability parameters, but the thermal stability, the machine stiffness and dynamic stability. The new ball bar test is the evidence that the machine in dynamic regime respect all the dynamic parameters according to the standard.

The authors of the present paper work show the principle of this aspect and the possibilities for the ram deflexion compensation, in order to obtain one acceptable machine in the standard precision class.

In the attached picture (**fig.1**) it is showed the actual standard machine CPFPH 1000 with four axes (with CNC detachable rotary table) and with the classic milling head, automatic in two positions H-V, which is not very heavy. The actual ram compensation is not enough for the next step of the development, the case of five axes machining.

DESCRIPTION OF THE NEW VARIANT

The machine principle regards the forces and the deformations it is showed in the **fig. 2.**

We are talking about of the bed milling machine moving table type, which can support heavy parts on the table.

On the other hand, on the vertical way of the column move the cutting machine part, this having vertical movement (as the vertical slide) and horizontal movement (as horizontal ram movement). More than that, the ram transport different head types, enough heavy, which deform the entire machine after variable law, and has negative influence about the machine precision. The heads are changed automatically.

Fig. 1 – CPFPH 1000, with H/V milling head, Stimin Oradea

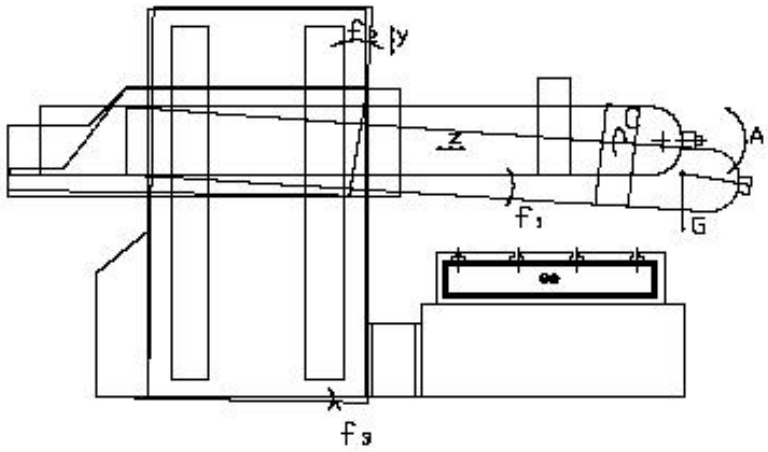

Fig. 2 – The principle of the machine deformation under the ram weight

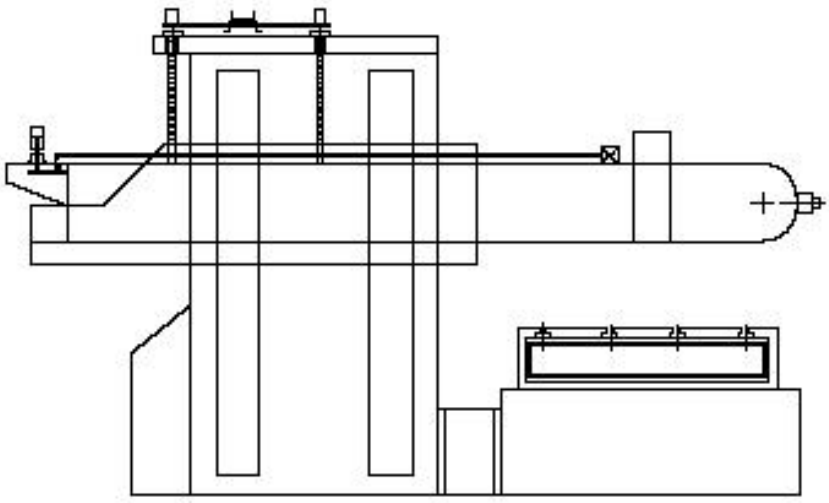

Fig. 3 – The new ram deflection compensation principle

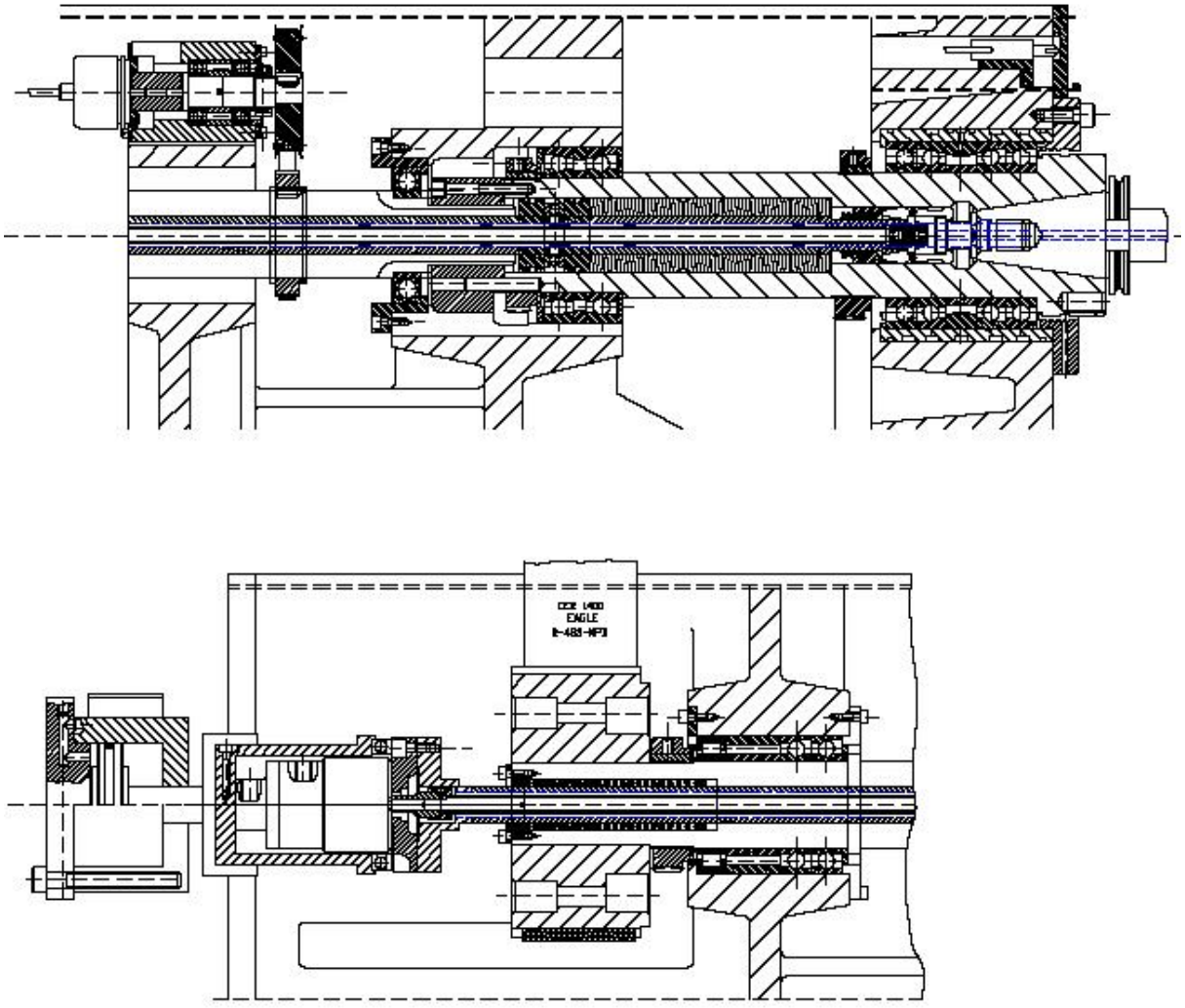

Fig. 4 – The new main spindle inside of the ram

The deformation diagram shows that at the ram weight will be cumulated the head weight, in different variants, and all these move in the 3D space (X, Y, Z cube), having different law deformation. The total deformation is the result of three component deformations: the ram deformation, the vertical slide deformation and the column deformation. The ram deformation is elastic deformation of the solid ram, the vertical slide deformation is at the guide system, and column deformation is on the leveling screws on the foundation. The first two have major influence; the ram deformation and the vertical slide deformation. The column deformation will be ignored because is very small.

In the **fig. 3** it is showed the compensation principle: regard the ram deflexion as solid deformable body, and the vertical slide compensation as guide improved system.

Also, in the fig. 3 it is showed both compensation principles:

- for the ram elastic deflexion as elastic body, the compensation is performed by two over disposed tensioning bars, actuated by the hydraulic cylinder on the rear side of the ram, under variable pressure piloted through the proportional reducing valve by the machine computer system and special software;
- for the vertical slide compensation, here is a un-adjustable system with two parallel feed mechanisms on vertical direction, synchronous actuated by belt reduction from the single axis servomotor, but having the possibility of pre-adjustment of the relative angular positions.

The machine project contains inclusive the new main spindle assembly (**fig. 4**), with higher speed, and the automatic head changing function by hydraulic Cytec units.

CONCLUSIONS

The automatic ram deflexion compensation is one new advanced concept, especially for the AHC function.

The Automatic Head Changing introduce more variables in the software concept, because which head with different weight, produces different deformation diagram, that means in the software it will be called an different calculus algorithms.

This action will be consisting of one future research activity of the authors.

BIBLIOGRAPHY

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