

CONSTRUCTIVE IMPROVEMENTS AT LARGE CNC HYDROSTATIC ROTARY TABLES AS ACTIVE CONTINUOUS CONTROLLED AXES ON HBMC MACHINES

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Abstract: The large CNC hydrostatic rotary tables mean the MRD tables produced by some machine tools manufacturers from Romania. These products are displaceable-rotary tables CNC controlled on two axes (linear and rotary), having modular construction for different dimensions (from 1700x2000 up to 4000x4000mm). All these are provided with hydrostatic circular bearing at the B axis (table rotation). The HBMC machine means Horizontal Boring Milling Centre, with different structure, normally with two bases in T. The MRD table must covers the X and B machine CNC axes. Now, the table construction is normally adapted at the positioning level, because the weight of the working part (between 15 and 100 tones at the entire modular machine family), is large enough. Positioning level means the using in static (clamped) position of the table on both axes. In the case of table using at HBMC machines, the table need to move quickly on all axes continuously, with high dynamic regime and high precision, even the weight of part is very large. At this application the constructive solution of the rotary part must be different of the classic solution at positioning level, which will be presented bellow.

1. INTRODUCTION

The classic solution for the hydrostatic circular bearing at the B-axis of the MRD unit is based on hydrostatic pockets, circular disposed. During the rotation, the hydrostatic installation is running, the pump work, and the table "float" on the oil film. The thickness of the oil film depends of more factors: oil pressure, oil temperature, oil viscosity, pocket surface, the load on the table, rotary speed, etc.

The variable thickness of the oil film has large influence on the positioning precision at rotation, because the vertical movement need to be controlled. In middle of the table is the positioning transducer scale type disposed, from Heidenhain (Germany).

2. DESCRIPTION

The MRD rotary displaceable table modular family contains more different table dimensions (loads), as follows: 1700x2000 (15 to), 2000x2000 (15 to), 2000x2500 (30 to), 2500x2500 (30 to), 2500x3000 (40 to), 3000x3000 (40 to), 3000x3500 (50 to), 3500x3500 (60 to), 3500x4000 (80 to), 4000x4000 (100 to). The travels for linear axis are modular: 1000, 1500, 2000, 2500, 3000, 3500, 4000 mm. UP to the load of 30 tones the linear guide is based on friction with intermittent lubrication, using pair of materials as Biplast on hardened steel, and respectively, over 40 tones the linear guide is hydrostatic. On the rotary movement the circular guide is hydrostatic at the entire modular machine family.

Regarding the CNC system, all these rotary displaceable tables are prepared for positioning system: that means to have slow dynamic with two moving speed: rapid and slow speed in order to be assured the stop at requested programmed position. On the programmed position the linear movement the saddle is clamped on the base, by 4 clamping units based on Belleville springs and hydraulic releasing. The clamping surface is the guiding surface of the base. This type of solution is typical for positioning system.

The rotary movement is provided with hydrostatic circular large bearing, having more hydrostatic pockets, in order to assure the positioning under the load, with similar functioning mode as the linear way. Here the clamping units use as clamping surface the

circular hydrostatic way, but without the oil film, because the hydrostatic oil film is assured during the movement time only.

Both movements are locked during the machining time of the working part disposed on the working table surface, having the X and B axes in static position. The positioning precision under CNC at both axes is 0.010-0.015/1000mm on the linear axis, and respectively 0.002deg on the rotary axis.

On the **fig.1** it is showed the view of the MRD 2000x2500 table from Stimin Industries SA, Oradea.

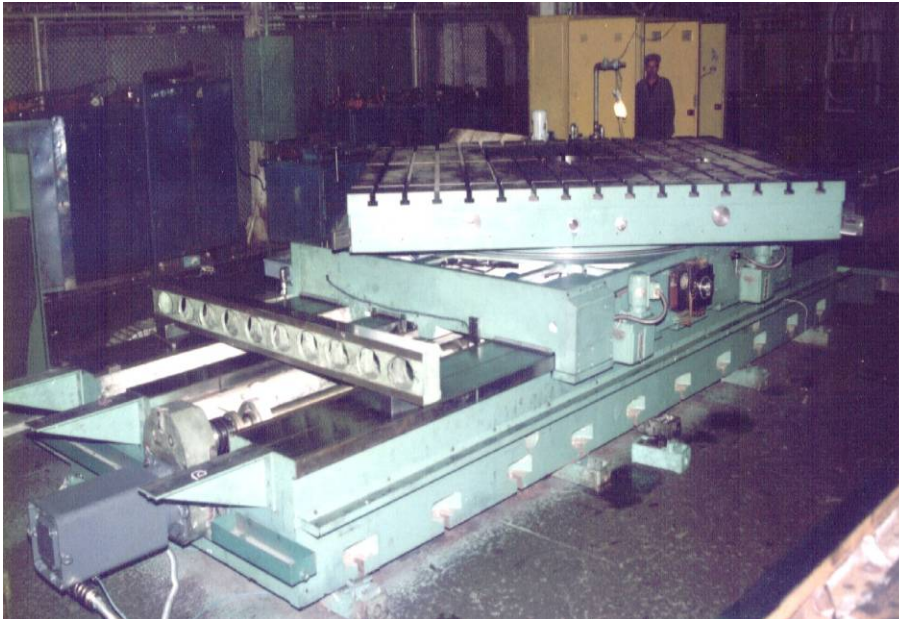


Fig.1 – MRD 2000x2500/2500, (Stimin Ind. SA, Oradea), [2].

Now, the intention is to use these MRD units as machining centres modules on X and B axes, but as permanent active contouring CNC axes, instead positioning axes. What it is the difference?

The difference consists by the fact that the both MRD movements are unlocked during the machining time of the working part, having now one high dynamic at the feed mechanisms and ways. The X and B machining centre axes are working permanently and the clamping units all the time are open. These clamping units can be closed at CNC command only, far the case of heavy regime.

How it is possible to modify the actual solution to the requested case?

The old functioning type is unusable because the machine dynamic and precision is not assured into the new conditions of contouring system.

More difficult to solve it is at the rotary movement because the hydrostatic circular way must be able for constant thickness film oil of max. 0.02mm all the time, the dynamic need to be improved, the residual torque from friction needs to be controlled on this axis (see the **fig. 2** with unlimited guiding in vertical direction).

More that than, is the pallet system introduced (optionally) at the MRD table, as APC function, which need to introduce a specific mechanism on the board of the rotary assembly including hydraulic functions.

In the **fig.3** it is showed the circular hydrostatic way of the rotary table with the hydrostatic pockets. In this case the clamping surface is separate of the hydrostatic circular way surface, and this can be used as vertical guiding in order to limit the oil film. But the residual friction torque can be uncontrolled at high hydrostatic pressure and this torque can be variable, depending of the load weight on the table.

In the **fig.4** it is showed the vertical guiding based on roller / balls way in order to reduce the residual friction torque at any hydrostatic pressure and any load on the table. Even the vertical force on the roller way is variable (oriented to upper direction); the roller range assures one slow residual friction torque and one constant film oil thickness, [1], [3], [4], [5].

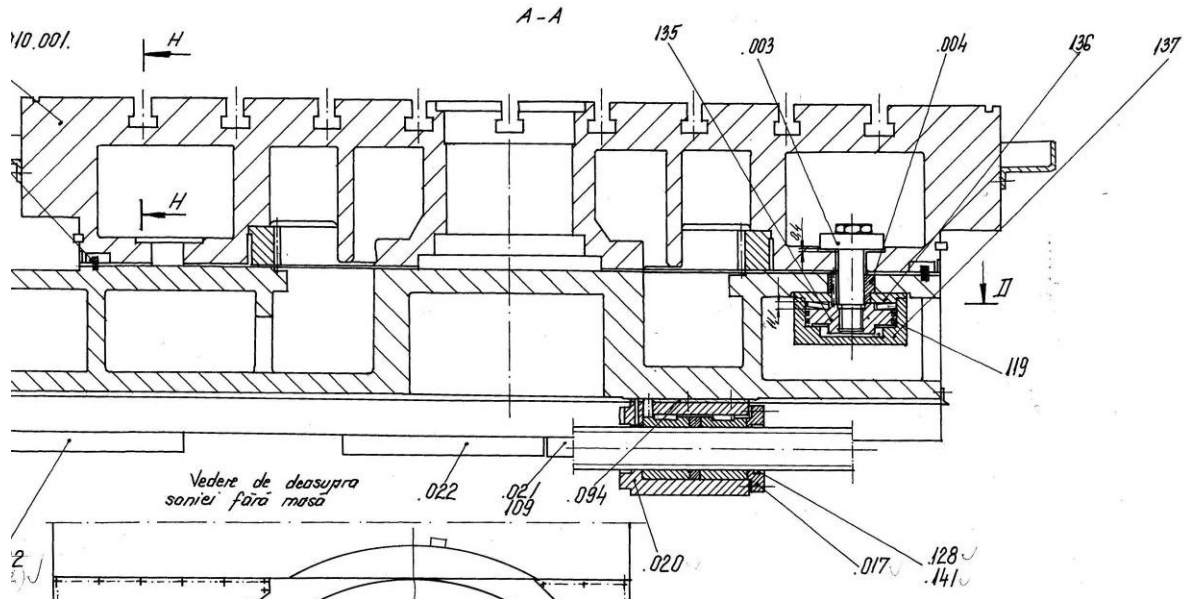


Fig. 2 – The actual solution without oil film thickness control at MRD product (Stimin, Oradea)

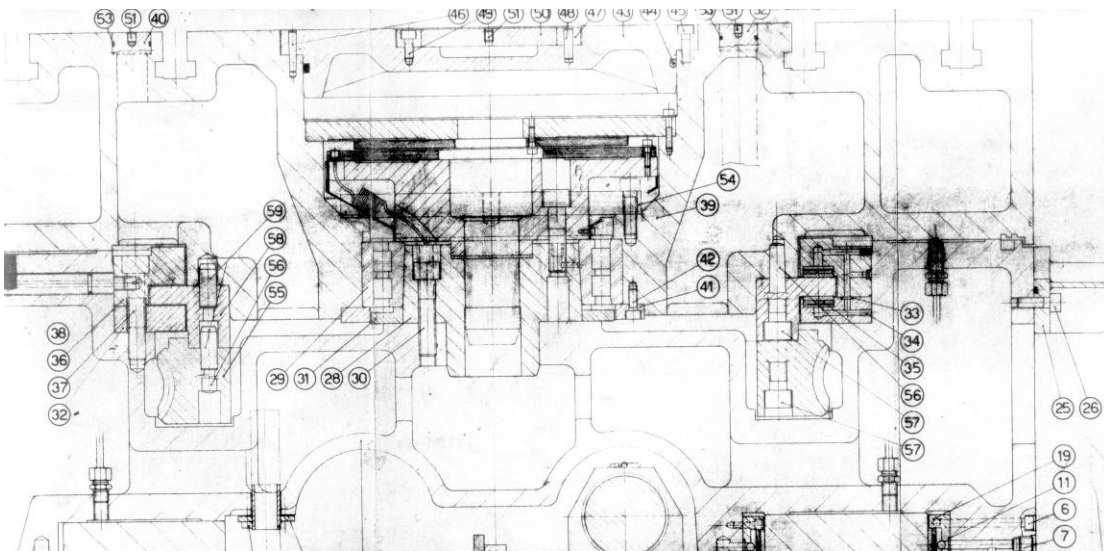


Fig. 3 – Sample about the separation between the hydrostatic way and the clamping surface

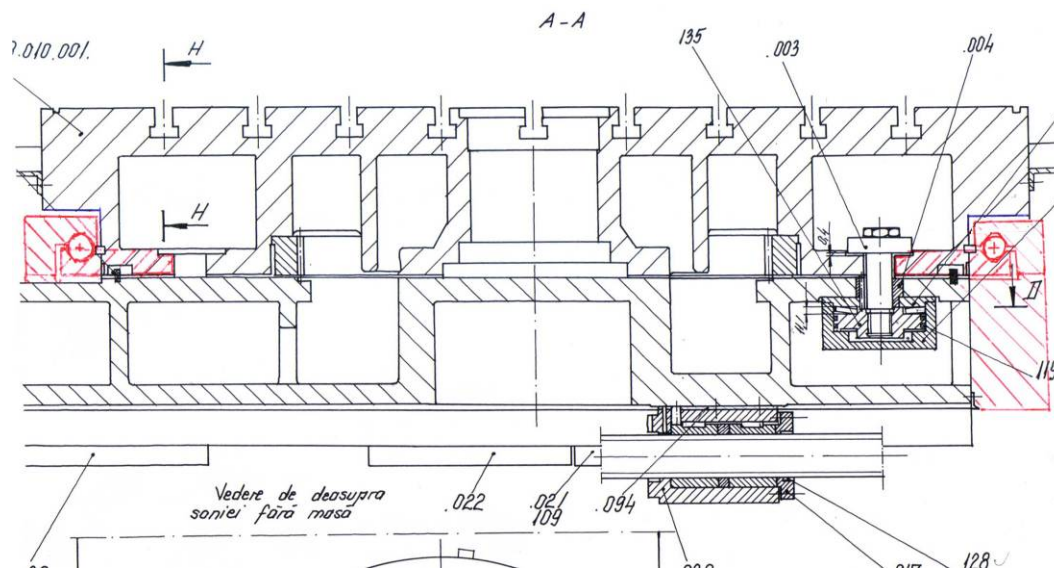


Fig.4 – Sample about the new solution with oil film limitation by ball range, introduced into the vertical guiding system in order to reduce the residual friction torque (Stimin, Oradea), [5]

3. CONCLUSIONS

The applied solution at the MRD tables in order to assure the CNC contouring regime is the combination between the hydrostatic ways and roller guiding at the circular way, the first one for the supporting of the large load, the second one to reduce the residual friction torque. On the other hand, it is necessary to modify the rotary feed mechanism at the “tensioning system” variant, able for backlash system and heavy regime with high dynamic.

These improvements, introduced recently into the construction of the newest horizontal boring milling centres from the special machine tool manufacturing program of SC Stimin SA Oradea, are very new and originals solutions on this domain, never used before.

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