ABOUT THE TECHNOLOGICAL ASPECTS AT THE FIVE AXES MACHINING OF PRISMATICAL PARTS

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Abstract

Keyword: ***Five axes machining***

The technological aspects at the five axes machining of the prismatic parts are connected to the actual level of this technology. This means that the technology evoluated in the time together with the machines and with the CNC units until the actual technical level.

Two main levels of this technology from the last period can be considered as representative, in order to stand out the main aspects and the most important stages.

Also, the first one for the real axes machines, the representative period was until the end of the years 90, based on machines tool and CNC units equipped with 3 linear axes with heavy moving parts, and also with two rotary axes. Here, it is most representative three different constructive solutions for the rotary axes as follows: 1 – head with two CNC orthogonal movements as tilting and swiveling (A and C, or A and B); 2 – head with one tilting movement (as A axis) combined with rotary table (as B axis); 3 - table with two orthogonal movements as rotation (as B axis) and tilting (as A axis). In all cases the heads and the tables can be integrated in the basic machine structure, or as detachable options delivered with the basic machine, and the CNC units as standard equipment with the TCPM soft (Tool Center Point Management), and anti-collision software. The generation in 3D space is based on the interpolation of the circle in one plane free oriented in the 3D space.

For the second case, the machines with virtual axes (all the axes), or hybrid machines (the linear axes as real axes and the rotary axes as virtual axes), the period of the launch on the market is after 2002, until today, when the machines touch high performances doe to the software of high level as special option at these machines.

The present paper work tries to shows the main technological aspects in the both cases, as actual level in this technology.

GENERALITIES

The five CNC axes machining suppose the tool axis orientation as normally direction on the curved surface in contact point in the Fresnet coordinates from analytic and differential geometry (fig. 1), **[1].**

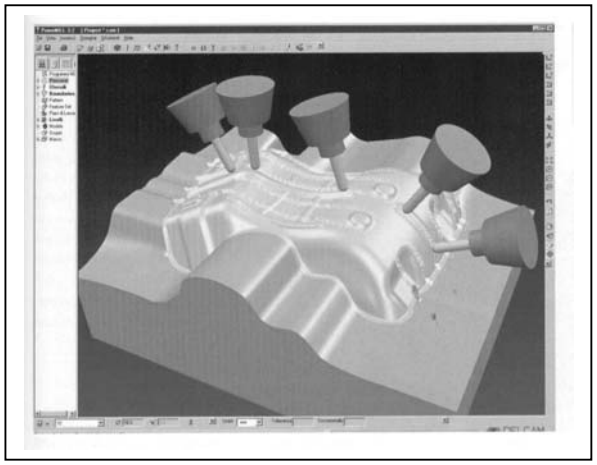


Fig. 1, [1],

Fig. 2, [1].

The most complexes and representative parts have a sculptural surface (fig.2).

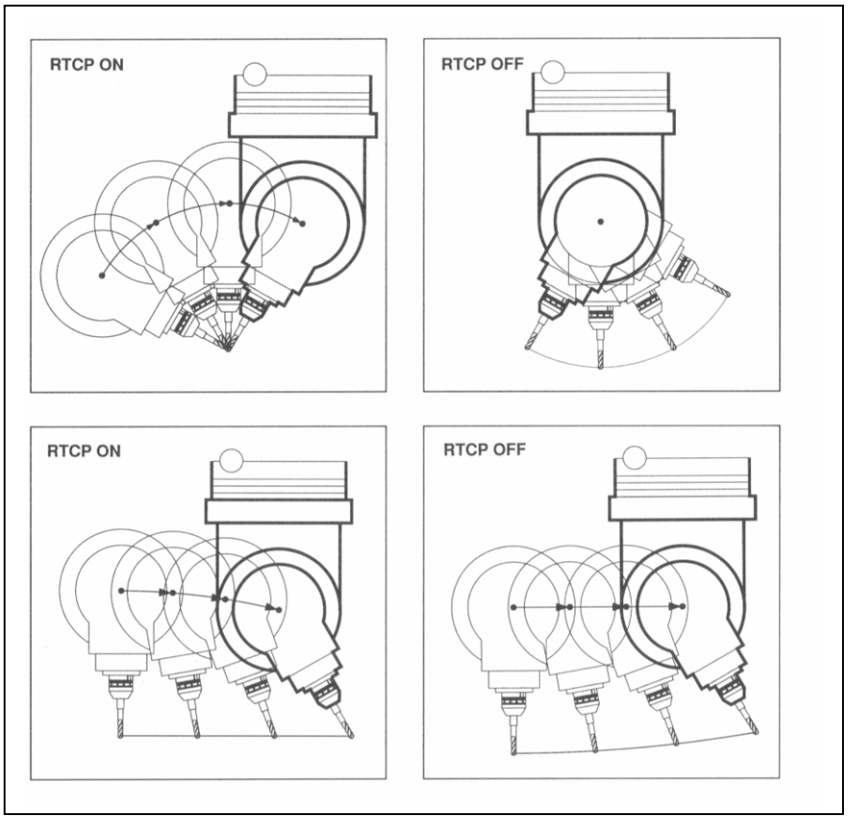


Fig. 3, [1].

One basic problem is a TCPM software (Tool Center Point Management), which permits the automatic combination of the machine axes movements in the interpolation time, in order to maintain the tool center point in permanent active contact on the part surface in the interpolation current point, or on programmable trajectory, as sample right line (fig. 3), **[1].** This software is delivered together the CNC units from the last generation on five axes, in order to make sure the connection between the rotary axes and the linear machine axes, for the cases of machines equipped with tilting heads, tilting tables, or both.

TECHNOLOGICAL CASES

The five axes machining of the prismatic parts on machine tools is basically solved in three typical technological cases:

1.– the rotary CNC axes are buildet on the tilting and swiveling milling head (fig.4), or
2.– the rotary CNC axes are buildet on the rotary and tilting table (fig. 5), or
3.– the rotary CNC axes are buildet on the both units: tilting head and rotary table (fig.6).

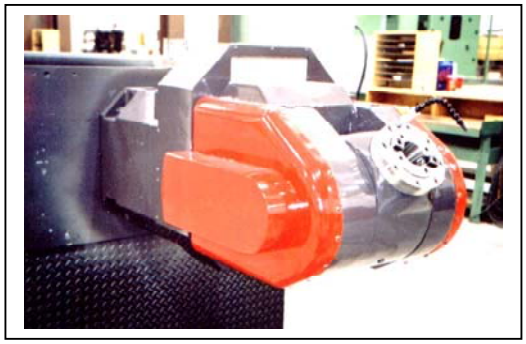


Fig. 4, [1],

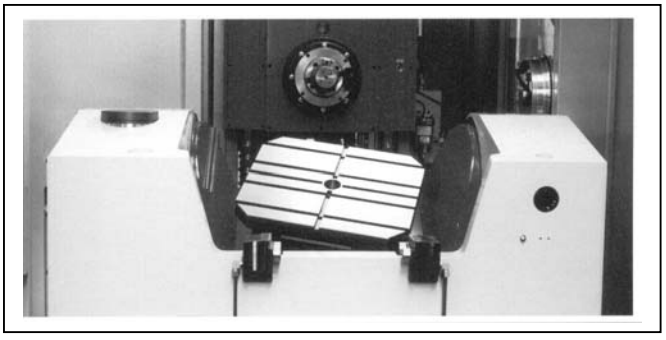


Fig. 5, [1],

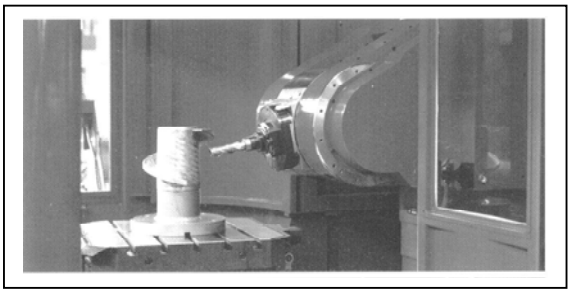


Fig. 6, [1] - *top*

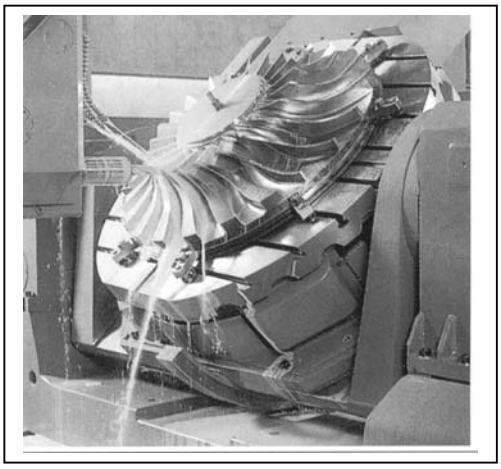


Fig. 7, [1] - *right*

The typical configuration of the parts on the three over mentioned cases is presented in the fig. 1 and 2 for the first case, in the fig. 7 for the second case, and in the fig. 6 and 8 for the third case.

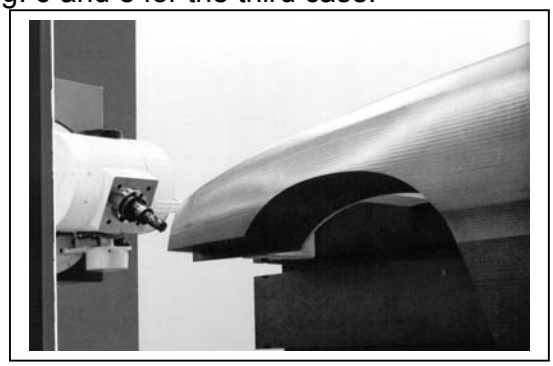


Fig. 8, [3] – top

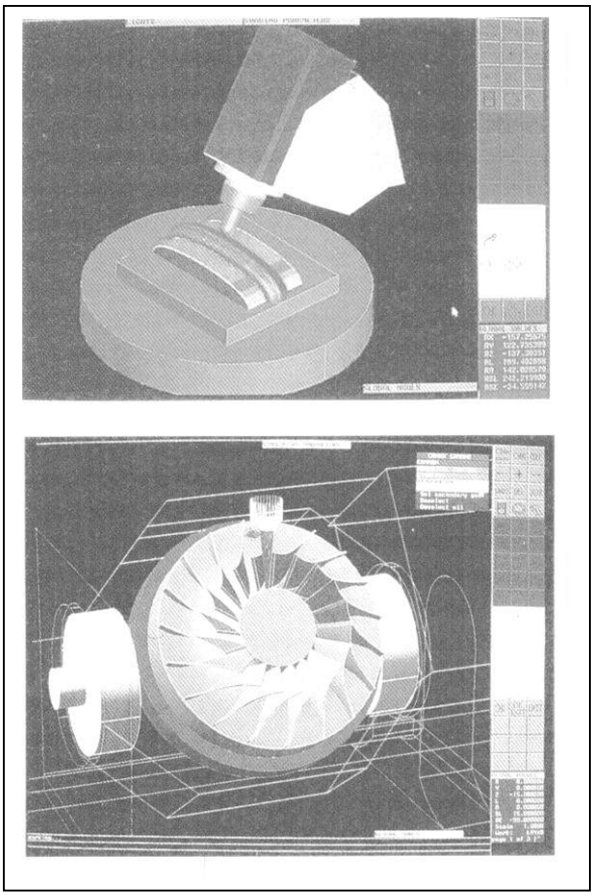


Fig. 9, [3] - *right*

The case 2 corresponds to the rotor form Of the parts, fan rotors, turbine rotors, etc. The case 1 corresponds to the sculptural forms or non regularly forms, having a negative angular tool positions (fig. 9). The case 3 is more universal and corresponds to the machining centers as modular construction, and permits the both 1 and 2 cases in the machine technological limits, **[3].**

It is possible to have a particularly technological cases, other than the special machines (as sample the machines for ship propeller, for turbine propeller, etc), **[1],** which permits the rotor parts machining, having two rotary tables (one on the other as in fig. 10), or the machining in four axes X, Y, Z, A (fig. 11), **[2].**

Also, frequently are used machines according to the second case, with rotary and tilting integrated table, with lower prices as the cases 1 and 2 and larger technological universality, (fig. 12), **[2].**

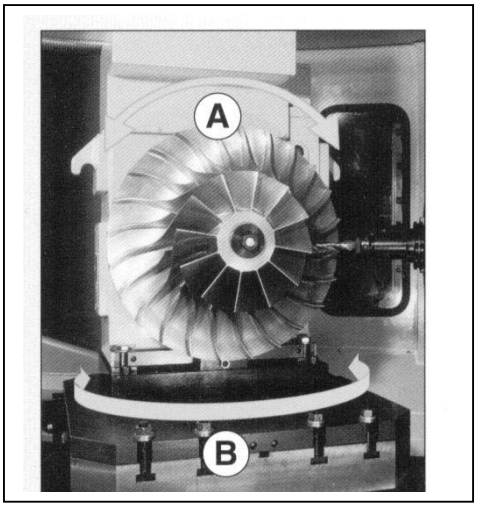


Fig. 10, [1],

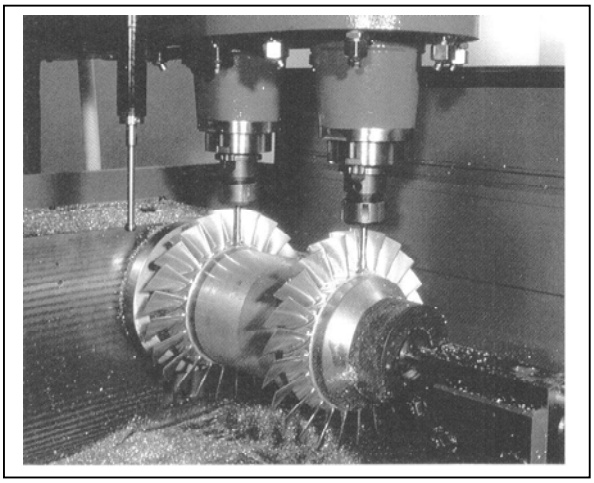


Fig. 11, [1],

Fig. 12, *[2],*

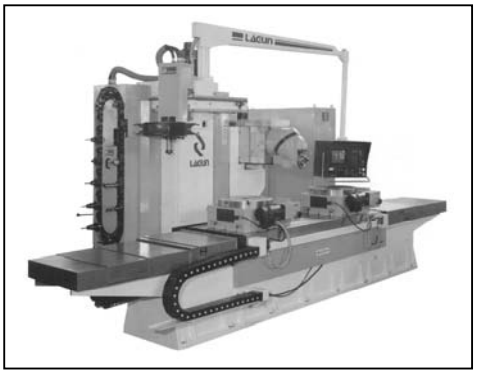
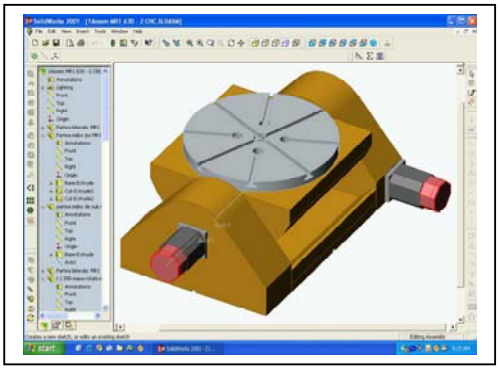


Fig. 13, [2] – top, Fig. 14 - down



Also, one frequently used technological case from the machine low price, is the case with universal automatically index birotary milling head, fig. 13, **[2],** which shares the curved surface in smaller spherical polygons, with fixed tool axis direction in the interpolation time. Here, the head have two rotating planes, vertical and diagonal, controlled by the PLC, instead by the CNC, through one special soft, on one standard four CNC axes equipment.

CONCLUSIONS:

On the base of the over mentioned things, the authors of the present paper works propose the performing of one rotary-tilting table the size 630 mm with 2 CNC axes (fig. 4), and respectively one 2 axes CNC milling head with small dimensions (the size 320 mm), both for the needs of development at SC Stimin Ind. SA Oradea.

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