Annals of DAAAM for 2010 & Proceedings of the 21st International DAAAM Symposium, Volume 21, No. 1, ISSN 1726-9679
ISBN 978-3-901509-73-5, Editor B. Katalinic, Published by DAAAM International, Vienna, Austria, EU, 2010
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DEVELOPMENT OF THE NEW CHAIR MILLING TECHNOLOGY

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Abstract: *This article is created to promote implementation of a specialized wood milling equipment, which is made for manufacturing of the back cuts of chair bottoms. Its' use into field of chair manufacturing in woodworking companies is described. Furthermore, the article describes technological challenges in relation with implementation of the above mentioned equipment into a small-scalmanufacturing facility and gives practical solutions, which could resolve manufacturing problems.*
Key words: *wood milling equipment, surface roughness, technological regimes*

1. INTRODUCTION

This article describes a unique and specialized milling machine for manufacturing of the back cuts of chair bottoms. The back cut of chair bottom is the sitting part of a chair (Fig.1.). Materials used in chair bottom manufacturing are: massive-wood, chipboard and MDF plate.

Overview of the most marketable models ("Pinus GB" Ltd., 2009) demanding angle processing show a wide variation of processing dimensions (Fig.1.A: 258-348mm, B: 7.5-44mm, C: 78-164deg). Current chair bottom manufacturing methods usually include slow and time consuming technologies (Hualian S&T group, 2009). Therefore, there is a clear necessity for a new technology providing easily and fast manufacturing, transposition and adjustment properties for different types of chair bottoms. Methods used to design improved processing technology are milling instead of sawing, and adjusted current frequency as a control system. As a result, high economical benefit has been gained, as well as fast and easy maintenance and possibility to process 8 chair backs simultaneously. That shall be considered as a great advantage. If necessary, an automatic condensate release system can be set up in future.

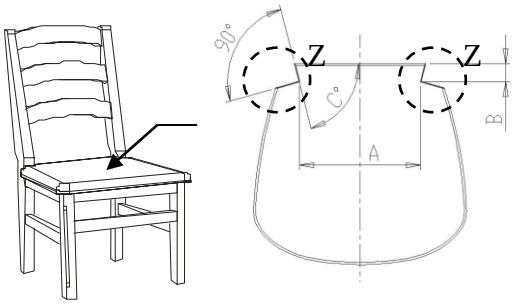

Fig.1.Chair bottom.Z-target area.A, B, C – relevant dimensions.

2. PROCESS

Current chair botto manufacturing methods are offering chai manufacturing by shaping each back cut and sawing it off on a circular saw (Fig. 2.).

These methods without any additional devices are only suitable for chair bottoms with a proper sawing off, perpendicular to one of side edges. In chair manufacturing,

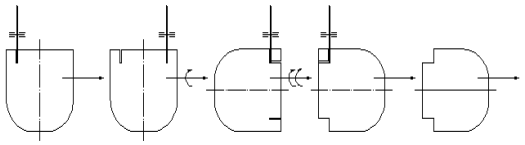

Fig. 2. Outdated chair bottom manufacturing technology

this kind of chair bottoms is very rarely common. Shapes of the rest side edges do not allow use of even a simple support. In processing of the remaining back bottom surfaces separate conductors (templates) must be manufactured. Appropriate back bottom surfaces are fixed in them and only then precise processing is possible. Conductors relieve handling of components, though use of these adjustments extends processing time of parts. In table 1 it is visible that exposure is sufficiently wide and each chair bottom requires a special matrix. To saw off corners, each chair bottom must be placed in appropriate matrix and then processed on a saw (Burrows, D., 2009). This is considered being a very time-consuming process. Nowadays, when companies are searching ways to optimize their manufacturing process and costs, the described outdated approach becomes economically disadvantageous. Advanced treatment is also necessary in this case – after sawing back cuts, handling on grinding machine is necessary since sawing traces in corners left by grinding machine are connected with diameter of disk and cannot be avoided.

2.1 Parameters and working principles of the unique chair milling technology

In newly designed machine, the sawing off of chair bottom back cut is replaced by milling. Machine operates two contrary directed wood milling cutters by means of two electro-motors with the power of 2,2kW and 5600 rpm at 100Hz frequency. These parameters are controlled by means of electronic adjustment of the current frequency. Technical parameters are shown in table 1.

Electrical part		
No. of el. motors	2	
Motor power	2.2kW	
Supply voltage	400V 50Hz	
Work frequency	50Hz	100Hz
Motor revolution	2800rpm	5600rpm
Total power	4.4kW	
Pneumatic part		
Req. pressure	6bar	
Air quantity	56m^3/h	
Supply	0-40m/min	
Press. in clamps	1kN	
Dimensions		
Height	1700mm	
Length	2400mm	
Width	1300mm	
Weight	560kg	

Tab. 1. Technical parameters of the device

Milling cutters are directly fixed on electro-motor shafts. Work units are based on the table and fixed by two pneumatic drop heads. Working table feeding motion is performed by pneumatic cylinder. (Wagner, Willis H., 2006) Required milling dimensions are obtained by adjustment of the milling cutters. The unique chair milling technology is shown in figure 3, motion scheme in fig. 4, where 1 – supply motion; 2 – adjustment motion; 2.1 – side impinge; 2.2 – crosswise support regulation; 2.3 – longitudinal regulation; 2.4 – milling angle setup motion; 3 – rotation (cutting tool).

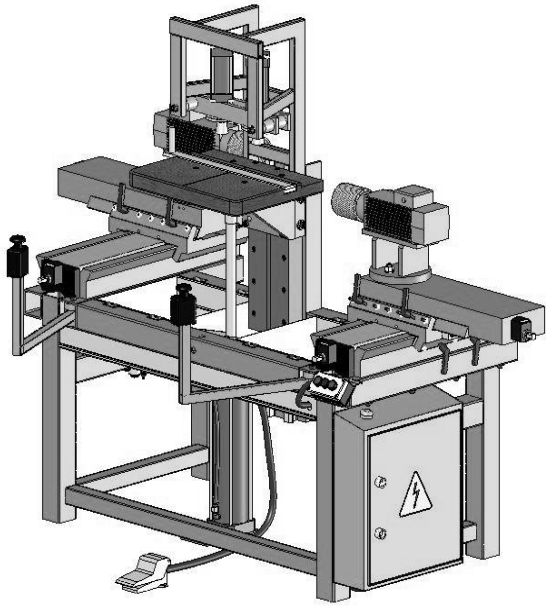

Fig. 3. Unique chair bottom mill

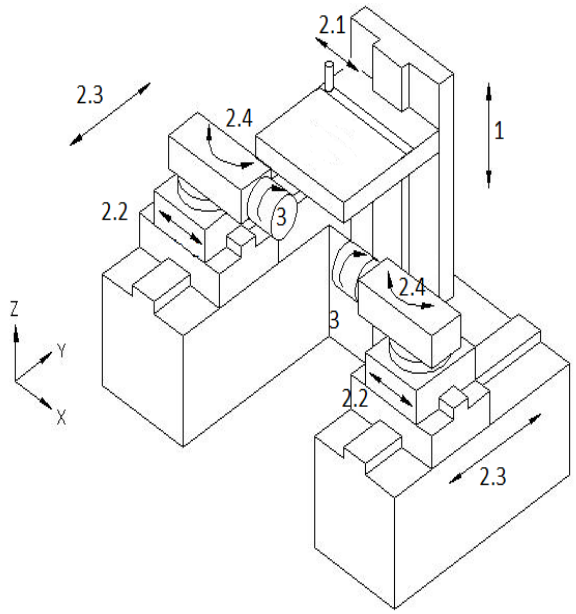

Fig. 4. Chair bottom mill motion scheme

2.2. Status and results

At this stage of research the working prototype is elaborated and introduced in "Pinus GB" Ltd., chair manufacturing company. The prototype now is in manufacturing already for 2 years and has paid-off itself less than a year. In order to introduce the chair mill in this concrete company, economical estimation was carried out and results are shown in figure 5.

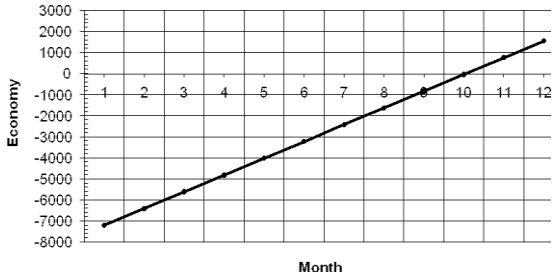

Fig. 5. Economy graph

During the operational time of 2 years the following advantages and disadvantages have been noted:

1. Advantages of the new machine:

- There is no need any more for the separate cutting pattern for each chair bottom type;
- Fast and easy setup;
- Simple work-piece basing;
- It is possible to process 8 chair bottoms simultaneously;
- Reduction of energy consumption up-to 30%

2. Disadvantages of the new machine:

- High efficiency of the new machine leads to some difficulties in coordination with other machines of manufacturing line;
- Additional operator training necessary.

3. CONCLUSIONS

A significant fact is that no maintenance repairs or improvements were needed during the operation except lubrication of guide ways once in 3 months, and release of condensate from air preparation compartment. By need, an automatic condensate release system can be established, which relies also to automatic gateway lubricating system.

According to calculations subjected to the involvement of the above described equipment into small-scale manufacturing, prime cost would fall at least by 22% (Kalpakjian, S., Schmid, S., 2009).

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