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AUTOMATIC COMPLEX FOR THE PUTTING OF ART IMAGES ON SEPARATE DETAILS FROM WOOD MATERIAL

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ABSTRACT

The aim of this paper is to suggest a structure for automatic complex for putting art images on separate details from wood material. For the putting of images is used tampon automatic stamp. The project parameters of the automatic complex are defined. 2D drafts and 3D models of the suggested variants are worked. An analysis and evaluation of the worked variant is made and the optimal was chosen which was projected and researched. The automatic complex was realized and experimental studies were done and part of the results were made in the present study.

Key words: automatic complex, putting of images, details from massive wood.

INTRODUCTION

Applying a liquid colored materials to obtain artistic images on the basis of solid wood is mainly done by hand in the drafting of icons or household items and folklore that are practical and aesthetic value. The mechanical processing in the production of details from massive wood with comparatively small sizes is done on the basic or specialized wood-processing machines by making in advance the necessary grouping of details with close constructive technological characteristics which permits easier way to find specific solutions for the automatization of the whole production .The sophistication of such details, their surface processing and the putting of the surface cover is still lagging behind as concerning the automatization of these technological operations. This report presents a methodology for the design of an appropriate set of devices, components and devices that perform automated dispensing of artistic image on a small piece of solid wood. The aim of the work is to create a functioning automated complex laboratory equipment for teaching purposes.

METHODS FOR PROJECTING OF AN AUTOMATIC COMPLEX FOR THE PUTTING OF AN ART IMAGE ON THE DETAIL OF MASSIVE WOOD

The design is a process comprising the following basic steps: identification of needs; of the problem; synthesis of design solutions; analysis and optimization; Assessment of the decision; presentation (documentation) results (Chakarski al 2005).

The details are of beech massive wood with cylindrical form and quadrangular cross section. The ratio between the radius of the circle and the thickness of the details is 3 to 1. It is necessary to create putting of an art image on the surface upper part of the details. From the common stream of the details it should be ensured the separation of one, which should be led to the position of putting an image, after which the processed detail should be taken to exit from the working zone of the automatic complex.

1. RESEARCH OF THE POSSIBILITIES FOR AUTOMATIZATION OF

THE PUTTING OF IMAGE ON A DETAIL FROM MASSIVE WOOD

1.1. Analysis of the timber material for the reception of separate details from massive wood

The wood species of the massive timber from which the details were produced is from primary importance for the definition of their basic points, characterizing the conditions in which their production would be realized. Most commonly, according to physical, mechanical and technological properties the wood is divided into soft and hard. The anatomical structure of the different tree species defines their different properties. As hard wood is defined the timber of the broadleaved species and as soft-the timber of the conifers. The moisture content level influences at a great extent their other properties. Because of this massive wood which is used for the production of details is dried till a percent moisture content is reached-most commonly 12 %.

According to the research for the definition of the timber density in air dry and absolutely dry condition the lowest values for density have the conifers and the poplar , and the highest-the broadleaved. In table 1 are presented the values of density of timber of locally growing tree species.(Enchev,1984).

Table 1: Density of timber of locally growing tree species

Tree species		Density of timber, [kg/m^2]			
		In dry condition	In dry condition	In air dry condition	In normal conditions
Spruce	sapwood mature wood	960 510	470	430	380
Fir	sapwood mature wood	980 510	450	410	360
Scots pine	sapwood mature wood	1040 650	520	490	430
Douglas fir	sapwood mature wood	910 540	510	470	415
Oak		1010	790	750	670
Beech		1070	720	680	560
Plane		830	630	590	525
Hornbeam		1060	830	790	670
Acacia		1100	770	730	660
Black poplar		900	450	420	365

For the realization of quality surface cover with a form of image it is necessary to take in mind the moisture absorption of timber. To make a clear and distinct image with clean contours the material put on the surface of timber material should not spill. Part of the put on the timber ink layer will penetrate in the timber in depth, which depends on the property of water absorption. Depending on the micro and macro structure of timber of a particular tree species the water absorption is defined. The capability of timber to absorb moisture depends on the water saturation border of the cell wall.The absorption of water of timber is called sorption, and the opposite process – of vaporization of the connected water-desorption. In desorption the moisture which reaches timber is higher than the moisture which is received in sorption in one and the same outside conditions. This condition is called histerezis of the equinox moisture of timber and its largeness depends on the size of the details. The maximal histerezis is received in materials from massive wood with thickness from 15 mm and length

over 100 mm and has value up to 2,5 % (Enchev 1984).

Because the putting of the image could be realized by a tampon stamp, which causes pressure on the surface layer of the detail from massive wood not to crush the macro-anatomic timber elements, it is necessary to analyze the strike resilience of timber. In table 2 are presented values of the strike resilience of timber of the most distributed tree species.

Table 2:Strike resilience of timber (Enchev 1984)

Tree species	Strike Resilience, [J/cm^2] in moisture, [%]		Tree species	Strike Resilience, [J/cm^2] при влажност, [%]	
	12	30 and more		12	30 and more
Larch	0,90	0,68	White acacia	1,21	0,96
Spruce	0,73	0,56	Beech	0,96	0,79
Scots Pine	0,72	0,55	Birch	0,80	0,67
Fir	0,65	0,50	Willow	0,73	0,62
Cedar	0,62	0,47	Poplar	0,68	0,57

After the research made the beech has been chosen as timber material for art image.

1.2. An analysis of the technological process for the production of specific single details from massive wood

The working out of details is carried out in the following consequence of technological operations: beech boards with the right thickness are cut by length on a many leaved circular saw and details are received with a size equal to the size of the boards. From the received products with a square cross section are worked on a turn or spindle molder cylindrical details with round cross section. The next operation is cross cutting which could be done by circular saw, band saw or specialized machine. The details received are sanded on a drum sand-machine till the necessary rough surface is received.

2. WORKING OUT OF AN AUTOMATIC COMPLEX – ANALYSIS, EVALUATION AND CHOICE OF AN OPTIMAL VARIANT

Three variants for an Automatic Complex have been worked out for the putting of an image on a detail from massive wood, which ensure the necessary work and assisting operations and basic work positions and are used three different variants of moving: pneumatic, electric and combined..

2.1.1. Variant I.

An automatic complex consists of: two pneumatic double acting cylinders; pneumatic preparing group; two sided two positional distributors, a console, feeding block, controlling block, two navigating, two censors for end position, print, ink pot and mounting elements. The moving is done pneumatically.

2.1.2. Variant II.

The automatic complex consists of: a step drive engine, double acting pneumatic cylinder, pneumatic group, four censors for end position, print , ink pot, feeding block, corpse and mounting elements. The moving in this variant is combined.

2.1.3. Variant III.

The automatic complex consists of: step drive engine, screw driver facility, two censors for end position, automatic print, feeding block, controlling block, corpse and mounting elements. The mobility is done electrically.

2.2. Analysis and evaluation of the variants. Choice of an optimal variant.

The worked out variants are analysed and evaluated by the described in the literature (Chakursky and Hadjikosev 2008, Dimitrova and Hadjikosev 2013) quality and quantity analysis. In the quality analysis are defined the advantages and disadvantages of all the worked out variants. For the conduct of the quantity analysis has been used the method of prof. Chakursky, the so called method of the no size coefficients. Concerning the received results from both methods of analysis and evaluation the variant which is optimal was chosen –Variant III.

The automatic complex consists of : collector, stand for a collector, mechanical thumb, a rotating separating mass, three step drive engines, automatic print, screw driver, stand rolls, two censors for end position, stand instrument, line controlling, line rolls, controlling support, exit circuit, base, legs, feeding block, controlling block and mounting elements.

The principle of work is the following: in a vertical collector are arranged cylindrical details – 12 numbers. After the starting of the systems rolling separating mass cuts and transports the detail to work position for the image putting. The moving of the Automatic complex is done by a step drive engine, which in a left turn moves the screw driver facility and the translational movement of the automatic stamp below is done. After the reaching of the below end position and the image print the step engine is turned to the right and the automatic print returns in the upper end position. The processed detail is taken out the working zone of the automatic complex by a gravitational way through an outside conduit. The position of the rotating mass and the instrument are controlled by two censors (Dimitrova and Hadzhikosev 2013). The constructive peculiarities of the automatic complex are: maximum visualization of the functional characteristics; experimental execution, module principle. Automated complex used in the learning process to visualize the training of students as a functioning laboratory stand.

2.3. A common 2D and 3D model of the chosen optimal variant of the automatic complex

The worked out two D model of the automatic complex AC is shown on fig.1. A three size model of the automatic complex shown on fig.2 has been worked out.

3. PROJECTING AND WORKING OUT OF AN AUTOMATIC COMPLEX

3.1. Projecting of a feeding position (Dimitrova 2008, Chakarski and Vakarelska 2008). Worked out is a vertical collector which realizes the oriented storage of the details.

3.2. The projecting of a separating table. For the existence of a separate detail and conduit till the work position is worked out , rolling six position separates mass VDS (Dimitrova 2008, Chakursky and Hadjikossev 2008).

3.3. The project of work position. For the existence of a work operation putting the image of detail is used an automatic tampon print. The step electromotor through a screw driver executes the moving of the stamp (Chakarski and Vakarelska 2008).

3.4. Projecting of the outcome position. An outcome conduit is done , by which the gravitational outlay of the ready made details outside the work zone of the AC (Chakarski al 2005).

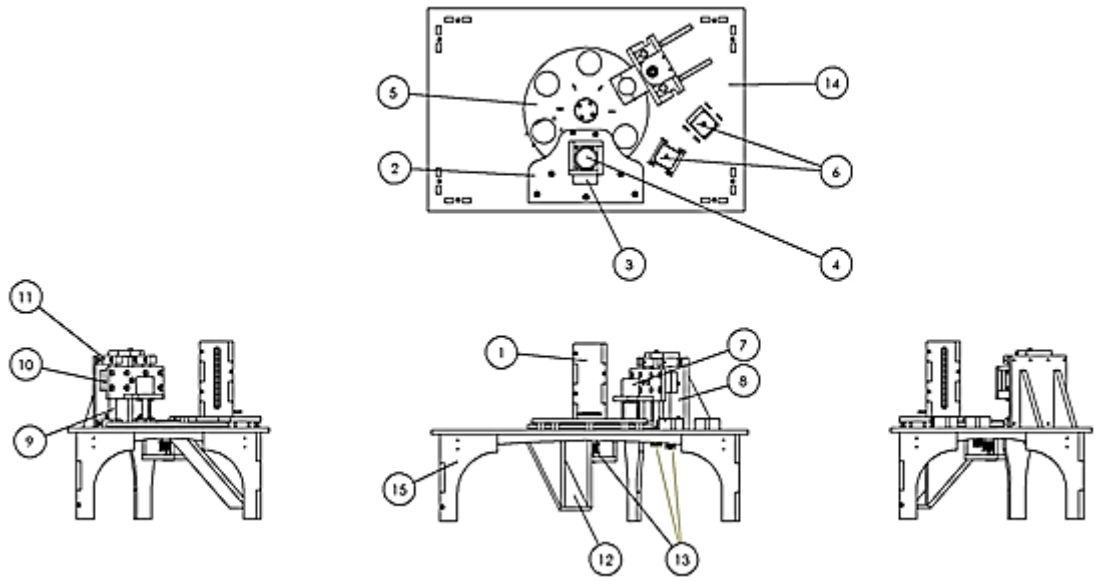

Figure 1: 2D model of AC 1 – MS; 2 – Stand MS; 3 – Thumb; 4 – Detail; 5 – VDS; 6 – Step engines; 7 – Print stamp; 8 – Stand instrument; 9 – Line controlling; 10 – Line rolls; 11 – Stand controller; 12 – Output conduit; 13 – Teeth rolls; 14 – Base; 15 – Leg.

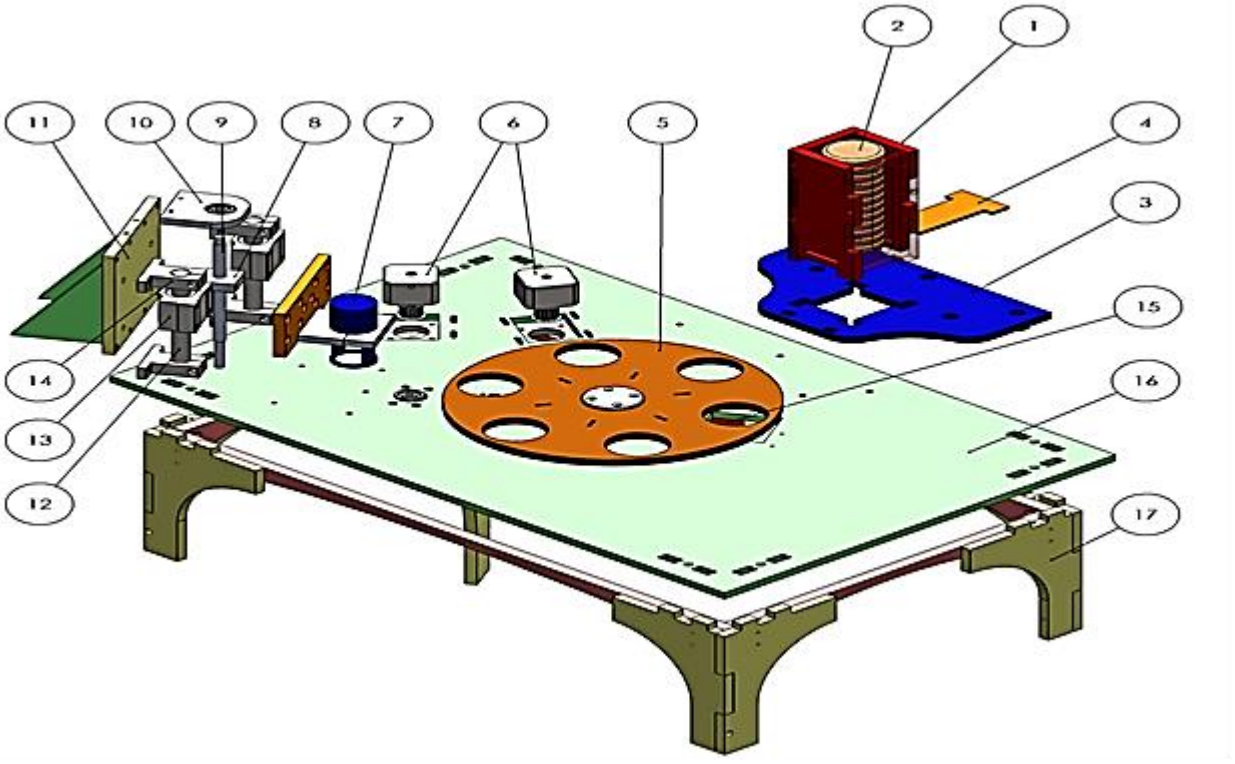

Figure 2: 3D model Automatic Complex: 1 – MS; 2 – Detail; 3 – Stand MS; 4 – Thumb; 5 – VDS; 6 – Step drives; 7 – Print; 8 – Screw driver; 9 – Screws; 10 – Stand rolls; 11 – Stand instrument; 12 – Line controlling; 13 – Line rolls; 14 – Supprt controlling; 15 – Output conduit; 16 – Base; 17 – Leg

3.5. The working out ,research and introduction in exploitation of the projected AC (Gogov 2013, Malakov 1999, Chakarski al 2003). The worked out and ready for exploitation automatic complex for the putting image on single details from massive wood is shown on fig. 3.

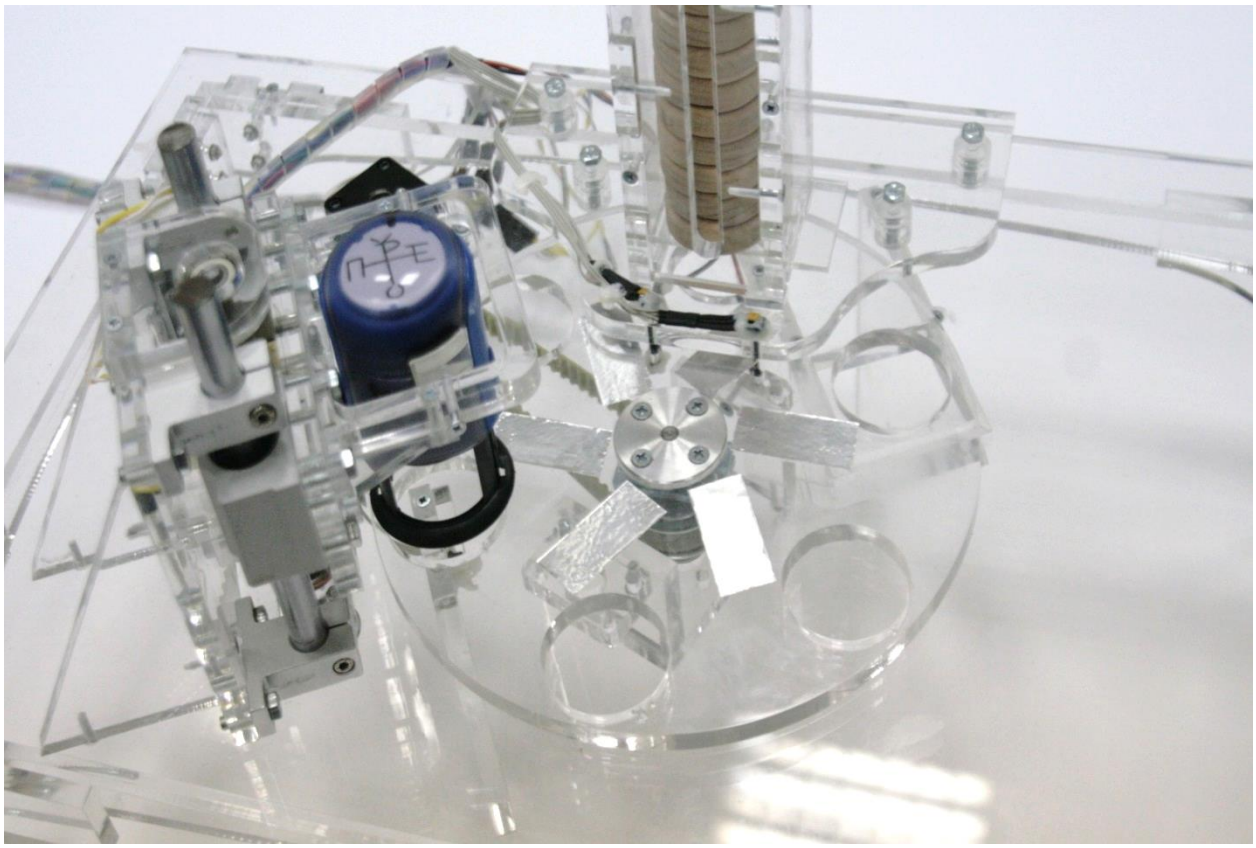

Figure 3: A photo of the worked out Automatic Complex for the putting of images on cylindrical details

RESULTS

An analysis has been done and is chosen the suitable massive timber material ,the necessary for execution of working automatic complex for putting of art image on a single detail from massive timber. The results from the analysis of physical , mechanical and technological properties of the details from massive timber could be put images on details from massive wood , and could be used for the putting of images on details with different forms.

Worked out are three of AC on which was done qualitative analysis, has been made an evaluation of the different variants through a quantitative analysis, by using the method of prof. Chakursky.

The optimal variant is projected, worked out and is functioning .

CONCLUSION

The projected automatic complex was worked out as an educational stand in the Department "Automatization of the Discreet production " of the Machine Faculty of the Technical University – Sofia.

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