The pyrography, from solar radiation to laser radiation

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Abstract: - The article shows a brief history of pyrography in order to decorate the organic materials. The paper is structured in three parts: materials that are suitable for pyrography, pyrography apparatus and working heads. The focus is put on the wood pyrography. Also the paper is a synthesis of the methods and woodworking tools for burning out. It also presents the main advantages and the main disadvantages for each material, tool and head work. How to work with each tool will be covered in a future article.

Key-Words: - pyrography, wood burning, materials, apparatus, working heads, tips, heat sources.

1 Introduction

Pyrography is a technique used to decorate the art objects. It consists of incising a draw using a termocauter. This technique has occupied an important place in Romanian folk art, for decorating small wooden objects (bone forks, spindles, wooden pails, cups, spoons and other household items) [1].

2 Materials

The materials used for pyrography are organic. These are: skin, bone, cork, wood.

Pyrography on leather is used in the leather goods industry, but also it is uses in the livestock industry for the marking of the animals. The main advantage of using this method in the livestock sector is that once meant the sign no longer deletes just by sacrificing the animal.

Pyrography on bone is used in jewelry industry. This type of pyrography is used less and less nowadays because the trend in jewelry design is to have a glow as possible. The pyrography is an art which it prints sobriety to objects.

The pyrography on cork is used in alcoholic beverage industry, mainly for marking the stoppers of wine bottles. The main advantage of using this method is that the marking is not deleted in wet conditions.

The wood is used both as solid wood and veneer form, usually plywood. Wood species used for pyrography are homogeneous species, with uniformly dispersed pores, without drawing obvious and light colored. Usually it uses common species that are not aesthetically valuable. Wood density is a physical property of wood which it has not a significant influence about burning out. The most common species are: beech wood [2], lime wood [1], hornbeam wood, sycamore maple wood [1], balsa wood, poplar wood [2], fir wood [1], alder wood [1] and cherry wood [1]. The advantage of using this method in the case of wood is that it is better exploits of the aesthetic lower woody species.

3 Apparatus

Depending on the source of energy for heat production, the pyrography tools are divided into: electrical source, source with liquefied gas, solar radiation source, laser radiation source.

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3.1 Electrical tools

Electrical tools are the most currently used. They have relatively low cost and they have high control possibilities. The main disadvantage of these devices is that they require a source of electricity power. According to principle of operation, electrical tools are divided into: tools with electrical transformer and tools with electrical resistance.

3.1.1 Tools with electrical transformer

It consists of a transformer and a resistance (ear). The components of such a device are presented in Fig. 1. The transformer is designed to reduce operating voltage from 220V to variable voltage between 1 ... 5V [3]. Stress resistance increases at low temperature. In this way the ear heats up to 700°C. The current intensity is 2-3A [3]. These devices have the advantage that they have low thermal inertia. The temperature can be adjusted easily and in a short time. The main disadvantage is that the ears have small diameter and they break-down easily. The ears need to change very often because they cannot be glued if they were broken.

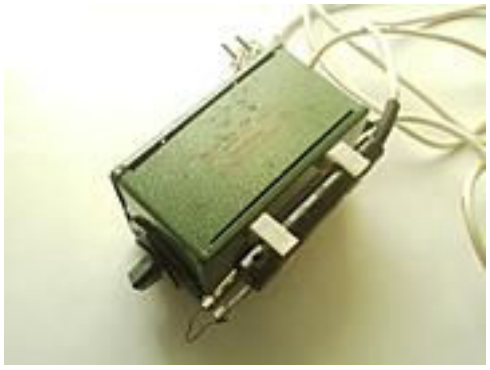

Fig. 1 Tool with electrical transformer

3.1.2 Tools with electrical resistance

These devices are relatively new in to wood burning tools. Such a tool is shown in Fig. 2. It is like a soldering tool.

Fig. 2 Tools with electrical resistance

The principle of operation is based on a power resistor. It is connected to the 220V source. Peak heating is made through thermal convection. The main advantage of these devices is that the tips are not damaged as frequently as those with transformer. The main disadvantage is that they have high thermal inertia. To get from room temperature to operating temperature takes 5 minutes. To reach the working temperature to ambient temperature takes 25 minutes.

3.2 Tools with liquefied gas

Tools with liquefied gas are used due to their autonomy. It does not need to connect to the mains power. Such a device is shown in Fig. 3. The main disadvantage of this energy source is the reduced temperature control options, particularly due the thermal inertia. Another disadvantage is the apparent difficulty of automation. A burning picks are made of brass and they are thicker compared to those used in electrical tools.

Fig. 3 Tool with liquefied gas

3.3 Tools with solar radiation

Tools with solar radiation are the oldest instruments in the world. They were used long before the discovery of metal. The principle of the method consists in amplification of solar energy using a magnifying glass. The main disadvantage of this method is due to the fact that it depends on the weather stare. Another disadvantage of this method is that the temperature control is very difficult. This energy source is not used currently. Its principle of operation is taken now by laser radiation. An example of pyrography made using solar radiation is shown in Fig. 4. Of course it is a poor pyrography, but it is a good example of using this method of work.

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Fig. 4 Pyrography made on wood with solar radiation and a lens

3.4 Tools with laser radiation

Tools with laser radiation are currently booming. Basic physical principle of optical quantum generators – laser – is the amplification of light by stimulation of the radiation emission. This is based on the population inversion.

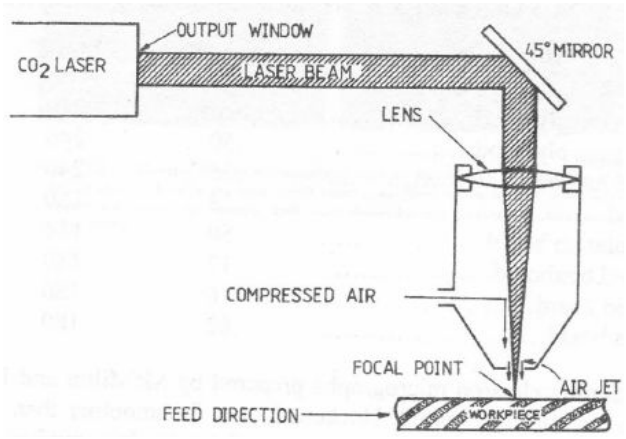

Fig. 5 Diagram of experimental air-jet-assisted, carbon-dioxide, laser-cutting device [4]

Photonic cutting is based on wood influence of a high power light rays (10^6 … 10^9 W/cm^2) [4] which heated the material up to temperatures of evaporation.

Photonic processing possibility is determined by the thermodynamic properties of the material and in the first place it is determined by the thermal conductivity.

If the thermal conductivity of the material is lower, the photon processing will be better. Because wood has a lower thermal conductivity than other materials, it is suitable for photonic processing.

Generally, the industrial application of laser focus system uses the lens of a beam of light energy. Laser active medium are usually solid or gas mixtures. The most common lasers, for applications but and for manufacturing, use gas. The advantage of these is that the emitted wavelengths can be determined with precision, they are established and they remain independent of environmental conditions. These lasers use gas mixture consisting of CO_2, H_2 and He. The schematic diagram of the CO_2 laser is shown in Fig. 5. Radiation beam which emerges from the mirror is almost parallel. It can focus to a diameter of 0.1 ... 0.01 mm.

Cut surface coloring is dependent on wood species, laser power, feed rate, thickness, density of energy flow. The color is from light brown to black. At a short action, at a constant and relatively low laser energy on wood occurs a charring of the material. This results in decorative shapes.

Mainly used lasers for decoration is with CO_2 and He.

The main advantage of this method compared to other methods is that it allows finer processing in a shorter time. The main disadvantage of this principle is the currently high costs of processing. Processing costs are influenced by radiation production, cooling processed surface and machine construction. The machine construction must provide high manufacturing precision.

4 Working heads

Working ends are divided into: working heads for tools with electrical transformer, working heads for tools with electrical resistance and working heads for tools with liquefied gas.

Tools with solar radiation and tools with laser radiation do not use working heads. This is a great advantage to these devices because we do not have costs for repair and maintenance tools.

4.1 Working heads for tools with electrical transformer

Work ends for tools with electrical transformer are called ears. The ears are made from kupfer-nickel wire. The kupfer-nickel is an alloy of 80% nickel and 20% chromium. The thickness of wire used for pyrography is between 0.5 ... 1mm. [2, 3] If it uses a wire thinner than 0.5 mm, it will break easily. If it uses a wire thicker than 1mm, it does not heat up enough. The wire length is between 20 ... 80mm [3]. Wire length varies depending on the tip shape. The wire length is such that it heats to the light red only

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the folded area (Fig. 6). Several types of ears are shown in Fig. 7.

Fig. 6 - The correct ear heating

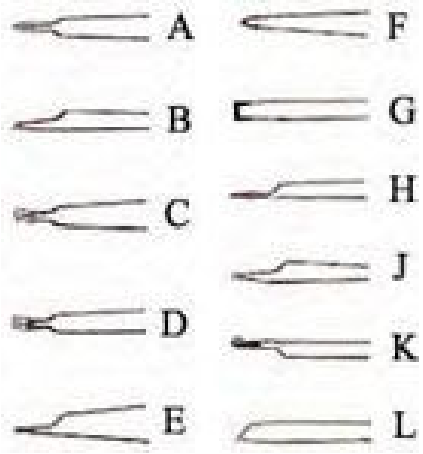

Fig. 7 - The ear shapes

4.2 Working heads for tools with electrical resistance and working heads for tools with liquefied gas

Pyrography heads for tools with electrical resistance and heads for tools with liquefied gas are made of brass. Brass is an alloy composed of copper and zinc. Brass also contains small amounts of nickel, manganese, iron, tin and lead.

Some forms of pyrography heads for tools with electrical resistance and heads for tools with liquefied gas are shown in Fig. 8.

Fig. 8 - The head shapes for tools with electrical resistance and working heads for tools with liquefied gas

5 Conclusions

Over time working methods evolved together with technological developments. Some technologies have improved; others have remained in history, their place being occupied today by other technologies. Whatever the working principle, pyrography is a always in fashion decorating method. Fig. 9 is a good example by what can it make with a heat source, a wood panel and talent. The advantages of this method of decoration are: low consumption of consumables, their artistic effects that cannot be obtained by other methods, friendly environment.

Using laser combined with the use of CNC machines ensures high productivity and high quality processing.

Fig. 9 – Pyrography on wood

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