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Assembly of Laser Engraving Machine

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A B S T R A C T

As per feasibility study need to optimized the cost of the laser cutting and engraving machine with the capacity of 5500mW, 445nm wavelength. Based on Assembly steps of working procedure simplified the laser cutting and engraving machine is to assembled. The key point was proficient that was to produce a laboratory modelled Laser cutting and engraving machine is assembled.

Keywords: Light Burn, Laser GRBL

1. Introduction

Laser engraving machines are tools that use laser beams to etch designs, text, or images onto a variety of materials such as wood, acrylic, glass, leather, and metal. They work by directing a focused beam of light onto the surface of the material, which causes it to vaporize or change colour creating the desired pattern or text. Laser engraving machines are widely used in industries like manufacturing, signage, jewellery making, and personalization, offering precision, versatility, and high-speed operation.

These machines often feature computer-controlled systems that allow for precise control over the engraving process, including adjusting power, speed, and depth of the laser beam. Additionally, they may have advanced software interfaces for designing and manipulating graphics or text before engraving. Overall, laser engraving machines offer a fast, efficient, and precise method for creating intricate designs and customizations on a wide range of materials Structure

2. Literature Review

C.Leone et [1] at 2009 has been investigated wood engraving by Switched diode pumped frequency doubled the influence by engraving panels made of different types of wood using a Q-switched diode pumped Nd:YAG green laser working with wavelength 532nm. The Ram speed and the number of laser scansions also called repetitions. The working parameter and engraved depth were

Dharmesh K, Patel & Dr. Daval.M.Patel [2] at April. 2014. "Parametric Optimization of Laser Engraving Process for different Material using Grey Relational Technique-A Review".

Sefika Kasman [3] " Impact of parameters on the process response: A Taguchi orthogonal analysis for laser engraving". Dokuz Eylul University. Izmir Vocational School. Buca. and Izmir, Turkey. Measurement 46 (2013) 2577-2584.

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S. Genne. C. Leone. V. Lopresto. L. Santo F. Trovalusci, [5] "Study of fibre laser machining of C45 steel: influence of process parameters on material removal rate and roughness". Int J Mater Form (2010) vol. 3 suppl 1: 115-1118.

J. Qi et [6] at 2003 has been investigated a study on the laser marking process of stainless steel using a Q- switched Nd : YAG laser was used in this process. The influence of laser beam on the mark depth width and mark contrast have been studied in this paper. The mark contrast is the ratio o the apparent brightness between the mark. An optical microscope scanning electron microscope and surface profile instrument were used to measure the effect of pulse frequency on the mark depth and width. An image analysis analysis system with frame grabber card and charged couple device was used to measure mark contrast. It has been ensure the mark depth width mark contrast on influence by the pulse frequency. There is maximum mark depth when almost frequency increasing, evaporation of material becomes less and at the same time oxidization become more significant which leads to improvement of mark contrast. The highest mark contrast obtained when pulse frequency of laser was about 8 KHz.

3. Assembly Specification

- Laser Source: This is the core component that emits the laser beam. It can be a CO2, fiber, or diode laser, depending on the application and material being engraved.
- Motion Control System: It includes motors, rails, and controllers to move the laser head precisely over the workpiece in the X, Y, and Z axes.
- Controller: This device controls the operation of the laser, including power, speed, and intensity. It interprets design files and translates them into commands for the laser and motion control system.
- Cooling System: Lasers generate heat during operation, so a cooling system, typically involving water or air, is necessary to maintain optimal operating temperature.
- Ventilation: Since laser engraving produces fumes and particles, a ventilation system is needed to remove them from the work area to ensure safety and quality.
- Safety Features: These include enclosures, interlocks, and emergency stop buttons to protect users from laser radiation and moving parts.
- Software: Design software is required to create or import designs and convert them into formats readable by the engraving machine.
- Power Supply: Provides electrical power to all components of the system.
- Workpiece Fixturing: Different methods are used to hold the workpiece securely in place during engraving, such as clamps, jigs, or vacuum tables.

4. Objective

The objective of a laser engraving machine is to provide a precise, versatile, and efficient tool for etching designs, patterns, text, or graphics onto various materials with high accuracy and repeatability.

5. Description of components

Laser Module

- Laser modules used in engraving machines can vary widely depending on factors such as power output, wavelength, beam quality, and intended applications
- The working temperature range of the machine is $-5^0C – 50^0C$.
- Low Power Laser(1-5mW) Medium power Laser(5-50mW): High power laser (500 mW several Watts or more).
- Length: 100-150 mm
- Tool: Wood Board, Paperboard, Black Acrylic, Leather, Food, Stainless Steel, Power Coated metal, Etc.
- Engraving Speed: 0-10,000MM/Min
- Operating Temp: -200C-500C
- Diameter: 100-130 mm
- Engrave Area: X400mm*Y400m*Z50
- Laser type: LU2-4 laser module*1
- Max engraving speed: 10000mm/min
- Wavelength: 445+5nm
- Input Voltage: 110V-220V
- Power adapter output: 24V/2V
- Laser power: 4500-5000mw.
- Max luminous power: 5500mw
- Focal length: 30mm

Mainboard

The mainboard of the Laser engraving machine is the central component that controls the operation of the laser engraving machine. It typically includes the necessary hardware and firmware to manage tasks such as motor control, laser power modulation, and communication with a computer or other control interface.

24v 2amps Controller Wiring Connection

The controller wiring of a laser engraving machine typically involves connecting various components such as the laser module, stepper motors, limit switches, power supply, and control board. Each machine may have a slightly different setup depending on its design and components.

X-Axis Assembly

- **Linear Rail or Guide System**: This is a precision rail or guide along which the laser head moves horizontally. It ensures smooth and accurate motion.
- **Stepper Motor:** The stepper motor is responsible for driving the movement of the X-axis. It converts electrical pulses into precise rotational motion.
- **Belt or Screw Mechanism**: This mechanism transfers the rotational motion of the stepper motor into linear motion along the X-axis. It could be a timing belt and pulley system or a lead screw setup.
- **Laser Head Mounting Bracket**: This is the component that holds the laser head securely in place while allowing it to move along the X-axis.
- **Bearings**: Bearings are used to support and guide the movement of the X-axis assembly along the linear rail or guide system, ensuring smooth and precise motion.

Timing Belts

Timing belts are commonly used in laser engraving machines to transmit motion from the stepper motor to the X-axis assembly, Y-axis assembly, or other components requiring linear motion.

Stepper Motors

Stepper motors are commonly used in laser engraving machines for precise control of movement along the X, Y, and sometimes Z axes. They provide accurate positioning by rotating in discrete steps, allowing for intricate designs and precise engraving patterns. These motors are essential for controlling the movement of the laser head across the material being engraved, ensuring high-quality results

a b c

d e f

Fig 1- (a) Laser Module, (b) Mainboard, (c) 24v 2amps Controller Wiring Connection, (d) XAxis Assemly, (e) Timing Belt, (f) Steeper Motor

6. Assembly

a

b

c

d

e

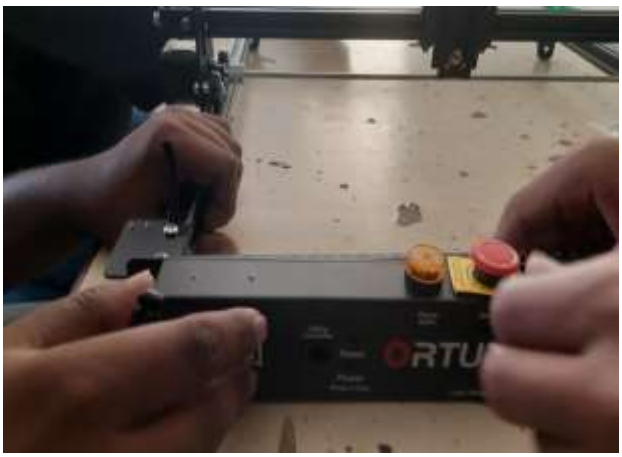

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Fig 2- (a) Assembly of Laser Frame, (b) Assembly of X-axis Assembly, (c) Assembly of Timing belts , (d) Assembly of Stepper Motors, (e) Assembly of Mainboard (f) final Assemble of Laser engraving machines

7. Conclusions

As per feasibility study optimised the cost of the laser cutting and engraving machine with the capacity of 5500mW, 445nm wavelength. Based on Literature review and Assembly steps of working procedure simplified the laser cutting and engraving machine. The key point was proficient that was to produce a laboratory modelled Laser cutting and engraving machine is assembled. The result seems for the better quality cutting and engraving

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