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Fabrication of Smart Pantograph Engraver

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ABSTRACT

The Pantograph Engraving Machine is designed to cut wood, plastics, and mild steel plates into any shape with the appropriate accuracy and precision. Pantograph machines consist of traditional cutting equipment and a pantograph, which is a mechanical linkage connected in a parallel manner and is further used to copy and scale complex line drawings. The pantograph engraving machine works on the basis of a four-bar mechanism, in which one link is fixed while the rest pivots. These other links move according to the movement of the tracing link. Overall, this apparatus is highly valuable and low cost. To create the Pantograph engraving machine, a CAD model was designed using commercially available components together with CAD packages like AutoCAD and CREO. All components have been carefully fabricated. If the fabricated components are not precise and accurate, the performance of the machine will suffer, resulting in a poor surface finish. At university of technology and applied sciences (UTAS), nizwa, this project will be useful for the final year project students to engrave the name plate and display boards for their final year projects. This engraving work can be extended to consultancy work for the outside industry. Apart from engraving, this project can be useful for training the students to do welding operation during their workshop, classes. This will enhance their welding skill and make the students as professional welder.

Key words: Pantograph, Engraving applications

INTRODUCTION

Pantographs are geometrical instruments used in drawing offices to reproduce geometrical figures or areas of any shape on an enlarged or reduced scale. It can also guide cutting tools. It is a mechanism that can reproduce the displacement of a reciprocating engine's cross-head, giving the displacement position in effect. Art and craft are greatly enhanced by the use of pantographs, which are simple yet powerful tools. An image can be copied to a reduced or enlarged scale with a pantograph depending on how the parts are measured and assembled. The pantograph creates the finished copy of your image based on how close its pivot points are. That is the 'algorithm' the pantograph uses. Pantographs make copies of originals such as those shown in the illustration. A copy that is smaller than the original can be obtained by flipping the pencil and stylus.

PROBLEM STATEMENT

Traditional engraving systems are cumbersome and are hard to switch from one location to another. This sort of system has massive workspace, excessive weight, and suitable manoeuvrability; it's miles maximum essential in area of timber or metallic engraving. Here, we designed a pantograph for engraving letters on timber which has a smooth managing, portable, low cost, and occasional weight as evaluate with conventional engraving machining.

OBJECTIVES

Our assignment subject matter is titled as “Design, improvement and evaluation the portable pantograph for engraving letters on acrylic or wood.” For layout and fabricate an engraving system we use pantograph mechanism. The engraving device hooked up on the pantograph must tour the equal course given with the aid of using stylus as an input. Stylus

will hint the form of already current item. Using such sort of manipulator, we will generate the de-scaled reproduction of the item or we will say it to be a copying system which may be hired in mass manufacturing with not pricey manufacturing.

So we will enlist the goals of our assignment such as-

1) Design an engraving system with the aid of using the use of pantograph mechanism.
2) For engraving system the use of diverse scaling component for descaling purpose.
3) Machine must be compact in length and mild weight.
4) Total fee for manufacturing of an engraving system stays low.
5) Machine must be smooth for managing for unskilled workers.
6) Engraving system must be portable.

LITERATURE REIVEW

Barpateet al (2016) "Design, improvement and evaluation the transportable pantograph for engraving letters on wood." For layout and fabricate an engraving gadget we use pantograph mechanism. The engraving device set up at the pantograph should journey the identical direction given through stylus as an input. Stylus will hint the form of already current object. Using such sort of manipulator, we will generate the descaled reproduction of the object or we will say it to be copying gadget which may be hired in mass manufacturing with affordable manufacturing, version of pantograph engraving gadget is having low weight, transportable and clean to take care of for unskilled individuals additionally than different complex engraving machines.

Iliescu, (2011) "Study on Holograms Laser Engraving Process" Holograms and holography grow to be increasingly more vital for these days' life, particularly due to their function in protection and protection. Some studies effects on holograms laser engraving procedure parameters are evidenced through this paper. Application of holography and holograms may be very wide, covering: protection and product authentication, packaging - purchaser items brand protection, artwork and interactive graphics, etc.

Wendland, (1901) Deep engraving of metals for the automobile zone the usage of excessive average electricity diode pumped stable nation lasers" This creator investigates deep engraving of metal and aluminium through laser. Material elimination costs of up to twenty mm3/min for metal and forty mm^3/min for aluminium are verified as much as a most engraved intensity of 1mm. The cloth elimination costs achieved, that are ninety mm^3/min for aluminium alloy and 25 mm^3/min for stainless metal, are very appealing for industrial applications.

Singh et al (2014) From the literature assessment it is located that for floor roughness the maximum considerable parameters are pace, feed and nostril radius and least considerable parameter is DOC and for MRR the maximum considerable parameters are DOC, feed and pace and least considerable parameter is nostril radius. In this paper studied the exclusive methods for the machining parameters with the best usage of those parameters. Now in recent times those parameters play a very crucial function for the machining and applied in the industries. In this study, the contrast between exclusive coolants impact to the milling of AISI 304 chrome steel is done. Studied a neural network modelling technique for the prediction of floor roughness in CNC face milling. Taguchi layout of experiments approach is used and MATLAB version 5.3.0.10183 (R11) application become used to create, train and take a look at the ANNs.

Barpateet al (2016) "Design, improvement and evaluation the transportable pantograph for engraving letters on wood." For layout and fabricate an engraving system we use pantograph mechanism. The engraving device installed at the pantograph should tour the equal direction given with the aid of using stylus as an input. Stylus will hint the form of already present item. Using such type of manipulator, we are able to generate the descaled reproduction of the item or we are able to say it to be copying system which may be hired in mass manufacturing with low-priced manufacturing, version of pantograph engraving system is having low weight, transportable and clean to address for unskilled humans additionally than different complex engraving machines. We designed such mechanism for engraving system that's safe; therefore, there are no troubles in production too

PHASES OF WORK

This project is planned to execute in the following 8 phases:

Phase 1: Design the product with solid works drawing.
Phase 2: Material selection
Phase 3: Marking and cutting material for pair of upper and lower arms
Phase 4: Gear cutting for arms
Phase 5: ACME threads cutting, nut and pivot joint metal member machining
Phase 6: Fabrication of base plate and top holding member
Phase7: Assembly and test trail
Phase 8: Finishing and painting

WORKING PRINCIPLE

The objective of this project is to build a smart pantograph engraver. Through the parallelogram principle, a pantograph enables one pen to trace an image, while another traces an identical image through a mechanical linkage. The first point on a line drawing will trace a duplicate, enlarged, or miniaturized copy of the first point. A pantograph can be used for other types of duplication, including sculpture, minting, engraving, and milling. A pantograph can be considered to be a rhombic pattern. It is formed by compressing or stretching like an accordion. The pantograph is a mechanism used to operate electric locomotives and trams that consists of an arm mounted on the rails. Other examples include extension arms for mirrors mounted on walls, temporary fences, and scissor lifts. Pantograph is one of the examples of a four-bar mechanism. The manipulator is based on a parallelogram linkage mechanism and translates along with horizontal directions and z-axis motion *i.e.* vertical movement is provided by effective stylus length. At the end-effector, a palm router installed with a milling cutter is mounted. A de-scaled profile can be traversed using the stylus, as opposed to conventional milling machines. A prototype is made-up to perform milling operation on any contour.

PRODUCT DESIGN AND SOLID WORKS DRAWING

The project is work on principle of mechanical movement with help of the handle rotation. The base of the project consists of two bottom base support attached with vertical support. The arms are attached on the vertical support to make the upper pantograph engraver movable. Using connection pieces that weld in the arms to make it more.

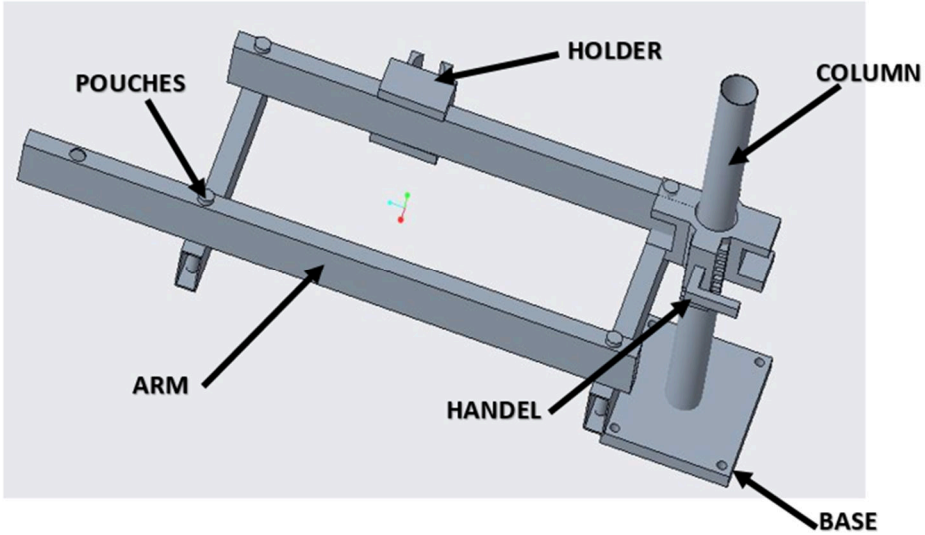

Fig. 1 Pantograph Assembly drawing

MATERIAL SELECTION

A careful study was made in selection of various materials and the selected materials and their manufacturing details are given below:

Table -1 Brief Summary of material details

S. No.	Component name	Quantity
1	Box pipe 40*80mm	2 m
2	Iron rood 38mm	1.5 m
3	Iron rood 22mm	1 m
4	Iron sheet 12mm	1*1 m
5	Engraver device	1
6	Rack with gear	1
7	Pouches	8
8	Connecting bolt	4

Table -2 Brief Summary of material details

S. No.	Component name	Manufactured/ purchased	Specification details	Remarks
1	Base plate	Manufactured	1 Plate 250 x 300 x 10mm	
2	Bolt &Nut	Purchased	Assembling parts	
3	Crank	Manufactured		Installation between motor and coupler
4	Front plate assembly	Manufactured		Installation between wheel and connecting rod
5	Connecting rod	Manufactured	$\emptyset 25 \times 35\ mm$	Transmission of movement
6	Gear	Manufactured	Gear Assembly	-
7	Coupler	Manufactured		Transfer power
8	Support block-1	Manufactured	70 x 150 x 10 mm	To support gear assembly
9	Gear block base	Manufactured	200 x 70 x10 mm	

COMPONENTS AND ITS FUNCTION

The following are the components of the project:

Base plate: Is a M.S plate of square or flat shape and is on the bottom to hold all parts.
Pouches: Made of M.S that used to connect the parts.
Handle: Made of M.S plate that movement the part up and down.
Column rod: Made of M.S plate to support full part in base plate.
Box pipe: Made of M.S box pipe to support the graving machine.
Connection pieces: Made of M.S plate to adjust the box pipe together.

STEPS INVOLVED IN FABRICATION PARTS

Base plate:

Step 1- Bring two M.S plate with a thickness of 12 mm and marking five circles with a radius of 18mm for four holes in each corner and 35 mm for one hole in centre.
Step 2- Cut the M.S plate with a band saw.
Step 3- connect the two plate together by wilding.
Step 4- to make the small hole, fixing the plate in the vertical drilling machine.
Step 5- To make the big hole, doing same step 4.
Step 6- cut the wilding and clean the plate.

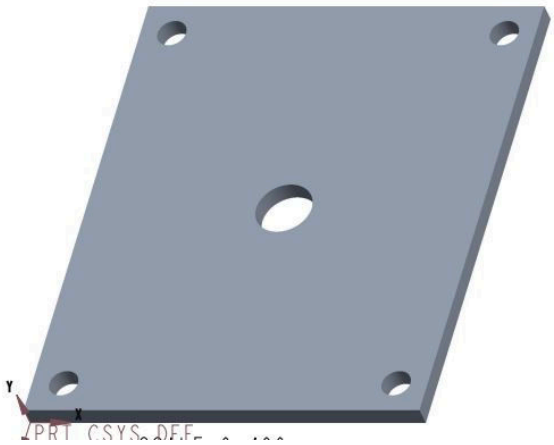

Fig. 2 Base Plate

Pouches:

Step 1- To make the pouches we need the M.S rod with 20 mm.
Step 2- Fix the rod in lathe Machin.
Step 3- Start do facing and centring in rod.
Step 4- then, do turning and step turning.
Step 5- After that, make the hole by using small bit until 18mm bit.
Step 6- Perform the chamfer for the head.
Step7- Continue the same steps for 8 pieces.

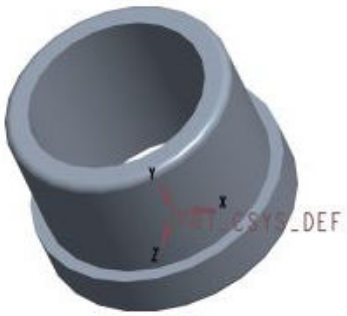

Fig. 3 Pouches

Handle

Step 1 – Bring M.S rod 18mm and cutting.
Step 2 – Then, fixing in lathe Machin and do facing, turning and step turning.
Step 3 – Perform the grinding and cleaning.
Step-4- Last step, fixing the gear in the handle.

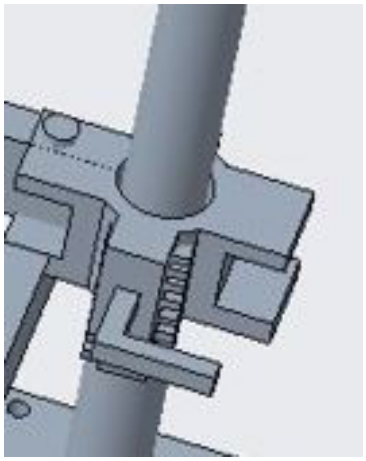

Fig. 4 Handle

Column rod

Step 1 – Cut the M.S rod of diameter 38mm
Step 2 – facing, turning and step turning as per the drawing.
Step 3 – Grinding cleaning surface.

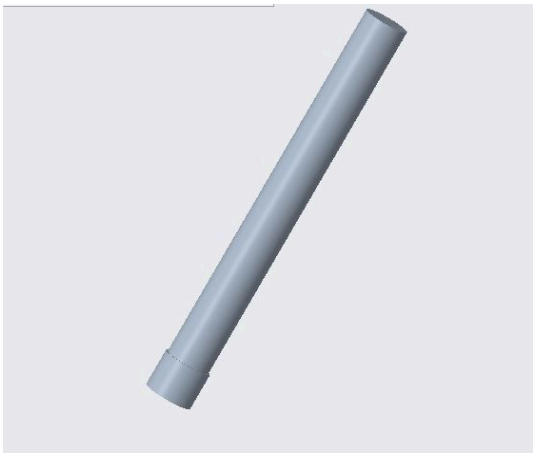

Fig. 5 Column

Box pipe

Step 1- Select M.S box pipe 40*80mm.
Step 2- Cut the four piece two 500mm, 250mm 400mm lengths
Step 3- Mark the hole by using punch.
Step 4- Start making hole in two side for all box pipe with 18 mm.
Step 5- Clean all box from sharp pieces.

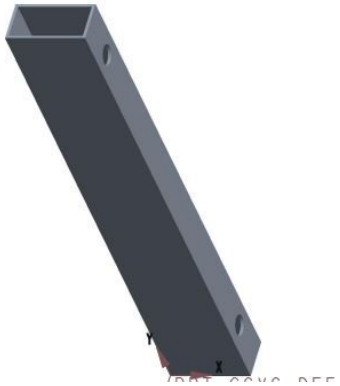

Fig. 6 Box Pipe

Connection pieces

Step 1 – Select M.S plate with 6mm thickens.
Step 2 – Use band saw Machine to cutting 8 pieces with size 39*90mm
Step 3 – Then start mark the hole.
Step 4 – Make hole with 18mm in all pieces.
Step 5 – Last step, do cleaning for all pieces.

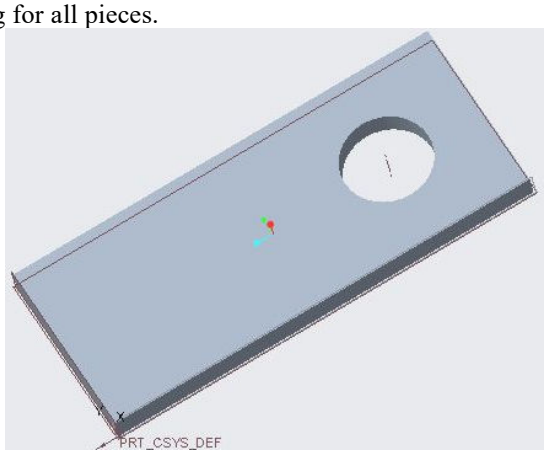

Fig. 7

ASSEMBLY AND TESTING

After careful machining of individual parts, the parts are assembled with the help of various joining process including temporary and permanent types.

Fig. 8 Assembled Pantograph with the engraved parts

Benefits

1. At UTAS Nizwa, this project will be useful for the final year project students to engrave the name plate and display boards for their final year projects.
2. This engraving work can be extended to consultancy work for the outside industry.
3. Apart from engraving, this project can be useful for training the students to do welding operation during their workshop, classes. This will enhance their welding skill and make the students as professional welder.

CONCLUSION

In this project work, "Fabrication of Smart Pantograph Engraver" was done by using various machining process such as welding, drilling, chamfering, grinding. Despite it being an old mechanism, pantographs still have many beneficial uses in the present day. Pantograph is a parallelogram linkage used to engrave material and is also used for other purposes. Pantograph is a parallelogram linkage used for engrave material on wood. In addition to having low weight and portability, this engraving machine is also easy to handle for untrained operators, unlike other complicated engraving machines. We developed a mechanism for engraving machines that is safe, so it is easy to manufacture.

REFERENCES

[1]. Barpate N., Thakur S., Kshetre P., Wankhede P., (2016) "Design and development of a Portable Pantograph for Engraving Letters" dInternational Journal for Scientific Research & Development. Vol. 4, Issue 01, 2321-0613.

[2]. Deshmukh B., Pardehi S. and Mishra P. (2012), "Conceptual Design of a Compliant Pantograph International." Journal of Emerging Technology and Advanced Engineering, Vol. 2, Issue 8, 2250-2455.

[3]. Singh M., Verma S., Dr. Jain S. (2014), "Different materials on Cnc." International Journal of Emerging Research in Management and Technology. Vol.3, Issue 8, 2278-9359.

[4]. W endland J., (1901), "Deep engraving of metals for the automotive sector using high average power diode pumped solid state lasers." Application of Laser and Electro Optics. Vol. 3, Issue 4, 2277-9655.

[5]. Diaci J., Gorkic D., Mozina J., (2011) "Rapid and flexible laser marking and engraving of tilted and curved surfaces." University of Ljubljana Faculty of Mechanical Engineering. Vol. 49, p.195–199.

[6]. Illiescu M., (2011), "Study on Holograms Laser Engraving Process." Politechnica University of Bucharest. Vol. 43, Issue 4, 303-311.

[7]. Glass J., (1951) "Mechanism for simultaneously presenting a pattern to a tracer and a piece of material to be work upon to a tool." Patent No. 2,718 ,702.

[8]. Zwick K., (1932) "Pantograph Engraving and Copying Machine." Patent No. 2,067,962.