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PANTOGRAPH ENGRAVING MACHINE - A REVIEW

[1]TRIPATHIUTKARSH, [2]LIHAZSHAIKH, [3]TABISHUDDINSAIYED, [4]SANDEEPGIRI, [5]MAYANKDEV SINGH

[1]Student, Mechanical Engineering Department, Sigma Institute Of Engineering, Vadodara, Gujarat, India.
[2]Head Of Department, Mechanical Engineering Department, Sigma Institute Of Engineering, Vadodara, Gujarat, India.
E-mail: [1]utkarshtripathi43@yahoo.com, [2]shaikh.lihaz@gmail.com, [3]saiyedtabish4@gmail.com, [4]Giris6720@gmail.com, [5]mayank.mh.engg@sigma.ac.in

Abstract - This project 'Pantograph Engraving Machine (PEM)' is designed and is used mainly to cut wood, plastics, mild steel plates in to any shapes with desired accuracy and correctness. The Pantograph machine consists of the traditional cutting equipment along with a pantograph which is a mechanical linkage connected in a manner based on parallel orgasm and which is further used for copying and scaling line drawings and complex images. The working principle of pantograph engraving machine is based on four bar mechanism in which one link is fixed and other links are pivoted. These other links move according to the movement of the tracing link. This is a low cost and high valuable apparatus. In this project, a model of the Pantograph engraving machine will be designed using CAD packages like AutoCAD, pro- e etc. taking into consideration of the commercially available components. Care has been taken in the fabrication of components. The lack of accuracy and precision in fabricated components would lead to a diminished performance of the machine resulting into a poor surface finish.

Keywords - Pantograph, Engraving Machine, Linkage, Four Bar Mechanism.

I. INTRODUCTION

Engraving is the machining process of using rotary cutters to remove material from a work piece advancing (or feeding) in a direction at an angle with the axis of the tool. It covers a wide variety of different operations and machines, on scales from small individual parts to large, heavy-duty engraving operations. It is one of the most commonly used processes in industry and machine shops today for machining parts to precise sizes and shapes. The pantograph is one of the most fascinating pieces of engineering equipment ever invented and in some form or other it should be part of every engineering shop's equipment. Engraving lettering in two dimensions is just one of its functions, more sophisticated versions work in three dimensions and will copy complicated three dimensional designs and• engineered components, enlarging or reducing them in size as required. A pantograph is a simple yet powerful tool which can broaden the scope of artwork and crafting. We can enlarge or reduce images with a pantograph depending on how the parts are measured and assembled. The pantograph does the image resize calculating for us by using the distances between its pivot points as the "algorithm" for creating your finished copy. The pantograph in the illustration would produce a copy smaller than the original. By changing the distances between the pivot points you can change the percentage of enlargement your pantograph provides.

By using spirograph and pantograph mechanism together we are able to get complex shapes on wood and marble, such a complex shapes which are useful for decoration purpose. spirograph is a mechanism in which kind of gear arrangement is used which gives perfect shapes with high precision and accuracy in our objective is to get the such shapes so we are using this combination of mechanism as a part of our project. Tracing element can trace the shapes as per spirogragh and pen element give the same shapes on the other hand of the pantograph machine.

As a Engraving machine
A pantograph is used for a engraving which include the removal of the surface matter by using proper tool in order to obtain desirable shape of on the surface.

As a Milling Machine
Milling is the machining process of using rotary cutters which is attached with pantograph to remove material from a workpiece by advancing (or feeding) in a direction at an angle with the axis of the tool.

As a cutting machine
In order to cut the workpiece in proper shape with the straight motion of the tool which is connected with the pantograph linkages.

II. LITERATURE REVIEW

Glass et al (1951)[1], the invention relates to reproducing devices or copying devices and particularly to pantographs other like. An object of the present invention is to provide pantograph for use with a heavy-duty metal-working or wood-working machine such as a milling machine.

Zwicket al (1932)[2], his invention relates to engraving and copying machine of type in which a pantograph system is used, a cutting tool and tracing point or stylus being mounted on the pantograph system. An object of the invention is to provide a generally improved and more satisfactory machine of this character, and particularly one in which heavy

cutting may be accomplished with little or no exertion on the part of the operator, irrespective of the direction of the cut.

More et al (2016)[3]In engineering many process is required and different parts require different processes. But the properties of materials and other things change with the processes. Project is a mission of creating something new, which is innovative i.e. manufacturing of new product. This machine uses a high speed cutter that can be fed up or down to give depth of cut whereas the x-y axes table is given motion using a pantograph mechanism that copy or scale the template or shape that is to be produced on the job, this is an accurate method so also the first job will be same as the last job.

Wallace, (1821)[4]invented the eidograph to improve upon the practical utility of the pantograph. The eidograph relocates the fixed point to the centre of the parallelogram and uses a narrow parallelogram to provide improved mechanical advantages.

Benton et al(1884)[5]American typeface designer Linn Boyd Benton created the Benton Pantograph, an engraving machine capable not only of scaling font design patterns to a variety of sizes, but also condensing, extending and slanting the design. Mathematically, the pantograph works in affine transformation which is the fundamental geometric operation of most systems of digital typography today, including PostScript. Aesthetically the machine was incapable of replacing the punchcutter's intuitive balancing of line weights, counterpaces and proportion as the type was scaled. He has also invented a pantographic punch cutter, a router-like engraving machine for cutting the steel punches for type. That was the most important technical development in typography since Gutenberg's invention of variable-width type moulds in the 15th century." "The machine age in the form of the pantograph and mechanical typesetting was beating against the door of hand-work.By the 1920's the whole process of type manufacture had been taken into mass production, and carried out under factory conditions.

Feynman(1959)[6] used the analogy of a pantograph as a way of scaling down tools to the nanometer scale in his talk There's Plenty of Room at the Bottom. Numerous trade-show displays use 3-dimensional pantograph mechanisms to support backdrops for exhibit booths. The framework expands in 2 directions (vertical and horizontal) from a bundle of connected rods into a self-supporting structure on which a fabric backdrop is hung.

Cheverton et al (1836)[7]Cheverton'smachine was fitted with a rotating cutting bit to carve reduced versions of well-known sculptures. Of course a three-dimensional pantograph can also be used to enlarge sculpture by interchanging the position of the model and the copy.Another version is still very much in use to reduce the size of large relief designs for coins down to the required size of the coin.

Leone et al (2009)[8]"Wood engraving by Q-switched diode-pumped frequency-doubled Nd:YAG green laser" Laser deep engraving is one of the most promising technologies to be used in wood carver operations. The aim of this work is to investigate the influence of the process parameters on the material removal rates by engraving panels made of different types of wood using a Q-switched diode-pumped Nd:YAG green laser working with a wavelength λ = 532 nm. In this work, the features and the performances given by a 5W of nominal power Q-switched diode-pumped frequency-doubled Nd:YAG green laser in the engraving of different kind of woods are discussed and the main conclusions are the following:

- The surface carbonization depends on an incorrect selection of the process parameters and, for the adopted laser, it happens at beam speeds of up to 10mm/s.
- For speed more than 40mm/s, the engraved depth is very low and multiple laser scanning are required to obtain deep engraving. The engraved depth is strongly affected by the mean power, the pulse frequency, the beam speed and the number of repetitions.
- Increasing the speed is possible to obtaining engraving with a reduced frequency range around the value where the maximum output power is achieved. The maximum speed necessary to obtain engraving linearly depends on the mean power.

Iliescu, (2011)[9]"Study on Holograms Laser Engraving Process" Holograms and holography become more and more important for nowadays life, specially because of their role in security and protection. Some research results on holograms laser engraving process parameters are evidenced by this paper. Application of holography and holograms is very wide, covering: security and product authentication, packaging - consumer goods brand protection, art and interactive graphics, etc. This paper is a study on hologram marks, more specifically, on hologram laser engraving process parameters. In order to obtain high resolution engraving results low speed, high frequency and small pulse duration of the laser beam should be used.

Diaci et al (2011)[10] "Rapid and flexible laser marking and engraving of tilted and curved surfaces" Author present a novel method for rapid and flexible laser marking and engraving of tilted, curved and freeform work-piece surfaces. A low power CW laser regime is used to measure the 3D shape of a work-

piece surface while a high-peak power- pulsed laser regime is used for processing. This paper discusses key issues concerning an implementation of the method and presents typical examples of markings and engravings. A novel method is presented that allows rapid and flexible laser marking and engraving of tilted, curved and freeform work- piece surfaces. The measurement phase takes typically less than 10 seconds.

Wendland, (1901)[11] Deep engraving of metals for the automotive sector using high average power diode pumped solid state lasers" This author investigates deep engraving of steel and aluminium by laser.Material removal rates of up to 20 mm3/min for steel and 40 mm3/min for aluminium are demonstrated up to a maximum engraved depth of 1mm. The material removal rates achieved, which are 90 mm3/min for aluminium alloy and 25 mm3/min for stainless steel, are very attractive for industrial applications. This paper show that it is possible to achieve good contrast which is needed for barcode marking on bare metals.

Singh et al (2014)[12]From the literature review it is found that for surface roughness the most significant parameters are speed, feed and nose radius and least significant parameter is DOC and for MRR the most significant parameters are DOC, feed and speed and least significant parameter is nose radius.In this paper studied the different approaches for the machining parameters with the optimum utilization of these parameters. Now these days these parametersplay a very vital role for the machining and utilized in the industries. In this study, the comparison between different coolants effect to the milling of AISI 304 stainless steel is done. Studied a neural network modelling approach for the prediction of surface roughness in CNC face milling. Taguchi design of experiments method is used and MATLAB version 5.3.0.10183 (R11) program was used to create, train and test the ANNs.

Deshmukh et al (2012)[13]The compliant joints which when used with the PZT can give the sub micron resolution as the Compliant Systems are free from backlash;inaccuracies at the joints can be overcome/ improved. The problems of lubrications are automatically solved due to one piece construction. There is a need of miniature components in the development of Microfactories and compliant mechanisms can give an alternative for the existing position systems. For linear positioning systems, Pantograph can be used as the kinematic chain and Pseudo Rigid Body Model (PRBM) approach [4, 7] needs to be used. Researchers have carried out analysis of the mechanisms using FEM, ANSYS and ADAMS software. These software's are capable of static and dynamic analysis of the flexure based mechanism. ANSYS Workbench module is capable of determining the fatigue life also. The simulation can provide the data regarding the deformation and stress analysis at the critical zones. Different fabrication methods for compliant mechanisms are discussed however the non conventional machining process viz, Laser machining or EDM need to be explored.

Barpateet al (2016)[14]"Design, development and analysis the portable pantograph for engraving letters on wood." For design and fabricate an engraving machine we use pantograph mechanism. The engraving tool mounted on the pantograph should travel the same path given by stylus as an input. Stylus will trace the shape of already existing object. Using such kind of manipulator we can generate the descaled replica of the object or we can say it to be acopying machine which can be employed in mass production with economical production, model of pantograph engraving machine is having low weight,portable and easy to handle for unskilled persons also than other complicated engraving machines. We designed such mechanism for engraving machine which is safe; hence there are no problems in manufacturing too.

III. WORKING MECHANISM

Pantograph is a linkage constituting of five link connected with pin joints to form revolute pairs. It is connected in a manner based on parallelograms so that the movement of one point, in tracing an image, produces identical movements by second point. A pantograph is used to reproduce to an enlarged or a reduced scale and as exactly as possible the path described by a given point. If a line drawing is traced by the first point, an identical, enlarged, or miniaturized copy will be drawn by a pen fixed to the other. One of the revolute pair is fixed into the base, so that we can move this mechanism with respect to fixed point. Because of their effectiveness at translating motion in a controlled fashion, pantographs have come to be used as a type of motion guide for objects large and small. The point which traces the profile can be in any form e.g. Simple pin having conical point, rod having a bearing mounted at its end. And the point which gives the output can be in forms like router, pen, drilling machine etc. The pantograph is made up of five links. One end is hinged and at the other end is the stylus which we will be moving manually. The link will work in only X & Y direction and Z axis will be restricted. As the stylus willbe moved the tool will also follow the same path. The scaling factor will be responsible for the change in size of the engraved profile.

Model

The physical model consist of four links namely link A, link B, link C and link D. The links are connected with pins as shown in fig.3. The motor is mounted on

link C at the center. It is adjustable for which sliding slots are provided on link C. The motor has specification as follow: Voltage-220V, Frequency–50Hz, Power–300W, RPM– 2600. On link D, at the end point, Stylus is provided with curved bottom to ease the movement on the surface. The whole setup is clamped on a table. The stylus can only be used in 2D as one dimension is restricted. The engraving tool bit used is of 4 mm diameter. The experiments are performed on soft wood. Letters are engraved on wood with good finish and accurately.

Figure 1: A Portable Pantograph.

Application

1) This machine can be used almost in all types of industries. (Large, small, medium scale industries).
2) This machine is mainly used in fabrication oriented industries.
3) The material can be removed at any shape like oval, rectangular, ellipse, square, circular, pentagon, hexagon shapes etc.
4) This machine is used to guide the cutting tools.
5) This machine is used for reproduction of maps and plans on enlarged or reduced scale.
6) A modified pantograph is used to collect the electric power at the top of an electric locomotive (e.g. electric train)

Advantage of Pantograph

1) Setting of machine is easy.
2) It reduces the fatigue of the worker.
3) Skilled labor is not required.
4) Labor cost is less.
5) Production cost decreases.
6) Machine looks compact in size, so it can be carried from one place to another place.
7) The process is most economical.

CONCLUSION

Pantograph may be old mechanism, but still in present days it has many beneficial uses and many other advantages. Pantograph is parallelogram linkage which is used in our paper engraving purpose on material like wood, steel, plastic etc. Our model of pantograph engraving machine is having low weight, portable and easy to handle for unskilled persons also than other complicated engraving machines. We designed such mechanism for engraving machine which is safe; hence there are no problems in manufacturing too.It works with accuracy.It has a highly effective working mechanism.Hence the letters are traced successfully without any difficulty.

REFERENCES

[1] 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.
[2] Zwick K., (1932) "Pantograph Engraving And Copying Machine." Patent No. 2,067,962.
[3] More A., Tapkeer S., Gaikwad s., (2016). "X-Y Axis Profile Cutting Machine 2D Profile Cutting Machine." Vol.4, Issue 1, p. 454-456.
[4] Wallance W., (1821)"Transactions of the Royal Society of Edinburgh. - Edinburgh" Transactions. Vol.13, Issue 637, p.418–439.
[5] Benton L., (1884), "The Inland Printer" Linn Boyd Bentons – The Man and His Work. Vol.70, Issue No. 1, p. 60-64.
[6] Feyman R., (1959), " There's Plenty Of Room"
[7] Journal of Microelectromechanical Systems. Vol.23, Issue 5, p.22-36.
[8] Cheverton B., (1836), " machine for versions of well known sculpture."
[9] Leone C., Lopresto V., Iorio I., (2009) "Wood engraving by Q-switched diode-pumped frequency-doubled Nd:YAG green laser." Department of Materials and Production Engineering. University of Naples Federico II, P.leTecchio 80-80125 Naples, Italy. Vol. 47, Issue 1, p.161-168.
[10] Illiescu M., (2011), "Study on Holograms Laser Engraving Process." Politechnica University of Bucharest. Vol.43, Issue 4, p.303-311.
[11] 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.
[12] Wendland 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, p.2277-9655.
[13] 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, p.2278-9359.
[14] 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, p.2250-2455.
[15] 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, p.2321-0613.

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