A Review of Different Mechanism Adaptable On Profile Cutting Machine

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Abstract— This paper discuss of literature review of Profile cutting machine. Without profile cutting, getting the right shape out of the metal could be difficult and time consuming. Profile cutting machine helps to make it easier, especially when making a batch or mass production work. As well as speeding the process, the cut is highly accurate and easy to carry out. In today's cut throat competition manufacturers and designers are forced to constantly design novel manufacturing strategies for reducing production time and cost. In this paper authors intends to gather the information of mechanisms employed in Profile cutting systems to cut desired shape.

Keywords- Profile cutting machine, manufacturing strategy, mechanisms, desired shape, production machine.

I. INTRODUCTION

The development of manufacturing systems and CAD/CAM systems are evolving to the phase of integrated manufacturing systems, which is oriented towards the need of the hour. Keeping it as center stone of all economic activities and ensuring that manufacturing remains competitive and upto date with the fast pace changing complex industrial systems. Optimization of manufacturing activities for reducing resources, time and cost is one of the greatest targets of the system. Since it has been believed that only those manufacturing systems are capable of effective manufacturing which would withstand the changes in job to be machined and that too least time is required for arranging these machines for machining various jobs. A CNC (Computer Numerical Controlled) machine is controlled by actuators by using programs done on computers. Various works have been done to import the CAD data for co-ordinates of the profile to be cut into the CNC machines. The approach is to achieve least human intervention required to program them to achieve the profile to be cut. There are various X-Y positioning table and various changes have been done so far to make it economical. Various innovative mechanisms have been proposed by the researchers to achieve highly accurate precision.

II. LITERATURE REVIEW

In reference [1], author proposed a mechanism and its design to crush a stone, i.e; stone crusher which reduces the size of stone up to 2.5cm*2.5cm. Two mechanism crank & lever mechanism and rack & sector gear mechanism are utilized for kinematic synthesis of stone crusher. Both static and dynamic force analysis are done graphically for the mechanism in this paper.

In reference [2], author replaced conventional lead screw to a ball screw used as a mechanical linear actuator that translates rotational motion to linear motion with little friction to convert conventional cutting machine to automated CNC gas profile cutting machine.

In reference [3], author had used Ultra low power microcontroller of MSP430 is used to design X-Y plotter using belt drive mechanism and timing pulley for plotting to achieve the x-y motion. In this paper, ultra low power microcontroller of MSP430 is used which consumes only 3.5v as input. Moreover, in several plotter design manufacturers use Pulse Width Modulation based driver circuit which has in-built timer circuit in it which makes the user easy. But, when the user tries to modify the timer, they feel difficult to modify as they wish. So, author feels it is better to use separate timer circuit which is available in microcontroller.

In reference [4], author proposed a mechanism for sheet metal cutting operation in which metal sheet hold by X-Y movement table, movement of sheet is controlled by microcontroller with the help of nut lead screw and stepper motor according to profile co-ordinates feed manually to the microcontroller.

In reference [5], a new window based application software was devised which takes a standard CAD file .DXF as input and converts it into numerical data required for the controller. It uses VB6 as a front end whereas MS-ACCESS and AutoCAD as back end. The coordinates of drawing is extracted and send in the form of specific command to embedded system which controls the stepper motor to achieve the desired movement. Gantry type arrangement is made to provide X and Y motion by stepper motor & gas cutting torch is attached to Y arm .

In reference [6], in this research author investigated the suitability of PC-based CNC pipe cutting machine by simulation control of two axes.

In reference [7], in this research design and implementation of bi directional DC motor speed and position control system by using microcontroller to achieve the desired speed & desired angle in X-Y position on work piece. Pulse width modulation technique (PWM) is used which is generated using micro controller.

In reference [8], this research proposed the design and analysis of 2-DOF flexure mechanism for the Nano positioning to have minimum cross axis motion. Improved compliances mechanism is used to have minimum parasitic motion and higher band width.

In reference [9], This paper represents how to work on profile cutting machine by using PLC technique. PLC system has been designed to program with particular shape and size, the cutting machine runs according to programming of PLC and cuts the profile with perfection.

In reference [10], in this paper Adaptive Robust Control (ARC) is applied to make resulting closed loop system robust to model uncertainties, instead of disturbance observer (DOB). Compared to DOB, the proposed ARC has a better tracking performance & transient in presence of discontinuous disturbances such as coulomb friction and it is of lower order.

In reference [11], in this research for very accurate positioning of mechanical devices such as surgical tools, assembly robot, micro mechanism etc. a proposed controller applies narrow torque to move a mechanism to move a desired position. The pulse shape generated by the controller is computed using a fuzzy logic approximation of the dependence between the desired displacement & the torque pulse shape.

In reference [12], As the oxygen pressure goes up, the diameter of the stream increases comparatively faster than the increase in oxygen flow. This increases the width of cut and provides less oxygen to oxidize the steel which results in loss of quality. Smaller nozzles can be used to cut heavier thickness with dramatic reductions in speed with comparatively good quality.

In reference [13], to fulfill the demand for micro-components in biomedical, opto-mechatronics, and automotive applications this thesis work proposes an innovative X-Y positioning table. The design arrangement is for minimal moment loads and measurement errors with the use of air bearings. And have discussed about various errors such as Linear Positional Error, Straightness Error, Angular Error, Dynamic Error, Servo Error and Thermal Error. Hence, the overall emphasis of this work was to propose ultra-precision machine tool.

In reference [14] Output of belt drive to the eccentric shaft, is connected to the slider which allows to reciprocate the single point tool in the guide ways. This tool reciprocates in only vertical direction (Z). The metal sheet hold by X-Y movement table sheet holder, movement of sheet is controlled by microcontroller with the help of nut-lead screw and stepper motor according to the profile coordinates feed manually to the microcontroller.

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In reference [15], this paper presents the development of a low-cost controller for the 3-axis CNC plasma cutting machine. The developed controller is capable of digitally-controlling the mechanical motion of the three (3) axes (X, Y and Z) and the plasma generator. For the tool path generation and post-processing, TAP extension file format was used.

In reference [16], this paper presents the position control algorithm for a belt driven servo mechanism of the laser cutting machine is described for XY table. High-accuracy position tracking control procedure for system with inherent elasticity due to the low-cost belt-driven servomechanism is derived based on continuous sliding mode technique. The proposed robust position tracking control algorithm was tested by simulations and used in the industrial application of a motion controller for the CNC machine.

In reference [17], this paper too uses X-Y table but the objective is to design and develop a laser cutting machine which is portable and economical. The machine is designed to be highly precise, compact and easy to operate. Laserbot serves as a substitute for uneconomic Laser Cutters available in the market and is intended to expand the use of laser cutting technology by making it affordable to common man. Laserbot is a low cost machine capable of positioning the laser module in three axes, using 1 W 450 nm Laser Diode, achieving planar positioning and actuating the laser up and down vertically.

In reference [18], a means of developing a basic postprocessor to interface a CAD/CAM package with a numerically controlled machine tool is given. The examples cited show the effectiveness and flexibility of the approach.

In reference [19], 2-D drafting systems are defined. The implementation of primary functions, editing functions and important utilities for a practical 2-D drafting system are discussed and illustrated in pseudo-code. Such systems can be developed with facility entirely in a high-level language with programming environments available today.

In reference [20], it is pointed out that with today's software tools, it is well worth the effort to develop one's own programming station software rather than to depend on expensive or unsuitable alternatives. Features necessary for programming stations are discussed and their implementation is illustrated in a PASCAL-like pseudo-

code. Programming station software developed on the principles outlined is described, and its use is discussed.

In reference [21], a Lorentz force-based XY positioning stage with a stack of four electromagnetic linear motors in parallel configuration is presented. The overall design of the positioning stage consists of a mobile and a fixed part separated using a four point contact technique.

In reference [22], the design and analysis of 2-DOF flexure mechanism for a nanopositioning stage is presented. Improved compliance mechanism is used to have minimum parasitic motion and higher bandwidth, unlike the lumped-compliance mechanism circular hinge is used only on the drive end of the mechanism.

In reference [23], an XY table is used to position the laser focusing head to automate the welding process for laser spot welding. A program has been developed to control the XY table. The performance of the XY table for linear and circular interpolation was analyzed. A user interface was also developed to read Computer Aided Design (CAD) data file and transform it into XY movement.

CONCLUSION

From the above discussion we found that most of the researchers had attempted for achieving profile cutting machine with XY positioning table utilizing customized programs according to the profile. Few have attempted to modify this XY positioning table by replacing conventional lead screw to a ball screw to reduce friction. And, others have tried by using belt drive mechanism and timing pulley with Ultra low power microcontroller. Another researcher has tried with the arrangement for minimal moment loads and measurement errors with the use of air bearings.

To ease the process and to reduce the human intervention for feeding co-ordinates of the profile an application software was devised which takes a standard CAD file .DXF as input and converts it into numerical data required for the controller. An attempt with Improved compliances mechanism for the Nano positioning to have minimum cross axis motion to be used for minimum parasitic motion and higher band width had been proposed.

Works on profile cutting machine by using PLC technique and Adaptive Robust Control (ARC) is also proposed. It has been attempted to achieve a profile cutting machine to be highly precise, compact and easy to operate. For achieving higher accuracy fuzzy logic approximation and Lorentz force-based XY positioning stage with a stack of four electromagnetic linear motors in parallel configuration has been tried. But rare attempt has been done for the improvement of manual profile cutting machine.

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