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METHODOLOGY OF SPECIAL PURPOSE SHEET METAL CUTTING MACHINE

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Abstract: Special purpose machines are not available off the shelf. These machines are designed and made as per the customer's specific requirements. It is designed for getting higher efficiency and economy in desired condition. The recent developments in digital technology, have now enabled us to make low cost machines for real time applications. The aim of this paper is to present the concept of special purpose mild steel sheet cutting machine using single point cutting tool and easily available low cost microcontrollers.

Keywords: Special Purpose, Mild steel sheet, Micro-controller, Single point tool.

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INTRODUCTION

Special Purpose Machines (SPM) are wide uses in modern era of manufacturing. SPM are designed in such a way that they will easily perform the desired operations. SPM minimizes the operation time, human fatigue due to repetitive operation, product cost; it also increases the productivity and assures the quality. The recent advancement in digital systems, have now enabled us to make low cost machines. In India, traditionally, the task of metal sheet cutting is accomplished using manual or semi-machines, gas cutting machines, and shearing machines etc. During our visit to engineering works agricultural machinery manufacturing division, I have seen various processes, activities, machines which they are using for production. There are so many components which are made up of mild steel sheet by manual marking and cutting using chisel and hammer and shearing mechanism slowly, this effect the low productivity, wastage of manpower, more waiting time to next operation.

Necessity of the Sheet Cutting Into Different Profiles:

Sheet metal cutting is automatic machines like circle cutting New Changes and Cut according to marking with the help of Chisel and Hammer the primary process of all the processes. The sheet metal cutting is needed in manufacturing different shapes of parts of the thresher machine. 15-20 parts of each thresher are from sheet metal. Proper cutting provide the proper folding and close fits into the mating parts. Sheet metal cutting is so equally important like any other operation otherwise the parts cannot be in required dimensions.

Current Available Facility for Sheet

Metal Cutting: The shape and geometry of the each part body is very different than any other component. The manual cutting by chisel- hammer and manual shear machine is the only option on which the sheet metal cutting operation can perform. There are so many aspects involved in the actual operation, but currently there is no other option other than manual cutting.

Set Standard size MS Sheets

i) 914mm x 1828mm ii) 1219mm x 2438mm

Thickness 1 mm to Max 2mm



Fig2: Shearing Machine

Three Workers are engaged for cutting operation, proper coordination required in three of them, proper aligning is difficult. This process is continuous for whole year. Cutting and bending of sheet of desired shape on Power press required new dies with modified dimension for new changes in dimension. Frequently changes in dimensions due to continuous modification according to market demand and competitors, consumes cost and time. Storage problem due to Seasonal Product Market demand around 5000 machines per year. Each machine has 15-20 sheet metal parts, for fulfillment of market demand, standard components needs to be stored. Everyday new machine launch with advance sophistication needs modification in some components. For fulfillment of market demand assembly done at the time of season

MATERIALS AND METHODS

Literature review: Many works have been done to carry out the various machining operations, for that special machine, tools, fixtures are invented. Some inventor had tried to carry out the Sheet Metal Cutting operation by inventing special purpose machine for it. Merrill L. Ridgway¹, The present invention relates to mechanical presses, and is particularly concerned with a cupping press of unique and relatively simple design, A cupping press is a press in which stock, usually coil stock is blanked out and the blanked out work member is then formed, as by drawing, with both the blanking and drawing operations. Harry C. Wold², This invention relates to devices for cutting sheet metal and more particularly to the type of machine having a pair of relatively reciprocal shearing members which make successive short cuts or bites in a sheet as the latter is fed through the machine. Hans Poersch³, The invention concerns a peripheral auxiliary system for the automatic feeding and unloading of a stamping /nibbling machine. According to the invention, the gripping mechanism of the robot is also designed to remove the stamped parts, and a stacking means is provided. Joseph V. Warren⁴, The present invention relates to an apparatus for cutting metal work pieces, particularly metal plates.



Fig1: (a)Manual Marking and (b)Cutting

Marking according to standard size pattern
(Manually). Every time need new pattern

Metal cutting machines which employ a laser cutting head are known, wherein the laser cutting head is mounted on a moveable gantry, and so that the laser cutting head may be moved in a predetermined path of travel to cut a sheet metal plate or other product positioned on a table underlying the gantry. James E. Hulings⁵, A plasma cutting table includes an open frame table, a movable bridge extending across the table and a gas evacuation system. A pair of opposed plenums are positioned adjacent the table on opposite sides of the table extending along the general length of the table with each plenum forming a channel. A hopper extends across an underside of the table and is attached to the bridge to be movable relative to the table with the bridge. Thomas Haar⁶, One is often confronted with the problem of cutting blanks from panels of sheet metal, for instance, of aluminum, or other materials of different thicknesses. 'For this purpose, the panel is clamped in a feeding device and is moved between punch and die in such a manner that the latter cut a predetermined number of blanks out of the panel. For saving material it is required to obtain the largest possible number of blanks from a given panel area.

Ergonomic: Human activity analysis (RULA Analysis) on CATIA 5 R19 is done according to actual working condition load of 5Kg (Hammer) on right side and 0.25Kg(Chisel) on left side on intermittent posture parameter is applied in the software .



Fig3: Using Chisel & Hammer

It gives the final score 5 which means (In Ergonomie final score is 7 in catia which is worst indicated by red colour.



Fig4: Shear Machine Operator

Operator shown in fig 5 continuously work on shearing machine, in every two minutes he has to press the handle by load about 10 Kg for shearing the sheet. RULA Analysis gives the final score of 6 which means Investigate further and change soon. This is the reason of no new worker is retain more than a month from two years in the sheet metal department. And it is decided that to go for automation.

Checklist of Information Useful in Investigation of Solution for Sheet Metal Cutting :

- The sheet metal cutting by manually is a not profitable, so we need to develop the solution which is having economical, simple in operation and less costly.
- Properties of the materials, we have to cut and cutting tools available for cutting these materials.
- Focus on some current available facility which is helpful to make some new economical and useful solution.
- The mechanism which is suitable for the type of operation of sheet cutting.
- Selection of suitable drives for the mechanism like Belt drive, Chain drive and cam follower. Also find the advantages and disadvantages of this drives.
- Dimensional requirement and finishing requirement of sheet metal cutting operation.
- User friendly and low maintenance solution.

Construction And Working of Proposed Mechanism:

This system is used for sheet metal cutting operation. It consists of smaller pulley, V belt, larger pulley, eccentric shaft, Guide way for slider, tool holder; single point HSS tool bits, X-Y movement table, and controller.

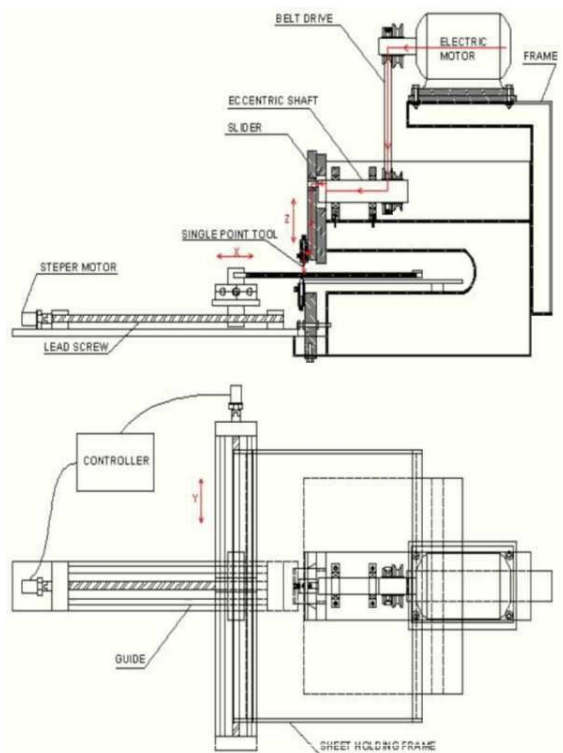


Fig5 : Single Point Tool and X-Y Movement Table

Working:

We can externally supply the power and speed from the motor to the belt drive mechanism. 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.

Belt Drive: A Belt is a looped strip of flexible material, used to mechanically link two rotating shafts they may be used as a source of motion, to efficiently transmit power, or to track relative

movement. Belts are looped over pulleys. Power transmission is achieved by specially designed belts and pulleys. Belts run smoothly and with little noise, and cushion motor and bearings against load changes, but have less strength than gears or chains.

Advantages: Cheap, Allows misalignment, Protects from overload, Absorbs noise and vibrations, Cushion load fluctuations, Little maintenance, High efficiency (90-98%).

Eccentric shaft and slider: It is often employed to convert rotary motion into linear reciprocating motion. As the speed of the rotating shaft increases, the reciprocation of the slider is also increases so the single point tool cut metal with high speed. This mechanism work as a cam and follower, eccentric shaft transfer the rotating power of motor to the tool through slider in to reciprocating motion. The eccentric shaft is supported by two bearings and slider is supported by v-guide. One sensor is provided at the slider end which senses the position of the slider and send signal to the controller which is used for movement of the X-Y motion table.

Single point cutting tool: A tool bit is a non rotary cutting tool used in lathes, planers and shapers. Such cutters are known by the name single point cutting tool .the cutting edges is ground to suit a particular machining operation and it is reshaped as needed. Normally all tool bits were made of High Speed Steel (HSS) with appropriate tempering and hardening. Other tool materials like ceramics, carbides are used but these materials are expensive.

X-Y Movement Table: Profile of desired shape is obtained by movement of the sheet in x and y direction because tool movement is in only z direction. This is achieved by nut-leads screw stepper motor and position sensor arrangement controlled by microcontroller which gets feedback, calculate the coordinate and provide the signals to stepper motor according to feed information.

Conclusion:- In this paper discussion is done about the sheet metal cutting operation and methodology. In this suggesting special purpose machines for profile cutting operation perform on the sheet metal. In existing process required more time for completion of operation of profile cutting as well as difficult to achieving to each sheet metal cutting. This problem eliminating by providing dedicated sheet metal cutting machine i.e. providing special purpose machine. Above suggesting mechanisms in facilitate to loading the sheet in short time as well as unloading, easily performing operation on metal sheet. This system also increase rate of production with accurate dimensions.

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