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Automation in Deburring Operation of Cross Piece Using Servo Slide Mechanism

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Abstract: *Automation is a step beyond Mechanisation, to increase productivity and to improve the quality. Automation involves, very minimum labour involvement in work. As per today's scenario, many Industries trying to develop.Automation on different levels of production. Hence PLC (Programmable Logic Controllers) and CNC (Computerized Numerical Control) can be used to automate the Industrial fixtures, to reduce the complexity of the process. In the following research We have developed a xyservo slide CNC based control system to simulate the automation for deburring operation and analysed it for category of high production. This automation is mainly for deburring of cross piece which is die casted.*

Keywords: *Fixture, CNC Control System, Deburring, Cross Piece, Production, SPM.*

1. INTRODUCTION

Burrs are caused by many machining process including milling, drilling, turning, casting and broaching. Edge finishing like deburring, blending during manufacturing is important because of the following reasons-Sharp edges may pose personal hazardous, since they can cause injuries to worker.Part making may be more difficult due to clearance restriction caused by burrs and to enhance part appearance. Deburring is performed at the final stage of manufacturing, where parts have their highest added value, quality control is absolute necessity. Despite this requirement, even in today's most fully automated factories it of still a common sight to see dozens of worker manually chamferedparts produced by CNC machines. Edge finishing is typically performed manually using two methods-Hand held powertools with brushes, abrasive tips, or rotary files and manual files and knives.The technique employed with these tools is not well documented and inspection of this deburred edge is not quantitatively defined, typically the worker runs the finger over the edge to inspect the work. Improving both the efficiency and quality of deburring is a major concern. Deburring is labour intensive and can represent a significant portion of the expense of manufacturing machined parts. In addition, deburring is frequently a dirty, noisy, and undesirable job and high turnover in terms of personal. Trainingpersonal is proper deburring technique is costly and this, coupled with high turnover rate adds to the overall expenses of the deburring. Variation in skill level deburring personnel causes variation in the quality of the part. Errors encountered in the deburring operation which causes the part to be scrapped are costly, as the part is near the end of its manufacturing cycle. Automatic deburring operation has been investigated for the number of years as a solution to this problem.

2. LITERATURE REVIEW

In Research paper named as "A New Approach For Tool Path Control In Robotic Deburring Operations [1]" which is published by author S. T. Bagde. From these paper we concluded that Automation of surface finishing operations such as deburring, grinding operation is an active area of investigation in the manufacturing industry. These operations constitute a significant portion of effort and money in manufacturing industry. Research towards automation has focused in many directions from integration of two operations to development of an intelligent system. Deburring is performed at the final stage of manufacturing, where parts have their highest added value, so inspection is absolute necessity. Manual inspection is error prone and highly dependence on skill labour. Automatic inspection is best choice in industries, and image processing is increasingly used today.

The Research Paper "Design of an X-Y Table for Investigating And Rehabilitating Human Motor Control[2]" made by "Donne11 Eugene Crear". The proposed research project seeks to design, build, and test a powered X-Y table capable of applying force fields for human CNS studies. The goal is to develop an

X-Y table that is capable of applying more effective force fields than existing robotic devices. Initial experiments will be conducted in order to validate that the X-Y table functions as designed and is capable of applying the desired force fields required for the investigation of the human CNS. Once the X-Y table effectiveness has been verified, the system will later be used in tests designed to validate existing kinematic and dynamic models.

Manjushree D. Sutar & Bhagyesh B. Deshmukh published a paper entitled "Linear Motion Guideways – A Recent Technology for Higher Accuracy and Precision Motion of Machine Tool[3]" is about the Guideway is one of the important elements of machine tool. The main function of the guideway is to make sure that the cutting tool or machine tool operative element moves along predetermined path. The Linear Motion Guideways provide a smooth and linear motion in machine tools, due to which higher accuracy and precision can be obtained. The paper deals with the study of Linear Motion Guideways, its structure, Advantages and Applications in various machine tools where precision is of great importance.

Rajendra Rajput &Dr. Ajay kumarSarathe did the review and published the paper on "CNC Controllers and its Related Parameter: A Review[4]". These paper state that CNC controller is the heart of the CNC machine which controls most of the functions of CNC machine. Perfect machining in minimum time is the requirement of manufacturing industries and along with other hardware and machining process parameters CNC controllers are also playing vital and an important role. Hence, in this work an attempt is being made to investigate and analysis of the various types of CNC controllers i.e. used in the CNC machines especially in milling and turning. This paper gives the detail about the three major CNC controllers used by industry. In view of above, this paper also presents a review of work in the area of the CNC controllers.

Douglas K. Lawson, patented the tool named as "Pneumatically Driven Deburring Tool Having An Articulated Air Joint[5]". Deburring tools have long been utilized in automation systems to perform repetitive tasks. These deburring tools are capable of performing a wide variety of deburring functions Such as deburring the edges of machined and cast parts. In this tool having a special arrangement of that, it can self-compensated during operation so it will not remove the core material of workpiece.

3. PROBLEM STATEMENT

The component which is shown in the picture is made by casting process and thereafter it get trimmed for removing the extra material. After trimming, burr may present as it is at edges of component shown in figure.

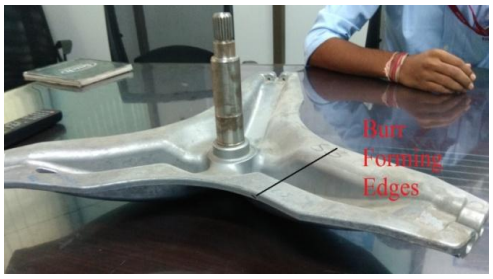

Fig 1: *Work piece showing burr forming edges*

Previously deburring of workpiece done by filing with help of man labour.This process was so time consuming and wasting of money on unskilled man labour for simple deburring operation. This problem put infront of us by problem solver of company, then after researching on it we find solutions to solve this problem. We find the solution of problem by making automation and by designing a special purpose machine for deburring of workpiece. The automation in a machine mainly done by using servo slide and controllers for controlling tool motion.

4. DESIGN OF MACHINE

In design method, firstly we understand the problem statement. Then we find various solutions to overcome the problem and how to automize the operation.

The difficult task of designing is that to follow the path of uneven profile of component then on that basis we made various conceptual rough drawings of machine.

Then we discussed the drawings with design engineers of that company and at the end we finalize the design. We made basic model of machine of rough drawings on the designing software CATIA V5.

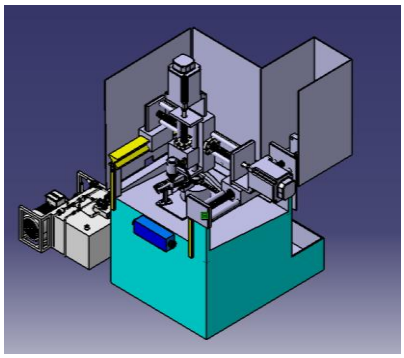

Fig 2: *Three-Dimensional View of Machine Assembly*

5. LAYOUT OF MACHINE

The layout of machine simply looks like VMC machine. In layout, the various component position shown in above fig. The main components in layout of machine are-

a) Base Table
b) Hydraulic chuck
c) Pin type arrangement for casting compensation
d) Tool Holder
e) Pneumatic deburring tool with articulated air joint
f) Ball screws (3 nos.)
g) Linear Guideway
h) Bearing &Bearing Housings (3 nos.)
i) FRL Unit
j) Various Safety Sensors
k) Servomotors (3 nos.)
l) Safety Doors
m) CNC controller
n) Control Panel

6. MECHANISM FOR AUTOMATION

Mechanism for automation of special machine consists of –

A. One ball screw with ball nut is attached to provide X-direction movement of tool. The ball screw aresupported with two supporting bars. The ball nut reciprocates about the ball screw which is driven by servomotor and also support another ball screw assembly for Y-direction movement. This ball screw assembly is on right hand side of machine.

B. On the other side, there is linear recirculating guideway which only supports the other end of Y-direction ball screw assembly. By using this mechanism there is saving in the cost of one servomotor.

C. Second ball screw assembly which gives Y-direction motion to tool movement. This assembly having same arrangement that of first one. This ball screw assembly form a bridge structure over the other ball screw assembly on its one side and linear guideway on other side.

D. For up and down movement of tool small length ball screw is used with assembly. This assembly provides Z-direction movement to tool and it runs by using servomotor attached at top. This assembly guides along Y-direction over the second ball screw assembly.

E. The main heart of machine is the tool. Tool is pneumatically driven having a special arrangement that its having articulated air joint so that it can be self- compensated incase tool removes the core material of component. The main objective of using this tool is that component die casted due to which various allowance may occur on the component. So to overcome the problem that component changes its dimension this special design tool has been used. The sketch of tool as shown below.

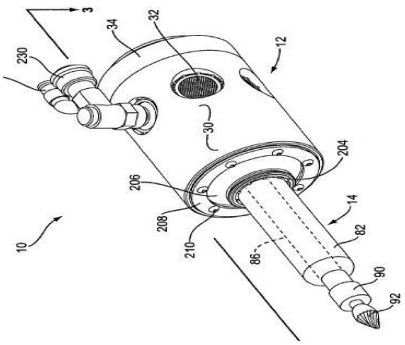

Fig 3: *Peumatic Deburring Tool With Articulated Joint*

F. All ball screw assembly has been driven by the servomotor. These servomotors are being controlled by CNC based control system. A CNC controller completes the all important link between a computer system and the mechanical components of a machine. The controller's primary task is to receive conditioned signals from a computer or indexer and interpret those signals into mechanical motion through motor output. There are several components that make up a controller and eachcomponent works in unison to produce the desired tool movement.

G. For cooling arrangement, the mist type coolant system used. Cooling must be needed for the operation because machine will continuously running so there will heating at tool end, these may result in burr material get stick tool and possibility of tool damages. In mist coolant system, coolant is injected through nozzle in spray form at contact of tool and workpiece. This system uses less amount of coolant and gives effective cooling.

7. FIXTURE

A fixture is a device for holding a work piece during machining operation. The name is derived from the fact

that a fixture is always fastened to a machine or bench in a fixed position. It does not contain special arrangements for guiding the cutting tool, as drill jigs do. In a setup using a fixture the responsibility for accuracy depends upon the operator and the construction of the machine tool.

Fixture may ensure the worker to load the component in same position for every time of loading.

Also it is used to avoid the movement of cross piece while operation because if it is only hold in chuck there may be chances of rotation of the component along its shaft and this may result in less accuracy in machining also it may damage the tool.

For fixing of workpiece we have done the pin arrangement. This pin is made tapered shape having the dimension same as slot which is on the one of section of cross piece. The 3D view of pin arrangement shown below.

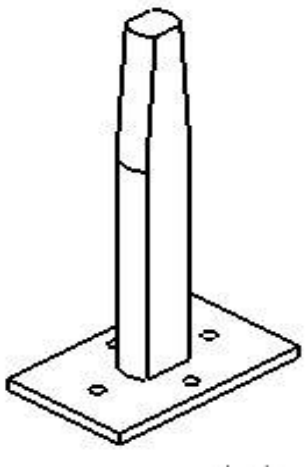

Fig 4: *Fixture- Pin Arrangement*

8. CONCLUSION

An effort is taken to design the special purpose machine for deburring of cross piece using servo slide mechanism. New concept of automation is developed with focuson specialization of operation, simultan eousoperation and increased flexibility strategies of automation.

Various two-dimensional and three dimensional geometric drawings are prepared by using CATIA V5 software.

Considerable improvement inproductivity both qualitative and quantitative isobserved with all other benefits of automation. It is

concluded that new developed special purposemachine is technically and economically justified andproven its effectiveness over conventional process.

We gained unique experience of integrating andevaluating theory and practical aspects of design and manufacturing. This helped us to extract valuableknowledge and data. We came to know the reality of ground level working on the workshop floor. We are sure

that, this valuable experience will be useful in our future in all aspects of life.

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