ISSN No:-2456-2165

Design and Fabrication of Rotary Fixture for Control Valve Cylinder Head of Tractor

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Abstract:- "To increase the production, industry decreases the production time; To decrease the production time everyone is developing new mechanism and automation". There is lot of revolution in manufacturing technology, as consequences on which several development like CNC lathe, CNC machine centre, flexible manufacturing system, fabrication centre, transfer machines, robotics etc.

Fixture plays an important role at the planning stage before shop-floor production. A desired fixture design can be used to hold the work part securely so that slippage and excessive deformation can be prevented during machining. Therefore, appropriate fixture contributes for high machining quality.This paper represent the design, development and analysis of rotary fixture for the internal drilling operation. Actually VMC is the best option for required operation but due to stationary fixture it will be not used to perform same operation in two different angles in single processing cycle. That's why we introduced new modified rotary fixture for VMC machine. The structural analysis has been carried out in ANSYS 17.0 whose result helps to examine the design.

Keywords:- *VMC machine, Rotary fixture, Structural analysis.*

I. INTRODUCTION

Our aim is to make an arrangement which will reduce the time consumed for two different operations on CNC. The machine tool industry has undergone sufficient changes as the requirement of user engineering systems changed; first it started with the manufacture of basic general purpose machine tools. These machines though Offered higher flexibility were not suitable for mass production. With growing need of fast production, mass production machines are conceived. These machines were highly specialized but inflexible. Thus great need is felt for tools that could bridge the gap between highly flexible general purpose machine tools and highly specialized, but inflexible mass production machines. Numerical control machine tools with proper fixture set up have to take up this role very well. And this has excited this research work on design and development of rotary fixture for CNC [1]. By comparing the development trend with the current situation of large equipment machining technology, it can be concluded that it has become the inevitable requirement of the times expanding. So we should upgrade the machining technical content of large-scale production as soon as possible [2]. Generally, the costs associated with fixture design and manufacture can account for 10%–20% of the total cost of a manufacturing system. Approximately 40% of rejected parts are due to dimensioning errors that are attributed to poor fixture design. Fixture design consists of a number of distinct activities: fixture planning, fixture layout design, fixture element design, tool body design, etc. They are listed in their natural sequence, although they may be developed in parallel and not necessarily as a series of isolated activities in actual execution [3]. In machining fixtures, the deformation that can happen in the work piece due to clamping and cutting forces is essential to be minimized to maintain the machining accuracy [4]. The most important and widest used within the general purpose fixture classifications are modular fixtures. As the flexible manufacturing system has been adopted by more and more manufacturers who are trying to remain competitive in this rapidly changing market by running production with short lead times and well controlled cost, modular fixtures have gained in popularity because of its performance on easy usage, versatility, and its adaptability to product changes. Modular fixtures allow a wider flexibility by making use of standard workholding devices and components. Their flexibility is derived from the large number of possible fixture configurations from the different combinations of fixture components. The application of modular fixtures contributes considerably to shortening the lead time and reducing the cost in small-volume production with versatile Products [5].

II. PROBLEM STATEMENT

The same operation is done in two angles at two different positions but for that another VMC machine is employed. Due to this production rate will be decreases, required extra loading-unloading time and also required one extra operator for other VMC. Hence we are design and fabricate the rotary fixture for the purpose of getting both angle operations in one VMC and increase production rate with less cost.

ISSN No:-2456-2165

VMC No	Loading time	Machining time	Unloading time	Total time
1. 90°	8 sec	6 min	8 sec	6min16sec
2. 21°	5.6 sec	6 min	5.6sec	6Min.12 sec

Table 1. Showing machining time analysis

III. LITERATURE REVIEW

*A. Design, Modelling & Analytical Analysis of Rotary Fixture for CNC,*N. P. Maniar, D. P. Vakharia.

This paper presents design and development of rotary fixture for machining real industrial component - Flow TEE body of petroleum refinery. Actually HMC is the best solution for performing the required operations, but HMC costs around 12.5 million rupees whereas CNC turning centre costs only about 2.5 million rupees. A fixture is designed with the help of which these operations can now be performed on CNC turning centre and hence 10 million rupees are saved in installation cost. Methodology for mass balance of rotary fixture developed by investigators mostly act as post-mortem tool; calculating unbalanced mass after fixture is manufactured. In the present work, a pre-mortem tool is developed to predict unbalanced mass well before manufacturing. The present research also proposes three other methods for mass balancing of rotary fixture using Prototype Mechanism. Analytical calculations are also covered [1].

B. Automatic indexing fixture system Karan Panchal , Ashit Patel, Jayneel Prajapati

Many industries nowadays are using automation for their production process. Automation has great advantages over manual labour but setting up an automated machine like VMC, automatic turning centre, CNC lathe is very costly. A conventional machine can be made to work as a CNC machine by changing guide way or fixture. Our aim is to make an arrangement which will reduce the time consumed in marking the centre of the hole on work piece and to prevent the requirement to make jigs. Instead of making the whole guide way automated we will develop a fixture which will automatically adjust the centre of the hole of work piece. By using this method the production rate will be increased with minimum efforts of human [7].

C. Design and Analysis of Fixture for a Bearing Plate,- Yogeshwar.M, Sri Ram Prasath.K, Santhosh Kumar.M.G, Subash.V, Jithin Velayudan

In machining fixtures, the deformation that can happen in the work piece due to clamping and cutting forces is essential to be minimized to maintain the machining accuracy. The design of fixtures plays major role in many manufacturing industries, so that it should be done with very much care. This can be achieved by selecting the optimal location of featuring elements such as locators and clamps. The fixture set up for component is done manually. For that more cycle time needed for loading and unloading the material. So, there is required to develop system which can help in improving productivity and time. Fixtures minimise operation time and increases productivity and quality of operation. [4]

D. Design and Fabrication of CNC Lathe Fixture for Square BlockVivek Khond, Vicky R. Gedekar, Himanshu S. Rewatkar, Kunal L. Parate

Manufacturing industries have brought lot of revolution in manufacturing technology, as a consequence of which several developments like CNC lathe, CNC machine centre, flexible manufacturing system, fabrication centre, transfer machines, robotics etc. took place. Even with these advancements in the manufacturing industries, there is a continued use of jigs and fixture in some form or the other either independently or in combination with other systems. [6]

E. Final Machining of Large-Scale Engine Block with Modularized Fixture an Virtual Manufacturing Technologies Hong Liu, Fan Peng , and Yi Liu

This paper indicates the problem of unstable machining quality of large-scale high-precision internal combustion engine block; the key machining technologies of complex thin-wall internal combustion engine block are studied. This dissertation takes the L type engine block that is used as research object; the modular and fast changing fixtures have been designed for machining engine blocks; due to the fact that this type of engine blocks has different number of cylinders, we made a model of precision machining scheme based on virtual manufacturing technology and manufacturing method; on this basis, the scheme is applied to the actual production process to verify the feasibility of the program. The research represent the precision machining process established based on virtual manufacturing technology can effectively solve the key machining technology of the engine block, and one purpose of using this method is to improve machining precision and efficiency of the assembly production. This study introduce final machining technology project of high-precise product, and this will

ISSN No:-2456-2165

formulate and gradually perfect a machining process framework for large engine block, which has engineering exploration value to promote machining technology. [2]

IV. DESIGN & DEVELOPMENT OF ROTARY FIXTURE

A. Material Selection

Base plate- It is an EN19 alloy steel material, circular base plate at 226mm diameter and 37 mm thickness after facing and machining operation. Two holes are provided of 13mm diameter for locator and one hole is creating for mounting and fixing the workpiece also we provide extra two holes for clamping purpose.

4.1.2 Locator pins- For clamping purpose Harden Carbon Steel bolts are used.

B. Principal of Location

The principle of location is being discussed here with the help of a most popular example which is available in any of the book covering jigs and fixtures. It is important that one should understand the problem first. Any rectangular body many have three axes along x-axis, y-axis and z-axis. It can more along any of these axes or any of its movement can be released to these three axes. At the same time the body can also rotate about these axes too. So, total degree of freedom of the body along which it can move is six. For processing the body, it is required to restrain all the degree of freedom (DOF) by arranging suitable locating points and then clamping it in a fixed and required position. The basic principle used to locate the points is desirable as follows: - Six Points Location of a Rectangular Block Considering the six degree of freedom of a rectangular block as shown in Figure 01. It is made to rest on several points on the jig body. Provide a rest to work piece on three points on the bottom x-y surface. This will stop the movement along z-axis, rotation with respect to x-axis and y-axis. Supporting it on the three points is considered as better support then one point or two points. Rest the work piece on two points of side surface (x-z); this will fix the movement of work piece along y-axis and rotation with respect to z-axis. Provide a support at one point of the adjacent surface (y-z) that will fix other remaining free movements. This principle of location of fixing points on the work piece is also named as 3-2-1 principle of fixture design as number of points selected at different faces of the work piece is 3, 2 and 1 respectively. Body to be restrained (each of the axis can be divided into two halves positive and negative)

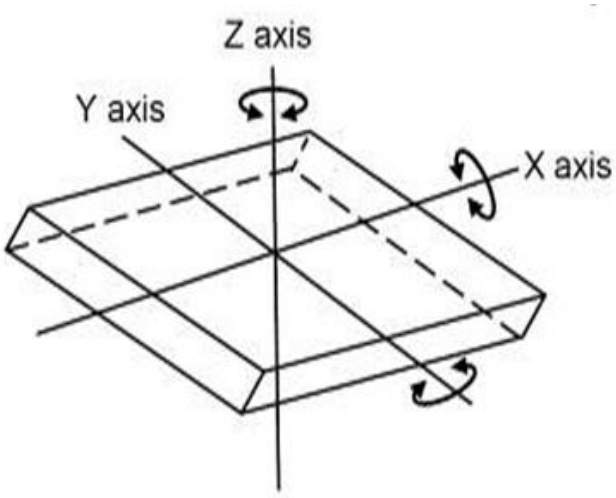

Fig 1:- Degree of Freedom of Rectangular Block

C. CAD Design of Fixture

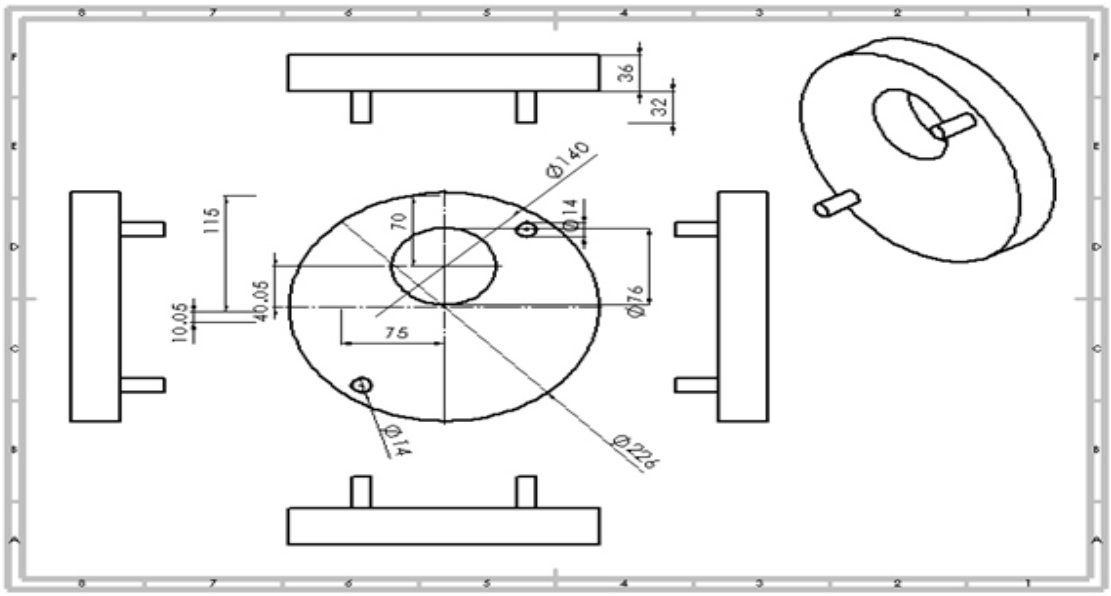

Fig 2:- *CAD Design*

D. Analysis Work

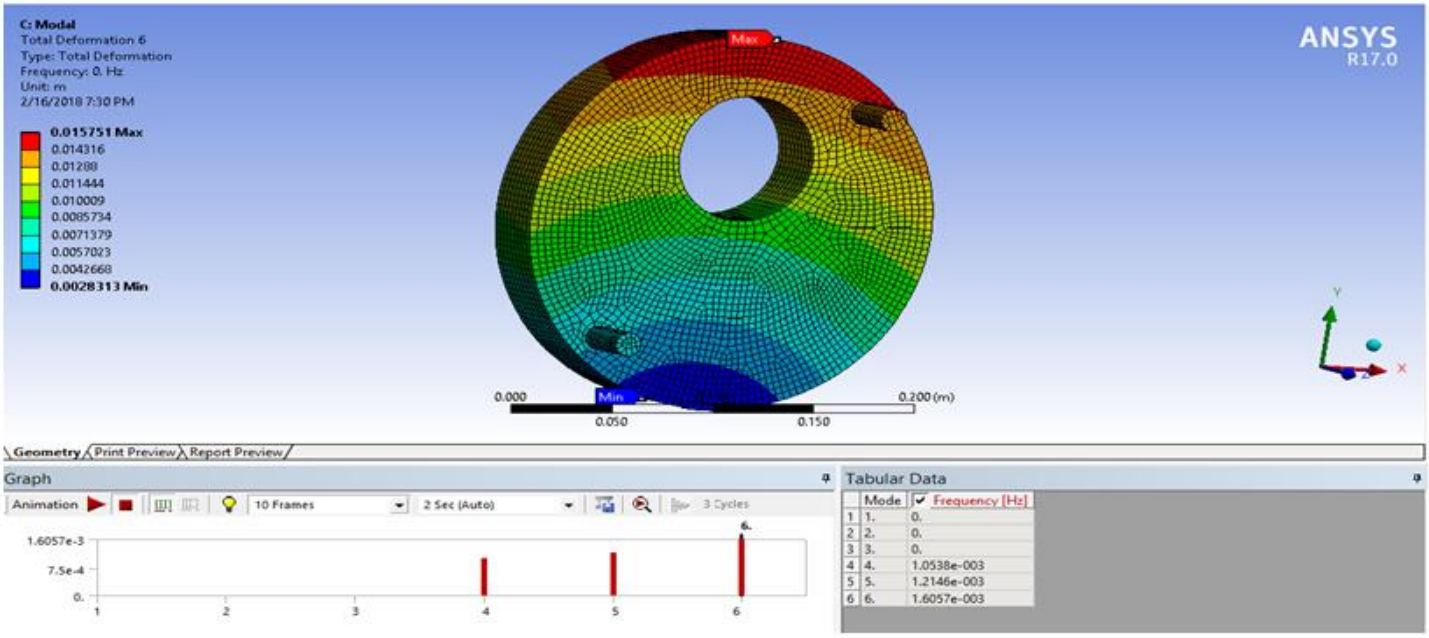

Fig 3:- Analysis Work

V. WORKING

We use the rotary table for rotate the fixture from 90^0 to 69^0 Counter clockwise (21^0) and club the operation in single Vertical Milling Centred. The Fixture is mounted on a rotary table and after that rotary table mount on CNC machine. The aim of fixture design is to maximize the production with minimum time duration. The rotary fixture is connecting with CNC control panel for the purpose of step rotation of fixture by coding.

Firstly, we mount the fixture with rotary table on the CNC machine with the help of M16 Allen bolts. After that we mount the workpiece on the cylindrical locator which is used to reduce or eliminate the space between base plate and workpiece, resulting in reduced vibration of base plate and increasing the fixture life for smooth operation. Once the work part fix with the fixture after that operation on work part will be start. Firstly all operation done at an angle of 90 after that due to the coding of rotary table the fixture rotate automatically and done operation at an angle 21(CCW). After machining two hexagonal nuts are loosen with the help of spanner then finished workpiece is easily removed. The same cycle is repeated for same work. For the single cycle 9-10 mins are required including clamping of workpiece, processing of operations, and de-clamping of workpiece after machining is completed. In this way, the total working of fixture is done.

VI. RESULT

In the previous method total time for operation at an angle of 90&21(anti) is 12min 28 sec and workpiece moving one machine to another machine is required 1min. Hence after the using rotary fixture the following result is getting and moving time also remove.

VMC	Loading time	Machining time	Unloading time	Total time
90^o & 21^o	8 sec	12min	6sec	12min 14 sec

Table 2. Result after Modification of fixture

VII. CONCLUSION

From this project, we have learned how to detect the problems in industry and how to minimize this problem. We have learnt about how to design a Fixture and the problem created during manufacturing and resolved it. In the present day life the cost of the CNC is very high so due to the small modification most of the cost is reduce and also reduce the time consumption in operation. During the purchasing of raw material, we know more information about the market. Getting a practical knowledge about the various operations like

milling, tapping, drilling, and welding which used in manufacturing. Understanding more knowledge about CNC machine and CNC programming, saving money of industry by giving them new idea about the fixture.

Fig 4:- Actual Fixture With Workpiece

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