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Hydraulic Operated Fixture for VMC Machining

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***Abstract* - Fixtures play an important role within many manufacturing processes. They accurately locate and secure a work piece during machining such that the part can be manufactured to design specifications. Thus fixtures have a direct effect upon machining quality, productivity, and the cost of products. This report represents design and development of hydraulic fixture for real industrial component. The components are ALUMINIUM BRONZE CASTING PRODUCTS which are used in the electric machinery. The operations to be performed on castings are drilling, reaming & tapping on VMC (vertical machining center). The aim of this project is to design & develop a hydraulic fixture to save time for loading and unloading of component. The evaluated fixture uses hydraulic link clamp cylinder for holding the work piece driven by hydraulic power pack. Thus the fixture achieves automatic and simultaneous clamping of work pieces.**

Keywords: Hydraulic, Fixture, VMC Machining, vertical machining center.

I. INTRODUCTION

Over the past century, manufacturing has made considerable progress. New machine tools, high-performance cutting tools, and modern manufacturing processes enable today's industries to make parts faster and better than ever before. Although work holding methods have also advanced considerably, the basic principles of clamping and locating are still the same. Mass production methods demand a fast and easy method of positioning work for accurate operations on it. Fixtures are production tools used to accurately manufacture duplicate and interchangeable parts. Fixtures are specially designed so that large numbers of components can be machined identically, and to ensure interchangeability of components.

A fixture is a device for locating, holding and supporting a work piece during a manufacturing operation. It is a production tool that locates, holds, and supports the work securely so the required machining operations can be performed. Fixtures must correctly locate a work piece in a given orientation with respect to a cutting tool or measuring device, or with respect to another component, as for instance in assembly or welding. Such location must be invariant in the sense that the devices must clamp and secure the work piece in that location for the particular processing operation.

Fixtures are normally designed for a definite operation to process a specific work piece and are designed and manufactured individually. Jigs are similar to fixtures, but they not only locate and hold the part but also guide the cutting tools in drilling and boring operations. A fixture should be securely fastened to the table of the machine upon which the work is done.

II. LITERATURE SURVEY

Review Paper on Design Strategies for Manufacturing Fixtures as per Machine Operations Supriya A. Patil Dr. S. S. Goilkar Volume 2, Issue 3 Asian Journal of Convergence in Technology Issn No.:2350-1146, I.F-2.71.

To make the standard machine tool, more versatile to work as specialized machine tools, the use of special production tools, jigs and fixtures is necessary. They are normally used in large scale production by semiskilled operators; however they are also used in small scale production by when inter changeability is important various areas related to design of Fixture has been studied and described by various authors. Those ideas and techniques should be summarized and needs to be applied practically in industries. The content gives the thorough idea of Fixture design process. This strategy can be used for further designing of fixture for any one. Also there are various alternatives which allow us to alter the design for best results.

Kiran Valandi, M. Vijaykumar, Kishore Kumar S, Development, Fabrication and Analysis of Fixture, International journal of science technology management and research; 2014, Vol.3, Issue 4.

A fixture is designed, built to hold, support and locate every component to ensure that each is drilled or machined with accuracy and manufactured individually. A fixture can be designed for the particular job using production tools which make the standard machine tool more versatile to work as specialized machine tools. They are normally used in small scale production by semi-skilled operators. This dissertation work aims at designing a fixture used for performing machining operations at certain angle (102.5 degree) on the Crank case used in commercial vehicles The design of the fixture is simple, the loading and unloading of component is

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very easy. At a time, all the operations such as milling, boring, drilling, tapping can be done in a single set up which in turn decreases the handling.

Sridharakeshava K B, Ramesh Babu. K, "An Advanced Treatise on Jigs and Fixture Design" International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181Vol. 2 Issue 8, August – 2013.

Jigs and fixtures are special production tools which make the standard machine tool, more versatile to work as specialized machine tools. Even with the advancement of manufacturing industries, there is a continued use of jigs and fixture either in some form or other, either independently or combination with other systems. This paper addresses the jigs and fixture design verification issue. In this paper, the work piece location, clamping stability under dynamic machining and frictional conditions at the interface between jigs and fixture elements and work piece are taken into account.

Shailesh S Pachbhai and Laukik P Raut, "Design and development of Hydraulic Fixture for machining Hydraulic lift Housing", International Journal of Mechanical Engineering and Robotic Research ISSN 2278 – 0149Vol. 3, No. 3, July, 2014.

In machining fixtures, minimizing work piece deformation due to clamping and cutting forces is essential to maintain the machining accuracy. The recent trends in industry are towards adopting the hydraulic techniques, because it saves time generates accuracy and it is having some flexibility. Hydraulic Fixture is major application in the field of designing, where in several software's are available for the purpose of design. The proposed fixture will not only provide the repeatability and high productivity, but also offers a solution, which reduces work piece distortion due to clamping and machining forces. All the values of deformation and von misses stress calculated with ANSYS software is comparatively lower than standard values and hence, we can conclude that design is safe. As per calculations, the proposed fixtures have a direct impact on product quality, productivity and cost.

N. P. Maniar, D. P. Vakharia," Design & Development of Fixture for CNC –Reviews, Practices & Future Directions" International Journal of Scientific & Engineering Research Volume 4, Issue 2, February-2013 ISSN 2229-5518.

Various areas related to design of fixture are already been very well described by various renowned authors. This section reviews some of the developments in fixture design and proposes directions for future research initiatives. Fixtures have a direct impact upon product manufacturing quality, productivity and cost, so much attention has already been paid to the research of computer aided fixture design (CAFD) and many achievements in this field have been reported. Many academic and applications papers have been published in this area. But still Fixture design needs to be tested and evaluated in real manufacturing environments and integrated with other design activities, which often are related with production resources, equipment, cost and machining processes, etc. Another important research is on the integration of various techniques directly used in computer aided fixture design. As we know, an optimal fixture solution is a hybrid result of many different considerations, such as tolerance configuration, stiffness configuration, machining process, etc. Hence attention should be paid on the establishment of a systematic way of integrating various techniques, such as Computer Aided Mass Balancing Method (CAMBM) and FEA methods for work piece-fixture system.

S.D.V.V.S.B.Reddy, P.Satish Reddy, V. Subrahmanyam, "Design And Analysis Of Machining (Hydraulic) Fixture For AVTEC Transmission Case Component" International Journal of Science Engineering and Advance Technology IJSEAT, Vol 2, Issue 7, July - 2014 ISSN 2321-6905.

These instructions give you basic guidelines for preparing papers for conference proceedings. Fixture is a work holding device used in the manufacturing industry. Fixture's primary purpose is to create a secure mounting point for a work piece, allowing for support during operation and increased accuracy, precision, reliability, and interchange ability in the finished parts. This paper present design of hydraulic fixture for engine side. This component is a part of three wheeler auto. The operation to be performed is & finishes milling of flange, drilling, reaming & spot facing on VMC. The evaluated fixture uses hydraulic swing clamp, hydraulic cylinders, and hydraulic work support for holding the work piece driven by hydraulic power pack. Thus the new fixture achieves automatic and simultaneous clamping of parts.

III. PROBLEM STATEMENT

The current manufacturing system relies on human clamping of fixtures to keep the work piece in place while machining operations are performed on the part, resulting in a high rejection rate. Due to the high volume of these activities performed each day, the operator may become quite exhausted, which will decrease his productivity. Additionally, the amount of time spent on this activity has a significant impact on what is produced.

These issues can be solved by automating fixture performance. In any type of activities carried out on the work component, providing the appropriate work holding platform is a crucial concern. In this approach, automation has been crucial in developing a quick and dependable clamping system that can shorten clamping cycles while improving precision, reducing the risk of damage to workpiece.

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IV. METHODOLOGY

The "Hydraulic Operated Fixture for VMC Machining" project was created to suit the machining industry's needs for ease of operation, dependability, quality, flexibility, efficiency, and speed. Today, every manufacturing sector aims to reduce manufacturing time and resources.

They have been looking for several types of customized production systems for this aim. One way to efficiently provide this demand is through fixtures. Fixtures are a type of special purpose tool used to make manufacturing (machining, assembling, and inspection activities) easier when work piece are to be provided on large scale.

Fixtures establish a relationship between the work and the cutting tool with predetermined tolerances, enabling the production of interchangeable components. Any number of duplicate components may be manufactured easily and without further setup once a fixture has been properly set up.

V. SYSTEM DESIGN

The components of a fixture are as follows:

Locators: Locators are tools that help people find a work-piece's exact location and orientation.
Clamps: Clamps apply clamping forces to the work-piece, causing it to be firmly forced against locators.
Supports: Supports are either fixed or movable parts of a fixture.
Fixture Body: A fixture's main structural component is the fixture body.
Design of Fixture:

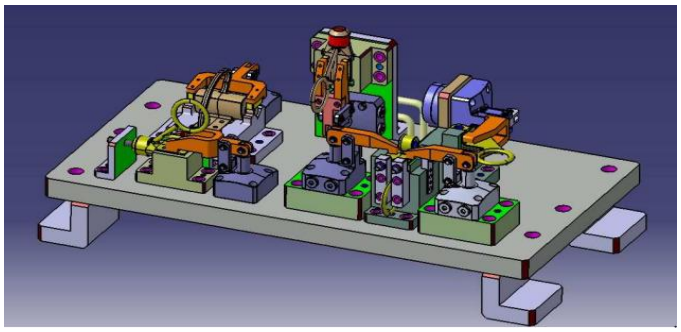

Figure 1: Design of Fixture

VI. MATERIAL SELECTION

A) For Main Fixture Blocks

Material Used: EN31

EN31 is an extremely high strength steel alloy including nickel, chromium, and molybdenum, which results in high tensile steel strength and wear resistance. EN31 is also applicable to a wide range of applications. A good compromise between ductility, strength, and wear resistance is provided by EN31. Commonly used for bearings, balls, ejector pins, taps, guages, dies, etc.

Composition Table as Below:

Sr. No	Composition	Weight Percentage (%)
1	Silicon Oxide (SiO)	0.25
2	Chromium (Cr)	1.46
3	Carbon (C)	1.08
4	Sulphur (S)	0.015
5	Phosphorous (P)	0.022
6	Nickel (Ni)	0.33
7	Molybdenum (Mo)	0.06
8	Manganese (Mn)	0.53
9	Iron (FE)	Rest

B) For Rest of the Components

Sr. No	Composition	Weight Percentage (%)
1	Silicon (Si)	0.20
2	Carbon (C)	0.17
3	Phosphorous (P)	0.16
4	Manganese (Mn)	0.54
5	Iron (FE)	98.7

VII. PROJECT ASSEMBLY

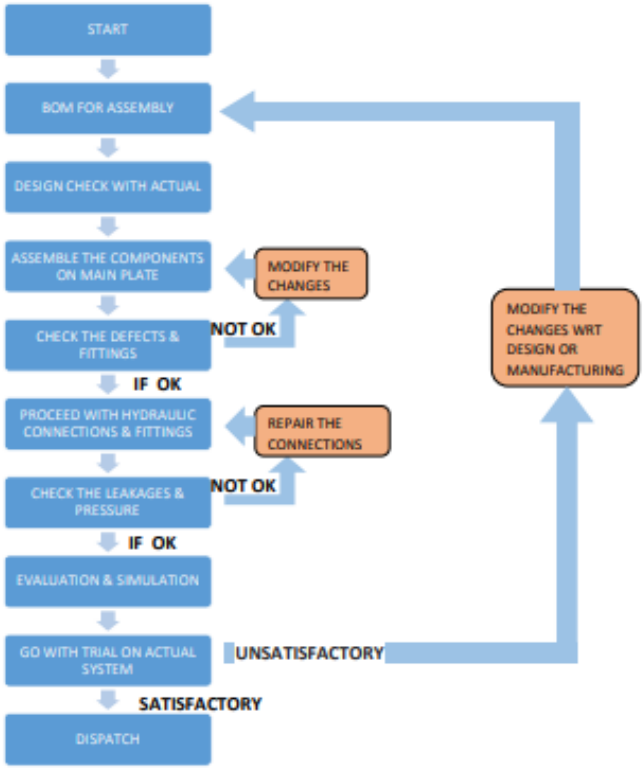

Figure 2: Project Assembly Flowchart

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VIII. CONCLUSION

The proposed fixture will not only provide repeatability and high productivity, but it will also give a solution that eliminates work piece distortion caused by clamping and machining forces. The implementation of this project eliminates the requirement for a human operator to clamp manifolds. The cycle time is shortened. It offers a sustainable economic design. Additionally, guarantees precise and effective clamping of pieces. The proposed strategy facilitates the development of advanced, exact, dependable, safe, and accurate production procedures. The clamping systems are made to withstand the significant retention forces that are delivered to the work piece during machining processes.

Manifold production is insufficient in industries when manual fixtures are used. Therefore, a hydraulic fixture is a smart choice to boost manifold production.

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