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A Review on Design and Manufacturing of Hydraulic Fixture for VMC-640

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Abstract

The automotive industry has been experiencing a competitive environment and striving hard to find methods to reduce manufacturing cost, waste and improve quality. The ultimate goal is to speed up the process there by increasing productivity with quality through a proper utilization of man and machine.

The problems is by using SPM or Conventional machines to manufacture connecting rod it takes more effort and time consuming process, also less accurate assembly of connecting rod sub-assembly. By replacing Special Purpose Machine with Vertical Machining Centers it gives proper assembly of connecting rod at joint face with reducing operation and production time of connection rod without disturbing its quality or rather to say with a better quality.

Keywords- *Fixture Design, Machining Operation, Cycle Time, Hydraulic fixture, VMC-640*

I. INTRODUCTION

The connecting rod as we know it today, operating inside the cylinder of an internal combustion engine, was first used in 1860, when the French inventor, Etienne Lenoir, built a small, single-cylinder, internal-combustion engine. In 2008, an estimated 62.5 million automobiles will be manufactured globally. Assuming an average of 5 cylinders per engine, this is 312.7 million connecting rods manufactured for the automotive industry alone. These connecting rods will be manufactured by a variety of manufacturing processes and a variety of materials. Figure 1 presents schematic illustrations of a connecting rod and its location and function in an engine. [1] Connecting rods that function in internal combustion engines are subjected to high cyclic loads comprised of dynamic tensile and compressive loads. They must be capable of transmitting axial tension and compression loads, as well as sustain bending stresses caused by the thrust and pull on the piston and by the centrifugal force of the rotating crankshaft.

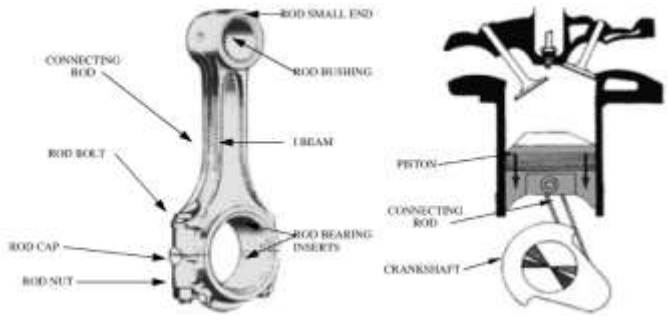

Figure 1. Schematic illustrations of a connecting rod [1]

Table 1. Separate machining on rod and cap

Machines	Process with operations	Rod	Cap
m/c 1	Rough face both sides	√	√
m/c 2	Hole boring	√	√
Joint Face Operations			
m/c 4	*Bolt hole drill*	√	√
m/c 5	*Reaming*	√	×
m/c 6	*Tapping*	√	×
m/c 7	*Face milling*	√	√
m/c 8	Assembly with bolts	√	
m/c 9	Grinding both sides	√	
m/c 10	Bush fitting	√	
m/c 11	Finish boring	√	

II. POSSIBILITIES TO MANUFACTURE CONNECTING RODS

1) Hot Forging: It is a predominant technology to fabricate conrod. Due to a complex geometry, conrod cannot be produced in one blow and therefore dies with several impressions have to be employed.

Figure 2. Conrod forging Process [2]

2) Powder metal (PM) based process: In this process pre-blended powder material is filled up into the die, and then compacted at room temperature with the subsequent creation of preform by sintering at 1050-1300°C for 15 minutes. This preform is afterwards ejected from the die, heated in the furnace and finally hot forged to the final shape. In this way high density forging is produced.

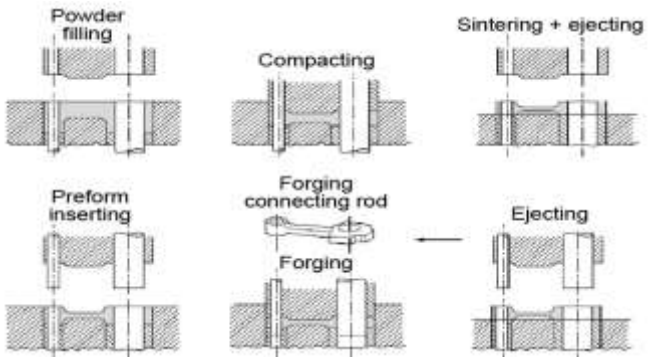

Figure 3. Schematics of powder forging [2]

3) Casting: Cast conrods are produced in green sand molds. Due to specific requirements of casting technology design of conrod has to be modified (I-beam cross section, radii). Material utilization in conrod casting reaches 90%. Mechanical properties of cast conrod are improved by sand blasting or shot peening. [2]

III. LITERATURE SURVEY

Danielle Visser [3] this paper discuss a brief history of the connecting rod and then discuss the various methods of modern manufacture including: sand cast, wrought forged, and powder metallurgy, with focus on wrought forged and powder metallurgy. Finally, this paper will cover some of the more recent developments in the connecting rod industry including: titanium, aluminum, magnesium, and polymeric connecting rods. It was concluded that for larger engines with lower RPMs powder metallurgy was the dominant method of manufacture in North America. However, in Europe and Asia, forged connecting rods seemed to be the preferred method of manufacture.

D.V.V.S.B. Reddy et al. [4] they present fixture designed is hydraulic operated and used for operation like face milling, drilling, Tapping, Rough & Finish Boring of the crankcase. Design standards are taken from Makino for designing this machining fixture. In the design process based on the geometry of the component to be machined, the machine, the table layout and corresponding clamping slot positions are then selected. The fixture is then designed by considering all the clamping forces from various cutting operations.

C. RadhaMadhavi et al. [5] in this literature fixture is designed in such-a-way that part/product change overtime is very less. The report consists of study of input data from customers like Part drawing and Assembly drawing. The fixture design begins with part modeling, Machining and Analysis of various parts in the fixture assembly using AutoCAD and Solid works, for an analysis COSMOS Software package is used. After that machining fixture concept is done. Locating and clamping points are decided. This also includes accessibility, loading and unloading sequence of parts, required material for this fixture is selected, and Fixture is designed.

K. Nanthakumar et al. [6] the proposed method has to be design and fabricated the multi-operational Fixture for the complete machining operations in a single machining centre. The Fixture design has will serve for the economic production for the component.

Stampfer M. et al. [7] it shows that system is introduced that gives us recommendations on the number and the order of the needed setups. Also proposal on appropriate fixture needed at machining for work piece. Input data in system like ProE, Solid works, CATIA are the CAD model of the workpiece saved in IGES format.

Mane R. et al. [8] This paper uses newer and innovative design of present day manufacturing industries for locating, positioning, clamping, for unforced clamping hydraulic clamping's are used. Fixture design is one of the important factor that play a role in providing manufacturing processes with more productivity and have brought many benefits like reduced rejection. The paper includes finished parts model and 3D assembled view of fixture using Pro/Engineer Wildfire.

Shankaran V. R. et al. [9] this paper shows the reduction in cycle time, by recommendation of new tools. Also worked on improving the process parameters taking into consideration the materials and type of machining operations used in manufacture of components on automated manufacturing machines.

Hui Wang et al. [10] in this paper First, an introduction is gives on the fixture for specific component applications in industry. Then, significant work has been done in the CAFD field, with including their approaches, requirements and working principles are discussed.

Boyle I. et al. [11] The primary conclusion of this paper is that while significant advances made in supporting fixture design, there are primarily two research issues which requires further effort.The first of these is current CAFD research is segmented in nature and there remains a need to provide more cohesive fixture design support. Secondly, a greater focus is required on supporting the detailed design of a fixture's physical structure to be manufactured.

V. Shekhar et al. [12] This paper discusses the case study and comparison of productivity of component using conventional horizontal milling machine and special purpose gang milling machine for manufacturing of chain bushes. Also in this paper the following studies are carried out Reduction in cycle time Increase in productivity both qualitative and quantitative, less human intervention, indirectly reduction in operator fatigue,

Timasani R. et al [13] the purpose of this study is to find out the significance of quick changeovers in machining line. The Set-up activities are a vital part of the production lead-time and so affect overall product cost. Tools like Pareto analysis, root cause analysis and method study have been used to analyze the existing procedure of set-ups. Based on the initial studies the pallet system was proposed for vertical machining centre as quick change fixture base on which the existing stage fixtures are located. Similarly the quick change jaw system was proposed for the turning centre. The fixture mechanisms were designed to eliminate 40% unwanted activities in the design stage itself. The Quick Change Fixtures and Quick Change Jaws were designed and validated thru real time simulation.

IV. CONCLUSION

Concluded that how to design fixture for machining process. Centering, locating, orientating, clamping and supporting can be considered the functional requirements of fixture. Different Steps for fixture design process methodology; Functional requirement, Fixture functions, Functional design, detailed design and fixture validation. Throughout Process to create connecting rod in 3D modelling software. Detailed spatial arrangement of manufacturing devices and workstations is organizational activity influenced on material moving in the manufacturing process, cutting process and machine interactions for a wide variety of cutting processes.

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