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A Review on Design and Analysis of Four Jaw Chuck

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Abstract:- The manufacturing industry has been trying to attain a required cutting performance of high precision, fast productivity and less maintenance cost .Vibration during machining can be a serious problem influencing parts quality, precision, tool service life, lathe performance and cutting rates. Four Jaw Chucks are critical units of the high speed horizontal lathe, while the interference fit between the chuck and spindle is one of most important factors influencing the performance of the high speed horizontal lathe. To simple structure of geometry form regulation, the static and dynamic formulas are derived for the calculation of force analysis of the stress by the theories of theoretical mechanics, materials mechanics and elastic mechanics. But to the complicated structure of four jaw chuck and spindle, the fault having no way to calculate a precise is a surplus of measuring the analytical solution.

Index Terms: - Four jaw chuck, cutting tool, FEM ,model analysis, balancing.

1. INTRODUCTION

For a manufacturing company to compete in today's market they must produce a quality product at the highest possible efficiency, productivity and less maintenance cost. Vibration during machining can affect the quality of manufactured parts, precision, life of tool, performance of lathe machine and cutting rates.

Different types of chuck used in the lathe machine

1) Three jaw chuck

2) Four jaw chuck

Three jaw chuck have advantage of self centering and limitation is that it not recommended for high speed load condition.

Four Jaw Chucks are critical units of the high speed horizontal lathe, while the interference fit between the chuck and spindle is one of most important factors influencing the performance of the high speed horizontal lathe. It is very important to monitor the chucking condition of the power chucks for safety consideration in Lathes, especially high speed lathes. They can be used to hold irregularly shaped parts. Multiple gripping method is one of the advantage of four jaw chuck.

YOGLAKSHMI INDUSTRY MIDC wardha which is producing the irrigation pipes. They used four jaw chuck lathe machine for internal and external threading of the cast iron double flange (CIDF) pipe. It has been observed that because of four jaw chuck the company did not get very quality pipes. So in this project, I am going to analysis the four jaw chuck by modeling and FEM analysis.

High speed cutting is used more and more widely because of high efficiency and perfect quality. For ensuring human safety and avoiding damages to expensive machine tools,real-time condition monitoring to spindle units , clamping devices and feeding units is becoming increasingly important.

1. Chucking condition of the power chuck.

Cheng Zhou et.al in his paper defined it is very important to monitor the chucking condition of the power chucks for safety consideration in CNC Lathes, especially high speed lathes. Measuring the pressure of the oil supplied to the rotary cylinder is a widely used method to monitor the input force of the power chuck.

1.1 This paper proposes a direct input force method measuring for real time monitoring with more reliability compared to traditional methods. An input force sensor is developed and tested in the experiment, which monitors the variation of the input force of the power chuck accurately and promptly. The sensor is

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less likely to be polluted by the cooling water and scrap iron.

2. Reduction remedies for aerodynamic noise.

Y.Konda et. Al in this paper he reveal that the air flow around the three jaw scroll chuck is observed by means of the tuft and smoke wire methods to establish the reduction remedies for the aerodynamic noise by chuck itself . The axial flow becomes duly propelling-like at the front of the chuck body, especially when the chuck has the protruded components, e.g., jaw and cylindrical work piece.

2.1In this case, two major flows are prominent, i.e., radial flow blowing out from the jaw area and axial flow merging with the radial flow, and both of which can be considered as a major cause of aerodynamic noise.

3. Multiple sensor used for tool setting.

Y. Prado et.al he reveals that Precision machining of components with tight tolerances requires not only to do a fine presetting of tools, but also to carry out on-line tool-path corrections in order to compensate the form deviations that arise in the which work piece derived from the action of cutting forces. This is used for machine-tools equipped with multiple sensors. It was in this work and compared each other and also with respect to experimental machining test.

4.Improving the product quality.

Shuyan Zhao et al in this paper For the simple structure with geometry and regulations, can be applied to the theory of mechanics of materials and elastic mechanics, derived the theoretical formula of face chuck and spindle interference amount. The exact solution of the amount of analytical interference, it must use numerical simulation method. Through the research results, realized spindle and face chuck performance, this economic losses during product reduces manufacturing process and can greatly shorten the product design quality.

5. Effect Of Clamping Force

S. Selvakumar in his paper In any manufacturing operation, the deformation of the workpiece can be minimized by optimizing the parameters such as Clamping forces, Number of locators and clamps and Positions of locators and clamps. The system gives minimum deformation when clamping forces are minimum. The minimum clamping forces required to hold the workpiece can be determined by using balancing force moment method and the coulomb static friction law. For a milling operation the enough amount of clamping forces are determined for the five various positions of the tool on the workpiece. Then the maximum values of clamping forces among these are taken as the optimum clamping force. Finally, the deformation of the workpiece for the optimum clamping forces is determined by Harmonic analysis using FEM software.

6. Fatigue analysis of four jaw chuck

Jan Vojna in his paper The main goal of the present study is a fatigue analysis of using the Finite Element Analysis (FEA) with the Ideas and Ansys FEA code. Clamping jaws are used for horizontal centre lathes SR2 manufactured by Skoda Machine Tool. However, before providing the fatigue analysis of the clamping jaw using Ansys . FEA is necessary to obtain stress and strain results for different variants of clamping jaws. Finally, some analysis and comments on fatigue life prediction through loading cycles or working hours of clamping jaws are discussed.

7. Investigation of vibro-acoustics properties of modern lathe collet chuck

This paper presents an analysis of the cutting process using model methods. Static and dynamic deformation of lathe collet chuck have a significant impact on cutting process stability, which affects the quality of manufactured parts and productivity rates .Utilising a model analysis ,a mathematical model of chuck dynamic ,which consist of a number of mode shape each with natural frequency and model damping, has been developed. Model analysis of lathe collet chuck was performed using a FEM element method.

8.Conclusion

This paper provides an overview of the research principles, methods, technology, systems, and standards which are being

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adopted in typical modern day manufacturing industries.

After studying this literature, we have conclude that, still there is a scope to do work on manufacturing industries for design and analysis of four jaw chuck so as to improve the quality of cast iron flange pipe.

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