

A Review on Design and Analysis of Hydraulic Powerpack and Pumps

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ABSTRACT - This paper is about an idea of design and development of hydraulic system for clamping of workpiece on Vertical Machining Center (VMC). Clamping system plays vital role within many manufacturing processes. They accurately locate and secure a workpiece position during machining in such way that the part can be manufactured to design specifications. The existing system uses manual clamping system so to increase the accuracy and precision of machined component with in increasing production rate and reducing cycle time. So, the aim of this project is to design hydraulic system and analyzing different pumps for their application.

Key Words: Clamping, Accuracy, Design, VMC, Analysis, Production rate.

1. INTRODUCTION

Now a days all manufacturing industries require to bring down the cycle time and increase productivity with high accuracy along with resources. For that purpose, they search various new special purpose manufacturing systems. Clamping of workpiece is one of the important parameters which accomplishes this need effectively. A clamp is holding device which hold or secure objects tightly together to prevent its movement through the application force applied on it. This special purpose tool which assist the production when workpiece is to be produced on mass scale.

The current system uses the manual clamping i.e. nut -bolt type fixture for holding the workpiece and maintain the correct and secure position while machining operations is being done on the part due to which there is higher rejection rate. These operations have to be done on several times in single day so this may cause considerable fatigue to the operator, thereby reducing efficiency also this effect on production rate.

These problems can be overcome by making system clamping systems automatic so it provides a reliable and fast clamping system which will reduce the cycle time of clamping with increase in accuracy, safety and reliable system. For automation purpose we have different systems like pneumatic system, hydraulic system and electrical system.

1.1 Hydraulic system

Hydraulic clamping system uses high pressure liquid to produce force on the clamp and hold the workpiece in proper position. This system has many advantages over manually clamping system. In all the cases they reduce cost and increase the efficiency.

- ❖ Time required for loading and unloading of workpiece is reduced which eventually reduces the overall cycle time and increase the capacity of manufacturing.
- ❖ In hydraulic system the clamping force is constant which result in very precise positioning and clamping of workpiece
- ❖ This system is compact and less noisy
- ❖ This system eliminates the human errors and allows operators to be consistently more productivity with less effort.
- ❖ Due to clamping consistency the part quality is increased along the productivity is increased.
- ❖ This system is safer due to the use of various check valve and control devices also due to incompressibility of hydraulic oil.

For that all advantages we move towards the hydraulic system and we design the whole system which consist of hydraulic power pack unit with all control devices. We will analyze the different types of hydraulic pumps for this clamping system and from that we will select the suitable pump for the system.

2. PROBLEM STATEMENT

To design & develop hydraulic system for clamping of workpiece on Vertical Machining center, various machining operations are carried on VMC. The main problem in such operation is high rejection with low productivity due to manually operated clamping system. It is very complicated process for the workers because present method of machining makes use of Nut-bolts and clamps only which required long processing time.

Maximum time of worker is used for setting of workpieces on the fixture. Also, accuracy is not so precise. The main focus of our project is to make the loading and unloading process simple, the time required should be minimized and operation should be easier one, to increase the productivity and reduce the rejection rate

3. LITERATURE REVIEW

1. **ISO Standard 4409 [3]** Defines the necessary measurements, symbols, measurement accuracy and suggested tests for pumps and motors.
2. **ISO Standard 8426 [4]** Presents a method of determining the actual displacement of a pump or motor during a test. For a certain displacement set point, several pressure measurements are used to extrapolate a line whose intercept is the actual displacement.
3. **Srinivas R et al., [7]** -A hydraulic system is a group of hydraulic elements arranged in an order and using these hydraulic element powers is transmitted using a confined liquid i.e. Oil. Hydraulic power units are drive system for hydraulic machines
4. **Sridharakeshava K. B. et. al., [1]** has discussed about the General Requirements of a Fixture which includes constraints of Deterministic location, contained deflection, geometric constraint in order to maintain the work piece stability during a machining process. They also discussed three broad stages of fixture design, Stage one deals with information gathering and analysis, Stage two involves product analysis, and Stage three involves design of fixture elements
5. **Vektec, hydraulic clamping information [2]** describes Hydraulic Systems & Circuits which includes Power Supplies, Valves, System Types, Accumulators, Orifices, Filtration, Flow Requirements, Line Sizing, Circuit Design; General Description, information & Application Recommendations of Work Supports, Swing Clamps, Cylinders & Position Sensing
6. **Wen Wang et al., [6]** -In these study oil pump models with different gear tooth shapes were established and the internal flow field simulation were conducted by utilizing pump links. Especially the flow pulsation of dislocation gear pump is much lower, than straight gear pumps.
7. **E.A.P. Egbe [5]** Present detailed design procedure of external gear pump. And also, the fabricating methods and their analysis and results. The design analysis, fabrication and testing of an external gear pump, which will serve as a spring board for technological transfer and development of country. The components of this gear pump were fabricated by machining.
8. **Dipen Rana et al., [10]** -Present CFD analysis is applying for to know flow behavior inside the pump that cannot be captured in physical testing. This experimental simulation is applying to simulate for 4 psi delivery pressure which is required to circulate in punching machine.
9. **N. P. Maniar et. al., [8]** they present the reviews on locating and clamping considerations, taxonomy of fixture planning & design, also shows an example of fixturing alternatives and characteristics for three types of fixtures i.e. Modular fixturing, General fixturing, Permanent fixturing. They provide a system view of fixture planning and Design for data & information exchange also gives detailed discussion on CAFD- Computer Aided Fixture Design.
10. **Tudor Paunescu et.al., [9]** the present work is focused on conceptual design of linear hydraulic pumps mechanically actuated by the machine tools also they introduced nine new concepts of hydraulic pump are detailed.
11. **Johnson et al [13]** Presents a model of the torque on the swash plate of variable displacement axial piston pumps. It does not include any information on efficiency. This is an example of a model which explains the behavior of the internal parts of a P/M, but does not directly address performance and efficiency
12. **Hibi et al [14]** Present detailed dynamic models of vane pumps and motors. They also develop the beginnings of a physical-based efficiency model. Both derive full free body diagrams for the vanes in different portions of rotation. We did not use any vane pumps in the HHPV, but the method outlined in the model could be extended to an axial piston P/M for use in a physical-based model.

13. S.D.V.V.S.B. Reddy et. al. [11] has discussed about data required to design fixture, hydraulic fixture elements for transmission case, cutting force calculation and analysis of fixture body to check whether the fixture is withstanding the maximum cutting force during machining.

14. Shailesh S. Pachbhai et. al., [12] focuses on the advantages of Hydraulic Fixture. They also offer a solution of hydraulic fixture, which reduces workpiece distortion due to clamping and machining forces

3.1 Concluding Remark from Literature Review

There are many systems working on hydraulic system and these systems are more efficient and reliable, in this they study various pumps and research on that also they suggest various design procedure for clamping system also importance of clamping system. This is all documents really help us to design a new hydraulic system.

4. PROPOSED WORK

The present work is aimed at designing and analysis of Hydraulic power pack and Pump unit for clamping and de-clamping of jobs on VMC (vertical machining center). So, our work is related to designing the Hydraulic power pack unit for above application and also selecting and designing the proper pump for hydraulic power pack unit and other related components of hydraulic pack unit are selecting from standard CatLog.

The main focus of our project is to design of hydraulic clamping system which consist of different parts from that all we will designing

- Hydraulic clamping cylinders
- Hydraulic pump
- Motor for pump
- Reservoir or tank
- Control devices

5. CONCLUSION

Implementation of this project eliminates the need of human operator for clamping of various workpiece. It reduces the cycle time. It gives an economically feasible design. Also ensures accurate & efficient clamping of parts. By using manual clamping system production of various workpiece is insufficient in industries. Hence, hydraulic clamping system is a good option to increase the production rate.

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