UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF VACUUM CLAMPING FOR MILLING MACHINE

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Engineering Technology (Bachelors of Engineering Technology Process) (Hons.)

by

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I hereby, declared this report entitled Development of Vacuum Clamping For Milling Machine is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering Technology (Process And Technology) with Honours. The member of the supervisory is as follow:

……

(Dr. Norfariza Binti Ab Wahab)

ABSTRAK

Mengapit bahan kerja dalam penggilingan biasanya menggunakan alat dan peranti pemegang seperti ragum untuk mengapit bahan kerja. Projek ini adalah untuk mencadangkan peranti pengapitan baru untuk proses memotong. Mesin yang digunakan dalam proses untuk menghasilkan produk ini adalah mesin penggilingan dan mesin gerudi. Selepas produk siap dihasilkan, satu ujian dilakukan pada pengapit vakum untuk menilai produk. Ujian ini adalah ujian kekasaran permukaan dan di mana hasil pengapit vakum dibandingkan dengan hasil ragum. Hasilnya menunjukkan bahawa pengapit vakum mempunyai hasil kekasaran permukaan yang lebih baik daripada ragum. Kesimpulannya, mengambil tindakan mengunci vakum ini mampu dihasilkan dan digunakan untuk tujuan mengajar.

ABSTRACT

Clamping in milling usually use tools and holding devices such as vise to clamp workpiece. This project is to propose a new clamping device for cutting process. The machine used in the process to produce this product are milling machine and drilling machine. After product is finished, a testing is done on the vacuum clamping to evaluate the product. The testing are surface roughness testing and where vacuum clamping result is compared to vise result. The result shows that vacuum clamping has better surface roughness result than a vise. As a conclusion, the vacuum clamping is able to be produced and used for teaching purpose.

DEDICATION

I dedicate this thesis to my parents who have always been nearest to my heart and have been so close to me that I found them with me whenever I needed. It is their unconditional love that motivates me to get higher target. I also dedicate this thesis to my sisters(Ivy and Cherish) and brother (Darence) who are my nearest surrounders and have provided me with a strong love shield that always surround me and never let any sadness enter inside.

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Thanks also go to my fellow friends at the Faculty of Technology Engineering of University Techincal Malacca. Special thanks go to my them who helped me throughout this academic exploration.

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CHAPTER 1

INTRODUCTION

1.1 Background

A clamp is a fastening device used to hold objects securely to prevent movement through the application of inward pressure. In demanding high speed cutting process, clamping is a key element. The workpiece that are being machined must be clamp securely and tightly to achieve precise and accurate machining results. Clamps provide two main purposes which are hold the workpiece against its locator and prevent movement of the workpiece. The primary cutting forces generated by operation should be resist by the locators.

Clamps functioning as to hold the position of the workpiece against the locators.Clamps should resist the secondary cutting force. When the cutting tools leaves the workpiece, secondary cutting forces is generated. In drilling for an example, in the axis of the drill, the primary forces is directed down and radially. Whereas the secondary forces are generated once the part tend to raise once the drill breaks through the alternative aspect of the half. The clamps need to be strong enough to secure the workpiece against the locators and also resist the secondary forces.

There are several types of clamp in the market. These clamps have different types of operation and different purpose. The first type of clamping is hand clamp. Hand clamp are hand operated tools, usually used for hold and positon workpiece while undergoing manufacturing or assembly. Hand clamp are used for many application such as door making, bookbinding, picture framing or as jigs in manufacturing process. Second is material handling clamp. Material handling clamps are used for holding heavy material as it being manipulated or lifted. This type of

clamping is usually used on cranes for lifting loads such as pipes and rails. They are also used in foundries and factory. The other types of clamps are hose clamp, cable clamp, pipe clamp and ground clamp.

For milling machine, there are two common vise that used for clamping workpiece which are universal angle milling vise and plain milling machine vise. For holding workpiece that has parallel sides, plain milling vise is used. While for universal angle vise, they are used when there are part that related in angle need to be machined.. There are a few limitation in using these vises such as cannot clamp workpiece with complex shape and no fix pressure acting on workpiece in holding the workpiece. So, this project is to develop a new clamping method which is vaccum clamping to overcome the limitation in these vises.

Figure 1.1 universal angle milling vise [retrieved from http://www.toolzone.com/acatalog/11707.jpg]

Figure 1.2 plain milling machine vise [retrieved from http://www.use-enco.com/ProductImages/7003819-11.jpg]

Vacuum clamping is one of the new clamping method in recent years. They are mostly used for clamp wood in woodworking. Vacuum clamping provide simple

machining so it will increases productivity and cost-saving. The advantage of using vaccum clamping is they will not causing any harm to the workpiece. Since vacuum clamping provide simple machining, no time-consuming labor required. In a short time, vacuum clamping can clamp workpiece even when the workpiece does not have parallel side and various shapes. With all these advantages, vacuum clamp could be the best clamping method for milling machine.

1.2 Problem Statement

There are several setback in using vises in milling machine. Firstly is less adaptability to complex shapes of workpiece. As the vises only can hold worpiece with parallel side. Second, there is no fix force for clamping the workpiece using vises. Too much force acting on workpiece may damage the workpiece especially for soft material. Beside that, there are also safety issue in using the vises where cutting tool may collide with the vise. Colliding with the vise will cause damage to the cutting tools and also dangerous to the operator. Lastly, the clamping process using the vise take much time. The clamping process alone take too much time in whole milling cutting process operation.

1.3 Objective

The project objective that have been determined are:

1. To design a new vacuum clamping method for milling machine
2. To choose suitable material for developing vacuum clamping
3. To develop a new vacuum clamping for milling machine
4. To evaluate the results base on the developed vaccum clamping

1.4 Project Scope

Scopes for this project is based on objectives that have stated and there are the several scopes that will be carrying out :

1. Design of the vaccum clamping is based on milling machine at laboratory and only for teaching purpose
2. Material that will be used for develop vacuum claming are aluminium and mild steel
3. Development of the vacuum clamping is using all machine that available at the factory
4. The result of surface roughness will be conducted to evaluate the result of vacuum clamping

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction of machining process

Machining is a process where a piece of material is cut into a size and shape. There are three main principle in machining process which are milling, turning and drilling. Operation such as planing, boring, broaching, sawing and shaping fall into various categories.

Drilling is a process of producing round holes in a solid material or enlarging existing holes with the use of multi- tooth cutting tools called drills or drill bits(Marinov & Technology, n.d.). Enlarging an existing hole with multitooth cutting tools is also a drilling process. Various cutting tools are available for drilling, but the most common is the twist drill.

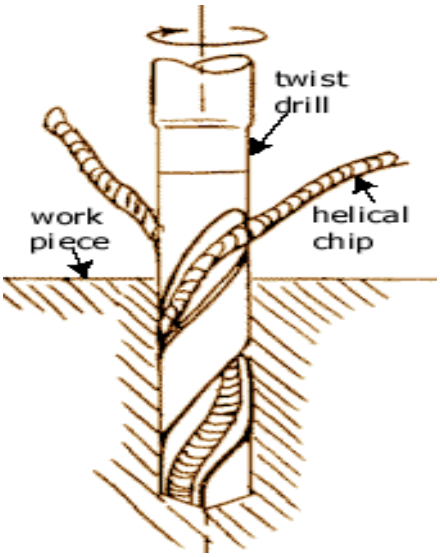

Figure 2.1 Drilling [retrieved from
http://www.efunda.com/processes/machining/images/drill/drill_helical_chip_1.gif]

Turning is a type of machining, a material abstraction method, where rotational parts is created by removing the material. A turning machine or lathe is used in the turning process. Others compenents needed are cutting tool, fixture and workpiece. Secured to the fixture where it is secured to the turning machine, a workpiece is a material that allowed itself to spindle at a high speed. For the cutter, it is a cutting tool that also secured to the machine and usually a single point cutting tool. When the workpiece is rotating, the cutting tool will move in and feed the workpiece to produce the desired shape.

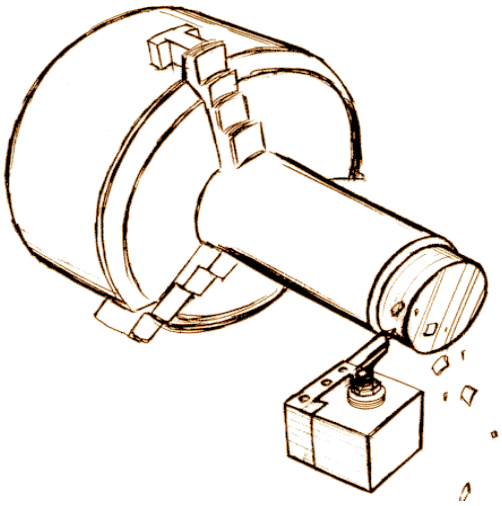

Figure 2.2 Turning[Reprinted from efunda, Retrieved from http://www.efunda.com/processes/machining/images/drill/drill_helical_chip_1.gif]

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Milling is a machining process where a rotating cutting tool is used to remove material. From small part to big part, milling cover a wide variety of process and have many different operation and machine. For machining part to accurate desired shape and sizes, milling machine is commonly used in the industry.

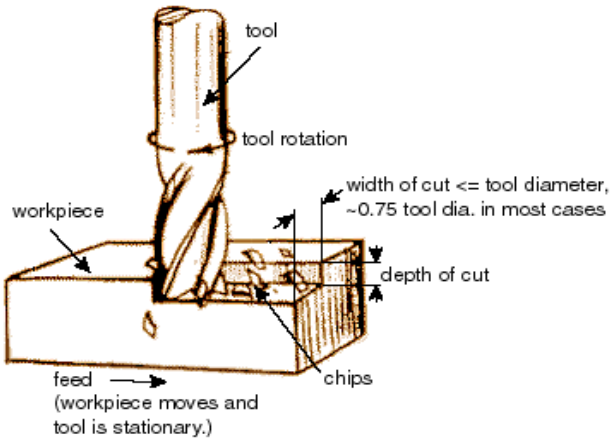

Figure 2.3 Milling [retrieved from http://www.efunda.com/processes/machining/images/mill/end_milling_2.gif]

2.1.1 Conventional machining process

Traditional machining process or otherwise called conventional machining as a usually utilizes the use of hard material to change the shape of the material. Using traditional machining process demand of energy and time and hence increments in expenses so in sometime, tradtional machining is not suitable to use. Tradtional machining additionally expenses as tool wear and the quality can be affect in the process. As the demand for hard alloy product is keep increasing due to technological advancement, more interest have been on the use of traditional machining. Tradtional machining can be characterized as a procedure where mechanical energy is used.

Characteristics of contact machining process are :

1. Generally plainly visible chip development by shear deformation
2. Present of physical tool
3. Harder cutting tool material compare to the workpiece
4. Main energy is mechanical where utilize the cutting force to remove material
5. Workpiece and tool have direct contact between them
6. Low surface finish
7. Less tool life
8. Higher waste of material

9. Low capital expense
10. Manually to operate

The examples of traditional machining are milling, turning, boring, and drilling. These process consider as traditional machining as there are contact between cutting tool and workpiece in their machining process.

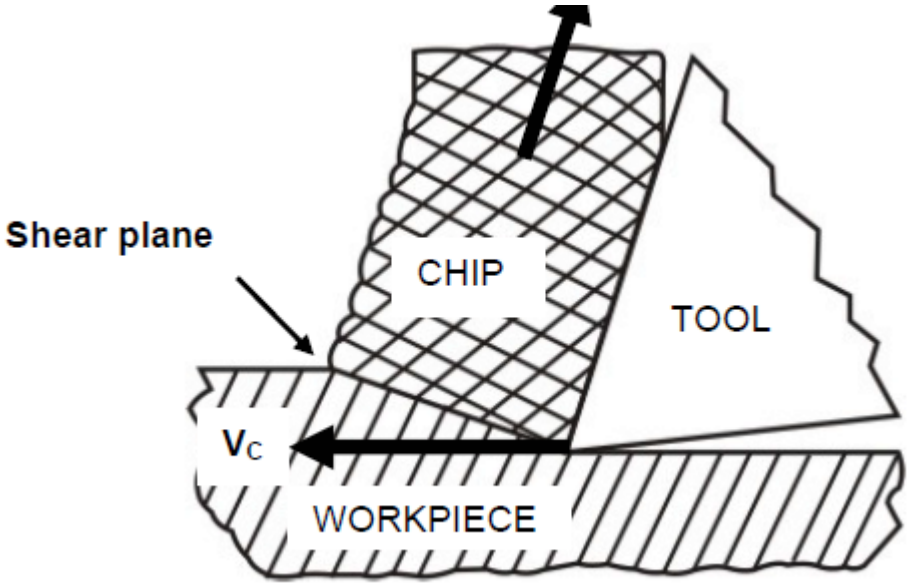

Figure 2.4 Shear deformation (Kharagpur, n.d.)

2.1.2 Advanced machining process

Over the past 10 years, traditional machining have been covered the requirement in the industries. But, new fascinating work materials and additionally complex parts and products put a lot of pressure to the traditional machining to produce the part . Due to that, advanced machining have been form for an improvement in the industries in producing parts with accuracy and economically. With advancement in the advanced forms, right now there are regularly the main choice and not an alternative option for routine procedures for certain specialized requirement.

Characterization of advanced processes categorised according to their type as follow:

• Mechanical Processes

- Ultrasonic machining
- Water jet machining

• Electrochemical Processes

- Electrochemical grinding process
- Electrochemical machining
- Electro jet drilling

• Electro-Thermal Processes

- Electro-discharge machining (EDM)

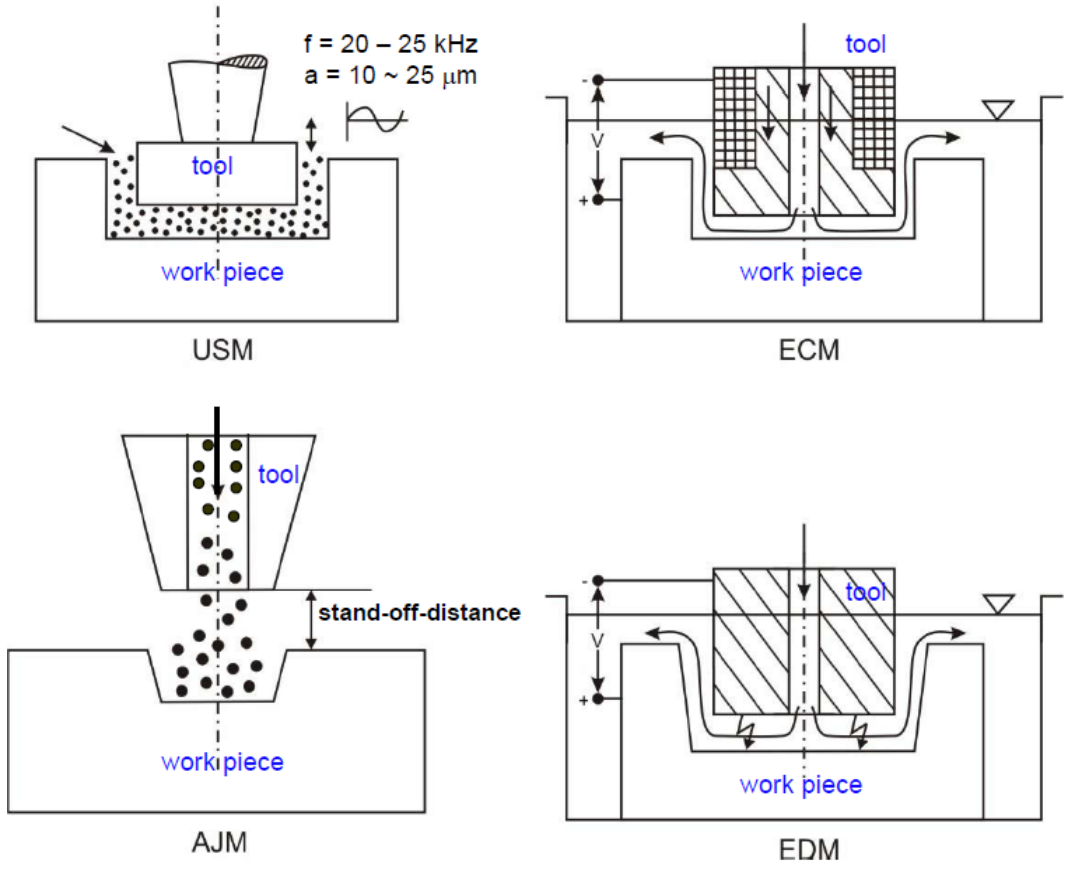

Figure 2.5 No physical contact between the tool and workpiece (Kharagpur, n.d.)

Characteristic of advanced machining are as follow:

1. Material removal can happen with or without formation of chips
2. There is usually no physical tool present
3. Does not depend on mechanical energy for material removal to take place
4. High surface fininsh and accuracy