UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF FLEXIBLE 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 (Process and Technology) (Hons.)

by

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SUPERVISOR DECLARATION

I hereby declare that I had read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the purpose of the granting of Bachelor’s Degree in Manufacturing Engineering Technology (Process and Technology) With Honours.

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STUDENT DECLARATION

I hereby, declared this report entitled "Development of Flexible 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:

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(Dr. Norfariza Binti Ab. Wahab)

ABSTRAK

Proses penggilingan adalah salah satu proses penting dalam pembuatan. Ia boleh ditakrifkan sebagai prosedur pemesinan daripada menggunakan putaran pemotong untuk mengeluarkan bahan dari bahan ujikaji yang dimesin. Dalam proses ini, terdapat beberapa perkara yang kita perlu tahu terutama jenis pengapit digunakan. Pada asasnya, pengapit atau pegangan kerja adalah istilah generik untuk mana-mana peranti yang digunakan untuk memegang bahan ujikaji manakala proses pemesinan. Penggilingan mesin ragum adalah salah satu daripada peranti pengapit biasa yang digunakan dalam industri dan untuk tujuan pembelajaran. Tujuan penggilingan ragum adalah untuk mengurangkan masa bekerja dengan membenarkan solek set-up. Selain itu, ia juga berfungsi sebagai penyokong semasa pemesinan proses dan membantu untuk meningkatkan ketepatan bahagian selesai. Walau bagaimanapun, pengapit konvensional ini mempunyai kelemahan sendiri. Salah satu daripadanya adalah hanya permukaan bahan ujikaji boleh dipotong dalam satu pengapitan tunggal. Ini memerlukan pengendali untuk memuatkan dan memunggah ragum pengapit dengan beberapa kali. Jelas sekali, proses itu tidak berkesan dan efisien kerana pembaziran masa. Dalam projek ini, reka bentuk pengapit dikemukakan untuk membolehkan kedudukan bahan ujikaji fleksibel semasa proses pemesinan. Produk ini akan membolehkan pengendali mesin mengurangkan masa persediaan mereka dan pemeriksaan manual. Selain itu, mesin yang digunakan untuk menghasilkan produk ini ialah penggilingan mesin dan mesin berputar. Selepas produk selesai, satu ujian dilakukan pada pengapit fleksibel untuk menilai kekasaran permukaan produk yang diuji menggunakan ‘Portable Surface Roughness Tester, SJ-401’. Kemudian, keputusannya akan bandingkan dengan keputusan ragum semasa. Daripada keputusan itu, ia menunjukkan bahawa purata nilai Ra menggunakan ragum semasa sebagai kaedah

pengapit adalah lebih tinggi daripada menggunakan pengapit fleksibel sebagai kaedah pengapit iaitu 1,543 apabila menggunakan ragum semasa dan 1,151 dan 1,106 apabila menggunakan pengapit fleksibel sebelum dan selepas untuk Delrin sebagai bahan ujikaji. Manakala bagi aluminium sebagai bahan ujikaji, purata nilai Ra menggunakan ragum semasa sebagai kaedah pengapit adalah lebih rendah daripada menggunakan pengapit fleksibel sebagai kaedah pengapit iaitu 0,542 berbanding 0,640 apabila menggunakan pengapit fleksibel.

ABSTRACT

Milling process is one of the important processes in manufacturing. It can be defined as the machining procedure of utilizing rotating cutter to remove material from a work-piece. In this process, there are a few things that we must know especially type of clamping used. Basically, clamping or work holding is a generic term for any device used to hold the work-piece while machining process. Milling machine vise is one of the common clamping device that use in industry and for learning purpose. The purpose of milling vise is to reduce working time by permitting snappy set-up. Besides that, it also functions as a supporter during machining process and help to increase accuracy of the completed parts. However, these current vises have its own weakness. One of them is only limited surface of the work-piece can be cut in one single clamping. This required the operator to load and unload the clamping vise with a several times. Obviously, the process is not effective and efficient due to waste of time. In this project, the design of the clamping is presented for flexible positioning of the work-piece during machining process. This product will allow the manufacturer reducing their setup time and manual inspection. Besides, the machine used in the process to produce this product are milling machine and turning machine. After product is finished, one testing is done on the flexible clamping to evaluate the product which is surface roughness testing using Portable Surface Roughness Tester, SJ-401. Then, the result will compare to current vise result. From the result indicate that the average of Ra value using current vise as a clamping method is higher than using flexible clamping as a clamping method which are 1.543 when using current vise and 1.151 and 1.106 when using flexible clamping before and after rotation respectively for delrin as a work piece. While for aluminum as a work piece, the average of Ra value using current vise as a clamping method is lower than using flexible

clamping as a clamping method which are 0.542 compared to 0.640 when using flexible clamping.

DEDICATION

To my beloved family especially my father and mother, En. Abdul Rani Bin Hassan and Pn. Zuraidah Binti Awang, I thank my parents for their continuous support to me in performing this difficult task, and the journey does not end here.

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CHAPTER 1
INTRODUCTION

1.1 Background

Milling process is one of the most important processes in manufacturing process which can make an assortment of elements on a material by removing the unwanted material. Thus, the milling process requires a milling machine, work-piece, fixture and cutter. There are many types of milling machine with different function and characteristic which is universal horizontal milling machine, ram-type milling machine, universal ram-type milling machine, knee-type milling machine, and swivel cutter head ram-type milling machine, etc. The work-piece is a pre-shaped material and its was located at the clamping vice. The cutter which similarly secured in the processing machine is a cutting device with sharp teeth and turns at high speeds. Material will remove form the work-piece by sustaining the work-piece into the rotating cutter as little chips to make the wanted shape. The various milling process performed by different milling cutter which is peripheral milling and milling machine operations. Function of peripheral milling is to produce a machined surface parallel to the axis of the cutter. Besides, it was classified under two headings which is up milling and down milling according to the relative movement between the tool and the work-piece. While, the operations that often used by a manufacturer in a milling machine is face milling, end milling, slotting, thread milling, plain milling and side milling, etc.

Besides that, milling also is used to make non axis symmetric parts or various components such as holes, slots, pockets, and even three dimensional surface shapes. Next, parts that are made absolutely through milling commonly incorporate segments which its used as a part of restricted amounts possibly for models. For example, brackets and custom designed fasteners. In addition, milling is additionally regularly utilized as an optional procedure to add or refine highlights on parts that were made utilizing an alternate procedure. As a result of the high tolerances and surface finishes that milling can offer, it is ideal for adding precision components to a section that have been framed.

1.2 Problem Statement

As a basic machining operation, conventional milling machine is one of the important machines that used in learning system. It is because it is one of the most broadly utilized metal removal processors as a part of industry and milled surface are to a great extent used to mate with other part in die, aerospace, automotive and machinery design as well as in manufacturing industries.

Therefore, machine operator usually requires a lot of time to load and unload the work-piece into the milling machine. Obviously, the process is not effective and efficient due to waste of time. This can affected the percentages of the production. Besides that, the operator also requires a lot of manual labour to load and unload the work-piece. This can affected the quality of their work and also the quality of the product.

The clamping of this machine also have its own weakness which is only limited surface of the work-piece can be cut in one clamp. This can increase the time setup of the clamping during machining process.

1.3 Objective

i. To design a flexible clamping for milling machine.
ii. To develop a flexible clamping for milling machine.
iii. To evaluate the results of surface roughness by using developed clamping device.

1.4 Scope

Today, rivalry in the manufacturing business throughout the following decade will be centered on the capacity to adaptably and quickly react to changing economic situations with altogether abbreviated product life cycles. This makes the manufacturing environment is becoming more competitive; it is necessary needed an idea of new manufacturing systems to meet new challenges in order to survive and keep growth in the market. To overcome these diverse issues, its needed technology support in improving the flexibility and automation to improve the manufacturing environment as a main reason for the introduction of Flexible Manufacturing Systems (FMS) (Nurdin & Hakim, 2015).Therefore, the scope of this project will cover:

1) Design of flexible clamping for milling machine at FTK.
2) Material that used to produce the product is mild steel and aluminum.
3) Development of the product is using all conventional machines that available at factory.
4) Evaluate the results of surface roughness by using developed clamping device.

However, there are a few limitations in this product. Firstly, the minimum thickness of work-piece is 64mm and the maximum thickness is 90mm. Besides that, length of the work-piece also has its own minimum and maximum which are 80mm and 150mm. In addition, the maximum width of the work-piece is 100mm. This is due to the estimated size of the product and the clamping method. As mention before, the main function of the product is it possible to rotate the clamping 90 degree from both sides. So, the work-piece is able to be machine at all surfaces.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction of machining process

In machining process, a cutting tool is utilized to remove little chips of material from the work-piece into a craved last shape and size by a control of material-removal process. The procedures that have this basic subject, controlled material removal, are known as subtractive manufacturing, while in refinement from procedures of controlled material expansion, and are known as addictive manufacturing. Precisely what the "controlled" part of the definition suggests can change, yet it quite often infers the utilization of machine apparatuses. There are numerous sorts of machining operations, for example, specific part geometry and surface texture. The example of the machining operations are turning, drilling and milling. The other operations such as boring, broaching, shaping and sawing were falling into miscellaneous categories. There are for conventional machining which usually used in learning purpose. Furthermore, there are situations where conventional machining processes are not satisfactory, economical, or impossible for the following reasons :

1. Material is very hard and strong, or too brittle.
2. Work-piece is too flexible, or difficult to fixture.
3. Complex shapes.
4. Surface finish and dimensional accuracy requirements.
5. Temperature rise and remaining burdens are not alluring.

Therefore, non-traditional machining or advance machining are needed to full fill the problem when using conventional machining. There are three main forms of energy used in non-traditional machining which is mechanical, chemical and electro-chemical and thermal energy. The typical examples of single-action, mechanical, non-traditional machining processes in mechanical energy are water jet machining (WJM) and ultrasonic machining (USM. The others examples of mechanical machining are abrasive water jet machining (AWJW) and ice jet machining (IJM).

In thermal energy, the capacity is to expel the machining stipend by liquefying or vaporizing the work-piece material. Numerous optional wonders identifying with surface quality happen amid machining, for example, micro cracking, arrangement of heat-affected zones, and striations. The example of thermal machining are electrical discharge machining (EDM), electron beam machining (EBM), laser beam machining (LBM), plasma beam machining (PBM), and ion beam machining (IBM).

While in chemical and electrochemical energy, the process basically use a chemical dissolution action to eliminate the machining allowance through ions in an etchant.In addition, some of the machining process use an electrochemical disintegration stage to remove the machining allowance utilizing particle exchange as a part of an electrolytic cell. The example of electrochemical and chemical are chemical machining (CM), photochemical machining (PCM) and electrochemical machining (ECM), etc.

2.1.1 Contact Machining Process

Contact machining process means there may be a physical tool present during machining process. So, it can be conclude that all conventional machining are contact machining process. It is because, conventional machining includes the immediate contact of tool and work-piece. There are numerous sorts of machining operations that fit for creating specific part geometry and surface composition which is milling, turning and drilling. Besides that, there are different operations that falling into incidental classifications incorporate shaping, sawing, boring and broaching.

2.1.1.1 Turning Process

In turning process, a cutting tool is utilized to remove material from a rotating work-piece to create a tube shape. The essential movement is given by rotating the work-piece, and the feed movement is accomplished by moving the cutting tool gradually in a course parallel to the axis of rotation of the work-piece. By using the turning process we can produce wide variety of products. The turning operation is performed on the lathe machine.

Figure 2. 1 : Conventional Lathe Machine

There are different types of turning operations that are performed internally and externally which is face turning or facing, straight turning, thread cutting, grooving, eccentric turning and boring, etc.