UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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AUTOMATING THE PRODUCTION OF THE AUTOMOTIVE RETAINER USING THE ROTARY INDEXING MECHANISM

This report submitted in accordance with requirement of the UniversitiTeknikal Malaysia Melaka (UTeM) for Bachelor Degree of Manufacturing Engineering (Robotic and Automation) (Hons.)

By

MUHAMMAD HAZIM BIN ABD RASHID

B051110243

900629-10-5031

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Kampung Bukit Kapar 42200 Kapar
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Cop Rasmi:

DR. MOHD ARFAUZ BIN ABDUL RAHMAN
Lecturer
Faculty of Manufacturing Engineering
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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Robotic and Automation) (Hons.). The member of the supervisory is as follow:

.....

(Official Stamp of Supervisor)

DR. MOHD ARFAUZ BIN ABDUL RAHMAN
Lecturer
Faculty of Manufacturing Engineering
Universiti Teknikal Malaysia Melaka

ABSTRAK

Pengeluaran semasa untuk penahan automotif dalam industri adalah melalui kaedah proses konvensional. Proses ini melibatkan penggunaan operasi manual bagi mesin penekanan besar dan jig. Pendekatan ini memerlukan penglibatan yang tinggi daripada pekerja di bahagian pengeluaran. Akibatnya, masa kitaran yang diperlukan lebih panjang untuk melengkapkan proses tersebut. Keadaan ini secara tidak langsung akan mengurangkan kadar pengeluaran. Operasi manual dalam pendekatan ini juga menyebabkan kos buruh yang lebih tinggi. Bagi mengatasi isu-isu ini, mengautomasikan pengeluaran penahan automotif dilihat sebagai satu pendekatan yang berpotensi. Idea utama projek ini adalah mencadangkan satu konsep reka bentuk sistem automasi untuk pengeluaran penahan automotif. Konsep ini mencadangkan penggunaan mekanisme pengindeksan berputar. Tiga peringkat akan terlibat dalam projek ini. Pertama, ia melibatkan kajian tentang sistem pengeluaran yang berkaitan. Kajian ini adalah untuk mendapatkan maklumat yang berasas tentang jenis penahan automotif, pengeluaran penahan automotif di dalam tangki bahan api, pendekatan pemindahan bahan dalam sistem pengeluaran, peralatan dalam reka bentuk sistem pembuatan serta analisis mekanisme pengindeksan putar untuk sistem pengeluaran automatik. Peringkat kedua ialah peringkat reka bentuk. Reka bentuk dan simulasi proses sistem automatik yang dibangunkan akan melibatkan penggunaan perisian CATIA. Peringkat akhir melibatkan dengan simulasi dan analisis hasil simulasi. Apabila sistem pengeluaran automatik telah direka, proses analisis akan dilakukan dengan menggunakan perisian SolidWorks. Analisis ini akan melibatkan perbandingan menyeluruh pada masa kitaran semasa dan kadar pengeluaran dengan versi automasi yang dicadangkan. Keputusan dijangka akan meningkatkan kitaran masa dan juga kadar pengeluaran. Apabila semua siap, pendekatan sistem pengeluaran automatik dalam menghasilkan penahan automotif diharap dapat memberi manfaat kepada industri.

ABSTRACT

The current production of automotive retainer in the industry is through conventional process. The process involves the use of manual operation of huge stamping machines and its jigs. This approach requires high involvement of workers in the production line. As a consequence, longer cycle time is required to complete the process. This situation will indirectly lower the production rate. The manual operation in this approach also indicates higher labour cost. To overcome these issues, automating the production of automotive retainer is seen as a potential approach. The main idea of this project is to propose a design concept of automation system for the production of the automotive retainer. The propose concept include the utilization of rotary indexing mechanism. Three stages were involved in this project. Firstly, it involves the study of the related production systems. The study involving reviews on the related production system has been included in this project. The review is to gain the information based on the type of automotive retainer, the production of the automotive retainer in fuel tank, material transfer approach in the production system, tools in design of manufacturing system as well as analysis of the rotary indexing mechanism for automated production systems. The second stage is the design stage. The design and simulation process of the developed automated system involved the use of CATIA software. The final stage involves with the simulation and analysis of the simulation outcomes. Once the automated production system has been designed, the analysis process is performed using SolidWorks software. This analysis include a thorough comparison on the current cycle time and production rate with the proposed automation version. The results show the improvement of the cycle time as well as the production rate. The outcome of this new automated approach in producing the automotive retainer is hoped to benefit the industry in the future.

DEDICATION

To my beloved parents Abd Rashid Jubari and Hasnah Mohd Amin, my supportive siblings and my fellow friends,I love u all.

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Bismillahirrahmanirrahim. With the name of Allah the most Gracious and the most Merciful.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

CATIA	-	Computer aided three-dimensional interactive application
AMS	-	Automated manufacturing system
CAD	-	Computer aided drawing
ICG	-	Interactive computer graphics
3D	-	Three dimensional
CAM	-	Computer aided manufacturing
CAE	-	Computer aided engineering
FMS	-	Flexible manufacturing system
DOF	-	Degree of freedom
IGS	-	Initial Graphic Specifications

CHAPTER 1

INTRODUCTION

1.1 Background

In manufacturing the automotive fuel tank, there are few child parts required and used to complete the construction of one fuel tank. The child parts that are assembled in the fuel tank includes the tube breather, pipe fuel inlet, plate Fuel Tank separating, sub-part tank fuel, Support Fuel sub-tank, Reinforcement fuel tank upper and clamp. One of the prominent and important child parts is the bracket. The bracket is known as an automotive retainer that uses to attach the fuel pump assembly. The automotive retainer is assembled at the upper fuel tank at the lid of the fuel pump assembly.

Figure 1.1 and Figure 1.2 below show the automotive retainer in the fuel tank.

Figure 1.1 : Complete part of Automotive retainer (Sourse : United Vehicles Industries Sdn. Bhd.)

Figure 1.2: Fuel tank upper that assembled with automotive retainer.
(Source : United Vehicles Industries Sdn. Bhd.)

From the Figure 1.2, the dimension sizes of the automotive retainer is divided into two sizes. The big size dimension is attached at the center of fuel tank while the smaller size is at the edge of the fuel tank. The function is same as a bracket which is to attach the pump oil fuel and the tube of pump oil fuel.

In order to produce the parts of the fuel tank, the appropriate process manufacturing, material selection and manufacturing system approach is concerned to get a better fuel tank in case for the quality of the product. This is because the automotive fuel tank is the safety product used by users. The production of the fuel tank needs to be of high quality manufacturing process involving the child part, system production and quality inspection. The material used to produce the fuel tank is made of sheet metal. This sheet metal is shaped using stamping machine.

The production rate of automotive retainer is important to make sure the part is not released before the assembly process occurs. The production rate of these parts must be consistent that will be effect the process cycles time, the manufacturing stamping process and the raw material. The process stamping that involved in the several types such as the blanking process, chamfering process, form/embossing process, sheaving process, piercing process, flattening process and tapping process.

In this industry, the current production process of automotive retainer is using the big stamping machine and the conventional tooling. For examples, the process used the stamping machine is also used for producing the retainer and other process to achieve the desired parts. In addition, the mold and die can have changed to produce the other parts as well as follow the company production planning. The operation of the stamping machine needs at least one or two operators to operate the stamping machine which includes the material input and output. After the stamping process finished, the next process will be followed.

1.2 Problem statement

At present, the current production line approach used in the industry for the production of the automotive retainer is through the conventional process. Typically in the conventional process of an automotive retainer, stamping machine is widely used. This is because of the large size of the stamping machine that is able to produce this part. Hence, this will change the process method of stamping machine for another process part. In brief, the problems identified due to the conventional production line are as follows:

(a) Longer cycle time to complete the process.

(b) Lower production rate.

(c) Higher labor cost increase to operate the production.

To overcome the elaborated issues, automated production system is seen as a potential replacement system. The company can improve the production rate of the automotive retainer through the design of the automated production line and reduce the cycle time of the process.

1.3 Objectives of Project

To complete this project, three objectives have been identified. The objectives of this project are:

(a) To review and analyze the current production approach of the automotive retainer in industry.
(b) To propose the design conceptual of automating the production of the automotive retainer using rotary indexing mechanism.
(c) To analyze the cycles time and production rate for the proposed automated production approach.

1.4 Scopes and Limitations of Project

The main idea of this project is to automate the production of the automotive retainer. The proposed mechanism for this project will utilize the rotary indexing mechanism. In this project, CATIA software and SolidWorks software will be used to design the propose automated production line. Once the production line has been designed, analysis of the cycle time will be analysed for the process involving both the current method and the automated method will be performed.

Due to time constraint and the limitation of the software, this project does not encompass on the design of the jig and fixtures for the handling of the retainer parts. For the purpose of this project, the cycle time is calculated based on the material handling of the input until end of the production line process.

1.5 Structure of the Report

The report is organized into five chapters. Chapter 1 will introduces the project which includes background of project, problem statement, objectives to be achieved throughout the project, scopes, as well as the limitation of the project.

Chapter 2, literature review begins by discussing several terms related to automated production of the automotive parts, especially for retainer fuel tank, which is followed by the system types of automated production that suiTable for the process involved and the types of the material transfer mechanism on available design.

Chapter 3, methodology chapter discusses the method employed upon completing the project. Mixed methodologies comprising qualitative and quantitative approached are used to gather data. Flowcharts also will be shown for this chapter. Project design and analysis are elaborate more to get the outcomes of the design of the production. The simulation the automated production process will be created and analysed to get the quantitative data such as the standard cycle time.

Chapter 4 is about the result, analysis and discussion with will discuss the outcomes of the design and analysis of the automated production line, process selection to be automated for appropriate process, engineering concept for manufacturing production and the quantitative data of the cycle time process.

Chapter 5, the conclusion and recommendation chapter state the findings of the study and discusses its implications. This study draws its conclusion primarily for the design of automated production line as well as the analysis the time cycle process for thisproject.

CHAPTER 2
LITERATURE REVIEW

This chapter summarizes the current state of knowledge and information about the automating production of the automotive retainer using the rotary indexing mechanism. The most important part of this chapter is the review of several scope of the automotive retainer. Related issues regarding the production process system includes the comparison between the automated process and the conventional process. The review of cycle time and production rate of the production is also being discussed. The basic idea of the material transfer in production process system is also included. At the end of this chapter, there will be brief information of the design and simulation of the automated process production which is created by using either CATIA or SolidWorks software is included in this chapter.

2.1 Retainer

The retainer is defined as “a clip, frame or similar device that prevents a part of a machine, engine and other component from moving (Collins English Dictionary - Complete & Unabridged 10th Edition) . From the definition, retainer is a component that attached the structures so that it will e in placed. This sub chapter will explain about the retainer for automotive and mechanical discipline to produce.

2.1.1 Automotive retainer

In the automotive application, the retainer allows the use of components car such as at a body panel as cited by (Purcell, 1978). The retainer comprises a strip attached to the support structure and is conFigured to hold the body panel. Typically in the fuel tank, pipe filler oil and body car are widely used.

2.1.1.1 Automotive retainer at fuel tank

Automotive oil pump fixing ring was invented and shown in Figure 2.1 ("Automotive oil pump fixing ring" 2013)). It provides the design of automotive oil pump which is attached at fixed ring set on the upper tank. Existing car fixed ring mostly have a steel ring with bolt hole circle on the plate and then fitted with bolts.

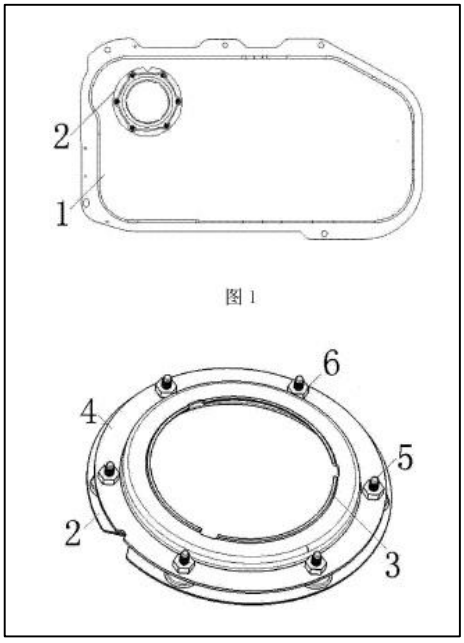

Figure 2.1 : A perspective view of automotive oil pump fixing ring. ("Automotive oil pump fixing ring," 2013)

In this design invention, there are some issues encountered for the existing fixed wrong pump. The issues include the work piece operation, the part is easy to loose and remove, low processing efficiency and high production costs, the retainer ring is

not quite to locate the oil pump, impede to ensure the accuracy of the assembly and operational effectiveness, the stability is poor and the quality of the product is different. In the technical problem, the utility model is implemented to achieve a simple assembly operation and assembly of high precision purposes. To solve this problem, the utility model approaches such as provided a car fixed ring pumps including pumps fixed ring body, the body of the pump unalterable ring is provided on the upper tank, the pump oil pump is provided on the cap retainer ring body between the pump body and the stationary ring pump gland bolt and spot by spot welding nuts.

2.1.1.2 Automotive retainer at pipe filler oil

Craig and Cupp (1983) invented the support of the fuel fill pipe for an automotive type fuel tank. Moreover, it relates to a retainer that resists fill pipe withdrawal as well as supports and locates the lower end of the fill pipe relative to the fuel tank. A partially exploded view of the fuel tank filler pipe retainer is illustrated in Figure 2.2 as follows.

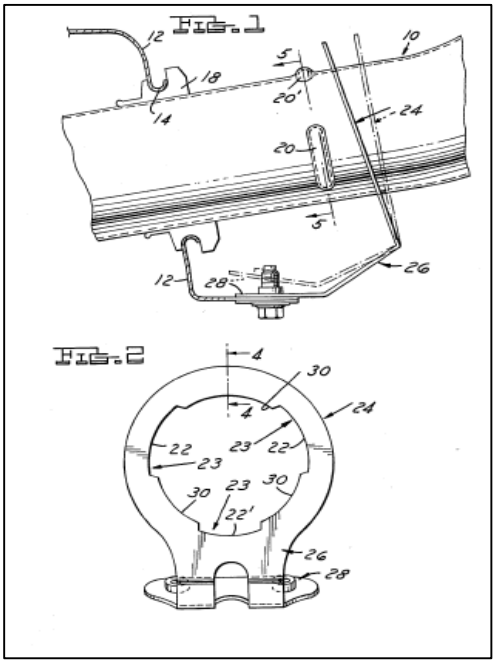

Figure 2.2 : Aperspective view of fuel tank filler pipe retainer. (Craig & Cupp, 1983)