DESIGN, ANALYSIS AND FABRICATION OF REGENERATIVE AUTOMOTIVE SUSPENSION SYSTEM TEST RIG MODULE

RAZLAN BIN RAZALI

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

SUPERVISOR DECLARATION

"I hereby declare that I have read this thesis and in my opinion, this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Automotive)"

Signature : .....

Supervisor : DR MOHD AZMAN BIN ABDULLAH

Date : .....

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RAZLAN BIN RAZALI

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DECLARATION

"I hereby declare that the work in this thesis is my own except for summaries and quotations which have been duly acknowledged."

Signature : .....

Author : RAZLAN BIN RAZALI

Date : .....

Special to

Beloved Mom and Dad

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ABSTRACT

The quantity of vehicle nowadays is increasing rapidly from year to year, the automotive sector has undergone a new era by producing hybrid vehicle. The definition of a hybrid is a vehicle utilizes more than one form of on-board energy to achieve propulsion. This means that a hybrid will have an internal combustion engine and fuel tank as usual car, but also will have one or more electric motors and a battery pack. This project is about the energy regenerative suspension system (EReSS). As we know when the car is moving, it would produce waste energy in the suspension system which will be wasted. Normally, this waste energy is dumped in a form of thermal energy in conventional of mechanical shock absorber. This project is about harnessing the energy and convert it to useful energy such as electrical energy to charge the battery pack by using the electromagnet concept. Every time vehicle move on the broken or cracked profile road, then the suspension system will move upward and downwards in vertical motion. The motion will cause the magnet to move together with the absorber. As the result of the process, magnetic flux occurs due to the presence of coil copper wire around the housing which will produce electricity through the copper wires. The main target of this project is to draw EReSS using CATIA V5R20 software and do deformation analysis of the model. Then, fabricate the test rig module was fabricated so that it can be used in the future.

ABSTRAK

Jumlah kenderaan pada masa kini meningkat dengan pesat dari tahun ke tahun. Sektor automotif telah memasuki era baru dengan menghasilkan kenderaan hibrid. Definisi hibrid adalah sesebuah kenderaan yang mempunyai lebih daripada satu tenaga untuk menggerakan kenderaan tersebut. Ini bermakna sebuah kenderaan hibrid akan mempunyai enjin pembakaran dalaman dan tangki minyak seperti mana kenderaan biasa yang lain tetapi akan juga mempunyai satu atau lebih motor elektrik dan pek bateri. Projek ini adalah mengenai sistem tenaga penyerap hentakan regeneratif. Seperti mana yang kita ketahui, apabila kereta bergerak, kereta tersebut akan menghasilkan sisa tenaga yang terbuang dalam penyerap hentakan. Kebiasaannya, sisa tenaga ini akan berbentuk sebagai tenaga haba dalam penyerap hentakan mekanikal. Projek ini akan menggunakan tenaga tersebut dan menukarkannya kepada tenaga yang boleh diguna pakai seperti tenaga elektrik untuk mengecas pek beteri dengan mengguakan konsep electromagnet. Apabila kenderaan bergerak di atas jalan yang rosak atau retak, sistem penggantungan akan bergerak dari atas ke bawah dalam keadaan menegak. Gerakan ini akan mengakibatkan magnet tersebut untuk bergerak bersama dengan penyerap hentakan. Hasil daripada gerakan tersebut, fluk magnet akan terhasil disebabkan oleh kehadiran gegelung wayar tembaga disekeliling perumahan yang akan menghasilkan tenaga elektrik melalui wayar tembaga. Tujuan utama projek ini adalah untuk melukis seluruh sistem penggantungan EReSS menggunakan perisian CATIA V5R20 dan mengkaji perubahan bentuk selepas meletakkan daya ke atas model tersebut menggunakan perisian yang sama. Selepas itu, membuat fabrikasi ke atas model tersebut akan dibuat.

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LIST OF SYMBOLS

N	=	Newton
˚C	=	Degree Celsius
H_z	=	Frequency
V	=	Volt
%	=	Percentage
kg	=	Kilogram
mm	=	Millimeters
W	=	Weight
F	=	Force

LIST OF ABBREVIATION

EReSS	=	Energy Regenerative Suspension System
KERS	=	Kinetic Energy Recovery System
CATIA	=	Computer Aided Three-dimensional Interactive Application
EMF	=	Electromotive Force
DASYLab	=	Data Acquisition System Laboratory
MATLab	=	Matrix Laboratory
COG	=	Centre of Gravity

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CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

Today's world is full of technologies and commitment, the need of a person to be at one place after another is a must. Therefore, a vehicle is a necessity for a person to do such thing.

Harvesting energy from vibration is one of the most promising technologies. There were researches to figure out where energy is being wasted in a moving vehicle. Some hybrid cars are already recovering the energy from breaking. Therefore, the research interest had been searching elsewhere and narrowed down on the suspension system. There were different types of car models, which had been attached sensors to the suspension, to determine energy potential and then recorded the sensor data from laptop computers. The test revealed that a significant amount of energy was being wasted in conventional suspension system (Zuo & Tang, 2013).

The waste energy will be used for good, this Energy Regenerative Suspension System (EReSS) is designed to change the waste energy to form another type of energy which is electrical energy. The energy then can be used by attempted system. For this project, we can use the electrical energy to recharge the battery pack. The energy conversion that will take place is from kinetic energy to electrical energy. In order to convert this energy, electromagnetic concept is implemented. The magnet will be used to generate electricity by moving the magnet inside the coil for the regenerative

system. This project is to make sure that the test rig module will be used in the future to compare the data and increase the voltage by research.

1.1 PROBLEM STATEMENT

There was waste energy produced in suspension system while travelling. This project is to ensure that the waste energy produced from the vibration of suspension system can be used for something useful. This Energy Regenerative Suspension System (EReSS) can change the waste energy which is kinetic energy created by the movement of suspension due to the condition of the road surface to electrical energy using the theory of electromagnet. This voltage from EReSS can be used to recharge the battery pack. Unfortunately the voltage produced is in small scale. Therefore, mathematical models should be developed in order to make a simulation so that the parameter can be changed and run easily. Therefore, this test rig module is essential to be used in comparison to EReSS being put at Perodua Myvi to find ways to increase the voltage in the future.

1.2 OBJECTIVE

The objective of this project are to design, to do analyze and fabricate the EReSS test rig module.

1.3 SCOPE OF PROJECT

The scope of this project is to do the drawing of suspension system with the three main components which are spring, absorber and EReSS using CATIA V5R20 software. After that, deformation analysis will be done using the CATIA V5R20 software. Then, fabrication will be done using mild steel to produce the top and lower mounting of the suspension system for test rig module.

1.4 SUMMARY

In this chapter, the introduction, background, problem statement, objective and scope of the project are being described. The EReSS should be implanted to the future vehicles. This is to ensure that we can use the waste energy for good purposes. This one invention would leads to the development of the green technologies that the world needed right now.

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

The regenerative energy from the suspension is the method that uses energy resulting from the vibration of the vehicle while driving on the road. The kinetic energy can be converted into useful energy such as electrical energy. The electrical energy can be used to recharge the battery pack. The product that's being designed in this project is called as “Energy Regenerative Suspension System” (EReSS). Based on the study that had been done, the profile of the road surface in this country, mostly bumpy, uneven and cracked which will help to produce vibration in the vehicle while driving. Therefore, the energy regenerative vibration can be produced. This chapter will discuss the vehicle suspension system, the use of magnets and coil to produce regenerative energy.

2.1 VEHICLE SUSPENSION SYSTEM

2.1.1 Background of Suspension

The suspension of the vehicle has been traditionally designed to have a compromise between the three factors of conflicting criteria. The three factors are passenger comfort, load carrying and road holding. The suspension system needs to support the vehicle, provide the effective isolation of passenger or payload from the road disturbance and give the proper directional control during handling maneuvers.

The thing needed to give good ride comfort is soft suspension, while insensitivity to applied loads requires stiff suspension. So to give good handling of the vehicle, it would require a suspension setting between the soft and stiff. The ability to store energy via a spring and to dissipate the energy via a damper is called as passive suspension system. While the ability to store, dissipate and to introduce energy to the system is called as an active suspension system. So due to the demands of consumers, the suspension need to be designed as something of a compromise. Usually, it will be determined by the type of use for which the vehicle was designed. **Figure 2.1** shows an example of the vehicle suspension system.

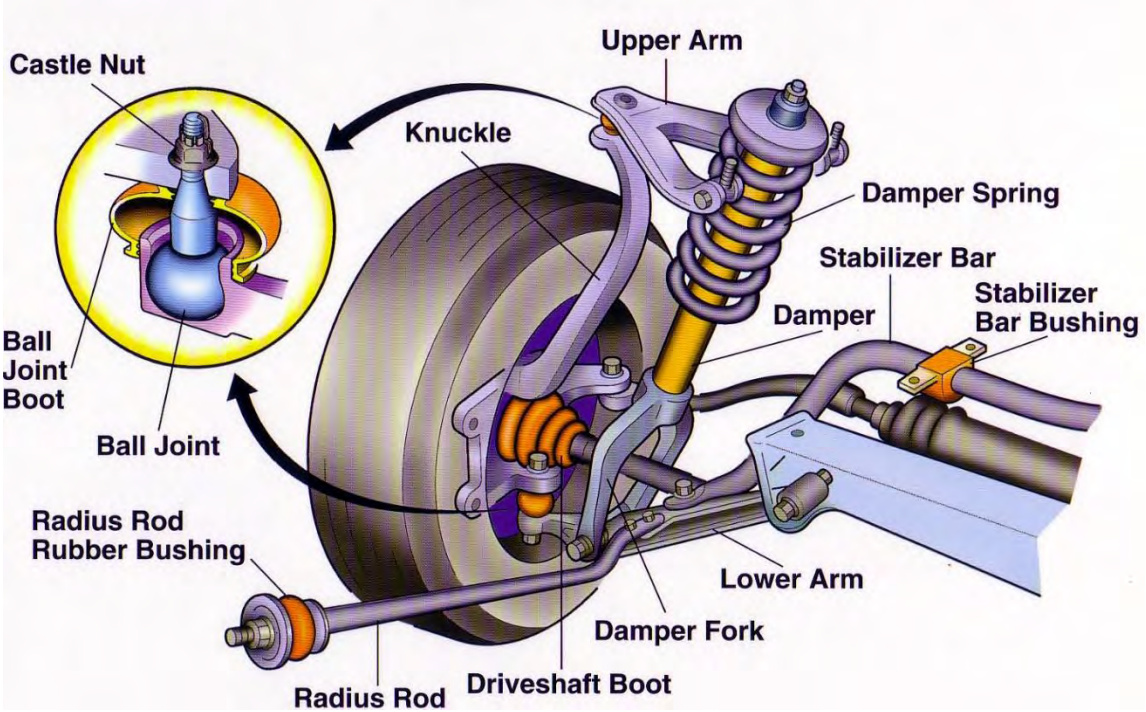

Figure 2.1: The basic component of the suspension system (Source: Hdabob, 2009)

In the early 19th century, British horse carriage has a spring suspension system installed in their design. Made of low-carbon steel, the spring suspension system took the form of multi-layer leaf spring. However, the British spring suspension system is not suitable for American carriage design due to the rough road condition. In 1820's, an antique suspension system, the coaches were supported on a leather strap that give a swinging motion instead of up and down movement caused by the spring suspension system (Uniquecar, 1999).

As the innovation of auto development, the steed drawn enhancing vehicles into fueled by interior burning motor, the suspension framework utilized for the carriage was esteemed out of date because of the distinction in velocity since the suspension framework for the carriage is inadmissible for motor controlled vehicle. The suspension framework was later modify by Mors of Paris in 1901, when the car organization fitted a safeguard to their vehicle. Henri Fournier won the prestigious Paris-to-Berlin race on the twentieth of June 1901 because of this change.

Torsion bar was presented as a component of the suspension framework in 1921 via Leyland Motors. In 1922, independent front suspension was utilized as part of the outline of Lancia Lambda and get to be regular in mass business sector vehicle since 1932.

2.1.2 Purpose of the Suspension System

The suspension system is located between the wheel axles and the vehicle body or frame. The purpose of suspension system are to support the weight of the vehicle, to maintain the traction between the tires and the road, cushion bumps and hole in the road and hold the wheels in alignment.

The suspension system allows the vehicle to travel over rough surfaces with a minimum of up and down body movement. Besides that, it will also allow the vehicle to corner with minimum roll to lose the traction between the road surfaces and the tires. This provides a cushioning action so road shocks have a minimal effect on the occupants and load in the vehicle. Road shock is the result of action from tires moving up and down as they meet bumps or holes in the road.

2.1.3 Component of Suspension System

The component of suspension system includes the spring and all the related parts that support the weight of the vehicle body on the wheels and axles. The main part of suspension system is the shock absorber and springs. The shock absorber will help to control the spring action, while the spring will support the weight of the vehicle