I/We admit that have read
this work and in my opinion this work
is enough in terms of scope and quality to bestowal
Bachelor of Mechanical Engineering (Automotive)

Signature : ……
Supervisor's Name 1 : ..……..
Date : ……

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Supervisor's Name 2 : ..……..
Date : ……

DESIGN OF A PHYSICAL MODEL OF THE CAR CHARGING SYSTEM

MOHD KHAIR BIN SALEHAN

The PSM (Projek Sarjana Muda) report is considered as one of the essential for students to complete their bachelor program in Mechanical Engineering (Automotive)

Faculty of Mechanical
Universiti Teknikal Malaysia Melaka

27 MARCH 2008

"I admit that this report is my own work accept precise and extract which is each of them I already telling resource"

Signature : ……...……

Writer's Name : MOHD KHAIR BIN SALEHAN

Date : 27 MARCH 2008

"I would like to dedicate this to my beloved parents and family"

ACKNOWLEDGEMENT

I would like to thanks to my supervisor Mr. Herdy Rusnandi for his guidance and impetus during implement this report.

I also want to thanks to my parents and all my friends for their support and encouragement to succeed and finished this report. Hopefully, this report will become a reference and the guideline to other student in the future.

ABSTRACT

The purpose of this project is to design and fabricate a physical model of the car charging system that can be used for teaching, learning and testing for educational purposes. We hope that with this model, it will useful to any educational institution to teach about the car charging system. In this project we used the Toyota's charging system as a reference. We will see how the car charging system operates and how the electrical load influences the charging system. This model will have the wiring diagram which is use to see how the system operates and the volt and ammeter which are use to see how the electrical load influences the volt and the current in the car charging system.

ABSTRAK

Tujuan projek ini adalah mereka bentuk dan menghasilkan suatu model mengenai sistem pengecas kereta yang boleh digunakan untuk pengajaran, pembelajaran dan ujian untuk tujuan pendidikan. Kami berharap dengan model ini, ia dapat digunakan di mana-mana institusi pendidikan untuk tujuan pengajaran khususnya dalam sistem pengecas kereta. Di dalam projek ini, kami menggunakan sistem pengecas bagi jenama Toyota sebagai panduan kami. Di dalam model ini juga kita boleh melihat bagaimana sistem pengecas kereta ini beroperasi dan bagaimana muatan elektrik kereta mempengaruhi sistem pengecas kereta. Model ini akan memaparkan gambar rajah pendawaian sistem pengecas kereta di mana pendawaian ini digunakan untuk melihat bagaimana sistem itu beroperasi dan ianya juga mempunyai voltmeter dan ammeter yang digunakan untuk melihat bagaimana pengaruh-pengaruh muatan elektrik terhadap voltan dan arus elektrik di dalam sistem pengecas kereta.

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CHAPTER I

INTRODUCTION

The PSM (Projek Sarjana Muda) Report is considered as one of the essential for students to complete their bachelor program. In this report, it will cover the problem statement, scope, objective and the overall overview of the project. Every effort has been taken in ensuring the report is a compact and concise piece of reading material. It has been organized in a systematic manner to guarantee that the reader fully comprehends the information contained in this report.

1.1 Background Of The Project

The charging system includes the alternator, voltage regulator which is often a part of the alternator itself), the battery, and the indicator gauge or warning light on the dash (See Alternator, Battery and Voltage Regulator). The charging system's job is to generate enough current to keep the battery fully charged, and to satisfy the demands of the ignition and electrical systems. The voltage regulator senses the demands on the electrical system, and controls alternator output so sufficient current is produced. A loose V-belt, or a defective alternator or voltage regulator can cause the dash warning light to glow red (or the amp gauge to show and steady discharge). If the problem isn't corrected, the battery will run down and eventually go dead.

The purpose of this project is to design and fabricate a physical model of the car charging system that can be used for teaching, learning and testing for educational purposes. We hope that with this model, it will useful to any educational institution to teach about the car charging system. In this project we used the Toyota's charging system as a reference. We will see how the car charging system operates and how the electrical load influences the charging system. This model will have the wiring diagram which is use to see how the system operates and the volt and ammeter which are use to see how the electrical load influences the volt and the current in the car charging system.

1.2 Objective

The main objective in this project is to design and fabricate of a physical model of the car charging system. In this project we must understand the wiring diagram and proper diagnosis of charging system problems requires a thorough understanding of the system components and their operation.

1.3 Scope

The scopes in this project are the design should be based on real car charging system. The electrical load system and the physical model can be use for teaching, learning and testing purpose.

1.4 Problems Statement

1. I choose this project because I concern about the educational facility for student to learn and study especially in car charging system. With this model, I hope that it will make easier for the lecturer or teacher in teaching, learning and testing.

2. Make easier for the mechanics or workers during testing the alternator whether the alternator is in good condition or not.

3. Help the car users learned of the system and the common problems about charging system in their car. With this model, the mechanic will gives the explanation and show the problems to the car user about the problems that occurred.

4. Learned about the influences of the electrical loads in the voltage and current of the car charging system.

1.5 Project planning

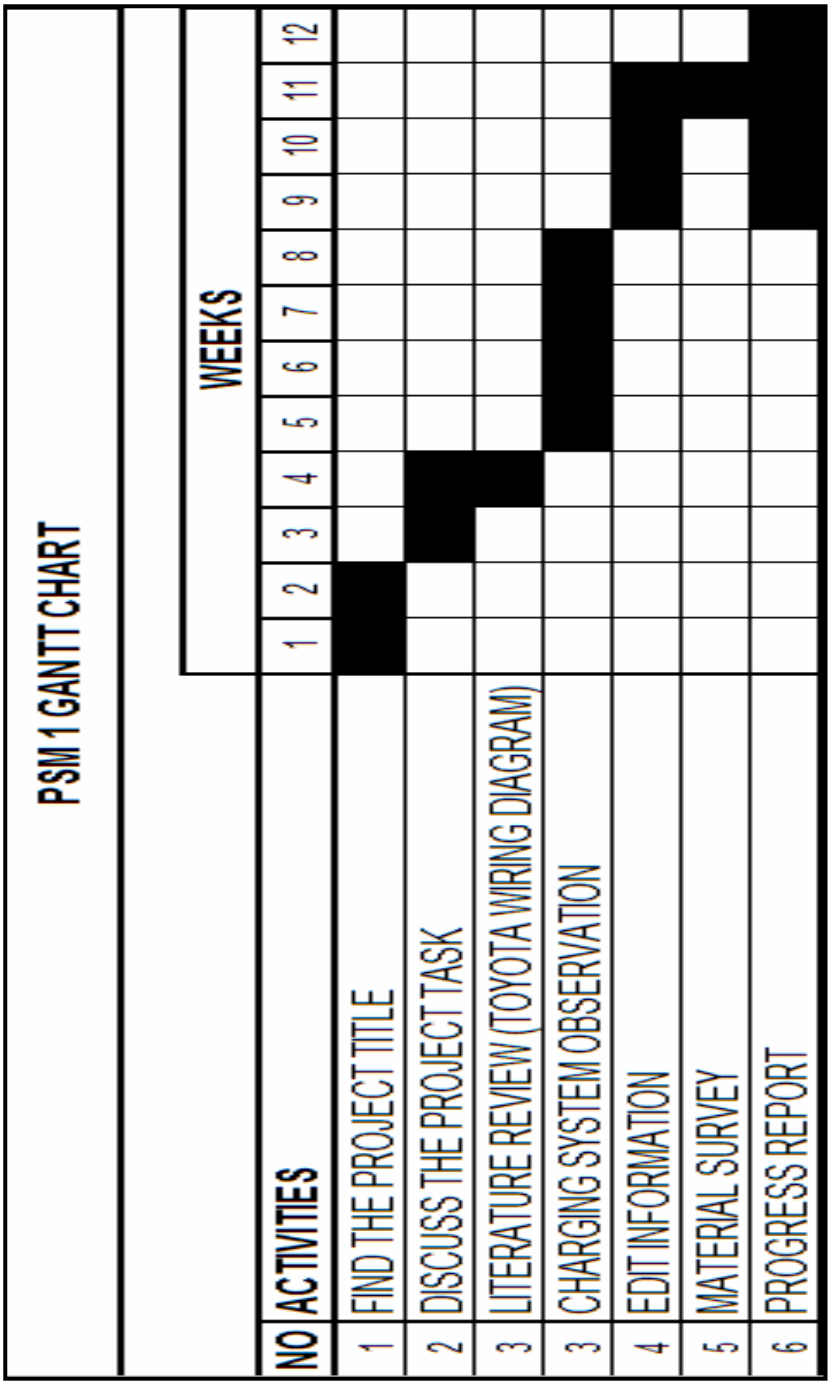

Table 1.1: PSM 1 Gantt Chart

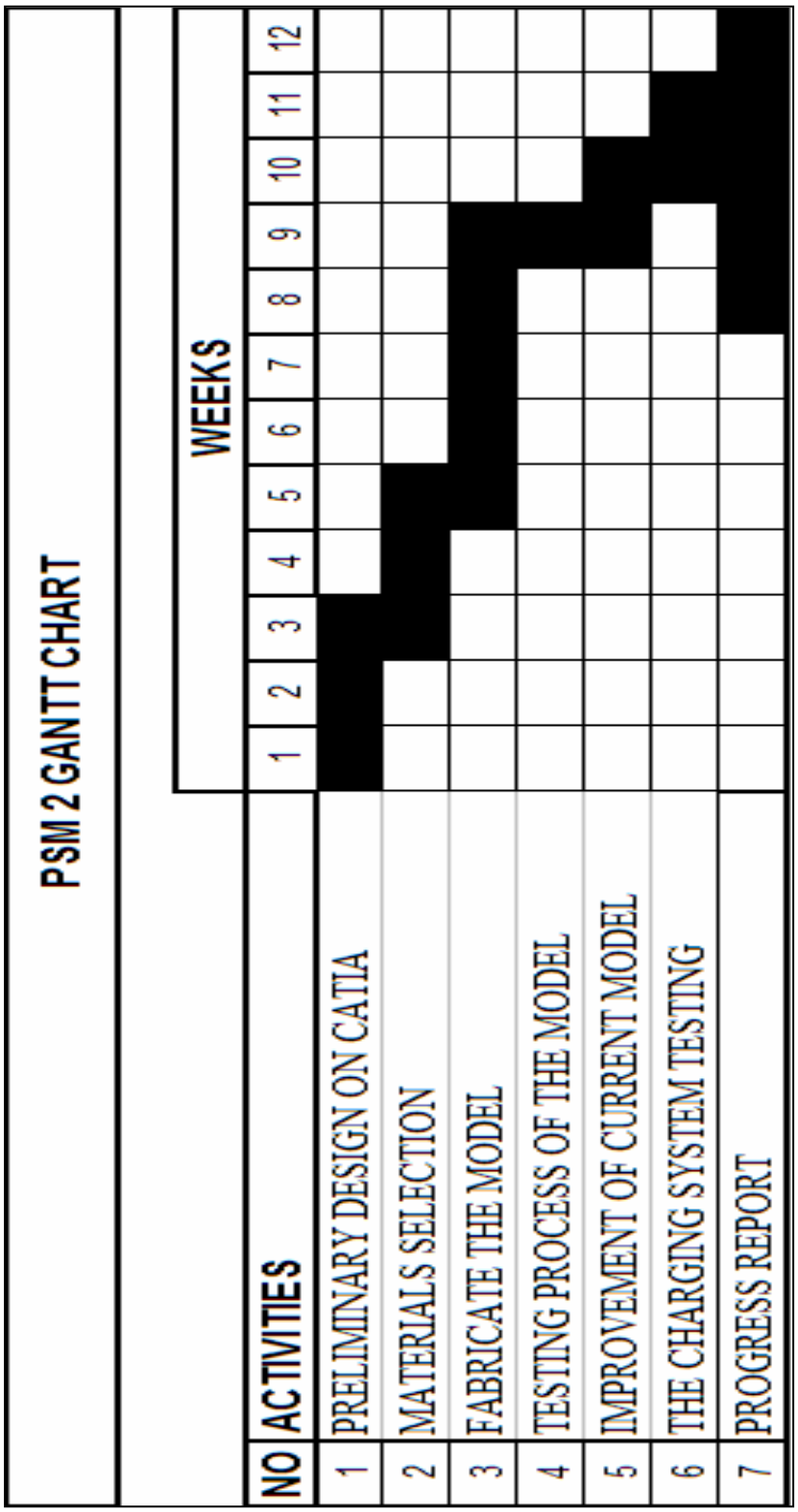

Table 1.2: PSM 2 Gantt Chart

CHAPTER II

LITERATURE REVIEW

2.1 Charging System

The modern charging system hasn't changed much in over 40 years. It consists of the alternator, regulator (which is usually mounted inside the alternator) and the interconnecting wiring. The purpose of the charging system is to maintain the charge in the vehicle's battery, and to provide the main source of electrical energy while the engine is running. If the charging system stopped working, the battery's charge would soon be depleted, leaving the car with a "dead battery". If the battery is weak and the alternator is not working, the engine may not have enough electrical current to fire the spark plugs, so the engine will stop running. If the battery is "dead", it does not necessarily mean that there is anything wrong with it. It is just depleted of its charge. It can be brought back to life by recharging it with a battery charger, or by running the engine so that the alternator can charge it.

The main component in the charging system is the alternator. The alternator is a generator that produces Alternating Current (AC), similar to the electrical current in your home. This current is immediately converted to Direct Current (DC) inside the alternator. This is because all modern automobiles have a 12 volt, DC electrical system. A voltage regulator regulates the charging voltage that the alternator produces, keeping it between 13.5 and 14.5 volts to protect the electrical components throughout the vehicle.

Figure 2.1: Alternator (source: www.familycar.com/Classroom/charging.htm)

There is also a system to warn the driver if something is not right with the charging system. This could be a dash mounted voltmeter, an ammeter, or more commonly, a warning lamp. This lamp is variously labeled "Gen" Bat" and "Alt". If this warning lamp lights up while the engine is running, it means that there is a problem in the charging system, usually an alternator that has stopped working. The most common cause is a broken alternator drive belt.

Figure 2.2: Engine (source: www.familycar.com/Classroom/charging.htm)

The alternator is driven by a belt that is powered by the rotation of the engine. This belt goes around a pulley connected to the front of the engine's crankshaft and is usually responsible for driving a number of other components including the water pump, power steering pump and air conditioning compressor. On some engines, there is more than one belt and the task of driving these components is divided

between them. These belts are usually referred to as: Fan Belt, Alternator Belt, Drive Belt, Power Steering Belt, A/C Belt, etc. More common on late model engines, one belt, called a Serpentine Belt will snake around the front of the engine and drive all the components by itself.

Alternator output is measured in both voltage and amperage. To understand voltage and amperage, we must also know about resistance, which is measured in ohms. An easy way to picture this is to compare the movement of electricity to that of running water. Water flows through a pipe with a certain amount of pressure. The size (diameter) of the pipe dictates how much resistance there will be to the flowing water. The smaller of the pipe, more resistance will produce. We can increase the pressure to get more water to flow through, or we can increase the size of the pipe to allow more water to flow using less pressure. Since too much pressure can burst the pipe, we should probably restrict the amount of pressure being used.

Voltage is the same as water pressure. Amperage is like the amount or volume of water flowing through, while resistance is the size of the wire transmitting the current. Since too much voltage will damage the electrical components such as light bulbs and computer circuits, we must limit the amount of voltage. This is the job of the voltage regulator. Too much water pressure and things could start breaking. Too much voltage and things could start burning out.

2.2 Operation

When the engine is running, battery power energizes the charging system and engine power drives it. The charging system then generates electricity for the vehicle's electrical system. At low speeds with some electrical loads 'on' (e.g. lights and window defogger) some battery current may still be needed. But at high speed, the charging system supplies all the current needed by the vehicle. Once those needs are taken care of, the charging system then sends current into the battery to restore its charge.

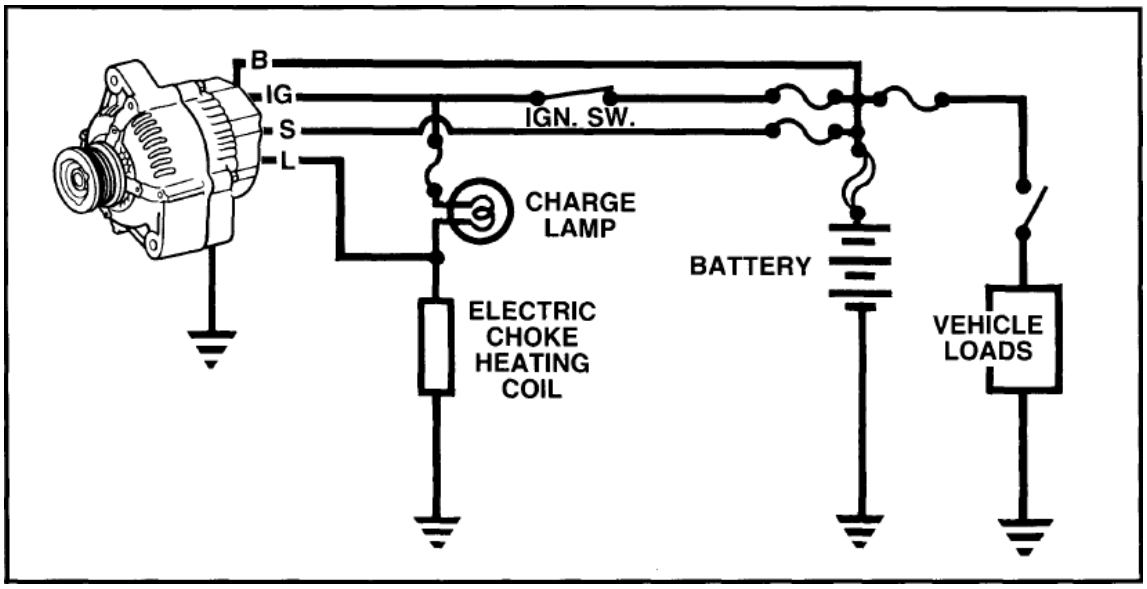

Figure 2.3: Wiring Diagram (source: www.autoshop101.com)

2.3 Typical Charging System Components Include

- Ignition switch

When the ignition switch is in the on position, battery current energizes the alternator.

- Alternator

Mechanical energy is transferred from the engine to the alternator by a grooved drive belt on a pulley arrangement. Through electromagnetic induction, the alternator changes this mechanical energy into electrical energy. The alternating current generated is converted into direct current by the rectifier, a set of diodes which allow current to pass in only one direction.

- Voltage regulator

Without a regulator, the alternator will always operate at its highest output. This may damage certain components and over charge the battery. The regulator controls the alternator output to prevent over charging or under charging. On older models, this is a separate electromechanical component which uses a coil and contact point to open and close the circuit to the alternator. On most models today, this is a built in device.

- Battery

The battery supplies current to energize the alternator. During charging, the battery changes electrical energy from the alternator into chemical energy. The battery's active materials are restored. The battery also acts as a shock absorber or voltage stabilizer in the system to prevent damage to sensitive components in the vehicle's electrical system.

- Indicator

The charging indicator device most commonly used on Toyotas is a simple ON/OFF warning lamp. It is normally off. It lights when the ignition is turned "on" for a check of the lamp circuit. And, it lights when the engine is running if the charging system is undercharging. A voltmeter is used on current Supra and Celica models to indicate system voltage. It is connected in parallel with the battery was used on older Toyotas.

- Fusing

Fusible links as well as separate fuses are used to protect circuit in the charging system.

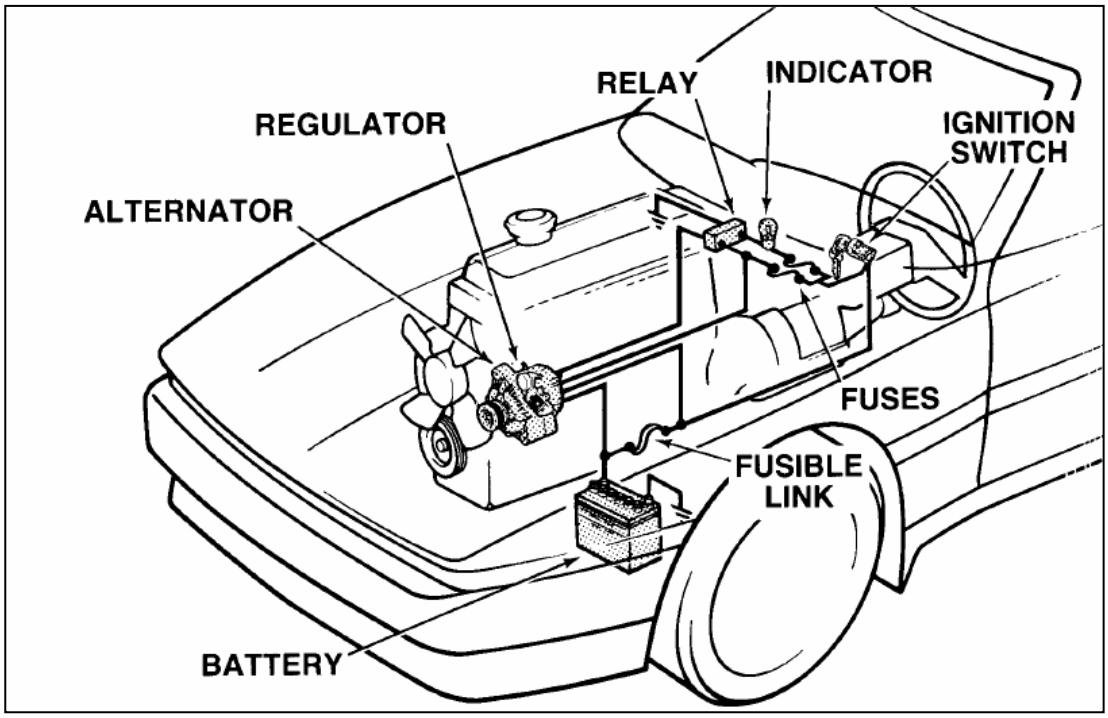

Figure 2.4: Charging System (source: www.autoshop101.com)

2.4 Alternator

Figure 2.5: Alternator Stator (source www.familycar.com/Classroom/cgarging.htm)

The alternator uses the principle of electromagnetism to produce current. The way this works is simple. If you take a strong magnet and pass it across a wire, that wire will generate a small voltage. Take that same wire and loop it many times, than if you pass the same magnet across the bundle of loops, you create a more sizable voltage in that wire.

There are two main components that make up an alternator. They are the rotor and the stator. The rotor is connected directly to the alternator pulley. The drive belt spins the pulley, which in turn spins the rotor. The stator is mounted to the body of the alternator and remains stationary. There is just enough room in the center of the stator for the rotor to fit and be able to spin without making any contact.

The stator contains 3 sets of wires that have many loops each and are evenly distributed to form a three phase system. On the some systems, the wires are connected to each other at one end and are connected to a rectifier assembly on the other end. On other systems, the wires are connected to each other end to end, and at each of the three connection points, there is also a connection to the rectifier. More on what a rectifier is later.