



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**Fabrication of Emergency Tyre Inflator Generated from
Motorcycle Exhaust Gas**

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Maintenance Technology) with Honours.

by

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Date :

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 Mechanical Engineering Technology (Maintenance Technology) with Honours. The member of the supervisory is as follow:

.....

(Project Supervisor)

ABSTRAK

Kajian ini tertumpu kepada kajian awal iaitu untuk mengkaji fungsi, kerja, reka bentuk dan reka injap sehalu “*inflator*”. Injap sehalu adalah jenis injap biasa yang merupakan kelengkapan peralatan yang membolehkan aliran udara hanya melalui satu arah. Dalam kajian ini, tayar motosikal adalah sasaran untuk membolehkan tayar tersebut dalam keadaan yang normal. Tayar boleh kehilangan udara melalui pemanduan biasa atau selepas mencecah lubang pada jalan atau sekatan. Tayar kehilangan 1 atau 2 psi setiap bulan di musim panas dan hujan. Dalam projek ini, terdapat beberapa isu yang ingin diselesaikan iaitu jarak yang jauh untuk mendapatkan bengkel apabila berlaku tayar pancit, oleh itu tercetuslah idea untuk merekabentuk projek ini. Selain itu, jika perjalanan jauh dengan menggunakan motosikal, kemalangan dan kejadian yang tidak diingini seperti tayar pancit, tekanan udara yang rendah dalam tayar sering berlaku. Objektif projek ini adalah untuk membangunkan satu sistem tayar “*inflator*” baru untuk membolehkan operasi yang lebih mudah, lebih selamat dan lebih dipercayai. Cadangan projek ini adalah daripada gas ekzos motosikal yang menghasilkan tekanan dari enjin dan ia akan digunakan sebagai sumber untuk operasi kerja “*inflator*” dan cara-cara praktikal untuk mengepam tayar dalam keadaan kecemasan. Pada akhir projek ini, pembuatan produk ini mencapai semua objektif projek dan hasil yang diperoleh dari pengujian antara pemampat udara dan “*inflator*” tayar kecemasan adalah hampir sama. Tetapi “*inflator*” tayar kecemasan akan menjadi sangat biasa pada masa akan datang jika kajian lebih terperinci dijalankan untuk membolehkan produk ini digunakan secara meluas dalam industri automotif.

ABSTRACT

This study focused on the preliminary study on function, working, design and fabricate of the one-way valve (inflator). The one-way valves are a common piece of instrumentation fittings which allows flow in one direction only. Tyre can lose air through normal driving or after hitting pot holes or curbs. Tyre lose 1 or 2 psi each month in the summer and rainy season. In this project, there are several issues to be solved, including long distances to get the workshop when a flat tyre occurs, then the idea come out to design this project. Besides that, when it comes to travelling by motorcycles, mishap and unwanted incidents such as tyre punctured, low air pressure in tyre are extremely common occur. The objective of this project is to develop a new tyre inflator system in order to make the operation easier, safer and more reliable. This project proposal is about waste exhaust gas that produce pressure from motorcycle engine will be used as the source to the tyre inflator and practical ways to pump tyre in emergency situation. At the end of this project, the fabrication of this product is achieve all the project objectives. Because the result obtain from the testing between air compressor and emergency tyres inflator is similarity. But the emergency tyre inflator will become very common in the near future if more detailed studies are carried out to allow this product to be widely used in the automotive industry.

DEDICATION

To my beloved mother Mrs. Teh Binti Osman and my beloved father Mr. Abdullah
Bin Jaafar

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

| | | |
|-----------------|---|------------------------------------|
| DC | - | Direct Current |
| NDP | - | Non-Displacement Pump |
| PDP | - | Positive Displacement Pump |
| CO ₂ | - | Carbon Dioxide |
| CO | - | Carbon Monoxide |
| NO _x | - | Nitrogen Oxide |
| RR | - | Rolling Resistance |
| DOT | - | Department of Transportation |
| WDM | - | Weighted Decision Matrix |
| LCD | - | Liquid Crystal Display |
| QFD | - | Quality Function Deployment |
| HOQ | - | House of Quality |
| ATPC | - | Automatic Tyre Pressure Controller |
| PP | - | Polypropylene |
| RM | - | Malaysian Ringgit |
| ETI | - | Emergency Tyre Inflator |

CHAPTER 1

INTRODUCTION

1.1 Invention of The Motorcycle Tyre

In 1846, a Scottish engineer in France who was given a patent for this tyre and after a year in the USA 1847. The development of this tyre was exceptionally basic. It comprised of an empty round belt made of Indian rubber which was then inflated with air. Today, the modern motorcycle tyre was design has experienced many changes and transformations a middle the most recent century. These improvements have prompted the modern tyre. One of these improvements is the outspread tyre. The first outspread tyre design were patented in 1915 and maker in San Diego, CA. However, after the outspread tyre design and patent, Michelin in 1946 further built up this type of tyre too and also made a commercial business achievement of it. This new design was an additional benefit for a motorcycle as it upgraded the street hold and footing while riding (Madan G Singh, 2011).

However, innovation moves forward the inner rubber tube was disposed of and in 1972, Dunlop come out with the tubeless tyre. The changing requests throughout the years, market forces and customer preferring has had the advancement of the motorcycle tyres and many new types are out on the road. The essential function of a tyre is to give the rider and his passenger behind a motorcyclist on the motorcycle a smoother ride. They should have relatively resistant to punctured and most important give a good road grip that is so fundamental in motorcycle riding. One thing that should be consider, is that tyre are the most important part of a motorcycle as not only it helps the motorcycle move forward, but are also important for the safety of the motorcycle and the rider (Madan G Singh, 2011).

1.2 Background of The Study

This was a revolutionary invention, motorcycles are two wheel that powered by internal combustion engine either two-stroke or four-stroke has used a variety types of tyre that have a safety and advantages features. According to the latest statistics in table 1.1, total accumulated motorcycles in Malaysia was 11,629,265 units in 2014 equal to 46% or nearly half of the overall total accumulated vehicle.

Table 1.1: Total Accumulated Vehicle in Malaysia According Types of Vehicles and State in 2015

| JENIS KENDERAAN NEGERI | Kenderaan Persendirian | | Kenderaan Perkhidmatan Awam | | | Kenderaan Barang | Lain-lain Kenderaan | Jumlah |
|---------------------------|------------------------|-------------------|-----------------------------|----------------|------------------------------|---------------------|------------------------|-------------------|
| | Motosikal | Motokar | Bas | Teksi | Kereta Sewa Pandu Sendiri | | | |
| Perlis | 73,621 | 22,833 | 175 | 126 | 79 | 1,982 | 2,266 | 101,082 |
| Kedah | 853,278 | 314,324 | 2,940 | 2,319 | 1,370 | 38,957 | 30,499 | 1,243,687 |
| P Pinang | 1,311,249 | 1,064,250 | 5,006 | 3,713 | 1,685 | 75,364 | 38,953 | 2,500,220 |
| Perak | 1,274,019 | 726,350 | 4,601 | 3,664 | 878 | 73,723 | 59,404 | 2,142,639 |
| Selangor | 1,273,286 | 1,068,420 | 6,460 | 14,647 | 1,990 | 181,434 | 133,718 | 2,679,955 |
| W Persekutuan | 1,707,324 | 3,633,331 | 18,144 | 54,057 | 41,905 | 258,614 | 236,110 | 5,949,485 |
| N Sembilan | 514,775 | 322,283 | 2,460 | 1,933 | 564 | 46,899 | 16,310 | 905,224 |
| Melaka | 433,604 | 322,338 | 1,673 | 1,554 | 431 | 27,443 | 13,709 | 800,752 |
| Johor | 1,722,944 | 1,397,582 | 8,482 | 12,370 | 2,754 | 145,404 | 96,188 | 3,385,724 |
| Pahang | 548,213 | 359,248 | 1,953 | 1,888 | 982 | 45,220 | 28,536 | 986,040 |
| Terengganu | 354,736 | 196,226 | 1,042 | 925 | 327 | 21,994 | 13,414 | 588,664 |
| Kelantan | 502,917 | 285,542 | 1,980 | 1,521 | 587 | 29,343 | 16,572 | 838,462 |
| Sabah | 338,902 | 591,868 | 7,042 | 4,566 | 3,779 | 121,021 | 98,123 | 1,165,301 |
| Sarawak | 720,395 | 723,701 | 3,086 | 2,405 | 1,606 | 92,119 | 98,639 | 1,641,951 |
| Portal Rakan Niaga | 2 | 171614 | 0 | 1 | 8 | 355 | 26 | 172,006 |
| Jumlah | 11,629,265 | 11,199,910 | 65,044 | 105,689 | 58,945 | 1,159,872 | 882,467 | 25,101,192 |

Source: Import Association and Vehicle Dealer in Malaysia (PEKEMA, 2015)

These statistics show that many people in Malaysia usually use motorcycle as their transportation. A power source for motorcycle is internal combustion engine. Internal combustion engine is combustion that occur in the combustion chamber by ignite the mixture of compress of air and fuel. The combustion produce power to move the motorcycle from one place to another place.

From Table 1.1 also show that many people usually used motorcycle as their transportation because motorcycle used less fuel. However, if motorcycle lack of maintenance especially tyre do not maintained properly it will cause unwanted problem. For example, flat tyre occur on a motorcycle give high possibility causing accident to the rider.

In this situation, rides on a tyre punctured is dangerous and should not be done. Once get a signal that tyre punctured happen, slow down to 20 kmh and find a safe stopping point as quickly as time permits. If has own experience, it can change the tyre punctured and replace it with the spare tyre or call a mechanic to change the tyre. In addition, caused this issue always occurs on the motorcycle riders, many riders are switching to tubeless tyre. These tyre help to make a tyre punctured considerably less likely. So hence, it shows up the idea to developed a new tyre inflator is less expensive and easier to used when tyre punctured happen especially for motorcyclist.

The focus of this project is to study method, operating and testing of the emergency tyre inflator. The tyre inflator a common tool of instrumentation fittings which allows pressure flow in one-way direction. In this project, there are several issues to be solved, including long distances to get the workshop when a tyre punctured happens and safe stopping point, at that point the idea come out to developed this product. Other than that, when it comes to travelling by motorcycles, undesirable occurrences for example, tyre punctured, low air pressure inside tyre are extremely common. This project also is about using harvested gas pressure from exhaust that released from motorcycle engine will used as a source to operating tyre inflator and it practical approaches to pump tyre in emergency situation.

1.3 Problem Statement

When it comes to travel by motorcycles, undesirable occurrence such as tyre punctured, low air pressure inside tyre are greatly normal, it is an unexpected emergency case for example, tyre punctured happen and this situation hard to be prevented. Other than that, conventional tool like hand air pump that are now available on the market difficult to carry because size of the air pump component relatively large. However, nowadays a variety of tyre inflator have been developed to fill the air pressure inside the tyre. But tyre inflator today are typically manually operated and therefore require substantial physical effort on the part of the user. In other case, it makes usage more difficult to fill the pressure air especially for the women and elderly people. In term of size, tyre inflator that are now available on the market today mostly large and need a more space when travelling by motorcycle. Besides that, the conventional method of replacing tyre punctured is difficult to do for a single person and the operating process can be carried out is dependent on the skill and experience of the person (Adakmol et al. 2016).

From the reviews it is known that a pressure drop in motorcycle tyre will affect the tyre wear, safety, fuel mileage and whole motorcycle performance. Roads are the most important way of transport nowadays and motorcycle are integral part of it. Tyre lose air pressure through normal rides especially when run through pot holes and permeation. Moreover, temperature changes seasonal are also one of the reason because of which tyre lose air pressure. At the point when tyre punctured occur, the thread wears more quickly. This equates to 15% less kilometers it can rides on the road for each 20% that are properly inflated. Other than that, tyre punctured also overheat more quickly compare with properly inflated tyre, which cause more tyre defect and damage (Junankar et al. 2015).

1.4 Project Objective

- a) To solve unexpected emergency flat tyre occurs during travelling.
- b) To fabricate emergency tyre inflator system in order to make the operation easier, safer and more reliable.

1.5 Scope of Project

This project work scope is listed below:

- a) Motorcycles that powered by internal combustion engine only (four-stroke).
- b) Motorcycle LC 135cc was used for these trials and testing.
- c) Standard pressure motorcycle tyre is 32 psi to 34 psi.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The industry has shown a lot of growth in terms of automation of automobile and motorcycle parts for better service quality and efficiency. However, there are several of factors such as efficiency, convenience, safety and cost savings are a priority basis in the development of automation today. Tyre is an important part in the development of motor industry. This chapter will explain more about the mechanisms and the comparison between an existing air pressure pump.

It is also important to understand the mechanisms that enable these contributions as well as their significance. In this chapter also study how to determine current tyre inflator system theories, design and fabricate methods as well as to better understand the concept and working principle of tyre inflator for tyre pressure monitoring and maintenance.

2.2 Identify The Problem

From the reviews it is known that a pressure drop in tyre will affect the tyre wear, safety, fuel mileage and whole motorcycle performance. For examples, airshot portable inflator tubeless is an equipment that are already exists in the market as a tool to fill the air pressure inside the tyre punctured. The system is simple, just fulfilled the airshot canister with track pump to 130psi, then attach the pipe to the valve after removing valve core and open the release valve to blast the air into the tyre.

However, the price of this equipment is quite expensive on the market compare with the other tool that are already exist. So therefore, it appears the idea to developed a new tyre inflator is cheaper and easier to used when tyre punctured occur especially for motorcyclist. (Adakmol et al. 2016).

Tyre is the most fundamental part of motorcycle and it assumes significant part in ensuring safe ride. As a point by point study has accompanied outcome that pressure drop inside tyre by only few of psi leads the decrease in fuel mileage, tyre life, safe riding and drop the motorcycle performance. Ignorance of correct pressure requirement, sudden environmental changes are also some of causes for tyre running with improper pressure. (Wadmare & Pandure 2017).

Figure 2.1, 2.2 and 2.3 shown which need leg strength to press the pump, need the help from other person to change the flat tyre and high force is required to press the stand pump for fill air into flat tyre.



Figure 2.1: Need Leg Strength to Press the Pump (John et al. 2016)



Figure 2.2: Need Help from Other Person to Change The Flat Tyre (Ajas et al. 2014)



Figure 2.3: High Force Is Required (Anand & Warikh 2009)

2.3 Previous Project Research

The facts are that, tyres with proper inflated pressure would safe be able to its life up to 20% which is nine months a greater amount of its life expectancy. It can also save fuel from 4% to 10%, increase braking efficiency up to 20%. Other than that, correct inflating tyre pressure can also keep tyres from overheating, explosion and then again, it can ease monitoring and reduce maintenance cost. The air pressure pump at fuel stations may not provide the desired pressure as set. Then again, user need to use pressure measuring gauge to double check the correct pressure inside their tyre (St. Nicholas, 2008).



Figure 2.4: ATPC Made of Aluminum With Three Pre-Sets (Anand & Warikh 2009)

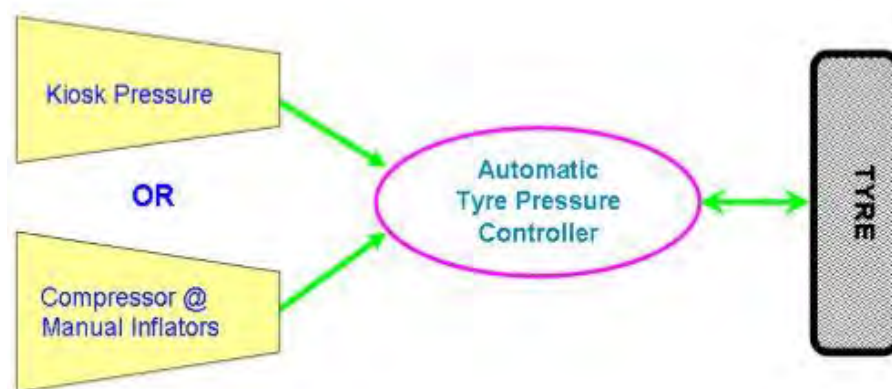


Figure 2.5: The schematic of operating procedures (Anand & Warikh 2009)

Figure 2.5 above explained further on how the ATPC can be used together with other pressure resources to inflate tyres and also shows the schematic of using ATPC.