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PERFORMANCE COMPARISON BETWEEN CNG AND PETROL FUEL IN INTERNAL COMBUSTION ENGINE

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

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fulfillment of the requirements for the award
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DECLARATION

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

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DEDICATION

I would like to give my dedication to my beloved parents, Mr. Kamarulzaman bin Mohammed Yusoff and Mrs. Salbiah binti Harun because they always give me moral support and everything. Next, to Dr. Musthafah bin Mohd Tahir which is my final year project Supervisor who always guided me throughout my final year. Not forget to Master students Muhammad Syahir bin Ali and Muhammad Muhaimin bin Mohd Syafi'e who helped me during my experiment and being a teacher when I have a problem on analyzing the data and understanding things. Lastly, to my course mates, PSM under Dr. Musthafah team, and FKM staffs. Thank you.

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ABSTRAK

Dalam laporan ini, ciri-ciri pembakaran dan pelepasan daripada enjin empat lejang, satu silinder palam pencucuhan dianalisis menggunakan petrol dan gas asli mampat (CNG) sebagai bahan api untuk dilihat prestasinya. Enjin telah ditukar kepada sistem dwi-pembakaran dan boleh dikendalikan dengan menggunakan petrol atau CNG sebagai bahan api. Enjin berjalan pada kelajuan antara 1500 rpm hingga 4000 rpm dengan 500 rpm peningkatan senggatan bagi kedua-dua bahan api iaitu petrol dan CNG serta CNG dengan penambahan PCC. Oleh itu, pembakaran boleh dikaji melalui beberapa eksperimen serta rujukan. Terdapat maklumat yang menyatakan bahawa CNG lebih baik dari petrol dan itu adalah keputusan yang diharapkan dalam kajian ini. Walaubagaimanapun, kajian adalah penting untuk mengurangkan kadar pelepasan bahan bakar yang mencemarkan alam sekitar malah lebih menjimatkan dari segi ekonomi kerana peningkatan harga petrol yang melampau pada masa kini.

ABSTRACT

In this report, the characteristics of the combustion and emission from 4-stroke, single cylinder spark ignition engine is analyzed in respect of gasoline and compressed natural gas (CNG) to review its performance. The engine was converted to bi-fuel system and can be operated either with gasoline or CNG. The engine was run at the speed between 1500 rpm to 4000 rpm with 500 increasement for both fuels, namely CNG and gasoline. Therefore, the combustion can be studied so the performance result of gasoline and CNG are compared and the expected result is for CNG be better than gasoline. However, the experiment of CNG with PCC also are tested and the result is compared with CNG without PCC. This is important to reduce greenhouse emission which pollutes the environment and more economical in terms of the economy due to the increasing of gasoline price nowadays.

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CHAPTER I

INTRODUCTION

This chapter will roughly elaborate about the advantage of the Compress Natural Gas (CNG), why this kind of fuel is chosen and the problem in the combustion that needs to be studied and improve so that the CNG can be better compared to gasoline and diesel. The scope of this project is generated based the objective given.

1.0 PROBLEM STATEMENT

A regulation requiring clear burning in engine combustion, the Compressed Natural Gas (CNG) was introduced which is lower greenhouse gas emission compared to the gasoline (Petrol).

Now days, due to the advantage of Natural Gas Engine such as High thermal efficiency, lower Nitrogen Oxide and soot emission, lower lubricant consumption, produce less Carbon Monoxide and cause less ozone formation, easier starting, more reliable idling and smoother acceleration, many of car consumer switched to CNG as an alternative to conventional fuel (Bhandari, Bansal, Shukla, & Khare, 2005).

But the CNG engine itself also has its disadvantage that are it theoretically has higher loss output power compare to LPG engine by 5.5%, compression ignition natural gas engine is the poor ignitibility of methane, a long and variable ignition delay is undesirable as it leads to sharp heat release and the CNG engine has high mechanical load due to an increased combustion in the premixed part (Zheng, Zhang, & Zhang, 2005).

Thus, the application of CNG systems into current vehicle nowadays needs a lot of improvement due to the performance of CNG engine compared to the gasoline fuel engine is lower with 20% difference. This power dropped might due to several factors needed to be studied in the combustion.

1.1 OBJECTIVES

The objectives needed to be done in order to complete this project are listed as follows:

1. To compare engine performance between two different types of fuel which is gasoline and Compressed Natural Gas.
2. To study CNG combustion in the 4 stroke, single cylinder engine.
3. To find the method to increase the CNG performance.

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1.2 SCOPES OF STUDY

The scope of this project is to conduct an experiment in order to find the performance comparison between gasoline, which is Petrol fuel and Compressed Natural Gas (CNG) in EY20D single cylinder spark ignition (SI) engine. In addition to analyse the performance of CNG with pre-combustion chamber (PCC) also conducted and compared. The data collected from experimental with help of combustion analyser will be analysed at the range of 1500 rpm until 4000 rpm using petrol fuel and CNG. Finally, the result gained for all experiment will be discussed.

CHAPTER II

LITERATURE REVIEW

2.0 OVERVIEW

This chapter will discuss about the revolution in the modern transportation sectors and some explanation about the internal combustion engine (ICE) including the spark ignition (SI) engine and four-stroke engine (EY20D Engine) which are used in this project. The background study about the Compressed Natural Gas (CNG) also will be elaborated. Moreover, the energy consumption and emission take place in the combustion by the transportation sectors and also the valve timing which can contribute to the emission will be discussed. Finally, the combustion analyser in this case, data acquisition (DAQ) also mentioned based on previous study, reference books, journal and other resources.

2.1 INTERNAL COMBUSTION ENGINE (ICE)

The Internal combustion engine is a heat engine that converts chemical energy in a fuel into mechanical energy, usually made available on a rotating output shaft. Due to the upward and downward movement of the piston and valve in it, internal combustion engine (ICE) also known as reciprocating engine. The chemical energy of the fuel is first converted to thermal energy by means of combustion or oxidation with air inside the engine. This thermal energy raises the temperature and pressure of the gases within the engine, and the high-pressure gas then expands against the mechanical mechanisms of the engine. This expansion is converted by the mechanical linkages of the engine to a rotating crankshaft, which is the output of the engine. The crankshaft, in turn, is connected to a transmission or power train to transmit the rotating mechanical energy to the desired final use. Before modern engine is developed, heat engine has served human kind over two centuries by use steam energy as its power source.

Ali, M.S (2012) said the first engine is developed by Abu al-'IZ Ibn al-Razaz al Jazari (1136-1206) then during 1860, J.J.E.Lenoir (1822-1900) have developed the first spark plug engine. The unstoppable engine revolution continuously advanced lead by Nicolaus A. Otto (1832-1891) and Eugen Langen (1833-1895) when they successfully developed the first atmospheric engine in 1867 Due to the low efficiency of the engine, Otto has proposed four cycle engine called four stroke engines. During 1876, he successfully develops first four stroke engine where the new era of modern engine begins. Later, during 1892, Rudolf Diesel has created compressed ignition engine. Compressed ignition (CI) engine usually bigger in size, slow in speed and louder operation, but win in terms of efficiency compared to gasoline engines. In 1920, compressed ignition engine is redesigned where engine successfully modified to be small enough to be used in automobile. (Ganesan, V. 2010)

The internal combustion engine can be divided into two types that are reciprocating engine and rotary engines. Reciprocating engine can be divided into two types, which is Spark ignition (SI) engine and compressed ignition (CI) engine. Spark ignition engine starts the combustion process in each cycle by use of a spark plug. The spark plug gives a high-voltage electrical discharge between two electrodes which ignites the air-fuel mixture in the combustion chamber surrounding the plug. Compressed ignition engine starts the combustion process when the air-fuel mixture self-ignites due to high temperature in the combustion caused by high compression. Combustion engine working principle can be divided into two types that are four stroke engine and two stroke engines.(Heywood, JB.1988) Four-stroke cycle has four piston movements over two engine revolution for each cycle meanwhile, two-stroke cycle has two piston movements over one revolution for each cycle.

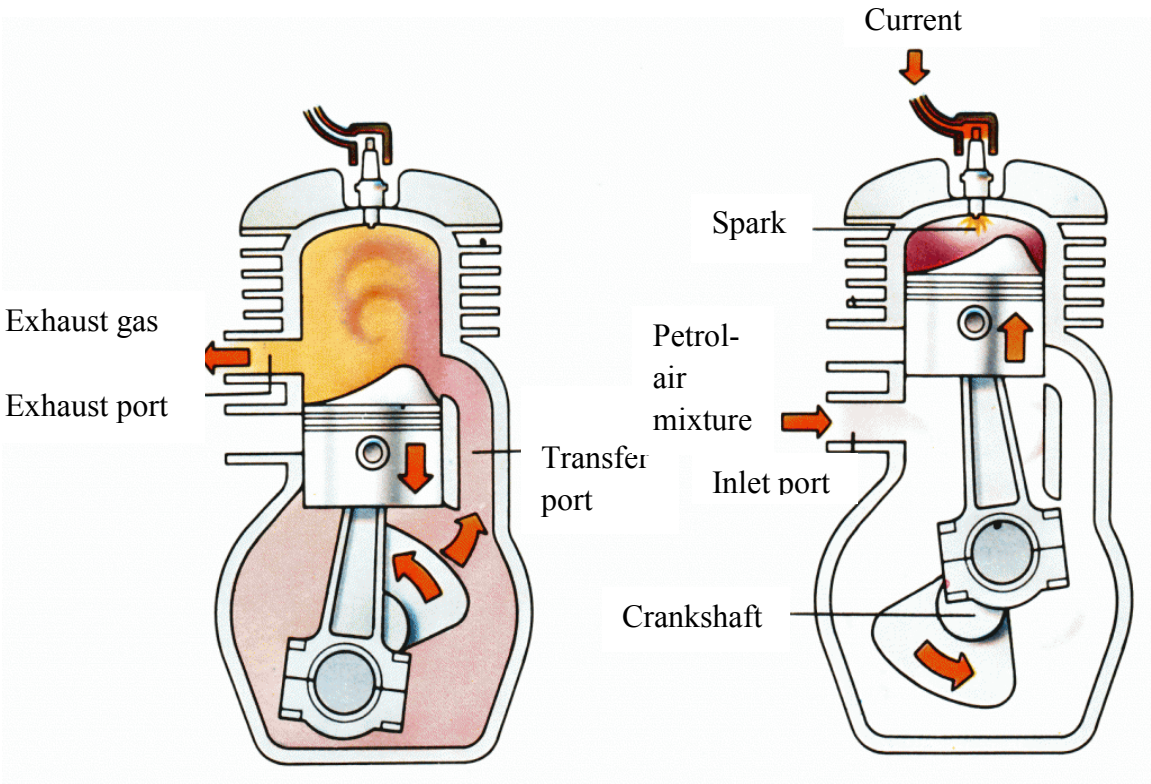

Figure 2.0 : The two stroke cycle engine (Harikrishnan, P.R. 2014)

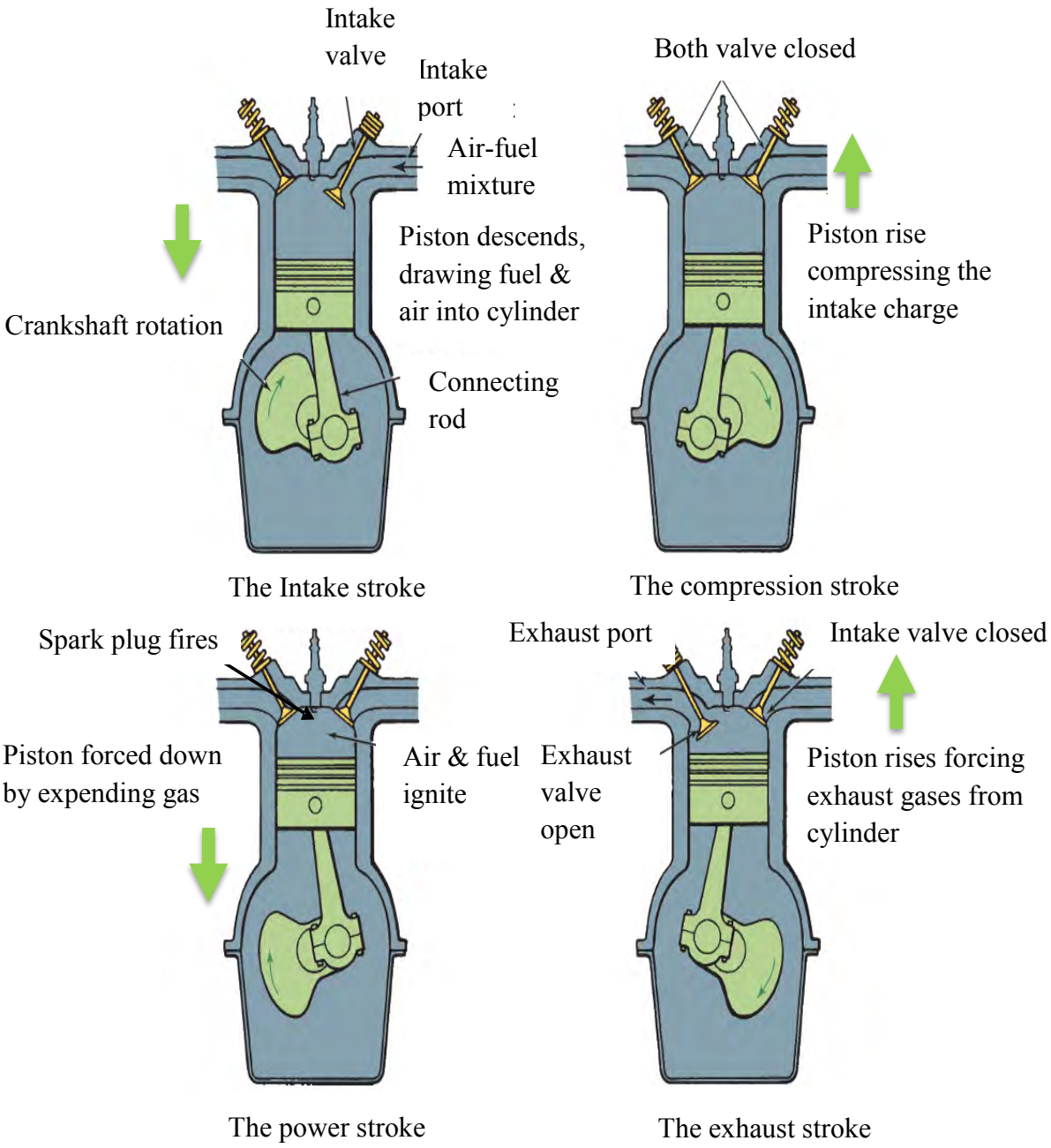

Figure 2.1 : The four stroke cycle engine (Halderman, J.D. 2012)

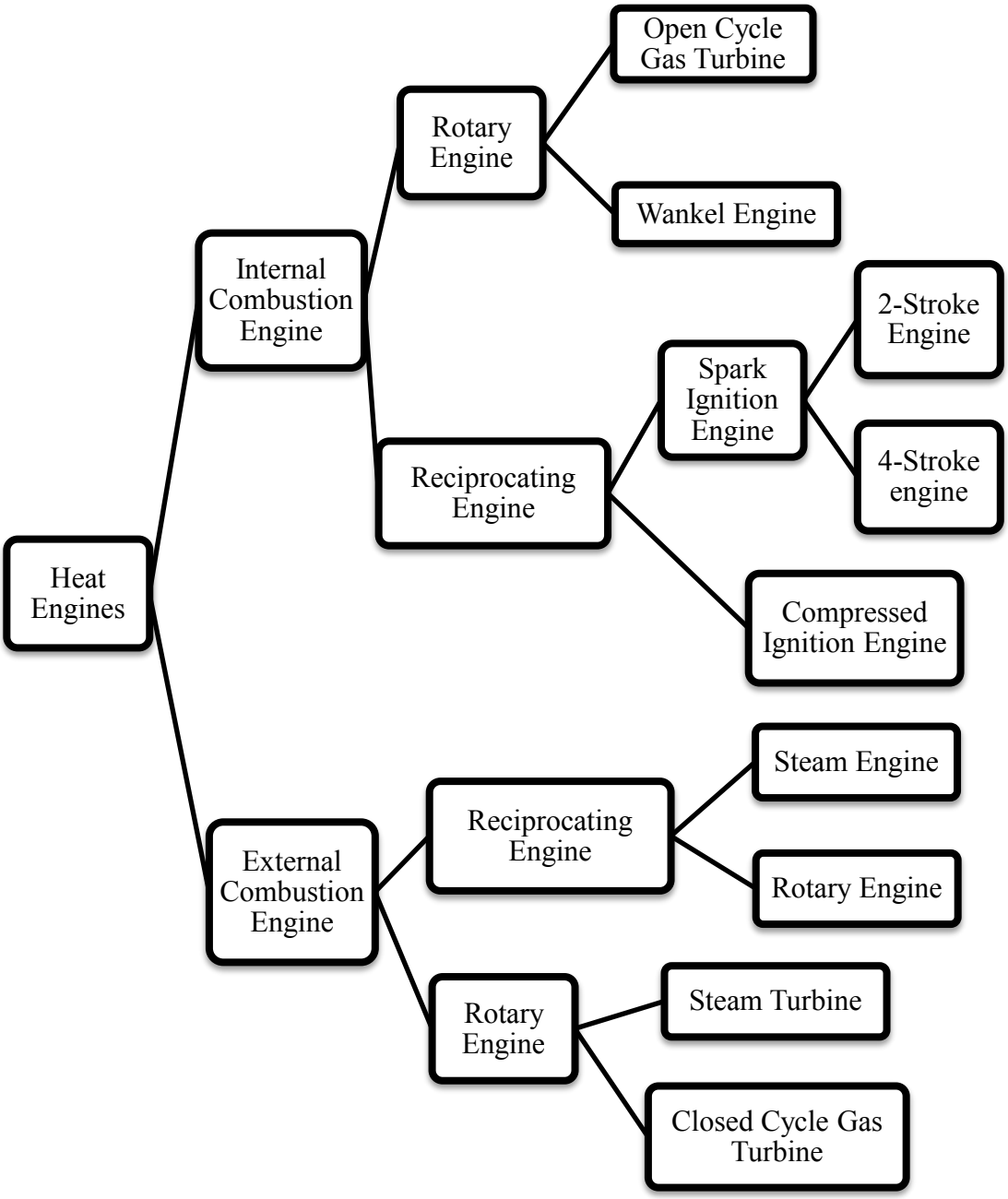

Figure 2.2: The simplification of the engine based on type and operation.

(Ganesan, V. 2010)

2.2 VALVE TIMING

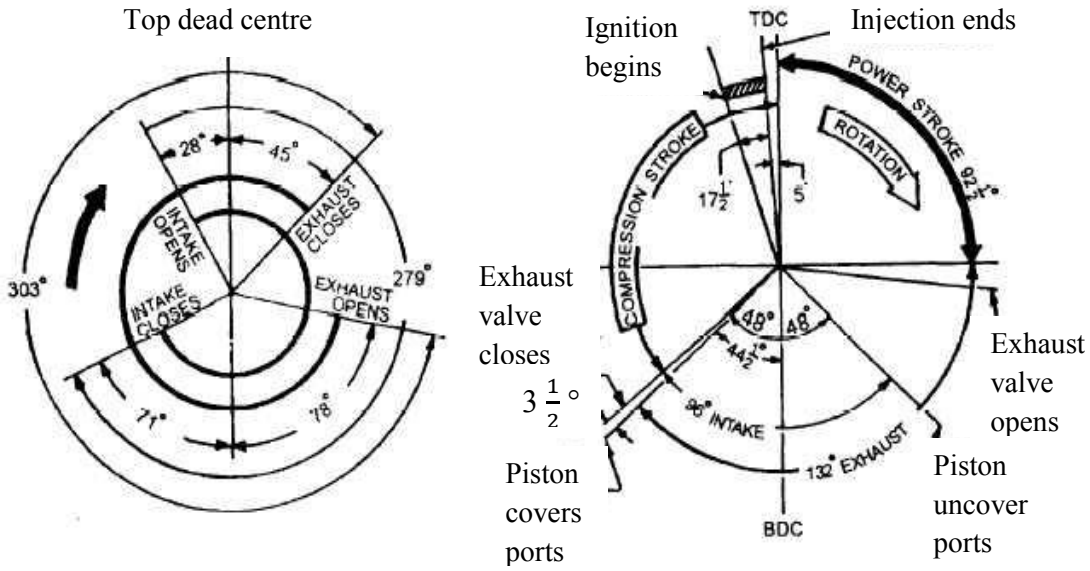

Figure 2.3 : Typical valve timing diagram (SweetHaven, 1985)

The valve timing is a system developed for measuring valve operation in relation to crankshaft position (in degrees), particularly the points when the valves open, how long they remain open, and when they close. Valve timing of 4stroke and 2stroke engine can be visualized as shown in Figure 2.3.

Valve timing is one of the most important factors in tailoring an engine for special needs. An engine can be made to produce its maximum power in various speed ranges by altering the valve timing (SweetHaven, 1985).