STUDY ON THE PERFORMANCE OF INTERNAL COMBUSTION ENGINE BY IMPLEMENTING THE AIR COOLER FOR INTAKE MANIFOLD

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Projek Sarjana Muda II

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MUHAMMAD SHAZNIL IZWAN

This report is submitted
in fulfillment of the requirement for the degree of
Bachelor of Mechanical Engineering (Thermal-Fluid)

Faculty of Mechanical Engineering

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JUNE 2016

DECLARATION

I declare that this project report entitled “Study On The Performance Of Internal Combustion Engine By Implementing The Air Cooler For Intake Manifold” is the result of my own work except as cited in the references.

Signature : .....

Name : MUHAMMAD SHAZNIL IZWAN

Date : .....

APPROVAL

I hereby declare that I have read this project report 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 (Thermal-Fluid).

Signature :. .....

Name of Supervisor : SAFARUDIN GAZALI HERAWAN

Date : .....

DEDICATION

To my beloved mother, father and my family whom i will forever be indebted.

ABSTRACT

This study commisioned to develop cold air intake models for an internal combustion car engine that operates on a Otto Cycle and to measure the increment of performance made by the models by calculating the temperature drops. Since the performance of an internal combustion is limited, therefore a solution is needed to improve the efficiency and the performance of a car at the same time by spending less money. It is found that when the temperature of the air is lower, the density of the oxygen increases, thus allowing a better combustion of the air and fuel mixture in the combustion chamber. The study was carried out by measuring the temperature drops on four models. Two of the models were made by implementing with thermoelectric coolers, one was made so to operate without energy and last one by sharing cold air from inside the cabin of a car. At the end of the study, it was found that all models of the cold air intake were able to cause decrement on the temperature of the air. However, three of models showed increment that were believed to be at an insignificant and unnoticable range of less than 1 % increment. Only one of models showed a significant increment in the value, which is by drawing the air from the car cabin to the intake valve. The increment made by the model almost reach 3 %, which can be improved if the material of the model and the position of the model be revised in order to eliminate heat transfer at the engine bay.

ABSTRAK

Kajian ini bertujuan untuk menghasilkan model pengambilan udara sejuk bagi sebuah kereta enjin pembakaran dalaman yang beroperasi berdasarkan Kitaran Otto dan untuk mengukur peningkatan dalam segi prestasi berdasarkan daripada model yang telah dihasilkan dengan mengira penurunan suhu udara. Disebabkan prestasi sesebuah engin pembakaran dalam adalah terhad, oleh itu, sebuah penyelesaian diperlukan bagi meningkatkan kecekapan dan prestasi sesebuah kereta pada masa yang sama tidak mengeluarkan belanja yang tinggi. Mengikut teori, jika suhu udara itu rendah, maka ketumpatan oksigen padanya meningkat, menyebabkan proses pembakaran angin dan petrol di dalam kebuk pembakaran lebih baik. Kajian ini dijalankan dengan mengukur penurunan suhu pada empat model yang berbeza. Dua daripada empat model tersebut dihasilkan dengan memasang penyejuk termoelektrik, satu dihasilkan agar ia tidak memerlukan tenaga untuk beroperasi, manakala yang terakhir dihasilkan dengan menyedut udara daripada ruang kabin penumpang. Pada akhir kajian ini, didapati kesemua empat model mampu menurunkan suhu udara. Namun demikian, tiga daripada model tersebut menunjukkan penurunan suhu yang dipercayai tidak ketara dengan kadar peratusan kurang daripada 1 %. Hanya satu model (menyedut udara sejuk dari ruang kabin) menunjukkan hasil yang memberangsangkan, di mana mampu menghasilkan peningkatan prestasi sehingga 3 %, di mana ia boleh ditingkatkan lagi jika bahan buatan model tersebut dan kedudukannya dikaji semula supaya dapat menghilangkan pengaliran haba.

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First and foremost, I would like to express my gratitude to the Almighty Allah S.W.T because of His blessing and forgiveness I am able to complete this final year project report.

Secondly, I would like to thank my project supervisor, Mr. Safarudin Gazali Herawan for giving me the opportunity to carry out my final year project under his supervision and to guide me well throughout the period of this final year project. I would also like to thank assistant engineer, Mr. Asjufri for assisting and guiding me in this project.

Not to forget, my parents who had been with me through ups and down. Your support has made me a stronger person and I will forever be grateful.

Last but not least, I would like to thank to my coursemates for giving me their support, patience and encouragement.

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LIST OF ABBREVIATIONS

ICE – Internal Combustion Engine

ECE – External Combustion Engine

IC – Internal Combustion

TDC – Top Dead Center

BDC – Bottom Dead Center

SI – Spark-Ignition

CI – Compressed-Ignition

TE – Thermoelectric

TEG – Thermoelectric Generator

TEC – Thermoelectric Cooler

HP – Horsepower

LIST OF SYMBOLS

q_{in} = Heat supplied

q_{out} = Heat rejected

w_{in} = Work in

w_{out} = Work out

u = Entalphy

Cv = Constant Volume

Ƞ = Efficiency

h = Entropy

Cp = Constant Pressure

T = Temperature

R_c = Cutoff Ratio

P = Pressure

V = Volume

R = Gas Constant

n = No. of moles

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

One of humans greatest invention is the heat engine. Heat engine converts thermal energy into mechanical energy. It utilizes fuel in the form of gasoline, diesel and natural gas in order to convert the thermal energy to mechanical energy to perform such work. Heat engines also can be combined with hybrid electricity to form hybrid engines to increase engine effieciency thus reducing fuel consumption. Heat engines can be classified into two major categories; Internal Combustion Engine (ICE) and External Combustion Engine (ECE).

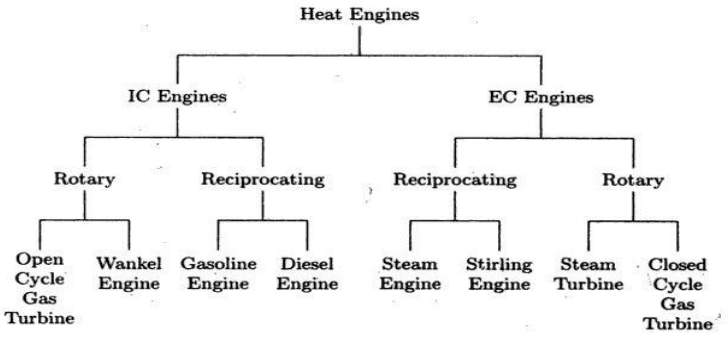

Figure 1. 1 : Classification of heat engines

(Ganesan,V. 2012)

There are two types of engines working principle, the spark-ignition working principle and the compression-ignition working principle. Today, most automobile car engines are operating on the four-stroke spark-ignition engines. The reason it is called four-stroke is because of the rotation of the crankshaft that makes a number of four strokes in order to complete a cycle. The spark-ignition means that the combustion process inside the engine is ignited by the spark plug. The credit of inventing the spark-ignition engines goes to Nicolaus A. Otto (1876) which then mostly referred as Otto Engine.

During the four stroke in a spark-ignition engine,there are five process to be completed within the four strokes, which are; suction, compression, combustion, expansion, and exhaust. Every stroke will give a 180 degree rotation on the crankshaft and upon completing the whole four strokes, a total of 720 degrees is achieved on the crankshaft.

The first stroke in the four-stroke engine is the inlet/suction stroke. The combination of air-fuel mixture will be 'sucked' into the cylinder through the inlet valve due to the motion of the piston. Secondly, the compression stroke is where the air-fuel mixture is compressed by the piston. The mixture is then ignited by the spark plug located at the cylinder head. The third stroke is the expansion/power stroke. The burnt mixture will push the piston downwards. Power is produced during this stroke. The final stroke is called the exhaust stroke. During this stroke, inlet valve remains closed while the exhaust valve is opened. Burnt gases from previous stroke are released (Ganesan,V. 2012).

Thermoelectricity, on the other hand, was discovered by a German physicist named Thomas J. Seebeck. He found that when two metals with different temperatures are touching, voltage diffrence are produced which can drive electrical current in closed circuit. Today, it is known as Seebeck Effect. A bit later after Seebeck founded that theory, a French physicist named Jean Peltier discovered and proved the reverse of Seebeck Effect. If a current is passed through two different metals, the temperature on one of the metal will increase while the other one will decrease. This is known as Peltier Effect today.

1.2 PROBLEM STATEMENT

The performance of an internal combustion engine in a car is limited and there are many reasons regarding to this factor. Low perfomance is a result of low efficiency. Nowadays, there are many ways to increase the performance of a car. Among of rhe common methods to increase the performance of a car are turbocharger engine, supercharger engine, aftermarket performance chips and also reducing the weight of a car. All of these methods are proven to be effective. Eventhough these methods are effective, unfortunately they are exceptionally high in costing and also need some reconstruction to a car. Due to the economic crisis today, an alternative solution is needed in order to increase the performance of a car. Besides increasing the performance of the car, the solution must be low in costing and easy to constuct and install.

1.3 OBJECTIVE

The objectives of this project are as follows:

1. To study the effect of cold air in the intake manifold of an IC engine.
2. To develop an air cooler intake for the intake manifold of an IC engine.
3. To measure the temperature of the air after implenting cold air intake.
4. To calculate the increase in power after using cold air intake.

1.4 SCOPE OF PROJECT

The scopes of this project are:

1. Limited to four-stroke spark-ignition engines only.
2. Developing a cold air intake model which reduces the temperature of air that goes into the intake valve of a car.

CHAPTER 2

LITERATURE REVIEW

2.1 INTERNAL COMBUSTION ENGINE

From what being introduced previously in chapter one, there are two types of heat engines, which is the internal combustion engine (ICE) and also the external combustion engine (ECE). External combustion engine a type of engine where the combustion process took part outside the the engine, while the internal combustion is vice versa to the ECE, where the combustion process took part inside or within the engine. This study focuses on the internal combustion engine.

The combustion process for internal combustion engine occurs inside a confined space which is known as the combustion chamber. ICE normally are seen in transportation such as cars and others. The advantages of internal combustion engine are the portability. ICE is proven to be more convenient over electricity. But everything has it's advantages and disadvantages, the same goes to ICE. The disadvantage of ICE are the pollution that the engine produces. The most obvious type of pollution is air pollution and noise pollution. There

are many components in an Internal Combustion Engine that has function of its own in order for the ICE to perform to produce power.

2.1.1 FOUR-STROKE SPARK-IGNITION ENGINE

In a four-stroke engine, the cycle of operations is completed in four strokes of the piston or two revolutions of the crankshaft. The reason it is called four-stroke is due to the number of the strokes needed to complete through the 720 degree rotation of the crankshaft which are the intake stroke, the compression stroke, the power stroke and the exhaust stroke. Spark-ignition refers to the method of how the air-fuel mixture are combusted, which is by using the spark plug (Ganesan, V. 2012). Figure 2.1 shows the working principle of a four-stroke spark ignition engine.

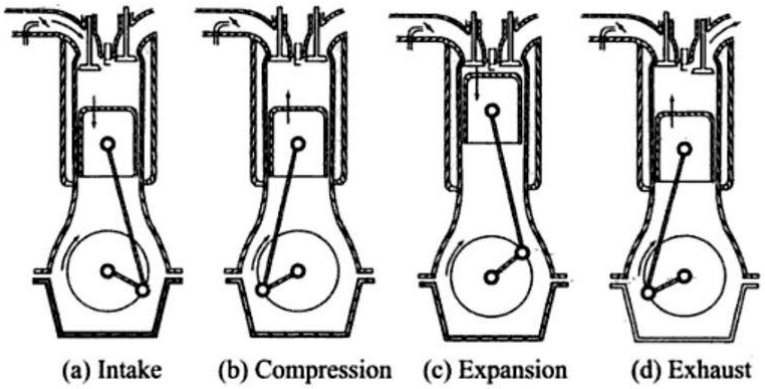

Figure 2. 1 : Principle of a 4-stroke SI engine

(Ganesan, V. 2012)