DESIGN OF AN EXPANSION CHAMBER FOR POWER TUNING OF A TWO STROKE ENGINE

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'Saya akui bahawa telah membaca

karya ini dan pada pandangan saya karya

ini adalah memadai dari segi skop dan

kualiti untuk tujuan penganugerahan

Ijazah Sarjana Muda Kejuruteraan Mekanikal (Automotif)'

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This report is submitted in partial fulfillment of the requirement for the Bachelor of Mechanical Engineering (Automotive)

FACULTY OF MECHANICAL ENGINEERING

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APRIL 2008

DECLARATION

I hereby declare that this project report entitled

DESIGN OF AN EXPANSION CHAMBER
FOR POWER TUNING OF A TWO STROKE ENGINE

is written by me and is my own effort and that no part has been plagiarized without citations.

SIGNATURE :.....

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DATE : 13th May 2008

DEDICATION

Special appreciation dedicated to my parents, Mr & Mrs Roland Renggie Jawa for all their support throughout this semester. Also, thousands of thanks to my supervisor, Mr Faizul Akmar Abdul Kadir for giving me support and motivation while implementing this project. All the support and encouragement given has become one of the roots for me in achieving my success.

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ABSTRACT

Expansion chamber is an exhaust system used for power tuning in two stroke engines. The importance of designing appropriate expansion chamber is for power – tuning in two – stroke engine to ensure the engine to produce more power output with a reduction of polluted emissions as well. The two stroke engine doesn't utilize an exhaust stroke or complicated valve to emit the burnt gases from cylinder like four stroke engine. The incoming mixture charge is used to help push the burnt gases out of the exhaust port. This is not an efficient process since some of the burnt gases remained in the cylinder and may be some of the new mixture charge escaped through the open exhaust port. Thus, expansion chamber enhances and controls the flow through the engine by using pressure pulses. The design of expansion chamber will have an effect on the pressure movement. The design was based on different cross section and length, depending on the requirement of the type of engines. Expansion chamber will be designed using empirical design process. By simulation, results obtained will be used to verify which expansion chamber gives out the best power performance of two – stroke engine. Thus, to ensure better engine performance, the design of expansion chamber must match with the engine specifications.

ABSTRAK

Expansion chamber adalah sistem ekzos yang digunakan untuk menala enjin dua lejang. Kepentingan merekabentuk *expansion chamber* yang sesuai adalah untuk mendapatkan kuasa maksimum pada enjin di samping dapat mengurangkan pengeluaran hasil pembakaran yang boleh mencemarkan alam sekitar. Enjin dua lejang tidak mempunyai injap atau lejang ekzos untuk mengeluarkan hasil pembakaran seperti enjin empat lejang. Maka, campuran yang memasuki silinder tersebut akan menolak gas yang sudah terbakar keluar melalui lubang ekzos. Proses ini kurang efisien kerana masih terdapat sedikit gas yang sudah terbakar masih menduduki silinder tersebut dan kemungkinan juga sebilangan daripada campuran yang baru memasuki silinder tadi keluar melalui lubang ekzos yang terbuka tadi sebelum pembakaran berlaku. Maka, *expansion chamber* akan digunakan untuk mengawal aliran yang berlaku di dalam enjin tersebut dengan mengawal tekanan yang berlaku pada paip sistem ekzos tersebut. Reka bentuk *expansion chamber* akan mempengaruhi pergerakan tekanan bendalir tersebut. *Expansion chamber* akan direka mengikut diameter dan panjang yang berbeza bergantung kepada jenis enjin yang diuji mengikut proses empirikal. *Expansion chamber* akan diuji melalui dengan kaedah simulasi untuk mengenalpasti *expansion chamber* yang akan mendapatkan kuasa paling maksimum pada halaju enjin tertentu yang dikehendaki. Maka, untuk mendapatkan prestasi dan kuasa maksimum yang dikendaki, *expansion chamber* yang direka haruslah menepati specifikasi enjin yang ditetapkan.

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LIST OF SYMBOL

Ao = speed of sound, m/s

= specific heat ratio of air

= gas constant, J/kgK

Temp = average exhaust temperature, °C

= flange diameter ratio

= midsection diameter coefficient

= tail pipe diameter coefficient

EP = exhaust period, deg

RPM = engine speed of rotation in revolutions per minute, RPM

LP = length of pipe, mm

LT = Tuned length of pipe, mm

Lx = length from piston face to flange

LP1 = header pipe, mm

LP2 = diffuser section 1, mm

LP3 = diffuser section 2, mm

LP4 = dwell section, mm

LP5 = convergent section, mm

LP6 = stinger, mm

Dx = exhaust port effective diameter, mm

D1 = diameter at barrel flange, mm

D2 = diameter at diffuser section, mm

D3 = diameter at dwell section, mm

D4 = diameter at stinger section, mm

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CHAPTER 1

INTRODUCTION

This project involved with the design of an expansion chamber which will be used to tune a two stroke engine. This is important since constructing an expansion chamber will ensure that the engine is able to breathe correctly and produce efficient power output.

An expansion chamber is designed by varying its diameter (cross section) and length. It is used to enhance power output produced by increasing the volumetric efficiency of the two stroke cycle engine. Volumetric efficiency is the ratio of the volume of air drawn into a cylinder to the piston displacement.

The performance of two stroke engine will be tested through simulation. Different sizes of expansion chamber are used during the testing session. Result of the performance of engine is obtained after modeling an engine and run the simulation by using GT-Power. The result is used to evaluate at which size of the expansion chamber will the maximum power is obtained.

1.1 Background

Basically, after completing one revolution for each cycle, burnt gases and fresh mixture (unburned gases) will suck out from the cylinder. These high pressure gases which exit through the cylinder initially flows in the form of a wave front and subsequently enter a pipe called expansion chamber which is already occupied by gas from previous cycle. The gas from previous cycle will be pushed ahead and this will cause a wave front. Although the gas flow itself stops, the wave still goes on by passing the energy to the next down stream until it reaches the end part of the pipe.

However if the wave encounters any changes in cross section or temperature, it will reflect a part of its strength in the opposite direction it travel which practice the wave dynamics principles. Thus, expansion chamber will be designed by using this basic principal since its diameter (cross section) and length are varied as a way to push back the fresh mixture back into the cylinder at the desired times in the cylinder.

Good chamber works by giving lots of power over a wide rpm-range. Thus, the cross section of an expansion chamber influences the power output since the power is tuned when the reflected wave is out of phase with the primary wave at the exit of the exhaust valve.

1.2 Objective

The objective of this project is to design an expansion chamber to tune a two stroke engine in order to obtain maximum power at certain engine speed.

1.3 Scope

These project scopes consist of the following:

a. Study on single cylinder of two stroke engine.
b. To study and design expansion chamber based on condition required.
c. To conduct simulation on power testing of different sizes of expansion chamber
d. To choose the most suitable expansion chamber on certain engine speed required.

1.4 Problem Statement

In two – stroke internal combustion engine, each outward stroke of the piston is a power stroke. As a way to achieve this operating cycle, a fresh charge of air and fuel must be supplied to the engine cylinder at a high pressure to displace the burned gases from the previous cycle. The combination of process between intake and exhaust process that clears the cylinder of burned gases and fills it with a fresh mixture (of air and fuel) is called scavenging process. This process is essential in having a smooth-running internal combustion engine.

As the piston moves from top to bottom dead center, uncovering the intake ports, the burned gases are pushed into the exhaust port by the incoming flow of fresh mixture (air and fuel). This is not an efficient process since some of the burnt gases remaining in the cylinder and some of the fresh air or fuel charge escape through the open exhaust port. At this point in time, the opening just begins to form, and as a result the flow in the combustion chamber changes dramatically. As the piston drops down and begin its return motion back to TDC the burned gases are pushed into the exhaust duct.

Thus, by modifying the exhaust system such as modifying the exhaust gas velocity (by changing exhaust tube diameters and lengths) it can detract from the "ideal" scavenging effects, and reduce fuel consumption as well as increase the power output.