GAS POWERED MODEL CAR

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”I hereby to declare that the work is my own except for summaries and quotations which have been duly acknowledged”

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ABSTRACT

Nowadays, price of gasoline (petrol fuel) become higher because of the higher demand by consumer and the reducing in quantity of fossil fuel in earth. To overcome this, many equipment used nowadays been converted to from using gasoline to liquefied petroleum gas (LPG). Besides higher price, using the LPG also help in reducing the emissions of harmful pollutants. Following above statement, many car users had converted the gasoline system to LPG system to reduce fuel consumption. This project is about applying LPG system to model car. For this purpose, selection and choosing efficient equipment is important to ensure the model car engine can operate using LPG. Besides that, research for internal combustion system for small engine and LPG properties were done to design a compatible system to be implied at model car. From the researches, a LPG system were design using simple equipment and modification of the engine been done to implied the designed system. From the conducted experiment, the design system was enabled the model car to operate using LPG successfully with maximum speed produced was 29154rpm.

ABSTRAK

Pada masa kini, harga minyak petrol semakin meningkat disebabkan permintaan tinggi daripada pengguna dan bahan mentah asli yang semakin berkurangan. Untuk mengatasi masalah ini, banyak peralatan yang menggunakan minyak petrol telah ditukar kepada penggunaan gas petroleum cecair (LPG). Selain harga yang meningkat, LPG juga membantu mengurangkan pengeluaran bahan pencemar berbahaya. Berdasarkan kenyataan diatas, banyak pengguna kereta telah menukar sistem petrol kepada LPG untuk mengurangkan penggunaan minyak. Projek ini berkenaan mengaplikasikan sistem LPG pada model kereta. Bagi tujuan ini, pemilihan barang yang cekap penting untuk memastikan enjin model kereta boleh beroperasi dengan menggunakan LPG. Selain itu, kajian mengenai enjin pembakaran dalam untuk enjin kecil dan ciri-ciri LPG telah dibuat untuk mereka sistem sesuai untuk di aplikasikan pada model kereta. Berdasarkan kajian yang dibuat, sistem LPG telah direka dengan menggunakan peralatan yang ringkas dan pengubahsuaian enjin telah dibuat untuk memasang sistem yang direka. Berdasarkan uji kaji yang dibuat, sistem yang direka membolehkan model kereta beroperasi dengan menggunakan LPG dengan jayanya dan menghasilkan maksimum 29154rpm.

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INTRODUCTION

1.1 Overview

Model car most frequently refers to scale miniatures of real production vehicles, designed as kits for the enthusiast to construct. They can be created in plastic, die-cast metal, even wood. Though most car models are static display items, individual model builders have sometimes powered their vehicles in various ways, including rubber bands, springs, inertia mechanisms, electric motors, internal combustion engines, air engines and steam engines.

Small model internal combustion (IC) engines used to powered model car have similar system as real IC engine where the engine was driven by the combustion in the cylinder. There are two type of small IC engine use to supply power to radio control (RC) model which is:

- Two-stroke
- Four-stroke

Big scale car, RC truck, RC airplane and RC helicopter usually use four-stroke engine because it produce more torque at lower rotation per minute (RPM) and use larger diameter propeller. Small scale model (1/10 to 1/16 ratio) usually powered by two-stroke engine. This type of engine is design in simpler way as camshafts and rocker arms are not needed to open and close the valves. This engine uses nitro fuel because it gave more power to undergo high speed. Nitro fuel can supplied more power to the engine but it is very expensive and hazardous. Therefore it is not suitable if use for spend time at the back yard.

LPG is the popular alternative fuel been used since the 1940s for spark ignition engines. Using LPG can reduce the fuel consumption close to half as much fuel compare with nitro. LPG also was widely used in this country, so it is easier to get supply compared with nitro oil.

Refer to above statement, it believe that designing a small IC engine powered by gas (LPG) is an effective yet commercialize way for RC car user beside control the emissions of harmful pollution.

1.2 Problem Statement

For all this time, LPG had been strongly promote by the car manufacture and government as it reduce the fuel consumption and reduces the emissions of harmful pollutants. However, there are several parts to be considered before designing the engine powered by gas.

The first factor to identify is to decide type of engine suitable for model car. There are several type of engine was design and the most suitable for model car is two-stroke RC Nitro Engine.

The problem of current system is the RC engine use nitro fuel and it ignited by glow spark. The purpose of this project is to apply the gas power in RC engine by installing appropriate part. As a result, a design of RC engine that can be powered by gas is proposed by:

i. Changing the ignition system from glow plug to spark plug
ii. Prepare a small tank for gas
iii. Design a suitable gas supplied to combustion chamber

1.3 Objective

The main objective of this study is:

- To apply the LPG in internal combustion engine

1.4 Project Scope

The scope of this project generally involved the following:

- To study an existing model car engine design
- To install appropriate parts for use of gas fuel (LPG)
- To evaluate the fabricated performance

CHAPTER II

LITERATURE REVIEW

2.1 Internal Combustion Engine

2.1.1 Introduction

The internal combustion engine is an engine in which the combustion of a fuel occurs with an oxidizer (usually air) in a combustion chamber. In an internal combustion engine the expansion of the high temperature and pressure gases, which are produced by the combustion, directly applies force to a movable component of the engine, such as the pistons or turbine blades and by moving it over a distance, generate useful mechanical energy.

All internal combustion engines depend on the exothermic chemical process of combustion: the reaction of a fuel, typically with oxygen from the air (though it is possible to inject nitrous oxide in order to do more of the same thing and gain a power boost). The combustion process typically results in the production of a great quantity of heat, as well as the production of steam and carbon dioxide and other chemicals at very high temperature.

The most common modern fuels are made up of hydrocarbons and are derived mostly from fossil fuels (petroleum). Fossil fuels include diesel fuel, gasoline and petroleum gas, and the rarer use of propane. Except for the fuel delivery components, most internal combustion engines that are designed for gasoline use can run on natural gas or liquefied petroleum gases without major modifications. Large diesels can run with air mixed with gases and a pilot diesel fuel ignition injection. Liquid and gaseous bio-fuels, such as ethanol and biodiesel can also be used. Some engines with appropriate modifications can also run on hydrogen gas.

Internal combustion engines require ignition of the mixture, either by spark ignition (SI) or compression ignition (CI). Gasoline engine ignition systems generally rely on a combination of a lead-acid battery and an induction coil to provide a high-voltage electrical spark to ignite the air-fuel mix in the engine's cylinders. This battery is recharged during operation using an electricity-generating device such as an alternator or generator driven by the engine. Gasoline engines take in a mixture of air and gasoline and compress it to not more than 12.8 bar (1.28 MPa), then use a spark plug to ignite the mixture when it is compressed by the piston head in each cylinder.

Diesel engines and HCCI (Homogeneous charge compression ignition) engines rely solely on heat and pressure created by the engine in its compression process for ignition. The compression level that occurs is usually twice or more than a gasoline engine. Diesel engines will take in air only, and shortly before peak compression, a small quantity of diesel fuel is sprayed into the cylinder via a fuel injector that allows the fuel to instantly ignite. HCCI type engines will take in both air and fuel but continue to rely on an unaided auto-combustion process, due to higher pressures and heat. This is also why diesel and HCCI engines are more susceptible to cold-starting issues, although they will run just as well in cold weather once started. Light duty diesel engines with indirect injection in automobiles and light trucks employ glow plugs that pre-heat the combustion chamber just before starting to reduce no-start conditions in cold weather.

Most diesels also have a battery and charging system; nevertheless, this system is secondary and is added by manufacturers as a luxury for the ease of starting, turning fuel on and off (which can also be done via a switch or mechanical apparatus), and for running auxiliary electrical components and accessories. Most new engines rely on electrical and electronic control systems that also controls the combustion process to increase efficiency and reduce emissions.

The term internal combustion engine usually refers to an engine in which combustion is intermittent, such as the more familiar four-stroke and two-stroke piston engines.

2.1.2 Two-Stroke Cycle

Engines based on the two-stroke cycle use two strokes (one up, one down) for every power stroke. Since there are no dedicated intake or exhaust strokes, alternative methods must be used to scavenge the cylinders. The most common method in spark-ignition two-strokes is to use the downward motion of the piston to pressurize fresh charge in the crankcase, which is then blown through the cylinder through ports in the cylinder walls. Spark-ignition two-strokes are small and light (for their power output), and mechanically very simple. Common applications include snowmobiles, lawnmowers, weed-whackers, chain saws, jet skis, mopeds, outboard motors, and some motorcycles. Unfortunately, they are also generally louder, less efficient, and far more polluting than their four-stroke counterparts, and they do not scale well to larger sizes. Interestingly, the largest compression-ignition engines are two-strokes, and are used in some locomotives and large ships.

These engines use forced induction to scavenge the cylinders. two stroke engines are less fuel efficient than other types of engines because unspent fuel being sprayed into the combustion chamber can sometimes escape out of the exhaust duct with the previously spent fuel. Without special exhaust processing, this will also produce very high pollution levels, requiring many small engine applications such as lawnmowers to employ four stroke engines, and smaller two-strokes to be outfitted with catalytic converters in some jurisdictions.

2.1.3 Four-Stroke Cycle

Engines based on the four-stroke cycle or Otto cycle have one power stroke for every four strokes (up-down-up-down) and are used in cars, larger boats and many light aircraft. They are generally quieter, more efficient and larger than their two-stroke counterparts. There are a number of variations of these cycles, most notably the Atkinson and Miller cycles. Most truck and automotive Diesel engines use a four-stroke cycle, but with a compression heating ignition system. This variation is called the diesel cycle.

2.2 Model Car Engine

There are many powered model car been design nowadays. Though most car models are static display items, individual model builders have sometimes powered their vehicles in various ways, including rubber bands, springs, inertia mechanisms, electric motors, internal combustion engines, air engines and steam engines. The common use for powered model car is internal combustion engine and electric motor.

Model car powered by internal combustion (IC) engine usually use small IC engine use for radio control car (RC Car), fuelled by nitro fuel. Nitro fuel is mostly methanol (methyl alcohol) mixed with usually about 1/5th nitromethane and 1/5th lubricating oil. This engine generally called “Nitro Engine” or “Glow Engine”. Most nitro RC engines are of the "ABC" type design. The ABC stands for ALUMINUM BRASS CHROME. This means that the piston is aluminum, the cylinder liner is brass, and the internal wear surface of the cylinder is plated with chrome. This hard chrome plating offers a much better wear surface than the soft brass underneath, and helps to prolong engine life.

2.2.1 Nitro Engine System

Nitro engine is a small IC engine that powered by combustion of nitromethane in combustion chamber (cylinder). These engines use two-stroke system to operate the engine. Two-Stroke engines only have one cycle to produce power and no cams. This single cycle can be divided into two strokes. The combustion occur when the air/fuel mixture in the combustion chamber were compressed by the piston to the top dead center. The exhaust gases occur from combustion rapidly expanding in combustion chamber will increase in pressure, forced the piston down. When piston move down, it will uncover the exhaust port on the side of the sleeve. This opening will make the exhaust gases escape through the manifold.

At time when the piston travel down the sleeve, it will pressurizes the crankcase. This crankcase is bathed in an air/fuel mixture and a sleeve intake port will opened when the piston almost reached the bottom of the stroke. This port directs the fuel to the top of the piston and thereafter, the piston reaches the bottom dead center. This is where the second stroke begins. The piston now starts to move up into the sleeve. This upward movement seals the intake ports and then blocks the exhaust port. The combustion chamber now starts to become pressurized as the piston travels higher into the sleeve. As the piston approaches the top dead center, the mixture's ignition point begins to be lowered until the heat from the glow plug initiates the combustion process. This explosion initiates the power stroke once again.

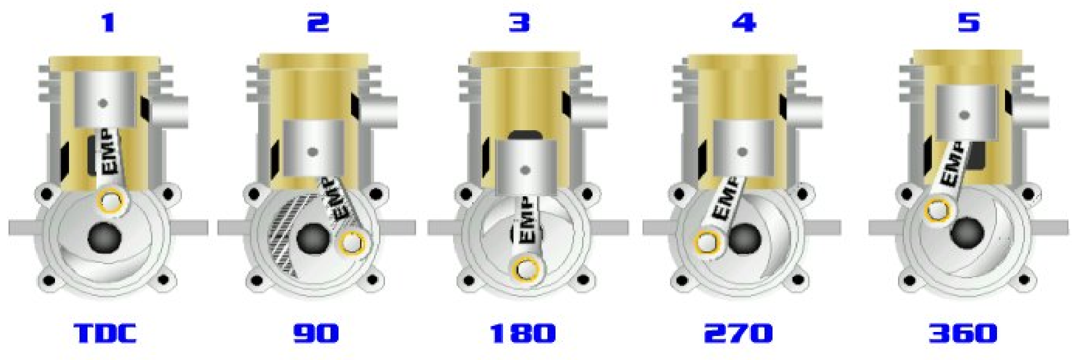

Figure 2.1 Step of Piston Rotation

(Source: http://www.nitrorc.com/articles/2strokepart1a.html)

1. Piston reach top dead center – combustion occurs
2. Piston move down uncovering the exhaust port – exhaust gases escape to atmosphere
3. Piston move down uncovering the sleeve intake port – air/fuel mixture entering the combustion chamber.
4. Piston move up covering the sleeve intake port
5. Piston move up covering the exhaust port – pressurize the mixture and ignition occur

Other part to be considered is engine timing. Engine timing is what determines the opening and closing time of the engine's ports. On 4-stroke engines, timing is controlled by the cams that open and close the valves at predetermined sequences to bring a fresh air/fuel charge in and to exhaust it out the manifold. On 2-Stroke engines there are no cams, belts or gears the engine timing is occur when the piston is moving inside the sleeve. Piston covers and uncovers a series of ports that either let air and fuel in or allow burnt combustion products out. It is the geometry of these ports that determines the timing of the engine.

All the timings on an engine are measured in degrees of crank rotation. This ties the size (height) of an opening on the sleeve to a specific amount of travel of the crank shaft in degrees. One full revolution of the crankshaft is 360 degrees. The timings that are most critical are exhaust timing (exhaust port) and intake timing (on the crankshaft). The opening on top of the crankshaft, called the intake port, is also measured in degrees of crank-shaft rotation. Engine builders try to stay within a certain range for both the intake and the exhaust timing of an engine for reliability and ease of tuning. Engine timing can be modified by engine experts. This usually affects the RPM/Torque curve of an engine to better suit the intended use of the engine. The timing also affects the required length of the tuned pipe.

Figure 2.2 Port in Cylinder

(Source: http://www.nitrorc.com/articles/2strokepart1a.html)

2.2.2 Fuel Feed System

Small IC engine use hollow crank shaft for fuel feed system. The hollow on crank shaft allows the air/fuel mixture that coming from the carburetor to reach engine’s crank-case. The mixture was fed to the top of the piston through the fuel inlet port. When the piston moves up in the sleeve, it creates a vacuum in the crankcase. It is the time that the intake port on the crankshaft opens and begins to suck air and fuel into the crank case. The port on the crankshaft closes before the piston goes down and pressurizes the crank case so that fuel is not blown out the intake port.