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AN ANALYSIS OF PETROL - COMPRESSED AIR POWERED INTERNAL COMBUSTION ENGINE: A HYBRID ENGINE CONCEPT

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ABSTRACT

Nowadays environment pollution becomes a much serious issue in the world. Vehicles' exhaust product is one of the major source of environmental pollution. The engine combustion products are causing the greenhouse effect, acid rains, ozone layer depletion and some other pollution. On the other hand, many study research on fossil fuel in the previous years, observed that if the oil is consumed at this rates, 81% of the entire available resource will be consumed very soon. So now we begin to get some alternative energy to replace fossil fuel. There is some alternative sources of energy, like battery, photocells, hydrogen fuel cell, bio-diesel or compressed air can be chose. Among them, compressed air is freely available as well as free from pollution contents , and also can be compressed to higher pressures at an extremely low cost. Present work describes the compressed air technology that addresses the problems of exhaust gas pollution from automobiles, as well as utilization of fuel. The development of the compressed air powered engine model starts with modify the existing engine, cleaning of engine ,and re-assembling of the parts as per need. After that build the engine into two working stages that working with gasoline for two cylinders in the first stage and working with compressed air for rest one cylinders in the second stage. In this thesis, the research focuses on the second stage.

KEYWORDS: Hybrid engine, Air engine, modern engine, Fuel- compressed air engine.

INTRODUCTION

Internal combustion engine is used extensively in the daily life, not only in vehicles but also in lawnmowers, snow blowers, chain saws, and generators, and pumps. The first internal combustion was invented by Reverend W. Cecil from England in 1820 (Christian, 2006). An internal combustion engine is the engine which burns fuel inside cylinders. It converts chemical energy of fuel into thermal energy to perform work as mechanical energy.

An IC engine consists of some accessory systems. Fuel system is used to store and control the fuel which supply at various load and speed. Ignition system ignites the fuel and air mixture in the combustion chamber and initiates combustion reaction. Air intake and exhaust system are used to intake fresh air from the atmosphere to mix with fuel and exhaust the product of combustion from engine. Cooling system is the system for cooling the engine parts which withstand high temperature, removing the excess heat. Lubrication system provides lubrication oil in moving parts so that can prevent metal to metal attrition and cooling the moving parts, as well. Furthermore, a starting system is used to start the engine by using electric-drive motor and gear arrangement.

The vehicle's exhaust product is one of the source of environmental problems. Their combustion products are causing the greenhouse effect, ozone layer depletion, acid rains and some other pollution . On the other hand, a current study research on fossil fuel in the year 2004, predicts that if the oil is consumed at the current ways, 81% of the entire

available resource will be consumed very soon. So now we begin to get some alternative source of energy which can replace fossil fuel

There is some alternative energy, such as battery, wind mill, photocells, hydrogen fuel cell, bio-diesel or compressed air can be chose. Among them, compressed air is freely and easily available as well as free from pollution, and also can be compressed to higher pressures at an extremely low cost.

Need. There is some alternative energy, such as battery, wind mill, photocells, hydrogen fuel cell, bio-diesel or compressed air can be chose. Among them, compressed air is easily available as well as free from pollution, and also can be compressed to higher pressures at an extremely low cost. The compressed air engine can become one of the prime options because it can be produced as almost zero emission of pollutants. At the same manner, compressed air method wastes only about 40% energy on leakage when the conventional internal combustion engine wastes 86% on heat. The development of the compressed air powered engine model starts with dismantling the existing engine, cleaning the engine, and re-assembling as per need. Then develop the engine into two working stages that working with gasoline for two cylinders in the first stage and working with compressed air for rest one cylinder in the second stage. In this thesis, the research focuses on the second stage. In this section the middle cylinder of Maruti 800 engine will run with the help of compressed air. The reason behind such cylinder choice is to avoid or minimize the possibility of bending and fluctuations of engine shaft so that power obtaining from the engine remains uniform. For that purpose some of the engine accessories related to middle cylinder needs to be modified.

DESCRIPTION OF TECHNOLOGY

Present work describes the compressed air technology that addresses the problems of exhaust gas pollution from engine, along with minimum utilization of fossil fuel. The development of the compressed air powered engine model starts with dismantling the existing engine, cleaning the engine, and re-assembling as per need. Then develop the engine could work into two stages that is working with gasoline for two cylinders in the first stage and working with compressed air for rest one cylinders in the second stage. In current approach, the research focuses on the second stage. After this, the power output and analysis the performance of new fuel - compressed air powered engine. The project achieves the objective of reducing the emission of pollutants. However the new model lacks the power output, reduction of fuel consumption and pollution so that continuous research is needed to fully prove the experimental values of the technology of the compressed air powered engine.

Short description of engine. The description of engine can be divided into two sections as :

1. Original Maruti 800 engine.
2. Actual or modified engine.

Original Maruti 800 engine.

Maruti 800 is a small city car that was manufactured by Maruti Suzuki in India from 1983 to 2013. The first generation (SS80) was based on the 1979 Suzuki Fronte and had an 800 cc F8B engine, hence the moniker. Widely regarded as the most influential automobile in India, about 2.87 million 800s were produced during its course of which 2.66 million were sold in India itself.

Some technical specifications of the engine are given below:

Engine model: F8
Type : Water cooled SOHC petrol
Displacement: 796 cc (49 cu in)
Number of cylinders: 3 inline
Valves per cylinder: 2
Bore & stroke :68.5 × 72.0 mm
Fuel type: Petrol
Max. Power: 37 BHP @ 5000 rpm

Actual or modified engine.

We begin to get some alternative energy which reduce fossil fuel consumption. There are some alternative energies, like battery, biogas, photocells, hydrogen fuel cell, compressed air etc. Among them, compressed air is freely and

easily available as well as free from pollution contaminants, and also can be compressed to higher pressures at an extremely low cost. Present work describes the compressed air technology that addresses the problems of exhaust gas pollution from engines, along with minimum utilization of fossil fuel. The development of the compressed air powered engine starts with dismantling the origina engine, cleaning the engine , and re-assembling as per need.

Then develop the engine into two working stages that working with gasoline for two cylinders in the first stage and working with compressed air for rest one cylinders in the second stage. In this thesis, the research focuses on the second stage. In which the arrangement of cylinders are managed in such a way that cylinder number one and three are operated with the help of petrol and cylinder number two i.e middle cylinder could run with the help of compressed air.

Fuel consumption calculations : There are several calculations could be made on current work such as mean effective pressure, fuel consumption, power output, emission elements concentration etc. This section contains two phases of fuel consumption, one is the analysis on actual engine with the help of Morse test rig and another one is on proposed modified engine, as:

Case I : Calculation for fuel consumption when all three cylinders run with petrol.

Fuel consumption can be obtained with the help of volumetric efficiency expression which is defined as the ratio of actual air consumed to the ideal air capacity and expression is given as:

Volumetric efficiency (η_{vol})

$$= \frac{mass\ of \text{ of actual air consumed}}{\text{the ideal air capacity of engine}}$$

$$(\eta_{vol}) = \frac{m_a}{(N/2\times60)\times V_d\times\rho_a} \quad \ldots..(1)$$

Where,

m_a = $mass\ of$ of actual air consumed (kg/s)

N = engine shaft speed (rpm)

V_d = engine capacity (m^3)

ρ_a = density of air (m^3/kg)

$= \frac{p}{RT}$ [where 'p' = intake air pressure (1.013×10^5)Pa]

[R = 0.287 kJ/kgK for air = 287 J/kgK ; T = 27 +273 = 293 K]

Hence,

$\rho_a = \frac{p}{RT} = \frac{1.013\times10^5}{287\times293}$ = **1.189 kg/s**

Form equation (1)

$$(\eta_{vol}) = \frac{m_a}{(N/2\times60)\times V_d\times\rho_a}$$

$$m_a = \frac{(\eta_{vol})\times V_d\times\rho_a\times N}{2\times60}$$

$$m_a = \frac{0.72\times796\times10^{-6}\times1.189\times5000}{2\times60} \text{ kg/s}$$

m_a = 0.0284 kg/s = 102.24 kg/ hr

As we are considering stoichiometric or chemically correct air fuel mixture which is generally taken as 14.1 :1 for SI engines. Hence,

$$\frac{\text{Air}}{\text{Fuel}} = \frac{14.1}{1}$$

$$\text{Fuel consumed} = \frac{\text{mass of actual air consumed}}{14.1}$$

$$= \frac{0.02854}{14.1}$$

Fuel consumed = 0.00202 kg/s =7.27 kg/hr

Case II : Calculation for fuel consumption.

Fuel consumption in such case can be calculated with the help of equation (1) as:

$$(\eta_{vol}) = \frac{m_a}{(N/2\times60)\times V_d\times\rho_a}$$

Where,

m_a = *mass of* of actual air consumed (kg/s)
N = engine shaft speed (rpm)
V_d = engine capacity (m^3)
= 530.67 cc (volume of two cylinders i.e cylinder number 1& 3)
ρ_a = density of air (m^3/kg)
$= \frac{p}{RT}$ [where 'p' = intake air pressure (1.013×10^5)Pa]
[R = 0.287 kJ/kgK for air = 287 J/kgK ; T = 27 +273 = 293 K]

Hence,

$\rho_a = \frac{p}{RT} = \frac{1.013\times10^5}{287\times293}$ = **1.189 kg/s**

Form equation (1)

$(\eta_{vol}) = \frac{m_a}{(N/2\times60)\times V_d\times\rho_a}$

$m_a = \frac{(\eta_{vol})\times V_d\times\rho_a\times N}{2\times60}$

$m_a = \frac{0.72\times530.6\times10^{-6}\times1.189\times4500}{2\times60}$ kg/s

m_a = 0.017 kg/s = 61.2 kg/hr

As we are considering stoichiometric or chemically correct air fuel mixture which is generally taken as 14.1 :1 for SI engines. Hence,

$\frac{\text{Air}}{\text{Fuel}} = \frac{14.1}{1}$

Fuel consumed = $\frac{\text{mass of actual air consumed}}{14.1}$

$= \frac{0.017}{14.1}$

Fuel consumed = 0.00120 kg/s = 4.34 kg/hr

CONCLUSION

Present scenario faces continue need of energy is increases, but basically conventional source of energy is in limited amount due to the rate of consumption and price of petroleum is also continues hiked day by day. To satisfy their need an alternate source of energy is required. But while considering alternate fuel some of factors are to be considered like available source, economy, and environment friendly etc., As we can see above that when engine run with total petrol means all three cylinders run by spark ignition combustion process. The amount of air required for complete combustion of the fuel also described along with fuel consumption per unit time. On other hand when engine moves towards some modification as per need, to form a fuel-compressed air powered engine, several advantages could be achieve such as reduction in fuel consumption and pollution.

On the basis calculated values we can see that by using -compressed air powered engine the amount of fuel combustion is reduced from 7.27 kg per hour to 4.34 kg per hour means approximately 45.9 percent. From pollution control point of view the concentration of CO2 emitted by engine is reduced hence reduction in pollutants concentration in similar conditions also reduced due to reduction in fuel combustion.

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