ISSN XXXX XXXX © 2017 IJESC

Research Article Volume 7 Issue No.6

Compressed Air Engine with Implementation of Pre-Heater

Karthik .A. V[1], Mukesh .K[2], Nithin Jacob[3], Anand Kumar[4], K. P. Abhishek[5]
Assistant Professor[1], UG Student[2, 3, 4, 5]
Department of Automobile Engineering
New Horizon College of engineering, Bengaluru, Karnataka, India

Abstract:
The idea of Compressed air as a fuel is not new, in fact it has been around for many years and many researchers are working on the idea of air as a non-polluting fuel. The zero emission engines can be obtained by modifications to the conventional gasoline I.C. engine's cam and some other minor changes. Although the compressed air engine gives out zero emissions, its performance is not on par with the performance of the conventional I.C. engine or of the electric vehicles. This project focuses on improving the performance of the zero emission vehicle like output power, torque etc. by introducing air preheater. The theory behind the experimentation is based on Gay-Lussac's Law which is also referred to as the Amontons' law of pressure– temperature which states that "The pressure of a gas with fixed mass and constant volume is directly proportional to the absolute temperature". So when the temperature of the gas is increased the pressure of the gas also increases.

Keywords: Compressed air engine, Air pre heater

I.INTRODUCTION

The increase in automobiles has resulted in the increase in pollution and with research going on every day to find solutions to reduce emissions, there are many ways to achieve the goal. Manufacturers have explored the option of using electric vehicles to reduce the emissions but electric vehicles are expensive to manufacture as well as expensive to run. The usage of air as a fuel is not a new idea, it has been around since the 19th century but it was Motor Development International (MDI) that introduced the first car that was completely driven by compressed air. In 2003 the company introduced the "Air car" which was a concept but failed to be put into production. The use of compressed air as a fuel is a non-expensive way of reducing the emissions. Compressed air can be run as a fuel in the existing I.C. engines by modification of certain parts of the engine which is an advantage because it prevents the cost of manufacturing a new engine.

Four stroke petrol engine:

The conventional petrol engine generally works on 2 stroke and 4 strokes. In 4 stroke engines the 4 strokes of the engine are:-

1. Suction/Intake stroke.
2. Compression stroke.
3. Power/Combustion stroke.
4. Exhaust stroke.

1. Suction/Intake stroke: - In this stroke the inlet valve is opened and the charge i.e. the combustible mixture enters the engine and during this stroke the exhaust valve remains closed. The stroke takes place for a 180 degree rotation of the crankshaft. During this stroke the piston moves from TDC to BDC.

2. Compression stroke: - In this stroke the combustible mixture is compressed under very high pressure by the piston which is moving from BDC to TDC. In this stroke the work is done on the mixture by the piston and this takes place for the next 180 degree of crankshaft rotation. At the end of this stroke there is a spark from the sparkplug which starts a flame. During this stroke both the inlet valve and exhaust valves are closed.

3. Combustion/Power stroke: - Power stroke is the only stroke in which the work is being done by the mixture on the piston. During the stroke the flame from the sparkplug travels through the mixture a d it burns the whole mixture, due to this the piston is pushed down from TDC to BDC and this produces the power. During this stroke both the inlet valve and the exhaust valves are closed. The power stroke takes place through the next 180 degrees of crankshaft rotation.

4. Exhaust stroke: - During exhaust stroke the exhaust valve opens and the burnt mixture is pushed out through the exhaust valve due to the pressure difference between the inside and the outside of the combustion chamber. During this stroke the work is done by the piston on the mixture as it helps push the gas out of the cylinder. This stroke takes place for the next 180 degrees of crankshaft rotation, thus completing 720 degrees of crankshaft rotation.

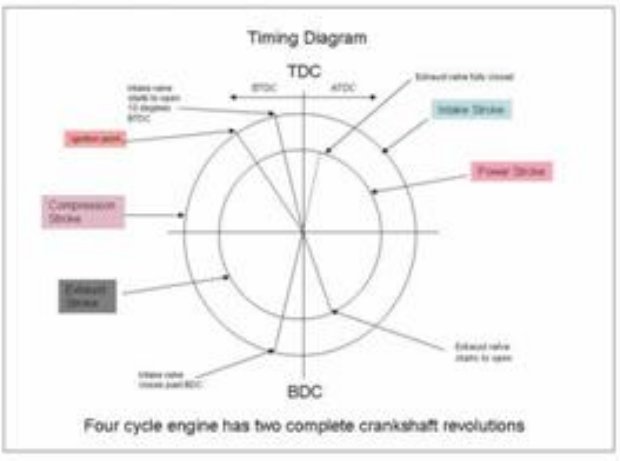

Figure.1. Timing diagram

II.PROBLEM DEFINITION

The compressed air engine has been around for many years but one of the primary concerns and reasons it has not been implemented in the real world or mass produced is that the performance output of the engine is very negligible. Hence this project primarily focuses on improving the performance aspects of the engine. The solution to this problem that we are exploring is that when the pressure of the compressed air increases the performance also increases. There are many ways to increase the pressure of the compressed air, one way is to use compressors that can hold very high pressures but the cost and size of these compressors is very large. So, the idea behind the project is to implement a economical solution to the problem of achieving high pressure.

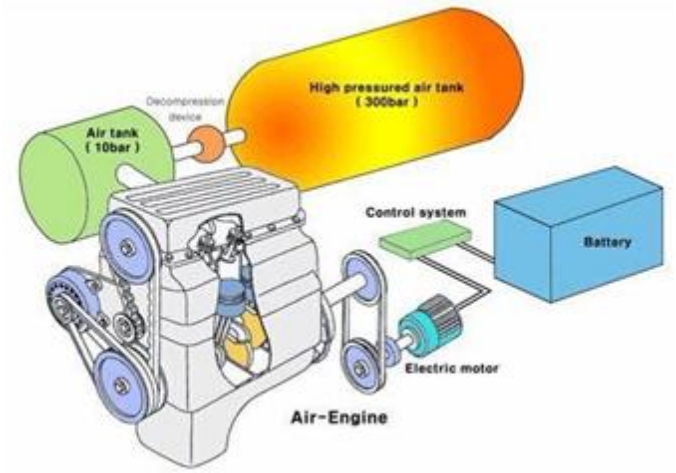

Figure. 2. Air- Engine

III.OBJECTIVE

As seen in previous research papers, the performance parameters of the compressed air engine are negligible. The main focus of this project was to, at least scarcely, increase the performance of the engine most importantly in the form of power output. The objective is to perform an analysis on the performance of the engine, firstly, without the implementation of a preheater. The preheater is the device that sets us apart from the past research done on this type of engine. Then, an analysis with the preheater being added to the experiment was performed. Lastly, a comparison study was done to observe the changes in data under common parameters.

Figure. 3. data under common parameters.

IV. EXPERIMENTATION METHODOLOGY

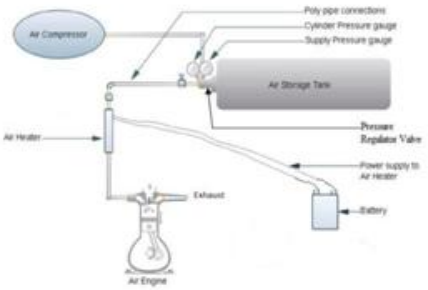

Figure. 4. Experimentation Methodology

a) Engine – the engine used is from a 2002 Honda Activa scooter. It's a single cylinder, 4 stroke engine. The displacement of the engine is 102cc. On conventional petrol, it churns out around 7 HP at 7000 rpm. The camshaft was further fabricated to convert the 4 stroke mechanism to a two stroke. This was done to produce a mechanism in which the timing of the inlet and exhaust valves are set to open and close at alternate strokes. The intake to the engine was also fabricated to allow a direct connection to the flow of compressed air.

b) Compressor – The compressor used is a piston type unit which has a capacity of 160 litres. It produces power of about 2 HP at 720 rpm. The maximum air flow rate is 264 l/min with the working pressure being around 9 kg/cm2.

c) Preheater –Glow Plug - A glow plug is a heating device used to aid starting diesel engines. The glow plug is a pencil-shaped piece of metal with a heating element at the tip. This heating element, when electrified, heats due to its electrical resistance and begins to emit light in the visible spectrum. Here, two glow plugs are used and are fitted at the ends of a cast iron housing. These are 12 V plugs that heat up to a temperature of about 120 0C as tested. The plugs are connected by leads at their ends which are in turn connected to a battery. A switch is present to turn the passage of current ON/OFF. A regulator is also present to vary the temperature of the plugs.

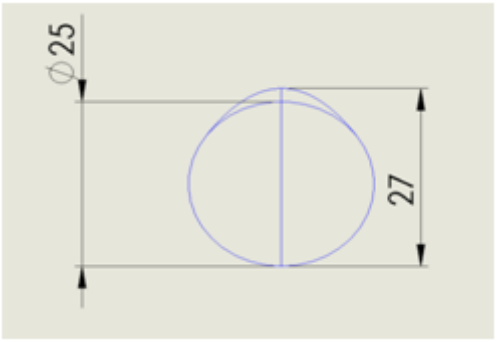

Figure.5. (Exhaust Cam)

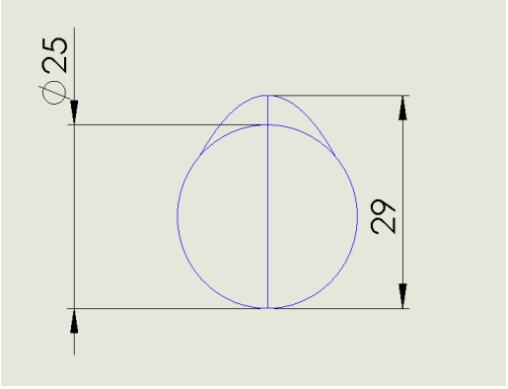

Figure.6. (Intake Cam)

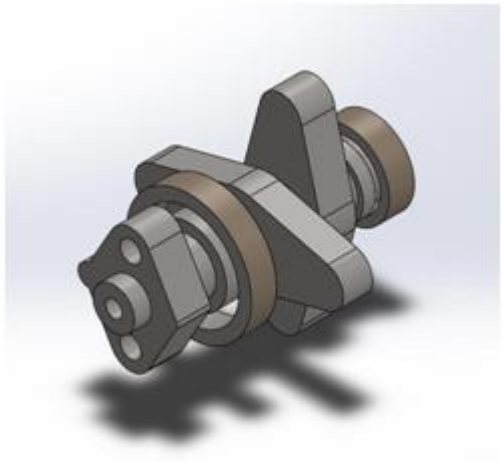

Figure.7. (Modified Cam)

V.OBSERVATIONS AND CALCULATIONS

DIAMETER OF PISTON – 50 MM = 0.05 M
STROKE LENGTH – 55.6 MM = .0556 M

AREA OF PISTON - $\frac{\pi}{4}D^2 = \frac{\pi}{4}(50)^2 = 1.9635\times10^{-3}$ M 2

Table.1.

Pressure in N/m^2	Speed in rpm	Indicated power in KW
6×10^5	760	0.83
5×10^5	743	0.676
4×10^5	726	0.527
3×10^5	684	0.372
2.7×10^5	0	0

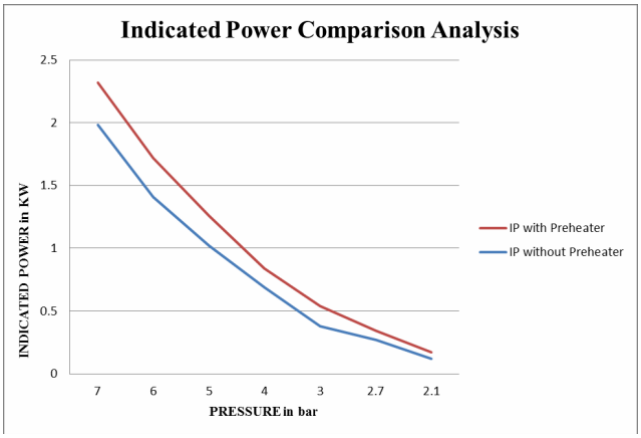

Figure.8. (Comparison of IP with and without air pre heater)

VI. CONCLUSION

The observations and calculations were prepared for the engine for both the cases. first one is for the normal compressed engine and the second one is for the air pre heater. We can see the slight improvement in power which is developed inside the cylinder with the installation of air preheater rather than without preheater.

VII. REFERENCE

[1]. Ruchil A. Patel, Department of Mechanical Engineering, Smt. S. R. Patel Engineering college, GTU, India, "A STUDY ON COMPRESSED AIR ENGINE TECHNOLOGY : A REVIEW", International Journal of Advanced Technology in Engineering and Science, Vol No 3, Special Issue No.1, April 2015

[2]. Mr. N. Govind, Mr. S. Sanyasi Rao, Mr. Manish Kumar Behera, "Design and Fabrication of Compressed Air Vehicle", International Journal & Magazine of Engineering, Technology, Management and Research ISSN No: 2348-4845

[3]. Mistry Manish K., Dr. Pavin P. Rathod, Prof. Sorathiya Arvind S., "STUDY AND DEVELOPMENT OF COMPRESSED AIR ENGINE-SINGLE CYLINDER: A REVIEW STUDY", Research Paper, International Journal of Advanced Engineering Technology, E-ISSN 0976-3945

[4]. Rahul B. Dudhat, Nainesh R. Patel, Vishal M. Kanadiya, Manish K. Mistry, Kandarp M. Joshi, "THE INVESTIGATIONAL STUDY OF PRAGMATIC MODEL OF COMPRESSED AIR SINGLE CYLINDER ENGINE FOR INCREASES THE PERFORMANCE", Research Paper, International Journal of Advanced Engineering Technology, E-ISSN 0976-3945

[5]. Sunil Prashanth Kumar, Karthik A. V., "Design and Fabrication of Compressed Air Engine Bike", Research Article, Volume 6 Issue No.7, International Journal of Engineering Science and Computing, July 2016

[6]. S. S. Verma, "Latest Developments of a Compressed Air Vehicle: A Status Report", Global Journal of Researches in Engineering, Automotive Engineering, Volume 13 Issue 1, Year 2013, Online ISSN: 2249-4596, Print ISSN: 0975-5861, USA

[7]. Nitin Parashar, Syed Mazar Ali, Sumit Chauhan, Ravi Saini,"Design and Analysis of Compressed Air Engine", International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol. 3 Issue 6, June – 2014

[8]. Qihui Yu, Maolin Cai, "Experimental Analysis of a Compressed Air Engine", Journal of Flow Control, Measurement & Visualization, 2015, 3, 144-153, Published Online October 2015 in SciRes.