# Design and Analysis of Compressed Air Engine

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***Abstract-*** **The excess exploitation of natural resources (especially in our contexts diesel and petrol) is the major cause of concern in the world. In the normal design engine diesel, petrol and natural gases are being utilized. It is also a fact that these natural resources are not unlimited and there is a need to maintain their exploitation for future. It is challenge for the scientific and the technical individuals to comment with certain fuels other than the above so that the available limited source of our natural resources are maintained.**
**Keeping in the view above social responsibility, the following options are available-**

- **Natural air**
- **Bio diesel**
- **Solar energy**
- **Water**

**Keeping in the view the various pros and cons of the above, it has been decided to work with natural air due to abounds availability in the nature. The air driven engine may be the point of research. Air driven engine may help to reduce the demand of conventional fuels.**
**Thus the objective of this research is to design & modify the four stroke petrol engine into the compressed air engine by modification in the cam lobes and also evaluate the comparison of economic characteristics between compressed air engine four stroke SI engines. By experimental investigation it is found that compressed air engine can run per kilometer at expense of 60 to 70 paisa.**

***Keywords: Compressed air engine, Investigation, Cam***

## INTRODUCTION

It is very known that conventional fuels such as diesel and petrol are the main sources of energy for internal combustion engine but these are increasingly consumed. Continuous consumption of conventional fuels may cause huge problem of scarcity of sources of energy. Depletion of these fuels has led researchers to anticipate the need to search the alternative way to drive the vehicles. Present work utilizes the air as a alternative of petrol or diesel.
As we know that air is non polluting and freely available in nature. The utilization of this freely available air is the good idea for automobile sector.
Compressed air technology attracts the researchers and several industries world widely. Compressed air engine operates with the compressed air and is very simple in construction and operation .Here, compressed air from the air cylinder pushes the piston giving the power stroke. In the next stroke piston escape the expanded air from the cylinder. The cycle is completed in two strokes. Therefore, uniform turning effort is obtained unlike four stroke engine

Fuel tank and spark plug is eliminated from the conventional four stroke engine.
In the case of a compressed air Engine, there is no combustion taking place within the engine. So it is less dangerous and non-polluting. It requires lighter metal only since it does not have to withstand elevated temperatures. As there is no combustion taking place and Carburetor is eliminated because carburetor is used for mixing of fuel and air purpose. There is no need for mixing fuel and air, here compressed air is the fuel and it is directly fed into the piston cylinder arrangement. It simply expands inside the cylinder and does useful work on the piston. This work done on the piston provides sufficient power to the crankshaft. The above experiment and modification is done on the motorcycle engine of Hero Honda (Model- Hero Honda Passion).

## WORKING OF FOUR STROKE SI ENGINE

A four-stroke engine is an IC engine in which the Piston completes four strokes. A stroke refers to the full travel of the piston along the cylinder, in either direction. The four strokes are as follows-

**INTAKE**: - This stroke of the piston begins at top dead center. The piston descends from the top of the cylinder to the bottom of the cylinder, increasing the volume of the cylinder. A mixture of fuel and air is forced by atmospheric (or greater) pressure into the cylinder through the intake port.

**COMPRESSION: -** With both intake and exhaust valves closed, the piston returns to the top of the cylinder compressing the air or fuel-air mixture into the cylinder head.

**EXPANSION: -** This is the start of the second revolution of the cycle. While the piston is close to Top Dead Centre, the compressed air–fuel mixture in a gasoline engine is ignited, by a spark Plug in gasoline engines, or which ignites due to the heat generated by compression in a diesel engine. The resulting pressure from the combustion of the

compressed fuel-air mixture forces the piston back down toward bottom dead centre.

**EXHAUST:** - During the exhaust stroke, the piston once again returns to top dead centre while the exhaust valve is open. This action expels the spent fuel-air mixture through the exhaust valve(s).

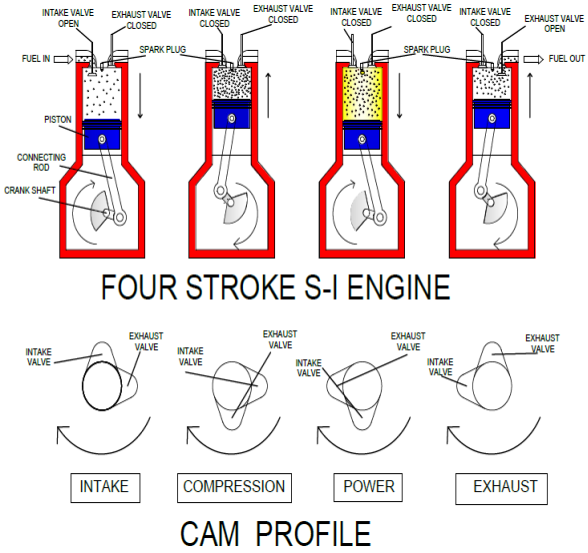


Fig (a)

WORKING OF MODIFIED COMPRESSED AIR ENGINE

A compressed air engine is an engine in which the piston completes two separates strokes. A stroke refers to the full travel of the piston top dead centre to bottom dead centre or bottom dead centre to top dead centre along the cylinder, in either direction. There are two commonly used termed as follows:-

**INTAKE**; - In this stroke inlet valve opens and exhaust valve closed. Compressed air enters in the cylinder during this stroke at pressure of 87.02264 Psi or 6 Bar to 94.27452 Psi 6.5 Bar. This stroke of the piston starts at top of the cylinder to the bottom of the cylinder by compressed air, increasing the volume of the cylinder.

**EXHAUST:** - In this stroke inlet or intake valve closed and exhaust valve opens. The piston once again returns to top dead centre and compressed air are pushed out to the cylinder into the atmosphere to the movement of piston through exhaust valve.

The working of modified compressed air engine is also shown in fig:-

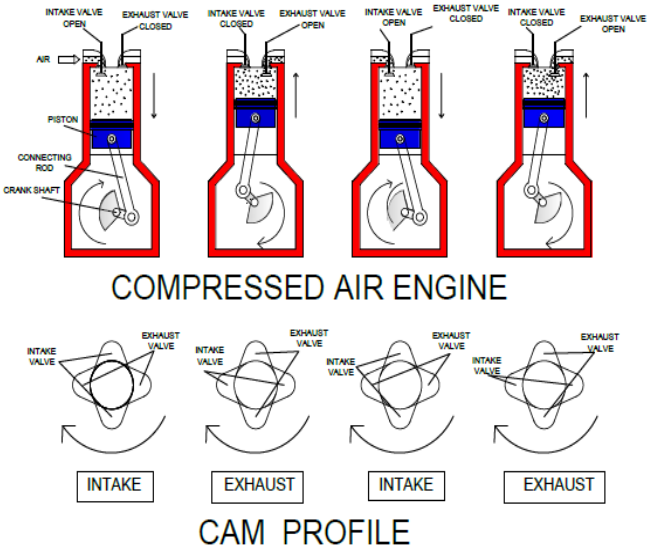


Fig ( b)

EXPERIMENTAL METHOD

**A) Experimental Setup**:-

For carrying out the research, Petrol engine of HERO HONDA PASSON PRO of 100 cc was used . As petrol is not being used in this experiment, so there was no need of the carburetor and thus the carburetor was removed. There is no combustion taking place inside the engine, so there is no need of a spark plug, so the spark plug is also removed.

In the inlet valve a hose (pipe) is attached and a regulator was also attached on the top of the cylinder. So that the starting pressure 87.02264 Psi or 6 bars to 94.27452 Psi or 6.5 bar could be made. When the regulator was opened air entered into the cylinder through the pipe. When the air entered at a pressure of 6 bar the piston moved from Top dead centre to Bottom dead centre (TDC to BDC).and piston reaches at bottom dead centre. After that, the piston started to move from Bottom dead centre to Top dead centre due to the weight of the flywheel. As piston started

To move upwards the engine stopped working. This was because the exhaust valve did not open and the compressed air did not moved out. So, engine stopped there. To overcome this a cam was designed. The engine used in the experiment had cam of two cam lobes. And the fig. (c) is shown the cam of the engine.

Camshaft of an engine with two lobes

Camshaft of an engine with four lobes
Fig (c)

To overcome this, in addition to two cam lobes, a new cam lobe was attached. Further, to make the exhaust valve open again one more cam lobe was attached. When the four cam lobes were attached, the engine started to work due to this, the petrol engine started to work as a compressed air engine in which there is no need of petrol and combustion. The specification of an engine is given below:-

**Engine Specification:-**

HONDA PASSON PRO of 100 cc

Fig (d)

**B) Economy Analysis:-**

A metallic cylinder of 60 Inches or 152.4 cm with a diameter 12 Inches or 30.48 cm was taken. The inside pressure was taken to be 140 Psi or 9.65266 Bar in half and 300 Psi or 21.6975 Bar (Maximum). The cost to fill the cylinder was Rs. 6. The engine was started by using this cylinder. The engine runs for 8-10 km (depending upon the conditions).

This experiment was repeated several times to check and the resulting average was between 7-9.5, 8-10 & 8.5-10. On an average it can cover 1 km in 0627 paisa. The air cylinder specification is given below:-

**Air Cylinder Specification**

| | |
|---|---|
| Type | Metallic/ Steel/ Regulator and |
| Length | 60 Inches or 152.4 cm |
| Diameter | 1 feet or 30.48 cm |
| Inside Pressure | 140 Psi or 9.65266 Bar in half<br>300 Psi or 21.6975 |
| Regulating Pressure | 101.526 Psi or 7 Bar |
| Engine Starting pressure | 87.02264 Psi or 6 Bar to 94.27452 Psi 6.5 |
| Volume | 300 Pond |

| | |
|---|---|
| Type | Air-cooled, 4-stroke single cylinder OHC |
| Displacement | 97.2 cc |
| Max. Power | 5.74 kW (7.8 Ps) at 7500 rpm |
| Max. Torque | 0.82 Kgf-m (8.04 N.m) at 4500 rpm |
| Bore x Stroke | 50.0 x 49.5 mm |
| Carburetor | Side Draft, Variable venturi type with TCIS |
| Compression Ratio | 9.0: 1 |
| Starting | Electric start / Kick start |

A metallic cylinder of 60 Inches or 152.4 cm with a diameter 12 Inches or 30.48 cm

**Fig (e)**

## RESULT & DISCUSSION

Through this experiment, it has been found that if instead of two cam lobes in petrol or diesel engine, four cam lobes are attached, the engine would start working as a compressed air engine. This compressed air engine does not require petrol or diesel but instead uses natural air for its working. This engine can travel 1 km in .65 paisa which is very less as compared to that of petrol and diesel engine and would further be economical to use. As there is no combustion taking place in the engine, so it is completely environmental friendly.

## CONCLUSION

Utilization of non-conventional energy sources such as compressed air engine we can set a milestone in the field of green technology because it is the demand of the time to adopt green technology. Compressed air engine have the following advantages-.

1) Start-up power is not required to run engine.

2) Exhaust air causes no harm to environment as it is cold and clean.

**Drawbacks:-**

1. Noise created by engine
2. Due to high pressure there is a possibility that cylinder can burst.
3. Speed of the engine is less than that of petrol and diesel engine.

**Future Scope:-**

1. To increase the speed of the engine.
2. Reduce the noise

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