

Compressed Air Driven Engine

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ABSTRACT

The Air Driven Engine is an eco-friendly engine which operates with compressed air. An Air Driven Engine uses the expansion of compressed air to drive the pistons of an engine. An Air Driven Engine is a pneumatic actuator that creates useful work by expanding compressed air. There is no mixing of fuel with air as there is no combustion. An Air Driven Engine makes use of Compressed Air Technology for its operation. The Compressed Air Technology is quite simple. If we compress normal air into a cylinder the air would hold some energy within it. This energy can be utilized for useful purposes. When this compressed air expands, the energy is released to do work. So this energy in compressed air can also be utilized to displace a piston

I. INTRODUCTION

At first glance the idea of running an engine on air seems to be too good to be true. Actually, if we can make use of air as an aid for running an engine it is a fantastic idea. As we all know, air is all around us, it never runs out, it is non-polluting and it is free.

An Air Driven Engine makes use of Compressed Air Technology for its operation. Compressed Air Technology is now widely preferred for research by different industries for developing different drives for different purposes. The Compressed Air Technology is quite simple. If we compress normal air into a cylinder the air would hold some energy within it. This energy can be utilized for useful purposes. When this compressed air expands, the energy is released to do work.

So this energy in compressed air can also be utilized to displace a piston. This is the basic working principle of the Air Driven Engine. It uses the expansion of compressed air to drive the pistons of the engine. So an Air Driven Engine is basically a pneumatic actuator that creates useful work by expanding compressed air. This work provided by the air is utilized to supply power to the crankshaft of the engine.

In the case of an Air Driven Engine, there is no combustion taking place within the engine. So it is non-polluting and less dangerous. It requires lighter metal only since it does not have to withstand elevated temperatures.

As there is no combustion taking place, 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.

Non-Renewable energy sources which meet most of the world's energy demand today are on the way of depletion. Also combustion product of these sources are causing problems like pollution, greenhouse effect and ozone layer depletion. To avoid human being from hazardous effect of these sources engineers are trying to develop such vehicle which will cause less harm to human being and also to the environment. In result of that, hybrid vehicles, electric cars and air cars are the new born child of this technology which is more efficient and less harmful.

The skill to apply engineering knowledge is one of the most important aspects that an engineering graduate must have acquired upon graduation. The only way to learn this practical skill is to have a specific engineering problem to solve. One must learn those all applicable theories in analyzing the problem systematically. Experimenting in a laboratory is essential. The process of experimentation involves organization, observation, familiarization with various pieces of equipment, working with others, writing and communicating ideas and information. These are the skills required of an engineer.

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In this project, a Air engine is designed and applied to make the combustion process faster and less destructive for

the vehicle. The new device must be reliable, with small dimensions, low construction and maintenance cost.

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.

Compressed air technology attracts the researchers and several industries world widely..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-CD 100.

II. LITERATURE SURVEY

AIR POWERED ENGINE

Prof. B.S.Patel et al. tried to develop a compressed air engine by modifying an 4-stroke, single cylinder SI engine by replacing the spark plug with a pulsed pressure valve, and using compressed air as the working fluid. The working of the engine is explained theoretically and the cost analysis is made which shows that the compressed air engine is cheap when compared to the conventional SI engine.

The basic principle of compressed air engine is slightly different from the engines which runs on gasoline fuel. In petrol engines, petrol burns itself & produces gases which are used to move the piston cylinder arrangement same principle is used in CAE but instead of using petrol only compressed air is used for displacement of piston. In CAE compressed air tank is the energy storage medium similar to a fuel tank is gasoline operated vehicles. Compressed air tank is used to supply necessary amount of air to the engine which is required for engine operation to run the vehicle efficiency the energy. Density of fuel used will be high but in fact compressed air is having less energy density as compressed to conventional fuels & rechargeable batteries. But it is possible to increase energy density of air by with greater storage tank pressure. Various gas laws explain how compressed air behaves. Boyles law state that

if volume of air halves during compression then pressure is doubled. Also, Charles law state that volume of gas changes in direct proportion to temperature. So according to this lows compressed air is used to run the engine by thermodynamic expansion

2.1. COMPRESSED AIR TECHNOLOGY

Air can be compressed into small volumes and can be stored in suitable containers at high pressures. Such air compressed into containers is associated with an amount of energy. When the stored compressed air is released freely it expands thereby releasing the energy associated with it. This energy released can be utilized to provide useful work.

The compression, storage and release of the air together are termed as the Compressed Air Technology. This technology has been utilized in different pneumatic systems. This technology has been undergoing several years of research to improve its applications.

Compressed air is regarded as the fourth utility, after electricity, natural gas, and water.

2.2. AIR COMPRESSOR

An air compressor is a device that converts electrical power or gas into kinetic energy by pressurizing and compressing air, which is then released in quick bursts. There are numerous methods of air compression, divided into either positive-displacement or non-positive displacement types.

Positive-displacement air compressors work by forcing air into a chamber whose volume is reduced to effect the compression. Piston-type air compressors use this principle by pumping air into an air chamber through the use of the constant motion of pistons. They use unidirectional valves to guide air into a chamber, where the air is compressed. Rotary screw compressors also use positive-displacement compression by matching two helical screws that, when turned, guide air into a chamber, the volume of which is reduced as the screws turn. Vane compressors use a slotted rotor with varied blade placement to guide air into a chamber and compress the volume.

Non-positive-displacement air compressors include centrifugal compressors. These devices use centrifugal force generated by a spinning impeller to accelerate and then decelerate captured air, which pressurizes it.

The details of the engine are as follows:

- It is having robust construction and also light weight.
- Displacement – 100cc
- Company Name - Hero Honda Private Limited
- Engine type - Single Cylinder Four Stroke Petrol Engine
- Power - 9.65Hp(7.0Kw) @8000RPM
- Gearbox - Four Speed
- Final Drive - Chain
- Clutch Type - Wet Multiplate

We only needed a simple piston-cylinder arrangement with an outlet and an exhaust. But as we know a normal four stroke engine contained one inlet valve and another exhaust valve, it also had the spark plug which we didn't require.

So, several modifications had to be done on the engine to suit our purpose.

The modifications comprised of:

- Closing the inlet and exhaust valve
- Removing the spark plug from the cylinder head
- Providing an inlet at the place of the spark plug

For closing the inlet and exhaust valve of cylinder head we had cut the lobes of the valves. We ended the connection between the camshaft and actuating valves. As a result of this modification the inlet and exhaust valves are remaining closed for the total span of operation.

There is no combustion taking place in an Air Driven Engine. So naturally there is no need for the spark plug. So the spark plug is removed from its respective position. It would be great if we provide the inlet for compressed air at the position of the spark plug as it is better to let the air enter from the top of the piston. So the connector which is used to connect the pipe from the compressed air tank has to be fixed at the position of the spark plug.

Specification of roller valve:-

- 3/2 pneumatic Roller type
- Continuous operation
- Manually operated
- Pressure range 3.5-8 bar
- Nominal flow rate 120 ltr/min

The 3/2 roller valve is actuated when the roller lever is pressed, for eg. it is pressed by the cam of cylinder. After release of the roller lever, the valve is return to its initial position by return spring. These type of pneumatic valve have 3 ports and 2 positions. The ports are operated by the lever which is mounted on spring.

III. WORKING OF COMPRESSED AIR DRIVEN ENGINE

Air engine works on the same principle of that of an internal combustion engine. The only difference between the two is that in an internal combustion engine; the explosion of fuel in the combustion chamber produces the energy to move the piston, while in an air engine the energy for moving piston is acquired from the supplied compressed air.

The complete assembly of our air engine consists of slightly modified ic engine, valve timing shaft attached to the valve mechanism, piping system, flow control valve, air compressor and air tank.

For the proper and continuous working of the engine the timing with which the compressed air is supplied is of great importance. So in order to make it precise we used roller controlled valve mechanism. The valve timing shaft is made with almost precision to precise operation of valve. For that the outer dead centre region (ODC) of the piston is found out and is marked on to the fixed valve timing shaft. By the same method the point just before the exhaust port opening (EPO) is found out and marked on the shaft with the help of a cross sectional change.

For starting; the engine is cranked by the kicker. This will rotate the crankshaft along with the valve in the clockwise direction. And the inlet port of the roller

operated valve is opened. The compressed air is passed through the valve to the cylinder and pressure is exerted on the piston. The piston moves from TDC to BDC due to exerted pressure. Then the inlet port of the valve gets closed. And due to cranking the air inside the cylinder is pushed back through the exhaust port of the valve. During this the piston moves from BDC to TDC and the cycle continues and the work is done.

IV. OBSERVATIONS

WEIGHT	PRESSURE								
	1	2	3	4	5	6	7	8	9
NO LOA D	3 4 4	4 1 3	4 5 6	4 8 4	5 1 3	5 3 3	5 4 5	5 6 3	5 8 8
.5	3 1 4	3 8 4	4 5 0	4 7 0	5 0 6	5 1 8	5 2 6	5 5 6	5 5 6
1	3 0 0	3 6 3	4 1 2	4 4 0	4 6 5	4 8 0	4 9 5	4 9 0	4 3 0
1.5	2 1 0	2 6 8	3 8 1	4 0 0	4 4 1	4 5 9	4 6 9	4 7 4	4 0 6
2	2 0 2	2 1 0	3 7 4	3 8 5	4 2 5	4 5 0	4 6 0	4 6 5	4 7 5
2.5	- -	- 3 2	3 3 2	3 7 5	3 2 0	4 2 6	4 3 6	4 5 2	4 6 0
3	- -	- 0 0	3 2 6	3 5 4	3 6 3	3 8 1	3 8 1	4 2 1	4 3 8

V. PERFORMANCE CHARACTERISTICS

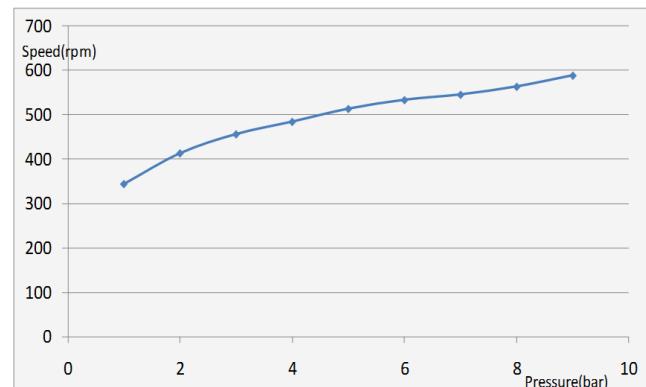


Fig: speed versus pressure

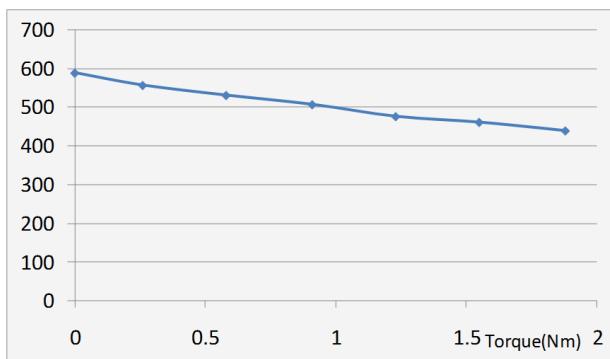


Fig: speed versus torque

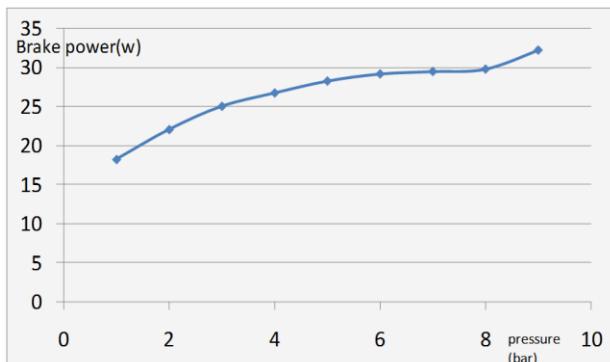


Fig: brake power versus pressure

VI. ADVANTAGES

- The air engine is an emission-free piston engine that uses compressed air as a source of energy.
- Compressed-air tanks can be disposed of or recycled with less pollution than batteries.
- Simple in construction. The engine can be massively reduced in size
- Easy to maintain and repair.
- No fire hazard problem due to over loading. Air, on its own, is non-flammable.
- Low manufacture and maintenance costs
- Comparatively the operation cost is less.
- Light in weight and easy to handle. The engine runs on cold or warm air, so can be made of lower strength light weight material such as aluminium, plastic, low friction teflon or a combination
- Compressed-air engines are unconstrained by the degradation problems associated with current battery systems.
- The air tank may be refilled more often and in less time than batteries can be recharged, with re-filling rates comparable to liquid fuels.
- Lighter vehicles cause less damage to roads
- The price of filling air tanks is significantly cheaper than petrol, diesel or biofuel. If electricity is cheap, then compressing air will also be relatively cheap
- Quick response is achieved.
- Less costly and more effective

VII. FUTURE SCOPE

- Design and fabrication of a new engine made of light metal will give better results.

• Usage of compressed air tanks for storage and supply will give it more scope in automobiles.

• Much like electrical vehicles, air powered vehicles would ultimately be powered through the electrical grid. This makes it easier to focus on reducing pollution from one source, as opposed to the millions of vehicles on the road. Transportation of the fuel would not be required due to drawing power off the electrical grid. This presents significant cost benefits. Pollution created during fuel transportation would be eliminated.

• Compressed-air vehicles operate to a thermodynamic process as air cools down when expanding and heats up when being compressed. As it is not possible in practice to use a theoretically ideal process, losses occur and improvements may involve reducing these, e.g., by using large heat exchangers in order to use heat from the ambient air and at the same time provide air cooling in the passenger compartment. At the other end, the heat produced during compression can be stored in water systems, physical or chemical systems and reused later.

• New engine designs; as shown in fig 14.1 shows the improved variants of the air engine. With these type of engines; which is more efficient; air powered automobiles could gain a bright scope in future.

VIII. CONCLUSION

On the whole, the technology is just about modifying the engine of any regular IC engine vehicle into an Air Powered Engine. The Air Powered Engine technology is cheaper in cost and maintenance, can be easily adapted by the masses and it doesn't cause any kind of harm to the environment. Instead, it's wide spread use will help mankind in controlling the serious problem of global warming. Future developments can be made by designing an ideal vehicle for this kind of engine. Efficient means of transportation.

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.

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