Zero Pollution Air Powered Engine: A Review

Lalit Patel[1] Dr. Ratnesh Sukla[2]
[1]Research Scholar [2]Assosiate Professor
[1]Rai University, Ahmedabad, Gujarat, India [2]Goverment Engineering College, Surat, Gujarat, India

Abstract— Internal-combustion engines pollute the environment seriously, and consume enormous non-renewable energy so Today the whole world is in search of alternative fuel and There are couples of option of alternative fuel such as solar power, tidal power, geo-thermal power, etc. and one of them is Compressed Air. The air engine runs on air only so no needs any Fossil fuels and carburetor. The present paper gives a brief description on zero pollution compressed air engine. As we are going to convert the already existing conventional engine into an air powered one, this new technology is easy to adapt and another benefit is that it uses air as fuel which is available abundantly in atmosphere. This technology is cheaper in cost and maintenance and it doesn't cause any kind of harm to the environment. Thus it is surely a revolutionary mode of transport.

Key words: Compressed Air Engine, Zero Pollution, Compressed Air Fuel (CAF), Eco Friendly Engine, Single Stroke Engine

I. INTRODUCTION

Nowadays the need of energy is increases, but basically conventional source of energy is limited due to that price of petroleum or gasoline is continuously rising. To satisfy our need alternate fuel or energy is required. But while considering alternate fuel some factors be considered as like availability, eco-friendly etc. Also, combustion products after using them plays an major role in causing global problems, such as the greenhouse effect, ozone layer depletion, acid rains and pollution which are great danger for environment and eventually for the total life on planet and also has the strength to completely destroy the planet at later of its stage so it Is necessary to control it on its Initial stage.. Due to these factors leading automobile manufacturers are forced to develop cars fueled by alternatives energies. Hybrid cars, Fuel cell powered cars, Hydrogen fueled cars will be soon in the market as a result of it. One of the possible alternatives is the air powered car [1].

A. Compressed air

Compressed air is a gas, or a combination of gases, that has been put under greater pressure than the air in the general environment. Numerous and diverse, including jack hammers, tire pumps, air rifles, and aerosol cheese are some of the current applications using compressed air. In this case Compressed air can also be defined as the fuel having the potential as a clean, inexpensive, and infinitely renewable energy source. Its use is currently being explored and can be an alternative to fossil fuels [1].

B. Behavior of Compressed Air

When compressed gas is used as a utility it a non-combustible, non-polluting utility and also compressed is clean, safe, simple and efficient and also there are no dangerous exhaust fumes or other harmful by products. When air at atmospheric pressure is mechanically compressed by a compressor, the transformation of air at 1 bar (atmospheric pressure) into air at higher pressure (up to 414 bars) is determined by the laws of thermodynamics. They state that an increase in pressure equals a rise in heat and compressing air creates a proportional increase in heat. Also Boyle's law explains that if a volume of a gas (air) halves during compression, then the pressure is doubled. And as also stated by Charles' law that the volume of a gas changes in direct proportion to the temperature. So according to these laws they explain that pressure, volume and temperature are proportional; that change one variable will also effect the other variables and one or two of the others will also change, according to this equation Compressed air is normally used in pressure ranges from 1 bar to 414 bar or in PSI 14 to 6004 PSI at various flow rates from as little as 0.1 m or in cubic feet per minute is 3.5 CFM and up [1]

C. Compressed Air Compare with Alternative Fuel

In this research paper focused on compressed air is used as fuel because of air is widely available in nature and its zero pollution and cost of the compressed air is very less compare to other alternative fuels like Hydrogen, Solar, Biogas and Ethanol. Solar energy also used as alternative fuel but the manufacturing cost and maintenance cost is higher compare to CAF. In CAF no need to any kind of complex circuit and costly panel like solar system. And CAF is not depends on atmospheric condition like solar system , so we can say that air is used as alternative fuel is more suitable then solar energy. Now if we talk about hydrogen so first of all its very costly process to produce hydrogen and also very dangerous to store and it's highly flammable and it is chance to blast if licked. So compare to hydrogen CAF is very safe and no chance of blast in any condition and also economic to produce compressed air. Now if we compare CAF with Ethanol, Ethanol can absorb water & if water enters the fuel tank and water dilutes ethanol, reducing its value as a fuel it causes problems with corrosion. So ethanol is not suitable in India because of its weather condition. Aldehyde, a function of ethanol volume, is a threat to nose, eyes, and throat & possibly causes cancer. CAF is nontoxic fuel and not harmful to the human health and not absorb water in side it so our engine will also safe during running.

So Air use as a fuel for existing internal combustion engine because of its vary economic, safe and widely available at everywhere.

D. History

The first air powered vehicles were actually trains. The Mekarski air engine, the Robert Hardie air engine and the Hadley-Knight pneumatic system were used in the 1800's to power locomotives. In 1925, an article appeared in the Decatur Review about a man named Louis C. Kiser who converted his gasoline powered car to run on air. Lee Barton Williams in 1926 claimed to have invented the first air car. Williams was from Pittsburg and claimed the car started on gasoline but after 10 mph it switched to compressed air only. In 1931, the Hope Star of Hope, Arkansas ran an article

about Roy J. Meyers of Los Angeles inventing the first air car. In 2007, Tata Motors introduced the MDI City Cat developed by Guy Nègre as the first commercial air car. As of 2009, two more models of MDI air cars have been showcased [2].

II. LITERATURE REVIEW

A. Literature Review Based On Industrial Contribution:

In fact, two centuries before that Dennis Pepin apparently came up with the idea of using compressed air (Royal Society London, 1687). In 1872 the Mekarski air engine was used for street transit, consisting of a single stage engine. Numerous locomotives were manufactured and a number of regular lines were opened up (the first in Nantes in1879).

MDI (Motor Development International), France has proposed a range of vehicles made up of Air Pod, OneFlowAir, City Flow Air, MiniFlowAir and MultiFlowAir. One of the main innovations of this company is its implementation of its "active chamber", which is a compartment which heats the air (through the use of a fuel) in order to double the energy output.

Tata Motors, India, as of January 2009 had planned to launch a car with an MDI compressed air engine in 2011. In December 2009 Tata's vice president of engineering systems confirmed that the limited range and low engine temperatures were causing problems. Tata Motors announced in May 2012 that they have assessed the design passing phase 1, the "proof of the technical concept" towards full production for the Indian market. Tata has moved onto phase 2, "completing detailed development of the compressed air engine into specific vehicle and stationary applications". Recently MDI (Motor development international) has developed a new car based on compressed air engine that can run at 56 kmph. The TATA Motors have also announced an air car to be launched in 2015. The car is named as AIRPOD and can run on a minimum air pressure of 20 bar and can attain a maximum speed of 70 kmh-1 [3].

B. Literature Review Based On Industrial Contribution:

Yadav et al. [4], compressed air was used as fuel to run an engine. The compressed air engine was modified with pneumatic cylinder, pneumatic solenoid valve, and compressor. In the proposed model, the input was connected with air compressor. The study showed that about 3m3 air at 30 bar pressure gave a mileage equal to 1 liter petrol and cost of production of compressed air was much lower than that of petrol, this proved it less costly. The engine designed was thus eco-friendly, pollution free and also economical.

Wang et al. [5] presented the applications of compressed air on an engine to run a motorcycle. A 100cc four-stroke internal combustion engine was revised to a two-stroke air compressed engine. The compressed air engine motorcycle was examined at different valve timings, gear reduction ratios and different air pressures. At lower pressure of 5 bar, the maximum speed was 28.9 kmh-1 travelling 2.5 km, whereas at high pressure of 9 bar the maximum speed attained was 36.5 kmh-1 travelling 1.7 km.

Vishal et al. [6] proposed that air powered engine could be an alternative of internal combustion engine. Two stroke engine gave 18 mph maximum speed while running on compressed air. Experiment showed that air powered engine was efficient and contributed to pollution free environment.

Verma [7], an analysis on problems related to compressed air engine was done. Zero emission of harmful gases was the greatest advantage. Results of analysis showed that compressed air vehicle was a bit distant dream for actual practice, but in laboratories researches were very rigorously going on.

Kumar et al. [8], a compressed air engine was proposed which used the energy of reciprocating piston to rotate the output shaft. Simulation showed inlet pressure was directly proportional to velocity and inversely proportional to cycle time.

Sharma et al. [9], a single cylinder engine was modified to make it work on compressed air. Pneumatic cylinder and solenoid valve were the main components introduced to the modified engine. The study showed that indicated power was directly proportional to load.

Boddapati et al. [10], modified a four stroke engine to a two stroke engine. The first stroke was suction/power stroke while the second was exhaust stroke. A cam was designed to set the inlet air timing for an air engine. Furthermore, 5 bar of pressure gave 850 rpm with mechanical efficiency of 80%.

Baig et al. [11], a 100cc internal combustion engine was modified to an air compressed engine. The engine was improved from a four stroke engine to a two stroke engine. Engine speed of 3000 rpm was obtained at a maximum pressure of 8 bar and temperature of 15ºC.

III. HOW COMPRESSED AIR CAN DRIVE A CAR?

The laws of physics dictate that uncontained Gases will fill any given space. The easiest way to see this in action is to inflate a balloon. The elastic skin of the balloon holds the air tightly inside, but the moment you use a pin to create a hole in the balloon's surface, the air expands outward with so much energy that the balloon explodes. Compressing a gas into a small space is a way to store energy. When the gas expands again, that energy is released to do work. That's the basic principle behind what makes an air vehicle move [2].

IV. WORKING PRINCIPLE OF AIR ENGINE

In any engine the charge enters from the inlet valve known as suction stroke then it is compressed by the piston due to crank rotation which is the compression stroke, then sparking takes place through the spark plug, the fuel ignites and combustion process takes place known as expansion stroke and finally the combustion product are let out of the engine by the exhaust stroke. Here air is initially taken up from the atmosphere, then it is compressed with the help of a compressor and sent to the engine cylinder. Piston is assumed to be at TDC, the inlet valve is closed permanently and initially exhaust valve also remains closed.

The compressed air gets filled in the clearance volume and when a small rotation is given to the crank this piston starts to slide down, the compressed air tends to expand and pushes the piston downwards. The piston moves from TDC to BDC in one stroke. Now the exhaust valve opens and due to pressure difference the air filled in the volume of the cylinder moves out and piston moves up from BDC to TDC. In this manner one cycle gets completed in

two strokes again the same process takes place and output is obtained [12].

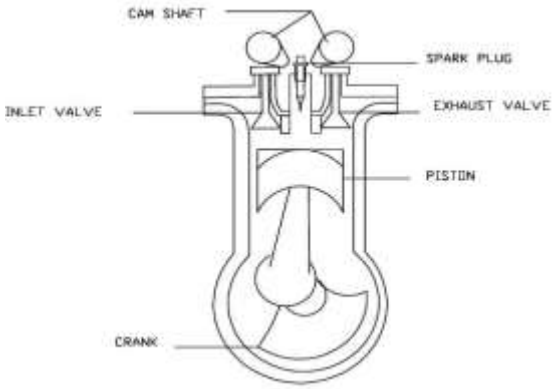

Fig. 1: Original Design of Engine

A. Advantages of Compressed Air Powered Vehicle:

- Transportation of fuel is not needed, hence its cost efficient and also reduces pollution of environment.
- High torque for minimum volume.
- The mechanical design of the engine is simple and robust.
- Low manufacture and maintenance costs as well as easy maintenance.
- Lighter vehicles would mean less abuse on roads, thus, resulting in longer lasting roads.
- The temperature generated is not very high hence a cooling system is not needed and also material of lower strength and lower thermal resistivity can be used to build this engine, by which cost can be reduced, Can be recycled, lower manufacturing and maintenance cost.
- The price of filling air powered vehicles is significantly cheaper than petrol, diesel or biofuel. If electricity is cheap, then compressing air will also be relatively cheap.
- Compressed-air tanks can be disposed of or recycled with less pollution than batteries.
- The tank may be able to be refilled more often and in less time than batteries can be recharged, with refueling rates comparable to liquid fuels.
- The tanks used in a compressed air motor have a longer lifespan in comparison with batteries, which, after a while suffer from a reduction in performance.

B. Disadvantages of Compressed Air Powered Vehicle:

- The main disadvantage is it uses indirect form of energy. As air needs to be compressed first and then that air is used in the engine to give the desired output. We all know that in any conversion of energy some energy is always lost hence the efficiency of engine suffers.
- We know that when air expands it cools down (Charles's law) and since the temperature goes down the movement of piston is affected and again in turn the efficiency is affected.
- Since this engine is not yet common it cannot be refilled at home but needs a compressor

V. Conclusion

With the present situation of alarming pollution and Depletion of fossil fuel, the concept of compressed air engine has taken a vital position in the research and development field. Nowadays the need for energy continuously increases, and we are using the conventional resources at an alarming rate hence an alternative fuel is much required and Compressed Air Technology can be one of the best alternative, as the pollution caused is zero and it is also cost efficient. The experiment which was performed also show that the vehicle ran at a good speed of 60kmph and the increased weight was 18.5kgs which only nominally affected the efficiency of the engine. Also there was no pollution caused. Hence it's a better and sustainable and eco-friendly than fuels such as petrol etc. 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, its wide spread use will help mankind in controlling the serious problem of global warming.

References

[1] Ruby Sharma, Naveen Singla Study And Fabrication Of Compressed Air Engine, International Journal Of Research And Development Organization, Vol. 2, Issue 1, Jan 2015, Paper 4.

[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, Volume No: 2 (2015), Issue No: 7 (July), Pp: 219-223.

[3] Ankit Sharma, Manpreet Singh, Parametric Analysis Of An Air Driven Engine: A Critical Review, International Journal Of Advanced Research In Engineering And Technology, Volume 6, Issue 4, April 2015, Pp. 123-131.

[4] J. P. Yadav, and B. R. Singh, Study and fabrication of compressed air engine, S-JPSET, 2(1),2011, pp.1-8.

[5] Y. W. Wang, J. J. You, C. K. Sung, and C. Y. Huang, The Application of Piston Type Compressed Air Engines On Motor Vehicles, Procardia Engineering, 79, 2014, pp.61-65.

[6] V. Sapkal, P. Bhamare, T. Patil, M. Sayyad, and G. U. Shrikant, Future Trends in Automobiles: Air Powered Vehicles, International Journal of Advance Research in Science and Engineering, 4(1), 2015.

[7] S. S. Verma, Latest developments of a Compressed Air Vehicle: A Status Report, Global Journals Inc, USA, 13(1), 2013.

[8] R. Kumar, Rahul, and M. G. Anand, Simulation And Construction Of Single-Stage Reciprocating Pneumatic Transmission System Engine, Department of Mechanical Engineering, Amrita University, International Journal Of Scientific and Research Publications, 2(7), 2012,pp. 1-6.

[9] R. Sharma, and N. Singla, Study and fabrication of compressed air engine, International Journal of

Research and Development Organizations, ISSN-3785-0855.

[10] V. Boddapati, S. V. V. Vinod, and D. Babu, Air powered vehicle-an eco-friendly engine, International Journal of IT, Engineering and Applied Sciences Research, 4(1), 2015, pp.29-33.

[11] Bilal Abdullah Baig, and Hakimuddin Husain, Design and Fabrication of Compressed Air powered Car, International Journal on Research and innovation Trends in Computing and Communication, 3(2), 2015, pp.17-2

[12] Arjit Mourya, Aarif Khan, Darshika Bajpayee, Nainsi Gupta, Modified Compressed Air Engine Two stroke engine working on the design of a four stroke petrol engine, IJTARME, Volume -3, Issue-4, 2014.

