

Review on Study of Experimental Investigation on the Performance of Zero Pollution Air Powered Engine

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ABSTRACT

This paper describes the working of a four-stroke single cylinder Engine which can run on pneumatic power as by compressed air, since it is an old technique which is attracting many scientists as well as Engineers from many years. This paper describes on the same with some new modification which is main objective of this review paper. Since engine is operated by Compressed air which contribute to reduce the air pollution and tend to zero pollution level of atmosphere and making a great environment. While developing it, some parameters like temperature, density, input power, emission control have to be mastered for development of safety. Since the Gasoline is a thing of past so the main advantage of CAE is no hydrocarbon fuel is required i.e. No combustion process occurs there.

Keywords: *Pneumatic motor, Storage tank, Compressed air engine, Emission output, Eco friendly, CAT, Energy released.*

1. INTRODUCTION

Compressed air is the air kept under a pressure that is greater than atmospheric pressure. It serves many domestic and industrial purposes. We know that our world is facing fuel crises now. All kinds of conventional source of fuels are the verge of exhaustion. Gasoline which has been main source of fuel for history of cars is becoming more and more expensive and impractical. These factors are leading car manufactures to develop cars fuel alternative energies. Two hybrid cars took to the road in 2000 & in three or four year's fuel -cell-powered cars will roll on to the world's highways. While gasoline prices in the United States have not yet reach their highest point. But cost is not only problem with using gasoline as our primary fuel [1]. It is also damaging to the environment, and since it is not a renewable resource, it will eventually run out. One possible alternative is the AIR POWER VEHICLES. It is hard to believe that compressed air can be used to drive vehicles. However that is true and "air vehicles" as it popularly knows has caught the attention of research worldwide. It has zero emission and is ideal for city driving condition. MDI (Motor Development International) is one company that holds the international patents for compressed air car.

Compared to fuels like petrol and diesel, compressed air is favourable because of a high energy density, low toxicity, fast filling at low cost and long service life. These issues make it technically challenging to design air engines for all kind of compressed air driven vehicles. To meet the growing demand of public transportation, sustainable with environmental consciousness, people are in the search for the ultimate clean car with zero-emissions. Many concept vehicles were proposed that run on everything from solar power to algae, but most of them are expensive and require hard-to-find fuels. Compressed air vehicle project in the form of light utility vehicle (LUV) (i.e., air car in particular) has been a topic of great interest.

2. LITERATURE REVIEW

The first air powered vehicles were actually trains. The Mekarski air engine, the Robert Hardie air engine and the Hoadley-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 [4].

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.

In fact, two centuries before that Dennis Paper in 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 in 1879). In 1892, Robert Hardie introduced a new method of heating that at the same time served to increase the range of the engine which in turn helped to increase the distance that could be travelled at a stretch. One of its new features was regenerative braking. By using the engine as a compressor during deceleration, air and heat were added to the tanks, increasing the range between fill-ups. However, the first urban transport locomotive was not introduced until 1898, by Hoadley and Knight, and was based on the principle that the longer the air is kept in the engine the more heat it absorbs and the greater its range. As a result they introduced a two-stage engine. Charles B. Hodges will always be remembered as the true father of the compressed air concept applied to cars, being the first person, not only to invent a car driven by a compressed air engine but also to have considerable commercial success with it. After twelve years of research and development, Guy Negre has developed an engine that could become one of the biggest technological advances of this century [3]

3. WORKING

A compressed air engine is a type of engine which does mechanical work by expanding compressed air. Pneumatic engine generally convert compressed air energy to mechanical work either into linear motion or rotary motion. Where linear motion comes from diaphragm and rotary motion comes from either a vane type air motor or piston type air motor. Pneumatic motors which are existing in many forms from the past two centuries, many compressed air engines improve their performance by modifying their compressed air tank and heating the incoming air or the engine itself.

4. COMPRESSED AIR TECHNOLOGY

The basic objective of Compressed air Technology is to implement in vehicle for consumption of minimum amount of energy and remain the output work same.

In today's world, everyone wants to afford a vehicle and its energy to power it. Engine air technology makes it happen from many aspects. It is very less in term of mass as compared with other sources of energy for transportation of man or material.

It also improves urban life style through sustainability & non-polluting vehicle. Its impact on the environment is also considerably low. It remains with intelligence, lighter, style and comfort.

Most of the work done by an air compressor is during compression stroke which will add energy to the air by increasing its pressure. Compression also produces heat, however, and the amount of work required to compress a quantity of air to a given pressure depends on how fast this heat is removed.

The compressed work done will lie between the theoretical work requirements of two processes and they are:-

1. Adiabatic:

A process which have no cooling and the heat remains in the air causing pressure rise that increases compression work requirements for the maximum value.

2. Isothermal:

A process that provides perfect cooling, in which no change in temperature of air and the work required for compression tends to the minimum.

But the given fig.1 indicates that isothermal expansion is higher than adiabatic expansion, the volume of the compressed air and flow rate are controlled at a particular compressed pressure.

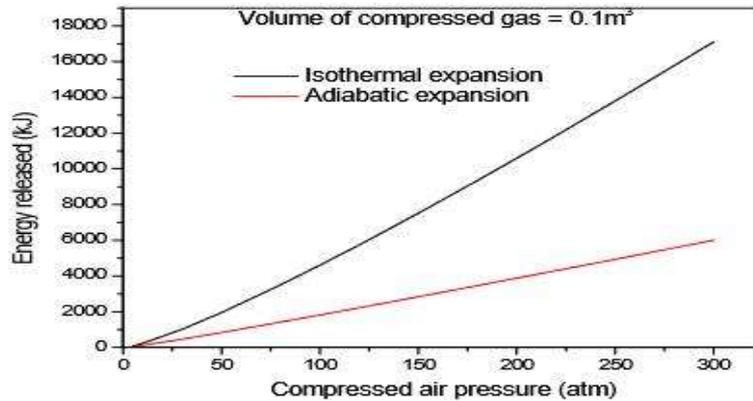


Fig.1: Energy Released As A Function Of Compressed Pressure At Constant Volume.[4]

Without any combustion the motor is driven by the compressed air in which after combustion, dangerous and harmful gases were comes out which results in a zero-pollution mobility concept ideal for current global warming concerns which makes the environment eco-friendly.

But as a sensible species of our planet, We doesn't tend to continue these fossil fuels that we have and the renewable energy is most sensible way forward is to use it effectively.

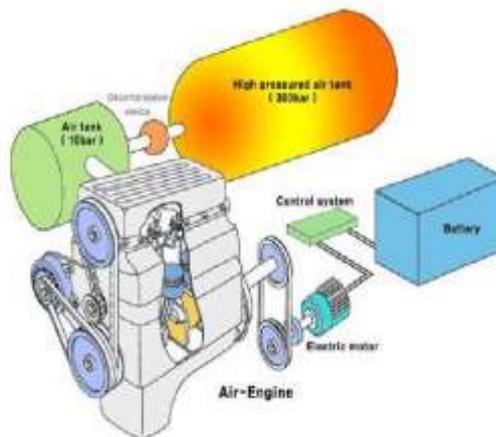


FIG.2: 3D-Diagram of an Engine that is operated by compressed air [2]

5. BASIC PRINCIPLE OF CAT

The innovative system is used to control the movement of the 2nd generation pistons and single crankshaft. The pistons work in two phases: first is motor stage and the other one is intermediate phase of either compression or expansion. The engine consists of 4 two-stage pistons, i.e. 4 compression and 4 expansion chambers. It has two functions: to compress ambient air and refill the air storage tank and also to make successive thereby approaching isothermal expansion.

How Compressed Air Can Fuel An Engine

1. First of all inflate a balloon.
2. Then the elastic skin of balloon is held by the air very tightly from inside, and at the same time create a hole through pin into it.
3. Then the air expands in the outward direction with so much energy that the balloon explodes.
4. Compressing the gas into a small space is a way to store energy.
5. If again the gas expands, that's mean; energy is released to do work.

6. ADVANTAGES OF CAE

Compressed air vehicle engine offers higher efficiency than most electric vehicle. Its only emission is cold air.

1. Air, on its own, is non-flammable, abundant, economical, transportable, storable and most importantly non-polluting.
2. CAE reduces the cost of vehicles production by about 20%, because there is no need to build a cooling system, fuel tank, spark plug, silencers etc.
3. Low manufacture and maintenance cost as well as easy maintenance.
4. The mechanical design of the engine is simple and robust.
5. The price of fuelling air powered vehicles will be low as compared to current fuels.
6. The tank may be able to be refilled more often and in less time than batteries can be recharged. [5]

7. DISADVANTAGES OF CAE

As it the CAE has many advantages but at other hand it has also many drawbacks. An air Compressed air is an extremely versatile source of power, if someone knows what they want before they buy it. Compressed air can offer a lot of benefits, but at the same time they should take care of it while choosing one to make sure they get exactly what they need. Some points which don't like about CAE are:

1. **Noise** – air compressors are very loud. This is a major downside if you live in an apartment or duplex and don't have the privacy to run loud equipment.
2. **Size** – bigger the air compressor tank is, more the power it provides. However, if someone need more power and they don't have the space to store a large air compressor tank, this can be a downside.
3. **Maintenance**– repair work should be done if the compressor malfunctions. [4]

8. POSSIBLE IMPROVEMENTS OF PRESSURE AIR ENGINE FOR THIRD WORLD USE

Imagine an engine which is powered by compressed air with upto 94% efficiency and zero % polluting emissions. A unique rotary piston concept which virtually eliminates vibration, internal wear and friction. Wind, solar and hydro power which can be used to compressed the air.

As the thermodynamic process is used to operate vehicle of compressed air engine because air cools down when expanding and heats up during compression. Since it is not practical, using theoretically ideal process because losses occur and improvements may also involve to reduce these.

India's largest manufacturing company TATA also working on compressed air technology.

9. FUTURE SCOPE

Compressed air vehicles are our near future and advancements in the presented project can be taken up by doing some ideal methods like:

1. Inserting an intermediate compressor after the gas exits the engine and compress the air again to the reservoirs.
2. Making a hybrid engine comprised of multiple ways of powering up the vehicle like gasoline and compressed air; electric and compressed air; re-cyclic modules.
3. Making the chassis light weight by selecting proper materials can also greatly affect the efficiency of the CAV

10. SUMMARY

Air powered vehicle is a realization of latest technology in automobile field. The air vehicles are clean, easy to drive, light in weight and good performance vehicles. It eliminates the use of non-renewable fuels and thereby preventing pollution and step to a healthier environment. Compressed air for vehicle propulsion is already being explored and now air powered vehicles are being developed as a more fuel-efficient means of transportation. Some automobile companies are further exploring compressed air hybrids and compressed fluids to store energy for vehicles which might point the way for the development of a cost effective air powered vehicles design. Unfortunately there are still serious problems to be sorted out before air powered vehicles become a

reality for common use but there is a hope that with the development in science & technology well supported by the environmental conscious attitude and need to replace costly transportation methods, air-powered vehicles will definitely give the bright future.[2]

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