

# Development & Testing of Compressed Air Driven Vehicle

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**Abstract**— As we all know in today's modern world nothing is possible without transportation and we all are familiar with the current scenario of fuels used for the IC engines, but they have their own side effects such as air pollution, fossil fuel depletion and high cost as well. So in context to it this project is based on using compressed air in the place of fossil fuels as it is free of cost and abundance in nature to the best way of an alternative fuel is the usage of Non-conventional source of energy which is air. It will decrease the cost and pollution by no compromise with transportation so this project replaces a gasoline based IC engine with pneumatic automobile (2-wheeler). Which will ultimately reduce the cost of the overall transportation as well as makes the transportation more convenient and eco-friendly by reducing the pollution level at a considerably higher level. A success to this project will also reduce the emission of the various harmful greenhouse gases such as various NO<sub>x</sub>, SO<sub>x</sub>, CO<sub>2</sub>, Some amount of CO and hydrocarbons to our environment leading to a greater relief to global warming and ozone layer depletion as well.

**Key words:** Pneumatic Rotor, Compressor, Pressure Gauges, Chassis, CAD Vehicle

## I. INTRODUCTION

A Pneumatic based Automobile 2-wheeler is powered by pneumatic rotor using compressed air, which can be stored in air tank. Instead of mixing fuel with air and burning it in the engine to drive pistons with hot expanding gases, pneumatic based automobile 2-wheeler use the compressed air to drive the vehicle. Main components of pneumatic based vehicle are pneumatic rotor, Controller (which controls the flow of the air), Air tank, Gear box (4-speed transmission) and oil filler. Also the 2-wheeler chassis is required to mount the components and drive the vehicle. Many compressed air engines improve their performance by heating the incoming air or the engine itself. Pneumatic motors have found widespread success in the hand- held tools but are also used stationary in a wide range of industrial applications. This vehicle is basically utilize pressure energy of air available from atmosphere and convert this pressure energy into useful work by means of the pneumatic rotor in order to ride the vehicle, or we can say that pressure energy of air is utilized as the traction force to rotate the vehicle.

## II. HISTORICAL PERSPECTIVE

At a first glance the idea of a pneumatically air driven vehicle seems very interesting and good, true and an awesome source of an alternative fuel, so if we can make an engine running on the base of air it would be fantastic as we all know air is all around us in abundant quantity which never runs out and obviously it's free. Various compressed-air-powered trams were trialed, starting in 1876. In Nantes and Paris such trams ran in regular service for 30 years. Currently, no water or air vehicles exist that make use of the compressed air engine.

Historically certain torpedoes were propelled by compressed-air engines. A compressed-air vehicle (CAV) is a transport mechanism fueled by tanks of pressurized atmospheric gas and propelled by the release and expansion of the gas within a Pneumatic motor. CAV's have found application in torpedoes, locomotives used in digging tunnels, and early prototype submarines. Potential environmental advantages have generated public interest in CAV's as passenger cars, but they have not been competitive due to the low energy density of compressed air and inefficiency of the compression and expansion process. Compressed-air propulsion may also be incorporated in hybrid systems, such as with battery electric propulsion. This kind of system is called hybrid-pneumatic electric propulsion. Additionally, regenerative braking can also be used in conjunction with this system.

## III. PROBLEM DEFINITION

- Most probably vehicles present are the hybrid vehicles which use the air as a secondary fuel along with the fossil fuels or battery as the major primary fuels which again means there is still no pure pneumatic based running vehicle available.
- Also some research occurs on the CAE (Compressed Air Engine) for vehicle, which is works on only Compressed air or Nitrogen gas. In those researches there are three types of CAE are used. (i) Piston and Cylinder mechanism (ii) Vane Rotor (iii) Dual acting pneumatic cylinder.
- The fuel used in the Dual acting pneumatic cylinder is nitrogen which is efficient but has more disadvantages than advantages such as failure of engines, heavy cost etc.
- Also the fuel nitrogen should be in the liquid stage and then should be converted in to the gaseous form before used and also should be heated with the help of a heat exchanger and run the double acting cylinder which is again a heavy and a complex assembly resulting to increase in size, high maintenance and heavy cost.
- Also are totally not pneumatic as nitrogen filling is not available at every place and nitrogen is to be separated from the free form of air available in the nature
- Few designs even if available like 'VANE' type are not that efficient and load carrying capacity type of design which again leads to an absence of a pure pneumatic vehicle.
- Many designs even used the turbo systems with the intercoolers set in between them for the production of heavy amount of compressed air and then run the vehicle with the help of that compressed air but it's still an extra assembly interrupting so once again not purely pneumatic.
- Also the attempts are made by using the 'Electric Motor' as well as the 'IC engines' for the generation of the

highly compressed air and again a high compressed air storage tank is needed for it again a complex assembly but which is again a help of an alternative 'Electric' or 'Chemical' based energies help taken means again a hybrid fuel used concept.

- The designs nearby to the concept are also either not load carrying or not that efficient.
- Hybrid engines produces less pollution as compare to IC engine, but still pollution occurs.

#### IV. RESEARCH OBJECTIVE

- To Design Compressed Air driven System for 2-wheeler.
- To investigate the Compressed Air driven vehicle on basis of speed and load carrying capacity.
- Testing of CAD (Compressed air driven) vehicle with different road conditions (on road, off road, hilly area)

#### V. MODIFIED DESIGN OF INBUILT PNEUMATIC JACK SYSTEM

##### A. Working

An air driven vehicle works on a simple phenomenon of the compressed air. First of all the air is compressed electrically in a cylinder and hence forth it stores some energy with in it and when the compressed air is being released the air expands and the energy is released which is used to do work. This energy from the compressed air is used to drive the pneumatic driver rotor which is connected further to the driven rotor and rotates it, which then rotates the gear box and likewise the power is being transmitted. In the case of the air driven vehicle there takes no combustion within in the engine so its pollution free and less dangerous also it is a light weight vehicle as light metal and material is used for its construction as it does not have to with stand any of the high temperatures. As there no combustion is taking place inside the engine there is no requirement of the proper mixing of the air and fuel for making the charge. Instead the compressed air is directly feed to the pneumatic rotor for the rotation and the propulsion of the vehicle.

##### B. Fabrication Process

For the purpose of making a new successful CAD vehicle a new modified frame is needed which is its basic step the fabrication process, it is made up of mild steel square rods, whereas the rest of the required instruments such as bulky tanks, pressure gauges etc. are made and fixed through several clamps and fixtures to hold them firmly at their respective places. However certain considerations are made so that the geometry of the frame do not interrupt or hinder the drivers riding comfort.

Components required for this new CAD vehicle are:

- Framed Structure of Splendor
- Compressor.
- Air Tank
- Safety Valve
- Pressure Gauge
- Pneumatic Rotor
- Hoses
- Connector
- Ball Valve

- Oil Filler
- Chain Drive
- Brake system

##### 1) Frame

It is used for support for the setup. Which is directly taken up from the market and required changes such as combustion engine removal, fuel tank removal etc. are made.



Fig. 2.1: Framed Structure of Splendor

##### 2) Pressure Gauge

Instruments used for measuring and displaying the pressure at integral unit are called pressure gauges. They are even known as Vacuum gauges as well.



Fig. 2.2: Pressure Gauge

##### 3) Compressed Air Tanks

They are a typical storing space or equipment's used for storing of highly pressurized air This kind of tanks can be filled with the help of the heavy compressors with the help of the electrically grid via an on board compressor.



Fig. 2.3: Compressed Air Tanks

#### 4) Connecting Pipes

Connectors pipes commonly known as air pressure pipes are used for the transmission of compressed air from the compressor to the Air tanks.



Fig. 2.4: Connecting Pipes

#### 5) Connectors

These are small attachments used for the connecting of the air pipes along with the air tank having threads on one side and pipe holding mechanism on another side. These are available with different sizes (currently used is of 8mm diameter)



Fig. 2.5.1: Top View of Connector



Fig. 2.5.2: Side View of Connector

#### 6) Ball Valves

These are one kind of flow control valves which come in different kinds of shape size and diameters and are used as per requirements. They are basically used for the control and regulation of the amount of air to be passed within the hoses, tanks etc.



Fig. 2.6: Ball Valve

#### 7) Compressor

It is a device which converts the naturally sucked atmospheric air in to compressed form with the means of external electrical supply.

### VI. IMPLIFICATION FOR FINAL DESIGN

Following figure shows the final model of the prototype of our project.



Fig. 3: Fabricated Model

### VII. SPECIFICATIONS OF THE EQUIPMENT'S USED

Sr. No.	Equipment	Property	Quantity
1.	Air tanks	Capacity = 10kg Pressure = 10bar to 15bar	2
2.	Connectors	Diameter=8mm	05
3.	Ball valves	One way	01
4.	Pipes	Diameter=8mm	03m
5.	Pressure Gauge	0 bar to 35 bar	01
6.	Compressor	Capacity=3-5hp	1

Table 1:

### VIII. CONCLUDING REMARKS

In this dissertation work, the prototype made for the attempt to reduce the consumption of non-renewable source of energy and reduce the emission of harmful gases producing from the exhaust of the vehicle. Also it provides a best alternative source of fuel and a great use of conventional source of energy and the results are satisfactory. The results are concluded as follows:

- 1) It can suggest best possible way to get in to use of compressed air as an energy to drive the vehicle.
- 2) The system is setup with the limited resources, hence it will provide cheapest cost to drive vehicle.
- 3) Today's vehicle gearbox are needed more power for drive vehicle and hence we have a huge scope to utilize compressed air driven system in 2 wheeler and 4 wheeler.
- 4) With the help of two air tank of 6 kg each air capacity. We can drive the vehicle just for 8-10 minutes, which can be only useful for small distance.
- 5) Air tank refilling system needed to be redesign in order to have more power.

- 6) Proper utilization of space management will add more value to the system in order to have commercialization of vehicle.
- 7) It can use for very small distance because which pneumatic rotor we use it work on high pressure.

#### REFERENCES

- [1] Mihai Simon. Pneumatic Vehicle, Research and Design, 10th International Conference Interdisciplinary in Engineering, INTER-ENG 2016 | ISBN : 1877-7058 |
- [2] Mr. Rixon K L , Mohammed Shareef V, Prajith K S, Sreejith S , Sreeraj P. Fabrication of Compressed Air Bike, International Research Journal of Engineering and Technology (IRJET)| ISSN : 2395-0056|
- [3] Valmik Patel, Shalin Shah, Pankil Shah, Jay Patel, S.Bhaduwala. Experimental Analysis of Pneumatic Vehicle, International Journal of Mechanical Engineering and Futuristic Technology | ISSN : 2456-1266 |
- [4] JP Yadav, Bharatraj Singh. Study and Fabrication of Compressed Air Engine, SAMriddhi- A Journal of Physical Sciences, Engineering and Technology| ISSN : 2229-7111 |
- [5] Guillaume Colin, G´erard Bloch, Yann Chamaillard, Andrej Ivanco. A real time neural energy management strategy for a hybrid pneumatic engine, 6th International Federation of Automatic Control | ISSN : 334-335 |
- [6] Devang Marvania, Sushakar Subudhi. A comprehensive review on compressed air powered engine, International Journal of Mechanical Engineering and Futuristic Technology | ISSN : 334-335 |
- [7] J. Naranjo, E. Kussul, G. Ascanio. A new pneumatic vanes motor, 6th International Federation of Automatic Control | ISSN : 242-427 |
- [8] In the year 2017, Adam Ilnicki, Mariusz R. Rzasa. Tests of a New Construction of Pneumatic Engine, 6th International Federation of Automatic Control | ISSN : 0033-2097|
- [9] In year 2017, Mihai Simon. Alternative Energy driven Pneumatic Vehicle, 10th International Conference Interdisciplinarity in Engineering, INTER-ENG 2016 | ISSN : 725-730|
- [10] In year 2017, Vishwajeet Singh. Compressed Air Engine, International Journal of Scientific and Research Publications |ISSN : 2250-3153|
- [11] Yuan wei wang, Jhieh jieh You, Cheng kuo sung and Chih Yung Huang. The Applications of Piston Type Compressed Air Engines on Motor Vehicle, 37th National Conference on Theoretical and Applied Mechanics (37th NCTAM 2013) & The 1st International Conference on Mechanics | ISSN: 1877-7058 |
- [12] Venkatesh Boddapati, S.V.V. Vinod, M. Dora Babu. Air Powered Vehicle- An Eco Friendly Engine, International Journal of IT, Engineering and Applied Sciences Research (IJIEASR) | ISSN: 2319-4413 |
- [13] Mistry Manish k. , Dr. Pravin P Rathod, Prof. Sorathiya Arvind S. Study and Development of Compressed Air Engine Single Cylinder, International Journal of Advance Engineering Technology | ISSN: 0976-3945 |
- [14] Bharat Raj Singh, Onkar Singh. A Study of Performance Output of a Multivane Air Engine Applying optimal Injection and Vane Angles, International Journal of Rotating Machinery |ISSN: 578-745|
- [15] In the year 2017, Samir Potdar, Dr. V.M. Kriplani. A Review on Innovative Compressed Air Powered System, International Journal of Engineering Science and Computing.
- [16] N. Prithviraj, M. Munikrishnan, N. Nandhakumar, S. Prem Ananth. Two Wheeler Driven by Compressed Air, International Research Journal of Engineering and Technology |ISSN: 2395-0056|
- [17] In the year 2013, Abhishek Lal. Design and Dynamic Analysis of Single Stroke Compressed Air Engine, International Journal of Renewable Energy Research
- [18] Ecole Polytechnique Federale de Lausanne. Gasoline Hybrid Pneumatic Engine for Efficient Vehicle Powertrain hybridization, 6th International Federation of Automatic Control | ISSN : 168-177 |