

Design and Development of a Pneumatic Car

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Abstract— In the present scenario of world, the engineers having the challenges to find the different ways drive efficient by using the alternative energy sources which are the eco-friendly to environment. The compressed air is used as a source for various operations in the industry and also having the environmental friendly. So, the engineers are focused on the compressed air as non-polluting fuel for the vehicles which is termed as pneumatic cars. This paper describes the brief introduction to latest development of pneumatic cars, the efficiency and properties of the compressed air with respect to enthalpy, internal energy, density of the compressed air. The working of the pneumatic car, with the use of the pneumatic actuators that creates useful work by expanding the compressed air, electronic component with simple mechanism. Hence, the pneumatic cars are affordable, safe and future of the automobile industry.

Index Terms- Fuel crisis, Compressed air, Pneumatic vehicle.

I. INTRODUCTION

In the recent trends of automobile, every company is moving towards the making the environmental friendly vehicles, i.e. Electric vehicle, pneumatic cars etc. the trend is changing because of limited storage of fossil fuels also there is reason that, the pollution created by the petrol and diesel vehicle is very harmful to the environment. alternatives for vehicle propulsion i.e. solar energy, electric vehicle, pneumatic operated vehicle, H₂ powered vehicle, etc This standard fights against the pollutants like hydrocarbons (HC), nitrogen oxides (NO_x), and carbon monoxide (CO) emitted by the vehicles on the Indian roads. It pares the emissions of carbon monoxide by nearly 60 percent and, hydrocarbons and nitrogen oxide by 50 percent by diesel vehicles. In case of petrol vehicles, there was a reduction of 20 percent in CO levels and of 50 percent in Nox and HC levels. At present, the emissions of air pollutants from the vehicles in Delhi itself consist of carbon monoxide (59%), hydrocarbons (50%), and nitrogen oxides (18%). The presence of the particulate matter

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(PM 10 & PM 2.5) in the air is a major contributing factor in air pollution. Now days the demand of everybody is having his/her own vehicle and the people relies to a great extent of different transportation system. Day by day there is increase in number of vehicle everyday which emits the toxic emissions.

Today the automobile industry having several technologies to reduce pollution level by introducing new technologies that will burn the fuel and overall use of generated fuel. The technologies will improve bike efficiency but the pollution level reduces considerably less. The technologies are following variable valve timing actuation, use of fuel injector in two wheeler (having low cc engine), EGR(exhaust gas recirculation), hybridization of vehicle .In this work the focus has been put on vehicle hybridization ways to make less use of petrol.

There are various vehicle hybridization can be done in various ways. Such as H₂ powered petrol, electric hybrid etc. The idea of electric hybridization is having some importance now days because it having advantages that regenerative braking system can apply, to reduce fuel consumption. But the main disadvantage with electric vehicle is that the infrastructure of charging station and they require extra propulsion system and large heavy batteries. This leads to extra manufacturing cost and price of vehicle be high it directly affects on the sales of vehicle.

On the other hand researches engineers are focuses more on the pneumatic car's which will minimize the vehicle manufacturing cost with moderate efficiency. In the case of retardation of the vehicle, then engine is used as a compressor that converts kinetic energy contained in the vehicle into energy in the form of compressed air which will be stored in receiver tank. The idle losses can be eliminated due to the system supports start/stop functionality [1].

Number of research teams over worldwide has demonstrated the potential pneumatic cars. Simulations made by Anderson where a regenerative efficiency is high as 55% for dual pressure tank system for heavy duty vehicles. The pneumatic vehicles with simple mechanism have presenting the lower pollution rate over the conventional vehicles.

II. OBJECTIVE

The objective of this paper is to study the pneumatic vehicle concepts with simple mechanism. To investigate the behavior of compressed air with different parameters like entropy, enthalpy, temp, specific volume. Demonstrate and determine the performance of the pneumatic vehicle which uses the compressed air along with the battery (12v) which supplies to the double acting pneumatic cylinders at the rear wheels. As it is working model, the screening mechanism can be given to the front wheel, as like in rear engine rear wheel drive. The compressed air pressure is around (7 bars).At the rear end only direct mini compressor is placed which will generate the compressed air and given to the double acting pneumatic

cylinder. To obtain the C.G for providing initial thrust, battery will kept in order such that the to get the stable pickup which is later switched to compressor to drive the vehicle.

Max Ampere = 14Amp
 Max Pressure = 15psi
 Displacement=35L/min

III. LITERATURE REVIEW

The literature review related to the design and fabrication of pneumatic car is presented below:

Singh [2] studied about alternative fuel for automobile engines with a special emphasis on compressed air driven engine. In view of the enormous potential of air as working fluid an engine is being designed to run on compressed air.

Pathak et al. [3] studied the effective application of pneumatic power. Pneumatic vehicle will replace the battery operated vehicles used in industries. Pneumatic powered vehicle requires very less time for refueling as compared to battery operated vehicle. On the whole, the technology is just about modifying the engine of any regular IC engine vehicle into an Air Powered Engine. Verma [4] briefly summarize the principle of technology, latest developments, advantages and problems in using compressed air as a source of energy to run vehicles. Compressed air for vehicle propulsion has already being explored and nowadays air powered vehicles are mostly being developed as a more fuel-efficient means of transportation. Ravi [5] analyzed the Climate change and energy security requires a small reduction in travel demand, model shift and technological innovations in the transport sector. Through a series of press releases and demonstrations, a car using energy stored in the form of compressed air produced by its compressor has been marked as an environmental friendly vehicle of the future. Verma [6] introduce to the latest developments of a compressed air vehicle along with an introduction to various problems associated with the technology and their solution. Compressed air as a source of energy in different uses in general and as a nonpolluting fuel in compressed air vehicles has attracted scientists and engineers for centuries.

The present literature review show that up till now the researchers studied on the alternative fuel as compressed air, various designs, analysis. So there is scope for design and analysis of pneumatic car. In this paper design and modeling of pneumatic car by using design software.

IV. MATERIAL SELECTION AND DESIGN

The components and their material used for preparing the pneumatic car model are discussed in this section.

The CATIA based 3D modeling of the pneumatic car is depicted in Fig.1.

A. Components and materials :

1) DOUBLE ACTING PNEUMATIC CYLINDER:-

It is double acting stainless steel made DIN ISO 6432, piston Dia. 16 to 25 mm. There are such two cylinders are used. Because of operating fluid is air the leakage from pneumatic cylinder will not drip out and contaminate the surrounding, making pneumatics more desirable. Where cleanliness is requirement. Depending on Different Parameters like level of loads, humidity, temperature and stroke lengths specified.

2) COMPRESSOR

The voltage required for the compressor is DC 12v-13.5v.

3) BATTERY

A lithium ion rechargeable 12v 24 amps of battery is used for vehicle these batteries are safe to charging and environment friendly.

B. Design of vehicle:

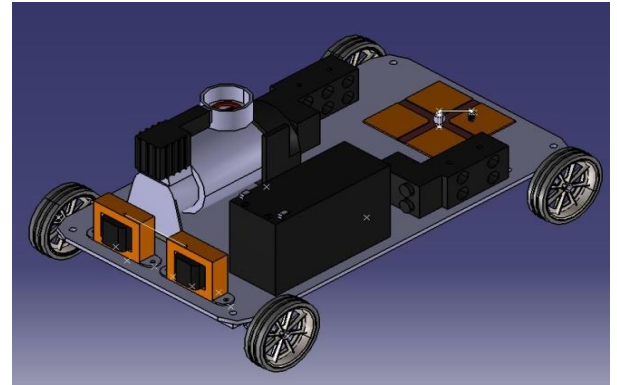


Fig.1 CATIA model Pneumatic car.

This is the design model which is made on CATIA v5 R21. The Fig.1 shows a base plate on which various components of the system are kept. From the front side the relays which is used to supply the power through the batteries. Behind this on left side the battery is mounted and at right side the compressors is placed. Behind this solenoid valve is used which is operated by electric current to control the flow of the compressed air.

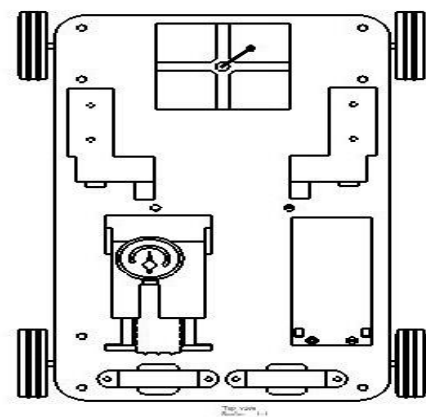


Fig.2 AUTOCAD model of the Pneumatic car.

The drafting of the CATIA model is represented in the Fig. 2.

C. Application:

- 1) Institutions industries etc. where less movement of vehicle that is for material handling.
- 2) Recently the TATA Motors with maximum started testing of compressed vehicle so that it will run easily as like petrol and diesel.
- 3) It can be used as personnel or commercial use, as it is pollution free.

D. Advantages

- 1) As it is light in weight it will give moderate efficiency
- 2) There is no effect to any human being if compressed air leak.
- 3) It is simple mechanism.
- 4) The interesting fact is the pneumatic system when the vehicle brakes, the kinetic energy from braking is used to drive a pump that helps to restore some of the lost pressure.
- 5) Overall Costing of Vehicle As the air is naturally available, since we are using the compressed air as to propel the vehicle there will be total reduction of cost of the fossil fuels.
- 6) If mass production of pneumatic cars are obtained, then the initial cost of pneumatic vehicle is lesser than electric cars. The real model of pneumatic car will cost around 6 lakh.

V. DISCUSSION

The design and development of a pneumatic car is presented in this paper. The detailed design of parts, material selection required for pneumatic car is briefed. The development of car is carried out by using CATIA software. The advantages and application of pneumatic car is presented in the last part of the paper.

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