COMPRESSED AIR VEHICLE: DEVELOPMENT OF A FEASIBLE ZERO EMISSION ALTERNATIVE TO FOSSIL FUELS

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ABSTRACT

Development of new technologies in the field of locomotion in automobiles is crucial in the quest to find new ways to make a vehicle perform. The current state of automobiles requires combustion of fossil fuels such as petrol, diesel, etc. to make the pistons move. Earth faces a difficult time ahead. With the fast depleting natural resources like coal and fossil fuels, we shall face a shortage of fuels very soon. Thus, the trips and tours that we take now days so conveniently shall not be possible any more. The fuel prices shall rise so fast that common people could not afford them anymore. That is why there is dire need of an alternate source of fuel.

With the help of this project we, are going to demonstrate that air can be successfully used as an alternative to the traditional fossil fuels, which in present day include petrol, diesel and CNG. Air is the most abundant resource that is available to us and can be used without the fear of being depleted.

Keywords: *CompressedAir, IC Engine, Fossil Fuels, Alternative Fuels, CAV*

1. INTRODUCTION

Development of new technologies in the field of locomotion in automobiles is crucial in the qu est to find new ways to make a vehicle perform. The current state of automobiles requires com bustion of fossil fuels such as petrol, diesel, etc. to make the pistons move. Earth faces a difficu lt time ahead. With the fast depleting natural resources like coal and fossil fuels, we shall face a shortage of fuels very soon. Thus, the trips and tours that we take now days so conveniently sh all not be possible any more. The fuel prices shall rise so fast that common people could not aff ord them anymore. That is why there is dire need of an alternate source of fuel.

With the help of this project we, are going to demonstrate that air can be successfully used as a n alternative to the traditional fossil fuels, which are petrol diesel and CNG. Air is the most abu ndant resource that is available to us and can be used without the fear of being depleted.

Air has the property of being highly compressible. Hence, we can compress large quantity of ai r into a small space and hence use the energy stored in the tanks over time to help commute fro m one place to another. Another good advantage of compressed air is that it is not flammable.

2. GOALS AND OBJECTIVES

Project work was targeted to design and develop a vehicle that would run on compressed air an d keep costs down while also having zero emissions.

What we achieved?

After completion of development and assembly phase we have a three-wheeler compressed air vehicle which can be used to as a means of transportation while expelling no harmful gases int o the atmosphere and keeping costs of making and

Fueling significantly low. This car is totally eco-friendly and Effective method with reduced pr ice tag. It is very easy to manage and repair. Also the running cost of the vehicle is very less. T he car is non-flammable because there is no combustion taking place in the cylinder of the engi ne. Also, the cost of manufacturing is very low.

Motivation: Why this project was undertaken?

The current situation of usage fossil fuels for vehicle to perform is one that would not be able t o sustain in the coming years. In order to find a solution that is both cheap and eco-friendly we need to start changing our approach of looking at the immediate alternative and start implemen ting new technologies to test their viability and figure out which one can last for long-term appl ication. There is barely air to breathe and we have already polluted a major amount of air so in this 21st Century we must come up with alternatives and better ideas to not pollute the air and a lso enjoy the travelling process.

Method: How it was carried out?

Firstly, the vehicle was designed and the list of components and raw material was crafted for th e compressed air vehicle and the costing was estimated. Once these processed were concluded, the components and raw materials were purchased in order of requirement to prepare a workin g model of the same.

THE TECHNOLOGY APPLIED

For evaluating the performance of the vehicle, various parameters will be taken into account. Efficiency while low will fulfill to prove that such a technology is indeed viable. Approach for this project was simple but also technical. The vehicle would use simple parts and work on the principles we learn in thermodynamics. The difference would be that instead of fuel having to be combusted and the making the engine run, we will use compressed air that would make the pistons move the same way as combustion would.

The effect would be the same but instead of harmful gases such as CO and Co2 being released on the environment from the exhaust as a byproduct, our vehicle would just expel the same air that was used to run it. Zero emission was the main ideology kept in mind and that is what we have been able to accomplish.

AN OVERVIEW OF THE PROJECT

The developed compressed air vehicle will be helpful in testing various parameters related to al ternative sources of fuel in vehicles taking pollution and efficiency factors into account. Also, t hrough surveying done on various materials that would be used in the final model helped in ke eping the total weight of the vehicle low and total cost of construction were also kept within ec onomic estimates that were made during the project's inception.

3. COMPRESSED AIR VEHICLE

PROBLEM DEFINTION

The objective of the project is to use compressed air as a source of fuel in IC engine. For this m odification in engine are needed. The engine is a conventional 4 stroke single cylinder IC engin e of Platina 100cc. the increase in quantities of pollutants in the environment and ever increasin g per litre costs of petrol and diesel form the basis of study of various source of alternative fuel.

A four-stroke singe cylinder IC engine is identified. The modification of the engine is required to get greater power output when using compressed air. In order to evaluate the feasibility of th e compressed air vehicle, we have to develop a way to be able to find a balance between what would be considered a reasonable speed and reasonable range.

Figuring out a solution for this problem will need research in the areas of material strength, wei ght & durability, tire dimensions, air pressure to be set for vehicle to operate, pipes of various d imensions & strengths to find out which would work best. We will also have to conduct variou s tests to find out how the vehicle performs in real world conditions.

Presently, there are many designs, which have all been made by larger OEMs. In order to take i nto account the economic constraints of this project, we will observe various materials, equipm ent and components so that we can achieve highest possible efficiency and quality at least possi ble cost.

REQUIREMENTS

The components required for completion of project are as follows –

1. Chassis/Frame
2. Tires
3. Cylinders
4. Pressure regulators
5. Steering
6. High pressure pipes
7. Seat
8. Pneumatic paddle

4. RESULTS AND DISCUSSIONS

The development of the CAV was carried out in phases, namely:
The Design Phase
The Development Phase

The Design Phase is carried out using Auto CAD software. The parts used in Air Compressed Vehicle are designed using Auto CAD software 2013.

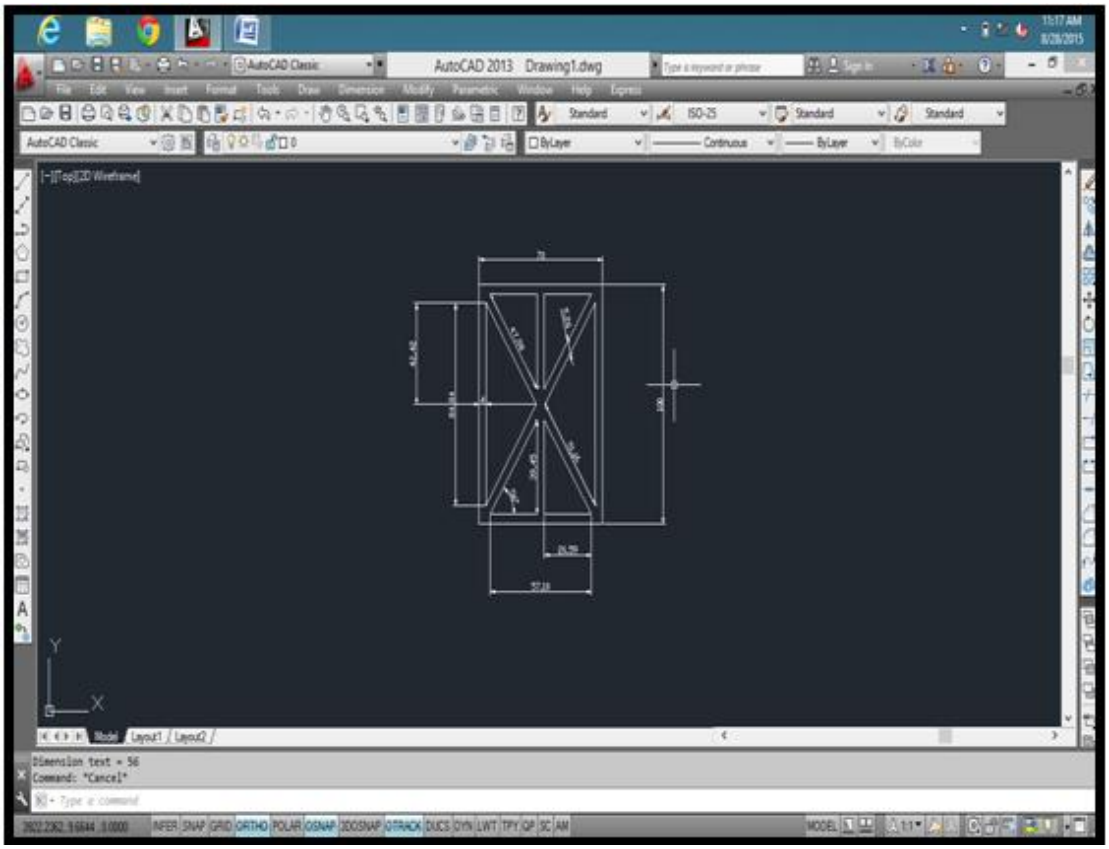

Figure: Initial Design of Chassis in Auto CAD

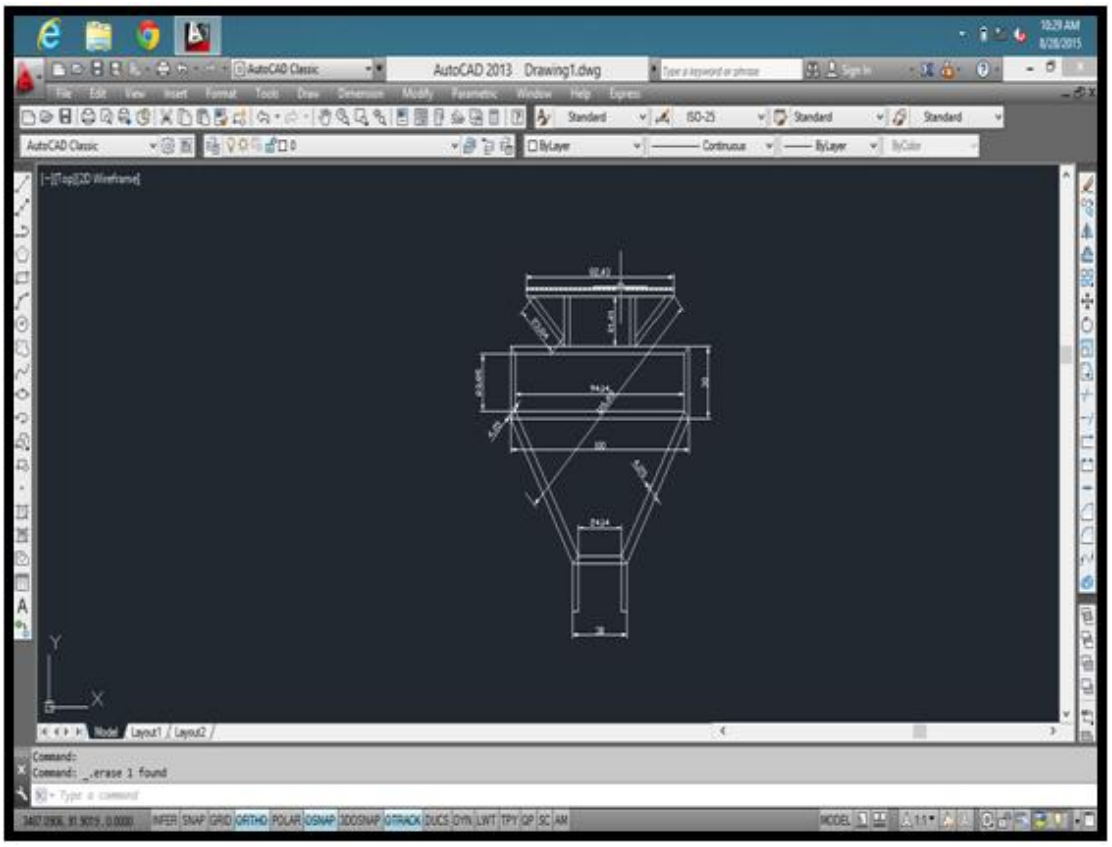

Figure: Final Design of Chassis on Auto CAD

Since compressed air is not flammable, we do not need huge engine structures to keep in mind the burning of fuel and we can considerably reduce the size of engine block. Since the compres sed air only needs a basic mechanism to power the piston compressed air cars are going to be li ghter and more agile than conventional cars.

Chassis Design Parameters

Chassis Fabrication: Chassis is made by triangular angular incorporating arc welding at various sections. It includes:

1. Lap joint welds
2. Butt welds
3. T joint welds.

Power Transmission:

The power transmission process is briefly described as follows -

Air is stored in the tank at a pressure of 11.03bar. From the tank, a regulator synchronizes airfl ow. This maintains pressure downstream. The gear is engaged on the first gear and a hand Clut ch is provided by extending the lever across the chassis. A pneumatic paddle has been used to r egulate the amount of air that would be going through the piston of this 100cc engine.

Schematic Diagram Approach

1. Chassis: It is the frame upon which the entire propulsion mechanism, seating and steering m echanism are mounted. A crucial part in bringing components of the CAV together.

2. Seat: A seat is a place to sit, referring to the area sat upon as opposed to other elements like a rmrests.Made or used for sitting on, such as a chair or stool.
3. Steering: Steering which allows a vehicle to follow the course in the direction desired. An ex ception is the case of rail transport by which rail tracks combined together with railroad switch es provide the steering function.
4. Wheels: A circular object that revolves on an axle and is fixed below a vehicle or other objec t to enable it to move over the ground. We have used e-rickshaw wheels, as these are more com pactable for our air car.
5. Engine block: - A cylinder block is an integrated structure which consists of the cylinder of a reciprocating engine & its associated surrounding structures like coolant passages, intake and exhaust passages and ports, and crankcase.

5. TESTING AND DEPLOYMENT

The car does not speed up as much but runs at a descent speed, which is enough for the car to move forward. The car's exhaust being air is non-toxic, eco-friendly.

This car being just a normal working model and if the car is developed in further future with m ore amenities and is funded more this concept can be the future for all the passenger carrying s ervice.

Specification of the Engine Used:

Type	Single cyl, 2-valve, DTS-I with ExhausTEC
Capacity	102 cc
Bore x Stroke (mm)	47 X 58.8
Max. Power (Ps @ RPM)	8.2 ps @ 7500 rpm
Max. Torque (Nm @ RPM)	8.6 Nm @ 5000 RPM
Starting	Kick + Electric Starter
Top Speed	90 Kmph (internally tested)
Carburetor	PTE 16 Manual choke
Transmission	4 speed All down
Frame	Tubular Single Down Tube with Lower Cradle frame

5.3 Testing and Performance

The power output is simply the inlet enthalpy minus the discharge enthalpy times your mass flo w rate.

Tentative selection of model (chain size):

T = W*F*K

W = Total weight of conveyed object (including pallet) except chain.

F = Coefficient of friction:

F=F1+F2

K = Chain speed coefficient

Calculation of required HP

HP = T * V / 33,000 * N

T: Maximum chain tension
L: Length
W: Total weight of conveyed object. Except chain
F1: Coefficient of friction between chain and guide when transferring.
F2: Coefficient of friction between chain and conveyed object when accumulating
F3: Coefficient of friction between chain and guide when accumulating
M: Weight of chain (lbs/ft)
HP: Required powerV: Chain speed (FPM).
N: Transition efficiency of drive unit

We used 2 air tanks with a capacity of 100 pounds each which run our car for 8 minutes.

Calculations:

No. of Cylinders = 2 of 100 psi each

Time = 2.5 minutes / cylinder

Speed = 1.5 m/s

Distance covered= 250 m

Initial Pressure (p1)= 100 kpa

Initial Temperature= 27 degree Celsius = 300 k

Now, Cylinder Volume (*V) = πr2h*

= 3.14 x (0.0619)^2 x (0.0419)

= 5.04 x 10^-4 mm^3

Clearance Volume (Vs) = 9 x 10^-5 mm^3

r = Volume Of Cylinder + Clearance Volume

Clearance Volume

r = 5.04 x 10^-4 / 9 x 10^-5 = 6.6

Now, Specific heat capacity for air (γ) = 1.4

So, Efficiency of engine = 1.1 / r^(γ-1) = 0.5299

η = 52.99%

Break Power = $2\pi N\Gamma$

60

BP = 3.7129 HP

Now, input work done (Indicated Power) = Output Work Done

η

Indicated Power (X) = 3851.670 Nm = 7.006 HP

Friction Loss = BP – IP = 3.2931 HP