IJFEAT
INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

COMPRESSED AIR VEHICLE

Ankit D. Giradkar[1], Rahul S. Jaisingpure[2], Nehal D. Motghare[3]
[1]*Student, Mechanical Engineering, Rajiv Gandhi College of Engineering, Research and Technology, Maharashtra, India,* ***ankit.giradkar.75@gmail.com***
[2]*Student, Mechanical Engineering, Rajiv Gandhi College of Engineering, Research and Technology, Maharashtra, India,* ***rahuljaisingpure71@gmail.com***
[3]*Student, Mechanical Engineering, Rajiv Gandhi College of Engineering, Research and Technology, Maharashtra, India,* ***nehalmotghare23@gmail.com***

Abstract
The production of domestic crude has been declining and the transport system has been increasingly dependent on imported crude oil to meet its needs. There is a growing concern that the world may run out of petroleum based fuel resources. All these make it imperative that the search for alternative fuels is taken in right earnest. With the current fuel sources diminishing, we are looking for alternative ways to power our automobiles. With these goal in mind, companies are actively developing various new technologies from the perspective of achieving energy security and diversifying energy sources, which is necessitated by the dwindling supply of petroleum resources. The main objective of this project is to reduce dependency of vehicle on conventional fuel. Compressed air is stored in storage tanks with some modifications from the compressor. The pneumatic wrench (air gun) is used to convert pressure energy into mechanical energy. The rotation of pneumatic wrench is controlled by controlling the air flow with the help of flow control valve. Unlike conventional transmission system includes clutch, counter shaft, flywheel, propeller shaft, differential, our pneumatic wrench is coupled to the rear wheel with intermediate gear box which greatly reduces the transmission losses and weight of vehicle. The running and maintenance cost for air car vehicle is less than conventional cars. This is revolutionary design which is not only eco-friendly, pollution free but also very economical. With some modifications in storage tanks, pneumatic wrench, material used for chassis it is possible to increase the performance of vehicle. So in this paper an effort is made to study the extent of research done and the potential advantages and disadvantages of the compressed air technology.

Index Terms: *Alternative Fuel, Compressed Air, Pneumatic Wrench, Storage Tank, Design Power and Speed, Eco-Friendly.*

---------- *** ----------

1. INTRODUCTION

The word pneumatic come from the Greek word Pneuma means air or wind. Tool and appliance driven by compressed air are known as pneumatic devices. Example of these devices are pneumatic –Vehicle, rock – drills, Jackhammers, spray and airbrakes.

Pneumatic vehicle, also called air vehicles, use air to transport one location to another. Pneumatic vehicle systems do this by generating air pressure levels measuring either above or below the atmospheric pressure to move the materials through pipes or tubes or by converting the pressure in to movement of mechanical device used as transport equipment in the vehicle system to the required destination. Storing Compressed air into a small air tank and then using it for actuation of the vehicle. This is the basic principle behind this vehicle. In this vehicle, the energy of compressed air filled inside the tank mounted on the vehicle is utilized. This compressed air actuates double acting cylinder and with the help of chain drive the actuation of the vehicle takes place. We designed this vehicle to carry the weight of one person of 45 kg. For ignition, we have used the battery. The vehicles capacity is less due to small size of the air tank.

The prototype of vehicle works on the principle of compressed air filled in the air tank for actuation of the vehicle. The air tank fitted on the vehicle is a compact unit. The vehicle runs by the reciprocating action of the piston in the cylinder by the power supplied by it to the gears. The gears transmit this rotating movement of the gears to the chain drive and this drive is connected to the shaft of the rear wheels and thus the vehicle runs. Tanks that will probably hold compressed air to about 11.03 bar pressure. Its accelerator operates a valve on its tank that allows air to be released into the hoses and then into the motor, where the pressure of the air's expansion will push against the vanes and turn the rotor. This will produce enough power for speeds of about 25-30 kilometres per hours.

This design of the vehicle is used to minimize the pollution to the environment and to overcome the rising prices of the petrol and diesel as it is the most important

concept of the common man ‘s life. This principle can mainly use for transportation of material and parts in the industries.

1.1 Aim Of Project

Compressed air as a source of energy in different uses in general and as a non-polluting fuel in compressed air vehicles has attracted scientists and engineers for centuries. Efforts are being made by many developers and manufacturers to master the compressed air vehicle technology in all respects for its earliest use by the mankind. Nowadays, almost every industry is trying to develop light and efficient vehicles. Today, all the vehicles running on conventional & non-conventional fuels are known for producing a large amount of harmful gases like CO2, SO2, NO2, etc. which acts increases global warming.

The motto of our project is to design & fabricate vehicle running on air pressure for material handling in industries and reduce power consumption. It is rear wheel drive. We develop the concept of pneumatic vehicle from pedal operated tricycle. The vehicle looks like three-wheeler in which manual operation is replaced by compressed air pressure. The following report gives a brief description of how a compressed air vehicle using this technology was made. While developing of this vehicle, control of compressed air parameters like temperature, energy density, requirement of input power, energy release and emission control must be mastered for the development of a safe, light and cost effective compressed air vehicle in near future.

1.2 Objectives

- To design various components of compressed air vehicle using theoretical design formulae.
- To manufacture the entire vehicle using dimensions obtained from the theoretical design.
- To use compressed air as a fuel to operate this vehicle thereby replacing the existing fuels like petrol and diesel.
- To create a system which will be eco-friendly as well as economical for conveying industrial materials like sand, concrete, coal, assembly components, boxed packages, etc.
- To modify the design of the pneumatic system by increasing the capacity of receiver tank, use of solenoid valve with a reset timer and to achieve high strength to weight ratio increasing the efficiency.

2. MODEL AND EQUIPMENT

Following figures shows the schematic representation of the CAV model.

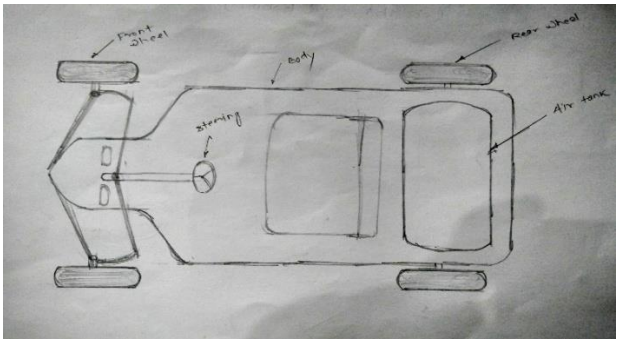

Fig.1- Top View of CAV model

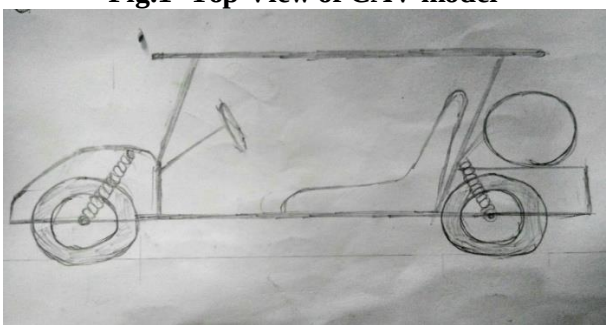

Fig.2- Side View of CAV model

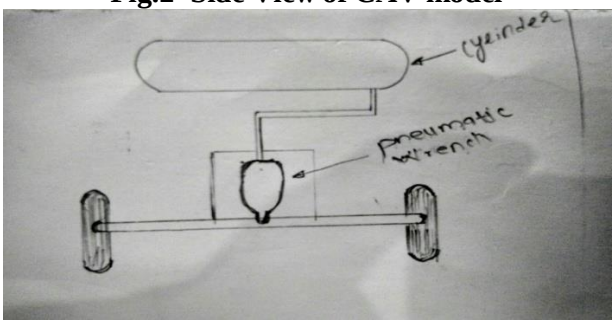

Fig.3- Arrangement of Pneumatic Wrench

2.1 MAIN PARTS

2.1.1 Pneumatic Wrench

A pneumatic wrench or compressed air engine is a type of motor which does mechanical work by expanding compressed air. Pneumatic wrenches generally, convert the compressed air to mechanical work through either linear or rotary motion. Linear motion can come from either a diaphragm or piston actuator, while rotary motion is supplied by either a vane type air motor or piston air motor. Pneumatic motors have existed in many forms over the past two centuries, ranging in size from hand held turbines to engines of up to several kilo Watts. Some types rely on pistons and cylinders, others use turbines. Rotary Vane Air motors feature durable construction with precision heavy-duty bearings throughout, and multiple blade rotors for smooth power. There is a wide range of speeds and torques as well as a choice of foot, face, or flange mounting. These wrenches require airline lubrication for long, trouble-free service. Mount the lubricator as close to the motor as possible. These motors perform satisfactorily in high temperature areas up to 200°F (93° C).

Fig.4- Pneumatic Wrench

Table-1: - Specifications Of Pneumatic Wrench

Idle speed	6300 rpm
When connected to wheel	2330 rpm
On load speed	425 rpm
Weight	6 Kgs
Torque	1000 N-m approx..
Air inlet (PT)	1/2 inch
Air Hose (ID)	3/4 inch

2.1.2 AIR TANK SPECIFICATION

1. Tank capacity – 130 litres
2. Tank size – length- 1070 mm (42 inch)
   Diameter- 356 mm (14 inch)
3. Time to fill – 4 mins
4. Cylinder storing pressure – 11.03 bar
5. Working pressure – 6.2 bar

Fig.4- Air Tank

3. WORKING

A pneumatic wrench uses air to produce rotational motion to a shaft. The rotating element is a slotted rotor which is mounted on a drive shaft. Each slot of the rotor is fitted with a freely sliding rectangular vane. The vanes are extended to the housing walls using springs, cam action, or air pressure, depending on the motor design. Air is pumped through the motor input which pushes on the vanes creating the rotational motion of the central shaft. Rotation speeds can vary between 100 and 25000 rpm depending on several factors which including the amount of air pressure at the motor inlet and the diameter of the housing.

Stored energy in the form of compressed air, nitrogen or natural gas enters the sealed pneumatic wrench chamber and exerts pressure against the vanes of rotor. Much like a windmill, this causes the rotor to turn at high speed.

Table -2: Comparative study with existing kind and CAV

Type of vehicle/powertrain	Fuel economy (mpg equivalent)	Range	Production Cost for given range	Reduction in CO2 compared to conventional
Conventional ICE	10-78 Long	(400-600 mi)	Low	0%
Biodiesel	18-71 Long	(360-540 mi)	Low	100%
All-electric	battery	Shorter (73-150 mi)	High	varies
Compressed air	30-60	380 mi	Medium	100 %

3.1 Particulars Of Components Used In The Vehicle

- 6mm, 8mm, 10mm bolts for brake, seat and angular fixtures.
- Grinding and metal cutting for minor parts are done using a portable grinding machine.
- 6mm drills with a hand drill, 8mm and 10mm drills with an upright drilling machine.
- Wheel rim dia.: 280mm.
- Wheel dia.: 380mm.
- Wheel width: 75mm.
- Front track length: 1070mm.
- Ground clearance: 280mm.
- Tank thickness: 3mm.
- Bearing OD: 35mm.
- Bearing: 15mm.
- Bearing thickness: 10mm
- Over-all length: 2340mm.
- Over-all height: 1060mm.
- Over-all width: 1290mm

4. CALCULATIONS

4.1 Calculation Of Design Power

Rated power

$$PR = \rho g Q H$$

Where, $\rho \rightarrow$ density of air

$g \rightarrow$ Acceleration due to gravity

$Q \rightarrow$ Discharge of air gun

$H \rightarrow$ Head of air column

$W = \rho g = 1.2\ kg/m^3$

$Q = 12CFM$ (Cubic feet/minute)

$H = 5160$ m

$\therefore Pr = 1.2 \times 0.3/60 \times 5160$

$= 30.96$ kg.m/sec

$= 303.717$ N-m/sec or Watt

Pr ≈ 300 Watt

∴ Design power of Air gun,

$Kl = 2$ (load factor)

$Pd = Pr \times Kl$

$= 300 \times 2$

Pd = 600 watts

4.2 Speed Of Pneumatic Wrench

Idle speed – 6300 rpm

Considering reduction of (2.7) i.e. V.R = 2.7 when connected to wheel

$\therefore$ N = 2333 rpm

Again considering load,

N = 424.18 rpm

N ≈ 425 rpm

4.3 Speed Of Wheel

Radius of wheel = 190 mm

$\therefore$ Diameter of wheel = 380 mm = 38 cm

$\therefore$ Circumference, C = πd = π×38 =119.38 cm

≈120 cm

i.e. one revolution of car = circumference of wheel

$\therefore$ For 425 revolution of wheel per minute,

= 425×119.38

= 50736.5 cm/min

i.e. 50736.5 cm/min = 0.50736 km/min

= 30.44 km/hr

≈ 31 km/hr

5. APPLICATIONS

1. Family Cars
2. Vans
3. Taxies
4. Pick-ups

6. ADVANTAGES

1. Major advantages of using compressed engine is that a pure compressed air vehicle produces no pollution at the tailpipe.
2. Use of renewable fuel.
3. Air, on its own, is non-flammable.
4. Low manufacture and maintenance costs as well as easy maintenance.
5. 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.

7. FUTURE SCOPE

The system eliminates the need for fuel, making the environment pollution-free. The compressed air drives the air motor, which turn the vehicle's wheels. Once compressed, the air is stored in a tank. The compressed air is used when the car needs a lot of energy, such as for starting up and acceleration.

In future, we can use air vehicle with some modifications:

1. After increasing tank capacity.
2. By using air engine and suitable pneumatic wrench.
3. By using different composite materials of high strength, weight of the parts like chassis, storage tank etc. reduces which results in low weight of the vehicle.
4. By providing different gear ratios in gear box.
5. By reducing losses of air flow through nozzles, pipes, etc.

With above some modifications it is possible to increase the performance and distance achieved by the vehicle.

8. CONCLUSION

From the observation, it can be concluded that compressed air power car can prove to the future vehicles. This is a revolutionary engine design which is ecofriendly, pollution free, but also very economical. This redresses both the problems of fuel crises and pollution. These are zero emission vehicle. To sum it up, they are non-expensive cars that do not pollute and are easy to get around in cities.

It's important to remember that while vehicles running on only compressed air might seem like a distant dream, but they still have public interest due to their environmental friendly nature. 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. This paper explores 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.

The performance can be improved by increasing inlet pressure, reducing the vehicle weight etc. However excessive research is needed to completely prove the technology for both its commercial and technical viability.

REFERENCE

1. "DESIGN AND DEVELOPMENT OF COMPRESSED AIR CAR"; Project Report, Rajiv Gandhi College Of Engineering, Research And Technology; Year- 2010-11
2. Anirudh Addla & Srinivasu Gangada, "Fabrication & Testing Of Compressed Air Car Viswanadha Institute Of Technology And Manegment", Globle Journals Inc (USA), 2013
3. Bilal Abdullah Baig, Hakimuddin Hussain," Design And Fabrication Of Compressed Air Powered Car", Internatinal Jornal On Resent And Innovation Trends In Compuitering & Communication Volume: 3
4. Karan R. Jagtap, Swapnil A. Patil, Shripad P. Raje, Sachin R. Pawar, Prof. Vinay J. Raje; "Design And Manugacturing Of Pneumatic Vehicle For Industrial Purpose"; Dept. Of Mechanical Engg; JSPM NTC, Narhe Pune, India; Year-2017
5. Www.Theaircar.Com
6. Www.Wikipedia.Com
7. Www.Engineeringtoolbox.Com