

Pneumatic Vehicle Using Compressed Air: A Real Solution To Pollution And Fuel Crisis

¹N.A.Todkar, ²R.H.Dhonde, ³N.S.Gawade, ⁴S.B.Shinde, ⁵S.S.Kale

^{1,2,3,4,5}Department of Mechanical Engineering, Jspm Narhe Technical Campus Narhe,Pune-41

Abstract: Now days the world faces fuel crisis and pollution problem. Also the conventional fuels are about to end in some years. This necessitates the search for alternative fuels. Compressed air is one of the best alternative fuels which are easily available in atmosphere in abundant form. The main objective of this project is to reduce dependency of vehicle on conventional fuel. The air car is a car currently being developed which is still in the R&D stage all over the world. Compressed air is stored in storage tank with some modifications from the compressor. The pneumatic motor (vane type motor) is used to convert pressure energy into mechanical energy. The rotation of air motor is controlled by controlling the air flow with the help of air gun (flow control valve). The gear box is provided at the end of motor shaft for increasing torque capacity of vehicle. Unlike conventional transmission system includes clutch, counter shaft, flywheel, propeller shaft, differential, our pneumatic motor 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 is less than conventional cars. This is a revolutionary design which is not only eco friendly, pollution free but also very economical. With some modifications in storage tank, pneumatic motor, materials used for chassis it is possible to increase the performance of vehicle.

Keywords: fuel crisis; alternative fuel; compressed air; pollution control; pneumatic vehicle.

1. INTRODUCTION

About 100 years ago, the major source of energy shifted from recent solar to fossil fuel (hydrocarbons). Technology has generally led to a greater use of hydrocarbon fuels, making civilization vulnerable to decreases in supply. The current study made in the year 2004, predicts that if the oil is consumed at the current rates, then by 2020, we will be consuming 80% of the entire available resource. This necessitates the search for alternative of oil as energy source or preserving it by tapping some other alternatives such as Non-conventional energy like battery operated vehicles, wind mills, photocells etc. and to convert their output into mechanical energy, which may alternatively preserve oil source.

From the last two decade lot of researches are being made to tap down air freely available in atmosphere at high compression, which can easily be stored in cylinders with little modified design. This compressed air can be used to run combustion engine with mixture of gas which gets fire at compression stroke at TDC. Compressed air helps for fire stroke when ignition is given. Thus efficiency of IC engine gets improved and without all running four stroke cycle it runs two stroke cycles.

The main objective of our project is to reduce dependency of vehicle on conventional fuel. These conventional fuels are available in very small amount & perish after some time. These fuels also produce a pollutants such as CO, CO₂, NO_x, SO_x which are harmful to human being & produce effects such as cancer, headache etc. So for these fuels alternatives are used for ex.CNG, Compressed air, biogas etc. Here development of pneumatic vehicle using compressed air (prototype) is main objective project.

2. COMPARATIVE STUDY

Comparison of several types of green car basic characteristic				
Types of vehicle or power train	Fuel economy (mpg equivalent)	Range	Production cost for given range	Reduction in CO ₂ compared to conventional
Conventional ICE	10-78	Long(400-600 mile)	Low	0%
Biodiesel	18-71	Long(360-540 mile)	Low	100%
Electric vehicle	Battery	Shorter(73-150 mile)	High	Varies
Compressed air	30-60	380 mile	Medium	100%

3. LITERATURE REVIEW

Anirudh Addala et. al. [1] examines the performance of a car which takes air as the working medium. Air car is a car currently being developed which is still in the R&D stage all over the world. Compressing a gas into a small space is a way to store energy. When the gas expands again, that energy is released to do work. That's the basic principle behind what makes an air car move.

A.A.Keste et. al. [2] describes the working of a vehicle which works on pneumatic power. In this system a double acting pneumatic cylinder is operated as a slider crank mechanism which converts the linear reciprocation of the cylinder piston rod into oscillatory motion of the driver crank about the pinion shaft.

S. S. Verma S.L.I.E.T., Longowal et. Al.[3] 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.

Dr. S.S. Thipse et.al.[4] describes the development of compressed air engine. MDI is one company that holds the international patents for the compressed air engine. . Although it seems to be an environmentally-friendly solution, one must consider its well to wheel efficiency.

B. R. Singh et.al.[5] 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

Saurabh Pathak, Kontham Swetha et.al.[6] states 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

S.S. Verma et.al.[7] 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 is already being explored and now air powered vehicles are being developed as a more fuel-efficient means of transportation.

D.Ravi et.al.[8] analyzed the Climate change and energy security require a reduction in travel demand, a model shift and technological innovation in the transport sector. . Through a series of press releases and demonstrations, a car using energy stored in compressed air produced by a compressor has been suggested as an environmental friendly vehicle of the future.

4. DEVELOPMENT OF THE SYSTEM



Fig. layout of pneumatic vehicle

Working :-

1. First we compress the air with the help of compressor. An air compressor is a device which compresses the atm. Air to a high pressure on the expense of external work (electric energy).
2. The compressed air is stored in the storage tank and supplied when required.
3. Pressure gauge is mounted on the storage tank to indicate the pressure inside the cylinder.
4. The compressed air from storage tank supplied to pneumatic motor through the air gun which acts as flow control vale. Pneumatic motor is an rotary actuator used for converting pressure energy of air into rotary motion.
5. Torque capacity of the motor is less than our requirement hence modification is done by adding the worm and worm wheel gear box.
6. Gear box is a power transmission device and it is generally used for torque variation. Worm and worm wheel gear is attached to the shaft to increase the torque capacity of the motor.
7. After the gear arrangement chain drive is connected to transfer the motion to the wheels. Wheels are last member of power transmission devices and it is directly contact with road surface.
8. Wheel drives the vehicle.

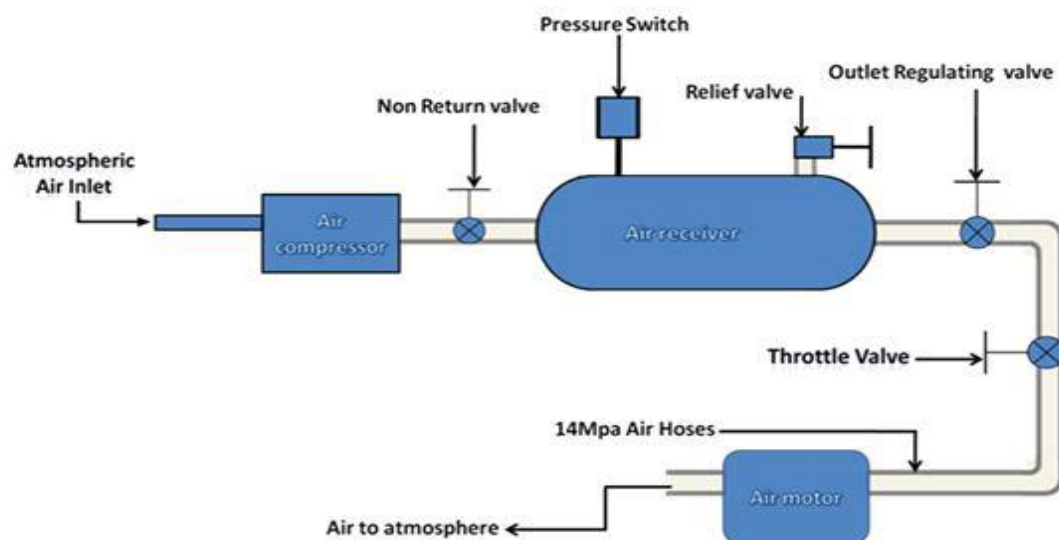


Fig .Block diagram of system

Main Components of system:-

- A. Storage tank
- B. Pneumatic motor
- C. Gear box
- D. Chain drive
- E. Wheel
- F. Lubricator
- G. Tubes

1. Chassis:

The basic structure or framework is the backbone of the vehicle component assemblies. It is the important component of the vehicle on which the other units such as storage tank, pneumatic motor and gear box are mounted. The shape of chassis is rectangular as per the requirement. Hollow bars (M.S.) are used to construct the chassis and CO₂ welding is the process used for the fabrication of chassis.

Wheel Mounting:

After the completion of chassis, wheels are mounted; one on the front side and two on the rear side.

Component	Dimensions in mm
Wheel rim diameter	440
Wheel diameter	520
Wheel width	45
Front track length	550
Ground clearance	260
Side length	850
Vehicle length	1200

2. Storage tank:

Cylinder is a mechanical device used for storing, receiving, processing or carrying the fluids. A cylinder may be

- Pressure vessel;
- Storage tank;
- Hydraulic device;
- Engine cylinder, or
- Pipe.

Depending upon whether the cylinder wall thickness is appreciable or not, in relation to the inner diameter of the cylinder, the cylinder are classified into two categories:

Thin cylinder ($D_i/T > 20$)

Thick cylinder ($D_i/T < 20$)

Cylinder used in this project is thin cylinder i.e. ratio of internal diameter to thickness is greater than 20. Cylinder is made up of C-40 steel.



Fig. cylinder

Technical specification

Parameters	Dimension
Internal diameter	200 mm
Outer diameter	208 mm
End closure	Semi elliptical
Maximum pressure	14 bar
Volumetric capacity	0.15^3

3. Pneumatic motor:

An air motor is opposite in principle to that of an air compressor. Air compressor takes mechanical power supplied by an external power sources and used it to compress air to a high pressure. Where as an air motor uses this compressed air to develop mechanical power by continuous rotation of a shaft.

Pneumatic rotary actuators provide continuous rotary motion to an output shaft. Rotational speeds of pneumatic actuators are generally very high as compared to that of hydraulic actuators.



Fig. Air Motor

Technical specification

1. Rated torque = 32 N-m
2. Rated speed = 60 RPM

4. Power transmission system:

Gear box is that part of power train system that provides a mean to have suitable variation of the motor torque to road wheels. The gear used in this system is worm and worm wheel type.

A chain drive consists of an endless chain wrapped around two sprockets. A chain can be defined as series of links connected by pin joints. The sprocket is tooth wheel with a special profile for the teeth. The chain drive is intermediate between belt and gear drive. It has some features of belt drive and some of gear drive. From the output power transmitted to wheel, we select chain drive as 12B chain.



Fig 4.6: Transmission system.

Technical specification**A. gearbox**

1. Gear ratio= 1:5
2. Module(m)= 16 mm ,
3. Number of teeth on worm(Z_w)= 2
4. Number of teeth on worm gear (Z_g)= 10
5. Diameter of worm (D_w)=32 mm
6. Diameter of worm gear (D_g)= 100 mm

B. Chain drive

1. Pitch of gear (p) = 19.05 mm
2. Roller diameter (d_1) = 12.07 mm
3. width (b_1) = 11.68 mm
4. transverse pitch (P_t) = 19.46 mm
5. simple chain with the braking load capacity= 28900 N

5. RESULTS & DISCUSSION

Compressed air technology allows engines that are both nonpolluting and economical. With the use of non-conventional energy sources such as compressed air we can set a milestone in the field of green technology because it is the demand of the time to adopt green technology.

Following are some results of the test carried out on the prototype of pneumatic vehicle.

For person having 55 kg mass and for plain surface:

1. Tank pressure: 10 bar
2. Distance achieved: 18 m (60 ft)
3. Time required: 22 sec
4. Velocity: 0.818 m/s

For no load condition:

1. Tank pressure: 10 bar
2. Distance achieved: 25 m (84 ft)

The main aim of our project is to run the vehicle on compressed air. As this is the prototype the results are in low range. After modification and development of this vehicle the performance will be better than conventional vehicles.

6. CONCLUSION

The technology of compressed air vehicles is not new. In fact, it has been around for years. Compressed air technology allows engines/ motors that are both nonpolluting and economical. We designed 3 wheeled vehicle in order to reduce weight. Unlike conventional transmission systems which include clutch, counter shaft, fly wheel, propeller shaft, differential, our pneumatic motor is coupled to the rear wheel with intermediate gear box which greatly reduces the transmission losses and weight of the vehicle. It also occupies lesser space compared to a four wheeler. However excessive research is needed to completely prove the technology for both its commercial and technical viability.

1. After successfully completing the project we conclude that we can use the air as an alternative fuel for conventional fuel.
2. The vehicle is pollution free and Eco friendly.
3. With some modification the performance of the vehicle will be increased.
4. Low initial cost
5. Running cost is less than the conventional vehicle. (MDI's air pod has running cost 1 Rs/km while conventional vehicles have 2 to 3 Rs/km.)
6. Transmission losses are reduced.
7. Low weight of vehicle.

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 are able to use air vehicle with some modifications:

1. After increasing tank capacity.
2. By using air engine and suitable air motor.
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.

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