

Application of Compressed Air Engine to Replace SI Engine: A Review

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Abstract - The latest trend in the automotive industry is used of Compressed air as a source of energy. Which is renewable as well as pollution free energy. Every automotive industry is finding the solution to reduce the weight of the vehicle as it helps in the better handling of the vehicle i.e. Light utility transport vehicles are becoming very popular means of independent transportation for short as well as long distances. Constant pollution with petrol and diesel are leading vehicle manufacturers to develop vehicles fuelled by alternative energies. Engineers are directing their efforts to make use of air as an energy source to run the light utility vehicles which increases the efficiency of the transporting vehicle where Compressed air filled by electricity using a compressor. The electricity requirement for compressing air has to be considered while computing overall efficiency. Now a days, the heavy transporting vehicles are known for producing a large amount of harmful gases/pollutants like CO₂, SO₂ etc. which act as the major source for global warming as well as pollution. So research is going on to find a light weight vehicle which tends to zero pollute the environment. One of the best alternatives is the use of compressed air to generate power to run an automobile vehicle. Due to the unique and environmental friendly properties of air, it is considered as one of the most important future fuels which will run the transporting vehicles. So in this review paper an effort is made to study the extent of research done and the potential advantages and disadvantages of the in the area under compressed air technology.

Key Words: Light Weight Vehicles, Compressed Air, Global Warming, Alternative Sources of Energy.

1. INTRODUCTION

The first compressed transport air vehicle was established in France by a Polish engineer Louis Mekarski in the year 1870.

It was patented in 1872 and 1873 and was tested & verified in Paris in 1876. The working principle of Mekarski's engine was the use of energy stored in the compressed air to decrease the pollution & to increase gas enthalpy of hot water when it is passed through hot water. Another application of the compressed air to drive vehicles comes from Uruguay in the year 1984, where Armando Regusci has been involved in constructing these wonderful machines. He constructed a four-wheeler with pneumatic engine which travelled 100000m i.e. 100 km on a single tank in 1992. The Air Car was developed by Luxembourg-based MDI Group founder and former Formula One engineer Guy Negre is which works on compressed air engine (CAE). This guy

developed a compressed air- 4- cylinders engine run on air and gasoline in 1998 which claimed by that guy as a zero pollution cars. The engine uses compressed air to push its pistons when running at speeds under 0.035 Kilometre per hour i.e. 35 mph and at higher speeds of 0.096 kilometre per hour i.e. 96 mph, the compressed air was heated by a fuel (bio fuel, gasoline, or diesel), due to this the air expanded before entering the engine. In this engine, fuel efficiency of about 100 MPG (imperial) was observed. Light weight transport vehicles are the next advancement in the development of area under automobiles. Reducing the weight of the transport vehicle has many advantages so that it increases the overall efficiency of the vehicle, which helps in improving manoeuvrability, requires less energy to run and stop the vehicle. The latest researches are going on around the whole world which tend to come up with innovative ideas which will be implemented in practical life. But global warming is also one of the most major problems which is affecting the biosphere as well as lifestyle of human beings. The temperature of the earth is increasing drastically and this in turn is causing climatic changes which directly affect our environment. The fossil fuels are widely used as a source of energy in various different fields like power plants, internal & external combustion engines, as heat source in manufacturing industries, etc. & if we compared to batteries or any electrical source, compressed air is favourable because of a high energy density, low toxicity, fast filling at low cost and long service life. But its stock is very limited and due to this tremendous use, fossil fuels are diminishing at faster rate. So, in this world of energy crisis, it is necessary to develop alternative technologies to use renewable energy sources & reduce pollution, so that fossil fuels can be conserved. One of the major source of the pollution is the smoke coming out from the machinery under the area automobiles. So an alternative way of producing the running the transport vehicle must be made so that we can prevent further damage to the earth & environment. The alternative sources of energy available are solar, electric, atmospheric air etc. Air acts like a blanket for the earth. It is the mixture of various gasses, which makes it neutral and non-polluting. It has the property to get compressed to a very high pressure and retain it for a long period of time. It is cheap and can be found abundantly in the atmosphere. So it can be used as an alternative fuel for the automobiles. Much research is going on in this field and scientists are trying to improve the effectiveness of this wonderful technology. It is experimentally found that the efficiency of the vehicle ranges from 72-95%. So this can be considered as one of the preferable choices to run the transport vehicle.

2 WORKING

A compressed air engine is a type of engine in which mechanical work by expanding compressed air. Pneumatic engine generally convert compressed air energy to mechanical work either into linear motion or rotatory motion. If compressed air is transferred into the on board storage tank, it is slowly released to power the transport vehicle's pistons. The motor then converts the air power into mechanical power. That power is then transferred to the wheels and becomes the source of power for the car. The engine that is installed in a compressed air transport vehicle uses compressed air which is stored in the car's tank at a pressure as high as 4500 psi. The technology used by air car engines is totally different from the technology that is used in conventional fuel cars. Approximately 90m³ of compressed air is stored in fiber tanks in the vehicle. The engine is powered by compressed air, stored in a carbon-fiber tank at 30MPa (4500 psi). The tank is made of carbon fiber in order to reduce its weight. The engine has an injector which is similar to normal engines, but uses the special crankshafts and pistons, which remain at top dead center for about 70 degrees of the crankshaft's cycle; this allows more power to be developed in the engine. The expansion of this air pushes the pistons and creates movement. To re-heat the engine and increase the road coverage overall atmospheric temperature is used. The air conditioning system makes use of the expelled cold air. Due to the absence of combustion and the fact there is no pollution, the oil change is only necessary for the corresponding working of air compressed engine.

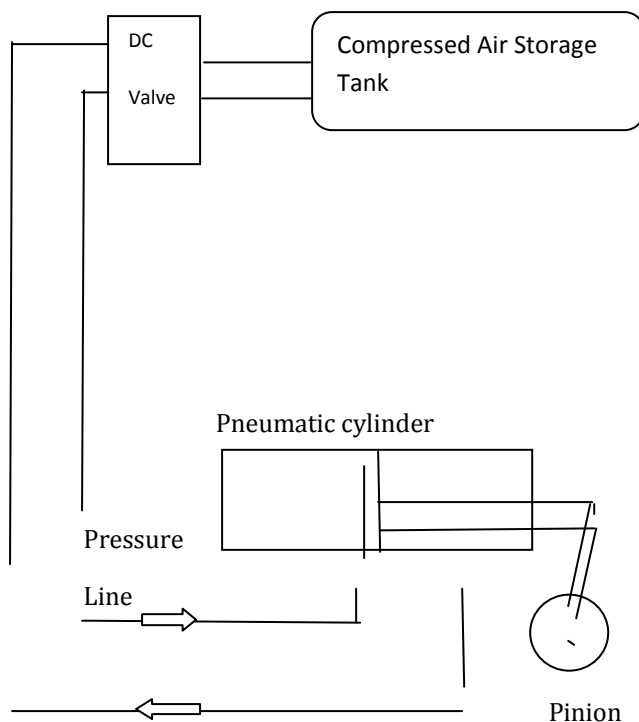


Fig: Compressed Air Engine Setup

3 COMPRESSED AIR ENGINE TECHNOLOGY

The basic object purpose Compressed air Technology is to implement in transport vehicle for consumption of very less amount of energy and remain the output work same. In this 21 century, everyone wants to afford a transport vehicle and its energy to power it. Engine air technology makes it happen from many aspects. It is very less in term of mass as compared with other sources of energy for transportation of man or material. It also improves urban life style through sustainability & Non-polluting transport vehicle. Its impact on the environment is also considered low. It remains with intelligence, lighter, style and comfort.

4. LITERATURE REVIEW

4.1 Air Powered Engine

Prof. B. S. Patel et al. who tried to develop such a compressed air engine by modifying an 4-stroke, single cylinder SI engine by replacing the spark plug with the help of pulsed pressure valve, and using compressed air as the working fluid which is pollution free or tend to zero pollution. The working of this engine is very well explained theoretically and the cost analysis is made which shows that the compressed air engine is cheaper than Spark ignition engine i.e. SI engine on the frame of reference of conventional SI engine.

4.2 Study of Compressed Air Storage System as Clean Potential Energy for 21st Century

International Journal of Mechanical & Production Engineering, ISSN: 2320-2092, Volume- 2, Issue- 4, April-2014 Compressed Air Vehicle: A Review

An experiment conducted by Dr. Bharat Raj Singh & Dr. Onkar Singh conducted together in which they both used a vanned type novel air turbine as a prime mover for a motor bike. In this experiment they tried to gain an output of 6.50 Horsepower i.e.4.84705 Kilowatt to 7.20 Horsepower i.e.5.36904 Kilowatt for the starting torque requirements of 500 to 750 rpm at 4 to 6 bars air pressure to running speeds of 2000 to 3000 rpm using 2 to 3 bars air pressure. The test was conducted in HBTI Kanpur

After conducting this research they have concluded that overall performance of air turbine for working Pressure ranging from 2.7-6 bar is found varying from 72%-97%. This technology can be used in the area under the future automotive industry.

5. Advantages of compressed air powered transport vehicle:

In comparison to petrol or diesel powered vehicles

“Air powered vehicles” have following advantages:

- Air, on its own, It is Natural resource, non-flammable, abundant, economical, transportable, storable and, most importantly, non-polluting.
- Compressed air technology reduces the cost of transport vehicle production by about 20%, because there is no need to build a cooling system, fuel tank, spark plugs or silencers.
- High torque for minimum volume.
- The mechanical design of the air compressed engine is very simple and robust.
- Low manufacture and maintenance costs as well as easy maintenance.
- Lighter vehicles would mean less abuse on roads, thus, resulting in longer lasting roads.
- The price of fuelling air powered vehicles will be significantly cheaper than current fuels.
- When the air has been compressed at reasonable speeds, it heats up. The heat given off during compression could be reclaimed for space heating or water heating, or used in a Sterling engine.
- Does not required Transportation of such a fuel does due to drawing power off the electrical grid. This presents significant cost benefits. Pollution created during fuel transportation would be eliminated.
- Compressed-air transport vehicles are comparable in many frame of references even to electric vehicles and their potential advantages over electric transport vehicles include:
- Compressed-air vehicles are unconstrained by the degradation problems associated with electrical battery systems.
- Much like electrical vehicles, air powered vehicles would ultimately be powered through the electrical grid which makes it easier to focus on reducing pollution from one source, as opposed to the billions of vehicles on the road.
- Compressed-air storage tanks does not create any danger can be disposed of or recycled with less pollution than batteries and tend to zero pollution.
- The tank may be able to be refilled more often and in less time than batteries can be recharged, with refueling rates comparable to liquid fuels.
- The tanks used in a compressed air tank which used in compressed air motor have a longer lifespan in

comparison with batteries, which, after a while suffer from a reduction in performance

6. CONCLUSIONS

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. Pneumatic vehicle will be replace the battery operated transport 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. The Air Powered Engine technology is cheaper in cost and maintenance, can be easily adapted by the masses and it doesn't cause any kind of harm to the environment. Instead, it's wide spread use will help mankind in controlling the serious problem of global warming. At the end of this review we conclude that the compressed air technology can be tested and developed using the Vanned Type Novel Air Turbine as there are minimal losses and practically their efficiency varies from 72-97% which is very high when compared to a conventional IC engine. Future developments can be made by designing an ideal vehicle for this kind of engine.

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