Air Powered Vehicles

S.S. Verma*

Department of Physics, S.L.I.E.T. (Deemed to be University), Longowal, Distt.-Sangrur, Punjab, 148 106, India

Abstract: Light utility vehicles are becoming very popular means of independent transportation for short distances. Cost and pollution with petrol and diesel are leading vehicle manufacturers to develop vehicles fueled by alternative energies. Engineers are directing their efforts to make use of air as an energy source to run the light utility vehicles. The use of compressed air for storing energy is a method that is not only efficient and clean, but also economical. The major problem with compressed air cars was the lack of torque produced by the "engines" and the cost of compressing the air. Recently several companies have started to develop compressed air vehicles with many advantages and still many serious bottlenecks to tackle. This paper briefly summarize the principle of technology, latest developments, advantages and problems in using compressed air as a source of energy to run vehicles.

Keywords: Environmntal pollution, alternative energies, compressed air, air powered vehicles.

1. INTRODUCTION

We are living in a very mobile society so light utility vehicles (LUV) like bikes and cars are becoming very popular means of independent transportation for short distances. Petrol and diesel which have been the main sources of fuel in the history of transportation, are becoming more expensive and impractical (especially from an environmental standpoint). Such factors are leading vehicle manufacturers [1-9] to develop vehicles fueled by alternative energies. When at present level of technological development fuel-less flying (like birds) i.e., flying based on the use of bio-energy and air power in the atmosphere seems to be almost impossible for human beings then engineers are fascinated at least with the enormous power associated with the human friendly as well as tested source of energy (i.e., air) to make **air-powered vehicles** as one possible alternative. Engineers [1-9] are directing their sincere efforts to make use of air as an energy source to run the LUVs which will make future bikes and light/small cars running with air power for daily routine distances and the travel will be free from pollution and cost effective.

2. TECHNOLOGY

Mankind has been making use of uncompressed air-power from centuries in different application viz., windmills, sailing, balloon car, hot air balloon flying and hang gliding etc. The use of compressed air for storing energy [3] is a method that is not only efficient and clean, but also economical and has been used since the 19th century to power mine locomotives, and was previously the basis of naval torpedo propulsion. In 1903, the Liquid Air Company located in London manufactured a number of compressed air and liquified air cars. The major problem with compressed air cars was the lack of torque produced by the "engines" and the cost of compressing the air. Recently several companies [1-5] have started to develop compressed air vehicles, although none has been released to the public so far. Compressed air tanks store power really well but are lacking on power density. They tie or beat batteries in the charge / re-charge efficiency and totally kill them on lifespan. Higher pressures are their big problem of compressed air vehicles while efficiency, cost, toxic chemicals, and lifespan are the big problems associated with chemical batteries.

The principle of compressed-air propulsion [6] is to pressurize the storage tank and then connect it to something very like a reciprocating steam engine of the vehicle. Instead of mixing fuel with air and burning it in the engine to drive pistons with hot expanding gases, *compressed air vehicles* (CAV) use the expansion of compressed air to drive their pistons. Thus, making the technology free from difficulties, both technical and medical, of using ammonia, petrol, or carbon disulphide as the working fluid. Manufacturers [5-9] claim to have designed engine that is 90 percent efficient. The air is compressed at pressure about 150 times the rate the air is pressurized into car tyres or bicycle. The tanks must be designed to safety standards appropriate for a pressure vessel. The storage tank may be made of steel, aluminium, carbon fiber, kevlar or other materials, or combinations of the above. The fiber materials are considerably lighter than metals but generally more expensive. Metal tanks can withstand a large number of pressure cycles, but must be checked for corrosion periodically. A company has stated to store air in tanks at 4,500 pounds per square inch (about 30 MPa) and hold nearly 3,200 cubic feet (around 90 cubic metres) of air. The tanks may be refilled at a service station equipped with heat exchangers, or in a few hours at home or in parking lots, plugging the vehicle into an on-board compressor. The cost of driving such a car is typically projected to be around Rs. 60 per 100 km, with a complete refill at the "tank-station" at about Rs. 120 only.

3. DEVELOPMENTS

Jem Stansfield [8], an English inventor has been able to convert a regular scooter to a compressed air moped shown in Fig. (**1**).

*Address correspondence to this author at the Department of Physics, S.L.I.E.T. (Deemed to be University), Longowal, Distt.-Sangrur, Punjab, 148 106, India; E-mail: ssverma@fastmail.fm

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Fig. (1). Air powered moped.

This has been done by equipping the scooter with a compressed air engine and air tank. Jem Stansfield created the bike by strapping two high-pressure tanks onto the side of his Puch moped. The tanks are basically scuba tanks. He uses the electricity from his house to fill the tanks. The power is then "stored" there, much like a battery, ready for use. The tanks used are carbon-fiber tanks of the sort used by firefighters for oxygen. But still, they're far cheaper than even the lead acid battery used in car now. Of course, the compressor works on electricity, so that's not always a clean power source but recharging options at night or off peak will enhance the chances to use the power that would be wasted otherwise. The top speed is about 18 mph, and it can only go 7 miles before the air pressure runs out and a lot more power could probably be pulled by tweaking his configuration. A small gear on the end of the air drill, connected to the chain of the bike would make a much more elegant solution.

Several companies [1-9] are investigating and producing prototypes, and others plan to offer air powered cars, buses and trucks. The compressed air is stored in carbon-fiber tanks that are built into the chassis. As the air is released, the pressure drives pistons that power the engine and move the car, and the pistons compress the air into a reservoir so that the process continues. After making a revolution by producing the world's cheapest car-Tata nano, India's largest automaker (Tata Motors) is set to start producing the world's first commercial air-powered vehicle. The "Air Car" will make use of compressed air, as opposed to the gas-and-oxygen explosions of internal-combustion models, to push its engine's pistons. Zero Pollution Motors (ZPM) (USA) [1] also expects to produce the world's first air-powered car for the United States by 2010. An earlier version of the car is noisy and slow, and a tiny bit cumbersome but then this vehicle will not be competing with a Ferrari or Rolls Royce and the manufacturers are also not seeking to develop a Formula One version of the vehicle. The aim of air powered vehicles is the urban motorist: delivery vehicles, taxi drivers, and people who just use their vehicles to nip out to the shops. The latest air car is said to have come on leaps and bounds from the early model. It is said to be much quieter, a top speed of 110 km/h (65 mph), and a range of around 200 km before you need to fill the tanks up with air.

4. ADVANTAGES

In comparison to pterol or diesel powred vehicles "air powred vehicles" have following advantages:

- Air, on its own, is non-flammable, abundant, economical, transportable, storable and, most importantly, nonpolluting.
- Compressed air technology reduces the cost of 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 engine is 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 fueling air powered vehicles will be significantly cheaper than current fuels.
- When the air is being 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 stirling engine.
- Transportation of the fuel would not be required due to drawing power off the electrical grid. This presents significant cost benefits. Pollution created during fuel transportation would be eliminated.

Compressed-air vehicles are comparable in many ways even to electric vehicles and their potential advantages over electric vehicles include:

- Compressed-air vehicles are unconstrained by the degradation problems associated with current 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 millions of vehicles on the road.
- Compressed-air tanks can be disposed of or recycled with less pollution than batteries.
- The tank may be able to be refilled more often and in less time than batteries can be recharged, with re-fueling rates comparable to liquid fuels.
- The tanks used in a compressed air motor have a longer lifespan in comparison with batteries, which, after a while suffer from a reduction in performance.

5. BOTTLENECKS

Disadvantages of compressed-air vehicles are less well known, since the vehicles are currently at the pre-production stage and have not been extensively tested by independent observers. Some bottlenecks of technology may be summarized as:

- Very little is known about air powered vehicles thus far.

- Compressed air vehicles likely will be less robust than typical vehicles of today. Which poses a danger to users of compressed air vehicles sharing the road with larger, heavier and more rigid vehicles.
- Compressed air has a low energy density comparable to the values of electrochemical lead-acid batteries. While batteries can somewhat maintain their voltage throughout their discharge and chemical fuel tanks provide the same power densities from the first to the last litre, the pressure of compressed air tanks falls as air is drawn off.
- When the air is expanded in the engine, it will cool down *via* adiabatic cooling and lose pressure thus its ability to do work at colder temperatures. It is difficult to maintain or restore the air temperature by simply using a heat exchanger with ambient heat at the high flow rates used in a vehicle, thus the ideal isothermic energy capacity of the tank will not be realised. Cold temperatures will also encourage the engine to ice up.

6. CONCLUSION

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. Some automobile companies are further exploring compressed air hybrids and compressed fluids to store energy for vehicles which might point the way for the development of a cost effective air powered vehicles design. Unfortunately there are still serious problems to be sorted out before air powered vehicles become a reality for common use but there is a hope that with the development in science & technology well supported by the environmental conscious attitude and need to replace costly transportation methods, air-powered vehicles will definitely see the light of the day.

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