A compressed-air engine is a pneumatic actuator that creates useful work by expanding the compressed air and converting the potential energy into motion. (A pneumatic actuator is a device that converts energy into motion.) The motion can be rotary or linear, depending on the type of actuator. Compressed Air Engine (CAE) are fueled by compressed air, which is stored in a tank at a high pressure. A Compressed Air Vehicle (CAV) uses this compressed-air engine as its mechanism for propulsion. Compressed air vehicle project in the form of light utility vehicle (LUV) (i.e., air car in particular) has been a topic of great interest for the last decade and many theoretical and experimental investigations. The difference between the compressed air engine and IC engine is that instead of mixing fuel with air and burning it to drive pistons with hot expanding gases, CAE’s use the expansion of previously compressed air to drive their pistons. The greatest advantages of compressed air vehicle are, no burning process and no waste gas discharge to the surrounding environment. It can be said as a green environmental protection vehicle with near zero pollution in the metropolitan cities.

With the policy of energy conservation and environment protection. The engines of compressed air cars are piston type, vane type, rotary type and the piston engine. At present, the piston engine power system has some disadvantages such as complex structure, easy wearing, high noise and low efficiency. Therefore, to develop and optimize engine power system is the key technique for compressed air vehicles.

HISTORY:

The first air powered vehicles were actually trains. The Mekarski air engine, the Robert Hardie air engine and the Hoadley-Knight pneumatic system were used in the 1800’s to power locomotives. In 1925, an article appeared in the Decatur Review about a man named Louis C. Kiser who converted his gasoline powered car to run on air. Lee Barton Williams in 1926 claimed to have invented the first air car. Williams was from Pittsburg and claimed the car started on gasoline but after 10 mph it switched to compressed air only. In 1931, the Hope Star of Hope, Arkansas ran an article about Roy J. Meyers of Los Angeles inventing the first air car. In 2007, Tata Motors introduced the MDI CityCat developed by Guy Nègre as the first commercial air car. As of 2009, two more models of MDI air cars have been showcased.
The first air cars will have air compressors built into them. After a brisk drive, you'll be able to take the car home, put it into the garage and plug in the compressor. The compressor will use air from around the car to refill the compressed air tank. Unfortunately, this is a rather slow method of re-fuelling and will probably take up two hours for complete refill. If the idea of an air car catches on, air re-fuelling stations will become available at ordinary gas stations, where the tank can be refilled much more rapidly with air that's already been compressed. Filling your tank at the pump will probably take about three minutes.

This air car will almost certainly use the Compressed Air Motor (CAM). Air cars using this engine will have tanks that will probably hold about 78 liters of compressed air. The vehicle's accelerator operates valve on its tank that allows air to be released into a pipe and then into the motor, where the pressure of the air's expansion will push against the vanes and turn the rotor. This will produced enough power for speeds of about 15-20 kilometers per hour.

Table: comparative study with existing kind and C.A.V

<table>
<thead>
<tr>
<th>Component</th>
<th>6mm</th>
<th>8mm</th>
<th>10mm</th>
<th>10-15</th>
<th>15-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>wheel rim dia.</td>
<td>: 280mm.</td>
<td>280mm.</td>
<td>280mm.</td>
<td>280mm.</td>
<td>280mm.</td>
</tr>
<tr>
<td>wheel dia.</td>
<td>: 380mm.</td>
<td>380mm.</td>
<td>380mm.</td>
<td>380mm.</td>
<td>380mm.</td>
</tr>
<tr>
<td>wheel width</td>
<td>: 75mm.</td>
<td>75mm.</td>
<td>75mm.</td>
<td>75mm.</td>
<td>75mm.</td>
</tr>
</tbody>
</table>
• 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.

Power specification of designed C.A.V:

It takes minimalist power in making the transport possible in doing that we found the following data to not only power up our vehicle but also to achieve a target to cut down travel to make the vehicle affordable by everyone.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input power consumption</td>
<td>79.2 Watts</td>
</tr>
<tr>
<td>Time of filling(2 cylinders)</td>
<td>6 minutes</td>
</tr>
<tr>
<td>Cost of filling @ (net charge 50)</td>
<td>Rs. 0.32</td>
</tr>
<tr>
<td>Air consumption</td>
<td>340 l/min</td>
</tr>
<tr>
<td>Cylinder steering pressure</td>
<td>11.03 bar</td>
</tr>
<tr>
<td>Working pressure</td>
<td>6.2 bar</td>
</tr>
<tr>
<td>Cylinder steering capacity</td>
<td>340 l.</td>
</tr>
<tr>
<td>Output power</td>
<td>2.169 kW</td>
</tr>
</tbody>
</table>

The end joints re butt welded and some internal angular sections are lap welded. The steering column support is given by welding a hollow shaft with a T weld to the front frame of the chassis.

FABRICATION

Chassis is made by arc welding at various sections for the Rectangular cross sections. It includes:

• Lap joint welds
• Butt welds
• T joint welds

The steering of a vehicle is so arranged that the front wheels will roll truly without any lateral slip. The function of the steering system is to convert the rotary movement of the steering wheel into angular turn of the front wheels. To keep effective control on the moving vehicle throughout its range of speed irrespective of the load and road conditions. The steering system of a vehicle should fulfill the following requirements:

1. It should multiply the effort applied on the steering wheel by the drivers.

2. The mechanism should have self-adjusting effect so that when the driver releases the steering wheel after negotiating the turn, the wheel should try to achieve straight ahead position.

3. It should not transmit road shocks to steering wheel.

TIMING GEAR MODIFICATION:

Fig: Valve timing diagram
Valve timing is as follows:

Inlet valve open: 10 degrees before TDC
Exhaust valve open: 20 degrees before BDC
Inlet valve close: 10 degrees after BDC
Exhaust valve close: 5 degrees after TDC
Pressure of compressed air: 150 Psi
RPM of crankshaft: 650-700 RPM

PROBLEMS FACED DURING DESIGNING

• Availability of components of desired specification in market as per the design.
• To vary the output speed.
• To prevent the air leakage.

SOLUTIONS ADAPTED

• As per market survey conducted by us we have selected the components with nearest possible specifications as per our design to get the desired power.
• With the use of air tight joints formed by the connectors we prevent the leakage of air.

Applications

(a) Mopeds

• Jem Stansfield, an English inventor has been able to convert a regular scooter to a compressed air moped. This has been done by equipping the scooter with a compressed air engine and air tank.

(b) Buses and Locomotives

• MDI makes Multi CATs vehicle that can be used as buses or trucks. RATP has also already expressed an interest in the compressed-air pollution-free bus.

ADVANTAGES:

1. Major advantage of using compressed engine is that a pure compressed air vehicle produces no pollution at the tailpipe.
2. Use of renewable fuel.
3. Compressed-air technology reduces the cost of vehicle production by about 20%, because there is no need to build a cooling system, fuel tank, Ignition Systems or silencers.
4. Air, on its own, is non-flammable.
5. The engine can be massively reduced in size.
6. Low manufacture and maintenance costs as well as easy maintenance.
7. The air tank may be refilled more often and in less time than batteries can be recharged, with re-filling rates comparable to liquid fuels.
8. Lighter vehicles cause less damage to roads, resulting in lower maintenance cost.
9. 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.

CONCLUSION:

The model designed by us is a small scale working model of the compressed air engine. When scaled to higher level it can be used for driving automobiles independently or combined (hybrid) with other engines like I.C. engines. The technology of compressed air vehicles is not new.

Compressed air technology allows for engine that are both non-polluting and economical. After ten years of research and development, the compressed air vehicle will be introduced worldwide. Unlike electric or hydrogen powered vehicles, compressed air vehicles are not expensive and do not have a limited driving range.

Compressed air vehicles are affordable and have a performance rate that stands up to current standards. To summit up, they are non-expensive cars that do not pollute and are easy to get around in cities. The emission benefits of introducing this zero emission technology are obvious. At the same time the well to wheels efficiency of these vehicles need to be improved.

This is a revolutionary car which is not only eco-friendly, pollution free, but also very economical. This addresses both the problems of fuel crises and pollution. However excessive research is needed to completely prove the technology for both its commercial and technical viability.
FUTURE SCOPE:

Compressed air vehicles are our near future and advancements in the presented project can be taken up by doing some ideal methods like:

1. Inserting an intermediate compressor after the gas exits the engine and compress the air again to the reservoirs.

2. Making a hybrid engine comprised of multiple ways of powering up the vehicle like gasoline and compressed air; electric and compressed air; re-cyclic modules etc.

3. Making the chassis lightweight by selecting proper materials can also greatly affect the efficiency of the CAV.

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