A Seminar Report On

"AIR POWERED CAR – FUTURE OF TRANSPORTATION"

Submitted By:

GANESH N. NAIK

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DEPARTMENT OF MECHANICAL

S.H JONDHALE POLYTECNIC (DOMBIVLI WEST)

UNDER THE GUIDANCE OF

PROFF.VINOD THOMBRE PATIL

DEPARTMENT OF MECHANICAL

S.H JONDHALE POLYTECNIC (DOMBIVLI WEST)

Maharashtra State Board of
Technical Education
(MSBTE)
Govt. of Maharashtra

DEPARTMENT OF MECHANICAL

CERTIFICATE

This Is to Certify that **Mr. GANESH N. NAIK**. Roll No. **1823** of 6th Semester Diploma in **Mechanical Engineering** has completed the seminar work satisfactory towards Fulfillment of the academic year **2010-11**as prescribed in the MSBTE curriculum.

Place: Dombivali Enrollment No.:08422516

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Seminar Guide H.O.D. Principal

ACKNOWLEDGEMENT

I EXPRESS MY SINCERE REGARDS TO MY GUIDE (PROFF. VINOD THOMBRE PATIL) HEAD OF (DEPARTMENT OF MECHANICAL),FOR MOTIVATION ,KIND OF COOPERATION MANAGEMENT AND VALUABLE SUPPORT

I AM THANKFUL ALL THE FACULY MEMBERS IN THE DEPARTMENT OF MECHNICAL FOR ENCOURAGING ME TO MAKE THIS REPORT.IAM THAKFUL

TO ALL MY FRIENDS, WHO HAVE ATTENDED THEIR CO-OPERATION

AND SUGGESTIONS FROM TIME TO TIME

GANESH N. NAIK

(T.Y.M.E)

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INTRODUCTION

We know that our world is facing fuel crisis now. All kinds of conventional source of fuels are on the verge of exhaustion. Gasoline which has been the main source of fuel for the history of cars is becoming more and more expensive and impractical (especially from an environmental standpoint). These factors are leading car manufacturers to develop cars fueled by alternative energies. Two hybrid cars took to the road in 2000 and in three or four years fuel-cell-powered cars will roll onto the world's highways.

While gasoline prices in the United States have not yet reached their highest point ($2.66/gallon in 1980), they have climbed steeply in the past two years. In 1999, prices rose by 30 percent, and from December 1999 to October 2000, prices rose an additional 20 percent, according to the U.S. Bureau of Labor Statistics. In Europe, prices are even higher, costing more than $4 in countries like England and the Netherlands. But cost is not the only problem with using gasoline as our primary fuel. It is also damaging to the environment, and since it is not a renewable resource, it will eventually run out. One possible alternative is the **AIR-POWERED CAR**.

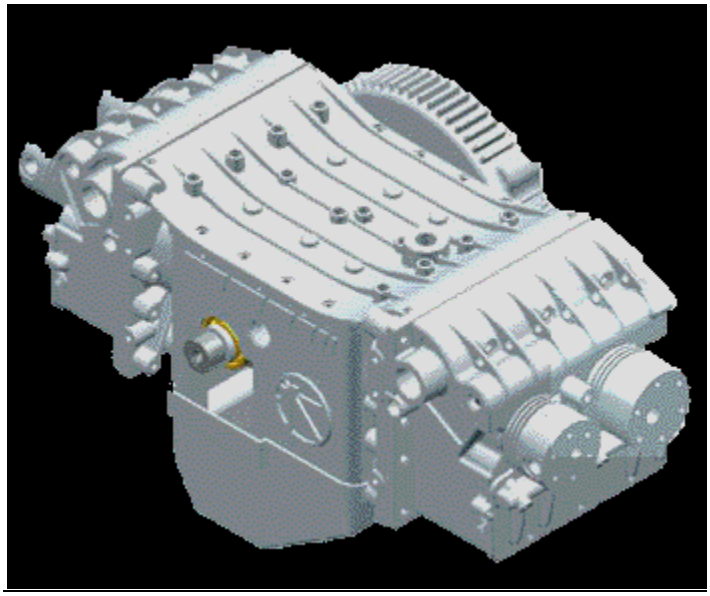
Air powered cars runs on compressed air instead of gasoline. This car is powered by a two cylinder compressed engine. This engine can run either on compressed air alone or act as an IC engine. Compressed air is stored in glass or fiber tanks at a pressure of 4351 psi.

Fig.1 An air powered car

Within the next two years, you could see the first air-powered vehicle motoring through your town. Most likely, it will be the evolution car that is being built by Zero Pollution Motors.

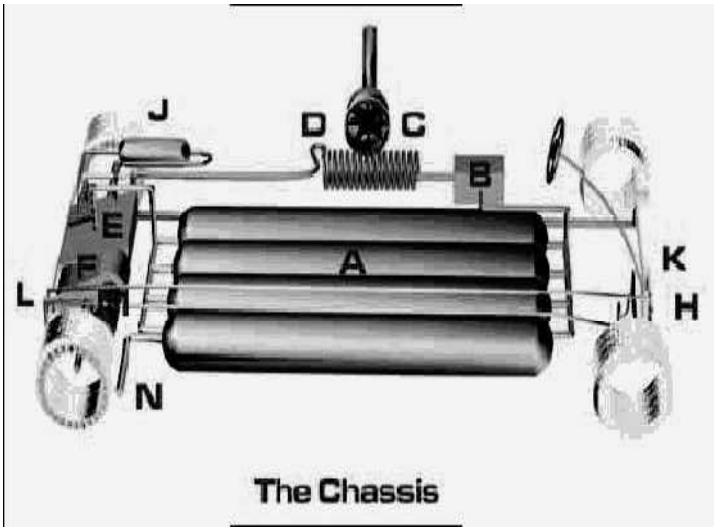
The cars have generated a lot of interest in recent years, and the Mexican government has already signed a deal to buy 40,000 evolutions to replace gasoline- and diesel-powered taxis in the heavily polluted Mexico City.

HOW DO AIR ENGINES WORK?



- 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 30 MPa (4500 psi). The tank is made of carbon fiber in order to reduce its weight.
- The engine has injection similar to normal engines, but uses special crankshafts and pistons, which remain at top dead centre 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. The atmospheric temperature is used to re-heat the engine and increase the road coverage.
- The air conditioning system makes use of the expelled cold air

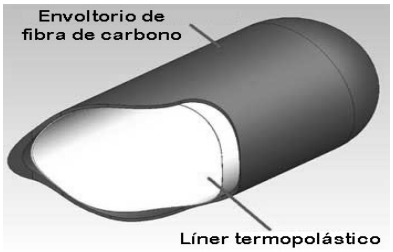
HOW COMPRESSED AIR CAN FUEL A CAR



In practical terms compressed air at 300 bars is stored in the carbon fiber tanks **A**. Air is released through the main line firstly to an alternator **B** where the first stage of decompression takes place. The now cold air passes through a heat exchanger **C** which adds thermal energy to the air and provides a convenient opportunity for air conditioning **D**.

The warmed compressed air now passes to the motor **E**. where a two more stages of decompression and re-heating take place. The motor drives the rear axle **G** through the transmission **F**. Control of engine speed is through a conventional accelerator pedal **H** controlling a valve within the motor.

COMPRESSED AIR TANKS



Compressed air tanks are one of the major parts of these cars. These tanks hold 90 cubic meters of air compressed to 300 bars. It is similar to the tanks used to carry the liquid gas used by buses for public transport. The tanks enjoy the same technology developed to contain natural gas. They are designed and officially approved to carry an explosive product: methane gas.

In the case of a major accident, where the tanks are ruptured, they would not explode since they are not metal. Instead they would crack, as they are made of carbon fiber. An elongated crack would appear in the tank, without exploding, and the air would simply escape, producing a loud but harmless noise. Of course, since this technology is licensed to transport an inflammable and explosive gas (Natural gas), it is perfectly capable inoffensive and non-flammable air.

It is fitting, therefore, that MDI has reached an agreement with the European leader in aerospace technology air bus industries for the manufacture of the compressed air storage tanks. With a remote supervision arrangement, Airbus Industries oversees the making of the storage tanks at each MDI factory. The coiled carbon fiber technology used in the construction of the tanks is complex and requires a substantial quality control process which the multinational company, home of the Airbus aircraft, will provide for our vehicles.

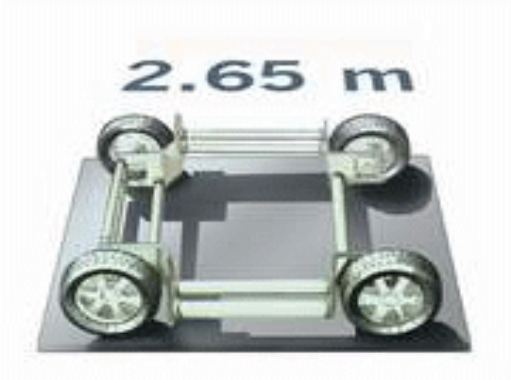
Brake power recovery

The MDI vehicles will be equipped with a range of modern systems. For example, one mechanism stops the engine when the car is stationary (at traffic lights, junctions etc). Another interesting feature is the pneumatic system which recovers about 13% of the power used.

THE BODY

- The MDI car body is built with fiber and injected foam, as are most of the cars on the market today.
- This technology has two main advantages: cost and weight.
- Nowadays the use of sheet steel for car bodies is only because of cost - it is cheaper to serially produce sheet steel bodies than fiber ones.
- However, fiber is safer (it doesn't cut like steel), is easier to repair (it is glued), doesn't rust etc.

THE CHASSIS



- Based on its experience in aeronautics, MDI has put together highly-resistant, yet light, chassis, aluminum rods glued together.
- Using rods enables us to build a more shock-resistant chassis than regular chassis.
- Additionally, the rods are glued in the same way as aircraft, allowing quick assembly and a more secure join than with welding. This system helps to reduce manufacture time.

THE AIR FILTER

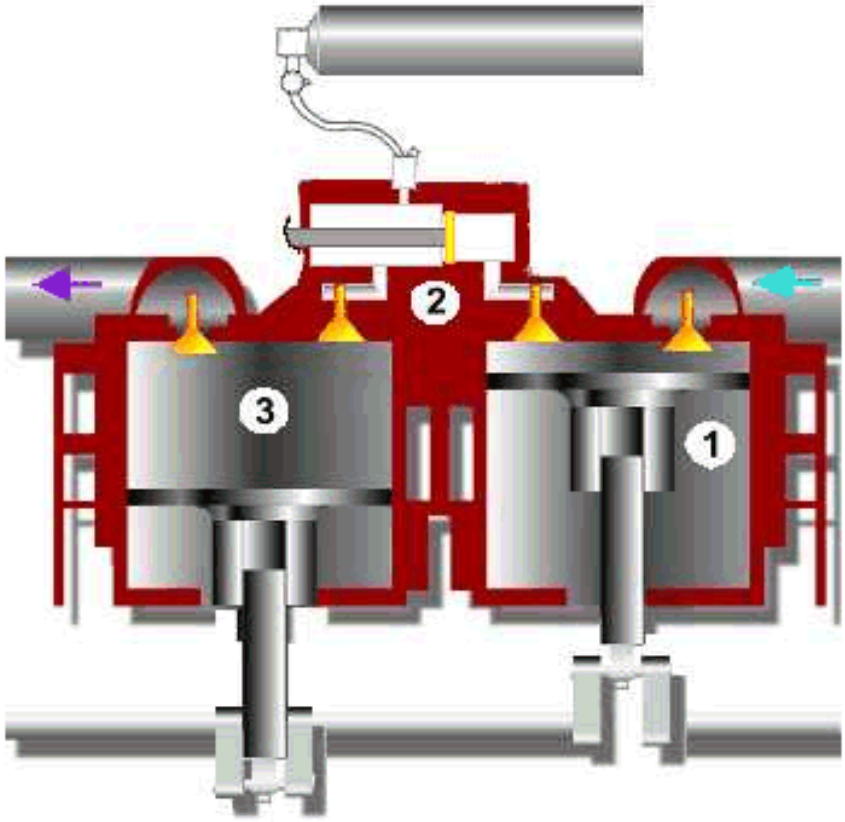
- The engine works with both air taken from the atmosphere and air pre-compressed in tanks. Air is compressed by the on-board compressor or at service stations equipped with a high-pressure compressor.
- Before compression, the air must be filtered to get rid of any impurities that could damage the engine. Carbon filters are used to eliminate dirt, dust, humidity and other particles which, unfortunately, are found in the air in our cities.
- This represents a true revolution in automobiles - it is the first time that a car has produced minus pollution, i.e. it eliminates' and reduces existing pollution rather than emitting dirt and harmful gases. The exhaust pipe on the cars produces clean air, which is cold on exit (between -15º and 0º) and is harmless to human life. With this system the air that comes out of the car is cleaner than the air that went in.

ELECTRICAL SYSTEM

- Guy Negre, inventor of the MDI Air Car, acquired the patent for an interesting invention for installing electrics in a vehicle.
- Using a radio transmission system, each electrical component receives signals with a microcontroller.
- Thus only one cable is needed for the whole car. So, instead of wiring each component (headlights, dashboard lights, lights inside the car, etc), one cable connects all electrical parts in the car.
- The most obvious advantages are the ease of installation and repair and the removal of the approximately 22 kg of wires no longer necessary.
- The entire system becomes an anti-theft alarm as soon as the key is removed from the car.

TECHNOLOGY DESCRIPTION

The following is the technology description of the actual functionality of the motor.



PROCESS DESCRIPTION

1. The first piston takes in ambient air and compresses it to approximately 300 psi and 200*f in the compression chamber during the first cycle of the engine

2. When the piston pause, a small amount of compressed air from the tanks is released into the expansion chamber to create a low pressured, low temperature volume of about 140psi.

3. Shortly before the valve to the exhaust cylinder is opened, a high-speed shutter connects the compression and expansion chambers. The sudden pressure and temperature difference between the low chambers creates pressure waves in the expansion chamber, thereby producing work in the exhaust chamber that drives the piston to power the engine.

The air tanks for storing the compressed air are localized underneath the vehicle. They are constructed of reinforced carbon fiber with a thermoplastic liner. Each tank can hold 3,180 ft^3 of air at a pressure of up to 4,300 psi. When connected to a special compressor station, the tanks can be recharged within 3-4 minutes. They can also be recharged using the on-board compressor 3-4 hours after connecting to a standard power outlet.

TECHNOLOGY OVERVIEW

These new vehicles incorporate various innovative and novel systems such as storing energy in the form of compressed air, using new materials such as fiberglass to build the car and vegetable oil for the motor lubrication.

Numerous innovations have been integrated in the engine design. As an example, there is a patented system of articulated condors that allow the piston to pause at top dead center. The following graph indicates this movement of the piston in relation to the driving shaft rotation.

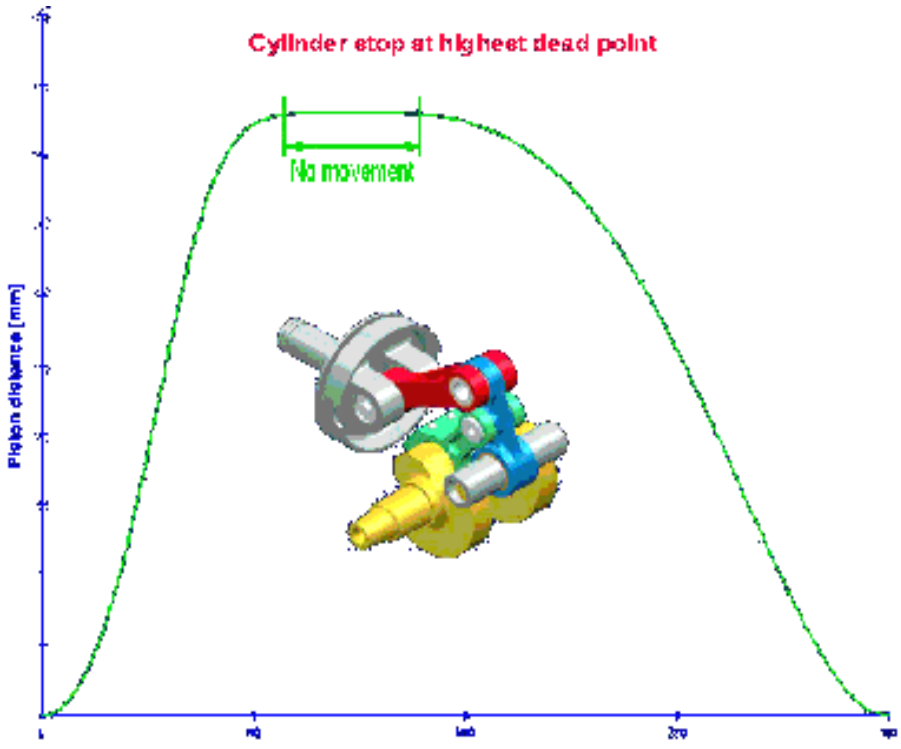


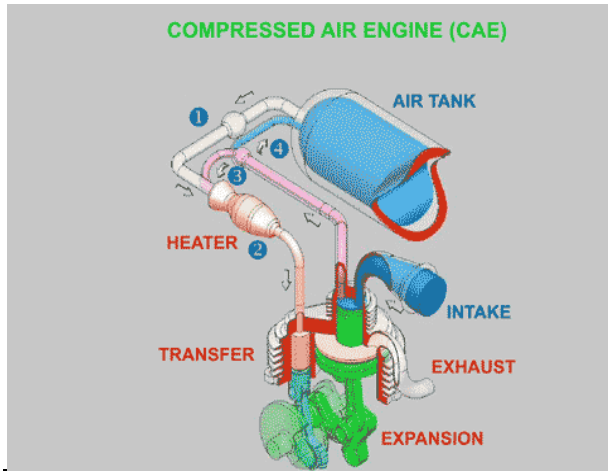
Fig 3 the graph showing the working

The car engine runs on compressed air and incorporates the three laws of thermodynamics.

1. The first law states that energy can neither be destroyed nor be wasted.
2. The second law describes the disorder within substances.
3. The third law defines that only in crystals at 0^{o} k, there is absolute disorder.

The car incorporates these laws of thermodynamics in the following way. First, the pressure that is created within on-board tanks during compression is in direct proportion to the energy that has been stored in it. This process is equivalent to the energy stored in a wire spring when it is compressed. Furthermore, thermal energy is dissipating from the system, thereby lowering the temperature of a compressed gas volume that expands. This process is equivalent to harnessing energy that has been stored.

WORKING



Air powered cars run on compressed air instead of gasoline. Since the car is working on air there is no pollution. A two cylinder, compressed air engine, powers the car. The engine can run either on compressed air alone or act as an internal combustion engine. Compressed air is stored in fiber or glass fiber tanks at a pressure of 4351 pounds per square inch. The air is fed through an air injector to the engine and flows into a small chamber, which expands the air. The air pushing down on the piston moves the crankshaft, which gives the vehicle power.

This car is also working on a hybrid version of their engine that can run on traditional fuel in combination with air. The change of energy source is controlled electronically. When the car is moving at speeds below 60kph,it runs on air. At higher speeds, it runs on a fuel such as gasoline diesel or natural gas.

Air tanks fixed to the underside of the vehicle can hold about 79 gallons (300 litres) of air. This compressed air can fuel the car upto 200km at a top speed of 96.5kph.When the tank nears empty it can be refilled at the nearest air pump. The car motors require a small amount of oil about 0.8 litres worth that have to change just every 50,000km.

GEAR BOX

Gear changes are automatic, powered by an electronic system device. A computer which controls the speed of the car is effectively continuously changing gears. The latest of many previous versions, this gearbox achieves the objective of seamless changes and minimal energy consumption.

DISTRIBUTION AND VALVES

To ensure smooth running and to optimize energy efficiency, engines use a simple electromagnetic distribution system which controls the flow of air into the engine. This system runs on very little energy and alters neither the valve phase nor its rise.

MOTO-ALTERNATOR

The moto-alternator connects the engine to the gearbox. It has many functions:

- It supports the vehicles motor to allow the tanks to be refilled.
- As an alternator it produces brake power

It starts the vehicle and provides extra power when necessary.

BASIC PRINCIPLES OF COMPRESSED AIR TECHNOLOGY ENGINE

It uses an innovative system to control the movement of the second-generation pistons and one single crankshaft. The pistons work in two stages and one intermediate stage of compression and expansion.

The engine has four stage pistons that are 8 compression and or expansion chambers. They have two functions:

1. To compress ambient air
2. To make successive expansions thereby approaching isothermal expansion.

THE DUAL ENERGY SYSTEM

The engine can be equipped with and run on dual engines. Fossil fuels and compressed air and incorporate a reheating mechanism between the storage tank and the engine. This mechanism allows the engine to run exclusively on fossil fuel, which permits compatible autonomy on the road. While the car is running on the fossil fuel, the compressor air tanks. The control system maintains a zero pollution emission in the city at speeds upto 60 km per hour.

CRYOGENIC HEAT ENGINE

Another version of an air-powered car is being developed by researchers at the University of Washington using the concept of a steam engine, except there is no combustion. The Washington researchers use liquid nitrogen as the propellant for their LN2000 prototype air car. The researchers decided to use nitrogen because of its abundance in the atmosphere -- nitrogen makes up about 78 percent of the Earth's atmosphere -- and the availability of liquid nitrogen. There are five components to the LN2000 engine:

- A 24-gallon stainless steel tank.
- A pump that moves the liquid nitrogen to the economizer.
- An economizer that heats the liquid nitrogen with leftover exhaust heat.
- A heat exchanger that boils the liquid nitrogen, creating a high pressure gas.
- An expander, which converts nitrogen's energy into usable power.

The liquid nitrogen, stored at -320 degrees Fahrenheit (-196 degrees Celsius), is vaporized by the heat exchanger. The heat exchanger is the heart of the LN2000's **cryogenic engine**, which gets its name from the extremely cold temperature at which the liquid nitrogen is stored. Air moving around the vehicle is used to heat the liquid nitrogen to a boil. Once the liquid nitrogen boils, it turns to gas in the same way that heated water forms steam in a steam engine

.

Nitrogen gas formed in the heat exchanger expands to about 700 times the volume of its liquid form. This highly pressurized gas is then fed to the expander, where the force

of the nitrogen gas is converted into mechanical power by pushing on the engine's pistons. The only exhaust is nitrogen, and since nitrogen is a major part of the atmosphere, the car gives off little pollution. However, the cars may not reduce pollution as much as you think. While no pollution exits the car, the pollution may be shifted to another location. As with the evolution car, the LN2000 requires electricity to compress the air. That use of electricity means there is some amount of pollution produced somewhere else. Some of the leftover heat in the engine's exhaust is cycled back through the engine to the economizer, which preheats the nitrogen before it enters the heat exchanger, increasing efficiency. Two fans at the rear of the vehicle draw in air through the heat exchanger to enhance the transfer of heat to the liquid nitrogen.

The Washington researchers have developed a crude prototype of their car, using a converted 1984 Grumman-Olson Kubvan mail truck. The truck has a radial five-cylinder that produces 15 horsepower with the liquid nitrogen fuel. It also features a five-speed manual transmission. Currently, the vehicle is able to go only about two miles (3.2 km) on a full tank of liquid nitrogen, and its top speed is only 22 mph (35.4 kph). However, because a liquid nitrogen-propelled car will be lighter, the researchers think that a 60-gallon (227 liters) tank will give the LN2000 a potential range of about 200 miles (321.8 km). With gas prices soaring, as they have over the past two years, it might not be long before many motorists turn to vehicles powered by alternative fuels. Although air-powered vehicles are still behind their gasoline counterparts when it comes to power and performance, they cost less to operate and are arguably more environmentally friendly, which makes them attractive as the future of highway transportation.

NEW MODELS, NEW APPLICATIONS

Though air powered cars are meant mainly for individual consumers in urban areas most of the early adopters will be businesses like taxi services and local transport.

Also products are manufactured for the retail and fleet customer market and are mainly used for local transportation. Each vehicle is equipped with the same type of engine power output of 25HP with a maximum speed of 68mph.

Following are some of the models developed by MDI :

(1) Family car:

- Description: A spacious car with seats which can face different directions. The vehicles design is based on needs of typical family
- Features: Airbag, air conditioning, 6 seats (Refer figure no. 6.1)

Family car

(2) Van:

- Description: Design for daily use in industrial urban or rural environments whose primary drivers would be tradesmen farmers and delivery drivers.
- Features : Airbag, air conditioning, 2 seats, 1.5 m3 (Refer figure no. 6.2)

Van

(3) Taxi:

- Description: Inspired by London taxi with numerous ergonomic and comfort advantages for the passenger as well as drivers.
- Features : Airbag, air conditioning, 6 seats (Figure no. 6.3)

Taxi

(4) Pick up car:

- Description: The Pleasure car designed for excursions outdoor sports or water sports. Also suitable for small business & tradesmen
- Features : Airbag, air conditioning, 6 seats (Figure no. 6.4)

Pick up car

- **Specifications which are common to above models:**

1) Dimension: 3.64m, 1.72m, 1.75m 2) Weight: 750 Kg

3) Maximum speed: 110 Kmph 4) Mileage: 200-300 Km

5) Maximum load: 500 Kg 6) Recharge time: 4hr (mains) & 3min (at stn)

5) Minicat:

- Description: The smallest and most innovative: three seats, minimal dimensions with the boot of a saloon: a great challenge for such a small car which runs on compressed air. The Minicat is the city car of the future.
- Features: Airbag, air conditioning, ABS, 3 seats, 1.5 m3. (Figure no. 6.5)

Minicat

❖ **Specifications which are uncommon those of above mentioned are:**

1) Dimensions: 2.65m, 1.62m, 1.64m 2) Maximum load: 270 Kg

REFILLING METHODS FOR AIR CARS

In the mains

Tanks are refilled by plugging the car into a mains socket to feed the motor-alternator which compresses the air with the motor-compressor.

Refilling time obviously depends on the source of electricity used. Here are our initial estimates:

For:

- 230V : 3 hrs 30mins - 4hrs
- 380V: 2hrs 30mins - 3hrs.
- 115V: currently being tested.

REFILLING AT A SERVICE-STATION

- As the energy is so easy to store, MDI anticipates the installation of air stations
- These stations can refill a car in 3 minutes.

HOW AIR CAR HELPS TO REDUCE POLLUTION

The most important pollutants in car exhaust include:

- Carbon monoxide (a poison). Carbon monoxide is formed because combustion is incomplete. Not enough oxygen is available fast enough to react completely with all of the carbon available.
- Nitrogen oxides - Because of the pressure and temperature inside a cylinder, nitrogen and oxygen in the air combine in various ways.
- Unburned hydrocarbons - not all of the hydrocarbons participate in the reaction because there is so little time available during the combustion phase.
- As about gasoline is the main source of pollution, if we use compressed air instead of gasoline then we can improve environment.
- As we know that nitrogen is the main constituent of environment, in case of air car we extract nitrogen from environment, liquefy it and used as fuel in car, then there will be nitrogen, only the exhaust gas which is not harmful to human being and environment. By using liquid nitrogen (compressed air) in car, we can reduce pollution up to 70-80%.

ADVANTAGES OF AIR CAR

- Refueling can be done at home using an air compressor or at service stations. The energy required for compressing air is produced at large centralized plants, making it less costly and more effective to manage carbon emissions than from individual vehicles.
- Compressed air engines reduce the cost of vehicle production by about 20%, because there is no need to build a cooling system, spark plugs, starter motor, or mufflers.
- The rate of self-discharge is very low opposed to batteries that deplete their charge slowly over time. Therefore, the vehicle may be left unused for longer periods of time than electric cars.
- Expansion of the compressed air lowers its temperature; this may be exploited for use as air conditioning.
- Compressed-air vehicles emit few pollutants, mostly dust from brake and tire wear.
- Lighter vehicles would result in less wear on roads.

DISADVANTAGES

- Any conversion of energy between forms results in loss. For conventional combustion motor cars, the energy is lost when oil is converted to usable fuel - including drilling, refinement, labor, storage, eventually transportation to the end-user. For compressed-air cars, energy is lost when electrical energy is converted to compressed air.
- Tanks get warm when filled rapidly. It would be difficult to cool the tanks efficiently while charging and thus it would either take a long time to fill the tanks, or they would have to take less than a full charge (since heat drives up the pressure).
- Refueling the compressed air container using a home or low-end conventional air compressor may take as long as 4 hours though the specialized equipment at service stations may fill the tanks in only 3 minutes.

COMPARISON WITH COMPETITION

Comparison chart	**2000 Nissan Altra EV**	**2001 Toyota Rav 4EV**	**2001 City C.A.T**
Fuel type	Electric	Electric	**Compressed Air**
MPG Avg.	123	104	**198**
Annual fuel cost	$331.00	$391.00	**$220.00**
Annual green house gas emissions	3.5	4.1	**1.2**
Range	129	126	**120**
Top speed	75 mph	78 mph	**60 mph**
Engine characteristics	62KW AC	50 KW DC	**Compressed air**
Recharge time	5 Hrs	6.75 hrs	**3 mins or 4 hrs**
Price (MSRP)	$50,999	$42,000	**$14,000**

A CAR THAT RUNS ON AIR, IN INDIA SOON

- **Tata Motors** has signed an agreement with **Motor Development International** of **France** to develop a car that runs on compressed air, thus making it very economical to run and be almost totally pollution free.
- Although there is no official word on when the car will be commercially manufactured for India, reports say that it will be sooner.
- The car could cost around **Rs 350,000** in **India** and would have a range of around **300 km** between refuels. The cost of a refill would be about **Rs 90.**

CONCLUSION

From all the disruption made one can say that by using air car there is reduction in air pollution. The emission benefits of introducing this zero emission technology are obvious. Also, the aim of project is to cut cost, create job locally. Also air car provides an answer to the shortage of fuel and high price of fuel.

With petrol and diesel prices going up and the price of oil subjects to fluctuation for motorist, this becomes headache; use of air motor is only the solution. All know that there will be shortage of gasoline (petrol, diesel), in future, engine that runs on compressed air is only the alternative for it.

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