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Air Car used for future transportation.

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Abstract: *The latest trend in the automotive industry is to develop light weight vehicles. Light utility vehicles are becoming very popular means of independent transportation for short distance. Today the heavy vehicles are run on basically petrol & diesel, which producing a large amount of harmful gases like CO2,SO2 etc. which act as the major source of global warming. The cost and pollution with petrol & diesel vehicles is very high manufacturers to develop vehicles is very high manufactures to develop vehicles fueled by alternative energies. One of the alternatives is the use of compressed air to generate power to run an automobile. Due to the unique and environmental friendly properties like compressed air for storing energy is a method that is not only efficient and clean, but also economical. So air is considered as one of the future fuels which will run the vehicles. This paper provides an overview of air power vehicles in brief and advantage and disadvantage of the compressed air technology. And assure the compressed air is the alternative fuel for the vehicles.*
Keywords: *Air powered vehicle, Alternative Source of Energy, Compressed air, light weight, Non-polluting.*

I. Introduction

Compressed air is the air kept under a pressure that is greater than atmospheric pressure. It serves the domestic and industrial purposes. Compared to batteries compressed air is favorable because of high energy density, low toxicity, fast filling at low cost and long service life. To meet the growing demand of public transportation, less pollution consciousness, people are in the search of ultimate clean car with zero emissions. It is hard to believe that compressed air is used to drive the vehicles. However that is true and “air car” as it popularly knows has caught the attention of research worldwide. MDI (Moteur Development International) is one company that holds the international patents.

Charles B Hodges will also be remembered as the true father of compressed air concept because he didn’t invent car which run on compressed air but also have considerable commercial success with it. After the hard work of twelve years of researches and developments French engineer by Profession Guy Negre, has also designed low consumption and low pollution engine for urban motering that runs on compressed air technology (CAT).In the year 2008, India largest car manufacturer company TATA was also announce that it would introduce world’s first commercial vehicle that will run on compressed air.

TATA Motors has signed the agreement with Moteur Development International (MDI) of France to develop the car that runs on compress air. It is named as “Airpod”.

Need of the air car.

Today the fossil fuels are widely used as the source of energy in various different fields. But in stock it is very limited and due to this tremendous use, fossil fuels are depleting at faster rate. So, as there will be shortage of fossil fuels it is very important to conserve these energies. One of the major field in which fossil fuels are used in internal combustion engine. An alternative of IC engine is “Air powered engine.” There are several technical benefits of using this engine, like as no combustion takes place inside the cylinder, working temperature of engine is very close to ambient temperature. This helps in reducing wear and tear of engine components. Also there is no possibility of knocking. This in turns result smooth working of engine. One more technical benefit is that there will not be any need for installing cooling system or complex fuel injection system. Air is compressed using compressor which in turns uses electricity, to run, which is cheaper and widely used. This add value of economic benefits. Also as discussed earlier as there is less wear and tear the maintained cost will be low, which will be economically beneficial.

One more interesting thing is that the exhaust temperature of this engine will be slightly less than the atmospheric temperature. This will help in cooling the environment and if this technology is widely used than it will help in controlling the global warming. These are some green bytes associated with this technology. Exhaust gas leaving the engine will be only air having the low temperature. So this will eliminate the problem of harmful emissions, in conventional engines. This gives us environmental benefits of using this engine. Also there will be no thermal radiation is produced, radar can’t detect these vehicle. So this will help our army too.

The component used in this technology is easily and readily available which helps in easily adapt this technology.

Airpod – The Mini Car.

Air pod is an alternative fuel vehicle which was developed by Motor development International, in collaboration with India's Tata Motor**s** and Paris based Air France. It works on the compressed air. The Airpod's engine works with the help of two linked cylinders. The manufacturing of these plants has been set up in Sardinia, Italy and it will be available in India by summer 2020.

Fig.1The Airpod.

1. Engine Construction

To convert a conventional IC engine into Air Powered one, few components are to be replaced. First of all repllace the **spark plug** with a **pulsed pressuree control valve** which can create required pressure. Now the pulsed air firing in this valve is controlled by controlling the supply of electrical signal to the plunger.for this we required an electronic timimng circuit which can control the flow of electrical supply to the plunger of this valve. This can be achieved by using PLC circuit. Now the speed of the engine is controlled by controlling this input signal.

Now **fuel tank** is to be replaced with **air vessel,** as it requires pressurised air input. And two things are taken care while desigining air vessel:

1) First its strength to withstand high internal pressure, which exist due to compressed air. For this outer body of it should be made of a material, having high strength,like carbon fibre.
2) Second its capacity to store air and its weight.

Now replace **cam** with a **modified cam.** this is to be done, so that both inlet and outlet valve open and close at the same time. Main advantage of doing this is to achieve better scavinging system.

2. Engine working.

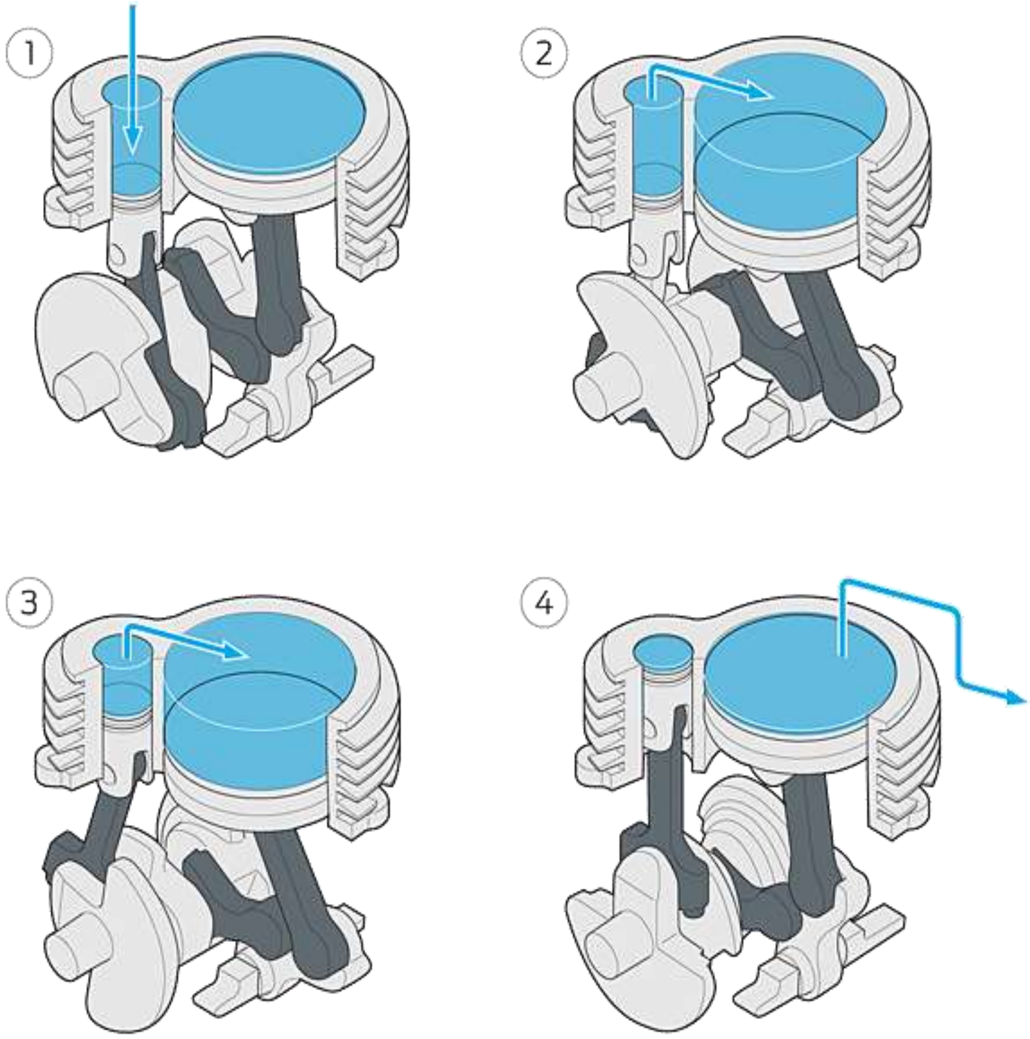

Fig:2 Engine working.

The air car uses two linked cylinders varying in diameter as shown in fig.
Stage 1:- At first the compressed air flows into the smaller cylinder at constant pressure 20 bar. At initial stage the piston is at TDC after the entry of compress air it travels to BDC.
Stage 2:- After the entry of compress air the inlet valve get close and compressed air starts moving towards the second cylinder which having larger diameter.
Stage 3:- The compress air gets expand, as the air flowing from smaller cylinder to larger cylinder at initial position piston is at BDC.
Stage 4:- At final stage both the .piston goes to TDC from BDC which pressurized the energy to do work and starts the displacement of the piston.

The sudden pressure and temperature difference between the compression and expansion chambers creates pressure waves in the expansion chamber, thereby producing work in the exhaust chamber that drives the piston to power the engine.

II. Future Scope.

A new celebrity with a lusciously curved body is turning heads on France's Côte d'Azur. No, not that kind of body. This one belongs to the AirPod, a 220-kilogram car with a sculpted composite shell and a back-to-the-future energy supply: 80 kg of air compressed to 350 times sea-level atmospheric pressure, roughly 350 bars. The engine of this tiny three-seater converts that air into mechanical energy, just as a pneumatic jackhammer does to blast apart concrete.

The AirPod won't exactly tear up the road, though: The current version tops out at 45 kilometers per hour (28 miles per hour). And yet there's definitely something addictive in its joystick steering and featherlike suspension. With expanding air pumping its pistons, the exhaust is literally a superchilled breeze. Grab the stick, step on the accelerator, and any guilt you may be harboring from driving an ordinary smog-producing carbon spewer falls away. Wouldn't life be great if everybody got around town in these clean little machines?

This rosy vision of future urban transport is the product of Motor Development International (MDI), a company registered in Luxembourg whose tech-chic atelier lies in Carros, a palmy industrial suburb of Nice, France. Guy and Cyril Nègre [above], the father-and-son team behind MDI, predict their technology will find mass appeal in the emerging city-car category, an automotive segment of small, efficient cars well suited for crowded European and Asian cities and not meant for long-haul trips.

Most carmakers think that battery power is the future for this category, but the Nègres beg to differ. The AirPod, they promise, can tank up in just 2 or 3 minutes using no more than 1.5 euros' worth of France's nuclear-heavy, low-CO_2 electricity to provide some 220 km (137 miles) of city driving. It has no batteries to wear out and replace—and so will cause no worries about its power source ever erupting in flames. And the AirPod will cost a mere €6000, the Nègres say (less than US $9000).

Storing energy in a long-lasting pressure tank made of carbon fiber rather than in batteries, posit the Nègres, makes the AirPod cheaper, more practical, and cleaner than a comparable electric vehicle (EV), once you take manufacturing and disposal into account. It's a bold assertion, and one that remains to be proved, which won't be possible until these cute little cars actually hit the road. And when that will happen is anyone's guess.

Though the AirPod is supposed to go on sale in a couple of months, the Nègres have been struggling to commercialize pneumatic vehicles for more than a decade, incurring a reputation for unfulfilled promises. No independent testing laboratory has assessed the AirPod's performance. And while deals over the past three years with India's Tata Motors and Paris-based Air France have bolstered MDI's credibility, it remains tough to find an automotive engineer who buys into the company's vision. The fundamental problem, they say, is the laws of thermodynamics, which make compressed air an impractical power source for vehicles. The AirPod's 200-liter tank is roughly the size of a common 55-gallon drum, but it carries the energy of little more than a liter of gasoline. And its air-powered engine makes inefficient use of it. MDI counters that the ultralight, low-speed AirPod needs very little to get around. Yet skeptics abound.

"I don't know how they can deliver what they claim," says Denis Clodic, a mechanical engineer and thermodynamics expert at France's prestigious École des Mines de Paris. "It's not a solution for the sort of vehicle we expect today," says Pascal Higelin, professor and director of the Mechanics and Energy Laboratory at the University of Orléans, in France.

And yet Higelin and Clodic count themselves among the growing number of propulsion authorities who say that vehicles combining compressed air and fuel combustion could overcome the primary drawbacks of both, providing an economical alternative to today's gasoline-electric hybrids. The greatest impediment to realizing such pneumatic hybrids, according to these two experts, is that the failure of MDI's air car could cast doubt on the whole idea.

So if the AirPod does whoosh onto French streets within months as promised, there will be quite a bit more riding on the quirky little runabout than MDI's fate. It could finally prove the viability of compressed-air transport—or doom it for the foreseeable future.

Fig:3 Tata airpod phase1

Pod Squad: Workers at Motor Development International are busy readying AirPod prototypes at the company's fabrication facility near Nice, France. Viewed from underneath its curvaceous shell [top], the AirPod reveals an aluminum frame, which encloses a composite tank holding air compressed to 350 bars [bottom left]. A steering wheel would be impractical, because the driver's door is located at the front of the vehicle. The solution is a joystick placed next to the driver's right hand [bottom right].

Pneumatic propulsion was high tech in the late 19th century, when compressed-air engines and equipment became commonplace in Europe and North America. Networks of compressed-air piping vied with then-nascent electrical grids to power machine tools, railway hoists, and switchyards, among other heavy gear. Meanwhile, the first jackhammers were revolutionizing mining and tunnel construction. Propulsion uses included pneumatic torpedoes, locomotives, and streetcars. Addison C. Rand, founder of Rand Drill Co., lauded pneumatic streetcars in his 1894 guide *The Uses of Compressed Air,* noting that they had neither the "distressing, jerky motion" of cable cars nor the capital costs of electric railways.

Combustion-powered automobiles and buses ultimately prevailed, as we all know. But a vestige of air propulsion survives in today's Formula 1 racing pits, where blasts of air crank the big engines to life, and it is from this world that Guy Nègre emerged. The self-taught mechanic studied philosophy and worked in French carmaker Renault's advertising department in the 1960s before setting up his first engine-design shop. There Nègre developed an unusual valveless engine for light aircraft, a design that was never commercialized. Nègre's second shop extended the valveless concept to powerful Formula 1 race-car engines. In 1990, a racing club installed Nègre's engine for the storied Le Mans 24-hour endurance race. But the engine refused to start, let alone endure for 24 hours. This firm, like the one before it, slid into obscurity.

The "thermo" of thermodynamics—the unstoppable flow of heat—makes pneumatic propulsion a considerable engineering challenge. The molecules of oxygen, nitrogen, and other gases in air give off heat when compressed, representing a loss of energy up front. Do the compression quickly, before the heat can dissipate into the surroundings, and the losses rise further. And the trouble only mounts when all this compressed gas is later released from the tank. The same molecules cool when they expand, hence the chill on your hand when you empty a spray can. Expand the gas slowly, and the pneumatic equipment can stay warm by reabsorbing energy from the atmosphere. But power-hungry vehicles must expand the gas quickly, so they are subject to extreme cooling, which hampers the engine or, at worst, freezes its air-feed lines.

By the late 1990s, MDI was talking up a first-generation engine it claimed could handle these complications. Its design would expand air in three stages, maximizing the opportunity to absorb heat, just as efficient multistage gas compressors maximize heat dissipation. The firm used this design to raise money, selling franchises for the local production and sale of its vehicles and raising expectations. For example, the sale of the first such franchise—rights to the Mexican market—sparked press reports that smog-choked Mexico City would soon mandate MDI's "zero-pollution" technology for its 87 000-strong taxi fleet.

Fig:4 Outer design

From 2003 to 2007, MDI was dead in the water. Debts mounted while the staff contracted, from a high of 50 employees down to 12. What saved the firm was a simpler engine conceived in 2005 and now being readied for the AirPod. In January 2007, Tata Motors purchased the Indian rights to MDI's technology for an undisclosed sum, widely reported as $30 million, repairing both the firm's finances and its tarnished reputation. "It was clearly the patents, the designs for the new-generation [motor] that convinced Tata to link up with us," says Guy.

MDI's second-generation design drops two of the three stages of expansion and is thus simpler and more robust, the Nègres argue. The key to efficiency, they say, is its pair of specialized, interconnected cylinders [see diagram below]. Air released from the tank is allowed to expand to 20 bars before being fed at constant pressure to the first cylinder, which MDI calls the active chamber. When the active chamber's piston reaches full extension, a valve attached to the air inlet closes. Only at this point is the air allowed to expand, pushing its way into the second, larger cylinder. Because the pressure in the active chamber is constant when the air valve is open, the valve and air-feed lines don't overchill. Only as the larger cylinder's piston moves does the air expand enough to reduce the temperature past the freezing point—well past it: During the exhaust stroke, the frigid air is expelled to the muffler at –40 to –70 C. "Once the valve is closed, you can cool [the air] a lot, because if there is ice it will go to the exhaust," says Cyril.

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