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Development and Scope of Air Powered Engine

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Abstract

The depleting non-renewable sources of energy are a major crisis the planet is facing. Search of alternatives is more urgent than ever. The abundance and the cost effectiveness are two major motivators of using air as fuel. In compressed air powered vehicles, the process of combustion is eliminated due to the absence of hydrocarbons therefore there is no waste emission, which basically eliminates the problem of pollution which our cities are facing.

In this project we have attempted to develop a simple feasible design for using air as fuel to power our vehicles. The four stroke SI engine is replaced by two stroke engine which operates using compressed air.

Keywords: Air powered vehicles, Compressed air, Environment friendly

1. Introduction

This project aims to develop a basic model of the compressed air driven vehicle and search for improvements in the already existing technology. The idea is to use the large amount of energy stored in the air cylinder and hence use it to drive the piston, which in turn drives the transmission system. Compressed air technology is not new to the industries; pneumatic pistons have been used for a very long time. The use of this technology did not transcend to cars due to major disadvantages and easy availability fossil fuels but now with depleting resources compressed air technology is one of the most environmental friendly and cost-efficient ways of driving a vehicle. The development of compressed air technology started in 2002, where MDI developed the first air engine to fit in a vehicle. Indian motor giant TATA have announced to develop a compressed air vehicle which is hoped to be launched in the subsequent year. The other automobile giants are yet to put forward their compressed air vehicle projects mostly because they wait for some major improvements in this sector before they invest money in it.

2. Parts of Compressed Air Engine

a. Rotary air pump
b. Solenoid actuated 5/2 DCV
c. Double acting cylinder
d. Rack and pinion arrangement
e. Transmission system
f. Wheels
g. Battery

Rotary air pump: Air pump is a device that uses electric energy to give compressed air as output. They collect the air from the atmosphere and raise its pressure by decreasing the volume. It supplies the high-pressure air to the piston and the pressure vessel is designed to withstand the pressure of the air inside. By reducing the amount of pressure drop and the rate of decay the flow of air is controlled. A flow control valve is provided to for refill control. It is basically

an air producing machine. Air pumps are basically used to raise the pressure of certain volume of air. Air purifiers are necessary for the air pumps because contaminated air can damage the parts of the engine. Coolants are necessary for maintaining the temperature of the air cause high temperature air can reduce the efficiency of the engine.

Battery: The battery is the primary source of energy. The battery has three important parts-anode, cathode and electrolyte. The negative electrode is the anode and the positive electrode is cathode. The electrolyte rests between them. Chemical reactions occur in the electrolyte when a circuit is connected. Negatively charged anions and positively charged cations are created during the chemical reaction. Anions give their electrons to the cations through the circuit. This way oxidation and reduction takes place. The flow of electrons from one terminal to the other produces electricity. When the electrons stop flowing the battery stops working.
This electrochemical reaction changes chemical energy in electrical energy. The battery provides power to the rotary pump and the solenoid valve to open or close the valves of DCVs.

Solenoid actuated 5/2 DCV: A solenoid actuated 5/2 direction control valve (DCV) is used here. A direction control valve is a device used to control the flow of the air towards the cylinder from the air pump and also the flow of air from cylinder to the atmosphere through the exhaust of the DCV. Here, 5/2 DCV is used and it is having 5 spools and 3 at the one side and 2 at the opposite side. Out of 3 spools the one which is at the middle is used for supply and the other 2 which are at the extreme sides are used for exhaust but only one of the 2 would be working at a time. The other two spools are to be connected to the cylinder. Moreover, it is solenoid actuated DCV. A solenoid actuated direction control valve is an electromechanically operated valve. In this solenoid is acting as the actuator for the DCV. It will give the signal to the DCV to supply the air to the cylinder and take the air form cylinder to the exhaust and it also controls that at which end of the cylinder air would be supplied. So in a sense we can say that it is acting as switch. Solenoid valve gets actuated through the system of normally open and normally closed concept. When the normally closed switch will become an open switch then the solenoid will actuate the DCV and the flow will start and similarly when the normally open switch will be normally closed switch then the air flow will start. But as soon as they return to their original position the flow will stop. They allow air flow into different paths from their source. They have a spool inside a cylinder which is mechanically or electrically controlled. The air from the pump is passed to the 5/2 DCV, this is then transmitted to the double acting cylinder. The solenoid valve changes the direction, thereby now air is transmitted from the other side of the double acting cylinder, therefore the piston is shifted to the other direction.

Double acting cylinder: A double acting cylinder is a cylinder in which the air acts alternately on both sides of the piston i.e. extension and retraction both use the force of air. The compressed air is supplied to the double acting cylinder through solenoid

actuated direction control valve by air pump. The cylinder is placed in contact to the rack and pinion. Therefore, as the cylinder extends or retracts then the pinion rolls over the rack. And hence this motion is transmitted to the gears.

Rack and pinion arrangement: This is a very important arrangement for whole of the system. The piston is connected to the rack. The extension and the retraction of piston from the double acting cylinder allows the rack to reciprocate and due to which the pinion rolls over the rack. This motion of the pinion is transmitted to the wheels through transmission system.

Transmission system: The role of transmission system is to transmit the power and the motion from one component to other in the system. Here the transmission system is consisted of 2 spur gears and a chain drive, although spur gears can be replaced by helical gears depending on the requirement, also the number of spur gears used can be increased if we require more it will depend of the gear ratio which we require, but the minimum number of the gears to be used must not be less than 2. The rack and pinion arrangement is connected to the transmission system through a shaft and the gears and the chain drive are on the shafts. In total 2 shafts, 3 sprockets and 2 spur gears have been used. Transmission system has to be arranged in such a way that the extension and retraction of the piston doesn't affect the direction of the vehicle moving. The rack will reciprocate by the extension and retraction of the piston and this rack will help in rotating of the pinion, which, further will, transmit the motion and the power to the transmission system and transmission system will then drive the vehicle forward.

3. Working

The battery provides power to the rotary air pump when the positive and negative terminals of the battery and pump are connected together. The high-pressure air from the air pump is supplied to the solenoid actuated 5/2 Direction Control Valve (DCV). Then the DCV controls the flow by their spool movement which in turn pushes the piston in the double acting cylinder which leads to extension. As the piston is connected to the rack and pinion arrangement, the pinion rolls over the rack thus providing rotation to the shaft. The shaft is then connected to the transmission system in order to provide the motion and power to the gears and the chain drive. This motion is then transmitted to the wheels of the vehicle through the transmission system. After complete extension of the piston, the solenoid gets actuated and then the DCV changes its direction of air flow to other end of the cylinder which results in retraction of the piston and the complete process is repeated again. This way the vehicle moves forward without any break due to extension and retraction of the piston.

4. THE LAYOUT OF OUR COMPRESSED AIR POWERED ENGINE DESIGN

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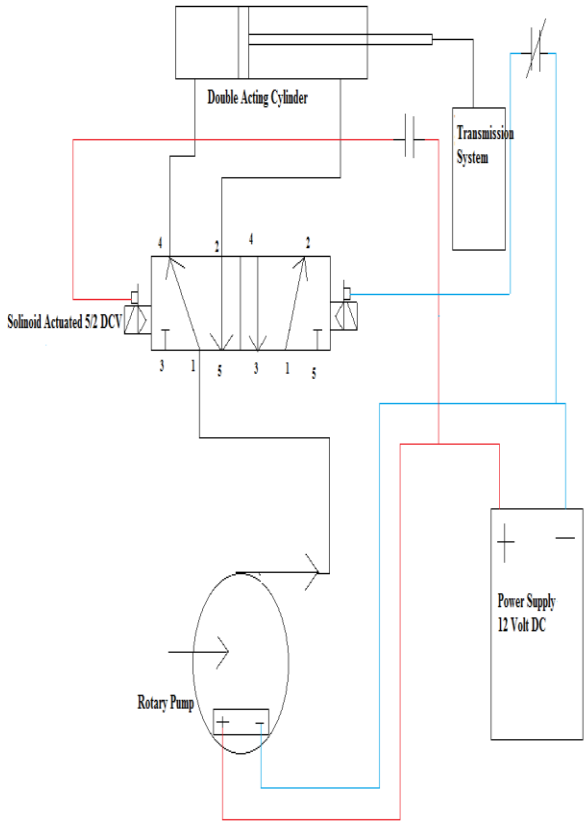

5. Advantages of compressed air vehicle

Air compressed vehicle have following advantages over other vehicles: -

a. Air is free and non-polluting.
b. Compressed air vehicles are much lighter which means there will less wear on the road.
c. It has lower manufacturing and maintenance cost than even electric cars.
d. Fuel transportation will be eliminated as the power can be drawn from the atmosphere.
e. The design is simple and robust.
f. Compressed air vehicles stack up heavily when compared to electric vehicles, the battery degradation problem is sorted, this significant cost benefits.
g. The refilling of the air tanks will be a lot quicker than charging of batteries.
h. The pump has a longer life than lithium ion batteries.

6. Drawbacks of compressed air vehicle

Compressed air vehicles are likely to be less robust than convectional fuel vehicles. Compressed air vehicles are unable to maintain the same energy density throughout the drive, as the air is drawn off the power densities keeps reducing unlike the gasoline vehicles which give the same power density from the first litre to the last litre. Due to adiabatic cooling at expansion of air it is difficult for the car to operate at higher temperatures.

Conclusion

Air powered vehicles have some issues to be solved before they can be launched into manufacturing, in the age of polluting and expensive vehicles, if proper research and development is devoted to this particular area, air powered vehicles will surely see the light of day. Some of the giants of automobile industry have already started the development process of air powered vehicle.

7. Acknowledgement

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9. Our Vision of Innovation

Using a compressed air engine in a automobile is a very challenging largely due to its space consumption. Previous attempts to develop such an engine have not produced much success. Our team made efforts to find a place where the engine can be used effectively. Our team visions the use of compressed air engine to be fairly simple in locomotives.

The engine block of the train is replaced by a series of model reviewed above. The pressure created by a certain number of models will be enough to drive the locomotive forward as we already know that the locomotives consist of pneumatic breaking system. So basically, we get the understanding that the air pressure has the capacity to drive the train forward. Pistons of appropriate size and pressure can be employed locomotives can work on free energy.

8. References

1) Haisheng Chen et al. "Air fuelled zero emission road transportation: A comparative study.
2) http://www.mcc-berlin.net/~creutzig/Papson CreutzigSchipper2010.pdf
3) Sciencedirect.com
4) Gizmag.com/tatamotors-air-car-mdi/22447/
5) Auto.howstuffworks.com/fuelefficiency/vehicles/air-car1.html
6) Hugh Currin "Air Engine Design for Machining Class"
7) BR Singh, O Singh, study of Compressed air Storage System as clean and potential energy for 21st century. Global journal of research in Engineering Mechanical and mechanics Engineering.
8) Pneumatic motors (http://en.wikipedia. org/wiki/ Pneumatic_motor)