



DEVELOPMENT AND EXPERIMENTAL ANALYSIS OF TWO STROKE DOUBLE CYLINDER ENGINE OPERATED BY COMPRESSED AIR

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Abstract

This paper describes the working of a two-stroke two-cylinder air Engine which can run on pneumatic power as by compressed air. Since it is an old technique which can attracted many scientist as well as Engineer's for many years. This paper describes on the same with some new modification which is main objective of this research paper. Since engine is operated by Compressed air which contribute to reduce the air pollution and tend to zero pollution level of atmosphere and making a great an environment. While developing it some parameters as like temperature, density, input power, emission control has been mastered for development of safety. Since the Gasoline is a thing of past so the main advantage of compressed air engine (CAE) is no hydrocarbon fuel is required i.e. No combustion process is occurred there.

Index Terms: Pneumatic motor, Storage tank, Compressed air engine, Emission output, Eco friendly.

I. INTRODUCTION

The motor which is operated by air was first applied to the field of transportation in the mid-19th century. A Two centuries before Dennis Pepin came up with the idea of using compressed air. The first successful application of the pneumatic motor in transportation was the Mikulski system which is used in locomotive. Mikulski engines was first used by Tramway de Nantes in December 13, 1879 to power their fleet of locomotives. It is located in Nantes, France.

Robert Hardy had introduced a new method of heating which increases the range of the engine which helped to increase in distance in 1892.

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

Compared to batteries, compressed air is favorable because of a high energy density, low toxicity, fast filling at low cost and long service life. These issues make it technically challenging to design air engines for all kind of compressed air driven vehicles. To meet the growing demand of public transportation, sustainable with environmental consciousness, people are in the search for the ultimate clean car with zero-emissions. It is hard to believe that compressed air can be used to drive vehicles. However, that is true and "air car" as it popularly knows has caught the attention of research worldwide. MDI (Motor Development International) is one company that holds the international patents for compressed air car. This review study reveals aim is to run the four strokes bike with help of compressed air, it will try to achieve a 50 km/h speed and range of refilling compressed air is after running of 70-80 km.

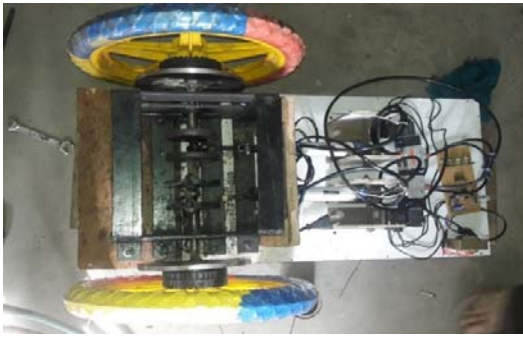


Figure 1. Two stroke two-cylinder air engine

If we compress normal air into a cylinder the air would hold some energy within it. This energy can be utilized for useful purposes. When this compressed air expands, the energy is released to do work. So, this energy in compressed air can also be utilized to displace a piston. This is the basic working principle of the Air Driven Engine. It uses the expansion of compressed air to drive the pistons of the engine. So, an Air Driven Engine is basically a pneumatic actuator that creates useful work by expanding compressed air. This work provided by the air is utilized to supply power to the crankshaft of the engine.

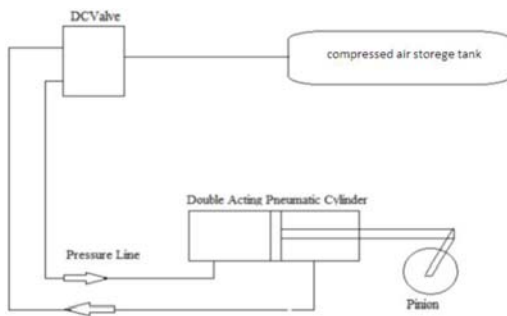


Figure 2. Layout of compressed air engine

In this air engine, we replace valve and valve mechanism with solenoid valves because the efficiency of solenoid valves is higher than the mechanical valves. And they required less maintenance than the mechanical valves

II. COMPRESSED AIR ENGINE TECHNOLOGY

The basic object with Compressed Air Technology is to implement in vehicle for consumption of minimum amount of energy and remain the output work same. In today's world, everyone wants to afford a vehicle and its energy to power it. Engine air technology makes it

happen from many aspects. It is very less in term of mass as compared with other sources of energy for transportation of man or material. It also improves urban life style through sustainability & Non-polluting vehicle. Its impact on the environment is also considered low. It remains with intelligence, lighter, style and comfort.

III. WORKING

A compressed air engine is a type of engine which does mechanical work by expanding compressed air. Pneumatic engine generally convert compressed air energy to mechanical work either into linear motion or rotatory motion. Layout of compressed air engine is shown in figure 2.

Once compressed air is transferred into the on-board storage tank, it is slowly released to power the car's pistons. The motor then converts the air power into mechanical power. That power is then transferred to the wheels and becomes the source of power for the car. The engine that is installed in a compressed air car uses compressed air which is stored in the car's tank at pressure as high as 4500 psi. The technology used by air car engines is totally different from the technology that is used in conventional fuel cars. 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 30MPa (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 crank shafts and pistons, which remain at top dead center 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. Due to the absence of combustion and the fact there is no pollution the oil change is only necessary.

Initially the air is such from the surrounding and compressor add some energy in the form of pressure into the air. This high pressure air is than fill into the tank. The air is store into the tank to make continues supply of air. This high pressure air supply through the pipes into the solenoid valves. Solenoid valve's make proper

timings as camshaft in IC engine and supplying air into the pneumatic cylinder.

Two multi acting pneumatic cylinder's connecting in parallel and for each single cylinder a solenoid valve is required so as here 2 multi acting pneumatic cylinder connecting in parallel are uses so we need 4 solenoid valves. And each valve supplying air into the pneumatic cylinder one by one according to the time. The timing is maintained by the electronic circuit made up for this purpose.

Initially piston 1 in cylinder 1 is at TDC point and respectively piston 2 in cylinder 2 is at BDC position. The valve connecting on the side of TDC position is supplying air and other hand is

work's the exhaust system. The air is entered into the cylinder TDC side and start expending and releasing their pressure energy. This pressure energy move the piston and piston reciprocate from TDC to BDC. When piston reach to the BDC then valve 1 is became as exhaust system and valve 2 is starting supplying air into the cylinder. And again, air start releasing their pressure energy and apply on the piston 1 other side and piston reciprocate from BDC to TDC. The air in opposite side of the piston is released through exhaust into the surrounding. This process continues and again and again.

And the working of second cylinder and valve 3 and 4 is similar to first cylinder as discussed above.

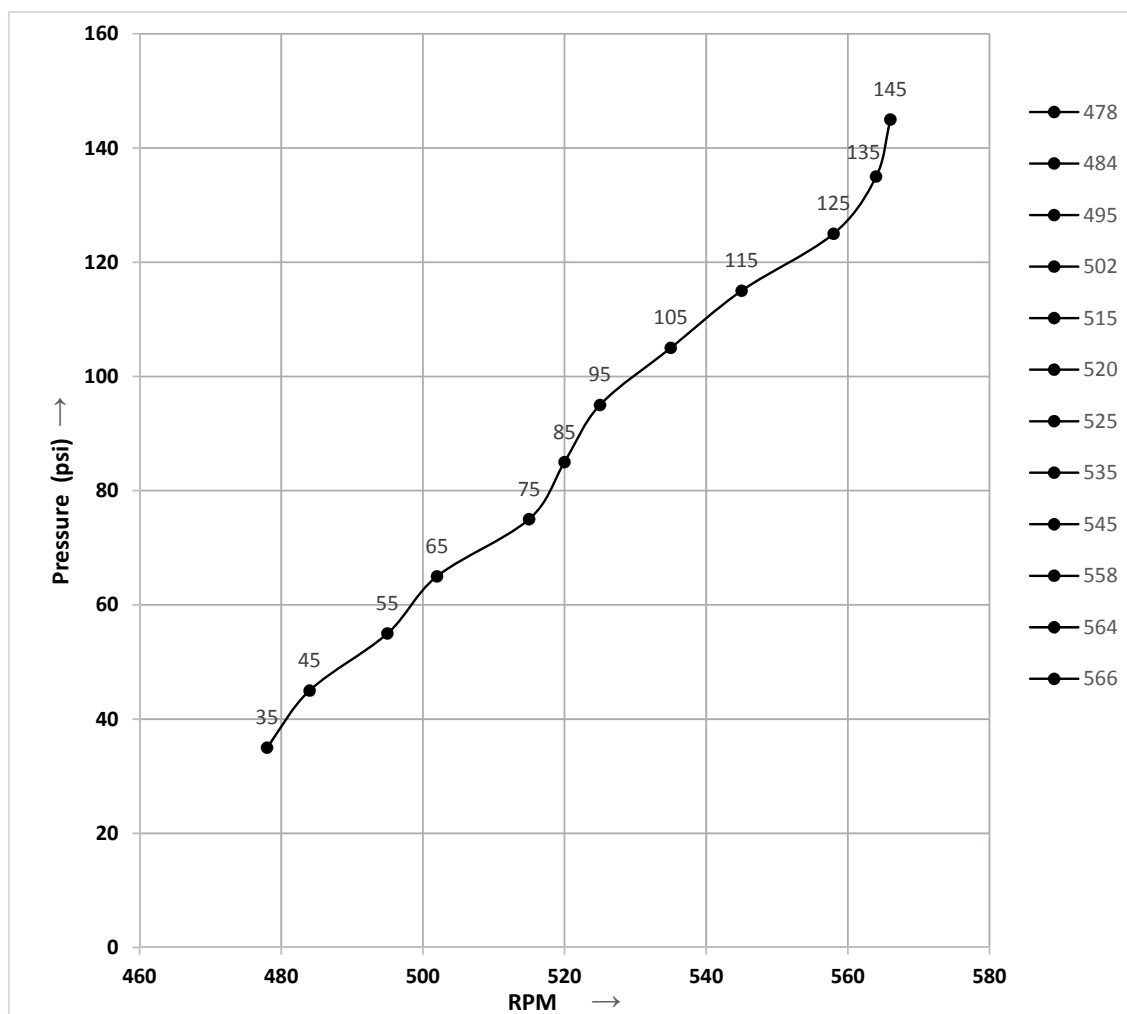


Figure 3. RPM vs compressed air pressure

The motion of piston is reciprocating so this reciprocating motion of piston is converted into the rotary motion with help of crankshaft.

IV. RESULT

In this chart we can see that as we increase the pressure the rpm of the engine also increase that means the speed of the air engine is directly depend upon the pressure energy of the compressed air added by the compressor. The project is ready to use and its functioning is very well.

The minimum pressure for working of this project is 35 psi below this pressure this air driven engine becomes stop and rpm increases with pressure at 140 psi after 140 psi speed remains same.

S.N	PRESSURE(psi)	RPM
1	35	478
2	45	484
3	55	495
4	65	502
5	75	515
6	85	520
7	95	525
8	105	535
9	115	545
10	125	558
11	135	564
12	145	566

Table 1: Engine RPM at different pressures of compressed air engine

V. ADVANTAGES OF COMPRESSED AIR ENGINE

Compressed air is a safe and reliable power source that is widely used throughout industry. In fact, approximately 70% of all companies use compressed air for some aspect of their operations. Compressed air vehicle engine offers higher efficiency than most electric vehicle. Its only emission are cold air. The feature and the multiple example of use are as follow

- **Construction trade** – drill and demolition hammers, conveyor system for stone factory.
- **Steel mills** – carbon reduction in steel production.
- **Chemical industry** – raw material for oxidation processes, process control.
- **Energy industry** – inserting and withdrawing reactor rods, ventilation system for boiler
- **Environmental technology** – forming oil barriers in the water, enriching water with oxygen slide actuation in sewage plants.
- **Compressed** –air vehicles are comparable in many way to electric vehicles, but
- Use compressed air to the store the energy instead of batteries. Their potential advantages over other vehicles include.
- **Compressed** –air technology reduces the cost of vehicle production by 20% because no need to build a cooling system, fuel tank, ignition system or silencers.
- The engine can be massively reduced in size.
- Low manufacture and maintenance costs as well as easy maintenance.
- **Compressed** –air tanks can be disposed of or recycled with less pollution than batteries.
- Lighter vehicles cause less damage to roads, resulting in lower maintenance cost.

VI. DISADVANTAGES OF COMPRESSED AIR ENGINE

As it the CAE has many advantages but at other hand it has also many drawbacks. An air Compressed air is an extremely versatile source of power, if someone know what they want before they buy it. Compressed air can offer a lot of benefits, but at the same time they should take care of it while choosing one to make sure they get exactly what they need. Some points which don't like about CAE are:

- **Noise** – air compressors are very loud. This is a major downside if you live in an apartment or duplex and don't have the privacy to run loud equipment.
- **Size**– the bigger the air compressor tank is, the more power it provides. However, if someone need more power and they don't have the space to store a large air compressor tank, this can be a downside.
- **Maintenance**– repair work should be done if the compressor malfunctions.

VII. POSSIBLE IMPROVEMENTS IN COMPRESSED AIR ENGINE

Imagine an engine which is powered by compressed air up to 94% efficiency and zero % polluting emissions. A unique rotary piston concept which virtually eliminates vibration, internal wear and friction. Wind, solar and hydro power which can be used to compressed the air. As the thermodynamic process is used to operate vehicle of compressed air engine because air cools down when expanding and heats up during compression. Since it is not practical, using theoretically ideal process because losses occur and improvements may also involve to reduce these. India's largest manufacturing company TATA also working on compressed air technology and their first upcoming Mini CAT cars which is operated by compressed air.

In future it is also possible to restore the exhausted air after expending in the cylinder during power stroke for farther use without compression.

VIII. CONCLUSION

It's important to remember that while vehicles running on only compressed air might seem like a distant dream, but they still have public interest due to their environmental friendly nature. After ten years of research and development, the compressed air vehicle will be introduced worldwide. If further improvement is carried out with stress analysis, thermodynamic analysis, minimize compressed energy loss and other losses then efficiency of CAE may be further increases.

The Air Driven Engine provides an effective method for power production and transmission. Even though its applications are limited currently, further research could provide wider applications.

In future, it is also possible to restore the exhausted air after expending in the cylinder during power stroke for farther use without compression.

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