Analysis of a Compressed Air Engine

Vinod M, Beemkumar N

Faculty of Engineering and Technology, Jain (Deemed-to-be University), Ramnagar District, Karnataka - 562112

Email Id- m.vinod@jainuniversity.ac.in, n.beemkumar@jainuniversity.ac.in

ABSTRACT: ***The air-conditioned automobile, CAV, is a pressurized air feedstock that is deposited inside a container as well as recharged by something like a motor. The air is created to broaden inside the generator via an air reservoir throughout this highly educated. The air machine is a descendant of the steam locomotive. For two centuries, Constant Angular Velocity is always present under different ways. Compressed air as an energy source, well known as a non-polluting resource, has been drawn to scientists and engineers for centuries as a solution to a lack of fossil fuel and environmental legislation. Many researchers, developers and manufacturers are making every effort to use compressed air car technology. This paper analyzes appropriate changes, advantages and reprimands of its air motor. A petrol motor is assessed with even a single cylindrical engine, reconfigured and evaluated again and in different operating conditions to collaborate with pressurized gas. The finding presented in this article suggests which pressurized air new technologies has become one of the latest tech as well as wants ever more consideration, since it is eco sustainable to get to and operates on energy that would be easily accessible. While compressed air motors seem bad to compete with gasoline motors in terms of range and strength and are highly restricted in their use because of narrow drive ranges, then strength for weighing ratios are improvement as motor weighing is reduced. When adequate study and development are carried out, the CAE would be an ideal mode of transport.***

KEYWORDS: Camshaft, Compressed Air, Emission Control, Global Warming, Exhaust System.

INTRODUCTION

Gas prices are increasing and growing, as well as this would be challenging to us in coping through such expense climbs, which have an effect on our everyday lives due to the rise in travel costs. The CAE exists as no emission since coming out air is air-conditioned. No fuel remains burned, so zero heat is generated, hence it helps to reduce carbon emissions to the environment, reduce air pollution as well as upsurge engine's lifespan which improve the engine's lifetime along decent presentation; the whole vehicle's reduced maintenance's costs as well as zero contaminating discharges from the environment. Some new technology such as the new four-stroke cam design is being developed, and new compressed air vehicle technology is also being provided. The benefit and drawback of compressed air vehicles is definite and this engine does not generate an experimental study such as load measurements, power output by engines and the pollution factor. The thermodynamic set up of temperature difference, mechanically as well as aerodynamically loosening, rechargeable production etc. will decrease the average productivity to 41 percent or less.

With the increase in pressure, the speed of the engine has almost linearly increased. The maximum attained speed was 33.5 km/h with a high 8 bar pressure [1]. The engine is changed from some kind of 4-strap to a 2 stroke system by adjusting the cam gear mechanism. About 20°C, merely 15.6 W of lifespan was absorbed by 21-liter gas tanks around 8 bars. The motor can be operated at top speeds of 38.20 kilometers per hr. and down to 5 kilometers mostly with compressed gas motor. Lightweight vehicles are still used by the automotive industry because they are performing better. Subject to air pollution, heavy vehicles emit toxic gasses, such as SO_2, CO_2. Similar to IC engines with lower maintenance costs, the CAE system is cheaper. The author states that pneumatic technology can be checked, built with noble air turbines of a vane form, and its performance is very high in comparison to IC engines, ranging from 71 to 45%, and this technology is commonly used to solve serious global warming problems. Various effects on different air engine parameters such as compressor tank size, numeric pulls, cylinders amount, compressor air pressure, electrical appliance usage, port and exhaust amount of pneumatic weapons pneumatic firearms [2]. Maximum speed about 28.9 km/h was 2.5 km at low 5 bars and maximum speed of 9 Bars was 36.5 km/h at a maximum travel distance of 1.7 km. at low pressures of 5 bars. Air is drawn from the intake valve vertically over the piston head in compressed air technology and changed shafts are utilized for altering valve timings. This engine reached an unprecedented speed of 61 km/h. The motor is very effective as it does not contribute to combustion and no harmful gasses are therefore released. The analysis shows that the

vehicle has an operating weight of 61 km per hour and 18.5 kg which has slight effects over the engine performance [3].

To achieve the CAE's performance, prototype to the CAE systems should be developed [3]. Experimental studies obtain the output torque, power, and performance. The findings show that the CAE system performs well with a low speed, the CAE's performance mainly is affected via rotational supply as well as speed pressures, also suppling pressure of about 2.0 MPa is 1.92 kiloWatt, and the maximum capacity of the CAE is 54.55 N5-0, with a maxi performance of 25%. A sample CAE structure is developed to achieve efficiency as of CAE. The results, strength, and performance in the experimental studies are obtained. It has been found that the low speed CAE system performs very well and that efficiency is primarily affected through rotational speed and supplied pressures, and supply pressures of 2 MPa are 1.92 kiloWatt, and CAE max. o/p being 54.5 N5-0, with a maximum output of 2%. Horizontal, single cylinder low velocity system adapted for operating on compressed air. The results show that the indicated capacity increases when the charge is raised, the speed decreases, the injection pressure must be maintained continuously and, when the pressure of the injection must be raised, the indicated average effective pressure rises; thus, the signaled power is increased when the charges are applied.

Although the load was high, the power produced was proportionate to the load applied. Once the load has been applied, the air pressure must be raised to keep it stable. The pressure is increased as shown injection. The speed was kept constant at 610 rpm in the current case. The brake power was slightly lower because the output speed was lower. With the rise in processing power, mechanical efficiency increases [4]. It was very low at lower performance. Different changes were made to the air compression based vehicles and to the engines utilized in such projects such as cam-shaped changes, new gearboxes for camshaft and other findings. Engine Speed (MPS) vs. Inlet pressure increases and motor speed also increases linearly with the motor torques vs. pressure from the inlet, with the torque increasing linearly over shafts and motor torques vs. engine's regular speed, with the speed of engine increasing linearly. Motor torques rises in linear as the engine speed rises [2]. A theoretical study of the 100 cubic centimeters internally combusted engines operating over air compressor at pressure of about 5 and 9-bars, using simplified thermodynamically models, and experimental tests. The maximum o/p of 0.950 kilowatt achieved around 9 bar besides 1.320 rounds per minute, the maximum torque of 9.99 Nm at the same pressure was achieved but the outlet pressure rose at 466 rpm, from 1.5-2.25 bar at 500-2000 rounds per minute, thermal rate within the chambers decreases to 17 °C from room temperature. Flowing rate which restricts its energy efficiency and leads to lubrication problems and dressing between the piston and the cylinder, is small at approximately 1050 L/min in use air engines. Performance in the compressed-air process has also been shown to be approximately 13 percent at a 5 bar air pressure supply, although innovative speeds are lower than 1500 rpm. When air pressure of 9 bar and air supply of 2000 rounds per minute along with the pressure through exhausted air pressure roughly 2.250 bar. Pressure energy (compressed air) and petrol have been shown to increase the Brakes Thermal Efficacy (BTE) about 34 percent as well as the total proficiency to 68.0%, reducing fossil fuels, reducing cylindrical temperature and decreasing exhaust gas residuals that boost volumetrically performance. It was specified, the engine's weights are significantly abridged leading to a high weight / power ratio, reduced power loss due to movement inertia, no engine start-up power needed and no emissions due to cold or clean exhaust air.

Besides, the CAE illustrated now keeping with above review. A sustainable energy vehicle air-driven engine is presented in this article. A physical CAE model is developed to provide a framework for optimizing CAE. A CAE prototype is designed to achieve the efficiency of the CAE. And experiments test the physical model of CAE. In recent decencies, significant attention has been paid to the severe environmental problems of greenhouse emissions, ozone depletion and fog and haze. The burning of fosil fuels was seen as the main cause of some significant environmental problems. The question of energy consumption was illustrated with regard to environmental conservation. Some scholars believe that the oil crisis will occur, which can end the low-cost oil era as well as developing ferocious rivalry to newer energies vehicles. To date, newer energies' vehicles, like electric vehicle, electric mixture and pneumatic electronic vehicle, have come to light gradually [4].

The typical non-pollution items involve the electric vehicles while toxic elements will emit toxic fumes in the batteries. The rising modes of future transportation power systems. A petrol and air compressor dual-energy generator as well as the related work is underway. A compressed air vehicle has been developed by Engine Design International (MDI). The air tanks on rear side on Evolution can contain 300 liters of air compressing to supply kinetic energy for vehicles. At a velocity at 96 kilometers / hr., vehicle can fly 200 km. And the virtue of the Evolution is the cycle of charge that takes only three minutes through an air charge station with high pressure [5].

COMPRESSED AIR ENGINE PART OVERVIEW

Numerous mechanic components cast off in the engines as follows:

a) Crank's shafts
b) Linking rods
c) Bearing
d) Valve
e) Piston

Description of the mechanical components:

1. *Crank shaft:*

The crankshaft is a part of an engine that converts reciprocal motion in a rotary motion, often loosely abbreviated to a crank. Crank's shafts comprises shaft's portions revolving inside major bearings, pins attached to ends of the connection rod, cables or cheeks linking the crank pins and shaft parts [6].

Fig. 1: Crank Shaft

Crank shafts may be divided into two types:

1.1.Crank's shafts with an overhung cranks else side cranks.
1.2.The crank's shafts along the center cranks.

Two lateral sides on either end or two or more aligned sleeves may be rendered with a crest shaft. The 2nd portion cranks or 2 center crank by way of multiple drawing shafts is called crankshaft with a single side crank (shown in Fig. 1). For small and large horizontal engines, the overhang crank shaft is used. Its main advantage is that only two covers, either in one or two crankshafts [8]. Their shafts are available. Dislocation causing maximum shafts letdowns in crankshafts which risks smaller inside shaft for 2 coats instead 3 instead even more covers. Total covers are therefore a highly significant designed element. Crank shafts are designed to meet the specifications of rigidity and vibration to be so denser as well as tougher is required for a strengths perspective. Therefore, a substance with very high strength cannot substantially reduce the weight. The material to be chosen depends on the production process, i.e. casting, welding or built. Building up crank's shaft is mostly applied aircraft engine with a very critical light weight [7].

2. *Linking rods:*

The rod seems to be a component including its machine that would be used to move and push its cylinder pin to something like the edge of the shaft (shown in Fig. 2). (shown in Fig. 2). The second objective of the valve will be to transfer the lubricant again from start to the finish of the pin to the column pin and then to sprinkle the piston coronation air-refrigerated. The valve plate base style is the face again for narrow end, long shank, and big end window that is normally broken to take the shells. [8]. Primarily via lower casting the internally burned motor connection rod are made. The rod of the connection should really be given proper power and speed. The materials of the rod connector vary from minor and medium carbon steels to alloy stones. Carbon steel is used for car engines with a gross tensile strength of 552 to 672 MPa..

Fig. 2: Connecting Rod

3. *Bearing*:

There's a very basic idea behind a bearing: objects roll faster than they slip. The rollers on the car are just like large hinges. You would have been much harder to pull your vehicle back if you did have anything like skis that wheels. This is because the tension between them creates a force that slows them down as things slip. However, the friction would be greatly decreased if the two surfaces turn over. Locks reduce friction by smooth ball bearings[9], wheel as well as a smoother inner and outer surface of metal with balls rotating on them. The load is "bear," certain balls or roller bearings allow the system to rotate seamlessly as can be seen in Fig. 3.

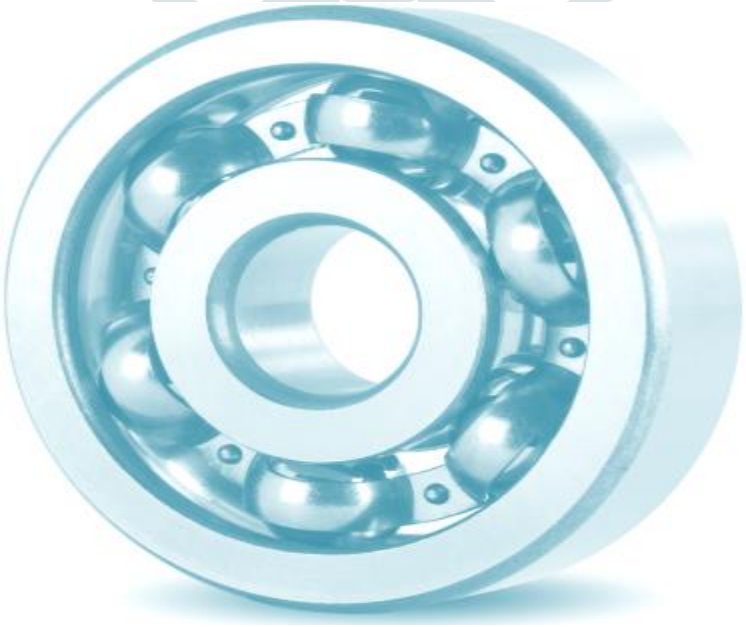

Fig. 3: Bearing

4. Piston:

A cylinder is indeed a revolving disc enclosed in a gas-proof piston shell. The drive operates in the tube when a vapor extends in the vessel but also contracts. A turbine is used to translate thermal energy into mechanical power. This makes it the main component of heat motors for pistons. As shown in Fig. 4. Pistons transmit the expanding gas's force generated in the cylinder to the crankshaft, supplying a spinning impulse to the fluid [10].

Fig. 4: Piston

CONCLUSION

The modern engine in use is subject to modifications such as the adjustment of the camshaft and the timing valve. The old cam is replaced with a profile that opens and closes in a compressed air engine for a single cycle of piston movement entry and exit valve as required. Compressed air is unusual energy that abounds in nature before the sun is in the universe. Despite global warming, green technology requires time. A thorough analysis and examination of compressed air motors were performed and the following details were summarized: safe, stable, easy and effective compressed air. If air which is compressed being utilized as it's a inflammable, not a pollutant device, there are no toxic exhaust gases or other materials harmful. At 2500 rpm, the average power output is 1732 Watts with stressed air of 9 bars and average efficiency of 21 percent. The maximum power is improved and compressed air pressure. Several suggestions for enhancing the efficiency of CAE can be made, such as, using lightweight materials to construct the engine. The engine should be tested at varying intake pressure and temperature, a thermodynamic model of CAE should be developed, so that engine output can be adjusted according to its operating conditions.

REFERENCES

[1] B. Kantharaj, S. Garvey, and A. Pimm, "Thermodynamic analysis of a hybrid energy storage system based on compressed air and liquid air," *Sustainable Energy Technologies and Assessments*, 2015, doi: 10.1016/j.seta.2014.11.002.

[2] C. Y. Huang, C. K. Hu, C. J. Yu, and C. K. Sung, "Experimental investigation on the performance of a compressed-air driven piston engine," *Energies*, 2013, doi: 10.3390/en6031731.

[3] T. K. Sharma, G. A. P. Rao, and K. M. Murthy, "Homogeneous charge compression ignition (HCCI) engines: A review," *Archives of Computational Methods in Engineering*. 2016, doi: 10.1007/s11831-015-9153-0.

[4] E. Yao, H. Wang, L. Wang, G. Xi, and F. Maréchal, "Multi-objective optimization and exergoeconomic analysis of a combined cooling, heating and power based compressed air energy storage system," *Energy Conversion and Management*, 2017, doi: 10.1016/j.enconman.2017.01.071.

[5] D. Marvania and S. Subudhi, "A comprehensive review on compressed air powered engine," *Renewable and Sustainable Energy Reviews*. 2017, doi: 10.1016/j.rser.2016.12.016.

[6] Q. Yu and M. Cai, "Experimental Analysis of a Compressed Air Engine," *Journal of Flow Control, Measurement & Visualization*, 2015, doi: 10.4236/jfcmv.2015.34014.

[7] T. Yusaf, P. Baker, I. Hamawand, and M. M. Noor, "Effect of compressed natural gas mixing on the engine performance and emissions," *International Journal of Automotive and Mechanical Engineering*, 2013, doi: 10.15282/ijame.8.2013.29.0117.

[8] A. Papson, F. Creutzig, and L. Schipper, "Compressed Air Vehicles," *Transportation Research Record: Journal of the Transportation Research Board*, 2010, doi: 10.3141/2191-09.

[9] H. Rios, E. González, C. Rodriguez, H. R. Siller, and M. Contero, "A mobile solution to enhance training and execution of troubleshooting techniques of the engine air bleed system on boeing 737," 2013, doi: 10.1016/j.procs.2013.11.020.

[10] P. Verma, M. P. Sharma, and G. Dwivedi, "Potential use of eucalyptus biodiesel in compressed ignition engine," *Egyptian Journal of Petroleum*, 2016, doi: 10.1016/j.ejpe.2015.03.008.