STUDY AND FABRICATION OF COMPRESSED AIR ENGINE

Ruby Sharma , Naveen Singla

ABSTRACT:

As we all know the world is hard pressed with the prices and crises of energy and fuel, and is also then compounded by pollution of all kinds, so we need an early solution to overcome this problem of fuel crises (which also further leads to fuel price hikes) and also the major problem of pollution , so any technologies that bring out the solutions to this problem is considered as a bounty. One of the solution to this huge problem in such new technologies, is the development of a new engine called as compressed air engine which does not require any of the fuels like Diesel, Petrol, CNG, LPG, Hydrogen etc. this works using only compressed air so it completely overcomes the problem of Pollution so also its exhaust is clean and cool measured practically as low as 5ºC. A proto type, a horizontal, single cylinder low speed engine was modified to run on compressed air. Since this engine runs only on high pressure compressed air, the exhaust of which is undoubtedly only air, making it a zero pollution engine. No heat is generated because there is no combustion of fuel, hence this engine needs no cooling system and it result in reduced cost, weight, volume and vibration. Also it's very cost effective and the operational cost is ten times less than that of petrol or diesel. Experimental analysis were carried out on this modfied engine to find out its performance characteristics like brake power, mechanical efficiency, overall efficiency, air to Air ratio, volumetric efficiency, cost analysis etc. Though the efficiencies were low as the frictional forces were high for the proto designed engine, however this concept can be carried out on a professionally designed engine to improve its performance and stability.

INTRODUCTION:

World's most of the known energy demand fulfilling Fossil fuels such as petroleum, diesel, natural gas and coal are being depleted rapidly and need an another option to save them from completely finished. Also, combustion products after using them plays an major role in causing global problems, such as the green houese effect, ozone layer deplition, acid rains and pollution which are great danger for environment and eventually for the total life on planet and also has the strength to completely destroy the planet at later of its stage so it Is necessary to control it on its Inital stage.. Due to these factors Leding automobile manufactures are forced to develop cars fueled by alternatives energies. Hybrid cars, Fuel cell powered cars, Hydrogen fueled cars will be soon in the market as a result of it. One of the possible alternative is the air powered car.

One of the prime option since atmospheric pollution can be permanently eradicated is Air, which is abundantly available and is free from pollution, can be compressed to higher pressure at a very low cost. Yes, It sounds a little of impossible thing to make an engine work with compressed air, but it is Possible. Where as All the attempts so far made are to eliminate the pollution but complete eradication is still not possible however some of the successful practices are done to reduce the consumption and pollution of fuels. One of the sucessful and proper pneumatic application for long proven is Compressed Air. Some of the various such Pneumatic equipment's that are in use are Air motors, pneumatic actuators. Some of vehicle also used Compressed air to Boost the initial torque. For example to enhance power and improve the efficiencies of the automotive engine Turbo charging has become one of the popular and common techniques. There are at two ongoing projects (in France, by MDI and in S. Korea) that are developing a new type of car that will run only on compressed air. Similar attempt are also being made but to modify the existing engine and to test on compressed air.

COMPRESSED AIR

Compressed air is a gas, or a combination of gases, that has been put under greater pressure than the air in the general environment. Numerous and diverse, including jack hammers, tire pumps, air rifles, and aerosol cheese are some of the current applications using compressed air. In this case Compressed air can also be defined as the fuel having the potential as a clean, inexpensive, and infinitely renewable energy source. Its use is currently being explored and can be an alternative to fossil fuels.

Behavior of compressed air:

When compressed gas is used as a utility it a non-combustible, non-polluting utility and also compressed is clean, safe, simple and efficient and also there are no dangerous exhaust fumes or other harmful by products. When air at atmospheric pressure is mechanically compressed by a compressor, the transformation of air at 1 bar (atmospheric pressure) into air at higher pressure (up to 414 bars) is determined by the laws of thermodynamics. They state that an increase in pressure equals a rise in heat and compressing air creates a proportional increase in heat. Also Boyle's law explains that if a volume of a gas (air) halves during compression, then the pressure is doubled. And as also stated by Charles' law that the volume of a gas changes in direct proportion to the temperature. So according to these laws they explain that pressure, volume and temperature are proportional; that change one variable will also effect the other variables and one or two of the others will also change, according to this equation Compressed air is normally used in pressure ranges from 1 bar to 414 bar or in PSI 14 to 6004 PSI at various flow rates from as little as 0.1 m or in cubic feet per minute is 3.5 CFM and up.

How compressed air is fuel in a car?

At first glance, the idea of running a car on air seems almost difficult to be true and good to think but it is very easy. Why wasting time thinking about other sources of fossil fuels and other ways to reduce the pollution If we can use air as fuel? Air surronds us almost every where.Also it never runs out is non polluting. And the best think about air of all, is it is free and will also end up the diseases caused by the pollution. Unfortunately, air alone can't be used as a fuel. At First, energy has to be stored by squeezing the air tightly using a mechanical air compressor. As we know that once the compressed air is released, it expands. Then this expanding air can be used for further use such as, to drive the pistons that power an engine.

The first air cars developed by the French company, Motor Development International (MDI) will almost certainly use the Compressed Air Engine (CAE). Air cars using this engine will have tanks that will probably hold about 3,200 cubic feet (90.6 kiloliters) of compressed air. The vehicle's accelerator operates a valve on its tank which when pressed will allow air to be released into a pipe and then into the engine, where the pressure of the air's expansion will push against the pistons and turn the crankshaft. This will produce enough power to achieve the speeds of about 35 miles (56 kilometers) per hour. When the air car surpasses that speed, a motor will kick in to operate the in-car air compressor so it can compress more air on the fly and provide extra power to the engine. The air is also heated as it hits the engine, increasing its volume to allow the car to move faster.

CONSTRUCTION OF COMPRESSED AIR ENGINE

The construction of compressed air engine is very easy and simple and can be constructed at low cost as it mainly consist of pneumatic cylinder, pneumatic solenoid valve and working, light chaser circuit, compressor, bearing & it’s working, and crank shaft.

Pneumatic cylinder engine:

The mechanical devices such as Pneumatic cylinders (sometimes known as **air cylinders**) uses the power of compressed gas to produce a force in a reciprocating linear motion. Like hydraulic cylinders, something forces a piston to move in the desired direction. The piston is a disc or cylinder, and the piston rod transfers the force it develops to the object to be moved. Engineers sometimes prefer to use pneumatics because they are quieter, cleaner, and do not require large amounts of space for fluid storage. Because the operating fluid is a gas, leakage from a pneumatic

cylinder will not drip out and contaminate the surroundings, making pneumatics more desirable where cleanliness is a requirement.

Pneumatic solenoid valve and working:

A valve which is electromechanically operated is known as solenoid valve. The valve is controlled by an electric current through a solenoid: in the case of a two-port valve the flow is switched on or off; in the case of a three-port valve, the outflow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold. Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design.

Light chaser circuit and its components:

This light chaser circuit (music-operated lighting effect generator) comprises five sets of 60W bulbs that are arranged in zigzag fashion. The bulb sets glow one after another depending on the intensity of the audio signal. No electrical connection is to be made between the music system and the lighting effect generator circuit. You just need to place the gadget near the speakers of the music system.

Compressor:

A **Gas Compressor** is a mechanical device whose work is to increase the pressure of a gas by reducing its volume. An air compressor is specific type of gas compressor. Compressors are similar to pumps: both the compressor and pump increase the pressure on a fluid and both can transport the fluid through a pipe. As gases are compressible, the compressor also reduces the volume of a gas. Liquids are relatively incompressible; while some can be compressed, to pressurize and transport liquids is the main action of a pump. Compressed air Piston range operates between 0.75 kW to 420 kW or in horse power is 1hp to 563hp producing working pressure at 1.5 bar to 414 bar or in PSI is 21 to 6004PSI. Compressed air Vane compressors operate between 1.1 kW to 75 kW or in horse power 1.5 to 100hp , producing working pressures of 7 to 8 and 10 bar or in PSI is 101 to145 PSI.

Crankshaft:

For conversion between reciprocating motion and rotational motion the **crankshaft**, sometimes also abbreviated to *crank*, is mainly responsible for motion. In a reciprocating engine, it translates reciprocating linear piston motion into rotational motion, whereas in a reciprocating compressor, it converts the rotational motion into reciprocating motion. In order to complete conversion between these two motions, the crankshaft consists of "crank throws" or "crank pins", additional bearing surfaces whose axis is offset from that of the crank, to which the "big ends" of the connecting rods from each cylinder attach.

To reduce the pulsation characteristic of the four-stroke cycle It is typically connected to a flywheel , and sometimes a torsional or vibrational damper at the opposite end, to reduce the torsional vibrations often caused along the length of the crankshaft by the cylinders farthest from the output end acting on the torsional elasticity of the metal.

ADVANTAGES OF USING COMPRESSED AIR VEHICLES:

Compressed-air vehicles are comparable in many ways to electric vehicles, but use compressed air to store the energy instead of batteries which adds an extra advantage to compressed air vehicle than electric vehicle. Their potential advantages over other vehicles include:

- Much like electrical vehicles, air powered vehicles would ultimately be powered through the electrical grid. Which makes it easier to focus on reducing pollution from one source, as opposed to the millions of vehicles on the road?
- Transportation of the fuel would not be required due to drawing power off the electrical grid. This presents significant cost benefits. Pollution created during fuel transportation would be eliminated.
- Compressed-air technology reduces the cost of vehicle production by about 20%, because there is no need to build acooling system, fuel tank, Ignition Systems or silencers.
- Engine can be massively reduced in size.
- Engine runs on cold or warm air, so can be made of lower strength light weight material such as aluminum, plastic, low friction Teflon or a combination.
- Low manufacture and maintenance costs as well as easy maintenance.
- Compressed-air tanks can be disposed of or recycled with less pollution than batteries.
- Compressed-air vehicles are unconstrained by the degradation problems associated with current battery systems.
- Air tank may be refilled more often and in less time than batteries can be recharged, with re-filling rates comparable to liquid fuels.

- Lighter vehicles cause less damage to roads, resulting in lower maintenance cost.
- Price of filling air powered vehicles is significantly cheaper than petrol, diesel or biofuel. If electricity is cheap, then compressing air will also be relatively cheap.

DESCRIPTION OF AN AIR ENGINE:

A compressed-air vehicle is powered by an air engine, using compressed air, which is stored in a tank. Instead of mixing fuel with air and burning it in the engine to drive pistons with hot expanding gases (causing pollution and depletion of resources), compressed air vehicles (CAV) use the expansion of compressed air to drive their pistons. One manufacturer claims to have designed an engine that is 90 percent efficient. Compressed air propulsion may also be incorporated in hybrid systems, e.g., battery electric propulsion and fuel tanks to recharge the batteries. This kind of system is called hybrid-pneumatic electric propulsion. Additionally, regenerative braking can also be used in conjunction with this system.

WORKING CYCLE AND ITS ENGINE:

The diesel engine works on constant volume cycle instead of constant pressure cycle because of the reason that dwell provided by the special connecting rod assembly. During this constant volume, air is injected by the injection system into the engine cylinder. This engine works like a diesel engine. At the end of compression stroke, a very high pressure air at room temperature is injected into the cylinder. Injection of air by electro-mechanical injection system is governed by the cam dwell during which the piston also dwells. As the in cylinder hot and compressed air mixes with the externally injected relatively cold and compressed air, injected at relatively higher pressure than the inside pressure, the mixture tries to attain a common equilibrium temperature of this mixture falls down, expansion takes place. The high inside mixture pressure impart a very heavy blow on the head of the piston, which is then set in motion and the engine runs. No combustion takes place; it is the expansive forces, which make engine run.

RESULTS AND DISCUSSION:

The prime aim being to test the concept of application of air and the suitability of special connecting rod assembly with its related advantages, and to make the engine run on compresses air hence the obtain result may not be the exact measure of its potential.

Since it wasn't very professionally designed the values noted down are used for calculating the mechanical efficiency, indicated power brake power; etc.

INDICATED POWER:

Power is defined as the rate of doing work. In the analysis of cycles the network is expressed in kJ/Kg of air. This may be converted to power by multiplying the mass flow rate of air through the engine in kg/ time. Since, the network obtained from the p-v diagram is the network produced in the cylinder as measured by an indicator diagram, the power based there on is termed indicated power (ip).

CONCLUSION:

It is an very safe, ecofriendly, pollution free, very economical engine design which can also stated as a revolutionary egine design which works on compressed air. This revolutionary engine designe over cones both the problems of fuel crises and pollution. However more research and work on engine is needed to completely prove the technology for both its commercial and technical use in an effective way. It can also be seen that for increase of load the indicated power is increasing. To maintain the speed as load is increased constant injection pressure has to be increased. As the injection pressure has to be increased, the indicated mean effective pressure gets increased; hence the indicated power is increased upon the application of the load. Though the applied load was small, however, the developed power was in proportion to the applied load. As load was applied the speed was reduced, to maintain it constant, the inlet air pressure has to be increased. As shown injection pressure is increased. As the output speed was less the brake power will be obviously significantly lower. The mechanical efficiency is increasing with the increase of output power. At lower output it was very low.