Modified Compressed Air Engine
Two stroke engine working on the design of a four stroke petrol engine

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Abstract: The world today is concerned about saving the environment, everywhere measures have been taken up to reduce pollution. Major amount of air pollution is caused by mechanical animals running on roads, they contribute to most of the air pollution hence engineers today focus on building an eco friendly engine which can reduce the pollution caused by vehicles. A big milestone in this process can be the engine working on compressed air.A compressed air engine works on air as fuel to drive the pistons and produce mechanical output without causing any harm to the environment. The engine takes in compressed air instead of using traditional fuels such as petrol diesel etc. Here this compressed air engine takes the intake of air from the vertically above the piston head. The design of the camshaft has been changed to alter the timing of the valves. Experimentally a speed of 60kmph was achieved by the use of this engine which is better then other works produced on the same topic. It is also efficient as the pollution caused is zero. It is also efficient then electrically operated vehicles as they can be charged instantaneously and amount of compressed air can last for a longer time which is not the case with electrically operated vehicles. Hence this engine can prove to be very successful and sustainable in future.

I. INTRODUCTION:

As we all know that vehicles are a major contributor to air pollution and global warming, using a bike which utilises compressed air as its working fluid or fuel is a wise step towards a pollution free environment. This is an effort to, make a motorcycle engine working on compressed air by changing some basic designs in engine and camshaft. The inlet valve is closed at all times and exhaust valve has a changed timing. It is a two stroke engine working on the design of a four stroke petrol engine.

II. FORMULAE USED:

We know that pressure is a big factor that is used in this design. The main formulae that were used to calculate the output were 1 psi = 0.0689 bar where Psi (pounds per square inch) also we know 1 bar= 10^5 N/m^2

To calculate the mass of the air ideal gas equation PV=nRT was used and we know

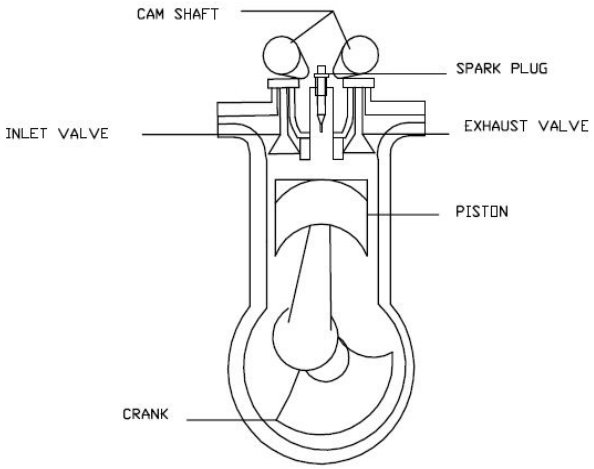
n= weight of compressed air / molecular weight of compressed air

so the weight of air can be calculated and a relation can be drawn as to how much weight accounts for how much energy output.

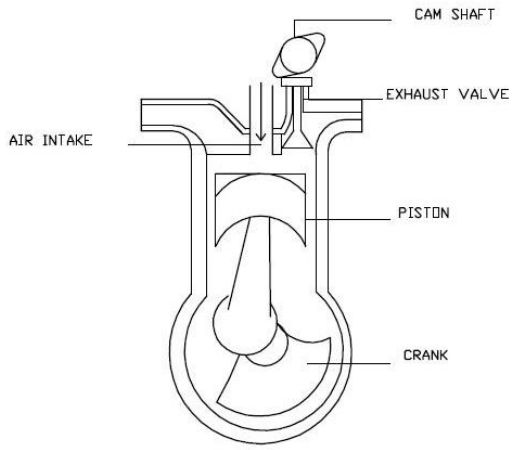
III. DESIGN OF ENGINE (MODIFIED):

Engine block:

The design is simple but a modified form of a four stroke petrol engine. A four stroke engine has an inlet valve, an exhaust valve, a spark plug. Here the inlet valve has been permanently closed and the exhaust valve works with an altered timing.



original design of engine



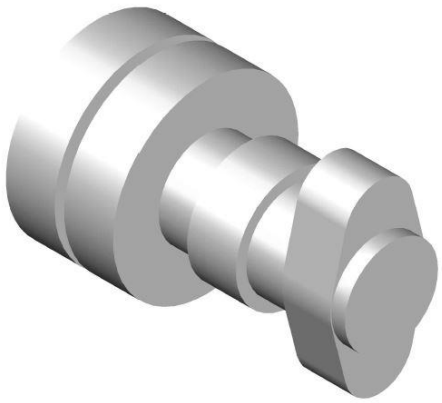
Modified design of engine

Camshaft:

The cam shaft originally had two cams with one lobe each which were mutually perpendicular to each other. The crank rotates due to the movement of the piston, the camshaft is attached with the crankshaft by a timing chain or a timing belt. And as the crank rotates the camshaft also rotates and hence the timing of the valves is managed. In the traditional camshaft the inlet n exhaust valve both functions.

Camshaft originally

In the modified camshaft the lobe of the cam working for the inlet valve was filed and cam was made circular, also the cam working for the exhaust valve was provided with another lobe right opposite to the lobe already present. This ensured the inlet valve to be closed and exhaust valve to work with changed timing.



Cam after modification

IV. MECHANISM OF AIR COMPRESSED ENGINE:

In any engine the charge enters from the inlet valve known as suction stroke then it is compressed by the piston due to crank rotation which is the compression stroke, then sparking takes place through the spark plug, the fuel ignites and combustion process takes place known as expansion stroke and finally the combustion product are let out of the engine by the exhaust stroke. Here air is initially taken up from the atmosphere, then it is compressed with the help of a compressor and sent to the engine cylinder. Piston is assumed to be at TDC, the inlet valve is closed permanently and initially exhaust valve also remains closed. The compressed air gets filled in the clearance volume and when a small rotation is given to the crank this piston starts to slide down, the compressed air tends to expand and pushes the piston downwards. The piston moves from TDC to BDC in one stroke. Now the exhaust valve opens and due to pressure difference the air filled in the volume of the cylinder moves out and piston moves up from BDC to TDC. In this manner one cycle gets completed in two strokes again the same process takes place and output is obtained.

V. PRACTICAL CASES:

a. Case 1: (In the lab)

Requirements:a motorcycle engine, a storage tank, a compressor.

Procedure:

Using the compressor the atmospheric air was compressed and was filled in the storage tank at 600psi. At this pressure the compressed air was sent to the engine and the engine worked accordingly. The air at 600psi has a mass of nearly two kilograms, this amount of air entered the engine block and the following observations were noted.

Observations: At 600psi the engine worked to travel a distance of 3.4 kms. Also a speed of60kmph was achieved in full throttle.

b. Case 2: (On Road)

Requirement:a motorcycle, a storage tank (LPG cylinder).

Procedure:

Compressed air was filled in the LPG cylinder at 600psi. and the vehicle was driven and the distance and speed achieved was observed.

Observations and Calculations:

Dead Weight of cylinder =15kg

Net weight after air filled =15+3.5 = 18.5kg

The vehicle ran for : 2kms

At the speed of : 45 kmph

Including the weight of the rider.

VI. ADVANTAGES:

Compressed air engine is comparable to electrical engines in many ways and its also better than the electrical engine.

- It is ultimately powered by electricity as a compressor works on electricity but its instantaneous and electrical vehicles take lot of time for charging their batteries.
- Transportation of fuel is not needed, hence its cost efficient and also reduces pollution of environment.
- The temperature generated is not very high hence a cooling system is not needed and also material of lower strength and lower thermal resistivity can be used to build this engine, by which cost can be reduced.
- The engine can be reduced in size, disposal of air tanks is easy.
- Can be recycled, lower manufacturing and maintenance cost.
- The tank may be refilled in less time as compared to battery getting charged in electrical system
- The 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.

VII. DISADVANTAGES:

The main disadvantage is it uses indirect form of energy. As air needs to be compressed first and then that air is used in the engine to give the desired output. We all know that in any conversion of energy some energy is always lost hence the efficiency of engine suffers.

- We know that when air expands it cools down (Charle's law) and since the temperature goes down the movement of piston is affected and again in turn the efficiency is affected.
- Since this engine is not yet common it cannot be refilled at home but needs a compressor.
- The capacity of the tanks has to be known as a large amount of gas above the sustainable limit of the tank can cause bursting of tanks.
- Again if the capacity of tank is low and the material is not of enough strength the efficiency is reduced. And if safe working is required less amount of air should be filled, but that would account for frequent refilling of the tanks.

VIII. POSSIBLE IMPROVEMENT:

The possible improvement that can be made is that the use of cylinders having lesser weight and less volume and a capacity to store high pressure. There are companies that make containers that can store air at a pressure as high as 4500psi and it can be concluded from this that if such high pressure is filled into the cylinders having less volume comparable to a small oxygen cylinder the vehicle can run easily for 30 to 35 kilometres with the driver, and the increased weight is very less and hence the efficiency can be increased. There won't be any need to refill the tanks frequently.

IX. CONCLUSIONS:

Nowadays the need for energy continuously increases, and we are using the conventional resources at an alarming rate hence an alternative fuel is much required and Compressed Air Technology can be one of the best alternative, as the pollution caused is zero and it is also cost efficient. The experiment which was performed also show that the vehicle ran at a good speed of 60kmph and the increased weight was 18.5kgs which only nominally affected the efficiency of the engine. Also their was no pollution caused. Hence it's a better and sustainable and eco-friendly than fuels such as petrol etc.

REFERENCES :

[1] "History and Directory of Electric Cars from 1834 to 1987"

[2] "What About Compressed Air Cars?"

[3] Green Speed Air Powered Motorcycle

[4] www.wikipedia.com

[5] SAE technical papers