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Compressed and Recycled Air Engine

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ABSTRACT:

The latest trend in the automotive industry is to develop light weight vehicles. Every automotive industry is looking to reduce the weight of the vehicle as it helps in the better handling of the vehicle and increases the efficiency of the vehicle. Today, the heavy vehicles are known for producing a large amount of harmful gases like CO2, SO2, and HC etc. Which act as the major source for Global Warming. So research is going on to find a light weight vehicle which does not pollute the environment. One of the alternatives is the use of compressed air to generate power to run an automobile. Due to the unique and environmental friendly properties of air, it is considered as one of the future fuels which will run the vehicles. In this project an effort is made to the engine which is works based on compressed and recycled air.

Introduction:

Compressed air is kept under a pressure that is greater than atmospheric pressure. The Density of air is 1.126 Kg/m3 at 1 atm (1.01325 bar).A Compressed-air engine is a pneumatic actuator that creates useful work by compressed air. 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, compressed air vehicles (CAV) use the expansion of compressed air to drive their pistons. They have existed in many forms over the past two centuries, ranging in size from hand held turbines up to several hundred horsepower. For example, the first mechanically-powered submarine, the 1863 Plongeur, used a compressed air engine. The laws of physics that the gases will fill any given space. The easiest way to see this in action is to inflate a balloon. The elastic skin of the balloon holds the air tightly inside, but the moment you use a pin to create a hole in the balloon's surface, the air expands outward with so much energy that the balloon explodes. Compressing a gas into a small space is a way to store energy. When the gas expands again, that energy is released to do work. That's the basic principle behind what makes an air cargo. Some types rely on pistons and cylinders, others use turbines. Many compressed air engines improve their performance by heating the incoming air, or the engine itself. Some took this a stage further and burned fuel in the cylinder or turbine, forming a type of internal combustion engine. 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.Compressed air as a source of energy in different uses in general and as a nonpolluting fuel in compressed air vehicles have attracted scientists and engineers for centuries. Efforts are being made by many developers and manufacturers to master the compressed air vehicle technology in all respects for its earliest use by the mankind.

Design of Mechanical Components:

Generally any engine having important components are Crank shaft, Camshaft, Piston, cylinder, Valves, Connecting rod, Roller bearing, Timing gear, Nozzle. In this paper modified to the Crank shaft and Timing Gears.

Design of Camshaft:

Initially, we having 4-stroke camshaft which do not works for our purpose. (i.e. compressed and recycled-air engine).

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Thus we converted 4-stroke into 2-stroke and made slight modifications in camshaft. Previously it was v-shaped for 4stroke, now we converted this to I-shaped i.e. the inlet & exhaust at 180°. Also for continuous supply of air, to generate more torque we shaped OVAL-CAM to the individual side through180°. (i.e. in both inlet & exhaust-cams).

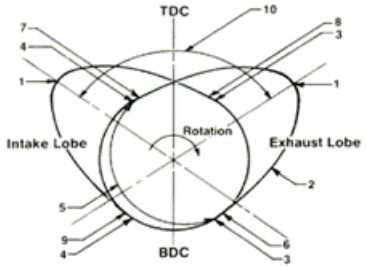

Fig: Design of cam

1.Max Lift or Nose.
2.Flank.
3.Opening Clearance Ramp.
4.Closing Clearance Ramp.
5.Base Circle.
6.Exhaust Opening Timing Figure.
7.Exhaust Closing Timing Figure.
8.Intake Opening Timing Figure.
9.Intake Closing Timing Figure.
10.Intake to Exhaust Lobe Separation.

Fig: Design of cam shaft.

Design of Timing Gear:

You take a 4-stroke engine, and make the following changes. Change crank and cam gear ratio to 1:1 instead of 2:1, so for every revolution of the crank, the cams also turn once. Cams profiles have to be changed.

Fig: Cam Shaft Gear

Problems faced during designing:

1. Availability of components of desired specification in market as per the design.
2. To vary the output speed.
3. To prevent the air leakage.

Solutions Adapted:

1. As per market survey conducted by us we have selected the components with nearest possible specifications as per our design to get the desired power.
2. With the use of air tight joints formed by the connectors we prevent the leakage of air.

Working of Compressed and Recyled Air Engine:

Working principle:

Today, internal combustion engines in cars, trucks, motorcycles, aircraft, construction machinery and many others, most commonly use a four-stroke cycle. The four strokes refer to intake, compression, combustion (power), and exhaust strokes that occur during two crankshaft rotations per working cycle of the gasoline engine and diesel engine.The cycle begins at Top Dead Center (TDC), when the piston is farthest away from the axis of the crankshaft. A stroke refers to the full travel of the piston from Top Dead Center (TDC) to Bottom Dead Center (BDC).

1. Intake Stroke:

In this Stroke the intake or induction stroke of the piston, the piston descends from the top of the cylinder to the bottom of the cylinder, reducing the pressure inside the cylinder. A mixture of fuel and air is forced by atmospheric (or greater) pressure into the cylinder through the intake port. The intake valve(s) then close.

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2. Compression Stroke:

In this Stroke both intake and exhaust valves closed, the piston returns to the top of the cylinder compressing the fuel-air mixture. This is known as the compression stroke.

3. Power Stroke:

In this Stroke the piston is close to Top Dead Center, the compressed air–fuel mixture is ignited, usually by a spark plug (for a gasoline or Otto cycle engine) or by the heat and pressure of compression (for a diesel cycle or compression ignition engine). The resulting massive pressure from the combustion of the compressed fuel-air mixture drives the piston back down toward bottom dead center with tremendous force. This is known as the power stroke, which is the main source of the engine's torque and power.

4. Exhaust Stroke:

During the exhaust stroke, the piston once again returns to top dead center while the exhaust valve is open. This action evacuates the products of combustion from the cylinder by pushing the spent fuel-air mixture through the exhaust valve(s).In this paper we have to modified these four strokes into totally two stoke with the help of inner CAM alteration. In air engine we can design a new CAM which is operate only Inlet stroke and exhaust stroke. Actually in four stroke engine the inlet and exhaust valve opens only one time to complete the total full cycle. In that time the piston moving from top dead center to bottom dead center for two times. A stroke refers to the full travel of the piston from Top Dead Center (TDC) to Bottom Dead Center (BDC).In this paper, we have to open inlet and exhaust valve in each and every stroke of the engine so that it will convert the four stroke engine to two stroke engine by modifying the CAM shaft of the engine.

Engine specification:

Type of fuel used	:	Compressed and Recycled Air
Cooling system	:	Air Cooled
Number of cylinder	:	Single
Number of stroke	:	2 Strokes
Arrangement	:	Vertical
Cubic capacity	:	100 cc

Fig: Actual Diagram

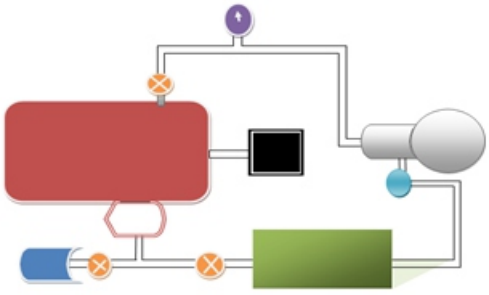

Fig: Cycle Diagram

- Primary tank
- Ball Valve
- Pressure Gauge
- Engine
- Non-Return Valve
- Battery
- Secondary Cylinder
- Air Filter
- High Capacity Blower

Main Components used in compressed and recycle air engine:

1. Engine
2. Compressed Air tanks
3. Non-Return valve
4. Ball valves
5. Connector or Nozzle
6. Air filters
7. Pressure Gauges

Working:

The compressed air from the compressor (primary tank) is sent to the engine through inlet nozzle which is fitted at the inlet manifold.

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The compressed air pushes the piston to move from TDC to BDC, in this time inlet valve is opened and exhaust valve is in closed position. The compressed air throws out by moving the piston from BDC to TDC due to crank revolution mechanism. In this position, exhaust valve is opened and inlet valve is closed. The exhaust air from the engine is collected into the secondary tank that air again sent to the compressor. Then the cycle is repeated. This is recycling process this is also known as cycle chain system.

By using recycled compressed air as input to the compressor, the input power is minimized. Working of Compressed and Recycled Air Engine is the Initially compressor is in working condition, In that time the atmospheric air is entered into the primary cylinder by using filter and ball valve. By using that compressed air the engine is working.

After engine is working the exhaust air is flows through the non return valve that air is enters in to the secondary cylinder. In this secondary cylinder exhaust air is filled through the pipe. That cylinder air enters in to the compressor then continuously working. This is recycling process this is also known as cycle chain system.

Advantages:

Main advantages of Compressed and Recycle Air Engine are:
1. Compressed and Recycled air engine is that a pure compressed air vehicle produces no pollution.
2. Use of renewable fuel.
3. Compressed-air technology reduces the cost of vehicle.
4. No need to build a cooling system, fuel tank, Ignition Systems or silencers.
4. Air is non-flammable.
5. The engine can be massively reduced in size.
6. Low manufacture and maintenance costs as well as easy maintenance.
8. The air tank may be refilled more often and in less time than batteries can be recharged, with re-filling rates comparable to liquid fuels.
9. Lighter vehicles cause less damage to roads.
10. The price of filling air powered vehicles is significantly cheaper than petrol, diesel or bio- fuel. If electricity is cheap, then compressing air will also be relatively cheap.

Disadvantages:

Compressed and Recycled Air Engine (CRAE) has some disadvantages, which are:
1. Probability of air leakage.
2. Tanks get very hot when filled rapidly are being filled would not be possible with tanks in a car and thus it would either take a long time to fill the tanks, or they would have to take less than a full charge, since heat drives up the pressure
3. The energy needed to compress the air is greater than the energy stored.
4. The vehicle, expansion and consequent pressure reduction in the throttle or engine chills the air, reducing its effective pressure.
5. Ambient heat will increase this pressure and this addition leads to a more complex propulsion system.
Applications:
Two wheeler and Four wheeler vehicles.

Conclusion:

Alternate Fuel some of factors are to be considered like Availability, economy, and environment friendly etc., Based on that CAT (Compressed Air Technology) and that exhaust air is also used to the working of engine by using RAT (Recycled air technology).By using Recycled air, efficiency of the engine is improved. The working medium is air then engine tend to zero pollutions.If further improvement is carried out with stress Analysis, thermodynamic analysis, minimize compressed energy loss and other losses then Efficiency of Compressed and Recycled air engine (CRAE) may be further increases.

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