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Two Stroke Air Driven 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 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. So in this paper an effort is made to study the extent of research done and the potential advantages and disadvantages of the compressed air technology. We propose the Air Driven Engine which is an eco-friendly engine that operates with compressed air. An Air Driven Engine uses the expansion of compressed air to drive the pistons of an engine An Air Driven Engine is a pneumatic actuator that creates useful work by expanding compressed air. There is no mixing of fuel with air as there is no combustion. An Air Driven Engine makes use of Compressed Air Technology for its operation The Compressed Air Technology is quite simple. 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.**

Keywords: **Two Stroke Engine, Light Weight Vehicles, Compressed Air, Global Warming.**

I. INTRODUCTION

At first glance the idea of running an engine on air seems to be too good to be true. Actually, if we can make use of air as an aid for running an engine it is a fantastic idea. As we all know, air is all around us, it never runs out, it is non-polluting and it is free. An Air Driven Engine makes use of Compressed Air Technology for its operation. Compressed Air Technology is now widely preferred for research by different industries for developing different drives for different purposes. The Compressed Air Technology is quite simple. 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.

In the case of an Air Driven Engine, there is no combustion taking place within the engine. So it is non-polluting and less dangerous. It requires lighter metal only since it does not have to withstand elevated temperatures.

As there is no combustion taking place, there is no need for mixing fuel and air. Here compressed air is the fuel and it is directly fed into the piston cylinder arrangement. It simply expands inside the cylinder and does useful work on the piston. This work done on the piston provides sufficient power to the crankshaft.

II. LITERATURE SURVEY

A.COMPRESSED AIR TECHNOLOGY:

Air can be compressed into small volumes and can be stored in suitable containers at high pressures. Such air compressed into containers is associated with an amount of energy. When the stored compressed air is released freely it expands thereby releasing the energy associated with it. This energy released can be utilized to provide useful work.

The compression, storage and release of the air together are termed as the Compressed Air Technology. This technology has been utilized in different pneumatic systems. This technology has been undergoing several years of research to improve its applications.

Compressed air is regarded as the fourth utility, after electricity, natural gas, and water. Compressed air can be used in or for:

- Pneumatics, the use of pressurized gases to do work.
- vehicular transportation using a compressed air vehicle
- scuba diving
- To inflate buoyancy devices.
- Cooling using a vortex tube.
- Gas dusters for cleaning electronic components that cannot be cleaned with water.
- air brake (rail) systems
- air brake (road vehicle) systems
- starting of diesel engines (an alternative to electric starting)
- compressed air breathers (such as Suisse Air)
- pneumatic air guns
- pneumatic screwdrivers

B. TWO STROKE ENGINE:

A two-stroke engine is an internal combustion engine that completes the thermodynamic in two movements of the piston compared to twice that number for a four-stroke engine. This increased efficiency is accomplished by using the beginning of the compression stroke and the end of the combustion stroke to perform simultaneously the intake and exhaust (or scavenging) functions. In this way two-stroke engines often provide strikingly high specific power. Gasoline (spark ignition) versions are particularly useful in lightweight (portable) applications such as chainsaws and the concept is also used in diesel compression ignition engines in large and non-weight sensitive applications such as ships and locomotives.

All functions are controlled solely by the piston covering and uncovering the ports as it moves up and down in the cylinder. A fundamental difference from typical four-stroke engines is that the crankcase is sealed and forms part of the induction process in gasoline and hot bulb engines. Diesel engines have mostly a roots blower or piston pump for scavenging.

There are no traditional valves in a two-stroke engine. In a two-stroke the engines fires once every revolution. This makes the engine highly efficient and lightweight compared to four-stroke systems. Rather than entering through valves, the fuel/air mixture enters through an intake port and exhaust exits out of an exhaust port. In place of traditional valves the two-stroke engine uses the piston's position to force out exhaust or suck in fuel mixture. Reeds are vital to a two-stroke system. The reeds are placed between the intake manifold and the carburetor, open and close to allow the fuel / air mixture to enter the case of the engine and trap it, and ensure the proper exchange of gasses in the engine. This procedure might sound complex, but it is, in fact, extremely effective and easy to understand.

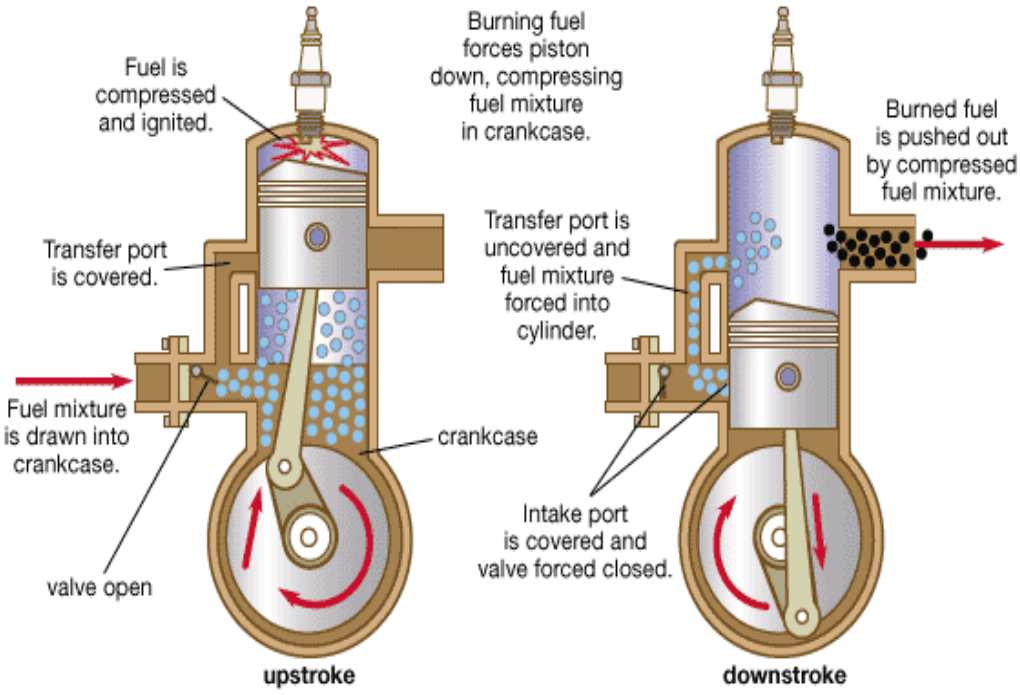

Fig. 1 working of two stroke engine

The whole cycle can be explained as follows:

1) As the piston moves from bottom dead center to top dead center it creates a vacuum to draw the fuel / air mixture through the carburetor and past the reed valve assembly.

2) The piston moves down from top dead center to bottom dead center. The reed closes, causing the pressure to build in the cylinder. The movement of the piston uncovers the intake port and pressurized the fuel / air mixture.

3) The piston now moves up from bottom dead center to top dead center, effectively ending a cycle and starting another. The spark plug ignites the compressed mixture, sending piston back down.

4) At this point the piston uncovers the exhaust port, allowing the spent gasses to escape. As it continues to bottom dead center, it uncovers the intake port and allows the fuel / air mixture through the carburetor and past the reed valve assembly.

C. SOLENOID VALVE:

A solenoid valve is an electromechanical valve for use with liquid or gas. The valve is controlled by an electric current through a solenoid coil. Solenoid valves may have two or more ports: 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.

A solenoid valve has two main parts: the solenoid and the valve. The solenoid converts electrical energy into mechanical energy which, in turn, opens or closes the valve mechanically. A direct acting valve has only a small flow circuit, shown within section E of this diagram. This diaphragm piloted valve multiplies this small flow by using it to control the flow through a much larger orifice.

Solenoid valves may use metal seals or rubber seals, and may also have electrical interfaces to allow for easy control. A spring may be used to hold the valve opened or closed while the valve is not activated.

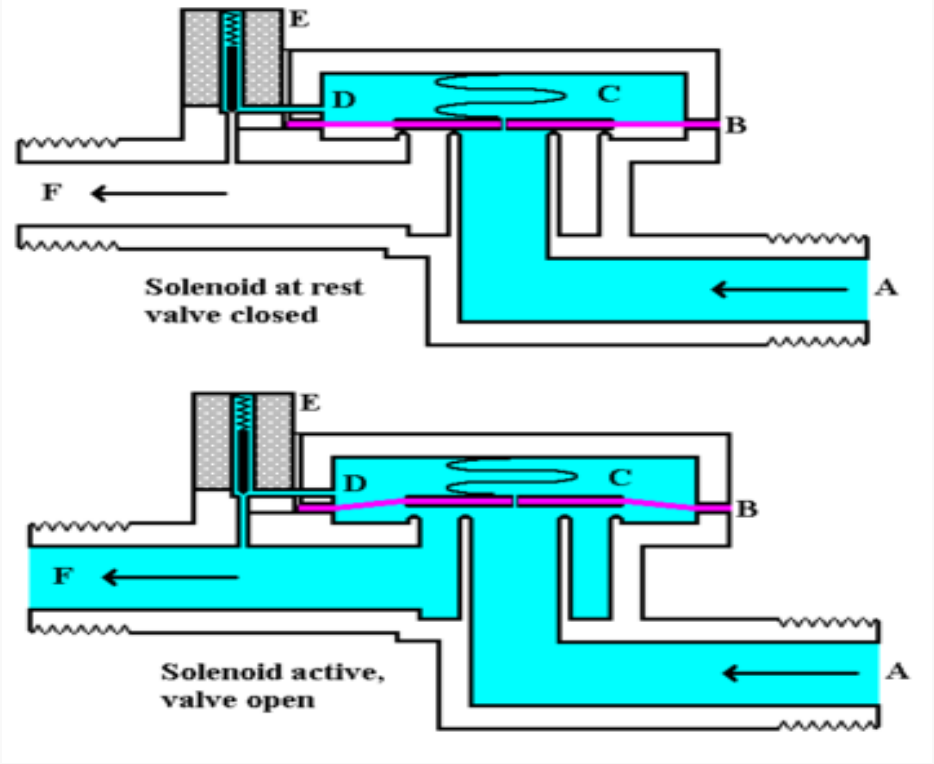

Fig. 2 Working of Solenoid Valve

A- Input side

B- Diaphragm

C- Pressure chamber

D- Pressure relief conduit

E- Solenoid

F- Output side

The diagram above shows the design of a basic valve. At the top figure is the valve in its closed state. The water under pressure enters at **A**. **B** is an elastic diaphragm and above it is a weak spring pushing it down. The function of this spring is irrelevant for now as the valve would stay closed even without it. The diaphragm has a pinhole through its center which allows a very small amount of water to flow through it. This water fills the cavity **C**on the other side of the diaphragm so that pressure is equal on both sides of the diaphragm. While the pressure is the same on both sides of the diaphragm, the force is greater on the upper side which forces the valve shut against the incoming pressure. In the figure, the surface being acted upon is greater on the upper side which results in greater force. On the upper side the pressure is acting on the entire surface of the diaphragm while on the lower side it is only acting on the incoming pipe. This result in the valve being securely shut to any flow and, the greater the input pressure, the greater the shutting force will be.

In the previous configuration the small conduit **D** was blocked by a pin which is the armature of the solenoid **E** and which is pushed down by a spring. If the solenoid is activated by drawing the pin upwards via magnetic force from the solenoid current, the water in chamber **C** will flow through this conduit **D** to the output side of the valve. The pressure in chamber **C** will drop and the incoming pressure will lift the diaphragm thus opening the main valve. Water now flows directly from **A** to **F**.

When the solenoid is again deactivated and the conduit **D** is closed again, the spring needs very little force to push the diaphragm down again and the main valve closes. In practice there is often no separate spring, the elastomer diaphragm is molded so that it functions as its own spring, preferring to be in the closed shape.

From this explanation it can be seen that this type of valve relies on a differential of pressure between input and output as the pressure at the input must always be greater than the pressure at the output for it to work. If the pressure at the output,

for any reason, rise above that of the input then the valve would open regardless of the state of the solenoid and pilot valve.

In some solenoid valves the solenoid acts directly on the main valve. Others use a small, complete solenoid valve, known as a pilot, to actuate a larger valve. While the second type is actually a solenoid valve combined with a pneumatically actuated valve, they are sold and packaged as a single unit referred to as a solenoid valve. Piloted valves require much less power to control, but they are noticeably slower. Piloted solenoids usually need full power at all times to open and stay open, where a direct acting solenoid may only need full power for a short period of time to open it, and only low power to hold it.

Solenoid valves are used in fluid power pneumatic and hydraulic systems, to control cylinders, fluid power motors or larger industrial valves. Automatic irrigation sprinkler systems also use solenoid valves with an automatic controller. Domestic washing machines and dishwashers use solenoid valves to control water entry to the machine. In the paintball industry, solenoid valves are usually referred to simply as "solenoids." They are commonly used to control a larger valve used to control the propellant (usually compressed air or CO_2). In the industry, "solenoid" may also refer to an electromechanical solenoid commonly used to actuate a sear.

Besides controlling the flow of air and fluids solenoids are used in pharmacology experiments, especially for patch-clamp, which can control the application of agonist or antagonist.

D. AIR COMPRESSOR:

An air compressor is a device that converts electrical power or gas into kinetic energy by pressurizing and compressing air, which is then released in quick bursts. There are numerous methods of air compression, divided into either positive-displacement or non-positive displacement types.

Positive-displacement air compressors work by forcing air into a chamber whose volume is reduced to effect the compression. Piston-type air compressors use this principle by pumping air into an air chamber through the use of the constant motion of pistons. They use unidirectional valves to guide air into a chamber, where the air is compressed. Rotary screw compressors also use positive-displacement compression by matching two helical screws that, when turned, guide air into a chamber, the volume of which is reduced as the screws turn. Vane compressors use a slotted rotor with varied blade placement to guide air into a chamber and compress the volume.

Non-positive-displacement air compressors include centrifugal compressors. These devices use centrifugal force generated by a spinning impeller to accelerate and then decelerate captured air, which pressurizes it.

The air compressors seen by the public are used in 5 main applications:

- To supply a high-pressure clean air to fill gas cylinders
- To supply a moderate-pressure clean air to supply air to a submerged surface supplied diver
- To supply a large amount of moderate-pressure air to power pneumatic tools
- For filling tires
- To produce large volumes of moderate-pressure air for macroscopic industrial processes (such as oxidation for petroleum coking or cement plant bag house purge systems).

Most air compressors are either reciprocating piston type or rotary vane or rotary screw. Centrifugal compressors are common in very large applications. There are two main types of air compressor's pumps: Oil lubed and oiless. The oiless system has more technical development, but they are more expensive, louder and last less than the oiled lube pumps. But the air delivered has better quality. The best choice depends of the application that the user needs.

E. INFRARED PAIR:

The infrared pair mainly consists of an infrared emitter and an infrared sensor. The infrared emitter emits the infrared rays to the infrared sensor. The sensor senses the infrared rays which are emitted by the emitter. Both the emitter and the sensor are LEDs of same rating. They are placed in correct position face to face and are aligned in a straight line. They are also placed close together and are enclosed by a covering with an opening for the rays to pass. This helps to increase the accuracy of the sensing of the sensor to its maximum.

Fig. 3 INFRARED Pair

III. THE COMPONENTS

The major components of our Air Driven Engine consist of:

1. THE ENGINE:

The basic engine that we have used in the project is a normal two stroke petrol engine. The details of the engine are as follows:

- Make: Bajaj M80
- Displacement: 78.04cc.
- No. of cylinders: 1

2. THE SOLENOID VALVE:

A solenoid valve is an electromechanical valve for use with liquid or gas. The valve is controlled by an electric current through a solenoid coil. 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.

For controlling the air flow in and out of the engine we use a 3/2 pilot operated normally closed valve. The symbol of the 3/2 valve is as shown:

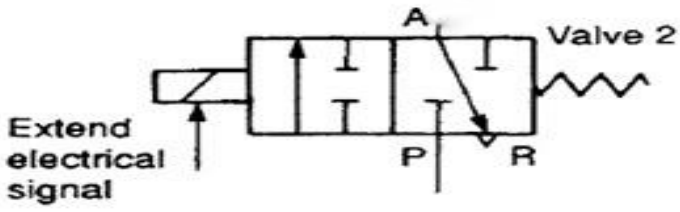

Fig 4. Valve Symbol

The specifications of the valve are the following:

Orifice: 12mm.

Operating pressure range: 2-10bar

Flow rate: 3000Litres/minute

Coil width: 32mm.

Voltage: 24V DC

Duty cycle: Continuous

3. THE VALVE ACTUATION SYSTEM:

The valve actuation system is the system used to actuate the valve mechanism. The valve here used is a 3/2 solenoid valve. This valve we used here is an always closed valve. This valve works only when a high voltage is applied to it. Normally this high voltage is 5v. The supply voltage of this valve is 24v. The high voltage for the opening of the valve is provided by the circuit. When a high voltage is applied to the valve it gets open.

The main components of the valve actuation system are the following

- Infrared pair
- Infrared emitter
- Infrared sensor
- Electronic circuit
- Batteries
- Wiring system
- Valve Timing Disc

4. THE PIPE SYSTEM:

The pipe system is used to connect the components involved in the passage of the compressed air. It is used to connect the cylinder to the solenoid valve and the solenoid valve to the cylinder head.

5. THE PRESSURE GAUGE SYSTEM:

The pressure gauges are used to measure or display the pressure at the position at which the pressure gauge is installed. There are different ranges of the pressure gauges. 0 to 10 bar pressure gauges are used in this project. A t shaped female connector is used to install the pressure gauge in the system and it also holds the pressure gauge at position. The pressure gauge is connected to the inlet of the solenoid valve. This helps to measure the pressure inlet to the solenoid valve.

IV. WORKING OF AIR DRIVEN ENGINE

Air engine works on the same principle of that of an internal combustion engine. The only difference between the two is that in an internal combustion engine; the explosion of fuel in the combustion chamber produces the energy to move the piston, while in an air engine the energy for moving piston is acquired from the supplied compressed air.

The complete assembly of our air engine consists of slightly modified ic engine, valve timing disc attached to the flywheel of the engine, sensor controlled valve mechanism, piping system, gauge system, air compressor and air tank.

For the proper and continues working of the engine the timing with which the compressed air is supplied is of great importance. So in order to make it precise we used sensor controlled valve mechanism. The valve timing disc is made with utmost precision to precise operation of valve. For that the outer dead centre region (ODC) of the piston is found out and is marked on to the fixed valve timing disc. By the same method the point just before the exhaust port opening(EPO) is found out and marked on the disk with the help of a cross sectional change.

For starting; the engine is cranked by the kicker. This will rotate the crankshaft along with the valve timing disk in the clockwise direction. During this rotation the ODC region of the disc cuts the IR beam first and followed by the EPO region.

When the IR beam is first cut by ODC region, the circuit activates the solenoid valve by electric signal. At the moment the valve gets opened and allows the flow of compressed air into the cylinder from the tank through the piping system. The whole region from the point of ODC to EPO on the valve timing disk is opaque and does not allows the IR beam through it. So all the way long the circuit maintains the solenoid valve open by supplying a continuous supply of electric current to the valve. At the same time the compressed air from the tank continues to fill in the cylinder there by pushing the piston further towards the bottom dead Centre (BDC). But to increase the fuel efficiency the fuel supply should be cut-off before reaching the EPO.

So when the EPO region of the valve timing disc sweeps past away from between the IR sensors, the IR beam will make connection again. This will cut the supply to the solenoid valve there by closing the valve. This will prevent the valve from being open at the same time of EPO; increasing efficiency.

When the disc rotates further, the valve remains closed throughout the area from the EPO to the ODC as the IR beam is closed. And this cycle continue.

V. CONCLUSION

On the whole, the technology is just about modifying the engine of any regular IC engine vehicle into an Air Powered Engine. The Air Powered Engine technology is cheaper in cost and maintenance, can be easily adapted by the masses and it doesn't cause any kind of harm to the environment. Instead, it's wide spread use will help mankind in controlling the serious problem of global warming. Future developments can be made by designing an ideal vehicle for this kind of engine. Efficient means of transportation.

REFERENCES

[1] Mistry Manish K., Dr.Pravinp.Rathod, Prof. Sorathiyaarvind S., "Study And Development Of Compressed Air Enginesingle Cylinder: Areview Study", Ijaet/Vol.Iii/ Issue I/January-March,2012/271-274

[2] Singh B.R. And Singh Onkar, 2008, Energy Storagesystem To Meet Challenges Of 21st Century- Anoverview-All India Seminar On Energy Manage Mentin Perceptive Of Indian Scenario -Held On October17-19, 2008 At Institution Of Engineer (India), Statecentre, Engineer's Bhawan,Lucknow-Proceedingschapter15, Pp 157- 167.

[3] Prof. B. S. Patel, R S Barot, Karan Shah, Pushpendra Sharma, "Air Powered Engine" National Conference On Recent Trends In Engineering & Technolog-B.V.M. Engineering College, V.V.Nagar, Gujarat, India,13-14 May 2011

[4] Gorla, R., And Reddy, S., 2005, Probabilistic Heattransfer And Structural Analysis Of Turbine Blade,Ijtje, Vol. 22, Pp 1-11.

[5] S.S. Verma, "Air Powered Vehicles",The Open Fuels & Energy Science Journal, 2008, Volume 1, Pp.54-56.

[6] Rose Robert, William J. Vincent, 2004, Fuel Cellvehicle World Survey 2003-Break Throughtechnologies Institute, February' 2004, Washington,D.C.

[7] B R Singh And O Singh, "Development Of A Vaned-Type Novel Air Turbine", Jmes993 © Imeche 2008, Proc. Meche Vol. 222 Part C: J. Mechanical Engineering Science, Pp. 2419-2426

[8] Singh B.R. And Singh O., 2010, Critical Effect Ofrotor Vanes With Different Injection Angleson Performance Of A Vaned Type Novel Air Turbine,International Journal Of Engineering And Technology, Chennai, India, Ijet-Issn: 0975-4024,Vol. 2 Number 2(28), 2010, Pp. 118-123.