DESIGN & FABRICATION OF AIR DRIVEN ENGINE

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ABSTRACT

An AIR DRIVEN ENGINE is an Eco-friendly engine which 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. Since, there is no combustion, there will be no mixing of fuel with air takes place.

An Air Driven Engine makes use of Compressed air technology for its operation. The Compressed air technology is quite simple in its operation. It works as 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 useful work. So, this energy in compressed air can also be utilized to displace a piston.

The primary objective of this work is to design and fabricate compressed air engine to cope up the shortage of most commonly used fuel engines and go for compressed air as an alternate fuel, after doing certain analysis and perform mathematical calculations.

KEYWORDS: Air driven Engine, Piston, pneumatic engine, compressed air.

INTRODUCTION

Since from 19thCentury, the compressed air has been used in power mines, locomotives & trains in cities previously on the basis of naval torpedo propulsion. In 1903, the liquid air company located in London. The England has manufactured a number of compressed air and liquefied air cars. The major problem with these cars and all compressed air cars is the lack of torque produced by the engines and the cost of compressing the air.

In 1872, the Mekarski air engine was used for street transit consists of a single stage engine.
The first recorded compressed air vehicle in France was built by the Frenchmen Andraud and Tessie of motary in 1838.The history of compressed air can be tracked back thousands of years when early civilizations discovered the power of the human being lung. With its ability to exhale oxygen, the lung made it easier to build fires for heating and Keeping warm.

The exhaust emission standard are getting more and more stringent and there now exits a discussion about the introduction of a mandatory emission standard of CO_2, a greenhouse gas that contributes to the climate change which is an issue of growing international concern.
This demand for lower exhaust emission levels together with increasing fuel prices leads to the demand for combustion engine with better fuel economy which forces engine develops to find and investigate more efficient alternate engine management.

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. The cars that increase in numbers every day emit toxic emissions gases on our highways and consume huge amount of fossil fuels but oil and gas Reserves may last until 2042.Consequently, unconventional energy sources must be increasingly harnessed. Because the low efficiency of compresses air engine(CAE) they were not used for long time. The piston type CAE's have been commonly used in high power machines that require a high starting torque.

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. Therefore, anAir 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.

OBJECTIVES

a) The basic objective of Compressed air technology is to implement in vehicle for consumption of minimum amount of energy and remain the same output work.
b) In today's world, everyone wants to afford a vehicle and its energy to power it. Engine air technology makes it happen from many aspects. It is very less in term of mass as compared with other sources of energy for transportation of man or material.
c) It also improves urban life style through sustainability & non-polluting vehicle. Its impact on the environment is also considerably low. It remains with intelligence, lighter, style and comfort.
d) Most of the work done by an air compressor during compression stroke which will add energy to the air by increasing its pressure. Compression also produces heat, however, and the amount of work required to compress a quantity of air to a given pressure depends on how fast the heat is removed.

METHODOLOGY

- Identification of Key Resources
- Literature survey & understanding the current requirement

- Aims & objective of work
- Identification of Key Unknowns
- Process of Execution of Project
- Results & Discussions.

DESIGN & ASSEMBLY

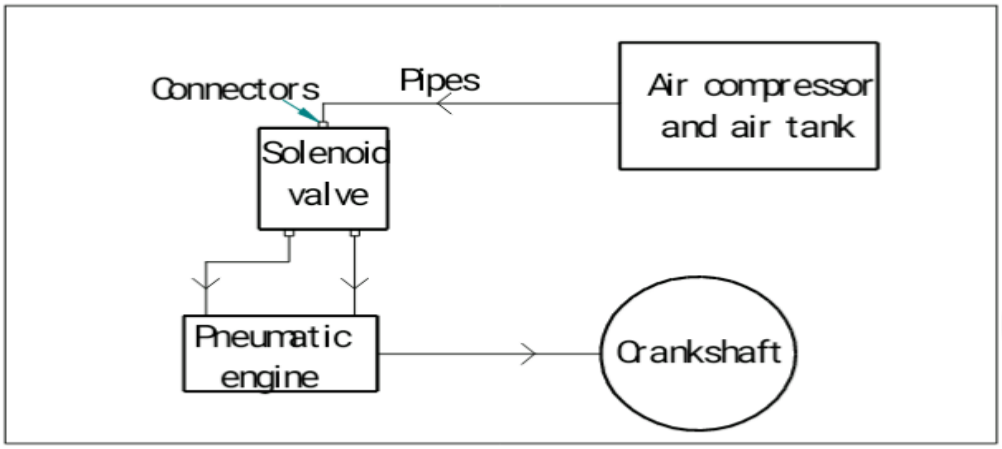


Fig 1: Assembly drawing

PNEUMATIC ENGINE

A pneumatic engine (air motor) or compressed air engine is a type of motor which does mechanical work by expanding compressed air. Pneumatic motors generally convert the compressed air energy to mechanical work through either linear or rotary motion. Linear motion can come from either a diaphragm or piston actuator, while rotary motion is supplied by either a vane type air motor, piston air motor, air turbine or gear type motor.

The basic engine that we have used in the project is a normal linear motion pneumatic piston actuator. A two object detecting sensors are used to know the location of the piston in the pneumatic cylinder. The sensor are fixed at both sides of the cylinder on one of the face as shown in the figure.

The specifications of Pneumatic engine are as follows:-

Bore diameter – 50mm, Stroke – 160mm, Pressure Range – 8-12bar

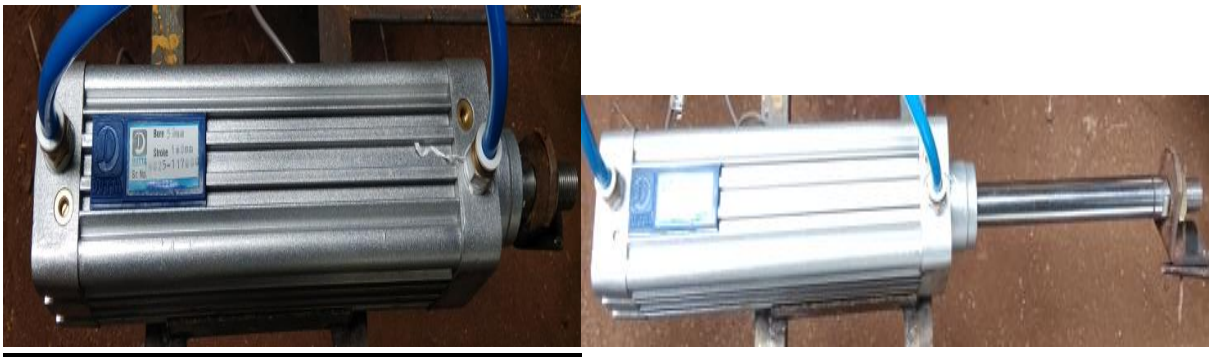


Fig 2: Pneumatic engine

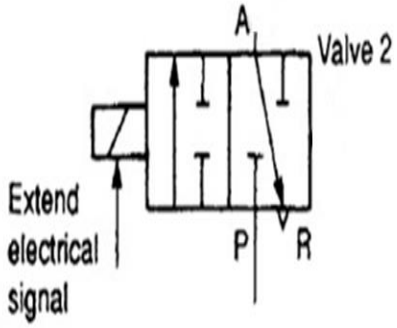
CRANK SHAFT

A crankshaft is related to crank which is a mechanical part that is able to perform a conversion between reciprocating motion and rotational motion. In a reciprocating engine, it translates reciprocating motion of the piston into rotational motion; whereas in a reciprocating compressor, it converts the rotational motion into reciprocating motion. In order to do the conversion between two motions, the crankshaft has "crank throws" or "crankpins", 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.

The shaft is subjected to various forces but generally needs to be analyzed in two positions. Firstly, failure may occur at the position of maximum bending; this may be at the center of the crank or at either end. In such a condition the failure is due to bending and the pressure in the cylinder is maximal. Second, the crank may fail due to twisting, so the connecting rod needs to be checked for shear at the position of maximal twisting. The pressure at this position is the maximal pressure, but only a fraction of maximal pressure.

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.



The specifications of the solenoid valve are the following:

- Orifice: 12mm.
- Operating pressure range: 2-12bar
- Flow rate: 3000Litres/minute
- Coil width: 32mm.
- Voltage: 23V AC
- Duty cycle: Continuous

The 3/2 solenoid valve utilized in our project is shown in the following picture:

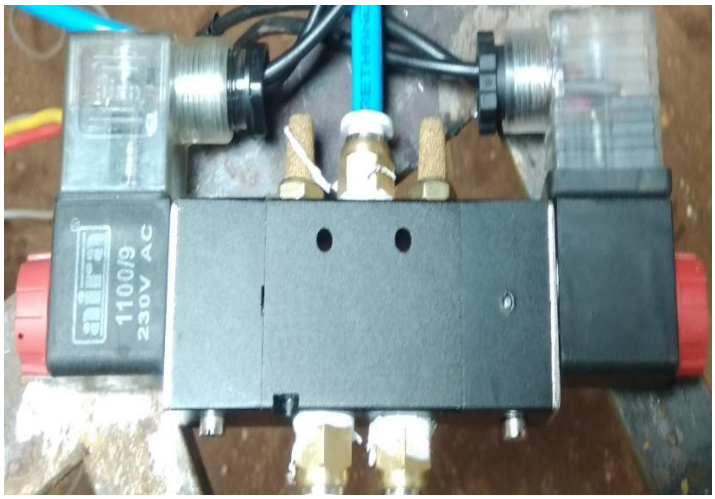


FIG 3: Solenoid Valve

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.

Pipes are used to convey fluids (gases) from one location to another. The engineering discipline of piping design studies the efficient transport of fluid from one location to another. Pipe system refers to the pipe design.

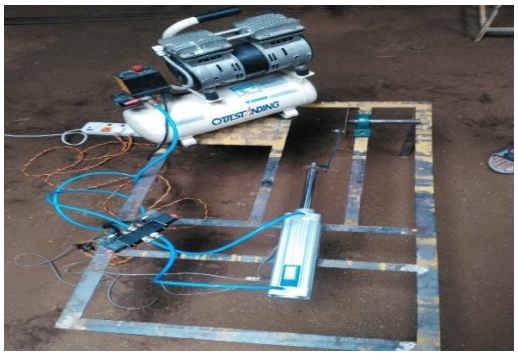


FIG 4: Pipe System

Here polyurethane pipes are used of diameter of 12mm and length of 1m. They are made of hard and flexible material so that they are able to pass the compressed air more efficiently and are highly flexible. These pipes are able to withstand high pressure and so are used to transport compressed air.

AIR COMPRESSOR & AIR TANK

An **air compressor** is a device that converts power into potential energy stored in pressurized air (i.e., compressed air). In other words an air compressor is a mechanical device which utilizes the electrical energy to compress the air. By one of several methods, an air compressor forces more and more air into a storage tank, increasing the pressure. When tank pressure reaches its engineered upper limit the air compressor shuts off. The compressed

FIG 5: Air compressor

Air, then, is held in the tank until called into use.[1] .The energy contained in the compressed air can be used for a variety of applications, utilizing the kinetic energy of the air as it is released and the tank depressurizes. When tank pressure reaches its lower limit, the air compressor turns on again and re-pressurizes the tank.

An air compressor must be differentiated from an air pump which merely pumps air from one context into another. Air pumps do not contain an air tank for storing pressurized air and are generally much slower, quieter, and less expensive to own and operate than an air compressor.

The specifications of air compressor and air tank are as follows:-

- Compressor weight – 8kg
- Maximum pressure – 12bar
- Air Tank dimension – 48*20.5*51cm
- Tank volume – 9litres

CONNECTORS

Connectors are used to connect the pipes with the components used in this project. The type of connector used is one touch male connector which has an internal hexagonal socket. The specification of the thread is BSPT R1/2 (British standard piping thread). The outer diameter is 21.5mm and the inner diameter is 12mm.

FIG 6: Air compressor

MAGNETIC PROXIMITY SENSORS

Magnetic proximity sensors are actuated by the presence of a permanent magnet. Their operating principle is based on the use of reed contacts, whose thin plates are hermetically sealed in a glass bulb with inert gas. The presences of a magnetic field makes the thin plates flex and touch each other causing an electrical contact. The plate's surface has been treated with a special material particularly suitable for low current or high inductive circuits. Magnetic sensors compared to traditional mechanical switches have the following advantage:

- Contacts are well protected against dust, oxidization and corrosion due to the hermetic glass bulb and inert gas; contacts are activated by means of a magnetic field rather than mechanical parts
- Special surface treatment of contacts assures long contact life
- Maintenance free
- Easy operation
- Reduced size

They are fixed on end sides of the pneumatic cylinder on the one of the face, so that it could senses the movement of piston inside the cylinder and helps to operate the solenoid valve for forward and retract motion of the piston in the pneumatic cylinder.

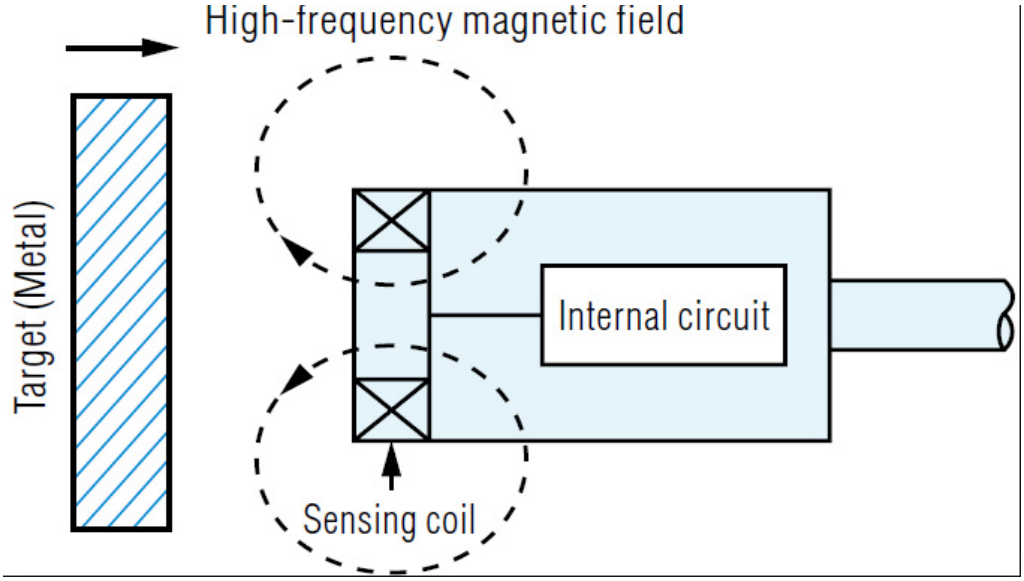


FIG 7:Magnetic proximity sensors

TESTING PROCEDURE

1. Made sure that all the connections were made correctly.
2. Made sure that the valve of compression tank is in closed position.
3. Then the tank is filled up to the required pressure by running the compressor.
4. Made sure that the engine is in no load condition.
5. Then the valve of the compressor tank is opened gradually to the maximum.

6. When the engine starts running and gained speed; no load readings of pressure in BAR as indicated on the engine and the speed of the crankshaft in RPM is taken down.
7. This process is repeated for different values of pressure ranging between 1bar and 8bar and the corresponding readings of speed of rotation are noted.

RESULTS & DISCUSSIONS

The graph of speed vs pressure is plotted as shown in below figure. With reference to the figure, as speed of engine increases with increase in pressure in compressed engine.

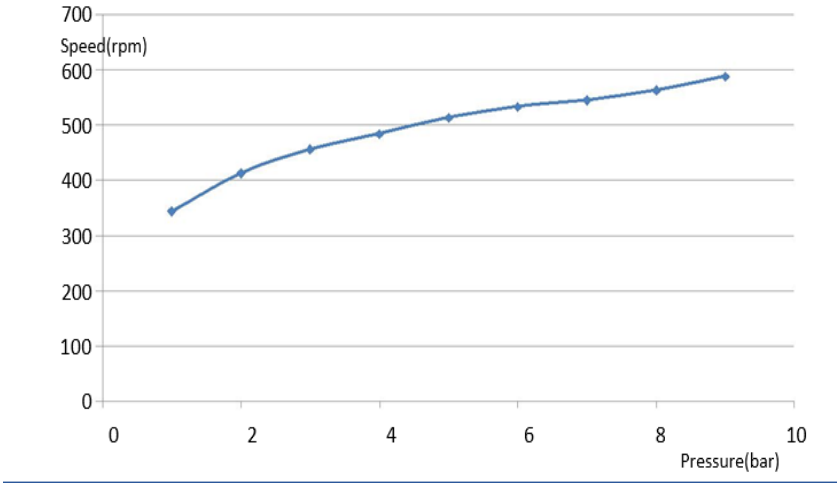


FIG 8: Speed vs pressure

The graph of speed vs torque is plotted as shown in below figure. With reference to the figure, as speed of engine decreases with increase in torque in crank shaft.

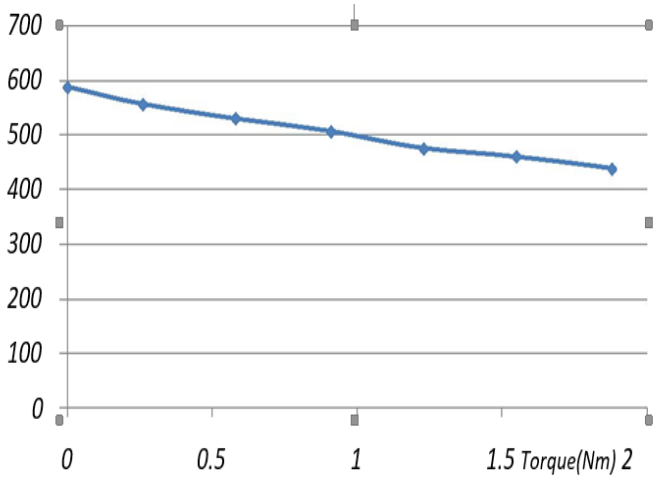


FIG 9: Speed vs torque

OVERVIEW OF THE PROJECT

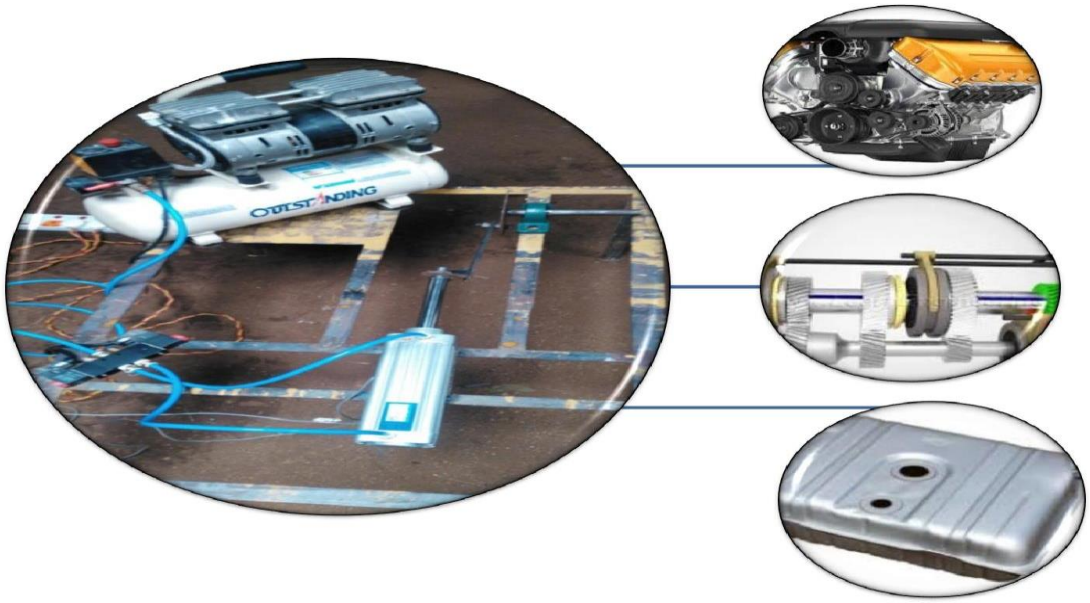


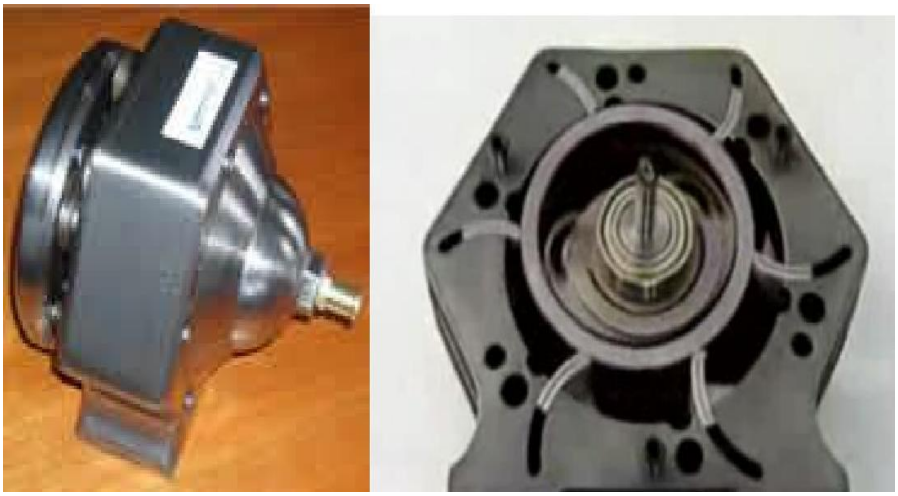
FIG 10:Overview of the Project

POSSIBLE OUTCOMES

1. A unique rotary piston concept which virtually eliminates vibration, internal wear and friction.
2. Wind, solar and hydro power which can be used to compressed the air [6].
3. As the thermodynamic process is used to operate vehicle of compressed air engine because air cools down when expanding and heats up during compression.

FUTURE WORKS

1. Design and fabrication of a new engine made of light metal will give better results.
2. Usage of compressed air tanks for storage and supply will give it more scope in automobiles.
3. New engine designs; as shown in fig shows the improved variants of the air engine. With these type of engines; which is more efficient; air powered automobiles could gain a bright scope in future.



CONCLUSIONS

The Air Driven Engine provides an effective method for power production and transmission. Even though its applications are limited currently, further research could provide wider applications.

The air driven vehicle is designed and developed which runs with the help of compressed air as the fuel. The pneumatic three wheeler reduces the environmental pollution and is beneficial for handicapped people and old age people for easy transportation.

The air powered vehicle is a realization of latest technology in automobile field. The air vehicles are clean, easy to drive, light in weight and good performance vehicles. It eliminates the use of non-renewable fuels and thereby preventing pollution and step to a healthier environment. Compressed air for vehicle propulsion is already being explored and now air powered vehicles are being developed as a more fuel-efficient means of transportation. Some automobile companies are further exploring compressed air hybrids and compressed a fluids to store energy for vehicles which might point the way for the development of a cost effective air.

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