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Air-powered Engine by Using Solenoid Valve and Electronic Circuit

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Abstract--The 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. There is no mixing of fuel with air as there is no combustion. 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: Solenoid valve, two stroke engine, Compressed air, valve timing disc and the pipe system

I. INTRODUCTION

In the case of an Air Powered Engine, there is no combustion taking place within the engine. So it is non-polluting and less dangerous for environment. It requires lighter metal only since it does not have to withstand higher temperatures and pressure. 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 expands inside the cylinder and does useful work on the piston. This work done on the piston provides sufficient power to the crankshaft.

II. OVERVIEW of AIR POWERED ENGINE

The major components of our Air Driven Engine consist of The Engine, The Solenoid Valve, The Valve Actuation System ,The Pipe System and The Pressure Gauge System

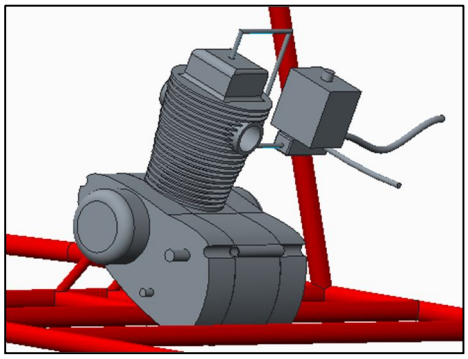

Fig.1 Air Powered Engine

A. Engine

The specifications of IC Engine are:

Engine Displacement: 59.86 cc Engine Type: Single cylinder, 2 - stroke, forced air cooled.

Maximum Power: 3.6 bhp @ 6500 rpm Transmission: 2-speed automatic

Several modifications had to be done on the engine to suit our purpose. The modifications comprised of providing a suitable connector at the cylinder head, closing the transfer port, closing the inlet port, removing the spark plug from the cylinder head, providing an inlet at the place of the spark plug.

The transfer port was to be sealed to provide maximum sealing of the piston-cylinder arrangement so that the chances of escape of air from the cylinder can be avoided. We made use of m-seal and araldite to seal off the transfer port. First a fine quantity of m-seal was filled in the transfer port fully except for a small clearance. We provide the inlet for compressed air at the position of the spark plug as it is better to let the air enter from the top of the piston. So the connector which is used to connect the pipe from the compressed air tank has to be fixed at the position of the spark plug

B. Solenoid Valve

Solenoid valves may use metal seals or rubber seals, and may also have electrical interfaces to allow for easy control 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.
The specifications of the valve are the following:
Orifice: 8 mm.
Operating pressure range: 0-10bar
Flow rate: 3000Litres/minute
Coil width: 32mm.
Voltage: 24V DC
Duty cycle: Continuous

C. 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

1) *Infrared pair*
   a) *Infrared emitter*
   b) *Infrared sensor*
2) *Electronic circuit*
3) *Batteries*
4) *Wiring system*
5) *Valve Timing Disc*

D. Infrared Pair And Electronic Circuit

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.
The electronic circuit mainly consists of the components namely Power supply, Power supply connector, Voltage regulator, Resistors Voltage divider, Infrared emitter connector, Infrared sensor connector, Transistor Valve, connector Comparator.

Fig 2 Electronic Circuit

E. Valve Timing Disc

The valve timing disc is used to represent the position of the piston inside the cylinder in a schematic manner. This helps to explain

the piston position more precisely. The portion bulged out is the power(expansion) stroke region. This is the region corresponding to the region between the outer dead centre and the portion just before the opening of exhaust. The disc rotates in the clockwise direction. The prescribed angle on the disc for the power stroke is 106'. The disc has a radius of 8 cm.

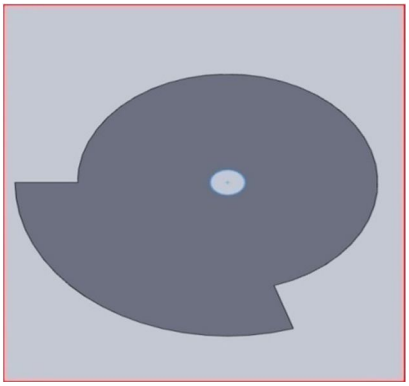

Fig 3. Valve Timing Disc

III. WORKING AND PERFORMANCE ANALYSIS

The emitter is forward biased and the collector is reversed biased. The emitter sends infrared radiations continuously and this is sensed by the sensor. Thus the circuit is short circuited. Hence low voltage is given to the comparator. When the power stroke region is reached the path gets cut off and as a result a high voltage is produced in the sensor circuit and this is given to the comparator. Comparator only provides the output when the input in the positive terminal is above 5v. Thus during the power stroke region the comparator is provided with a high voltage and thus it provides a high voltage at its output. This output is given to the transistor through a 1K resistor. The transistor acts as a switch. It conducts only when a high voltage is applied to it, and when this high voltage reaches it conducts it to the 3/2 solenoid valve.

Brake horsepower is the measure of an engine's horsepower without the loss in power caused by the gearbox, alternator. During testing, the output torque and rotational speed were measured to determine the brake horsepower. Horsepower was originally measured and calculated by use of a brake drum connected to the engine's output shaft. Brake power is the power produced by the engine as measured by the brake drum

IV. CONCLUSION

We were able to successfully complete the design and fabrication of the Air Driven Engine. By doing this project we gained the knowledge about pneumatic system and how automation can be effectively done with the help of pneumatic system. We were also able to gain practical knowledge about the basics of the normal IC engine and solenoid valves.

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.

V. ACKNOWLEDGMENT

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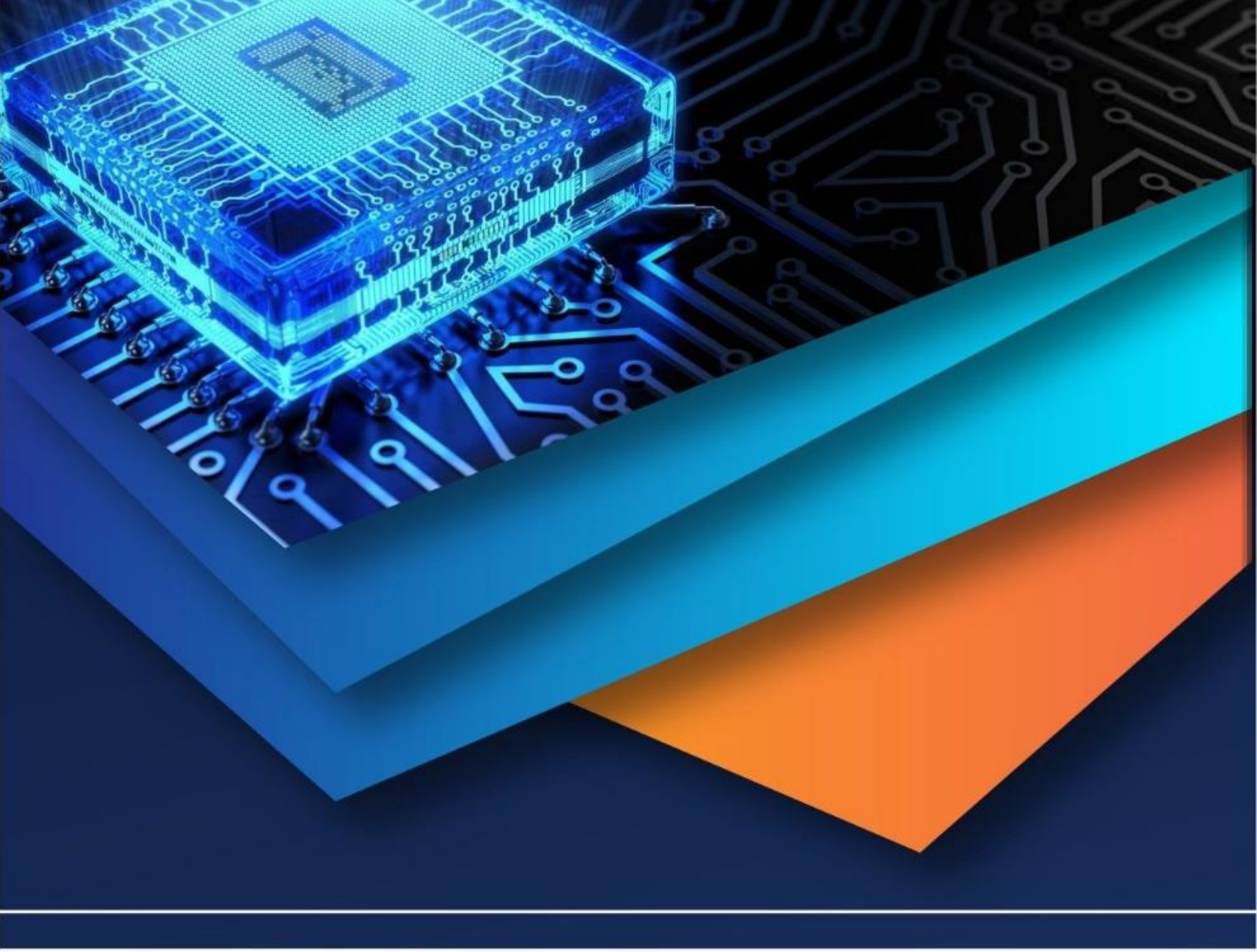

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