IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Review On Air Operated Vehicle

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Abstract

Nowadays, automobiles consume a large number of fossil fuels. However, the consumption of fossil fuels has brought many serious environmental problems, such as global warming, ozone layer depletion and fine particulate matter. To avoid such environmental problems, renewable energy has been applied to automobiles. An air-powered engine of a renewable energy vehicle is introduced. To lay a foundation for the optimization of compressed air engine (CAE), a physical model of compressed air engine (CAE) is established with cam which controls compressed air charge or discharge cylinder. To obtain performance of the CAE, a prototype CAE system is set up. The output torque, power and efficiency are obtained through experimental study. The results show that the prototype of CAE has a good economic performance under low speed and when the supply pressure is 2 MPa, the maximum output power is 1.92 kW; the maximum output torque is 56.55 N·m; and the maximum efficiency is 25%. This research can be referred to in the optimization of air-powered engine.

1.INTRODUCTION

A pneumatic automobile is one that runs entirely on compressed air. There is no need for gasoline or fuel. The fundamental law of thermodynamics is followed. When air is compressed, it stores energy in the form of pressure. When the air expands into the cylinder, this energy is transferred into mechanical energy. A series of pistons is often employed to create linear motion from compressed air. The piston's shaft is housed in an airtight chamber where compressed air is provided. When air is not being pushed into the chamber, a spring is wrapped around the piston's shaft to keep the chamber entirely open. As more air is pumped into the chamber, the force on the piston shaft begins to outweigh the force on the spring. The pressure in the chamber rises as more air is pumped in, and the piston moves down the chamber. The air pressure in the chamber is released when it reaches its maximum length, and the spring

completes the cycle by shutting the chamber and returning it to its original position. Compressed air vehicles (CAVs) use the expansion of compressed air to drive their pistons instead of combining gasoline with air and burning it in the engine to drive pistons with hot expanding gases. A 90 percent efficient engine has been claimed by one manufacturer. Compressed air propulsion can also be used in hybrid systems, such as those with battery electric propulsion and fuel tanks to replenish the batteries. Hybrid-pneumatic electric propulsion is the term for such a system. This technology can also work with regenerative braking.

1.2 Objective

- To understand the basic principal of the our project
- Describe the construction and working of various parts of our project
- Development of the working model of the our project
- To reduce time spent on this activity.
- To analyze the technology according to needs and capabilities.

1.3 Problem Definition

- Now days with use of modern technologies new automobile vehicles/Machines or instruments are being automatically operated or controlled.
- During survey (Survey of local Roads, Visiting garage) we found that in automobile vehicles like car, Truck, Rickshaws. It spreads lots of pollution which is very dangerous gases like SO2, CO2, SO3, Co, etc.
- We want to try to reduce pollution by use of alternate solution of combustion fuels.
- So we take at project title as “DESIGN AND CONSTRUCTION OF PNEUMATIC VEHICLE”.

1.4 Scope of Project

Objectives are as follows:

- To control the emission
- To save the non-renewable sources of energy
- In IC engine replace piston by using double acting cylinder
- To reduce the vehicle weight by changing components

2. Literature Review

Patel Raj, and et al., (2020), presented the compressed air can be used to drive vehicles. However that is true, and the “compressed air operated car”, as it is popularly known, has caught the attention of researchers worldwide. It has zero emissions and is ideal for city driving conditions. MDI is one company that holds the international patents for the compressed air operated car. Although it seems to be an environmentally-friendly solution, one must consider its well to wheel efficiency. The electricity

requirement for compressing air has to be considered while computing overall efficiency. Nevertheless, the compressed air vehicle will contribute to reducing urban air pollution in the long run.

B. U. Okonkwo, and et al., (2023), presented the design analysis of a pneumatic vehicle aims to investigate and evaluate the performance and efficiency of a three-wheeled vehicle powered by pneumatic technology. The vehicle utilizes two cylinder tanks for air storage and employs a pneumatic cylinder with specific dimensions of 50mm bore, 20mm rod, and 138mm stroke. The primary objective of this project is to comprehensively analyse the design aspects of the pneumatic vehicle and assess its potential applications and benefits. This research involves a detailed examination of the vehicle's overall design, including its structural components, pneumatic system, and power transmission mechanisms. The performance of the vehicle, such as speed, acceleration, and manoeuvrability is assessed through practical experiments. It is being constructed with light material, simple way of working, low manufacturing and maintenance cost, it does not produce exhaust emission. The outcome contributes valuable insights into the potential applications of pneumatic vehicles, particularly those with three-wheel configurations. By evaluating the design and performance of the vehicle, the research shed light on the feasibility and advantages of adopting pneumatic technology in transportation systems. The research findings also provide useful guidelines for further improvements and optimization of the pneumatic vehicle design. Review of the availability and the impact of the fossil fuels and the cost increment in the present and future generation led us to construct a vehicle, which runs on air, as a renewable energy source.

U. Sreekanth, and et al., (2021), presented the fossil fuel engines which were good enough for us before 30-40 years but now they are one of the sources of contributor of global warming and pollution with fossil fuel crises. The Air Powered Vehicle is an eco friendly vehicle which works on compressed air. An Air Powered vehicle uses air as a fuel. An Air Powered Vehicle 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. In this project, we are using a 5/2 solenoid valve connected to a flasher which is connected to a double acting pneumatic cylinder which is in turn connected to a modified piston head which rotates the flywheel and moves the engine forward thus creating motion.

Priyanshu Sachan, and et al., (2022) presented the compressed air as a source of energy in many applications and as a non-polluting fuel in compressed air automobiles. Our fossil fuel consumption has resulted in several environmental issues, yet vehicles that run on compressed air are indeed considered a pipe dream. The compressed air engine (CAE) is gaining popularity around the world since it is sustainable and produces zero pollution. Motorcycle engines emit the largest proportion of all fuel-powered engines. More than 3 million motorcycles (bikes, and covered three wheeled motorbikes known as tuktuk) are now fueled by fossil fuels in Egypt. The current article provides a quick overview of the most recent breakthroughs in compressed-air vehicles, as well as an overview of the technology's numerous difficulties and solutions. Control of compressed air characteristics such as temperature, energy density, input power need, energy release, and emission control must be mastered throughout the creation of a safe, light, and cost-effective compressed air vehicle in the near future.

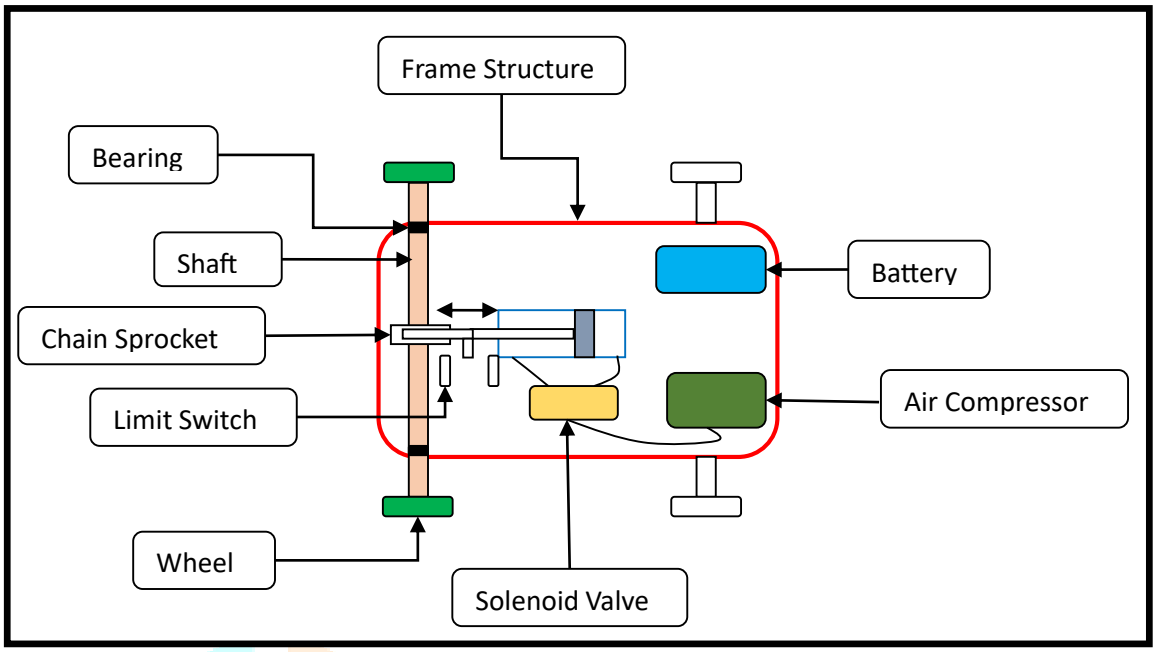
Mahadeo Jadhav, and et al., (2000) presented pneumatically operated vehicle is used to save the non-renewable sources of energy and stop the environmental pollution, which is harmful for human beings. Now a days battery operated vehicles used in all manufacturing industries has disadvantages like high weight, takes more time to charge the battery, critical connection of switches and relays. It requires more maintenance. These problems are solves in pneumatically operated vehicle which has low weight, easy circuits, takes less time for refuelling and requires less maintenance. The Compressed Air Powered Vehicle works on the principle of the compressed Air Technology (CAT). This energy can be utilized for useful purposes. When this compressed air expands, the energy is released to do work. By using the above Concept we are designed a proto-type model of pneumatically operated vehicle. In this system a double acting pneumatic cylinder is operated as a slider crank mechanism which converts the linear reciprocation of the cylinder piston rod into oscillatory motion of the driver crank about the pinion shaft.

Amey D. More 2021studided the Light utility vehicles are quickly becoming a popular mode of short-distance independent transportation. Vehicle manufacturers are developing vehicles fueled by alternative energies as a result of rising costs and pollution from gasoline and diesel. Engineers are focusing their efforts on using air as a source of energy for light utility vehicles. The use of compressed air for energy storage is a strategy that is not only effective and environmentally friendly, but also cost effective. The lack of torque produced by the "engines" and the cost of compressing the air were the two biggest issues with compressed air cars. Several businesses have recently begun to build compressed air vehicles, which have a number of advantages but also have a number of major hurdles to overcome. This document summarizes the basic principles of technology, as well as recent advances, benefits, and drawbacks of compressed air as a source of energy for automobiles.

3.PARTS USED IN PROJECT

Sr. No.	Name of Resource	Specification	Quantity
1	Pneumatic cylinder	15mm Diameter, 50mm Stroke Length	1
2	Solenoid Valve	5/2 , 1/4mm	1
3	Battery	6vdc 5Ah	2
4	Shafts	12mm Diameter	1
5	Wheels	4inch diameter	4
6	Bearing	12mm id	2
7	Chain Sprocket	18 teeth	1
8	Plywood Board	12mm thick	1

4. DESIGN OF THE PROJECT



4.1 Working of the project:

The working principle of "air compressed car" works on principle of alternatively power supply to the solenoid valves. Solenoid valves operate double acting pneumatic cylinder which will act as crank and connecting rod. The Reciprocating motion of pneumatic cylinder will convert into rotary motion by crank mechanism which will rotates the wheel. Thus, motion of the car can be generated.

Battery Powers the air compressor starts pressurizing the air and transmits it to valves via tubes. When the switch rod rotates over the switch plate, it powers the relay switches and in-turn powers the solenoid valves in phase due to the construction of the plate. As the valves turn On, it transmits the air through its opening to the pneumatic cylinder and actuates the piston.

Simultaneous switching of each of 2 valves produce continues actuation of each piston which transmits of its linear motion to the shaft. The shafts rotate continuously due to the cylinder movement and drives the wheels of the car.

A Compressed-air engine is a pneumatic actuator that creates useful work by expanding 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.

The laws of physics dictate that unconstrained 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 car go.

On compression, the work done by the pump gets stored as pressure energy. This compressed air is then stored in cylinders/tanks for later use. When this air is allowed to expand, the pressure energy of air gets converted to kinetic energy and causes propulsion.

Compressed air engine works in two stroke such as intake and exhaust stroke with compressed air as working fluid.

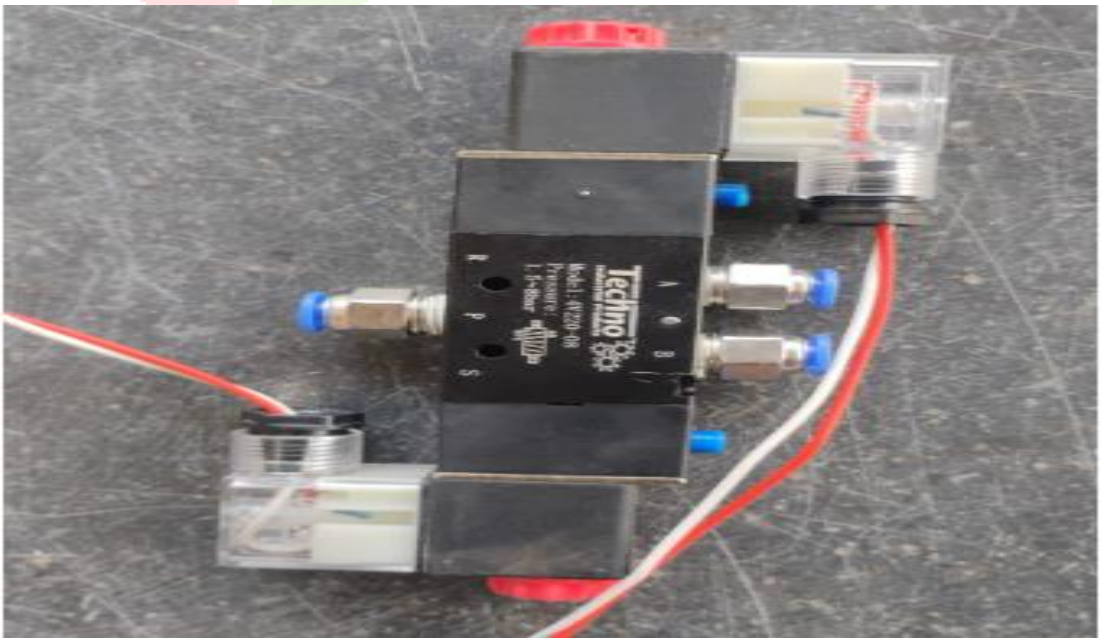
Intake: During this stroke, the piston is initially at top dead centre, inlet valve opens and exhaust valve is closed. Compressed air enters in the cylinder during this stroke at a specified pressure. Compressed air starts expanding exerting pressure on the piston, pushing the piston from top dead centre to bottom dead centre. As the piston reaches bottom dead centre the pressure of the compressed air reduces.

Exhaust: During this stroke, the intake valve closed and exhaust valve is opened. The piston moves from bottom dead centre to top dead centre pushing the low pressure used compressed air out of the cylinder through the exhaust valve. These two strokes repeat for the continuous working of the engine . The valve positions, cam position and working of a compressed air

Solenoid Valve:

Specification:5/2, 12vdc solenoid, 1/4mm

The directional valve is one of the important parts of a pneumatic system. Commonly known as DCV; this valve is used to control the direction of airflow in the pneumatic system. The directional valve does this by changing the position of its internal movable parts. This valve was selected for speedy operation and to reduce the manual effort and also for the modification of the machine into an automatic machine employing using a Directional control valve. A solenoid is an electrical device that converts electrical energy into straight-line motion and force. These are also used to operate a mechanical operation which in turn operates the valve mechanism. The solenoid is one in which the plunger is pulled when the solenoid is energized. The name of the parts of the solenoid should be learned so that they can be recognized when called upon to make repairs, do service work, or install them



Hose and Connecters:

Hose:6mm PU Tube

Connecters:1/8

Hoses used in this pneumatic system are made up of polyurethane. This hose can stand at a maximum pressure level of 10 x105N/m^2. In our system, there are two types of connectors used. One is the hose connector and the other is the reducer. Hose connectors normally comprise an adopted hose nipple and cap nut. These types of connectors are made up of brass (or) aluminum (or) hardened pneumatic steel. A hose is a flexible hollow tube designed to carry fluids from one location to another. Hoses are also sometimes called pipes or more generally tubing. The shape of a hose is usually cylindrical. Hose design is based on a combination of application and performance.

Mini Air Compressor:

Specification: 12dc, Reciprocating type

A compressor is an air-producing machine. They collect the air from the atmosphere and are in the running of the machine are the engine. Air compressors are utilized to raise the pressure of a volume of air. Air compressors are available in many configurations and will operate over a very wide range of flow rates and pressures. Compressed air was expelled by primitive man to give glowing embers sufficient oxygen to allow them to flare up into a fire. During the compression process, the temperature increases as the pressure increases. This is known as polytypic compression. The amount of compression power also increases as the temperature increases. Compressors are staged thereby reducing the temperature rise and improving the compression efficiency. The temperature of the air leaving each stage is cooled before entering the next stage. This cooling process is called intercooling. Volumetric efficiency also increases with multi-stage compression since the pressure ratio over the first stage will be decreased. The selection of the air compressor is only the first step in designing an efficient and reliable compressed air system. The air exiting the compressor is saturated with moisture and will have compressor lubricants (lubricated compressors only).

Machining operation on required parts:

Turning is a cutting operation in which the part is rotated as the tool is held against it on a machine called a lathe. The raw stock that is used on a lathe is usually cylindrical, and the parts that are machined on it are rotational parts – mathematically, each surface machined on a lathe is a surface of revolution. Machining is an essential process of finishing by which work pieces are produced to the desired dimensions and surface finish by gradually removing the excess material from the preformed blank in the form of chips with the help of cutting tool(s) moved past the work surface(s).Most of the engineering components such as gears, bearings, clutches, tools, screws and nuts etc. need dimensional and form accuracy and good surface finish for serving their purposes. Performing like casting, forging etc. generally cannot provide the desired accuracy and finish. For that such preformed parts, called blanks, need semi-finishing and finishing and it is done by machining and grinding.

- Grinding is also basically a machining process.
- Machining to high accuracy and finish essentially enables a product:
- Fulfill its functional requirements.
- Improve its performance.
- Prolong its service

Disadvantages of the project

Dis-advantages of the project as per following like as:

- High installation cost

Application of the project

Our project should use for following various applications like as:

- It can be used by Car Manufacturing Companies
- It can be used as Family car.
- It can be used as Van.
- As Taxi Purpose
- Personal uses

- Industries by workmen

5.COST ESTIMATION

Sr. No.	Name of Resource	Specification	cost
1	Pneumatic cylinder	15mm Diameter, 50mm Stroke Length	1500
2	Solenoid Valve	5/2 , 1/4mm	1200
3	Battery	12vdc	1000
4	Shafts	12mm Diameter	300
5	Flywheels	6inch diameter	200
6	Bearing	12mm id	500
7	Chain Sprocket	18 teeth	200
8	Plywood Board	12mm thick	200
9	Frame Structure		1500

6.Project Flow Chart

From the flow chart, this project started with the objective of the project. The objective of the project must follow the title. The objective must fulfill the title then follow up with design review about folding table and then study a lot of investigation about folding table. This is including study about several of stage, type of stage, types of material which suitable to make a stage. These tasks have been done through study on internet, books and others resources. After all information had been collected and gathered, the project continued with the design process. All the knowledge and lessons had been applied to make a suitable design for the project. After several design sketched, design consideration have been made and one of the design have been chosen by using Pugh's concept selection. The solid modeling and engineering drawing by using solid works software the fabrication process progress use drawing as a reference. The process consist fabrication to all parts that have been designed by the dimension using various type of manufacturing process. The manufacturing process includes welding, drilling, bending, cutting and etc. During the fabrication process, if there have error occur, such as fabrication error, so the process need to modification the process need to go back to the previous step and the process flow again, until no error occur the process can been continued smoothly until the final product finished. Then, the draft report need to be submitted to the supervisor for double checking if there had an error.

Future scope

As there is no combustion use of lighter engine parts like carbon fiber for piston and connecting rod will give more efficiency.

Reduction of diameter of piston improves volumetric efficiency.

Use of cam less inlet and outlet valves improve efficiency as the part of output power use to run cams through chain drives will not be needed.

An all-new technology combining Gasoline internal combustion engine and compressed air storage can be developed. It is developing this vehicle in response to the global need for energy efficient vehicles.

Conclusion

The performance of the Compressed air engine is mainly influenced by the rotation speed and supply pressure. In the first instance, the output power ascends sharply with the increasing rotation speed and reaches to maximum value. After this peak, the output power drops sharply. The prototype of Compressed air engine has a good economic performance under low speed. When the supply pressure is 2 MPa, the maximum output power is 1.92 kW. This is a revolutionary engine design which is eco-friendly, pollution free, but also very economical. This redresses both the problems of fuel crises and pollution.

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