

Design of Pneumatic Operated Bicycle by Inversion of Single Slider Crank Mechanism

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ABSTRACT:

Day by day increasing pollution through petrol, diesel and gasoline operated vehicles is point of concern, something must be done to overcome it, we should use other sources of energy like solar energy, electrical energy, hydraulic energy, wind energy, or other means of eco-friendly source of energy that are economical as well as easily available in enormous amount in nature. The easy solution to this problem is to use operated vehicles used compressed air as the source of energy.

Keywords: - Eco-friendly, Compressed air, Low running cost, Frame, valve, Air compressor, Lightweight vehicles (LWV).

1. INTRODUCTION

Lightweight vehicles^[1] are becoming very popular for short distance, the best example for lightweight vehicles is a bicycle. As we can see bicycles had already gone through many modifications among which electrically operated bicycle are the most popular ones.

Pneumatically operated bicycles require less maintenance as compared to electrical bicycles, therefore, pneumatically operated bicycles are a good replacement for fossil fuel vehicles. But the main problem associated with pneumatically operated bicycles or is the torque generated by them, to enhance it use can simply add a pair of sprockets to increase the torque generated by the pneumatic cylinder/actuators. And we can provide a gears system to controlled the speed of a bicycle, Pneumatic operated vehicles are eco-friendly as well as fuel used is easily available. You can operate by changing it home on your normal switchboard.

2. LITERATURE REVIEW

The history of pneumatically operated vehicles is very broad, many types of research had been conducted in it, the reason why the researches were conducted in the development of eco-friendly vehicles. The basic idea or principle on which their researches were done was providing compressed air to a pneumatic actuator and making it to provide

a reciprocating motion and father this reciprocating motion was conducted in rotator motion. Some of the researches are:

RESEARCHER	RESEARCH
S.S. VERMA (2008)	This research introduces the development of a lightweight vehicle which works on compressed air. In this research, the normal scooter is changed into a compressed air moped. The vehicle developed to run at a speed of 18mph and covers 7 miles in a fully filled tank. It works on compressed air propulsion principle for running the piston in compressed air vehicle.
V. Lohit A. Imran Mohideen (October 2014)	According to this research paper a pneumatic bike is represented in which IC power engine is removed by the pressurized air power and obtains the reciprocating motion of the piston, this motion is obtained by the continues reciprocating of the pneumatic cylinder and reciprocating motion converted into rotatory motion by the crank. It uses the compressor for compressing the air, torque sensor, NC & NO relay (normally closed and open relay), and a pneumatic cylinder.
Mr. Rixon K, Mohammad shareef V, Prajith K S, Sarath K, Sreejith S, Sreeraj P (03 March 2016)	According to this research compressed air is made to enter the turbine which has a sprocket bolted on it which is directly chained to the rear wheel. When the compressed air enters into the turbine it expands in the space between the rotor vanes, and this expansion caused by the compressed air moves the vanes and forces the turbine to rotate. With the rotating turbine the sprocket rotates and hence the rear wheel rotates with the help of a chain.
P Madhu Raghava, T. Lokesh, M. Ravichandra, O.Jayaramudu (April 2017)	According to this research a tricycle which is moving by the power of pressurized air, the pressurized air is used in the 1.3 hp ratchet fixed at the bottom of the body and when the pressurized air reach on the ratchet, it rotates the sprocket and transfer the motion with the help of chain to the rear shaft wheel. Basically, it develops a tri-cycle for handicapped people over the manually operated wheelchair in the development, it uses a 12V dc compressor for compressing the air, electrical control unit for control the supply of electricity and fluid power actuators and hose pipe.

A.A. Keste, S.B. vise, A.N. Adik, P.R. Bonase	This research focuses on developing a battery less vehicle. In this research, a double acting cylinder is used and the reciprocating produced by the piston is converted into rotatory motion with the help of a slider crank mechanism. The use of a compressed air tank is the reason why there is no battery requirement in the system.
Rayon Robert, Sharath Machaiah A.M., Jose K. Roy, Santo Sunny, Chennakeshava R (2018)	In this review paper, the power system of the conventional C engine is replaced by the pneumatic system. It uses a compressed air to run the double acting pneumatic cylinder. It uses the reciprocating motion of double acting cylinder to run the wheel of a bicycle with the help of a slider crank mechanism. It uses the hall effect sensor to measure the frequency of the rotating wheel, the measured frequency of the wheel is indicated in the display connected to the control unit. The sensors also help in controlling the frequency of opening and closing of the pneumatic valve.

There are many reasons to work on pneumatically operated vehicle some of which are-

The fuel used (Air) is pollution free/ eco-friendly.

The running cost is comparatively low as compared to other.

It is light in weight.

It is compact in design.

The heat generated is very low as compared to vehicle operating on Petrol, Diesel, and Gasoline.

The cost of the vehicle is comparatively low.

Pneumatic actuators also have a long life and well with negligible maintenance requirement throughout their life cycle.

Though it has many advantages over vehicles operated by petrol, diesel & gasoline. But it is no competition to them in terms of speed reason being the lack of generation of torque. And the efficiency of pneumatically operated vehicles is less as compact as compared to other.

3. OBJECTIVE

1. To increase the torque by using two cylinders.
2. Development of a pneumatically operated eco-friendly bike.

4. COMPONENTS

1. **Compressor:** - A compressor is a device which takes air from the environment and compresses the air and stores the air into the cylinder.
2. **Air tank:** - It is a standard horizontal tank with the maximum pressure of 11bar, the material used is carbon steel and capacity 10-3000 liter.
3. **Pneumatic cylinder and piston:** - Double acting pneumatic cylinders are used for movement of the piston.
4. **Hose pipes:** - It is used for guiding the way of the pressurized air from reservoir tank to the pneumatic cylinder.
5. **5/2 Way Solenoid valve:** - 5/2 solenoid valve is used for regulating the supply and direction control of the pressurized air from reservoir tank to the pneumatic cylinders.
6. **Safety valve:** - It is used for safety purpose.
7. **Pressure gauge:** - It is a measuring instrument which measures the pressure of the air tank.

ON/OFF valve: - ON/OFF valve is used to control the flow of pressurized air.

8. **Bicycle frame:** - Everything will be mounted on the bicycle frame.

5. METHODOLOGY

When electricity is supplied to compressor it pumps the air to the air storage tank which is connected to a solenoid valve with the help of pneumatic pipes, solenoid valve controlled by the Electrical control unit (ECU) to control the flow of air in the pneumatic cylinders. When air is supplied to a pneumatic cylinder the piston moves up and makes the sprocket rotate and because there are two pneumatic cylinders the one cylinder completes half rotation and the other creates the thrust to rotate the other half. The sprocket connected to the pneumatic cylinders is connected to a small sprocket mounted on the main sprocket of the bicycle, this addition sprocket increases the speed and helps us attain a better running speed.

5.1 MECHANISM USED:

5.1.1 SINGLE SLIDER CRANK MECHANISM: - It is the modification of 4 bar chain mechanism in which there are one sliding pair and three turning pairs, by this mechanism it converts rotatory motion to reciprocating motion and reciprocating to the rotatory motion.

5.1.2 OSCILLATING CYLINDER ENGINE MECHANISM:- By the inversion of single slider crank chain mechanism we make the oscillating cylinder engine mechanism in which the reciprocating motion convert into rotatory motion.

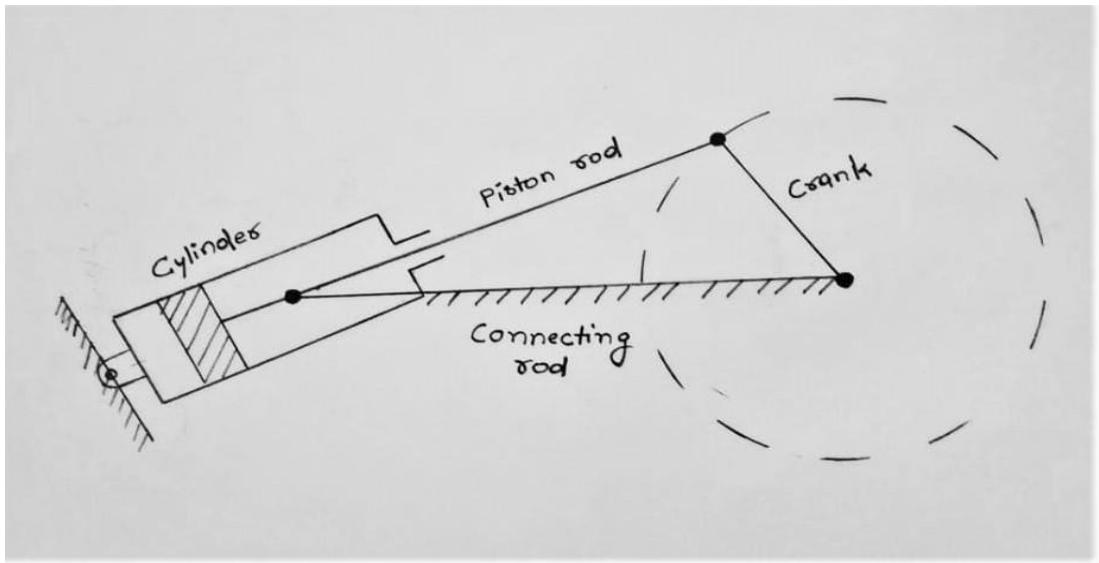


Fig. (a) Oscillating cylinder engine mechanism

When the pressurized air strike on the piston surface of the pneumatic cylinder the piston starts moving and push the piston rod and the crank starts rotating and convert the reciprocating motion into rotatory motion with the help of connecting rod and the cylinder starts oscillating about the pin pivoted point.

6. PROPOSED BLOCK DIAGRAM OF THE WORKING MECHANISM

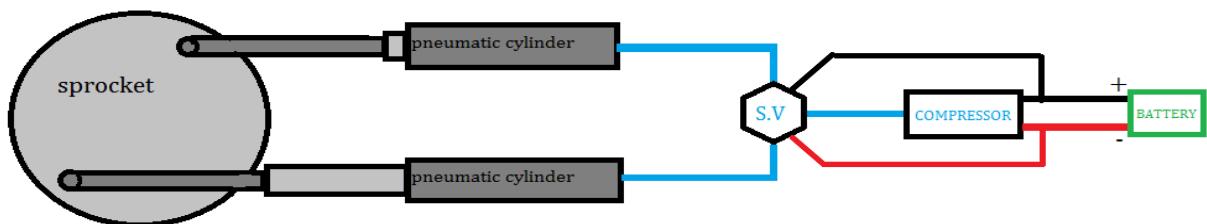


Fig. (b) Block diagram

7. PROPOSED DESIGN

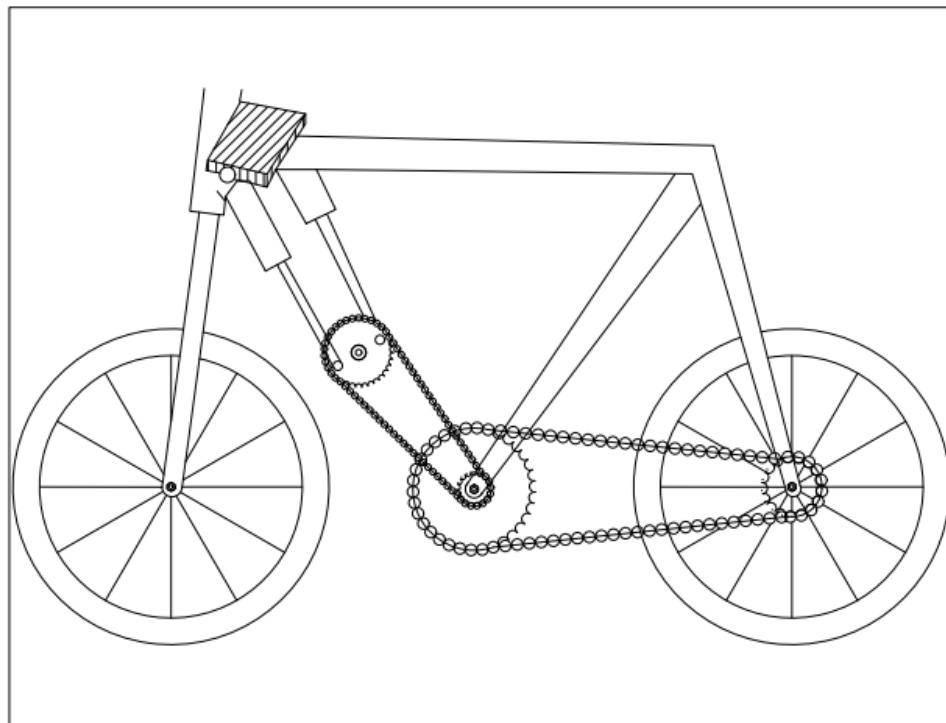


Fig (c). Proposed design

7.1 Specifications:

Size	26T
Suspension	Rigid
Bike weight	17.80
Crankset	40T x 6 crank
Freewheel	18Teeth
Tube	28 x 1.5"
Hub	32/40 Holes
Frame material	STEEL
Brakes	Linkage Brake
Gears	SINGLE SPEED
Frame size	19.7 Inch
Pedals	Reflectorized Anti-Skid Pedal
Rim	Steel, 26 x 1-3/8 32/40H
Tyre size	26 x 1.5"

(Source - <https://herocycles.com/Jet-Master-26T/product/87>)

8. CALCULATIONS [2]

Maximum pressure =10 bar

Atmospheric pressure =1.013 bar

Operating pressure =5.3 bar

Discharge =0.00191m³/sec

Maximum power = 2ΠINT/60

Speed [4]

The speed of the piston and rod depends upon the flow rate of the fluid. The volume per second entering the cylinder must be changed in exhaust volume per second

$Q \text{ m}^3/\text{sec} = \text{area} * \text{distance move per second}$

$Q \text{ m}^3/\text{sec} = \text{area} * \text{velocity (full side)}$

$Q \text{ m}^3/\text{sec} = (A-a) * \text{velocity rod end side}$

9. CONCLUSION:-

In this paper, we have successfully elaborated our approach towards working of pneumatically operated bicycle based upon currently available research and studies done in this field. Further, we have discussed the constructional and structural layout with function and operation methodology which will act as a foundation for our research work developing an automatic bicycle in near future. This research work has also shown the possibility of using compressed air in the application of movement of the bicycle.

10. FUTURE SCOPE

In future research, we can modify the structure and increase the velocity and load carrying capacity. And then increase the overall performance. A solar panel can be used for self-charging, gearing system can be added to control speed, and the braking system can be improved. Alternative for solenoid can be used to decrease battery usage.

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